

Investment Casting Is Old As Babylon, New as the Nineties

Thousands of years ago, a Sumerian or Babylonian craftsman making a bronze figurine might choose the lost-wax method as a way to create an intricate metal shape. Now, a Sandia engineer designing a fire-set housing or a triple battery container might choose the same process.

The lost-wax technique — more precisely termed "investment casting" — can produce complicated, precisely detailed and dimensioned parts that would be difficult or impossible to produce with other casting methods or by machining. That's why it's useful in meeting some Sandia designers' unusual needs. That's also why efforts are under way to update the traditional techniques with modern technology.

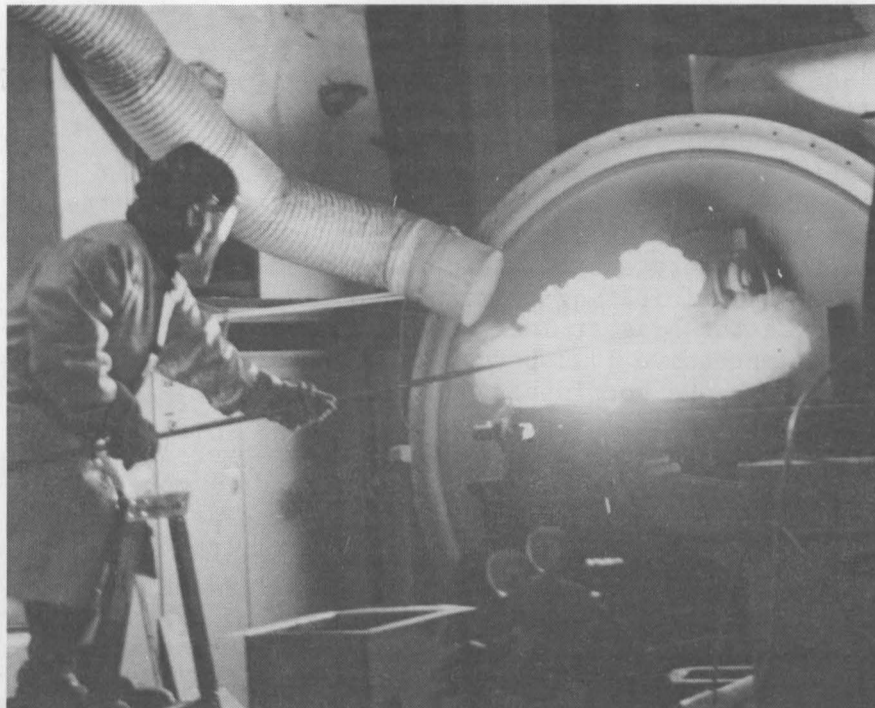
Sandia's investment-casting facility — in existence since 1985 — is operated jointly by Process Metallurgy Div. 1833 and Ceramics Processing Div. 7476. Its purposes are to provide engineers with quick turnaround for prototype parts and to

advance investment-casting technology.

The basic principle hasn't changed since ancient times: First make a pattern of wax or another easily worked and easily melted material. Then cover the pattern with several coats of ceramic

slurry — clay in the old days, colloidal silica at Sandia. When the ceramic has dried, melt the wax and let it run out. The ceramic is now a mold that exactly duplicates the wax pattern. Pour molten

(Continued on Page Four)



MOLTEN IRON is inoculated with magnesium before pouring. Open-air pours like this are infrequent at Sandia — most are done in vacuum inside a closed furnace. (Photo by Tom Lane, 7540)

One of Many Fabrication Choices

When needed, investment casting pays off — for instance, by reducing the machining needed to make a part in production quantities. Still, it isn't always the answer, as Dennis Pfeiffer (7476) is careful to point out.

"Sometimes people come in with a sketch and say, 'I want an investment casting,'" says Dennis, "and I say 'Horsefeathers — use die-casting, use sand-casting, get the part stamped, or welded, or hydroformed, or spin-formed.' A lot of processes are available, and they're cheaper to use if they'll produce the part you need.

"But we can help decide whether investment casting is the best production method — and when it is, here we are."



LAB NEWS

VOL. 41, NO. 24 SANDIA NATIONAL LABORATORIES DECEMBER 8, 1989

'National Impact' Expected

Technology Transfer: Getting Aggressive With New Initiatives

Sandia's technology transfer program, spearheaded by Dan Arvizu's Technology Transfer and Industrial Relations Dept. 410, is headed in new directions.

"We're committed to streamlining our technology transfer procedures," says Dan, "and making

them as user-friendly as possible. We're also starting an aggressive new program this fiscal year — the Technology Maturation Program [TMP]."

The goal of the TMP, Dan explains, is to motivate industry to undertake the development of marketable commercial products based on Sandia

technology. "Often in the past," says Dan, "we've developed a technology to the point where it was applicable in a government market, but not developed to the point where industry was willing or able to assume the risks and costs of bringing it to

"We're committed to streamlining our technology transfer procedures and making them as user-friendly as possible."

the marketplace for a commercial application. So there weren't any 'takers' in the private sector.

"The TMP, we hope, will change that," Dan continues. "The objective is to further the development of certain Sandia technologies as rapidly as possible to a level where they are commercially attractive to industry. We've selected 15 TMP projects [see "In a Nutshell"] for funding in FY90."

Targeted Industries

Industries targeted by the TMP, Dan says, are those with strategic value to national security and US defense posture — for instance, the semiconductor and specialty-metals industries — and those commercially oriented industries working on problems in areas of major national importance: energy, environment quality, health care costs, law enforcement, drug interdiction, and security systems.

The TMP will also offer training — based on a "Design for Manufacturability" short course originally developed at the Labs for Sandia/DOE engineers and designers — to US industry workers responsible for production of designs that meet customer performance requirements and that are

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WILLIAM BENNETT (middle) visited Sandia Nov. 29 to inspect technology that might have applications in drug interdiction and other law enforcement programs. Bennett, director of the Office of National Drug Control Policy, saw technology developed by both Sandia and Los Alamos national laboratories. Jim Jacobs (5200, right) and Deborah Fitzgerald (5265, left) are seen here demonstrating a video compression system to Bennett. The system reduces bandwidth requirements for sending images over transmission links such as military satellites. Senator Pete Domenici (second from left) and Congressman Steve Schiff (second from right) hosted Bennett on his visit to several New Mexico cities.

This & That

Good Morning, Sandia! - Heard it on an early-morning Albuquerque TV news program on Nov. 29. The newscaster said that federal drug policy director William Bennett would visit Sandia that day to inspect some sophisticated new drug-smuggling equipment developed here. He was here that day, but saw new drug-interdiction equipment instead (see photo on page one).

* * *

Supportive Sandians Come Through Again - Preliminary figures for Sandia's Employee Contribution Plan (ECP) 1989 campaign for Albuquerque employees weren't available until just before we went to press last issue. In our rush to get the story done, we didn't give proper credit to several organizations. Medical Directorate 3300 was credited with the greatest increase in ECP participation. That credit goes to Security and Facility Support Services Directorate 3400, which increased the percentage of its employees participating by more than seven percent. Medical Directorate 3300 had the biggest increase in the percentage of Fair-Share donors - up an impressive 15.3 percent - to 61.5 percent of its employees. A Fair Share is one hour's pay per month, or more.

ECP coordinator Joe Laval (3163) says the final figure on pledges is \$1,374,089, a seven percent increase over last year. The overall percentage of Sandians participating remained nearly constant - more than 89 percent. More than 48 percent of Albuquerque Sandians are Fair Share donors. And 9.6 percent of the Fair Share donors participate at the Gold-Share level, which is one percent or more of annual salary.

* * *

Mustang Mystery Solved - In the "40th anniversary wrap-up" story last issue, we asked if anyone knew if there was another automobile named "Mustang" before the Ford Mustang came out in the mid-'60s. Don Lewis (7231) posed the question after reading an old ad that we reprinted in the Nov. 1 40th anniversary issue. The ad, from 1961, listed a '59 Mustang for sale. Turns out there was another vehicle sold by that name - but not a car. Art Sena (9127) and Jay Snelling (1141) both called to inform us that the earlier Mustang was a popular brand of motorcycle. Art says they were sold in the '40s, '50s, and '60s.

* * *

Guarded Laughter - Many Sandians, when carrying papers out of the tech areas, utter a courteous "No classified" to the guards on duty. Heard an interesting variation of that recently when a Sandian exiting the area ahead of me boldly proclaimed, "No intelligence!"

* * *

Bewildering Biking - Not long ago, an irate Albuquerque resident called the Sandia Public Information office to say that two bicyclists wearing Sandia badges had given him the "single-finger salute" after the caller had shouted at them for ignoring a stop sign. The caller said he was going to wait for the offending pair with his camera and submit a photo of their misdeeds to the local newspapers and would see that their badges were in the photograph. It's unlikely that any newspaper would publish such a photo, but the episode points out the continuing need for courtesy, patience, and sound judgment (from bicyclists and drivers, alike) in "mixed" traffic.

* * *

Anyone Missing Mail? - I'm pretty sure that someone's mail was misrouted to me last week. I got an advertising flyer for "Communication Workshops for Ambitious Professionals." ●LP

Take Note

Bob Eagan, Director of Materials and Process Sciences 1800, is president-elect of the 13,000-member American Ceramic Society, headquartered in Westerville, Ohio. Bob takes over as president in April at the ACS annual meeting in Dallas.

* * *

Karen Shane (3551) has been elected Chairman of the Board of Trustees of the 4500-member New Mexico Chapter of The Nature Conservancy. The national nonprofit organization is a scientific and educational group devoted to protection of ecologically significant natural areas and to the diversity of life they support. Call Karen on 4-3268 for information about the group and its field trips.

Sandia Colloquium

Prof. Per-Anders Persson of the Center for Explosives Technology Research at New Mexico Tech will talk about the Center and its work on Friday, Dec. 15. The colloquium will be held at 9 a.m. in the Technology Transfer Center (Bldg. 825). For information, contact David Anderson (2510) on 4-4738.

The University of New Mexico is again offering an "Entrepreneurial Engineering" course (ME 456) in the spring semester. Sandia staff members with technical or business backgrounds who have a potential interest in business developments are especially invited to enroll. The Technology Transfer (410) and Patent (4050) departments both cooperate with the class. Some Sandia staff members who have taken the course have developed business plans, with class assistance, for companies they have contemplated starting. The class works in teams that develop plans for four new businesses each semester. Classes meet at UNM on Tuesdays (beginning Jan. 16) from 6:30 to 9:30 p.m. Enrollment must be completed in the Student Services Building Registration Center (277-5548) by Jan. 19. More information is available from Prof. Bill Gross on 277-6297.

* * *

The Albuquerque chapter of Professional Secretaries International meets Tuesday, Dec. 12, at the Holiday Inn Midtown (2020 Menaul NE) for its annual Christmas party. A roast-beef dinner will be served at 6:30 p.m., followed by entertainment by the Enchanted Mesa Chorus of Sweet Adelines. Each attendee should bring a new toy for the US Marines' Toys for Tots program. For information and reservations (due by noon, Dec. 8), call Mary Scott (9200) on 4-8034.

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Eight-Month-Old Baby Saved

Sandia CPR Training Pays Off Again

Jane Poppenger (7484) was attending her brother's wedding reception at an Ann Arbor, Mich., restaurant in early November. From an adjoining room, she heard a commotion, then a shout, "He's choking!" Jane and others rushed over and discovered a frantic mother holding an 8-month-old child who was not breathing and who was rapidly turning blue.

Jane, who took the Sandia CPR course some years ago, quickly asked if anyone else knew the technique. No one answered, so she took the baby boy, turned him head down, and tried to shake whatever was choking him from his throat. The baby still wasn't breathing, so she then applied the infant Heimlich maneuver. Even that didn't work at first, but she kept trying, and on the third or fourth try, the food that was stuck in the baby's throat dislodged, and he began breathing again. The baby soon opened his eyes, and Jane handed him back to his mother.

Jane plans to take a CPR refresher course soon. "I remembered the basics - that the main thing

was to get a person breathing again," she says.

CPR courses are taught regularly at Sandia. Albuquerque employees can get information from Elaine Squyres (contractor) on 4-7169. Livermore employees should call Mary Gould (8526) on 294-2700. ●

Fun & Games

Spring Softball Signup - Snowballs haven't started flying in Albuquerque yet, but it's time to start thinking about softballs flying next spring. Sandia Employee Recreation Program (SERP) softball has four men's leagues (A-D) and one women's league. The first members' meeting, at which coaches will obtain a sign-up/information package, will be held the first week in February. Rosters and fees are due the third week in March. Individuals interested in forming a team or "free agents" interested in playing on a team should call Cathy Rayborn (2855) on 821-5589 or Ed Marek (1524) on 275-2792 outside of business hours.

Big Jump in Computing Power**New Cray Arrives At Livermore**

The largest-memory Cray Y-MP supercomputer in the DOE complex now resides at Sandia, Livermore. The Cray Y-MP8/264 arrived Nov. 13, according to Bill Wilson (8230), who says there are only nine such machines shipped or on order in the world.

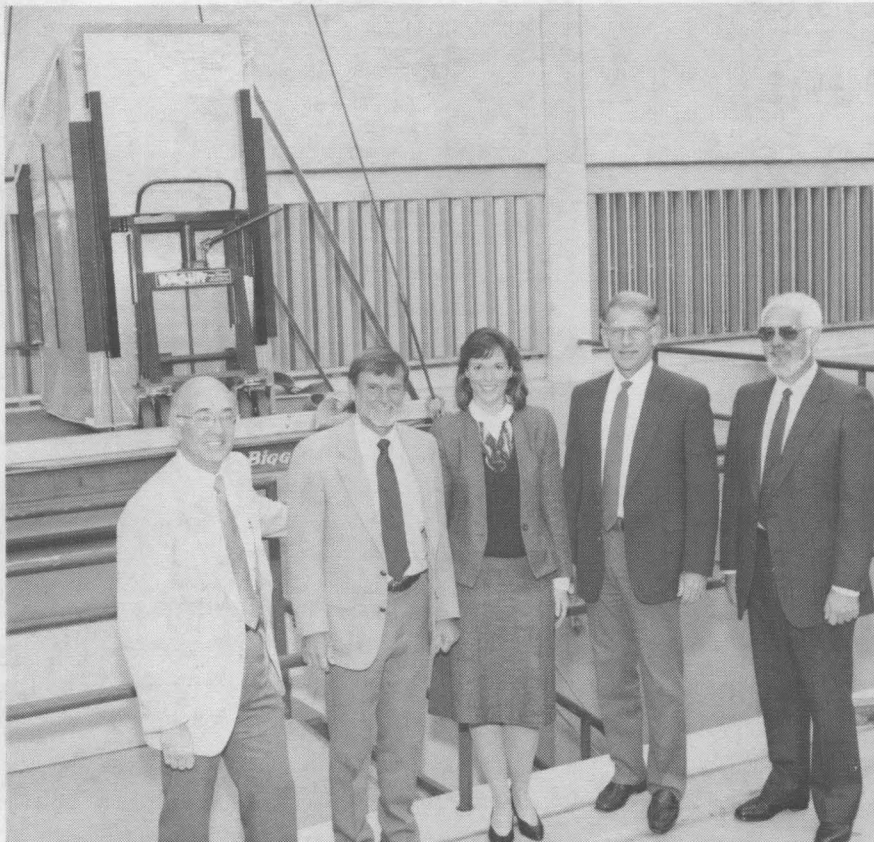
Sandia needs the fastest and most capable supercomputers for its work in materials research and engineering design, says Bill, who explains that the Y-MP was acquired to fulfill a number of requirements involving modeling.

For example, the control of environmental embrittlement — the loss of a material's strength due to environmental effects — is vitally important to weapon and energy programs. Says Bill, "The increase in supercomputer capability will allow Sandia to continue to help solve our nation's problems in military and commercial applications."

Memory Is 'Encyclopedic'

The Y-MP8/264 has 64 million words (64 bits each) of random-access memory, enough to hold a complete set of encyclopedias and an unabridged dictionary. It also has two processors that can work independently on different parts of the same problem. The memory can be expanded to 128 million words, and up to six more processors can be added.

Dona Crawford (8235) says, "The Y-MP enhances our computing capability — it's twice as fast and has 16 times as much memory as the two Cray-1S computers that it replaces." The Y-MP's



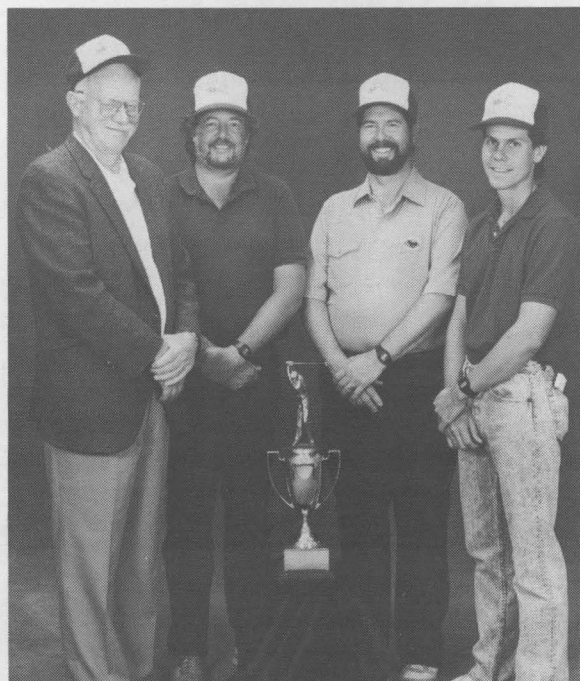
COMPUTER "WELCOMING COMMITTEE" — Checking out the new Cray Y-MP8/264 as it arrives on Sandia's computer center deck are (from left) Ron Detry (8200), Bill Wilson (8230), Dona Crawford (8235), VP John Crawford (8000), and Howard Watts, Cray account manager.

clock cycle of six-billionths of a second yields a peak performance of 650 million floating point operations per second for the two-processor version.

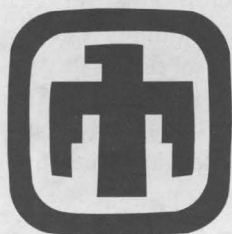
Systems Will Run UNICOS

The Y-MP will run UNICOS, the Cray Research, Inc., UNIX-like operating system. Karen Sheaffer (8235), UNICOS project leader, says, "The Y-MP will run in the Secure Computing Network and our existing X-MP will move to the Restricted Access Network (RAN), where it, too, will run UNICOS."

The move of the X-MP to the RAN is part of a Labs-wide experiment in supercomputing from afar. Once the details are worked out, open computing for all of Sandia will be done on a computer located at Livermore. Shortly thereafter, secure computing for all of Sandia will be done on an Albuquerque computer. Albuquerque users in Bldg. 823 will have supercomputer access only to the Livermore X-MP when their building goes "outside the fence" around June 1990. ●BLS



SAN CHALLENGE golf tourney winner this year was the Sandia, Livermore, team with a net average score of 75.4. Sandia team members are (from left) Doug MacMillan (8283), Dennis Fritts (contractor), Nick Wittmayer (8285), and Todd Howe (contractor). (Not pictured is team member Bill Ormond, 8501). Held at the Sunol golf course, the competition included Stanford Linear Accelerator, Lawrence Livermore National Lab, DOE San Francisco Operations Office (SAN), Lawrence Berkeley Lab, and EG&G. As 1989 tournament winners, Sandia will select the site and organize the tournament for the 1990 SAN Challenge Cup.

**SANDIA LIVERMORE NEWS****Take Note**

Two Sandia, Livermore, retirees at the annual retirees' dinner were overlooked in the story about pioneers who joined the company in 1949 or earlier (LAB NEWS, Nov. 1, 1989). Leo Adams joined Sandia, Albuquerque, in November 1948 to work in mechanical inspection, then transferred to Livermore in 1958 as an administrative assistant in an engineering division. Ken Foster joined the Labs in August 1948, first working in the Packaging Division. In July 1959, he transferred to Livermore as an order analyst and later became a section supervisor in shipping.

Congratulations

Joanie and Tim (8452) Eklund, a son, Trevor Van, Oct. 21.

Welcome

Livermore — Annette Andrade (8524), David Brekke (8514), Wendy Dolstra (8524), Marion Hunter (8236); *Other California* — Kari Holland (8512), Philip Kegelmeyer (8435), Doug Vrieling (8512), John Laroco (8354).

Elsewhere: *Alabama* — Robert Core (8134).

Supervisory Appointment

GEORGE THOMAS to supervisor of Hydrogen Storage Research Div. 8343.

In 1969, George began his career with Sandia at Albuquerque in the Materials Characterization Department, collaborating with Livermore and Albuquerque groups studying ion implantation effects. In 1973, he transferred to Livermore to do fusion materials research, studying helium and hydrogen effects in first-wall materials in the Physical Research Department.

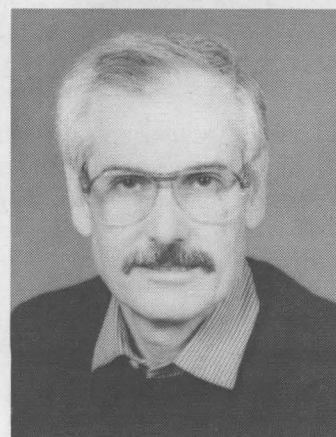
Since its inception, he has been involved in Sandia's Gases in Metals program, sponsored by the DOE Materials Science Division of Basic Energy Sciences. In 1983, he won an award for outstanding sustained research in this program.

George spent a year in Juelich, West Germany, performing experiments on the ALT-1 pumped limiter project, a joint Sandia, Kern Forschungs Anlage, and UCLA experiment on the TEXTOR

tokamak. Recently he set up a new high-resolution electron microscope laboratory in Livermore for atomic-resolution microscopy of defect and interface structures in materials.

George holds BS and MS degrees in physics from the University of Illinois, and a PhD in the same field from the University of Sussex in England.

He enjoys tennis and cross-country skiing. He and his wife Sarah have two sons and live in Livermore.



(Continued from Page One)

Investment Casting

metal into it, let the metal solidify, break away the mold, and there's a metal shape.

The part will require some additional processing — such as cutting off the “gates” where metal ran in — but it has, molded into it, intricate details or thin walls that are easy to form in wax but difficult (or impossible) to machine directly from metal or produce with a pattern that can't be melted out.

A great benefit of investment casting is its ability to reproduce fine details using a wide range

Investment casting can produce intricate details or thin walls that are difficult (or impossible) to machine directly from metal.

of alloys. Says Frank Zanner (DMTS, 1833), “You can take a wax pattern and put a scratch on it, and the metal will replicate that scratch exactly.”

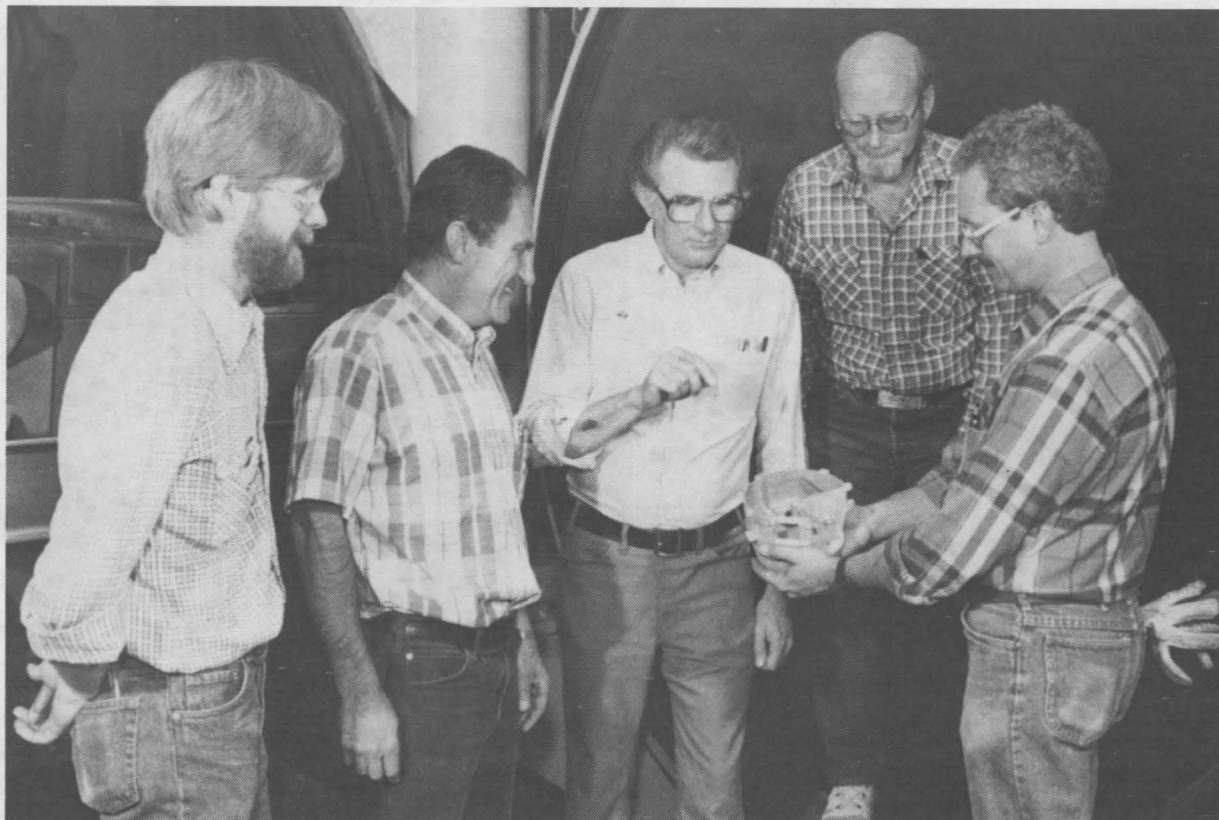
Process engineer Dennis Pfeiffer's (7476) display of items cast at Sandia runs heavily to nuclear-weapon parts. On-site investment casting helps weapon designers, he says, because parts can be produced readily for testing, often on a schedule impossible for an outside contractor to meet.

“We can start before the design definition is final,” says Dennis, “and because we're working with wax patterns, we can make changes quickly. We can communicate informally — work out a new idea on a blackboard or on the back of a napkin.”

Dovetailing With Weapon Development

If investment casting is to be used in production, it's also needed for prototypes. Dennis explains: “Before this facility was here, designers might get something machined out of a block of steel or aluminum because their schedule didn't give them time to get an investment casting made outside Sandia. So, in many cases, the development testing of a weapon would be done with machined parts.

“Then it became almost impossible to go back and make it as a casting — even when that would be much cheaper than machining, and the part



SANDIA'S INVESTMENT-CASTING capability is represented by (from left) Mark Miszkziel (1833), Frank Zanner (DMTS, 1833), Dennis Pfeiffer (7476), Leif Gonnson (7476), and Jim Maroone (1833). Behind is an induction furnace used for pouring investment castings in vacuum. (Photo by Randy Montoya, 3162)

would be lighter, and a wall or other feature could be put exactly where it was needed, instead of approximately. Designers couldn't change to investment casting, in many cases, because testing had

The basic “lost-wax” principle hasn't changed since ancient times.

been done on parts that had the properties of machined metal, not castings. They couldn't guarantee that a casting would behave the same way.”

Experiences such as these, says Dennis, were among those motivating John Ledman (Manager of Process Development Labs 7470) and Mark Davis (Manager of Metallurgy 1830) to establish a Sandia capability for investment casting.

Now that Sandia can do its own casting, parts to be investment-cast in production can start as cast prototypes. Not only is time saved as a result of quick turnaround, but Sandia's experts can stay in contact with the production agencies through the design process and into production. The people respon-

sible for producing the part can offer suggestions to improve producibility. And Sandia can, in turn, propose ways to overcome production problems without sacrificing important design features. The result: faster, easier, and cheaper production of parts.

As investment casting is now done, however, it requires a hefty dose of experience and intuition. For instance, before pouring metal into the mold — which is normally done at Frank Zanner's lab in Area III by Jim Maroone (1833) — someone has to decide where to add extra insulation to keep the metal from solidifying too fast. Insulation may go on the mold itself and on the hollow “runners” through which metal flows to the “gates” in the mold. The insulation keeps the metal from solidifying improperly.

“In some cases, we just put an insulating blanket around the whole thing,” says Dennis. “But often we have to insulate selectively, so that we get a complete fill of the mold, and so that the part solidifies from the inside outward to the gates. We want progressive solidification, so that

(Continued on Next Page)

Modern Investment Casting Is a Complex Process

Here are some of the procedures involved in investment (“lost-wax”) casting:

First, a wax “pattern” is made, identical to the object that will be cast, except for being slightly oversize to allow for the metal's shrinkage as it solidifies. To that pattern, wax “gates” and “runners” (often looking like a cage enclosing the object) are added so that there will be channels through which molten metal can reach all the areas of the mold.

The wax is dipped into a ceramic slurry, and then the liquid-coated pattern is covered with sand so that the ceramic mixture won't run or slump while drying. The coat of ceramic is allowed to dry in a high-humidity chamber, so that the drying is slow and even.

Each Wax Pattern Yields One Mold

The process of dipping, sanding, and drying continues until about a quarter inch of ceramic surrounds the wax. Each cycle is about the same, except that extremely fine zircon sand is usually used for the first coats (the ones that will be closest to the metal) and coarser fused-silica sand for the rest.

The next step is where the term “lost wax” applies. The ceramic mold, now surrounding

(“investing”) the wax, goes into a steam autoclave. In just a few seconds, the pressure in the preheated autoclave reaches 80-90 pounds per square inch and the temperature about 325°F.

“If you melt the wax out slowly,” explains Dennis Pfeiffer (7476), “it expands and cracks the mold. You have to get it melting quickly at its interface with the ceramic. When it starts to flow there, some of it soaks into the porous ceramic shell, with the rest of it flowing out of the mold.

“Especially in an intricate part, you may have cracks, which usually are possible to repair. Worse things can happen — buckling, spalling of the face coat, all sorts of defects that would ruin the mold. We control the process as tightly as we can to avoid problems.”

So now the wax pattern no longer exists, but a ceramic mold does. The ceramic goes into a furnace at about 1400°F to burn out the wax residue that has soaked in or puddled here and there in the ceramic.

The mold is now almost ready for molten metal to be poured in. The last step before that is to insulate parts of the mold with an alumina silicate blanket. The blanket helps control the sequence in which the metal will solidify when it's poured in — it should solidify progressively,

from the inside out, so that voids don't form as the metal becomes solid and reduces in volume.

The ceramic molds go to Frank Zanner's (DMTS, 1833) lab in Tech Area III for pouring and subsequent cleaning. These tasks are performed by Jim Maroone and Mark Miszkziel (both 1833). The mold goes into a small furnace for preheating, while the steel or other alloy is being melted, in vacuum, inside a large (more than head-high, about 10 feet long) induction furnace.

Pouring in Vacuum

When the metal is ready, the mold is brought out of its furnace on a cart the size of a child's wagon. The cart and mold enter a vacuum lock, which is — in a matter of seconds — pumped down to vacuum. Then the mold, still on the cart, enters the induction furnace.

The molten metal is poured from the crucible into the mold — which sounds easy, but has to be done by remote control, not only because of the heat, but also because of the vacuum.

After the metal solidifies, the mold is broken off with a high-pressure water stream, the gates and runners are cut off with a plasma torch, and any necessary heat-treating, machining, inspection, or other final work completes the process.

(Continued from Preceding Page)

as each area cools, there's liquid metal around it to make up for the volume change when it goes from liquid to solid. Selecting where to put the gates and insulating blankets takes a lot of experience. The more copies you make of any one part, the more you tune these variables."

Turning Art Into Science

The Sumerian craftsman had to rely on intuition, but Frank and Dennis hope to take away some of the judgment factor and replace it with

"We can . . . work out a new idea . . . on the back of a napkin."

scientifically based prediction of how the casting will behave. "What we'd really like," says Frank, "is to be able to simulate the manufacturing process on a computer before we make the part."

That's a goal of the whole investment-casting industry. The Sandia effort in that direction is the "Fast Cast" program. As Frank envisions the future, the designer would work with a solid-modeling specialist to define the shape by computer. Another specialist would do a three-dimensional thermal analysis to show how the part is going to solidify. The thermal analysis and the computer-designed model would show where to place the gates for the best solidification. All that data would then be input to a stress analysis to find out how the casting

"We'd really like . . . to simulate the manufacturing process on a computer before we make the part."

might twist or warp when it solidifies, so that changes could be made to minimize the distortion.

"It's still a research effort, but it has promise," says Frank. "We're trying to integrate several technologies. That's where Sandia's strength is. We're also working with university people and industry. The result, we hope, will be to cut a lot of time out of the process, so that our requesters have a product as soon as possible."

One accomplishment so far is the ability, during the design process, to generate an electronic data base used as input to numerically controlled machines that can shape the wax patterns, even correcting for factors such as the shrinkage that a metal part undergoes when solidifying. Some

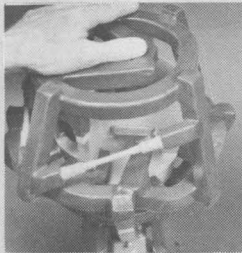
Open on Saturdays

Casting on the Artistic Side

Usually Leif Gonnsen (7476) works in investment casting for technical applications. But last year he spent a working vacation at a company that casts artistic objects — Shidoni Foundry and Galleries, in Tesuque, N.M. For two weeks, he worked a day or two in each part of the foundry, dipping waxes one day, divesting (removing the mold from the metal) another, and so on. "I was impressed by the esprit de corps among the people there," says Leif. "Most of them are artists themselves and do their own work after hours." He also notes that the foundry is open to the public on Saturdays, and that castings are poured Saturday afternoons — so it's an opportunity to see part of the investment-casting process. (Shidoni is on Bishop's Lodge Road; its phone is 988-8001.)

Averting a Compromise for SRAM II

As "Fast Cast" evolves (see main story), investment casting at Sandia continues in the more traditional manner, but emphasizing flexibility and responsiveness to Sandia's special needs. A



WAX PATTERN

case in point is SRAM (Short-Range Attack Missile) II, for which Jack LeRoy (2543) designed the fire-set housing. "I depended fairly heavily on Frank Zanner [DMTS, 1833] and Dennis Pfeiffer [7476] to judge whether this part

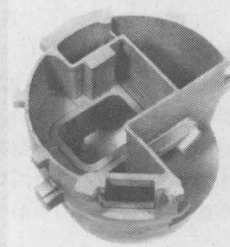
was a good candidate for investment casting," says Jack. "We also got the production people on board early," he continues, "and they seemed to concur that this would be difficult to machine. So Jim Maroone [1833] poured the first parts at Sandia to make sure that investment casting could give us the long, thin walls we needed. Then the production agency chose a supplier, as well as a second source, so it wouldn't be dependent on the first. But when a design change had to be made, the first source didn't want to continue, and the second wasn't ready to make parts yet. That was a problem, because 30 fire-set housings were needed to get ready for the first flight test. And even before that, we would need a couple of the housings for a qualifying unit to be assembled and lab-tested before the first flight test."

Dennis Pfeiffer tells what happened next: "We had a toolmaker in Albuquerque modify the die that had been used for the previous version of

the housing. We got the die in time for making the flight-test units, but not the housings for the qualifying unit. So we took wax patterns made for the old version, cut out the obsolete sections, and replaced them with sheet wax. They weren't dimensionally perfect, but they were acceptable for the purpose. Each of those sheet-wax parts took about a week and a half of work.

"When the dies were available, our group — plus several people borrowed from other organizations — started working overtime to make the wax patterns and the ceramic molds. We did 35 of them, after deciding that we should allow for five spares. After the metal is poured, there's still a lot to do for each part — things like x-ray inspections — but we're going to be ready for the flight test."

Jack sums up: "We don't actually know how big a problem it would have been if we



CAST HOUSING

hadn't been able to cast the parts here. We could have made housings by cutting and welding old ones, but the welds would have been in a critical area. That would have introduced an element of doubt. I don't know for sure how serious a doubt, but at Sandia we took it seriously.

"We were never really faced with the question of whether to compromise and use a welded part, because we knew that with in-house investment casting we would have the right parts ready in time."

thermal analyses have also been done, and there's a program for x-ray study of how metal flows inside a mold.

"Some of the key people at Sandia right now," continues Frank, "are Al Beradino [2812], who is responsible for tying all the activities together through CIM [computer-integrated manufacturing], David Gartling's division [Fluid Mechanics and Heat Transfer 1511] in fluid mechanics, Ray Krieg's division [Applied Mechanics 1521] in stress analysis, Pat Chavez's division [CAD Technology 2814] in rapid emeshment, Dennis Pfeiffer in the molds, and John Dunton and Paul Plomp [both 7483] in computer-aided machining.

Dennis adds, "And John Walters' people [in

Mechanical Processing Dept. 7480] have machined wax patterns for us and done the final machining of the castings. Allied Signal, Kansas City Division, is responsible for parts during weapon production — Gary Robbins and Homer Darbyshire from Kansas City have worked with us to incorporate manufacturing concerns early in the process."

Another aspect of the program is developing the capability to cast many kinds of metal: "Not just steel or aluminum," says Frank, "but maybe reactive metals such as titanium."

Though the basic principle remains the same, the techniques of lost-wax casting — and the uses for it — have clearly expanded far beyond the ancient Sumerian craftsman. ●CS



WAX PATTERN for B90 pre-flight-controller housing is dipped into ceramic slurry by Dave Toupal (7476). (Photo by Jim Bechdel, 3154)

(Continued from Page One)

Tech Transfer

manufacturable, reliable, and cost-effective. Broadcasts of colloquia, workshops, and lab demonstrations via video link to UNM and the instructional TV network will further one of the aims of another TMP project: to "turn on" students at all levels — kindergarten through 12th grade, as well as at universities — to science and engineering.

"It's an exciting and challenging time to be in the technology transfer business," says Dan. "The rapid rise of foreign competition and the overall decline of the US's position in the world market are clearly recognized as serious threats to our national economic security.

"We've had strong signals from both DOE and Congress that aggressive tech transfer programs at the national laboratories are considered a key part of the effort to help improve competitiveness of US industry in many areas.

"That's as it should be," Dan continues. "A significant contribution toward restoring US competitiveness in the world marketplace would be another important payback to US taxpayers, who, after all, have provided the funding that makes the technology expertise and vast technical resources at Sandia — and other national labs — possible."

Actively and aggressively seeking out contacts with industries most likely to benefit from technology developed at the Labs is a cornerstone of Sandia's technology transfer strategy, according to Dan. The Defense Authorization Bill, passed last month by the Congress and signed by the President, permits (and encourages) DOE labs to negotiate cooperative R&D agreements directly with industry and universities, thereby removing some of the bureaucratic red tape that previously slowed down the tech transfer process.

"The bill explicitly states that technology transfer is a mission of DOE's defense programs,"

Technology Transfer Effort Now Assigned to Org. 400

On Nov. 1, the Technology Transfer Department became part of Laboratory Development Directorate 400. Says Director Gerry Yonas, "The cross-cutting responsibilities of Org. 400 will broaden the focus of Sandia's technology transfer activities. We'll be assisting and supporting the efforts of all Labs organizations; they're the groups that will actually make this broader-based, more aggressive approach to tech transfer a reality."

Gerry credits President Al Narath for paving the way for the new approach: "Al took bold steps to provide Sandia's Technology Transfer and Industrial Relations Department [410] with the resources necessary to meet the technology transfer challenge. His insistence that tech transfer be managed and funded as a program has allowed the Technology Maturation Program to emerge as an innovative feature of an aggressive approach to tech transfer. Because of this program, Sandia is assuming a technology transfer leadership role among the national labs."

says Dan. "That gives us the opportunity — and license — to expand our efforts."

The new legislation also provides an incentive to industry not previously available: Commercially valuable information brought into, or developed under, an agreement between federally funded labs and industry may now be withheld from publication for a period of up to five years.

"To protect their commercial interests, companies need exclusive rights to a new technology," Dan explains. "There wasn't much incentive under the old system — which made federally funded technology available to everyone — to invest in



DAN ARVIZU (410, left) discusses one of the Technology Maturation Program projects — solar photocatalytic detoxification of water — with Larry Yellowhorse (6216). The "solar-detox" facility, shown here, is located near the solar power tower.

something that ten other companies might be working on."

The 15 Technology Maturation Program projects — chosen from a total of 56 proposals from Sandia organizations — are funded at \$2.7 million, slightly more than half of the \$5 million technology transfer budget managed by Dept. 410 in FY90. Selection criteria for the projects included, among other things, expected commercial value, technical feasibility, current level of maturity, and the amount of effort — and funding — required.

Though some of the TMP projects will be completed by the end of FY90, more than half, Dan estimates, will continue into the next fiscal year. "We'll re-evaluate the carryovers at the end of each year to make sure that development is coming along as expected and that the transfer outlook is optimistic," he says.

The Focus: Market-Driven Needs

"The TMP focuses on market-driven needs to benefit the private sector," Dan continues. "This is one kind of technology transfer that Sandia hasn't emphasized as much in the past, so it represents a new thrust — and new directions — for us."

Sandia's technology transfer management approach is unique in the DOE complex, Dan says. "Having a budget allocation of \$5 million going into the fiscal year makes it possible for us to manage technology transfer, rather than to just account for costs and 'let it happen,'" he notes. "I expect our resources can — and will — have a national impact.

"We now have the flexibility to establish programs such as the TMP and to branch out in other new directions as well — such as the discretionary funds we've set up this year in each vice-presidency."

The funds allot to Sandia line vice-presidencies an annual sum — \$75,000 each this year, or a total of \$600,000 — to be spent on technology transfer activities such as short-term technical staff assistance, hosting meetings, conducting workshops, staff travel, and exhibit preparation.

"The VP funds are to be used for smaller efforts that provide the opportunity for Labs organizations to strike up meaningful relationships — technology-transfer connections — with industry," explains Dan. "They won't be used to support R&D activities or tech transfer programs already in place."

Pitfall Possibilities

Sandia's new, more aggressive technology transfer outreach program is not without its pitfalls,

Dan cautions. "National security is one of our foremost concerns," he says. "We need to be mindful of export-control requirements, for example, when we transfer defense-related technology — especially if it combines information from several sources.

"Also, when you enter into an agreement that puts a company in an exclusive position for commercializing a product, questions could arise about conflicts of interest and/or fairness of opportunity to industry. Therefore, it's important to widely advertise a technology that will be available — for instance, through the TMP — and to establish a defensible rationale for entering into a tech transfer partnership with one particular company.

"These are not insurmountable problems, however," Dan continues. "Our job in Dept. 410 is to facilitate the process and to answer questions that line organizations may have.

"Ultimately, the success of Sandia's technology transfer program hinges on a couple of things. First, a cultural change — call it a change in cultural attitude — is needed. Sandians aren't used to looking

"It's important to widely advertise a technology that will be available . . . and to establish a defensible rationale for entering into a tech transfer partnership with one particular company."

at new programs with the idea of identifying — early on — the potential commercial value of technology being developed in those programs, and then managing that technology in a way that will benefit competitiveness in the private sector later.

"Second, and probably most important," Dan notes, "we're depending on individual staff members to establish connections with industry so that applicable Sandia technologies can be deployed in a cost-effective and timely way to satisfy market needs."

To help staff members in their technology transfer activities, each directorate is in the process of naming a contact person who will coordinate tech transfer activities and oversee the flow of information — either by compiling a local data base on the directorate's activities or by forwarding the information to Dept. 410. The contact person will also answer questions and attempt to stimulate technology transfer interest within the directorate.

•PW

In a Nutshell: Sandia TMP Projects for FY90

Below are capsule descriptions of Sandia's Technology Maturation Program projects recently selected for funding (total: \$2.7 million) in FY90:

• *Steel-Processing Techniques* — Will transfer technology, including optical diagnostics and computer models relevant to direct processing of steel. Objective: to revolutionize the US nonspecialty steel-making process by replacing the current 3-to-6-week steel-making process with a continuous-flow, 72-hour process that offers cost and energy savings, as well as environmental benefits. Principal investigator: Don Hardesty (8361).

• *Improved Production From Naturally Fractured, Low Permeability Gas Reservoirs* — Will further develop Sandia's Multiwell-Experiment (MWX) technology for the recovery of gas from "tight" formations, with the ultimate goal of developing an expert system for economic gas-recovery use in carbonate gas reservoirs nationwide. (It's estimated that some 600 trillion cubic feet of recoverable natural gas are contained in US low-permeability reservoirs like those found at the MWX field laboratory in Colorado.) Principal investigators: members of Geotechnology Research Div. 6253.

• *Numerical Control Part Programming* — Will further develop and transfer a Sandia-developed computer program for use with numerically controlled (NC) machines for the fabrication of mechanical parts. This could cut costs considerably for small-to-medium manufacturers, many of which have been unable to use NC machines because of the high cost of computer-programming them. Will involve expert system research for milling machines and lathes, testing software on PCs, and investigating interfaces with other CAD/CAM systems. Principal investigator: William Burd (DMTS, 7483).

• *Microelectronics Assembly Test Chip (ATC)* — The Sandia-developed ATC is a silicon chip with sensors to detect stress, corrosion, mechanical damage, moisture, and temperature. The ATC is used to objectively evaluate a new process or new equipment, and to quantify the reliability and manufacturability of a new package design or chip encapsulant. Further development includes incorporating new transducers into successive generations; the ATC will be produced in limited numbers so all US integrated-circuit companies can have samples for evaluation. Principal investigator: Jim Sweet (2134).

• *Semiconductor Research Integration Center (SRIC)* — This center will serve as a national facility to screen advanced microelectronic fabrication techniques developed at universities under Semiconductor Research Corporation (SRC) funding, and to select the most promising technology for direct transfer to SEMATECH and domestic semiconductor companies. (SRC is a consortium of US integrated-circuit companies that sponsors more than \$25 million worth of advanced research at universities throughout the nation.) Principal investigators: members of Semiconductor Components Directorate 2100.

• *Noninvasive Sensor for Glucose Determination* — Based on Sandia-developed chemometric methods to monitor very low concentrations of gases evolved during the aging of explosive materials, this project involves collaborating with UNM to develop a new sensor for noninvasive monitoring of glucose (blood sugar) levels in diabetics, thus improving the daily quality of life for millions of diabetics now on insulin therapy to control glucose-level fluctuation. Principal investigators: Kenneth Ward and David Haaland (DMTS), both 1823.

• *Robotics* — This project will develop automated edge-finishing processes used during the manufacture of machined parts (such as aircraft engines) and transfer the technology to US manufacturing companies. Further development efforts will improve deburring (brush-smoothing of edges) and chamfering (machining of bevels) with high-speed

robot impedance controllers and with direct feedback control techniques. The new controllers will allow robots to carry out all light machining operations at high speed, thus creating a new "tool" in the machine tool industry. Principal investigators: Clifford Loucks, James Novak, Colin Selleck, and James Wiczer (all 1411).

• *Lock and Tumbler (LAT) Pattern Recognition for Medical Applications* — Will transfer LAT-filter technology that can help reduce the cost of medical image diagnostics by providing a highly reliable tool for computer-image interpretation. Principal investigators: George Schils and Philip Kegelmeyer (both 8435).

• *Solar Photocatalytic Detoxification of Water* — Will involve further development of Sandia's demonstrated process for photocatalytic detoxification of water, extending it to a broad range of contaminants. Eventual applications include cleanup of contaminated ground water and detoxification of industrial wastes at their source. Principal investigator: Dan Alpert (6216).

• *Sol-Gel-Derived Thin Glass Films* — Sandia-developed, tailored sol-gel thin glass films promise to be useful in such strategic industries as optics, electronics, sensors, space, and energy. Sol-gel processing forms bulk glass at low temperatures without melting; applications for sol-gel thin films exist where either low-temperature substrates or very refractory glass compositions are required. Principal investigators: Carol Ashley, Jeff Brinker, Gregory Frye (all 1846), and Scott Reed (7476).

• *Corrosion-Resistant Amorphous Nickel-Chromium-Phosphorus (Ni-Cr-P) Electrodeposits* — Project will build on a Sandia-developed plating bath to deposit adherent, pore-free, amorphous Ni-Cr-P coatings for protecting base materials from corrosive environments. The coatings, with further development, could be substituted for expensive stainless steel or Hastelloy™ (a noncorrosive alloy) in a variety of corrosive environments such as oil fields, oil platforms, and space. Principal investigators: Terry Guilinger (1841), James Voytko (7413), and R.E. White (Texas A&M University).

• *Injection-Seeding System for Laser Oscillator of X-ray Lithography System* — Viability and competitiveness of the US semiconductor industry depend heavily on development of new technologies, such as x-ray lithography, for achieving higher circuit densities. This project will use Sandia's established expertise in injection seeding, a process that provides smooth laser pulses for improved reliability, reproducibility, and damage threshold, in developing an injection seeder appropriate for incorporating into laser-based x-ray lithography systems used by the semiconductor industry. Principal investigator: Randal Schmitt (8354).

• *Security Systems* — One project involves soliciting commercial participation in the development of automated thermal imaging systems that allow passive observation of naturally emitted thermal radiation from humans or inanimate objects that are warmer than their surrounding environment. Possible uses include drug interdiction, combating crime, and antiterrorist applications. Principal investigators: Richard Beckmann and Dan Pritchard (both 5238).

Sandia has developed and built two prototype Portable Surveillance Units (PSUs) for evaluation and demonstration. PSUs provide surveillance capabilities in situations that require quick setups, and could be used for police work, surveillance of drug activities, and monitoring border areas. Goal of this TMP project is to reduce the cost of PSU units by 50 percent by making them easier to build. Principal investigator: Charles Johnson (5217).

The Sandia-developed Target Cueing and Tracking System (TCATS) provides motion detection using standard video camera inputs. Its applications range from intrusion detection to target tracking for weapons. Commercially, it could be used for monitoring restricted areas at airports,

traffic analysis, and security-force cueing and dispatch. Objectives for the TMP project: lowering surveillance sensor costs, simplifying the user interface, and increasing reliability. Principal investigator: Steven Humphreys (2335).

Development of a low-cost intrusion detection system for use by drug-enforcement and immigration officials is the aim of another TMP security project. Based on Sandia technology used for development of sensor systems for military use, the commercial system would include a daylight version of a portable imaging device that would transmit data near-real-time, requiring little or no data processing. Principal investigator: Tom McConnell (DMTS, 9235).

• *Video Communication Link to UNM* — Will provide the Labs a two-way link to UNM via Technet, and from UNM, via instructional TV network, to New Mexico and US industry, schools, and universities. Purpose: to share information about Sandia's unique capabilities and technology advancements, and to "turn on" students at all levels to science and engineering. Principal investigator: Linda McEwen (3522), with Don Morrow (3522) and Richard Brown (2648).

• *"Design for Manufacturability" Short Course* — A Sandia-developed five-day "Design for Manufacturability" course, developed originally for Sandia engineers and DOE production agency employees, will be modified into a three-day short course for industry. Purpose: to help course participants produce designs that are manufacturable, maintainable, reliable, and cost-effective. Principal investigator: Linda McEwen (3522). •

Retiree Deaths

Edward Dylo (67).....	July 1
Werner Bach (77).....	July 12
George Corbell (70).....	July 15
Kenneth Shinn (73).....	July 15
James Minger (76).....	July 16
John Barnes (64).....	July 17
Warren Elrod (75).....	July 19
Edna Miller (85).....	July 20
Orville Howard (63).....	July 29
Eugene Hopkins (73).....	July 31
Clyde Howard (83).....	Aug. 10
Dorothy Bair (75).....	Aug. 23
James Wheeler (67).....	Aug. 24
John Chifalo (59).....	Aug. 27
Edward Krapf (75).....	Sept. 2
Alice Simon (83).....	Sept. 5
James Brock (69).....	Sept. 6
William Baldwin (76).....	Sept. 13
Betty Hitchcock (62).....	Sept. 23
Edward Salazar (60).....	Sept. 28

Take Note

Volunteer mentors are needed to work with Albuquerque's Valley High School students. The school recently received a grant from the General Electric Foundation to help increase the number of students from Valley High who graduate and go on to college. More than 45 Sandians have already volunteered, but more are needed; contact Ruth Bitsui (3511) on 4-0370 for information.

Sympathy

To Dennis Kirson (7816) on the death of his brother in Trumbull, Conn., Sept. 26.

To Jerry Myers (5219) on the death of his mother in Heflin, La., Oct. 20.

To Art Trujillo (5245) on the death of his mother-in-law in Albuquerque, Oct. 27.

To Ursula Besse (3426) on the death of her sister in Germany, Nov. 7.

Supervisory Appointments



ED HOOVER to supervisor of Safeguards Integration Div. 5211.

Ed joined Sandia's System Analysis Division in 1978, developing computer models for optimizing the performance of photovoltaic energy systems. He transferred to the Geothermal Drilling Division in 1980, and developed and field-tested polycrystalline diamond compact drill bits.

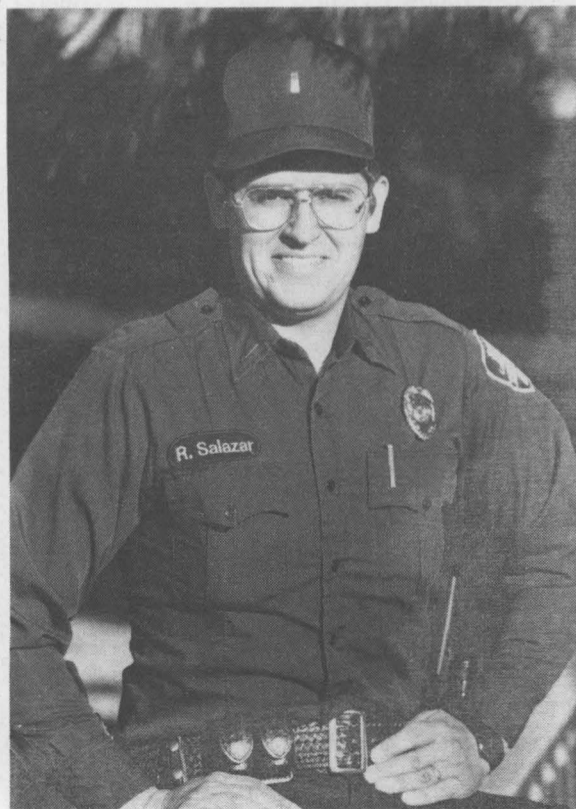
In 1982, Ed joined the Systems Research Division, developing less-intrusive treaty verification techniques, investigating advanced sensor concepts for battlefield use, and helping define the Tactical Remote Sensor System (TRSS) for the Marine Corps.

He transferred to the Exploratory Systems Division in 1985, where he worked on a special system for SWERVE (Sandia Winged Energetic Reentry Vehicle Experiment), was project leader of the Marine Corps Robot Sentry Program, and, for the past two years, was project leader of a joint Army/DOE program to develop automated target acquisition systems for battlefield use.

Ed has a BS in nuclear engineering from Kansas State University and an MS in mechanical engineering from Colorado State University.

He enjoys basketball, motorcycle riding, and auto mechanics. Ed and his wife Marilyn (3340) have three children and live in Sandia Park.

RAYMOND SALAZAR to security lieutenant Patrol Div. - North 3434.



RAY SALAZAR (3434)

Ray joined Sandia's Safeguards and Security Services Department in 1978 as a security inspector. He was a member of Sandia's Special Tactical Operations Personnel team when he was promoted.

He graduated from Coronado High School in Gallina, N.M., in 1971. He has an AAS in law enforcement from Trinidad (Colo.) State Junior College and a BS in criminology from the University of Albuquerque.

Before coming to the Labs, Ray was a member of the U.S. Army. He received the Major General Glenn Otis Certificate of Achievement for Noteworthy Performance of Duty as a military policeman in the Federal Republic of Germany.

In his spare time, Ray enjoys big-game hunting, horseback riding, hiking, camping, and travel.

He and his wife Therese have two daughters and four sons and live in Belen.

DON DAIGLE to supervisor of Office Systems Div. 2613.

Don joined Sandia's Advanced Weapon System Development Division in 1976, where he designed a prototype all-digital interface for weapons. He was project leader for a flight test demonstration of a fuzing system now used in the Trident II fuze. In 1981, he was accepted into the



DON DAIGLE (2613)

Doctoral Study Program and developed new methods to encode images.

In 1982, he transferred to the Exploratory Systems Development Division, where he designed a moving-map display system for an Army vehicle. He joined the Trident II Development Division in 1985, and developed methods to assess and improve the accuracy of fuzing components in the Trident II fuze. He was project leader for Advanced Navy Fuzing activities when he was promoted.

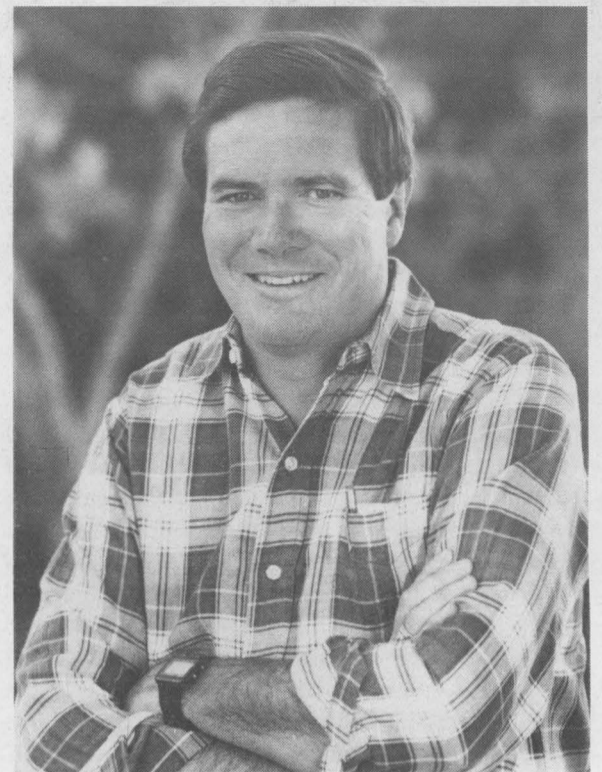
Don has a BS and MS in electrical engineering from Texas A&M and a PhD in electrical and computer engineering from UNM.

He enjoys woodworking, skiing, and gardening, and is active in church-sponsored projects. Don and his wife Dolores have two children and live in the SE Heights.

WILLIAM ROGERS to supervisor of Ceramics Development Div. 1845.

Bill joined the Labs in 1979 as a member of the Energetic Materials Division, where he researched surface and particle morphological properties of pyrotechnics and molecular high explosives.

In November 1985, he transferred to the Surface Science Division, where he performed materials research using surface analytical techniques on



BILL ROGERS (1845)

materials such as silicon nitride, silicon oxynitride, and titanium diboride.

He has a BS in chemistry and a PhD in physical chemistry, both from the University of Texas at Austin. He's a member of the American Chemical Society and the American Vacuum Society, where he is currently on the board of directors.

Bill enjoys skiing, hunting, darts, and cooking barbecue. He and his wife Lee have three children. They live in the NE Heights.

RUTH DAVID to manager of NDT, Electromagnetics, and Optics Dept. 7550.

Ruth joined Sandia in 1975 as a member of Measurements Development Division I. She was project leader for the Command & Control System for the first digital data-acquisition system fielded by Sandia on an underground nuclear test. From September 1981 to September 1984, Ruth was a member of Measurements Development Division II, where she participated in special projects in digital signal processing, including seismic data, ground penetration radar data, acoustical data, and adaptive signal processing.

She transferred to the NTS Instrumentation Development Division in 1984, where she was project engineer for development of high-speed

(Continued on Next Page)



RUTH DAVID (7550)

feed **back**

Q. President Narath: I am totally in support of efforts to maintain safety and health at Sandia. It must be one of our primary considerations. However, the present campaign wastes taxpayer money, damages the credibility of management, and — most importantly — does not contribute to environmental safety at the Labs. Since this effort stems from your direction, I address my comments to you. I see two major difficulties:

- Major safety and health infractions are treated on the same level as rather inconsequential infractions. This means that a proportionally large amount of time and money is spent on details such as attaching file cabinets to the floor, while less attention may be paid to critical areas such as high-voltage testing and PCB contamination; and

- What is deemed safe or unsafe is determined in an arbitrary way, with no feedback from the workers exposed to the supposed risks. This is totally in conflict with principles of quality management, and greatly reduces the credibility of management. This angers staff.

To remedy these deficiencies, some feedback from the staff must be provided in the determination of unsafe environments and practices. Past accident reports should also provide guidance. Special attention must be provided for critical ES&H issues. Do you have power to provide any such direction?

A. I appreciate your interest in safety and health as they affect the Sandia work environment.

(Continued from Preceding Page)

Supervisory Appointments

transient digitizer systems. Ruth was promoted to supervisor of that division in January 1986.

Ruth has a BS from Wichita State University and MS and PhD degrees from Stanford University, all in electrical engineering. She is a member of the Institute of Electrical & Electronic Engineers (Albuquerque Section chairman in 1988), Eta Kappa Nu (electrical engineering honor society), and Tau Beta Pi (engineering honor society).

From 1987 to 1989, she was Computer Systems Security Officer for the Dept. 7120 VAX Network. Ruth was the 1989 VP 7000 Savings Bond coordinator. She is also a UNM adjunct professor and has taught INTEC courses at Sandia and electronics courses at Albuquerque High School as part of the Career Enrichment Center program.

Ruth enjoys technical writing (she's co-author of a recently published textbook) and needlecraft. She lives in the NE Heights.

DOUGLAS McGOVERN to supervisor of Survivability and Security Exploratory Development Div. 5221.

Doug joined the Labs in 1969 as a member of the Exploratory Development Division, where he did case design and tests for "super-safe" weapons. He transferred to the Exploratory Systems Division in 1971 and worked on code control and offset guided missile development. He joined the Advanced Systems Development Division in 1974, developing security systems.

In 1976, he transferred to the Security Systems Integration Division and helped design the video assessment system for the Pantex upgrade. He was with the Intrusion Detection and Assessment Division from July 1977 until January 1978, when he went to Vienna, Austria, as a consultant to the International Atomic Energy Agency (IAEA).

Doug joined the Systems Studies and Engi-

I can understand how the intensity of our current ES&H campaign could raise concerns about its cost-effectiveness. I hope the following points will clarify the essential issues:

(1) We are required by law and DOE directive to comply with all applicable ES&H regulations. They are intended to provide a baseline approach to ensuring the safety of the workplace and respect for the environment. What is to be considered safe or unsafe is spelled out in regulations that we are obligated to comply with, even though those regulations may at times appear arbitrary. We are not free to choose on the basis of our own risk assessment. Our ES&H campaign aims to achieve full compliance and, at the same time, to create management processes that will maintain that level of performance in the future at minimum cost;

(2) At the same time, we must continue to depend critically, as we always have, on each and all of our employees for identification and rectification of hazards associated with specific activities that cannot be anticipated by general regulations. There is no change in this responsibility, which is as important as ever;

(3) Our immediate efforts are concentrating on identifying deficiencies that require remedial action. The findings to date are quite significant in terms of total numbers, and are being prioritized on the basis of severity. The few high-risk items that have been identified are receiving immediate attention. Others will be addressed as rapidly as possi-

ble, in order of priority and available resources;

(4) Improvements in the way we manage ES&H requirements are an important part of our campaign. This includes better dissemination of information, training, and documentation. Consistent with our growing Quality commitment, we intend to effect continuous improvements in our approach to ES&H management.

It is vitally important that we all understand the potentially serious consequences of non-compliance. We are at risk not only as an institution, but also as individuals. Our campaign is a serious undertaking. I am fully aware that the costs, in terms of total effort required — as well as interference with other activities — are considerable. Much thought went into the decision to initiate this effort, and I stand firmly behind it. The commitment of every Sandian is needed if we are to succeed without damaging impact on our programmatic obligations. I am cheered by the strong positive response that I have observed to date. I am confident we will achieve our goal.

Finally, I want to address briefly the larger issue that you raise. It is obvious that American competitiveness will be strongly influenced by the future evolution of ES&H regulations. Our nation must learn to apply rational health-based risk assessments in confronting the fundamental question, "How safe is safe enough?" The underlying philosophical and technical issues are complex. Instinctively, we all recognize that benefits of regulation must be weighed against cost. I believe Sandia is well positioned to contribute significantly in this important area. However, our credibility, and hence our ability to influence future regulatory decisions, will depend in large part on our continuing adherence to existing ES&H standards.

Al Narath — 1

Q. There must be a better, less expensive way to take care of employee expense vouchers than an option currently available. Recently, at Finance, I spent 10 minutes — or more — waiting while a secretary in front of me processed four or five vouchers of one kind or another. Each voucher was checked by the teller, and then checked again in the back office. As the line behind me grew during this wait, a lot of time went down the drain.

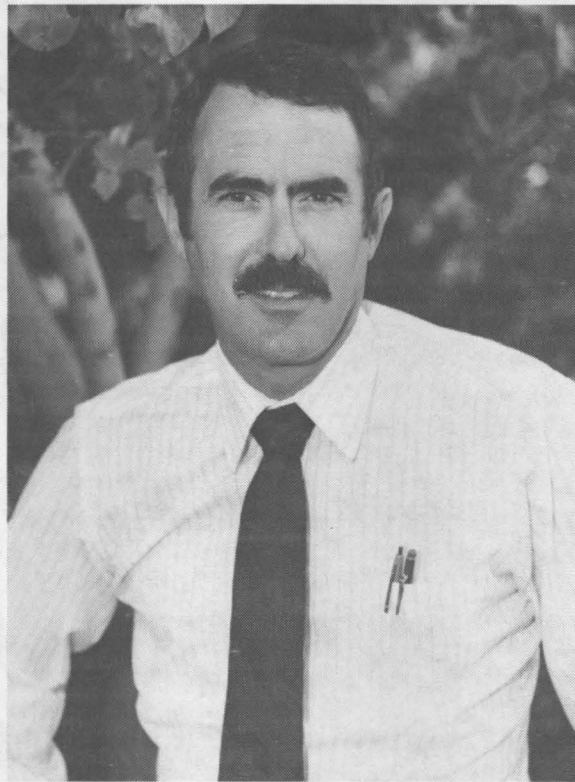
Can employee expense vouchers be mailed to Org. 150? Surely that would be more cost-effective than the situation described above.

A. Both the "Employee's Expense Voucher," SF 4601-B, and the "Reimbursement Voucher," SF 4601-D, may be submitted to Employee Accounting Div. 152 for account settlement. Funds due Sandia should be attached — in the form of a check — to the voucher. Amounts due the employee will be processed and remittances made in the form of a check payable to the employee. If the employee requires immediate cash settlement, the form should be hand-carried to the Financial Organization, 4021 (8523), where disbursement is made directly to the employee or line secretary.

When the voucher is processed, it is audited to ensure that funds are properly disbursed. If a cash settlement is required, the Finance teller verifies that there's a match between name and employee-number and that amounts and items vouchered are acceptable. Also, the teller determines that the employee has signed the voucher, and that the final approval signature is appropriate for the amount vouchered. The person picking up the funds must also sign the voucher.

As you note, it can be time-consuming and costly to stand in line waiting for cash disbursement. Some employees, however, may be in the position of requiring immediate account settlement; therefore, this service is made available by our Financial Organization.

Paul Stanford — 100



DOUG McGOVERN (5221)

neering Division in November 1978, developing containment/surveillance equipment for IAEA. In June 1980, he transferred to the Project Engineering Division and worked on insider protection systems.

He left the Labs in April 1982 to work for private industry. He returned to Sandia in July 1985 and did mobile robotics and teleoperation studies in the Advanced Technology Division. He transferred to the Advanced Systems Integration Division in 1988, developing security hardware.

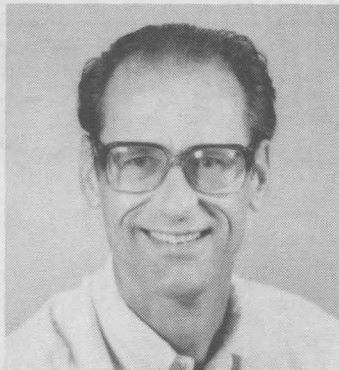
Doug has a BS in mechanical engineering from Northwestern University and an MS in the same field from Stanford. He has an MS in electrical engineering from UNM and a PhD in ME from Stanford.

He enjoys running, automobiles, and refereeing soccer. He is a CPR instructor. Doug and his wife Nancy have three children and live in the NE Heights.

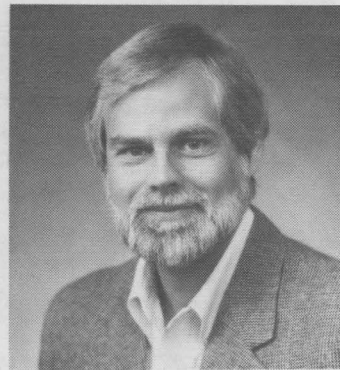
MILEPOSTS

LAB NEWS

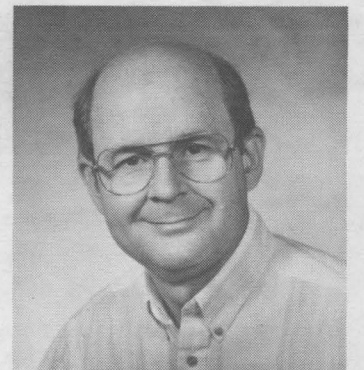
December 1989



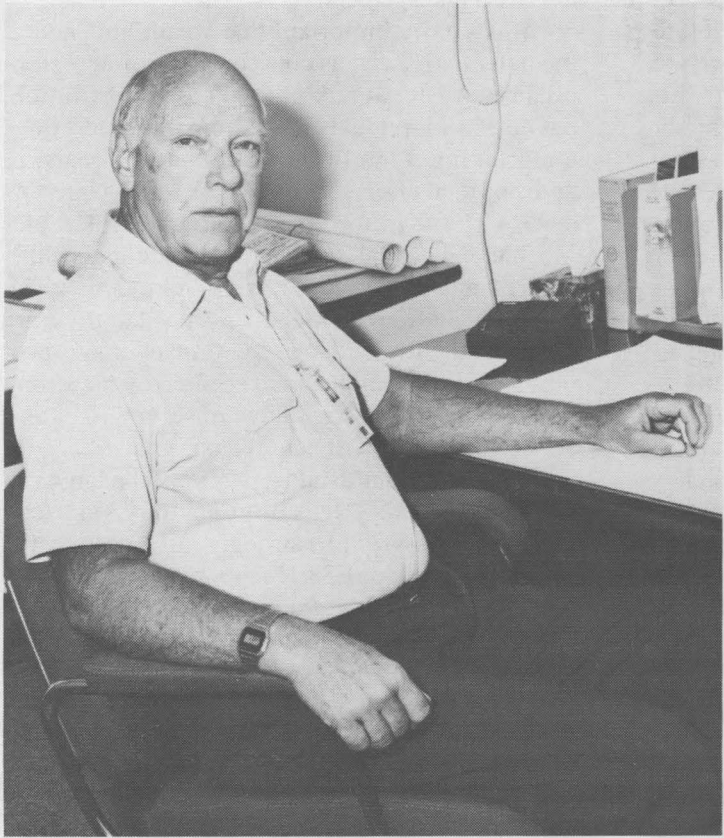
George Fisk (8353) 15



Robert Williams (9133) 15

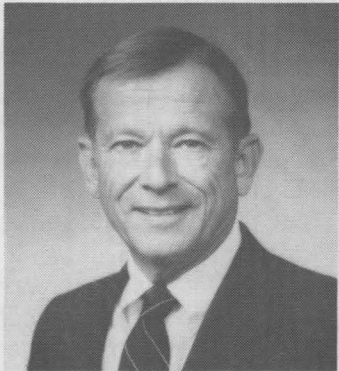


Bill Abel (DMTS, 2534) 20



Vernon Kerr (7131)

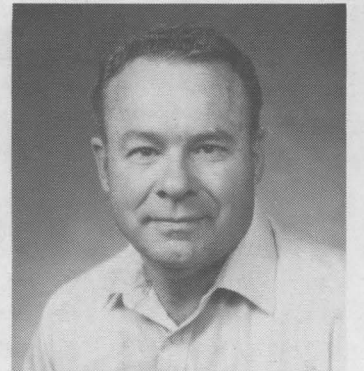
35



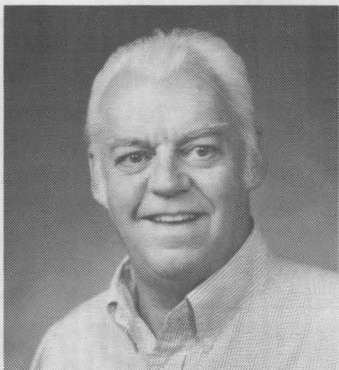
John Walter (7480) 20



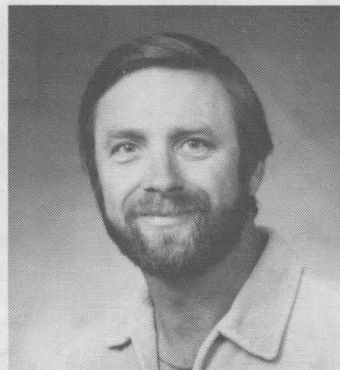
Janet Brooks (8532) 15



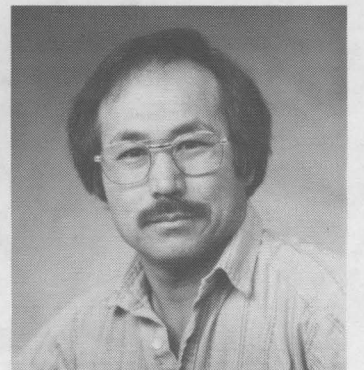
John Gieske (DMTS, 7552) 20



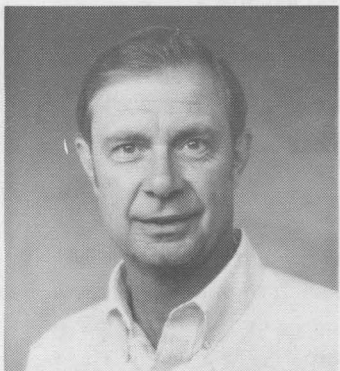
Jack Cyrus (9122) 30



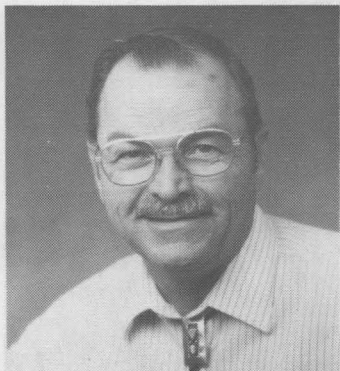
Don Cook (3202) 25



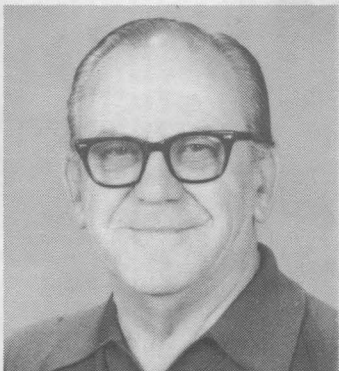
Frank Zamora (2852) 20



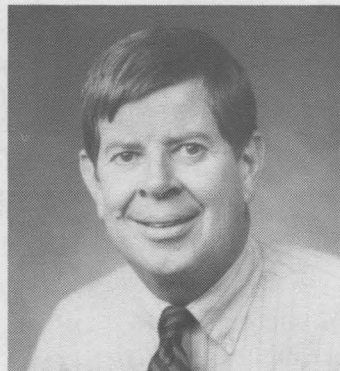
David Follstaedt (1112) 15



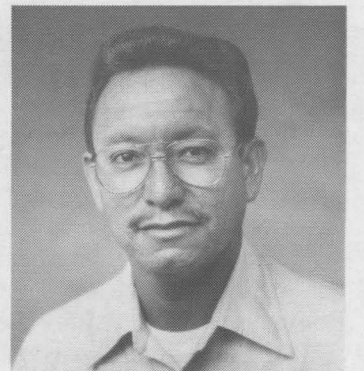
Milt Stomp (6215) 30



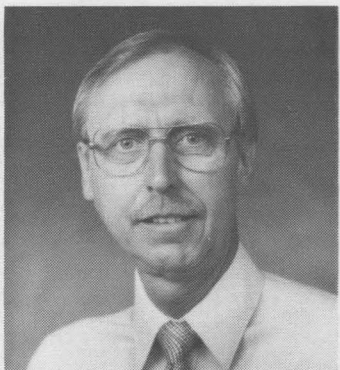
John Molitor (8284) 20



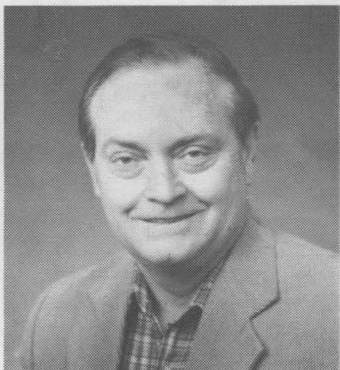
Bob Banks (3531) 30



Silviano Candelaria (7212) 25



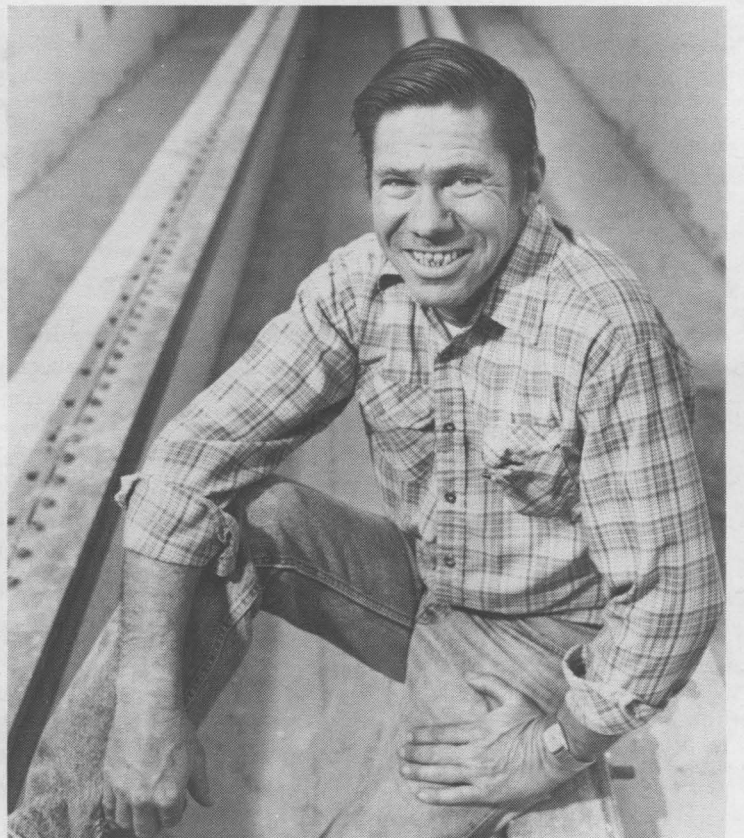
Bill Schaedla (2343) 15



George Edgerly (7471) 30



James Rice (1270) 20

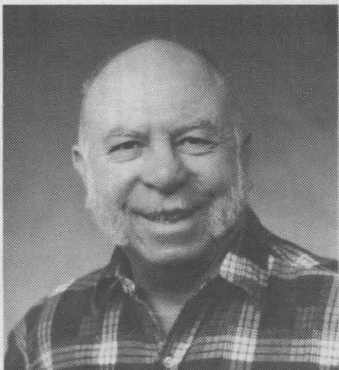


Terry Demaree (7541)

25



Lee Radosevich (DMTS, 8133) 20



Urbano Salas (3428) 15

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

TRaverse ROD, 7', walnut veneer, \$10; one roll 23" R19 insulation, \$6. Underhill, 294-5774.

HP CALCULATOR, 12C, business functions, \$40. Holmes, 292-0898.

DRESSER/TWO NIGHT STANDS, walnut veneers, \$350. Olbin, 275-2681.

COACHMAN RV TRAILER, self-contained, 19', gooseneck hitch for ball in pickup bed, \$3800. Shank, 877-4497.

FOUR-PIECE BEDROOM SET, \$300 OBO. Lewin, 898-2303.

KONICA FS-1 CAMERA; Hexanon lenses: 40mm f1.8, 28-135mm zoom, 2x teleconverter; filters; Konica X-24 auto flash; tripod; Kiwi case; \$350 OBO. Martello, 881-7835.

EXERCYCLE, \$38; electric chain saw; hedge trimmer; bedroom/living room furniture; kitchen cabinet, Formica top; lamps. Pilat, 292-4727.

HUMMEL FIGURINE, "Auf Wiedersehen," 5-1/2" high, catalog no. 153/0, retail price \$125, received in error, sell for \$79.75. Buchanan, 299-7487.

SKI RACK, fits all cars with roof gutters, \$45; Kenmore heavy-duty washer, \$75; new 14" tire chains, \$15. Benecke, 292-5009.

BALDWIN HOME THEATER ORGAN, full pedal board, walnut cabinet, multi-speed tremolo, four presets, two manuals, \$1150. Price, 865-9042.

MINIATURE DOLLHOUSE, constructed, painted, ready to move into, 4-room Glencroft model, \$100 OBO. Jesse, 296-1709 leave message.

JUNIOR WEIGHT BENCH, w/leg lift and 100-lb. steel weight set, \$50 firm. Bishop, 299-8782.

STORM WINDOWS: 2' x 6' single slider; 4' x 6' dual slider; 4' x 9' dual slider, fit Eden homes, single-pane. Strascina, 299-2285.

DRESSER, \$35; bentwood rocker, \$35; antique Singer sewing table, w/glass top, \$35; hand-raised doves, \$10. Levan, 344-9794.

HUMIDIFIER for forced-air furnace, \$5; Hayden software for SAT, 6 disks, \$5. Hall, 298-8617.

LITTON MICROWAVE; exercycle; vibrator belt; answering machine; Wilson 1200 golf set; Hogan woods. Finley, 299-0739 after 2 p.m.

STAINED GLASS WINDOW, Tatkoski original, horizontal Southwest design, 55" x 22", \$300. Houston, 842-6988.

ASTRONOMICAL TELESCOPE, Jason Model 311, 280X, w/tripod, 2 extensions, 3 lenses, moon filter, \$49. Paul, 299-6387.

BURRIS 3 x 9 VARIABLE SCOPE, w/range finder/compensator, \$100. Dean, 299-3281.

STEREO SPEAKERS, new, 25" x 16" x 13", controls/reset button, \$159/both. Brooks, 298-8448.

TELESCOPE, 13.1", F/4.5, Odyssey 1, w/3 eyepieces & spotting scope, \$500 OBO. Grasser, 291-0947.

FRIGIDAIRE REFRIGERATOR/FREEZER, Elite model, frost-free, 17.5 cu. ft., 6 yrs. old, glass shelves, almond exterior, \$150. Girard, 821-5529.

UNM BASKETBALL TICKETS, two, for East Carolina game Dec. 27. Alpert, 294-1247.

REFRIGERATOR, Sears Coldspot, 17.1 cu. ft., gold color, new evaporator fan motor, \$125. Pavelko, 296-3346.

TRUNDLE BED, w/o mattress, \$70; queen-size water bed, complete, \$60; sectional couch, white, \$400 OBO. Ater, 822-9697.

MICROWAVE, Penney's, 650W, 10 power levels, memory, \$140; electric power blower, \$30. Chavez, 821-0275.

ROCKING HORSE, solid wood, \$25; Wonder Horse, \$20; tricycle, \$15; 1/8-size Kiso Suzuki violin, \$100. Akins, 867-3967.

RIFLE, .416 cal. and .375 H&H cal. Greene, 299-4163.

PATIO SWING, non-stationary; queen-size headboard w/bookshelf; end tables; headboards for twin beds. Long, 294-4591.

MOVING BOXES, various sizes, 50¢/box. Young, 897-3406.

HOTPOINT DOUBLE OVENS, electric, built-in, upper self-cleaning, avocado doors, \$25 or make offer. Case, 293-5466.

GOLF CLUBS, 3-PW, new grips, \$70; 2-piece professional cue stick, \$30. Holmes, 897-0916.

NIKE FITNESS MONITOR (distance, time, speed, heart rate), for walking, jogging, and bicycling, \$60 OBO. Shurtleff, 296-7870.

KING-SIZE ENGLANDER FLOTATION WATER BED, no hard sides, new \$850, asking \$275. Davies, 296-6905.

MERCURY OUTBOARD MANUALS, tune-up/repair, owner's, 1965-1979, both/\$5. Yingst, 884-3812.

SKI RACK, Bearcrafters SR-11, fits mid-size cars, used one season, \$50. Hendrick, 296-2163.

YAMAHA B-FLAT CORNET, silver-plate, \$225; Wurlitzer electric piano & acoustic amp, \$350. Guthrie, 299-7182.

TYPEWRITER, IBM Selectric, \$140. Cronin, 265-5229.

WASHER, \$50; hanging lamp, \$15; basketball backboard/rim, \$30; electric heater, \$10. Vigil, 899-0046.

FULL-SIZE MATTRESS, box spring, frame, 2 sheet sets, all for \$75 OBO. Cowen, 296-5980.

KEYBOARD, Casitone Model CT-640, used twice, \$180. Torres, 299-5789.

SONY TV, 19" remote-control color, still under complete warranty, \$275. Horine, 266-4534.

NOKIA CELLULAR PHONE, hand-portable, 6 months old. Complete with charger, \$750 OBO. Bassett, 873-0313.

HEATHKIT 23" COLOR TV, not working, manuals included, free, you pick up. Shapnek, 281-5913.

SOFA & LOVE SEAT, Bassett, earth-tone stripes, w/oak trim, \$250. Kelly, 281-9774.

SOFA & CHAIR, tan/rust plaid fabric, \$125 OBO. Maloney, 828-9610.

CHRISTMAS TREE STAND, \$10; records and albums; backrest pillow, \$10; typing table w/light, \$15. Lynch, 298-7817.

SEARS WOOD LATHE w/accessories, \$225; Sears miter box, \$10; cast-iron cook set, \$15; GE AM/FM cassette, \$17; antique ceiling fan, \$90. Grafe, 897-4745.

GROLIER ENCYCLOPEDIA, New Age Edition, 20 volumes, \$95 firm; family Bible, New Heirloom Edition, King James version, \$20. Montoya, 883-9115.

GARAGE DOOR, metal, roll-up, 8' x 7', hardware incl., \$50; Westinghouse refrigerator, runs, needs cleaning inside, \$25. Chavez, 842-6374.

TREADMILL, Ajay, manual, odometer/speedometer, timer, \$75. Cassell, 298-5262.

ENGLISH SETTER CHRISTMAS LIT-TER, registered, snow-white dam (chocolate-ticked), white sire (orange-ticked), reserve now, \$300. Horton, 884-8989.

DESK, 2-1/2' x 5', w/well for 12" x 22"

typewriter or PC keypad; 2-1/2' x 3' PC stand; two glass-top brass-frame end tables. Chavez, 294-3336.

HUNTER PROGRAMMABLE THERMOSTAT, Energy Monitor II, Model 42203, used two days, value \$65, sell for \$27. Hawley, 299-2516.

VHS-C CASSETTE RECORDER/PLAYER, Realistic, 7 lux, 6:1 zoom, auto-focus, battery, charger, case, 2.8 lbs., purchased 3/25/89, \$650. Giachino, 821-6351.

CROSS-STITCH TABLECLOTH, hand-embroidered, rose design, 58" x 104", permanent press, brand-new, never used, \$60. Larson, 299-2384.

OSTER AIR CLEANER, electronic, apartment-size, used one season, \$60. Guttman, 888-5114.

CANON EOS 650 AUTOFOCUS CAMERA, 70-210mm zoom, action photos by this system available for inspection, \$430 OBO. Parsons, 296-2353.

MISCELLANEOUS ARTICLES. Pinkerton, 255-2505.

STERLING FLATWARE, Lunt "Treasure," 77 pieces, 8 complete place settings, plus 11 service pieces, engraved "C." Gregory, 344-1436.

RACK STEREO SYSTEM, LXI, 100 watts, dual Dolby cassette, AM/FM, turntable, equalizer, 3-way speakers, new \$400, asking \$325. Schkade, 292-5126.

STUFFED ANIMAL, golden Labrador pup by Applesauce & Jackline, brand-new w/original ticket. Wagner, 823-9323.

BASKETBALL BACKBOARD, set in concrete, free to first one who comes to dig it out. Wladika, 255-9166.

KONICA FS1 SLR/AE 35mm CAMERA, auto-wind, electronic flash, \$425; Detonics .45 Combatmaster, tuned by Mowry, extra magazine, \$475. Thorp, 292-0169.

FREEZER, Gibson upright, 15 cu. ft., white, \$175; portable whirlpool attachment for tub, Ward's, \$40. Fanning, 892-0078.

MADAME ALEXANDER DOLLS, all MIB, Algeria, Belgium, English Guard, Sweden, \$35/ea.; Mary Cassatt, \$50. Van Deusen, 291-8196.

PFaff SEWING MACHINE, \$650 OBO. Serna, 865-0475 day or evening.

DINING SET, Danish Haywood Wakefield, champagne-finished solid-oak table w/2 leaves, 6 chairs, \$325. Packwood, 265-7333.

CAMPER for short-bed pick-up, slide-in w/sliding window, carpet and bubble window. Williams, 296-6282.

UPRIGHT PIANO, recently tuned, \$700; skis, 150cm & 185cm, Salomon bindings, \$20/pr.; woman's ski boots, size 7. Butcher, 884-4818.

WOMAN'S MINK JACKET; mink hat; man's suede jacket, size 40L. Sherwood, 299-8146.

PORTABLE CRIB; bathtub safety ring; walker; blankets; boy's clothes, size 2T; 2 twin-bed frames, heavy-duty casters. Liguori, 256-3613.

CANNING JARS, pints/quarts, \$2.50/doz.; Early American table, w/4 chairs, 2 captain's chairs, \$150. Huff, 296-3349.

GMC RIMS & CAPS, older-model, 5-hole, 6" x 15", four/\$60. Zirzow, 281-9896.

AIR CLEANER, Sears, electronic, \$25; Pfaltzgraf Yorktown stoneware, 4 place settings, 4 luncheon plates, completer set, \$50. Young, 256-9158.

QUEEN-SIZE HEADBOARD, 2 bed stands, chest, dresser, mirror (matched dark walnut). Vigil, 821-8059.

ANTIQUEROLLTOP DESK, Fred Harvey, \$1800; LGB train set, \$1800. Oravec, 266-9145.

PREFAB FIREPLACE, wooden, 16' triple-wall flue pipe. Lott, 296-8071.

QUEEN-SIZE SOFA/SLEEPER, w/matching recliner, \$375; 4-drawer desk, w/chair, \$250. Boyd, 298-4712.

TWO DOUBLE-PANE WINDOWS, 3' x 6', bronze, single-hung, free. Kerschen, 821-2848.

RADIO-CONTROLLED AIRPLANE, Futaba 6-channel radio, 4 servos, 2 Super Tigre engines, extra parts &

supplies, \$350 OBO. Prins, 821-0490.

TRANSPORTATION

'69 AMC REBEL, 40K miles, \$1100 OBO. Servais, 292-7016.

'87 DODGE DAKOTA, 4-WD, SE, 8' bed, V-6 engine, below book. Pryor, 294-6980.

'77 CHEV. MALIBU, 4-dr., AT, AC, PS, PB, \$875. Nickerson, 888-4159.

'87 MUSTANG LX HATCHBACK, 5.0 V-8, 5-spd., PS, PB, AM/FM cassette, cruise, \$7800. Rocco, 293-5381.

'87 NISSAN SENTRA SE SPORT COUPE, blue, loaded. Ayers, 291-8216.

'89 NISSAN MAXIMA SE, 15K miles, 5-spd., \$17,000. Terry, 897-4481.

'72 DODGE VAN, Sportsman Royale, AT, PS, PB, 8-passenger, 123K miles, \$1200. Fitak, 281-2748.

'55 OLDS ROCKET 88, engine completely restored, needs paint & upholstery, \$2600. Mares, 884-4843.

'72 HONDA CB500 MOTORCYCLE, newly rebuilt, \$300; dunebuggy, everything custom, \$2200. Gabaldon, 292-7340.

'86 VOLVO, 740 GLE, sunroof, PW, AM/FM, \$11,500 OBO. Lovato, 898-7842.

DIRT BIKE, paid \$100, sell for \$35; man's 10-speed bike, \$30; boy's scooter, paid \$70, sell for \$35. Lucero, 296-2473.

'76 TOYOTA LAND CRUISER, rebuilt engine and transmission, new tires, \$4500. Cronin, 265-5229.

'76 CAMARO, rebuilt engine, 300 miles, needs work. Alderson, 293-5112.

'87 NISSAN PULSAR, 40K miles, T-top, Yamaha stereo system, code alarm, AC, PS, refinance balance of \$10,300. Sanchez, 873-0219.

'86 HONDA HELIX, 250cc, \$1595 OBO. Babcock, 881-3563.

'77 GMC SIERRA, wired for trailer brakes, PW, PB, PS, PL, \$3200 OBO. Chavez, 242-6078.

'63 FORD GALAXY WAGON, parting out or whole. Shapnek, 281-5913.

'69 CAMARO RALLY SPORT 350, PS, AT, blue w/black racing stripes, \$7500 OBO. Rosario, 891-3291.

'76 TOYOTA CHINOOK CAMPER, 77K miles, stove top, icebox, furnace, sleeps two adults and two kids, \$3200. Steigerwald, 344-2765.

'85 MERCURY MARQUIS, 4-dr., V-6, all options, silver/gray, 39K miles, maintenance records available, \$5695 OBO. Curlee, 281-8940.

'81 JAGUAR XJ-6, metallic blue, 4-dr., fully automatic, electric sunroof, 61K miles, \$12,900. Shahinpoor, 822-9521.

'81 AMC CONCORD, \$1200 OBO. Ferguson, 294-7343.

'75 GMC JIMMY HIGH SIERRA, full-time 4x4, loaded, regular fuel, passed emissions, \$3675. Smith, 292-6425.

'84 CORVETTE, Bose stereo, saddle leather, red, Bilstein shocks, Ansa mufflers, AT, 24K miles, \$14,000. Kravitz, 867-3676.

'81 SUZUKI GS-250T MOTORCYCLE, 5.3K miles, Pacifico fairing, 2 helmets, service manual, Dryrider suit, stored indoors, \$475. Scott, 294-7183.

PEUGEOT BICYCLE, PSV-10, 56cm, Vitus 980, Campy, Shimano, Mavic, Strong, 21 lbs., \$600 negotiable. Van Deusen, 291-8196 evenings.

'87 MAZDA RX7 TURBO II, black w/gray interior, loaded, sell at NADA avg. trade-in, \$11,500. Derzon, 299-0523.

'69 FORD F-250 PICKUP, 360 engine, 4-speed, \$1700 OBO. LaMarr, 892-2339.

'82 AMC EAGLE LIMITED, 4-WD, 6-cyl., AC, PS, PB, AM/FM cassette, tilt, 85K miles, \$3200 OBO. Balk, 281-9083.

'77 TOYOTA SR5 PICKUP, 5-spd., 50K miles, \$1000; '77 Honda Civic hatchback, 4-spd., 92K miles, passed emissions, \$500. Coats, 255-9115.

'84 GRAND PRIX BROUGHAM, AC, PW (tinted), PL, sunroof, tilt, stereo cassette, cruise. Carriaga, 877-2646.

'79 FIAT BRAVA, 4-dr., 5-spd., AM/FM cassette, CB-wired, 73K miles, one owner, passed emissions, \$1150. Powell, 268-8607.

'78 FORD F-250 PICKUP, 460, supercab, AT, AC, \$3200. Brown, 281-3608.

'77 FORD BRONCO, 4-WD, V-8, AC, 95K miles, one owner, \$4200. Peters, 898-2270.

'73 SS EL CAMINO 350, new AT w/B&M ratchet shifter, custom paint, \$2700 OBO. Boultinghouse, 344-0780 before 1:30 p.m., 869-6264 after 3.

'67 PLYMOUTH BELVEDERE, 2-dr. hardtop sedan, 383 engine, needs body work, \$375. Carlson, 281-3141.

'83 MUSTANG CONVERTIBLE, red, 5L, 4-spd., PS, PB, AC, 56K miles, \$5800. Greenwood, 298-5268.

'85 VW VANAGON, 7-passenger, liquid-cooled, 68K miles, AC, \$6200. Kenefic, 256-9017 after Dec. 10.

'84 MUSTANG L, 2-dr., 4-spd., AM/FM cassette, AC, original owner, \$3800. Gregory, 275-3855.

'82 HONDA CIVIC WAGON, 5-spd., 58.5K miles, \$2000. Shunny, 265-1620.

REAL ESTATE

PATIO HOME, 3-bdr. or 2-bdr. w/loft, 2 baths, cul-de-sac, 2-story, double garage, 5 years old, Morris/Indian School area, \$120,000. Duggan, 299-1241.

CABIN, w/5 acres, Pagosa Springs (Colo.), double garage, year-round access, \$65,000. Mares, 884-4843.

3-BDR. HOME, Academy Acres NE, 1550 sq. ft., LR, DR, FR, FP, 2 baths, double garage, landscaped, \$98,500. Behar, 823-9499.

MOBILE HOME, 80' x 14', '86 Fleetwood, take over payments. Bailey, 898-3657.

2-BDR. HOME, Presley, 2 baths, double garage, Spain/Morris area, assumable 8 1/2% FHA, \$6000 down, \$740/mo. Nguyen, 275-7390 leave message.

3-BDR. HOME, 1 bath, 1125 sq. ft., pantry, single garage, covered patio, front sprinklers, NE University area, \$66,000. Packwood, 265-7333.

2-BDR. CONDOMINIUM, 1-1/2 baths, patio, new carpet/appliances/paint, Spain/Wyoming area. Switendick, 255-1003.

2-BDR. HOME, 2 baths, FP, 2000 sq. ft., study, wet bar, double garage, sun deck, \$116,250. Ortiz, 268-0109.

WANTED

HOUSEMATE, female, nonsmoker, \$250/mo., plus share utilities. Piatt, 293-1204.

CLASS C TRAILER HITCH AND RECEIVER, w/sway-control bars, for Ford F-150 truck. Davidson, 293-9486.

BICYCLE HELMET for 1-yr.-old. Adams, 821-9079.

HP41 CALCULATOR, w/programmable disks, manual. Chavez, 842-6374 after 6.

GO-CART PARTS for teenage son's project. Diegle, 294-5565 after 6.

SOMEONE TO SHARE SUBSCRIPTION COST of "100 Highest Yields" weekly publication. Fisher, 881-8072.

MUSIC STAND for young, first-year flautist. Walston, 298-1500.

SILVERSMITH TOOLS, equipment. Lujan, 299-4820.

MAH JONG SET, preferably 1920s or earlier. Weston, 255-1196.

CLEAN COPY of "Listen to the Warm" by Rod McKuen; 8" picture tree w/hanging photo frames. Boyd, 298-4712.

NORDICTRACK CROSS-COUNTRY SKI EXERCISER. Prevender, 296-8586.

SHARE-A-RIDE

CAR POOL WANTED: N217/old 66 area. Zirzow, 281-9896.

Coronado Club Activities

Ho-Ho-Ho Holiday Hoopla Set for December 22

GET IN THE HOLIDAY SPIRIT at the C-Club's annual season-celebrating party Friday, Dec. 22. Dinner, served from 6 to 9 p.m., features prime rib and all the trimmings (gentleman's cut, \$7.95; lady's cut, \$6.95). "Together" plays variety music for dancing from 8 until midnight. This is always a very popular event, so here's a word to the wise: Make those reservations early (265-6791).

ONLY ONE Sunday brunch is scheduled this month — this Sunday, Dec. 10, from 10 a.m. to 1 p.m. A fabulous food selection includes roast turkey, baron of beef, Albuquerque omelets (we really mean Denver), scrambled eggs, bacon, hash browns, and much more. The price is unbeatable: \$6.95/adults, \$3.50/children ages 3 through 11, and free/tykes under 3.

NEW YEAR'S EVE REMINDER: Deadline for buying tickets for the blast to welcome 1990 is next Friday, Dec. 15. Dinner, served from 7 to 9 p.m., includes prime rib or chicken breast teriyaki, baked potatoes, sautéed vegetables, green chile stew, full salad bar, and a variety of cakes for dessert. Dance your way from 1989 to 1990 accompanied by songs from Southside

(9 p.m. to 1 a.m.), and pause along the way at midnight for continental breakfast and a bottle of bubbly to welcome the new year. The ticket cost of \$20/member and \$23/guest covers all of the above, plus noisemakers and hats to put you in a celebratory mood.

SPEAKING OF SEASONAL CELEBRATIONS, the T-Bird card sharks are combining gaming action on Dec. 14 with a holiday party. Festivities start at 10 a.m., and Jim McCutcheon promises to wear either his angel costume or his Santa Claus suit, depending on the mood he's in that morning.

CORONADO SCHUSSBOOMERS (aka Coronado Ski Club members) meet this month on Tuesday, Dec. 19. Following a social get-together at 7 p.m., Henry Hornberger of Taos Ski Valley kicks off the 7:30 meeting with a talk about what's new up north. Topping off the evening is a fashion show featuring the latest in Alpine ski-wear. Also, there may still be some openings for this season's CSC trips to exotic places, so take this opportunity to sign up. Free holiday goodies and extra-special door prizes make this an evening to remember.

Welcome

Albuquerque — Raymond Cote (1833), Ruth Ann Duggan (5219), Jane Farris (3544), Wendell Forster (3411), Andrea Guss (7843), Darlene Hagerman (3723), Gary Hansen (9145), George Kenefic (7821), Salvador Lopez (7116), Daniel McLaughlin (1248), Donald Summers (9221), La Wanda Wold (6428), Gary Zender (1822); *Other New Mexico* — Stephen Conrad (6416), Paul Flores (2825), Daniel Grimes (7174), Ronnie Hospelhorn (2171), Gerald Savage (7843).

Elsewhere: *Arizona* — Peter Biskis (2362), Richard Hunt (9212); *California* — Priscilla Altisis (3532); *Illinois* — Dean Dixon (9222); *Maryland* — Jeffrey Payne (1555); *Missouri* — David Baur (9343); *Texas* — Jeffrey Duncan (9116), Raivo Leeto (9216); *Virginia* — Mark Heinrich (9133), John Zolper (2152).

Congratulations

To Roberta Gabaldon (3426) and Dennis Carroll (3434), married in Albuquerque, Oct. 13.

To Harriet (3000) and Alan Morgan, a son, Scott Douglas, Oct. 26.

To Alice (7123) and Michael Montoya, a son, Nolan Mitchell, Oct. 30.

To Denise and Robert (9213) Morris, a daughter, Carmella Juanelle, Nov. 15.



Events Calendar

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

Dec. 8-9 — Classical Concert Four: New Mexico Symphony Orchestra, conducted by Neal Stulberg, featuring Ruben Gonzalez on violin, Atar Arad on viola; music of Rossini, Mozart, and Shostakovich; 8:15 p.m. (free concert preview at 7 p.m.), Popejoy Hall, 843-7657.

Dec. 8-9 — "As You Like It," William Shakespeare's romantic comedy, performed by Theatre-in-the-Making's Youth Performance Workshop; 8 p.m., CenterStage (3211 Central NE), 260-0331.

Dec. 8-10 — "The Man in the Glass Booth" by Robert Shaw; layers of masquerades peel away slowly and painfully as the search for Nazi war criminals focuses on one man; 8 p.m. Fri. & Sat., 6 p.m. Sun.; Vortex Theatre, 247-8600.

Dec. 8-Jan. 3 — Special Holiday Exhibit, presented by the Pastel Society of New Mexico; third floor of Broadway Southwest (Coronado Center), 892-4000 or 898-5116.

Dec. 9 — Toy Train Swap Meet, presented by the Toy Train Operating Society (New Mexico Division); table sales, auction, raffle; opportunities to buy, sell, or trade; 12 noon-4 p.m., Jefferson Mid School (712 Girard Blvd. NE), 892-8249.

Dec. 9-10 — Christmas Potpourri Festival, benefit for Share Your Care adult day-care program; arts and crafts items, silent auction, raffle, bake sale, lasagna dinner Sat. night; 5 p.m.-8:30 p.m. Sat., 9 a.m.-5 p.m. Sun.; Boys and Girls Club (3333 Truman NE), 881-8982.

Dec. 15 — Concert, New Mexico Symphony Chorus and the Rio Grande Red Hot Chile Jazz Band; free admission, 7:30 p.m., South Broadway Cultural Center (1025 Broadway SE), 848-1320.

Dec. 16 — Holiday Festival, Roger Melone conducts the New Mexico Symphony Orchestra in a program of seasonal music, concluding with a sing-along of carols; 8 p.m., Kiva Auditorium, 842-8565.

Dec. 16 — "Kwanzaa," concert featuring Zimbabwe and jazz culture; 7:30 p.m., \$4 dona-

tion, South Broadway Cultural Center (1025 Broadway SE), 848-1320.

Dec. 17 — UNM Centennial Series for the Arts: "Noche de Navidad en Nuevo Mexico," holiday variety program featuring a bell choir, mixed choir, guitarists, jazz musicians, folk singers, and a New Mexico quartet; 5 p.m., UNM Conference Center (1634 University Blvd. NE), 277-2527.

Dec. 19 — "Shepherd of Pan Duro," a modern Christmas story of a homeless immigrant and his mother who must travel to the village of Pan Duro to register as citizens of their newly adopted nation, presented by La Compañia de Teatro de Albuquerque; 8 p.m., KiMo Theatre, 848-1320.

Dec. 20 — "A Merry New Mexico Christmas,"

presented by the Desert Chorale; holiday concert featuring music by de Victoria, Britten, and Poulenc (plus light Christmas favorites); 8:30 p.m., San Ysidro Church in Corrales, 277-4402.

Dec. 22 — "The Reluctant Dragon," children's holiday musical about a sensitive dragon and the young boy who befriends him, presented by the Desert Chorale; other holiday music and Christmas tales told by Joe Hayes; 5:30 p.m., Keller Hall, 277-4402.

Dec. 22 — "A Merry New Mexico Christmas," holiday concert presented by the Desert Chorale; post-concert Yuletide reception hosted by the Albuquerque Friends of the Desert Chorale; 8:30 p.m., Keller Hall, 277-4402.



DON ROHR (2161, left) receives a Naval Liaison Organization (NLO) plaque acknowledging his support (since 1977) of the Joint Nuclear Weapons Publication System. Giving Don the plaque are (center) Cdr. Mike Clayburn and Weapons Technician-Senior Chief George March. Until a recent transfer, Don supervised Weapon Procedures and Logistic Support Div. 7212.