volume 4 number 9

the laboratory connection

your community's link
to information, opportunities, and people
at Los Alamos National Laboratory

November 2003

a word from — Associate Director for Strategic Research

A Word from AD Tom Meyer

What has been lost or at least relegated to the back burner in the mind of the general public during this past year of turmoil at the Laboratory is a little something called science. LANL science remains as good as it always has been – and that is about as good as any place gets.

We are always delighted to demonstrate our total capability by showing that we provide scientific brilliance across the board. We are nuclear weapons, but much, much more. The nation has come to rely on us for scientific innovations in many areas.

The Directorate that we call Strategic Research collaborates closely with and supports our Nuclear Weapons and Threat Reduction directorates. It also leads the Lab's broad national security missions in energy and environmental security and is the home of research centers in nonlinear studies in geology and geophysics and initiatives in fuel cells, high temperature superconductivity and nanoscience.

As a broker of scientific knowledge and understanding, the Strategic Research directorate supports and enhances the scientific reputation of LANL through a vigorous basic research program and by serving as a gateway from the scientific world to industry and academia through collaborations with government laboratories, universities, and industry.

Americans may be assured that science remains much more than alive and well at Los Alamos.

Lab Scientists Explore "Undiscovered Country" of Biology

As we enter the 21st century, the attention of the worldwide scientific community is increasingly drawn to bioscience and biotechnology. While breakthroughs in physics were the dominating influence on how our lives changed in the 20th century, the enormous interest in the human genome project at the turn of the century heralded the emergence of a new focus area for revolutionary science. "Biology is modern science's undiscovered country," said Jill Trewhella, leader of the Lab's

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In July, 2002, Bioscience Division Leader Jill Trewhella met with President Bush and other federal officials to discuss technology that will benefit homeland security. Pictured left to right are President Bush, Homeland Security Secretary Tom Ridge (partially hidden), Speaker of the House Dennis Hastert, Raymond Orbach, director of DOE's Office of Science, and Trewhella.

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Bioscience Division. "We have drilled down into the physical universe to an incredible level of detail about the structures of fundamental particles, for example. But we only have a hint of understanding of the biological world, largely because of the enormous complexity of biological systems and the sheer number of players."
A simple bacterium, for example, may seem like a relatively unsophisticated life form. But this single-celled organism has several thousand megabases in its "genome" or DNA sequence, Trewhella said. In that sequence there are thousands of coding regions that specify how to create the different proteins that make up the infrastructure within the cell, giving it the ability to move, respond to light or send signals to different compartments within its architecture. With so many more complex higher organisms to study, it's difficult to imagine understanding biological systems in a predictive way.

"Physics drove the last century because we were able to predict what would happen through experiments," Trewhella said. "Now we are trying to predict with mathematical models, a scientific and technological challenge that is in many ways bigger than putting humankind. They will help us to understand and treat disease, and to detect and protect against exposure to emerging infections. They can help us understand what we're doing in the biosphere that can affect global climate change, enhance our ability to create novel materials, and assist with efforts to capture and transform energy. They can also help with clean energy alternatives and remediating the environment by using microorganisms and their components.

"The application of our expanding knowledge of biology feels limitless today," Trewhella said.

In the international Human Genome Project, Los Alamos National Laboratory was part of the Joint Genome Institute of DOE that had responsibility for mapping and sequencing chromosomes 5, 16 and 22. LANL had principal responsibility for chromosome 16. Now that the human genome sequence has been finished, work has shifted to other organisms, including microbes that account for as much as 97 percent of the earth's genetic diversity. Sequencing microbes will help us understand those that are pathogens and those that can be useful in biotechnology applications.

With the genome sequencing era well underway, biologists are already taking the next step to gather the data needed to gain a comprehensive understanding of a life form. Scientists at LANL were instrumental in stimulating the idea of "structural genomics" which aims to understand

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Bioscience Division Leader Jill Trewhella and Larry Tellier, the division's Operations Team Leader, inspect some of the equipment in the BSL 3 facility. Another worker checks an air release valve at the entrance to one of the Labs.

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all the protein structures coded for in an individual genome. We lead a large international consortium studying the structural genomics of tuberculosis, as part of a broad structural genomics initiative being directed by the National Institutes of Health (NIH).

"The World Health Organization has declared TB to be a global health epidemic with one third of the world's population infected," Trewhella said. "We hope to provide information that will help academia and industry develop better drugs to fight TB – including drug-resistant forms that are on the rise."

LANL is also working with the new Department of Homeland Security on bioforensics and detection of pathogens. Two years ago, the Laboratory was asked to help in analyses as part of the federal investigation into the anthrax letters in the US mail. In July of 2002, Trewhella met with President Bush to demonstrate the Lab's technology for doing simple threat agent characterization analyses in the field, and explained how these capabilities leveraged technology developed as part of the Human Genome Project.

The Lab's contributions to emerging bioscience research will be enhanced by the opening of its new Biosafety Level 3 laboratories. A biosafety level (BSL) is an assignment of a level of risk for work done with infectious agents. Each level designates laboratory standards, special practices and techniques, safety equipment, and facility design required to safely handle infectious agents depending on the hazards they present.

There are four BSLs defined by the Center for Disease Control and NIH. BSL-1 procedures are comparable to those used in a high school biology laboratory. BSL-2 procedures add access control and enhanced microbiological practices, and are commonly employed in medical centers, dentist offices and research institutions.

BSL-3 procedures add additional access control and engineering controls for air flow into and out of the facility. Procedures used in a hospital surgical operating suite, for example, are BSL-3 level. BSL-4 facilities are designed to handle the most deadly agents and have exceptional engineering controls. BSL-4 facilities are highly specialized and are only operated in a few locations.

Los Alamos currently operates research labs with Biosafety Level 2 capability. The new BSL 3 labs will be part of an approximately 3,000 square foot facility under construction at the Lab's main technical area. The building will contain two 600 square ft BSL-3 labs, and a 600 square ft BSL-2 lab, in addition to office and mechanical spaces.

"This facility will allow us to work more extensively with live pathogens in a safe, secure environment that protects the workers and the public and keeps the organisms fully contained," Trewhella said. "The BSL 3 laboratory is used to work with organisms which potentially can be lethal if they infect a person, but for which there are known vaccines or treatments. We will not be working with exotic organisms that do not have known vaccines or treatments. Nor will be work with agents like smallpox. Smallpox requires BSL 4 containment."

Trewhella said that the new facility will be used to study pathogens like *Bacillus anthracis* that causes anthrax and *Yersinia pestis* that causes plague. Each of these diseases is fully treatable and workers will be under medical surveillance programs. Local medical personnel will be aware of the work and the treatments.

"Our bioscience research is aimed at strengthening our ability to protect people against emerging infectious disease as well as the effects of biological agents that might be introduced into an environment, either by accident or for harmful intent," Trewhella said. "As a natural extension of this research, we need a facility that will allow us to handle under enhanced safety procedures pathogenic organisms and to explore the mechanisms by which they cause disease. Our BSL-3 facility will greatly benefit our researchers working with detection and protection technologies."

Although the pathogens that will be studied in the new facility have already been the subject of extensive research and treatments have been developed, Trewhella said the new research will be invaluable for speeding up diagnostics and improving our ability to detect an event.

"If you know you're infected, you can get treatment," she said. "The key is to know quickly that you've been exposed and what it is. Anyone who's had the flu knows that the sooner you get treatment , the less miserable you are. And for the most serious infections, a life can be saved."

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Lab Contributes to Advances in Many Areas of Science

The Laboratory can boast scores of important scientific accomplishments in 2003. Here is a sample of some of those projects:

Mars Maps from Odyssey Spacecraft

"Breathtaking" new maps of likely sites of water on Mars showcase their association with geologic features such as Vallis Marineris, the largest canyon in the solar system. The maps detail the distribution of water-equivalent hydrogen as revealed by Los Alamos National Laboratory-developed instruments aboard NASA's Mars Odyssey spacecraft.

For more than a year, Los Alamos' neutron spectrometer has been carefully mapping the hydrogen content of the planet's surface by measuring changes in neutrons given off by soil, an indicator of hydrogen likely in the form of water-ice.

"The new pictures are just breathtaking, the water-equivalent hydrogen follows the geographic features beautifully," said Lab space scientist Bill Feldman. "There's a lane of hydrogen-rich material following the western slopes of the biggest volcanoes in the solar system, a maximum reading sits right on Elysium mons, and another maximum is in the deepest canyon in the solar system."

Scientists are attracted to two possible theories of how all that water got into the Martian soils and rocks. The vast water icecaps at the poles may be the source. The thickness of the icecaps themselves may be enough to bottle up geothermal heat from below, increasing the temperature at the bottom and melting the bottom layer of the icecaps, which then could feed a global water table.

On the other hand, there is evidence that about a million years or so ago, Mars' axis was tilted about 35 degrees, which might have caused the polar icecaps to evaporate and briefly create enough water in the atmosphere to make ice stable planet-wide. The resultant thick layer of frost may then have combined chemically with hydrogen-hungry soils and rocks.

A team of Los Alamos scientists has begun a research project to interpret the Mars Odyssey data and their ramifications for the history of Mars' climate. Mars Odyssey was launched from Cape Canaveral Air Force Station in April 2001 and arrived in Martian orbit in late October 2001. During the rest of the spacecraft's 917-day science mission, Los Alamos' neutron spectrometer will continue to improve the hydrogen map and solve more Martian moisture mysteries.

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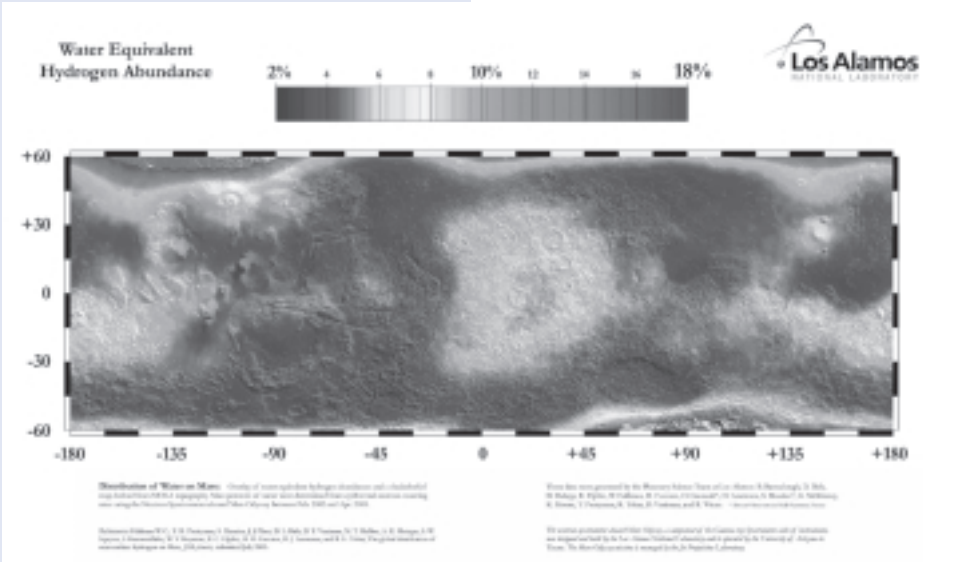

Overlay of water equivalent hydrogen abundances and a shade relief map of Mars topography. Mass percents of water were determined using the Neutron Spectrometer aboard Mars Odyssey between February 2002 and April 2003.

Finding HIV Weaknesses

A Los Alamos National Laboratory researcher and her colleagues have found that people with less common types of proteins on their white blood cells seem to mount a better immune response against the Human Immunodeficiency Virus — the virus that causes AIDS — and tend to fight progression of the disease better than people with common white blood cell proteins.

The research eventually might help researchers better understand and exploit potential weaknesses in HIV.

The researchers studied a large group of homosexual men who were enrolled in the Chicago component of the Multicenter AIDS Cohort Study — an ongoing study of the natural and treated history of thousands of men infected with HIV.

Los Alamos researcher Bette Korber, Elizabeth Trachtenberg of Children's Hospital Oakland Research Institute and colleagues examined the levels of AIDS

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virus and a type of T-cell in study participants. In healthy people, these "helper T-cells" help mount an immune response to an attacking organism. Since the AIDS virus attacks and destroys helper T-cells in humans — thereby limiting and eventually destroying a patient's ability to stop the virus from replicating — the number of T-cells within an individual person is an indicator of the progression of the disease; the fewer the T-cells, the greater the level of HIV infection. The researchers were able to track the progression of the disease and the viral load within study participants over time.

Korber, Trachtenberg and colleagues compared viral load and rates of progression to proteins contained on the surface of white blood cells of study participants. The proteins, called human leukocyte antigens (HLAs), perform key functions in helping the body fight infection. HLAs come in several varieties, or types, and exhibit tremendous genetic diversity. Everyone carries different combinations of these proteins. Korber and her colleagues found that study participants who had the most common HLA protein types tended to succumb to progression to AIDS significantly more quickly than the participants who had more rare HLA protein types.

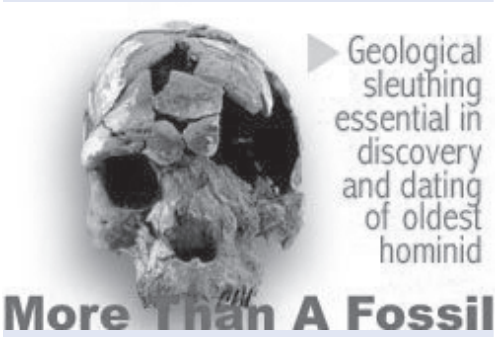
The study suggests that HIV adapts to the most frequent HLA proteins in a population, providing a selective advantage for patients with rare HLA proteins.

Korber and her colleagues cannot be absolutely sure that other subtle biological factors contribute to the association between HLA types and HIV progression. Therefore, Korber says, independent studies on other infected populations will be important to verify or refute the results of this study.

Human Predecessor Found in Africa

An international team of scientists, including a researcher from Los Alamos National Laboratory, has discovered fossilized skulls that lend further credence to the hypothesis that modern humankind originated in Africa.

The discovery also indicates that this ancient predecessor of modern man conducted early mortuary practices on their deceased contemporaries and may have dined on hippopotami.



The international team, know as the Middle Awash Research Group, discovered fossilized skulls of two adults and a child who lived 160,000 years ago in what is now the Afar Region of northeastern Ethiopia. The age of the fossils makes them the world's oldest near-modern humans, meaning that they are a subspecies of Homo sapiens — modern man. Researchers named the new subspecies Homo sapiens idaltu (idaltu means "elder" in the Afar language).

The team found skull, tooth and bone fragments as well as an entire cranium in sediments near Herto village in 1997. It took researchers years to successfully reconstruct and stabilize the fossilized remains.

One of the adult skulls and the child's skull bear marks indicating that they had been altered by stone tools. The child's skull shows evidence of polishing, perhaps from repeated handling, in an area where the base of the cranium was broken away. Anthropologists have found similar bone modifications in societies where the skulls of ancestors were preserved and venerated, leading the research team to believe that the marks are the result of a similar mortuary practice conducted by Homo sapiens idaltu.

Los Alamos geologist Giday WoldeGabriel, a co-leader of the research team, used geologic clues to characterize and describe the environment in which Homo sapiens idaltu lived. Although much of Europe was under ice as a result of major glaciation, the ancient hominids lived near the shore of a shallow freshwater lake that had been formed by major fault that blocked a river in the area. Fossils indicate that the lake was inhabited by abundant catfish, crocodiles and hippos. Stone tool marks on fossilized remains indicate that Homo sapiens idaltu at Herto had a taste for hippo, but researchers are unclear whether the hominids hunted the animals for food or scavenged them.

The Herto fossils have lent credence to the idea that modern man originated in Africa and spread throughout the world from there. The new subspecies is anatomically similar to modern humans. Previous to the Herto discovery, the oldest near-modern humans ranged from 90,000 to 130,000 years old and were found in Africa and the Middle East. The Herto remains predate the Middle Eastern remains by some 30,000 years.

But most significant to the research team, Homo sapiens idaltu is unmistakably a non-Neanderthal. As such, the Herto fossils indicate that near humans had evolved in Africa long before extinct The Middle Awash Research Group has discovered a wealth of fossils in the Afar Region throughout the past decade.

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Tri-Lab Consortium Addresses Diversity Concerns

In August 2001, representatives from the three National Nuclear Security Administration (NNSA) Laboratories convened in Albuquerque to participate in a "Tri-Labs Diversity Workshop" that addressed various workplace issues and challenges raised by the Asian Pacific Islander (API) community. The NNSA Administrator, senior management of the three Laboratories (Los Alamos [LANL], Livermore [LLNL], and Sandia [SNL]) were present as were the management of selected functional areas (e.g., Affirmative Action/Equal Employment Opportunity [AA/EEO], Diversity, Human Resources, Security, Counter Intelligence, etc.). Additionally, representatives from the University of California, DOE officials, and several API employees participated. The workshop also addressed the larger issue of the Asian Pacific Americans in Higher Education (APAHE) boycott against employment with the national Laboratories.

The workshop identified three major challenges, one of which was assigned as lead responsibility to each of the Labs as follows: LANL – Enhance the National Image of the NNSA Laboratories, LLNL – Leadership Development, and SNL – Streamlining Security Policies and Procedures.

As efforts proceeded to meet these challenges, the three Labs established a "Joint Charter to Address Racial Concerns" reflecting the guiding principles and commitment to:

- Promoting diversity awareness and management best practices;
- Maximizing retention and employee development efforts;
- Attracting and recruiting qualified applicants, including women and minorities; and
- Encouraging the transition to management of qualified candidates, including those of cultural or diverse background.

The charter established principles that are broadly applicable and relevant to all of the minority groups and women. As members of the NNSA Tri-Lab community, each of the Laboratories are both independently and cooperatively working to embrace these principles and promote equity among all races/ethnicities and genders.

In its lead responsibility to "Enhance the National Image of the NNSA Laboratories," LANL sought to address real or perceived image concerns, particularly those that impact recruitment and retention. Realizing that the best chance for success was to narrow the scope to doable efforts, the Lab formed a team and coordinated with its sister Labs four interrelated goals:

- Address the APAHE Boycott;
- Recruit the best talent;
- Retain the Laboratories' talented employee workforce; and.
- Collaborate and communicate the strides and efforts toward diversity.

LANL's initial efforts as well as those of the Tri-Lab consortium are detailed in a report to NNSA headquarters dated June 2003 that charts the progress and goals of the overall program. It's conclusion states: An objective of enhancing the image of the NNSA Laboratories supports a strategy to have the national Laboratories become an employer of choice in a competitive marketplace, thereby increasing the ability of the Labs to recruit and retain the best and brightest employees. To accomplish this, the Laboratories need to continue efforts and progress in increasing the representation of minorities and women within the workforce.

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At this workshop held in January at LANL, members of the seven Diversity Working Groups and the Diversity Affirmative Action Board began outlining the need for a Code of Ethics, finally introduced in October.

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Our mutual success in achieving this objective will be enhanced by collaboration between the Laboratories, accountability for delivering on commitments, and applying appropriate metrics by which to measure success.

The workplace and cultural changes necessary to creating an environment of inclusion, one in which all employees feel valued, requires multiple, long-term strategies that support the missions of the Laboratories. With a commitment to improve the quality of work life for all of its employees, NNSA and the national Laboratories will help to insure mission success.

The report was welcomed at headquarters, and initial efforts are successful and ongoing.

The complete report is available at http://int.lanl.gov/orgs/oeo/ under Useful Report.

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Science Stories
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Tracking 'Dirty Bombs'

One nightmare scenario: a terrorist dirty bomb is detonated in a major metropolitan area. Everyone's first question is "Who did it?"

One piece of the puzzle that would give law enforcement officials a head start in their search for potential suspects would be an accurate description of what radioactive materials are contained in the bomb debris. Standard isotope identification technology is relatively slow; the process can take 24 hours or more. Now a team of Los Alamos National Laboratory scientists has developed a new quick screening methodology to identify isotopes in dirty bomb debris, a procedure that can yield initial data in as few as six hours.

Developed by Bennie Martinez and colleagues from the Laboratory's Chemistry Division, the new procedure was presented at the 2003 American Chemical Society meeting in New York City.

Utilizing standard chemical analysis the Los Alamos team came up with a unique combination of procedures that extract and identify radionuclides from fused soils and rock, likely the most common constituents in bomb debris. Other ingredients might include concrete and asphalt residues, metal fragments, plastics and glass—anything present in a populated urban setting.

"We have achieved a result with fair to good resolution using very few chemicals in a quick turnaround time with a minimum of steps required in the process," said Martinez. "It's clear the method can identify a variety of radionuclides that might be present in dirty bomb debris," said Martinez. "Since the method is fairly simple and uses a minimum of equipment, we believe it could be forward deployed and could provide early data to law enforcement and others following a terrorist event. We want to help officials close in on the culprits as fast as possible."

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Tiny dots of a solution containing radionuclides are placed on a platinum disk and flamed over a Bunsen burner to evaporate out the liquids. The disk is then placed in an alpha spectrometer where the radionuclides are finally identified.

Business Briefs

Wells Fargo Named New LANL Banking Service Provider

Wells Fargo was recently selected as the Laboratory's new corporate banking service provider. This decision was made in an effort to embrace the recommendations resulting from two external reviews of the Laboratory's banking practices. Wells Fargo replaces Los Alamos National Bank (LANB), which provided service to the Laboratory for more than 20 years.

CRO Presented with the Allan F. Johnston Small Business Advocacy Award

The Laboratory's Community Relations Office was awarded the "Allan F. Johnston Advocacy Award" for outstanding support of small business and small business outreach at the 4th Annual Northern New Mexico Supplier Alliance Procurement Expo in October. The successful event was attended by more than 300 small businesses and 40 federal agencies. This year, it included two training sessions for procurement specialists and a job fair.

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Los Alamos NATIONAL LABORATORY

Ideas That Change the World

Reaching Out to Small Business

Laboratory staff participated in several small business outreach events recently including a well-attended Procurement Expo, held at Northern New Mexico Community College. Participants included representatives of federal agencies including the U.S. Department of Interior (DOI) and the Department of Energy. Pictured below are Department of Interior staff, from left to right, Mark Oliver, Lee Allen and keynote speaker Michael F. Trujillo, Deputy Secretary of the DOI.

The Lab's Small Business Office also hosted a Construction Forum as part of its small business outreach efforts. The forum was also well-attended and provided participants with information on upcoming Lab construction projects and their safety requirements.

Inside

The Laboratory Connection, a monthly publication for northern New Mexico, is published by the Information Management Division and the Community Relations Office. The staff can be reached by e-mail at community@lanl.gov, by telephone at 1-888-841-8256, by fax at (505) 665-4411, or by Laboratory interoffice mail at Mail Stop A117.

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