

Sandia's new 'inchworm' actuator studies friction at the microscale, provides detailed information

Main objective was to study validity of 300-year-old Amonton's Law at small proportions

By Michael Padilla

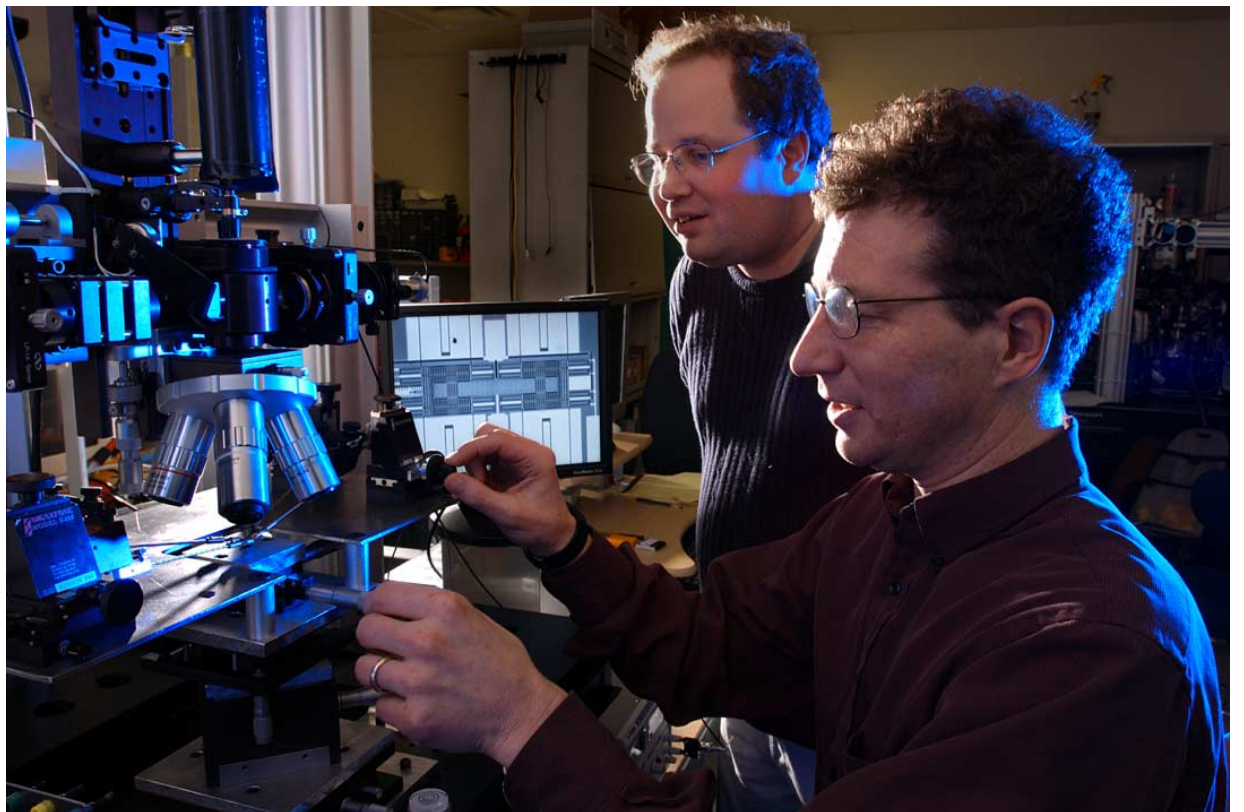
Creating a tool small enough to measure friction on a microelectromechanical systems (MEMS) device is not an easy task. The tool has to be about the width of a human hair.

Yet, Sandia researchers have developed a new "inchworm" actuator instrument that provides detailed information about friction at the microscale.

The main objective of the project was to study the validity of Amonton's Law at the microscale. This law, first stated 300 years ago, says that friction force is proportional to normal force (normal means perpendicular to the surfaces). Although it remains a good description of friction today, there are interesting deviations from Amonton's Law, especially at low normal forces, where adhesion between the two surfaces is thought to contribute extra force. Because of the large surface-to-volume ratio at the microscale, these adhesive forces could cause a strong deviation from Amonton's Law.

"We must accomplish several different functions in one device to study the laws of friction at the microscale," says Sandia researcher and inchworm creator Maarten de Boer (1762). "We need to build an actuator that controllably and accurately generates both very low and very high forces."

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MICROSCALE FRICTION — Maarten de Boer (1762), foreground, and Alex Corwin (1762) investigate friction at the microscale using a recently developed inchworm actuator fabricated by the Sandia Ultraplanner Multilevel MEMS Technology (SUMMiT) process. (Photo by Randy Montoya)

Team analyzing security standdown reports, proposals

Final recommendations for improvements due March 31

By Chris Burroughs

Organizations throughout Sandia took the Nov. 17-26 security standdown seriously, and now it's time for the Labs to begin acting on the recommendations and concerns.

That's the word from Terri Lovato, Level II Manager of Safeguards and Security Operations Dept. 4220. After the standdown, all departments and divisions submitted reports, expressing issues and concerns about security in their areas and offering lessons learned.

"Line organizations and executive management did an outstanding job and took the standdown seriously," Terri says. "As a result, we have an enormous amount of data to review. We know the line is anxious and wants to see results and reports immediately. However, we need to examine the data in a thoughtful way.

"Questions as simple as: 1) 'Do I need a clearance in a PPA?' to 2) concerns regarding corporate attitudes towards security, need to be addressed in a consistent manner. We are moving relatively quickly to provide answers to simple questions, and are vetting those questions both at New Mexico and California prior to release. We hope the line has patience while we develop and implement good-quality processes."

A team led by Terri is now analyzing the hundreds of pages of reports, seeking common themes and ways security issues can be resolved. Much of the analysis is being done in

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State of Labs talks tout Sandia's tech innovations, national security work

Military contributions, computing, Z, MESA, partnerships praised

By Larry Perrine

Labs President C. Paul Robinson and Executive VP Joan Woodard made one thing extremely clear during the three 2004 State of the Labs presentations that concluded last week: They could not be more proud of Sandians' technical accomplishments over the past year — particularly those contributing to national and global security.

Joan and Paul concluded the annual series Wednesday, Feb. 11, before several hundred Sandians in the Steve Schiff Auditorium and others watching live via video links at several remote Sandia locations. Joan and Paul presented the same basic information to a packed house of Albuquerque and New Mexico community leaders the



LABS PRESIDENT C. PAUL ROBINSON and Executive VP Joan Woodard made it clear they are proud of Sandia's accomplishments over the past year during the 2004 State of the Labs presentation. (Photo by Randy Montoya)

evening of Feb. 5. Session one was Feb. 2 at Sandia/California with Paul and California VP Mim John participating; Joan could not attend that session.

Early on, Paul emphasized several Labs contributions to the military, among the newest a Kevlar/carbon composite gauntlet that Sandia developed to help protect soldiers' arms from shrapnel wounds and burns. A special Labs team developed these gauntlets after Jack

Jones (6955), who served an Iraq tour of duty as a reserve officer, pointed out the need. Jack said soldiers riding Bradley fighting vehicles and Humvees were particularly vulnerable to severe arm injuries and amputations from roadside explosions. About 35 pairs of the gauntlets have been shipped to Iraq and are being tested by military volunteers.

Healthy budget this year

This is proving to be a "banner year for Sandia's budget," Paul said. "We have surpassed \$2.2 billion for the laboratory. What is amazing about that number is that in addition to growth in the nuclear weapons program — which has

(Continued on page 6)



5 Novel simulations harness proteins to build new, desirable nanostructures

8 Sandia President C. Paul Robinson on nuclear weapons in the 21st century

What's what

Winding down from work one day recently, and not quite ready to head home for the evening, I stopped in at a favorite watering hole to see if there might be an old friend or two there also winding down for the day. There was. One.

Gump, the editor of my community newspaper was there, alone at a table in a dark corner, sort of staring at his glass. The bartender stood leaning forward, her elbows on the bar, chin cupped in her hands, watching a cable-channel as a summary of the day's financial doings crawled from the right bottom corner of the screen into the obscurity of the left bottom corner. I ordered a drink and she delivered it, then went back to the television report.

I walked over to the table in the darkened corner and Gump waved me into a chair, still silent. "You're pretty glum," I said, omnisciently. "What's the problem? You're usually pretty upbeat."

Without looking up, he twirled his glass lazily, sending the little ice cubes clinking against the side and each other. "Humor," he said with finality.

When it was apparent he wasn't going to expand on that, I said, "Whattaya mean, humor? What about humor?"

He sighed, still looking at his glass. Then, finally, he looked up at me and asked, rhetorically, "What's happened to humor?"

Anticipating more after this torrent of words, I waited. But when it was obvious that was it, I said, "Well, I don't know what's happened to it, but it sure didn't show up here this afternoon." Then coaxed again, "What's got you in such a state?"

Pulling his hands away from his glass finally, Gump leaned back in his chair and looked at me for a moment, then said, "Why are people so sensitive, so combative? Why are they so quick to take offense, to feel attacked? Why are they so serious? Don't people watch Letterman, and Leno? Don't they have a sense of humor any more?" He looked at me, searchingly.

"Well," I started, thinking I sounded like Ronald Reagan and quashing the urge to say 'There you go again,' then continued, "why don't you tell me what you're getting at. What started all this?"

Sighing again, as if gathering the strength to speak, he said, "It was nothing, really. A silly, insignificant little thing." He paused a moment, then resumed, "You know how I always sign off the editorial page with some little quip? Well, when this week's edition was delivered, I got about a dozen e-mails from irate readers. They all read something different into it - something serious. Jeez! Anybody who's read the paper every week for any time at all knows that this is the sign-off funny! A joke!! What's happened to people's sense of humor? Don't they understand that there are different points of view, that they might be wrong? . . . might be missing the point?"

"Of course not," I said, soothingly, twirling my nearly empty glass. "A lot of people today are like the Wizard of Oz with a T-1 Internet connection - they have the illusion of omnipotence, the reality of near-anonymity. . . and they're empowered."

I drained my glass and as we both rose to leave I added, "Pogo pegged it: They are confronted with insurmountable opportunities."

- Howard Kercheval (844-7842, MS 0165, hckerch@sandia.gov)

Julia Phillips elected to National Academy of Engineering

Sandia's Julia Phillips has been elected to membership in the National Academy of Engineering (NAE), considered one of the highest professional distinctions that can be accorded an engineer. NAE announced the new members Feb. 13.

Julia is Sandia's Director of Physical and Chemical Sciences.

"It is always a pleasure when a Sandian achieves national recognition through election to the NAE," Sandia President C. Paul Robinson told the *Lab News*. "Anyone who knows of Julia or her work could hardly be surprised by this selection, as she certainly has ranked among the most deserving of our technical leaders for many years. Julia has participated in leadership positions in material research, the National Research Council, and has always been a standout for her deep technical knowledge and extraordinary communication skills. It's wonderful to see this deserved recognition come her way."



JULIA PHILLIPS

Academy membership honors those who have made "important contributions to engineering theory and practices, including significant contributions to the literature of engineering theory and practice," and those who have demonstrated accomplishments in "the pioneering of new fields of engineering, making advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education."

Julia's specific citation reads: "For leadership and distinguished research in the epitaxy of dissimilar materials."

Julia has held her current position at Sandia since 2001. She came to the Labs in 1995 after 14 years at AT&T Bell Laboratories. She has a PhD in applied physics from Yale University and a B.S. in physics from the College of William and Mary.

Her research has been in the areas of epitaxial metallic and insulating films on semiconductors; high-temperature superconducting, ferroelectric, and magnetic oxide thin films; and novel transparent conducting materials.

She was president of the Materials Research Society in 1995 and holds or has held elected positions in the American Physical Society and the American Association for the Advancement of Science. She is a Fellow of the American Physical Society and the American Association for the Advancement of Science as well as a National Associate of the National Academies.

She has served on the editorial boards of *Applied Physics Letters*, *Journal of Applied Physics*, *Applied Physics Reviews*, and *Journal of Materials Research* and has published more than 100 papers in these and other journals. She has also been involved in the National Research Council, currently serving as chair of its National Materials Advisory Board, and she serves on several other national and international scientific boards.

Other Sandians who are NAE members include Al Romig, Jack Jakowatz, and Jim Asay (all elected last year, *Lab News*, Feb. 21, 2003), Jeff Brinker and Gordon Osbourn (both elected in 2002), Paul Robinson, and George Samara. Altogether about 16 Sandians, current and retired, are members.

"It's wonderful to see this deserved recognition come her way."

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Ken Frazier, Editor 505/844-6210
Bill Murphy, Writer 505/845-0845
Chris Burroughs, Writer 505/844-0948
Randy Montoya, Photographer 505/844-5605
Nancy Garcia, California site contact. . . . 925/294-2932

Contributors: Janet Carpenter (844-7841), John German (844-5199), Neal Singer (845-7078), Larry Perrine (845-8511), Howard Kercheval (columnist, 844-7842), Will Keener (844-1690), Iris Aboytes (844-2282), Michael Padilla (284-5325), Rod Geer (844-6601), Michael Lanigan (844-2297) Michelle Fleming (Ads, Milepost photos, 844-4902).

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Retiree deaths

- Florencio Romero (age 86)Nov. 19
- Dorothy F. Watson (94)Dec. 1
- Richard O. Murdoch (80)Dec. 5
- Antonio Jose Mata (87)Dec. 5
- Richard G. Oliveira (72)Dec. 6
- Maxine M. Stephenson (78)Dec. 8
- Anthony T. Norwich (86)Dec. 9
- Hester E. Yett (91)Dec. 11
- Mary Ellen Puckett (54)Dec. 18
- Mabel G. Bracken (90)Dec. 20
- Troy D. Bewley (77)Dec. 23
- George Orr Thorne (86)Dec. 25
- Beryl F. Hefley (80)Dec. 26
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- Arnold E. Bentz (82)Dec. 31
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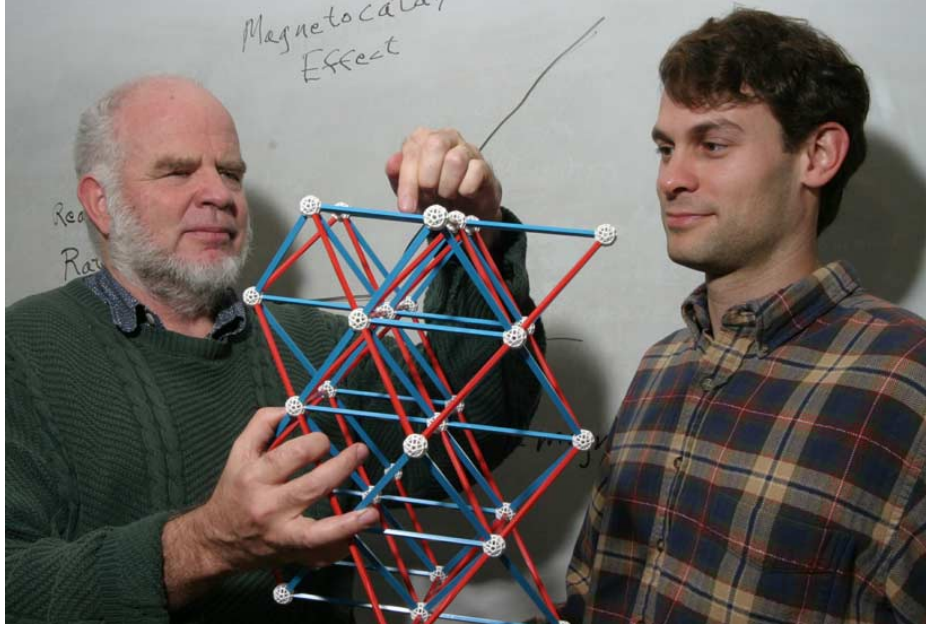
— Ken Frazier

Team solves a mystery of magnetism and chemistry

By Nancy Garcia

Materials science researchers here recently solved a 70-year-old mystery linking magnetism and chemical reactions.

Don Siegel, John Hamilton, and former Sandian Mark vanSchilfgaarde (all 8761) found the key while researching how low-level impurities affect grain boundaries in electroplated nickel



SOLUTION — John Hamilton, left, and Don Siegel with a model of nickel in front of a graph showing how the metal's catalytic activity sharply rises with an increase in temperature, a puzzle they finally solved through atomistic simulations. The simulations showed that the movement of carbon impurities in and out of the crystal lattice was responsible for the pronounced switch. (Photo by Bud Pelletier)

LIGA parts. Like other magnetic materials such as iron, nickel undergoes a magnetic phase transformation at a transition temperature known as the Curie point, about 350 degrees C. At higher temperatures nickel is nonmagnetic and carbon moves from the surface into the metal. At lower temperatures nickel is magnetic and carbon is expelled to the surface, where it hinders surface catalysis (the ability to facilitate chemical reactions). Carbon is expelled from bulk nickel because it disrupts the magnetic spin of nearby nickel atoms, making them lose their magnetism.

"I am very pleased that the longstanding puzzle about the magnetocatalytic effect could finally be completely resolved by your theoretical work," says Gerhard Ertl, a foremost surface catalysis expert. "I want to congratulate you and your colleagues on this significant achievement."

The surprising link between magnetism and catalysis was first discovered in 1934 when chemist J.A. Hedvall published a research paper indicating that materials such as nickel suddenly become better catalysts when they are heated to the point that they lose their magnetism. "Nobody knew why this happened!" said John.

John learned about the Hedvall effect linking magnetism and catalysis early in his career, publishing an experimental paper in 1981 showing that below the Curie temperature carbon is abruptly expelled to the surface. "But we still didn't find out why the carbon was expelled," he said.

John's early paper was summarized in the weekly journal *Nature* by

Mildred Dresselhaus, then director of MIT's Materials Science and Engineering center. She pointed out that the Hedvall effect is of both theoretical and practical interest. Nickel is used as a catalyst to hydrogenate vegetable oils to prevent spoiling and convert to a solid form, remove sulfur from diesel fuels, and produce about half the world's hydrogen gas supply through steam-reforming of natural gas.

In 1984, Gerhard Ertl showed that carbon impurities were responsible for the disruption of catalysis. For their experiments, his team

painstakingly removed the trace carbon impurities that are commonly present in nickel at parts per million levels. With the carbon removed, the Hedvall effect disappeared. He later commented that "The interpretation of our experiments . . . had been strongly assisted by your [John's 1981] studies."

While performing quantum-mechanical simulations of impurities in nickel, Don showed that

Sandia California News

carbon atoms in nickel disrupt the magnetic spins of nearby nickel atoms. At temperatures below the Curie point, nickel "wants" to be magnetic and consequently expels carbon from the bulk to the surface. At the surface, carbon's deleterious effect on magnetism is minimized. However, having a surface contaminated with carbon is very undesirable for catalytic applications, just as sulfur in automobile exhaust can poison a catalytic converter.

Don heard about the catalytic link to magnetism from John and decided it wouldn't hurt to look into why the catalysis efficiency jumps steeply above the Curie temperature.

"Of course the catalytic rate should increase with temperature," he says, "but this was really abrupt." His simulations showed that the shift occurs in tandem with increased solubility of surface carbon down into the metal.

Some of Don's early results were shown to Mark vanSchilfgaarde, a theorist with an expertise in magnetic phenomena. Mark became interested in the topic and performed a more detailed simulation of how carbon solubility changed across the magnetic transition. Don and his colleagues coined a new term, "magneto-expulsion" to describe this phenomenon.

The results of this research, carried out in intensive calculations using the computer cluster CPlant, were recently accepted for publication in the prestigious journal *Physical Review Letters*. In his congratulatory note Ertl commented that the Sandia work "make(s) now the final point to this story."

Feedback

Q: There is a Medical parking space in front of Bldg. 832 marked "73" that has been there for some time (years); yet when we come to Bldg. 832 to park in a handicapped space, many times there is not one available for visitors. But, you can be sure that "73" is wide open. What can be done in this instance? There should be at least one or two more handicapped spaces available for visitors at Bldg. 832.

There is also a dire need for visitors for marked additional handicapped spaces in front of Bldg 750. Would you address these requests?

A: I apologize for the times when you did not find an available handicapped parking space. Handicapped parking is a priority and Sandia will provide sufficient spaces to meet your needs. In an Integrated Enabling Services (IES) approach Medical, Facilities, Safety, and Security work together to provide handicapped and medical parking spaces in the most accommodating area for individuals; in addition handicapped parking spaces are provided in open parking lots and other high-use areas. Once a need has been identified, we work with the individuals to see that they have a space that meets their needs. Based on this Feedback we will add several new handicapped spaces in the near future, one by Bldg. 750 and two more spots near Medical. In addition, there are four handicapped spaces in the new lot directly west of Medical. Old #73 is a medical space provided for people who need a short-term accommodation; it will remain with its current designator. If you have additional needs, please contact your building manager (<http://facprod.sandia.gov/bldmgr/listbldg.idc>) and they will work with you to see that adequate handicapped parking is available. — Ed Williams (10864)

Q: As soon as Fleet Services moved from Facilities to Procurement, the service went away.

- If the gas tanks aren't empty, the pumps don't work.

- Oil changes used to be a 15-minute event (including drive time to Bldg. 875 and back). Now it's a one-hour event (if you're lucky) to drive to Jiffy Lube, Zip Lube, etc., charged to overhead or a customer.

- Repairs used to be one phone call away; call Fleet Services, someone picked up the vehicle, got it fixed, and returned it. Now, call Fleet Services and get the name and number of a mechanic in town authorized to fix the vehicle; call the mechanic and set an appointment; drive the vehicle over and either wait or get a ride back in a second vehicle which followed (leaving it unavailable for valid use). If second option, return to mechanic later to pick up vehicle; again, tying up the second vehicle (all on overhead or customer's dime).

If someone is responsible for more than one vehicle, all examples above apply to each vehicle.

Granted, everyone in Fleet is polite, and flat tires are usually repaired quickly. Other than that, what do the employees in Fleet "Services" do if we are doing all of this? Please put the service back in Fleet Services!

A: Thank you for your feedback. We apologize if you feel you have not received the level of service that you expected from the Fleet Management Department. Fueling your vehicle, ensuring scheduled preventive maintenance is performed, and ensuring repairs are performed in a timely manner is the responsibility of every vehicle owner and is very important to the safety and longevity of a vehicle.

The Kirtland Air Force Base Fueling facility, located on I Street, is the primary fueling location to obtain compressed natural gas, diesel, and

unleaded fuel. The secondary fueling location is located on Aberdeen Road on the west side of KAFB. The Fleet Management compound is the primary location to obtain E-85 fuel. In the unlikely event that both KAFB Fueling facilities are inoperable, the Fleet Management fueling facility may be used as a backup. In addition, fuel for GSA vehicles may be purchased off KAFB site at many gas stations using the GSA Voyager card.

Fleet management is still providing the same preventive maintenance and repair service as performed prior to Fleet's movement into Logistics. However, Fleet Management is in the process of implementing a preventive maintenance pilot program in the spring of 2004 in which GSA-approved maintenance shop vendors will retrieve vehicles from the Fleet Management compound, perform the required maintenance or emissions test, fuel, and wash your vehicle and return it to the Fleet compound in the same working day. The preventive maintenance pilot is expected to significantly reduce travel time and increase efficiency.

The services you described in your feedback are not part of the standard service we provided our customers — Fleet Management is not authorized to perform maintenance on GSA vehicles nor do we have the resources to deliver 900 fleet vehicles to off-site shop vendors for maintenance. If you received specialized services from Fleet Management in the past, it was not part of the standard service we provided other customers. We sincerely empathize with your predicament and we are working diligently to implement the preventive maintenance pilot program to reduce your commuting time, without increasing existing staff and resources allocated to the Fleet Management department. — Dave Palmer (10200)

Inchworm

(Continued from page 1)

These forces need to be applied both perpendicularly and tangentially to test the validity of Amonton's Law over a wide force range, he says. Another goal is to see if the friction measurements can describe the actual operation of the device.

Inchworm design

Parallel plates are easily fabricated in MEMS and can be used to obtain large normal forces. However, conventional MEMS tangential force actuators, known as comb drives, provide only 10 micronewtons of tangential force. Maarten wanted to achieve millinewtons of force and resorted to a mechanical amplification scheme. "We can bend plates to convert normal force to tangential force," he says. The inchworm has a force-amplifying plate that spans two frictional clamps. While "inching" along, its step size is very small, about 40 nanometers, but its stepping cycle can be repeated over and over.

Maarten and postdoctoral researcher Alex Corwin (1762) developed a measurement

methodology to confirm that the inchworm operates at up to 80,000 cycles a second, with a velocity of up to 3 millimeters per second.

The force the inchworm develops is measured by attaching it to a load spring that has a special nonlinear characteristic — for each step the inchworm walks, the force increases more than it did in the previous step. A maximum tangential force of 2.5 millinewtons is achieved when the inchworm stalls out, about 250 times more force than a comb drive.

Investigating Amonton's Law

So far this describes the inchworm's ability to move and provide forces. But Maarten asks the question: how does the inchworm give information on friction? To determine the coefficient of static friction, the inchworm is walked out a long distance of about 20 micrometers against the nonlinear load spring. Then, a large voltage on one clamp holds it in place. This voltage is then gradually reduced, which decreases the frictional force it can sustain. At a certain point, the load spring overcomes that frictional force, and the inchworm slides forward a short distance (several micrometers) until the load spring force decreases enough that it stops again. This measurement is now repeated and the next measurement is at a much lower load due to the load spring's nonlinearity. Now, Amonton's Law can be studied over a wide force range.

Working with Bob Ashurst, University of California, Berkeley, Maarten found that the friction force depends on the normal force from 1 millinewton down to normal loads as small as 50 micronewtons, in accordance with Amonton's Law. Alex further decreased the load and found that the coefficient of static friction began to increase. This was the deviation from Amonton's Law due to adhesive forces, Maarten says.

Alex and Maarten also mapped out a way to measure dynamic friction, accounting for the friction forces in the presence of inertial forces, air damping forces, and the spring force. The result was that dynamic friction is about 80 percent of static friction.

Large gross slip 'very surprising'

Maarten worked with David Luck (1769) to determine whether the frictional measurements made so far described the behavior of the device when it was operated. This test was different from the friction test and was conducted by loading the trailing clamp during the stepping cycle. They expected the average step size to decrease and it did. But when David tried to model the reduction in step size using the measured coefficients of friction, he could not get good agreement — the model predicted much larger step sizes than observed experimentally.

Something other than the coefficient of friction had to be affecting the step size of the inchworm in operation. The researchers had assumed that the leading clamp was stationary

Inchworm's uses

Besides serving as a test structure useful for model friction studies, the inchworm actuator is attractive for use in actual MEMS applications. Marc Polosky (2614) demonstrated its use in a MEMS system that performs mechanical logic functions.

"I had been looking for a good linear actuator," says Marc. "The inchworm provides a very high output force and can be moved controllably both backwards and forwards. On the MEMS scale, stiction forces can degrade system performance."

MEMS actuators that have large output forces improve design margin and reliability. "The inchworm actuator enabled us to replace a number of components in our discrimination system and improved our production yield," Marc says.

Dustin Carr (1769) believes the inchworm actuator can be especially useful in applications where precise positioning and control of micro-optical elements is necessary.

"The ability to do nanoscale positioning over many microns of range can enable the miniaturization of an optical lab benchtop, without using bulky or power-hungry piezoelectric devices," Dustin says.

in the stepping cycle, because the load applied to it was much larger than the load applied to the trailing clamp. Maarten reasoned that even though the leading clamp load was much larger, perhaps it was slipping back rather than remaining in position. Tests were devised to determine whether this slippage was occurring, and the researchers inferred that it was.

Alex wanted to see if this sliding could be directly observed. By using high-resolution imaging, he looked for movement of the inchworm before the static friction event. He observed slip over distances as large as 200 nanometers.

"A slip this large was very surprising," Maarten says, "Theories predict about one or two nanometers of slip given the details of our frictional interfaces. But in our experiments, the slip is one hundred times larger than this."

This means there is some gross slip mechanism going on before the static friction limit is reached, he says.

"This gross sliding is clearly very important for MEMS, where you want to position an object with nanometer accuracy for optical applications," he says "It is not something indicated by other friction instruments, but knowing about it will enable us to predict friction-related motion in MEMS with much better confidence."

Multidisciplinary research program

The inchworm work is funded by the Laboratory Directed Research and Development (LDRD) project, titled "High Fidelity Friction Models for MEMS."

Dave Reedy (9123) is serving as LDRD principal investigator. The joint project is among Centers 1700, 8700, and 9100.

"Modelers are excited by the inchworm test results, and now face the challenge of understanding and modeling newly observed phenomena such as gross slip prior to sliding," Dave says. "Our goal is to develop a capability to perform finite element simulations of MEMS components that accurately predicts response in the presence of adhesion and friction."

Sandia is also working with Rob Carpick, a nanotribology expert and professor at the University of Wisconsin.

"Working with the inchworm team gives us a chance to connect the nanoscale measurements we do at Wisconsin with the microscale measurements that come from the inchworm," Rob says. "By looking at the same materials under the same conditions, we want to see if we can determine the fundamental underpinnings of Amonton's Law. This could have implications in the study of friction that reach beyond the inchworm."

Standdown

(Continued from page 1)

Centers 4100 and 5500 where computer data mining capabilities are being employed.

"We received the last division report on Jan. 15, and by March 31 we will have a final report with recommendations from Safeguards and Security," Terri says. "We will then begin looking at changes, but we don't want to do any knee jerk reactions. We want to make informed decisions through analysis of the problems and the identification of changes. This process will include addressing current issues as well as identifying what solutions reduce potential risk."

Terri says there are several common themes already emerging from the reports — some which could even have "quick fixes." For example, problems were noted of 1) people taking personal cell phones into limited areas, 2) difficulties in filling out Foreign National

Request Forms, and 3) how to manage OOU [official use only] information.

The cell phone problem might be resolved by applying existing technology, Terri says. Sensors could be placed at the entrances to technical areas that would sound an alarm when someone enters with a cell phone. This effort is being worked with Center 4100 personnel. This could catch the potential infraction "before it becomes a problem."

Efforts are already under way to provide better instruction to the line when Foreign National Request Forms are submitted.

- Other recommendations that frequently appeared in the division reports were: A publication should be created that lists infractions and security incident information. These should be listed by organization and indicate the corrective action or discipline taken.

- The standdown homepage should be kept current and used for training purposes.

- A Security Awareness Campaign could

run for a year.

- OOU documents should be better managed.

- Commonly or frequently asked questions could be answered on the standdown homepage.

- Security messages could be carried on electric signs at main gates.

Safeguards and Security Team members

Safeguards and Security Team members who are analyzing reports from the security standdown include Terri Lovato (4220), Peggy Montoya (4220), Pauline Dobranich (4142), Greg Conrad (5511), Sally Kmetz (3133), Della Vieth (4202), Al Berardino (9311), and Suzanne Weissman (6000).

Novel simulations harness proteins to build nanostructures

Sandia husband-and-wife team building nanostructures like birds build nests

By Neal Singer

Sandia Fellow Gordon Osbourn last week reported a novel method of simulating protein behavior to achieve new, desirable nanostructures.

The method, achieved in prototype, treats proteins like little construction crews, sequencing and controlling their molecular behaviors to build structures of interest.

"A bird builds a nest differently each time, but you end up with a nest that works," says Gordon (1001), whose field is complex systems science. "We build simulated nanostructures the same way."

He developed the method with his Sandia colleague and wife, physicist Ann Bouchard, of Laser, Optics, and Remote Sensing Dept. 1118.

Gordon reported the achievement last Thursday at a session on nanotechnology at the annual meeting of the American Association for the Advancement of Science in Seattle.

"There are many paths to a useful outcome in our method," says Ann. "Many details in how the assembly happens don't matter. As long as the conditions are met [for protein interactions], we get a result we care about."

"The method requires a different mindset when designing self-assembly programs," says Gordon. "Instead of moving electrons around transistor circuits, we move molecules around, and add or remove them from constantly changing nanostructures."

Gordon and Ann use relatively unreliable stochastic processes to achieve a result that may be a nanowire or nanowall. Stochastic or random behavior is one way nature works, offering a range of possibilities rather than a single solution.

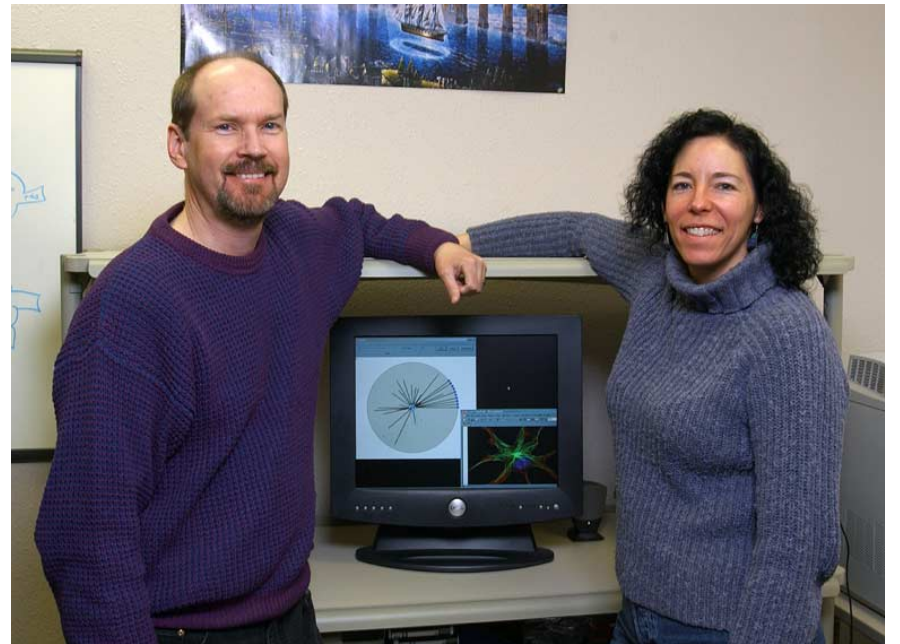
Polymer lengths and number of molecules represent

components of the program, which include motor proteins, their cargo, and constantly varying microtubules. Molecules may be attached or removed, or added or subtracted. They operate along time-dependent pathways that change as sites where molecules can attach, called docking sites, become visible or disappear. The process simulates protein behavior outside the animal cells in which they are normally found, a process other researchers have already demonstrated is accurate.

"We have shown," says Gordon, "that through stochastic simulations, certain protein self-assembly processes can act as a novel form of programmable computation, equivalent to Turing machines."

Gordon and Ann are working with experimentalists "to carry out the experiments suggested by our simulations and build the structures by following the steps demonstrated by the simulated components," says Ann.

Gordon is one of six researchers to attain the title of Fellow at Sandia in the last 50 years. The title



NEW PROTEIN BEHAVIOR — Sandia Fellow Gordon Osbourn and his wife, Sandia physicist Ann Bouchard, have developed a novel method of simulating protein behavior to achieve new, desirable nanostructures. (Photo by Bill Doty)

"A bird builds a nest differently each time, but you end up with a nest that works. We build simulated nanostructures the same way."

is awarded to those researchers of unusual insight whose contributions have brought about new ideas and notable advances in science and technology.

2004 Quality New Mexico conference: 'On the Road to Performance Excellence'

For the past year Les Shephard (2900) has been working with Julia Gabaldon, Lisa Polito (12105), and a team of about 20 to plan the upcoming Quality New Mexico conference.

As conference chair, he provides structure and context to the 11-year-old event.

"I love it," says Les, who is Director of Stockpile Resource Center 2900 at Sandia. "I get to work with a stellar team, all volunteers from across the state."

He became involved with Quality New Mexico as a board member two years ago and last year co-chaired the conference.

Les credits the success of the event, which annually draws some 600 participants, to Julia, a Sandia-loaned executive who helped found the organization and serves as its president.

"Sandia made a commitment to loan Julia to it," Les says. "She helped make Quality New Mexico a success. She's provided great leadership for the organization as it has grown continuously and has become the premier state quality program in the nation."

Quality New Mexico is a nonprofit organization that educates New Mexicans about quality principles and practices, and encourages and rewards quality in business, education, government, and healthcare. It also promotes an economic climate to foster and enhance the prosperity of the state.

Awards are patterned after the Malcolm Baldrige National Quality Awards standards — that require a rigorous examination process involving a minimum of 300 hours of review by an independent board of examiners. Three awards are given — the Zia Award (the top award), the Roadrunner Recognition for Progress, and the Pinon Recognition for Commitment.

Les says that this year, as usual, several Sandians volunteered their time to Quality New

Mexico. They include Lynne Adams (10258), Brett Locke (9733), Robert Richards (6850), Karl Ricker (12336), Daniel Roberts (3521), Laurel Moore, Vicki Northington, and Lisa Walter (all 12650) — people who go through the examiner training, work in teams, review applications, and write feedback comments. Gail Willette (9724) served as awards administrator.

— Chris Burroughs

2004 QNM conference

The 2004 Quality New Mexico Conference will be March 3-5 at the Hyatt Regency Tamaya Resort.

The conference will include a first-time golf tournament on March 3, nine Malcolm Baldrige National Quality Award recipients who will speak during four keynote sessions, and 40 seminars focused on business, education, government, and health care on March 4 and 5. The New Mexico Quality Awards ceremony will be the evening of March 4. Sandia will receive a Diamond recognition for providing a loaned executive to Quality New Mexico.

Featured speakers for March 4 and 5 include Martin Swarbrick of Motorola; Sister Mary Jean Ryan of SSM Health Care; David Spong, president of Boeing Aerospace Support; Robert McKanna, superintendent of Community Consolidated School District 15 in Illinois; and Rob Marchalonis of Stoner Inc. All were Malcolm Baldrige National Quality Award winners.

For conference information, call 944-2001 or see www.qualitynewmexico.org.

Recent Patents

Albert Marshall (9745), Stanley Kravitz (1763), and Chris Tigges (1742): Method of Fabricating a Micro Heat Barrier.

Michael Keenan and Paul Kotula (1822): Method of Multivariate Spectral Analysis.

Jeffrey Rienstra (5731), Stephen Gentry (5721), and William Sweatt (1743): Information-Efficient Imaging Sensor with TDI.

Bernhard Jokiel Jr. (1745), Gilbert Benavides (14184), and Lothar Bieg (1732): Planar-Constructed Spatial Micro-Stage.

Raymond Byrne (2338), John Harrington (15252), Steven Eskridge, and John Hurtado: Cooperating Mobile Robots.

Robert Crocker (8144), Cindy Harnett (8358), and Bruce Mosier (8144): Composition Pulse Time-of-Flight Mass Flow Sensor.

Alfredo Morales (8762): Method for Applying a Photoresist Layer to a Substrate Having a Pre-existing Topology.

Shawn-Yu Lin (1743) and Walter Zubrzycki (1742): Electrically Pumped Edge-Emitting Photonic Bandgap Semiconductor Laser.

Richard Jepsen (9134) and Jesse Roberts (6822): Oscillatory Erosion and Transport Flume with Superimposed Unidirectional Flow.

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State of Labs

(Continued from page 1)

just been substantial — we now get \$600 million from agencies other than the Department of Energy/NNSA. They [other agencies] are beginning to call on us more and more.”

Paul praised Sandia’s increasing strategic partnerships with private companies and universities and how the Sandia Science and Technology Park and Technology Ventures Corporation are helping establish and maintain these partnerships.

Sandia now has about 500 active partnerships, he noted, including a healthy mix of big-name companies and smaller firms, and these partnerships benefit Sandia and the companies at the same time. “They really value the chance to work with the laboratory, and we’ve become part of the strategic plans of many companies.”

Supporting partnering, Paul pointed out that six of the seven Sandia technical projects winning R&D 100 Awards in the most recent competition involved partnerships.

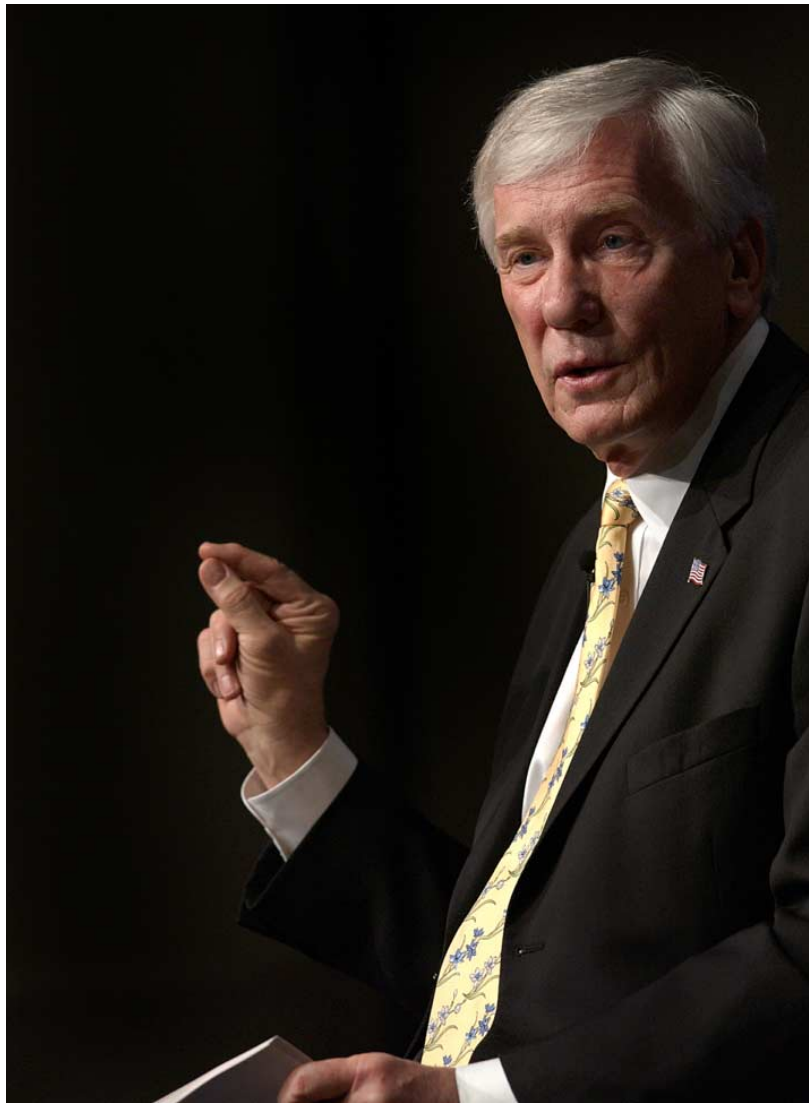
A big year for computing, Z machine

“This is going to be a big year for Sandia,” Paul said about the high-performance computing area. He said Sandia’s new Red Storm supercomputer will come on line this year — running at 40 trillion operations a second “right out of the chute,” and may be capable of being upgraded to 100 trillion operations a second. “That level is the ‘holy grail’ that we set in the ASCI program more than a decade ago,” he noted.

Paul said the Labs’ collaboration with NASA to help determine the cause of the Space Shuttle *Columbia* disaster last year (*Lab News*, Sept. 5, 2003) is a great example of how Sandia’s scientific computing folks work closely with other technical disciplines to solve difficult problems. He went on to say that the greatest potential of supercomputing is in helping to ensure up front that sophisticated hardware systems are designed and built properly to withstand all possible conditions and situations.

“Our vision is that you should build it first

“... we’ve become part of the strategic plans of many companies.”



SANDIA PRESIDENT C. PAUL ROBINSON said at the State of the Labs address that this is going to be a “banner year for Sandia’s budget,” which has surpassed \$2.2 billion. (Photo by Randy Montoya)

MESA is the largest construction project ever at Sandia and will add more than 390,000 square feet of laboratory, office, and clean room space to accommodate nearly 650 people. Total cost is projected at \$462.5 million, and it is scheduled to be completed in 2008.

in cyberspace, test it there, evaluate it there under all the conditions it will likely meet; and then when you think it’s ready, build the first one.”

Paul said Sandia’s Z machine work on fusion energy really came of age recently, and Labs researchers are now compressing deuterium pellets in a “beautifully symmetrical” way and heating them to temperatures that exceed those in the sun.

“This work is so exciting,” he said. “We’ve

been given the money for upgrading the Z machine, and we’re predicting some pretty spectacular things to come as we pursue fusion.”

Sandia’s biggest single construction project

Paul called on Don Cook (1900) at all three presentations to give a progress report on Microsystems and Engineering Sciences Applications (MESA) and what it will mean to the Labs’ future. MESA will comprise three new facilities and provide equipment required to design and prototype microsystem-based components for nuclear weapons and other applications.

MESA is the largest construction project ever at Sandia and will add more than 390,000 square feet of laboratory, office, and clean room space to accommodate nearly 650 people. Total cost is projected at \$462.5 million, and it is scheduled to be completed in 2008. It is about halfway complete now, on schedule and within budget.

“This project will provide computationally enabled microtechnologies for modernizing the safety, security, and reliability features of the US nuclear deterrent,” Don explained. “This is our most important intersection that involves microtechnology, modeling and simulation, and engineering sciences.”

Although he couldn’t go into detail because of the sensitivities of the work, Paul talked briefly about how a number of Sandians were called on over the holiday season at the end of 2003 to address some serious security threats to the nation. “Lots of your colleagues were working to protect us during those days, and we should all be thankful to them and thankful that nothing really bad happened,” he said.

Let there be LEDs

Paul discussed the Labs’ cooperative solid-state lighting research with industry and other labs and demonstrated a handheld light-emitting diode (LED) device that produces bright “white” light using only 8 watts of power (two LEDs of 4 watts each). The prototype white LEDs are produced by Sandia partner Lumileds Lighting.

“Twenty percent of the world’s electricity is now used for lighting,” noted Paul. “Experts estimate that white-light LEDs could eventually save up to 50 percent of this energy, so that would save 10 percent of the world’s electricity.” (Note: White-light LEDs are not yet practical because they are still too costly to produce, but bright colored-light LEDs are already saving energy and money in many applications, including traffic lights.)

Paul went on to talk about several Sandia projects to ensure adequate energy and clean water supplies and noted the Labs’ many contributions in the areas of homeland security, international nonproliferation work, proposed cooperative work with Mexico, and young, growing programs in biotechnology.

He acknowledged some troubling security difficulties last year, but said Sandians have cooperated well and worked hard to correct deficiencies. “Joan and I thank all of you for your hard work in the security stand-down.”

Joan’s points

Because time ran short at the Feb. 11 employee session, Joan talked briefly, making several primary points.

First, she acknowledged that the State of the Labs presentation traditionally does not talk much about the nuclear weapons program, but that the program is “core and primary to this laboratory. There is absolutely no question,” she emphasized. “So much technology that you saw here today comes from the science base and engineering capability of this laboratory that exists because of the nuclear weapons program.”

Joan praised work that Sandia’s weapons

(Continued on next page)



COMMUNITY CROWD — Albuquerque-area and other New Mexico leaders listen as Executive VP Joan Woodard talks about significant Sandia accomplishments at the Feb. 5 session in the Sheraton Old Town ballroom.

(Photo by Bill Doty)

State of Labs

(Continued from preceding page)

program scientists and engineers and doing, particularly on the W-76 and W-80 systems. "We have some big challenges, and I am thrilled with the progress and quality of the work. I want to thank you and let you know that we're very proud of your work even though we don't talk much about this in the community and in public addresses because of the sensitivity and the classification issues."

Sandia's Executive VP then discussed the \$2.2 billion Sandia budget, staffing, and hiring situations.

"We have 8,300 people, and we'll continue to have a very good hiring program," said Joan. "It will be trimmed back a little [from about 600 new hires per year in recent years] to about 450 because we are looking beyond this year at some of the issues associated with the federal budget deficit, where the overall nuclear weapons program will be going in size, and preparing to make sure we maintain the stability at this institution that is so important."

She then praised employees' involvement in community programs and contribution campaigns, noting that Sandians volunteered about 85,000 hours last year and pledged more than \$2.5 million during the last ECP and LEAP giving campaigns.

Joan concluded her employee talk by honoring Sandians who have been called to active military duty in the past few years, including several who served in Afghanistan and Iraq. Showing photos of those who served and returned to Sandia, she said, "If you see these folks, please thank them." She said nine other Sandians remain on active duty today.

Joan at community presentation

With more time at the Feb. 5 community presentation, Joan talked about other Sandia technical contributions.

Speaking about the Labs' homeland security capabilities and achievements, she said, "If I had



EXECUTIVE VP JOAN WOODARD told employees the Labs will continue to have a very good hiring program in 2004, but it will be trimmed back a bit. Sandia plans to hire about 450 people this year, down from 500-600 in recent years. (Photo by Randy Montoya)

"So much technology that you saw here today comes from the science base and engineering capability of this laboratory that exists because of the nuclear weapons program."

to suggest one area where we have special strengths, it would be in sensors and sensing technologies." As an example, Joan touted

Sandia's new MiniSAR — all-weather, day/night synthetic aperture radar — system that weighs less than 30 pounds and can be carried on small unmanned aerial vehicles (*Lab News*, Feb. 6).

She talked about work Sandia is doing cooperatively to improve the nation's precision weapons and surveillance capabilities, saying the Labs is developing "a suite of technologies to provide persistent surveillance of targets for national security applications. Perfecting these technologies is one of our Laboratory Directed Research and Development 'grand challenges.'

"This research taps into Sandia's strengths in sensor technologies, power sources, computing, robotics, and systems integration," she continued. "Ultimately, we're aiming for a system that can give our military a real-time picture of the movement of individuals."

Other Sandia-developed devices and technologies that Joan featured included the instant shooter ID kit in use by the military and law-enforcement groups, surface acoustic wave (SAW) sensors (making possible receivers the size of a grain of rice), biotechnology work that has demonstrated cells capable of detecting cholera, a microfuel cell that can produce electricity directly from glucose, the BioBriefcase (portable, easily concealed bio detector), and Sandia/California's Weapons of Mass Destruction Analysis Center.

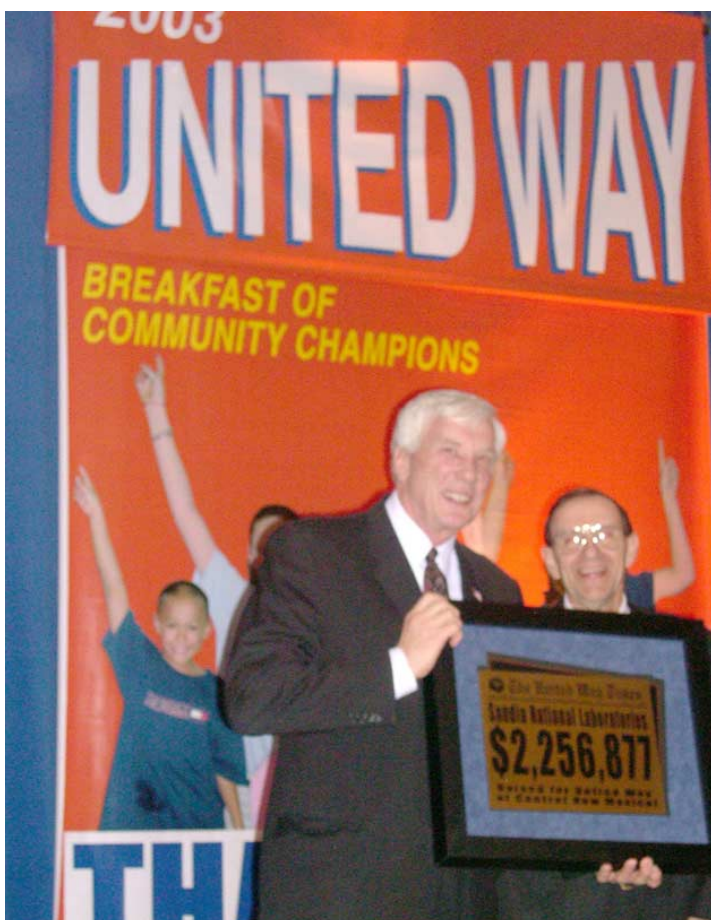
She also discussed Sandia's growing work in micro- and nanotechnology, quantum cascade laser research with MIT to develop tools for remote sensing of gases, new methods for testing and ensuring the reliability of radiation-hardened integrated circuits, how Sandia technology contributed to the success of the recent Mars missions, explosives-detection portal, and more.

Joan talked with obvious pride about how Sandia supports local business, particularly small and disadvantaged businesses. Citing New Mexico statistics, she said the Labs spent about \$866 million with the private sector for goods and services, including more than \$450 million with small businesses, \$120 million with small disadvantaged businesses, and \$69 million with woman-owned businesses.



MESA TALK — Don Cook explains Sandia's developing Microsystems and Engineering Sciences Applications (MESA) complex. The \$462.5 million complex is about half complete, on schedule, and within budget. (Photo by Randy Montoya)

Sandia honored by United Way for top contributions



LABS DIRECTOR PAUL ROBINSON accepts Sandia's award for top contributing company (\$2,256,877) from United Way of Central New Mexico CEO Jack Holmes at the annual awards breakfast Feb. 5 at the Hyatt Regency downtown. Sandia also received the Million Dollar Round Table Award given to companies contributing more than \$1M and the Platinum award for achieving \$200 per capita. Lockheed Martin Corporation received a Corporate Cornerstone Recognition Award. James Jaramillo (10842-3) and Michael McClafferty (14403) received awards for being Sandia's loaned executives, and James also received the Outstanding Labor Campaign Award, given to an individual for the first time. He is a union chief steward for the Metal Trades Council and was the first labor loaned executive in many years. He has also served as a community panel member for several years.

Paul Robinson on Nuclear Weapons in the 21st Century

This is the text of a short invited talk, "Nuclear Weapons in the 21st Century," delivered by Sandia President and Director C. Paul Robinson to a Nuclear Policy Research Institute symposium Jan. 26 in Washington, DC. Paul says he accepted the invitation to speak primarily because almost all of the talks were critical of nuclear weapons and felt unless he spoke, the other side of the story might not be heard. (NPRI's slogan is "creating consensus for a nuclear-free future.") We thought the Sandia community would find his comments of special interest, and Paul readily agreed to our request to publish them.

— Editor

By C. Paul Robinson

Thanks to Dr. Helen Caldicott — for inviting me to speak at this conference.

I noted that in the agenda for the meeting, there appear to be few others here who share my point of view. I did not accept in order to be the "skunk at the picnic," but to present my sincere views on the role of nuclear weapons past, present, and future. Let me say at the outset — I'm all too aware of the gulf that separates my views from so many of you.

It was Thomas Jefferson who said, "... Debate and controversy play the same role in a democracy as storms do in the natural realm." Unfortunately, by its nature, many of the details of my side of the subject are restricted from open discussion by the necessity to classify this information, lest it provide advantage to potential adversaries — and it has always been so.

Realizing those limitations, let me — to the extent I can — review the specifics of how US thinking about nuclear deterrence has developed over the years — and our present conception of its purpose and some of its particulars in the new security environment we face today, and are likely to face going forward.

History is always a good starting point, and let me recommend to you a recent book by British historian Peter Hennessey, entitled *The Secret State: Whitehall and the Cold War*. He notes, "The book that needs to be written — the definitive history of Cold War (will be) huge, probably multi-volumed, and some way off." He says, however, that "More is required by way of declassification of the official British archives before it can be fully attempted." He calls this present effort "a first stab at the anatomy of the Cold War — and very much a work in progress."

He begins the book with a quote from Sir Kevin Tebbit (Permanent Secretary of the Ministry of Defence) — which he made in 2001:

"Hardly anyone died in the Cold War, but we lived on a daily basis with the risk that everyone might. Our strategy...was managed successfully by a small number of dedicated officials, scientists, submariners and other members of the Armed Forces, operating necessarily in conditions of utmost secrecy even within their own organizations. . . . As a young man I saw them work. These were not Dr. Strangeloves."

Let me assert, that I have had a career approaching 40 years — first, as a scientist, then as an official of the US nuclear weapons establishment. I can state that for the most part, the work on our side had no Dr. Strangeloves either.

In the 20 minutes the organizers of this conference have generously given me, I have faint chance of achieving even a minute perspective of the relationship of nuclear weapons to human history. Let me do the best I can.

As Hennessey's book captures so effectively, in the period immediately following World War II, leaders of all nations were not all prepared to "live with the bomb," whose accelerated development in the Manhattan Project had led to the termination of the war in the two horrific uses in Japan.

History records that within the principal nations who emerged as victors of the European war against wartime Germany and the war in the Pacific against Japan, the military planners were not as shocked as we might have wished they had been by this "war to end all wars." Rather they were still each initially scrambling to seek advantage over the other, particularly as the uneasy alliance of the Soviet Union with the West soon began to unravel.

Thus, the now romantic notion that the two

Japanese explosions, with such devastating loss of life, had "irrevocably changed the world" was not at all clear in the immediate actions of most of the nations of the world at that time.

As the Soviet Union and western nations each accelerated their efforts to achieve larger arsenals of even more powerful nuclear weapons — with each side underestimating the speed with which the other side was making leaps in military technology — only slowly did the deep sense of fear arise that the destructive power of nuclear weapons had become so great as to have unarguably catastrophic consequences. One reflection by an intelligence officer looking back on that time was that "Neither side would allow themselves to believe the other side was as frightened as they were." (from the Hennessey book, op. cit.)

It was in that intellectual cauldron that the ideas began to emerge — intellectually, brick by brick — that in a world of perpetual vulnerability against such potential catastrophe — the best one might hope for is to find ways that could restrain any power from ever again contemplating a deliberate and major war.

Although the concept of "deterrence" pre-existed this post-WWII state of affairs, it was finally recognized that the stakes were clearly becoming far



I believe that nuclear deterrence must remain as a cornerstone of our defense posture for many, many years to come, at least until such time as nations cease stockpiling major weapons systems for use against others.

too high should a world war ever take place in the nuclear age.

Ironically, as Dr. Hennessey notes, although each nation elevated the priority of its intelligence assets to place the nuclear intentions of rival powers to be their number one focus, there was little direct intelligence available to any of the major decision makers of the time, and thus nuclear weapons policies developed in the inner circles in large measure from self-perceptions of what the impact of a nuclear-armed world might mean for their own strategic interests. Each nation, independently and in turn, had to speculate as to whether and how those perceptions of fear and vulnerability were affecting the strategic plans of others. I believe that when the history of the Cold War can be written, it will show that — on the whole — the thinkers and planners of that day should be commended by all of us who came afterwards, for their accomplishment in developing a strategic deterrence formulation which has endured remarkably well to usher us to today. Moreover, the Cold War never became "hot" — at least not with "nuclear heat."

The strategy which developed is quite simple (and I credit to my colleague General Larry Welch the following formulation): to prevent aggression by nations, we must maintain an ability to "hold at risk" assets within that nation which they value more than they value the actions we are trying to deter. I do not have time to expand on the many subtleties of this formulation. I will comment that the word chosen to describe this process — deterrence — is a very apt choice. Its root word is the Latin word *terre*, which means to frighten with an overwhelming fear. When you add the prefix *de-* you get a term meaning "to frighten from." This strategy, policy, and real capability grew into an enduring process, which has served the United States well for more than 50 years. It has become a potent antidote to military aggression. Deterrence serves as "a sobering force," one that can not only serve to prevent wars from starting, but can cap the level of military destruction that might otherwise result, and can force all sides to "come to their senses." Thus, I have come to believe that the world would become more dangerous, not less dangerous, were United States weapons to be absent from the scene.

Of course the world has changed significantly,

and we must constantly adapt our policies to that changing world. I believe that nuclear deterrence must remain as a cornerstone of our defense posture for many, many years to come, at least until such time as nations cease stockpiling major weapons systems for use against others. To adjust our deterrence policy I believe the "traditional" four categories of targets we focused on during the Cold War should be changed somewhat to the following four target sets that we should "hold at risk" in order to deter: (1) weapons of mass destruction, (2) the leadership that is fomenting aggression, (3) military forces capable of exporting aggression, and (4) war-supporting infrastructure and industry. I believe we can emphasize to all our policies that we will never directly target civilians or non-war-fighting populations, and that we maintain nuclear weapons not for war-fighting purposes, but as "weapons of last-resort." We keep our arsenal only to ensure any potential adversary that our capability to destroy those four essential categories of their military power is so certain, that they will restrain from committing aggression in the first place.

The current Nuclear Posture Review has challenged us to find better ways to hold strategic targets at risk, particularly through improved conventional weapons, in order to continually raise the threshold of any nuclear use. I believe this is sound strategy

and I believe there is much we can do. With the end of the Cold War, and our commitment to seek a new strategic relationship with Russia and the newly independent states as allies rather than adversaries, we live in a time of exciting possibilities. While doubtless any of the new regional powers we have referred to as "rogue states" do cause us continued concern, these concerns are greatly muted to those we faced during the Cold War. While admittedly such states could cause enormous damage to those around them, and could potentially cause serious harm to the US as well; the likelihood that they would not be deterred from major aggression is small, smaller than at any time in my life and yours. We should all in fact rejoice for that.

But where do we go from here?

Neither our militaries nor our peace activists alone can save us. Perhaps the synthesis of the two might offer better insights. Whether the synthesis of the two might improve the situation, I don't know. But I believe it is worth a chance for us to try. You and I are not natural enemies. I believe we in fact seek the same end goals — a peaceful and free world where the human spirit can create opportunities for all inhabitants of our earth to prosper and fulfill their hopes and dreams. I have never put much faith in the notion that "complete and total disarmament" is the realizable goal in any near-term. The nature of man as a species is sufficiently complicated, and we have repeatedly shown our inability to organize ourselves as world citizens to put much hope in being able to truly "outlaw" war and aggression any time soon.

I believe the US was quite serious in putting forward the Baruch Plan, to share the responsibility among nations as well as the burden of maintaining a common arsenal of nuclear weapons. I would wish that international institutions would gain the level of competency to earn the level of trust that might allow such a proposal to again be seriously considered. Meanwhile, I do not believe we have lost our way, but that we have developed a formula, which can maintain the peace in the interim.

I believe it appropriate for me to close this talk with the words of Winston Churchill: "Be careful above all things not to let go of the atomic weapon until you are sure, and more than sure, that other means of preserving the peace are in your hands."

Feedback

Is Sandia really the first choice for technology solutions?

Q: I was wondering if we have any data concerning Sandia's progress toward achieving: "Our highest goal is to become the laboratory the US turns to first for technology solutions to the most challenging problems that threaten peace and freedom for our nation and the globe." In that regard:

- (1) How many times did the US turn to Sandia first? Versus other labs?
- (2) What were the problems addressed?
- (3) Did Sandia step up to the plate in every case?
- (4) Did Sandia provide any solutions? If so, what were they?
- (5) How many dollars were involved?
- (6) Do we have a list of the "senior members of the US government and the Congress that identify Sandia with 'global security'?" And, are there some that we would like to have on the list but aren't on it now? If so, who are they, and what do we need to do to add them to the list?
- (7) Is Sandia the primary national security laboratory? If not, why not?

A: These questions are not easy to answer quantitatively because we do not have good metrics for tracking progress in the terms you specify. For example, we do not know how many times federal agencies turned to Sandia first, as opposed to other performers, and it may not be possible to collect that data. But please understand that Sandia's "highest goal" is as much a statement of vision for the Labs as it is a business goal.

Having said that, there are some metrics we can point out. In the year following the attacks of Sept. 11, 2001, Sandia's work on new national problems more than doubled. The nation turned to us after that emergency to provide technical solutions to certain urgent problems. Many of the solutions we delivered were documented in our annual Accomplishments publications. The decontamination foam, deployable SAR [synthetic aperture radar] imaging, bomb disablement technology and training, and the Washington Metro chemical detector test bed are familiar examples.

Since 2001, there have been fresh examples of the nation turning to Sandia first or in partnership with other NNSA labs. Many government agencies have sought our counsel in security matters — some for the first time, and some as return customers — including the Department of Defense,

the National Institute of Justice, the Secret Service, the Federal Aviation Administration, state and federal corrections systems, public school systems, and even the 2002 Winter Olympic Games. Certainly, the Nuclear Emergency Search Team (NEST) has been active behind the scenes. The National Infrastructure Simulation and Analysis Center (NISAC) — which began as a Sandia/LANL joint activity and now reports to the Department of Homeland Security (DHS) — advised the White House on Hurricane Isabel's potential impacts on national infrastructures. Quite a few other new activities are in progress that we were requested to perform for other agencies, but are too sensitive to discuss at this date.

DHS turned to Sandia for people — experts and technical managers — to staff key department functions as the agency was stood up. In FY03, we experienced new revenue growth in homeland security of \$15–20 million. Furthermore, we are on track to again double our DHS portfolio in FY04, as program development groundwork performed last year bears fruit.

The SMUs and individual program managers have been very active during the last fiscal year cultivating relationships with various agencies whose missions can benefit more directly from Sandia's involvement. One outstanding example is the maritime security work in Org. 6900 (formerly 5300), which has resulted in more than \$20 million of new work for Sandia. It is especially significant that most of this new work sprang from direct customer demand at the ports themselves, rather than from a program office in Washington. The port directors had confidence in what Sandia could do, and they insisted on working with us.

With respect to your sixth question, I want to make it clear that while we try to cultivate positive relationships with congressional members and their staffs and we provide information about our programs and capabilities to any member of congress or their staffs when requested, Congress is not an appropriate venue for program development activities. Program development should target customer agencies — the people with direct mission responsibility — and not individual members of congress or committees. Sandia's SMUs have the primary role in that activity. Our strategy must be to convince customer agencies — DOE, DoD, DHS,

DOT, DOJ for example — that Sandia is the lab they should turn to; we should not look to Congress to tell these agencies to work with us.

With respect to your seventh question, Sandia is one provider among many, which is fine and appropriate. The federal government has access to many national security laboratories as well as a strong defense industrial base to turn to for its needs. Given the reality of this competitive environment, perhaps it is logical for us to ask ourselves, "Why would federal agency program managers turn to us first?"

Three key reasons come to mind. First, Sandia's industrial heritage is unique among the nation's national security laboratories. In the best tradition of the premier industrial R&D centers that fueled America's technological development — AT&T, General Electric, RCA, Sperry, DuPont, IBM, and Lockheed Martin's precursors — we know how to bring science, engineering, and manufacturing design together to create solutions that can be turned into product.

Second, our industrial heritage has taught us to pay keen attention to our customers. We know that it is very important to meet the customer's expectations for performance, schedule, and cost. We strive for a close, long-term relationship with our sponsors. If we can understand our customers' strategic needs, we can anticipate those needs and be prepared with solutions.

Third, Sandia's status as a federally funded research and development center gives us the privilege of working as partners with agency customers and the obligation to provide them with objective, unbiased, technical counsel. This is a unique position of trust that we must continue to strengthen. Agency customers should never have reason to question our loyalty to their mission or our motives for advocating a technical position or solution.

Thus, I believe there are compelling reasons for a variety of customers to think of Sandia first when they are faced with daunting national security challenges. But they will do so based on their last experience with us. If we reliably provide exceptional service consistent with these principles, I am confident they will increasingly call on Sandia.

— Carol Yarnall (Executive Staff Director)

Management promotions

New Mexico

Earl Creel, from DMITS to Manager, Navigation Guidance & Control Dept. 15426.

Earl joined Sandia in August 1983. His work has focused on applications of inertial and GPS navigation systems to National Missile Defense Programs such as the Strategic Target System Booster, and target reentry vehicles for the Integrated Flight Test experiments.

He has a BS and an MS in electrical engineering from Kansas State University.

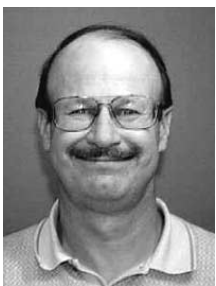
Allen Stroupauer, from PMTS, Weapons Complex Integration Strategic Planning Department I (9732), to Manager, Weapons Complex Strategic Planning Department II (9733).

Al joined Sandia in July 1994 upon his retirement as an US Army nuclear weapons officer. His first two years were in the DOE Washington, DC, Defense Programs Military

Applications Organization as a Senior Technical Advisor, where he supported projects such as the first Stockpile Stewardship Program Plan (Green Book) and the Joint DoD/DOE Stockpile Confidence Conference in 1995.



EARL CREEL



ALLEN STROUPAUER

In August 1996, Al returned to Sandia and joined the Systems Analysis Center and became part of the Defense Programs Analysis Group. During this period, he was one of the founders of the Stockpile Life Extension Program (SLEP) leading to the nuclear weapon refurbishment activities that Sandia and the rest of the Nuclear Weapons Complex (NWC) are implementing today.

In 2001, Al was one of two people in the emerging Sandia effort to provide cross-cutting integration support to the NWC. The goal was to align Directed Stockpile Work, Campaigns, Readiness in the Technical Base & Facilities, and Construction activities with the SLEP and identify disconnects that would prevent successful execution of the weapon refurbishment programs. This effort has grown into the Integration Studies and Support Group. In the ISSG, Al was a member of the Responsive Infrastructure Panel for the August 2003 DoD/NNSA Stockpile Stewardship Conference and is currently a member of the Infrastructure Integration Project Team for the Strategic Capabilities Assessment (the DoD Nuclear Posture Review Periodic Update).

Al received a BS in chemistry from Pennsylvania State University and a MS in nuclear chemistry from Georgia Institute of Technology.

Jorge Hernandez, from PMTS to Manager, Information Services Dept. 14411.

Jorge has been a member of Manufacturing Systems, Science, and Technology Div. 14000 since he joined Sandia. He came to the Labs as a contractor in 1995 and joined Sandia as a member of the technical staff in December 1996. He has an extensive back-

ground in discrete manufacturing and related information systems, specializing in corporate commercial software implementations. He contributed as project lead for the manufacturing systems for the Neutron Generator Production facility startup.

In 1999, he received corporate recognition for leading the implementation of Oracle Manufacturing software. Subsequently, Jorge contributed as a member of the leadership team for the implementation of the corporate Oracle Applications for Financials, Procurement, and Manufacturing, acknowledged in 2000 as the largest implementation of commercial software ever at Sandia.

Jorge served more than 10 years in the US Coast Guard Reserve. He has a BBA in information technology from the College of Santa Fe, Albuquerque, and is a Certified Manufacturing Professional by APICS and a Certified Oracle Master.

Sarah Renfro, from PMLS, Management Advisory Services Team Dept. 12801, to Manager, Ethics Office Dept. 12810.

Sarah joined Sandia in June 1995 as an auditor in Internal Audit Dept. 12830, where she conducted audits, performed special management reviews, and provided investigative assistance to the Ethics offices. For the past year and a half, she has been a member of the Management Advisory Services Team, provid-

(Continued on next page)



JORGE HERNANDEZ

Mileposts

New Mexico photos by Michelle Fleming



Larry Ruggles
35 1673



Steve Babicz
30 1736



Lorraine Curtis
30 1734



Kevin Murphy
30 1304



Theresa Apodaca
25 4224



Dori Ellis
25 6900



Paul Johnson
25 15272



Mike Arms
20 6224



Fran Chavez
20 6929



Neall Doren
20 5937



Jaime Gomez
20 5733



Pete Hamilton
20 5932



B.J. Jones
20 3500



Alejandro Pimentel
20 1739



John Strachan
20 6216



Steven Thornberg
20 1812



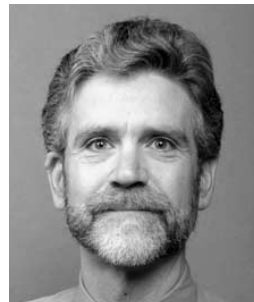
Michael Arviso
15 9134



Russell Bonn
15 2561



Judy Chavez
15 9338



Stephen Crowder
15 12323



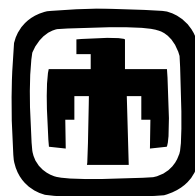
Raymond Griego
15 10268



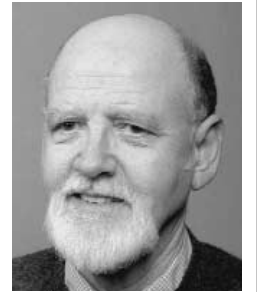
Michael Lanigan
15 12640



Steve Rezac
15 2116



Recent Retirees



Bennie Blackwell
36 9133



Sarah Lawrence
28 14186



Gwen Washington
23 5736

Promotions

(Continued from preceding page)

ing analysis and assessment of management approaches. Prior to joining Sandia, Sarah was an evaluator for the US General Accounting Office. She is a retired personnel officer from the New Mexico Air National Guard.

She has a bachelor's degree in finance from the University of New Mexico.



SARAH RENFRO

California

Tim Sheppard, from DMTS to Manager, Materials Chemistry Dept. 8762.

Tim has been a member of Sandia/California's Materials Chemistry Department since he joined the Labs in February 1988.

His career in polymer chemistry has focused on three areas: polymers for microfluidic (Homeland Defense) applications, the chemistry of explosives and chemical warfare agents, and the development of hydrogen getters for consumer and industrial product safety. Tim and LeRoy Whinnery received *R&D Magazine's* R&D100 recognition in 2001 for inventing the polymer hydrogen getters, which permanently remove unwanted hydrogen, an extremely flammable gas with a large explosive range in air. Tim won a second R&D 100 Award last year with Brian Kirby and David Reichmuth for cast-to-shape microvalves.

He has served as principal investigator or program manager on numerous Laboratory Directed Research and Development (LDRD) and Work for Others projects.

Tim has a BS in chemistry from UCLA and a PhD in chemistry from Caltech.

Ricky Tam, from SMTS, Videoconference and Collaborative Technologies Dept. 8947, to Manager, Site Business Office Dept. 8529.

Ricky joined Sandia/California in December 1992. He has worked in organizational development and training for Center 8500, Computer Supported Collaborative Work (CSCW) research for Center 8900, and in Dept. 8947 Homeland-Security-related projects.

Before joining the Labs, Ricky worked for more than 15 years in organization development consulting and was the director for Pro-Action Associates, an organization development consulting firm.

Ricky has a BA in recreation administration, a BS in business information computing systems, and an MSBA in human resources management, all from San Francisco State University.



RICKY TAM

Military base realignment and closure

Avoid rumors, keep informed – process has just begun

Note to Sandians: Kirtland AFB asked the Lab News to publish this report to inform Sandia employees of the latest status on this issue. — Editor

By Col. Hank Andrews

Kirtland Air Force Base commander

Recent news reports about proposed base realignment and closure actions have resulted in extensive speculation. The best way to avoid rumors is for us to share information with you on the BRAC process. As full partners in all that TEAM KIRTLAND does for America each day, we are committed to that information-sharing process.

The 2002 National Defense Authorization Act authorized DOD to pursue one round of BRAC in 2005. All military installations will be evaluated, and all recommendations will be based on approved, published selection criteria and a force structure plan.

DOD has released proposed criteria to be used in the determination of which bases to close or realign. This is a preliminary set of criteria sent out for a public comment period that will close this month. There is no list of bases recommended for closing at this time.

Both Congress and the Air Force recognize that military value must be the primary consideration in closing or realigning missions among U.S. military bases.

DOD must also consider the following factors:

- the extent and timing of costs and savings,
- the costs of potential environmental remediation,
- the economic impact of existing communities and
- the ability of both existing and potential for both bases and communities to support realigned forces, missions and personnel.

The goal of BRAC, according to Air Force

leaders, is to:

- maximize war-fighting capability,
- transform the Air Force by realigning infrastructure to meet future defense strategy,
- capitalize on opportunities for joint activity and
- eliminate excess physical capacity.

So far, there have been four rounds of BRAC (1988, 1991, 1993, and 1995). The four previous BRAC rounds have eliminated approximately 20 percent of DOD's capacity that existed in 1988. Through 2001, these actions produced net savings of approximately \$16.7 billion, which includes the cost of environmental clean-up. Recurring savings beyond 2001 are approximately \$6.6 billion annually.

"Prior BRAC analyses considered all functions on a service-by-service basis and, therefore did not result in the joint examination of functions that cross services," said Secretary of Defense Donald Rumsfeld. "While some unique functions may exist, those functions that are common across the services must be analyzed on a joint basis. I am confident we can produce BRAC recommendations that will advance transformation, combat effectiveness and the efficient use of the taxpayer's money."

Here are answers to some of the most common questions we receive:

Q. How may bases and installations will be closed?

A. It's too early to say, but this process represents an effort to reduce capacity, not a set number of bases. Using specific selection criteria that emphasize military value, DOD must complete a comprehensive review before it can determine which installations should be realigned or closed.

In 2005, an independent commission will review the Secretary of Defense's recommendations, hold public hearings, visit various sites,

and ultimately send its recommendations to the President.

Q. How soon will bases be selected for closure or realignment?

A. Criteria have just been submitted for public comment.

After extensive information gathering, the Secretary of Defense forwards recommendations for realignments and closures to the BRAC Commission in the spring of 2005. The commission then has approximately four months to study the recommendations and send its recommendations to the President.

The President has another two weeks to accept or reject the recommendations in their entirety.

If accepted, Congress then has 45 legislative days to act on the recommendations. If Congress does not act on the recommendations, they automatically become law.

Q. Which bases will be looked at in this round?

A. All military installations within the continental United States and its territories will be examined as part of this process. This includes laboratories and facilities used by medical, training, guard and reserve activities, as well as air stations and leased facilities.

Q. What about some base closure lists on Web sites that include Kirtland AFB?

A. There is no official base closure list. There are unofficial civilian Web sites where the authors speculate about the future of various bases. We have also seen some entirely bogus lists that identify senders who are non-existent Pentagon employees.

We will continue to provide you with current, reliable information on this subject.

ASC program and 'Off the Clock' win international video awards

Two Sandia-produced technical videos about the tri-lab Advanced Simulation Computing Program (ASC) have won acknowledgements from the New York Festivals, a 50-year old international awards competition for creative communication in 10 different media. A third Sandia video was also honored. The awards were presented on Jan. 30.

The bronze award went to the "Visions of Clarity" video describing the significance of ASC's Visual Interactive Environment for Weapons Simulation (VIEWS) Corridor at Sandia. Produced and edited by Regina Valenzuela (15230), this video is a team effort of Sandians and contractor associ-

ates from organizations 2992, 9326, 9904, and 15230.

The second video, "ASCI at Supercomputing 2002," won a "finalist" certificate, also considered an award. Its executive producer/writer, Reeta Garber (9904), interviewed ASC's NNSA federal managers and ASC executives and managers from Los Alamos and Lawrence Livermore. The interviewees expound on the significance of the tri-lab ASC program and its future. This video is a team effort of Sandians and contractor associates from organizations 9326, 9904, 15230, and 12610. This is the second tri-lab promotional ASC product to win international recognition for NNSA.

The third video, "Off the Clock," also achieved "finalist" status. "Off the Clock" is part of Sandia Video Services Dept. 12610's employee communications human interest series, shown on the Video Sandia network. "Off the Clock" is a monthly feature about interesting or unusual hobbies that Sandians engage in during their free time. Video Services produces it.

Your comments: Productivity, site safety get 'Your Thoughts, Please' attention

Fewer, shorter meetings. Reduced bureaucracy. Less time spent socializing or cozing up to the boss. Eliminating the 9/80 accelerated work-week schedule.

All those, and some additional, suggestions show up as ways Sandians say productivity at the Labs could be increased. Those and other ideas are available for reading on the internal-web-based employee comment feature, "Your Thoughts, Please," which recently asked "How might you or the people around you increase productivity?"

If you visit "Your Thoughts, Please," you can submit a response to the current question: "With recent talk around the Labs. . . about improving safety, what is the one thing — maybe the one stupid thing — going on right now that if done better or differently would improve safety throughout the Labs so that every member of the workforce truly could expect to go home injury-free every day?"

Responses to that safety-related question are being accepted through March 19.

Enter "Your Thoughts, Please" through the

internal web's Newscenter (<http://www-irn.sandia.gov/newscenter/news-frames.html>) and click on the appropriate button near the top left of that page or simply write a response to the current question and send it to thoughts@sandia.gov.

Sympathy

To Meg Luther (12105) on the death of her father, Estanislado Otero, in Albuquerque, Jan. 22.

To Adrian Gurule (14411) on the death of his mother, and to Michael Gurule (144024) and Matthew Gurule (9724) on the death of their grandmother, Alice Gurule, on Dec. 6.

To Everett Saverino on the death of his wife, Betty, in Albuquerque, Jan. 15.

To Jack Stayton on the death of his mother in Wellington, Kansas, Jan. 13.

To Shawn Littleford on the death of her mother in Albuquerque, Jan. 15.

Leadership
SERIES

The Spring 2004 Leadership Series brings to you the following video-linked and/or video-streamed speakers:



Steven Lundin
Streaming Video Only
Date available: February 19, 2004



Mary LoVerde
Streaming Video Only
Date available: March 4, 2004



Stephen Goldstein
Steve Schiff Auditorium
Date: March 25, 2004
Time: 9:00 am - 10:15 am
Also Available on Streaming Video



Laree Kiely
Steve Schiff Auditorium
Date: April 2, 2004
Time: 11:00 am - 12:30 pm
Also Available on Streaming Video



Tom Hinton
Steve Schiff Auditorium
Date: June 10, 2004
Time: 9:00 am - 10:30 am
Also Available on Streaming Video

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