Los Alamos NATIONAL LABORATORY
NewsLetter

Week of Aug. 5, 2002 Vol. 3, No. 15

Laboratory researcher's expertise key to understanding Homo erectus skull discovery

by James E. Rickman

Laboratory geologist Giday WoldeGabriel again has played a role in a major anthropological discovery — this one involving Homo erectus, a precursor of modern man that is believed to have roamed Earth between one and two million years ago.

Working with paleoanthropologist Tim White of the University of California at Berkeley, WoldeGabriel and an international research team unearthed fragments of a skull belonging to a member of the Homo erectus species from ancient sediment layers in Ethiopia. The skull indicates that Homo erectus populated Europe, Asia and Africa, and that species counterparts on each of those continents were the same — a finding highlighted earlier this year in a cover story in the journal, Nature.

Previously, some anthropologists had argued that Homo erectus fossils found in Asia represented a different species from the fossils of Homo erectus' contemporaries found in Africa and Europe, which had been named Homo ergaster.

The newest fossil discovery from Ethiopia by White's team indicates that Homo erectus was one species that populated all three continents.

"This fossil is a crucial piece of evidence showing that the splitting of Homo erectus into two species is not justified," said White. "This African fossil is so similar to its Asian contemporaries that it's clear Homo erectus was a truly successful, widespread species throughout the Old World."

The research team also asserts in Nature that the onset of the ice ages about 950,000 years ago led to divergent evolution among Homo erectus — with the African population most likely evolving into modern Homo sapiens; the European branch probably evolving into Homo neanderthalensis, or Neanderthals; and the Asian population becoming extinct.

Before the team's find, anthropologists had given different names to other Homo erectus discoveries, for instance calling them Peking Man or Java Man.

"What we are saying in this paper is that the anthropological splitting common today is giving the wrong impression about the biology of these early human ancestors," White said. "The different names indicate an apparent diversity that is not real. Homo erectus is a biologically successful organism, not a whole series of different human ancestors, all but one of which went extinct."

Although the team found the fossil fragments in 1997, it took team members more than two years to reassemble the pieces into a nearly complete skull.

Of vital importance in any of these fossil discoveries is the ability to accurately understand the temporal and spatial settings of the specimens in the field. WoldeGabriel's geological expertise in this area is invaluable. Using sediment layers that contain the fossil remains, WoldeGabriel of Hydrology, Geochemistry and Geology (EES-6) has been able to successfully assess the geological history and environment of the fossils.

WoldeGabriel's expertise in understanding the basin geology gave him the ability to characterize the environment in which our earliest human ancestors lived. In Homo erectus' time a million years ago, the Middle Awash was an expansive grassland inhabited by a number of animals, including antelope, elephants, baboons and hyenas; in fact, marks on the fossilized skull indicate that the Homo erectus specimen may have been gnawed on by hyenas or other animals after it died.

The latest fossils are about a million years old, making it a Homo erectus specimen much younger than the Asian and European discoveries — believed to be about 1.8 million years old.

The area where the nearly complete Homo erectus skull was found is located in the Middle Awash region of Ethiopia. The area is within the Afar rift system and is rich in fossil-bearing sediments. The area is familiar to the research team, which has made several discoveries there in the past.

The skull fragment shows massive brow ridges and the long, low vault characteristic of Homo erectus. The entire cranial base is preserved, and the specimen reveals a great deal of anatomical detail that allowed the investigators to infer its close evolutionary relationships to similar fossils in Java, China, Georgia and Italy. *Photo copyright by David L. Brill\Brill Atlanta*

WoldeGabriel said working with the team is exciting and rewarding. However, work in the study area never ends with a single find.

"Once you find something in an area, you can't just quit," WoldeGabriel said. "You have to keep going back. Each rainy season unearths other fossils, so you have to keep checking an area every year with every expedition."

As such, each successive discovery reduces the amount of free time that team members have to search for new sediment beds that may contain fossils of as-yet-undiscoverd species.

Last summer, WoldeGabriel and researcher Yohannes Haile-Selassie of UC Berkeley made scientific headlines when they announced the discovery of Ardipithecus ramidus kadabba, a creature who lived between 5.2 and 5.8 million years ago. At the time, the fossils were believed to be those of the oldest human ancestor discovered.

WoldeGabriel says he believes the Middle Awash study area where he and the team explores each year eventually could produce the "Holy Grail" of paleoanthropolgical discoveries: The so-called "Missing Link" — the split in the evolutionary tree between chimpanzees and humans. Those elusive fossils have yet to be found and may never be found. But to WoldeGabriel, the search continues.

"I plan to continue to go back as long as I can," he said.

Funding for WoldeGabriel's work in Ethiopia comes from Los Alamos' Institute of Geophysics and Planetary Physics.

To learn more about the man behind the science, see Page 8 for a feature on WoldeGabriel.

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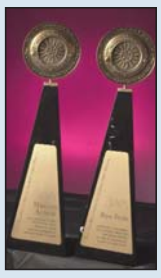
The Laboratory is seeking nominations for the second annual Los Alamos National Laboratory Medal award, which recognizes exceptional efforts on behalf of the Laboratory by individuals or small groups who have made a profound impact on the institution. . . . . **Page 7**



People
Featured in this week's people section are the new Decision Applications (D) Division leader; Safeguards Science and Technology's (NIS-5) new group leader; and the new deputy director for the Computing, Communications and Networking (CCN) Division. . . . . **Page 7**

A long, yet fulfilling, journey

Laboratory geologist Giday WoldeGabriel has been a key player in some of anthropology's most significant discoveries, providing geological and paleoenvironmental contexts for the remains of some of human kind's oldest ancestors. . . . . **Page 8**

Los Alamos NewsLetter

The *Los Alamos NewsLetter*, the Laboratory bi-weekly publication for employees and retirees, is published by the Public Affairs Office in the Communications and External Relations (CER) Division. The staff is located in the IT Corp. Building at 135 B Central Park Square and can be reached by e-mail at newsbulletin@lanl.gov, by fax at 5-5552, by regular Lab mail at Mail Stop C177 or by calling the individual telephone numbers listed below.

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Los Alamos enhances global security by ensuring safety and confidence in the U.S. nuclear stockpile, developing technologies to reduce threats from weapons of mass destruction and improving the environmental and nuclear materials legacy of the Cold War. Los Alamos' capabilities assist the nation in addressing energy, environment, infrastructure and biological security problems.

NNSA National Nuclear Security Administration

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FROM THE TOP

Science that serves society

by Laboratory Director John Browne

The recognition Los Alamos National Laboratory receives through its participation in R&D Magazine's annual, international R&D 100 Awards competition calls attention to the broad scope of achievements that the Laboratory contributes to technological innovation in this country and, indeed, the world. Our discoveries in science and the applications that result play an important role in shaping the future of our nation. When we transfer our inventions and technological advances from the Laboratory to the private sector for commercial development, we strengthen the nation's economic security by enhancing our industrial competitiveness.

I commend our researchers for the diligence and creativity they have applied to developing the technologies submitted to this year's competition. I am pleased with the diversity of applications, which range from data transmissions and security enhancements to health and safety, manufacturing and energy sustainability.

It is important to remember that these innovations have been born out of Los Alamos' goal to create science that truly serves society. I believe every submission is a winner for the Laboratory, the University of California and the American taxpayer.

Los Alamos participates in president's visit to Argonne National Laboratory

by David Lyons

Technologies developed at Los Alamos and other national laboratories that can be used in the nation's homeland security efforts were among those showcased last month at Argonne National Laboratory during a visit by President Bush.

Bush; Rep. Dennis Hastert, R-Ill.; Department of Energy Secretary Spencer Abraham; and Homeland Security Director Tom Ridge visited Argonne National Laboratory outside Chicago for briefings from DOE/National Nuclear Security Administration laboratory personnel on DOE's homeland security efforts.

Los Alamos played a significant role in the technology demonstration, which took place just before the president's speech. Los Alamos provided three of the five demonstrations for the president, including the National Infrastructure Simulation and Analysis Center (NISAC), DNA pathogen sequencing and analysis technologies and the Biological Aerosol Sentry and Information System (BASIS) that was deployed at the Winter Olympics in Utah. Steve Rinaldi, NISAC joint director for Sandia and Los Alamos, discussed critical infrastructure protection issues; Bioscience (B) Division Leader Jill Trewhella briefed the President on DNA analysis; and Kristin Omberg of Systems Engineering and Integration (D-3) presented the BASIS system.

Raymond Orbach, director of the DOE Office of Science, led the demonstration tour, with assistance from presenters from the laboratories. The technology demonstration also included Argonne's critical infrastructure work and its Program for Response Options and Technology Enhancements for Chemical Terrorism, or PROTECT, chemical detection system; Sandia's decontamination foam; and a demonstration of search equipment by a member of the Nuclear Emergency Support Team from Bechtel Nevada. The presenters also gave briefings to Illinois Gov. George Ryan and members of the Illinois congressional delegation.

During his speech to employees and the media, Bush said, "I've just come back from viewing some demonstrations of the great work done at national laboratories, whether it be here, or Los Alamos, or Sandia or others. The American people need to know we've got a lot of brain power working on ways to deal with the threats that we now face as we head into the 21st century."

Trewhella said her discussions with the president went very well. "He was very engaged, asking a lot of questions," she said. "We spent about five minutes discussing how we built the capability to respond to last fall's anthrax attacks from our work that sits at the intersection of basic biology and our nonproliferation and counterproliferation missions.

"It was a great thrill to be there," Trewhella continued. "He was very interested in the specific technologies that we had that could help defend the homeland."

Trewhella added that on his way out Bush said, "Say hello to those folks back in New Mexico. It's great country down there."

Omberg said that Bush asked about the future of sensors and detection technology, asking whether the BASIS Distributed Sampling Units would be the same size 10 years from now. The president also expressed interest in the BASIS Winter Olympics deployment, she said.

Jill Trewhella, far right, Bioscience (B) Division leader, briefed President Bush, left, and other officials during a visit to Argonne National Laboratory in Illinois in July. Trewhella talked about DNA pathogen sequencing and analysis technologies, one of several Department of Energy/National Nuclear Security Administration technologies that can be used in the nation's homeland defense efforts. With the president are, from left to right, Rep. Dennis Hastert, R-Ill., and Raymond Orbach, director of DOE's Office of Science. Also attending the presetation is Tom Ridge, the president's Homeland Security director. *Photo courtesy of the White House*

Lab continues winning way

GENetic Imagery Exploitation, or GENIE, which mimics evolution to create more effective algorithms for detecting features in digital images produced by a variety of remote-sensing techniques, has won a 2002 R&D 100 Award. This brings the Lab's total R&D 100 Awards to 192. This year, Department of Energy laboratories throughout the nation garnered 23 of the awards.

Now in it's 40th year, R&D Magazine annually recognizes the world's top 100 scientific research and technological advances with awards for innovations showing the most significant commercial potential.

According to the selection panel, "The sole criterion for making the grade is demonstrable 'technological significance' compared with competing products and technologies. Issues such as smaller size, faster speed, greater efficiency and higher environmental consciousness have continued to gain importance in successful award submissions."

Also in this section are the Laboratory's innovative research and development projects nominated for the 2002 R&D 100 Award.

GENIE: evolving feature-extraction algorithms for image analysis

GENIE (GENetic Imagery Exploitation) system mimics evolution to create more-effective algorithms for detecting features in digital images produced by a variety of remote-sensing techniques. GENIE assembles an initial set of low-level image-processing algorithms (e.g., edge detectors, texture measures and spectral operators) and then tests each algorithm's ability to find the feature of interest.

The "less fit" algorithms are discarded; the "more fit" ones are combined to produce superior ones. After several generations of survival of the fittest, the resulting algorithm is highly optimized.

Although features and imagery constantly change, GENIE's ability to evolve superior algorithms allows it to find the features of interest in nearly any set of images.

GENIE has been successfully used to find and map damage caused by wildfires, pollution and terrorist attacks.

Future applications could include other disaster scenarios such as hurricanes, floods, overgrazing and habitat loss, insect infestations and volcanoes.

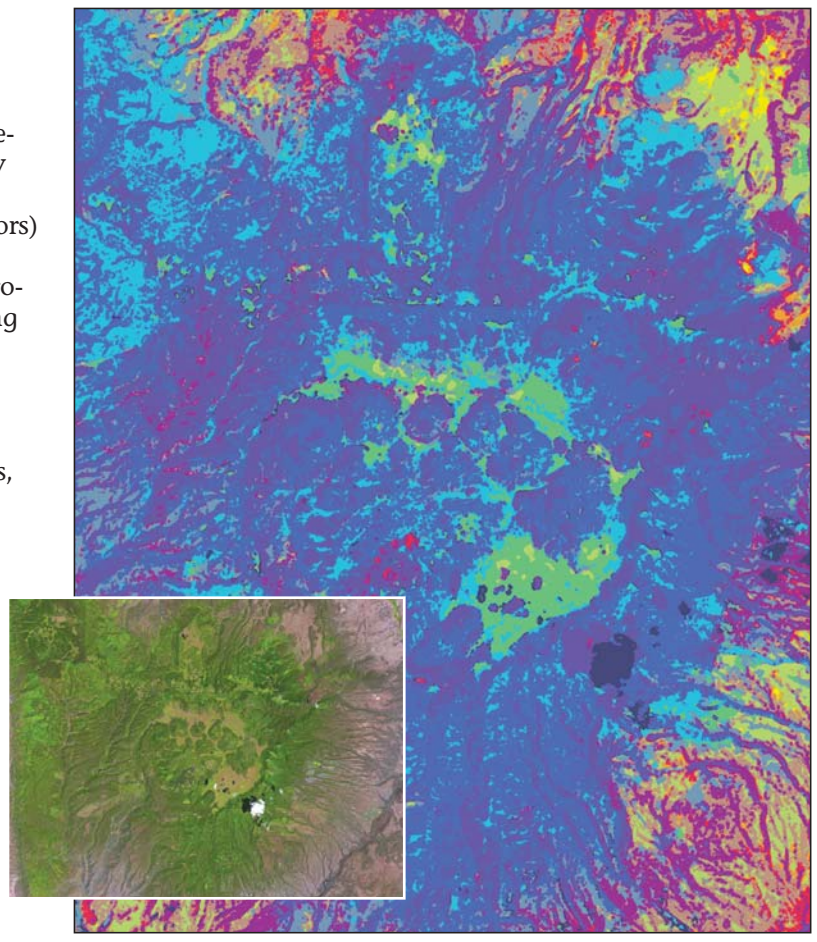
However, GENIE is not limited to mapping ecosystems and monitoring important environmental change. Presented with other, very different types of imagery, it is showing an ability to detect signs of disease in medical images and to map craters and other surface features on other planets. In the future, it might assist baggage screeners at airport security checkpoints and be used to detect defects in products made on assembly lines.

GENIE's results can be reused to help GENIE build up its "understanding" of complex tasks. For example, after GENIE learns to find water, it then can easily learn to find beaches.

GENIE learns to ignore unimportant image-to-image variations such as atmospheric haze or variations in overall illumination.

The volume and variety of digital images now available to scientists are truly staggering. They include Hubble Space Telescope images of the most distant objects in the universe; aircraft and satellite images of the entire surface of Earth taken in various spectral bands; images taken by NASA's lunar and Martian orbiters and rovers; spacecraft images of other planets in the solar system as well as of asteroids; and medical images such as conventional X-rays; biopsy micrographs; and CAT, MRI, PET and ultrasound images. All of these images contain information that until now could not be fully interpreted because of the limitations of human image-analysis and of existing image-analysis software.

Principal developers Jeffrey Bloch, Steven Brumby, Nancy David, Mark Galassi, Neal Harvey, Simon Perkins, James Theiler and A. Cody Young of Space and Remote Sensing Sciences (NIS-2); Diana Esch-Mosher and Reid Porter of Space Data Systems (NIS-3); and John Szymanski of the Research and Development Program (NIS-R&D)



The inset photo, a satellite image of the area affected by the Cerro Grande wildfire that occurred near Los Alamos in May 2000, contains seven spectral bands of imaging information. Analyzing the image would normally require considerable effort by scientists working closely with computer programmers. In this case, a single image analyst trained GENIE to identify land-cover classes in one session. The main photo shows the map GENIE produced for 12 land-cover classes. Forest classes (pine, conifers, aspen) appear in shades of blue, grassland in green, and bare ground and pinon-juniper scrublands appear in shades of red and brown. The algorithm that GENIE generated to produce this map also can be used to identify land-cover classes in other images.

CO_2 laser welding of quartz

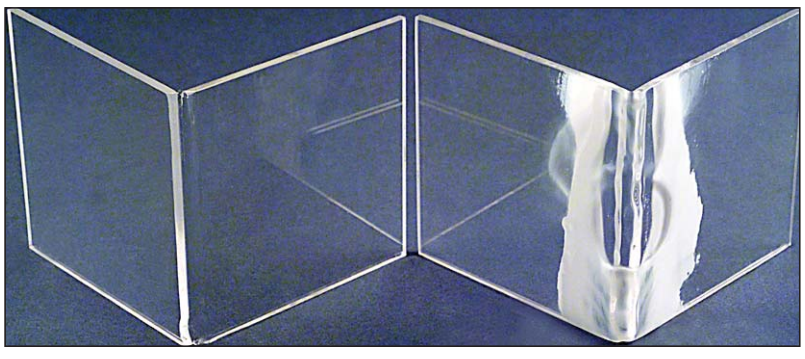
Quartz, in its glass form, is an extremely transparent, heat-tolerant and stable material widely used in industrial and consumer products. Welding is one method of forming quartz into finished products. As traditionally done with hydrogen/oxygen torches, welding is a cumbersome operation that, even when performed by a highly skilled glass blower, yields an irregular, potentially contaminated product. This new laser welding method produces cleaner, more precise welds quickly and simply. Our method uses a computer-controlled, continuous-wave CO_2 laser, a motion table and a vacuum-pump system to position, hold and fuse pieces of quartz glass. A standard shop vacuum removes any contaminants before they can adhere to the quartz surface. Based on the thickness, size and shape of the quartz pieces and the wavelength and power range of the laser, a technician programs the computer with the appropriate motion-table feed rate and laser settings. The weld is then automatically made and can be repeated as needed.

Quartz is used to manufacture everything from headlamps to fiber optics. In every industry that uses quartz, there is a need to join pieces together.

In the burgeoning number of high-tech industries (e.g., semiconductor, medical, environmental testing, laser technology and aerospace), there is a need to join pieces of quartz precisely and without introducing contamination, a task for which laser welding is ideally suited.

This technology has the following applications:

- The method makes quartz welding an efficient, automated, hands-free procedure.
- Laser welds can be replicated innumerable times, even by inexperienced technicians.
- Lasers produce precise, full-penetration welds that can withstand repeated exposure to the high temperatures used in semiconductor manufacturing.
- Contaminant-free, laser-welded quartz products readily meet the purity standards of high-tech industries.
- After the initial outlay for equipment purchases, laser welding is very inexpensive.
- Using a laser to weld quartz eliminates the need to store large quantities of explosive pressurized gas and to work with torch flames.



Principal developers McIlwaine Archer of Polymers and Coatings (MST-7), and Robert Carpenter and Martin Piltch of Materials Technology: Metallurgy (MST-6)

Comparisons of welds made by a technician using the CO_2 laser (far left) and by an experience glass blower using hydrogen/oxygen torch (right). Neither quartz product has been cleaned.

Multi-Platform Trusted Copy: an information assurance file review and transfer tool

Multi-Platform Trusted Copy is a cyber security software application used to review computer files for specific elements that can hide sensitive or harmful information. MPTC detects and, in specific cases, removes hidden data. MPTC also searches for user-supplied keywords/phrases and, as part of a comprehensive review, provides a function to open the file in its original application, permitting examination of the keywords/phrases, pictures and other nontext objects identified in the review. MPTC produces a "cleansed" version of the file and provides for transfer of this "trusted copy" of the file to a removable medium for further distribution. MPTC also generates encrypted logs containing information about who conducted the review and when, what was found and what information was transferred. Log-file detail also could help identify the person who hid it.

MPTC provides the federal government with a robust tool to review documents for hidden, classified or sensitive data before releasing the documents to the public or news media. In the private sector, MPTC could be used to prevent the transfer of hidden proprietary, personal or security-related information, particularly important in the legal, medical and financial sectors.

In addition, MPTC

• provides a more thorough review than a visual examination or basic ASCII keyword search, thereby increasing confidence that hidden information is removed or accounted for.

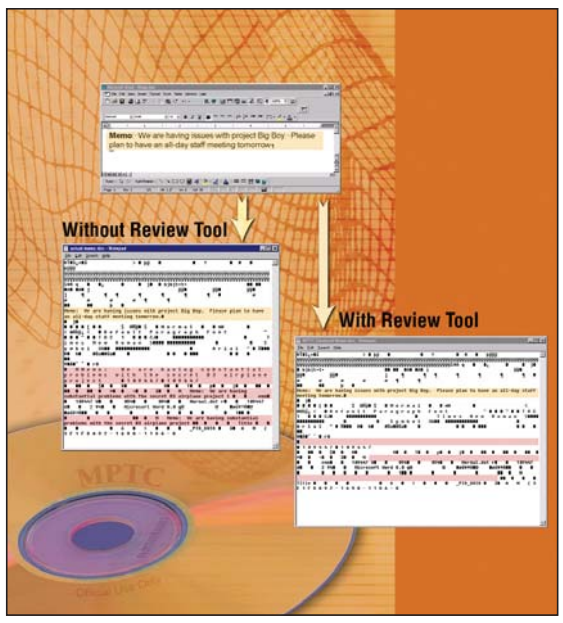
• provides an audit trail by preserving the history of review actions, findings and transfers in encrypted log files.

• minimizes the risk (and therefore the consequences) of inadvertent release of sensitive or confidential information.

• uses the same intuitive interface and simple three-step process — select files for review, review files and transfer files — on Solaris, Linux, Windows NT and Windows 2000 platforms. This commonality simplifies training requirements and maximizes use of existing resources.

• reviews numerous file types, including any ASCII or binary format (text files, some CAD files, computer source code and so forth) and Microsoft Office (97/2000) files.

Principal developers Keith Lindsay and Nabil Schear of High Power Microwave, Advanced Accelerator and Electrodynamic Application (NIS-10); Norbert Ensslin of Safeguards Science and Technology (NIS-5); Esther Martinez of Weapon Design Technologies (NIS-9); Rebecca Michelsen of Space Data Systems (NIS-3); Sheila Molony of Communication Arts and Services (IM-1); and Karen Bintz of C&M Enterprises



Computer users may not be aware that electronically generated documents contain information that is not visible on screen or on paper. Multi-Platform Trusted Copy is a software file review tool that removes hidden information. For example, the top memo was created in Microsoft Word. Can you spot the "secret" text in the "Without Review Tool" figure? A text editor reveals that the author originally entered and then deleted more text (pink highlights). An MPTC review automatically removes this hidden text ("With Review Tool" figure) and reports additional review findings in a Review log. Without an MPTC file review, the old text remains invisible but accessible to anyone examining the file.

The Attribute Measurement System with Information Barrier (AMS/IB) protects sensitive information from disclosure while analyzing the contents of sealed containers (background) that hold nuclear materials or weapon components. The AMS/IB measures nonsensitive material with the shielded cabinet door open (left inset) and sensitive material with the cabinet door closed (right inset). Either way, only nonsensitive information is displayed.

AMS/IB — tool for protecting data and verifying container contents

The Attribute Measurement System with Information Barrier (AMS/IB) is a modular inspection technology for verifying the contents of sealed containers without revealing any sensitive or proprietary information about those contents. It was developed as an accurate means of monitoring compliance with nuclear disarmament treaties. The system allows inspectors to verify that sealed containers hold nuclear material from dismantled weapon components without compromising sensitive information about the components' design. It uses simple hardware and software shielded against electronic surveillance or tampering to gather and analyze sensitive information but transmits only nonsensitive pass/fail results. The AMS/IB technology has been accepted as the International Atomic Energy Agency's preferred approach for future arms control verification.

It can

• monitor international compliance with treaties for disarmament and nuclear-materials control,

• verify the contents of nuclear-material containers in storage,

• protect sensitive personal information obtained from security checks based on whole-body imaging technology and

• conduct quality-control inspections on food and drug products without revealing proprietary information.

Principal developers Duncan MacArthur and Douglas Mayo of Safeguards Science and Technology (NIS-5); William (Chip) Johnson, Richard Morgado, Nancy Nicholas and Lawrence Sprouse of Advanced Nuclear Technology (NIS-6); Robert Landry and Rena Whiteson of Safeguards Systems (NIS-7); Diana Langner of the Nonproliferation Project Office (NIS-NP); and Thomas B. Gosnell, S. John Luke, Gregory K. White and James K. Wolford from Lawrence Livermore National Laboratory.

IMAGENE — ultrasensitive DNA analyzer

IMAGENE is an ultrasensitive DNA analyzer that images electrophoretic separation of DNA as it occurs. It thereby generates images of the entire ensemble of separating DNA molecules at any point during "separation time," rather than a sequence of piecemeal detection signals at a time subsequent to the separation process. IMAGENE's unique waveguide imaging system markedly improves both the speed and accuracy of DNA analysis. It also permits direct analysis of DNA mutations, an extremely labor-intensive process with existing technologies. IMAGENE's simplicity, speed, accuracy and versatility underlie its range of application to human genome analysis, genetic-predisposition diagnosis, expeditious pathogen screening for bioterrorist and public-health scenarios, and assessment of forensic evidence.

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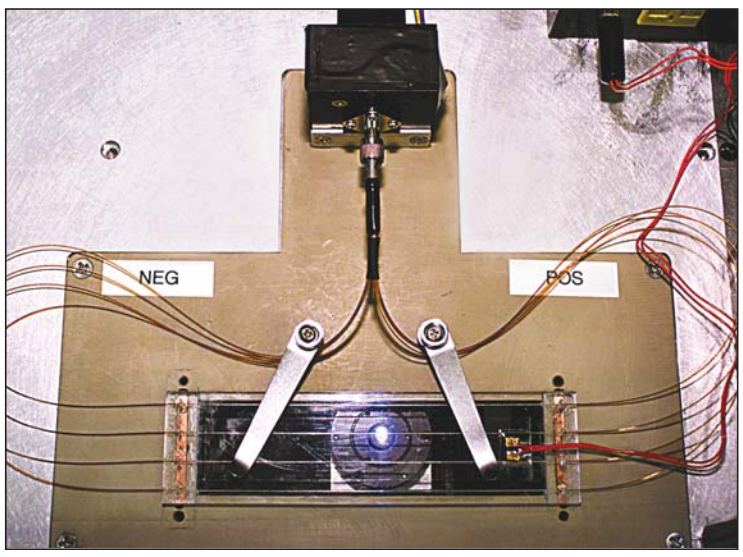
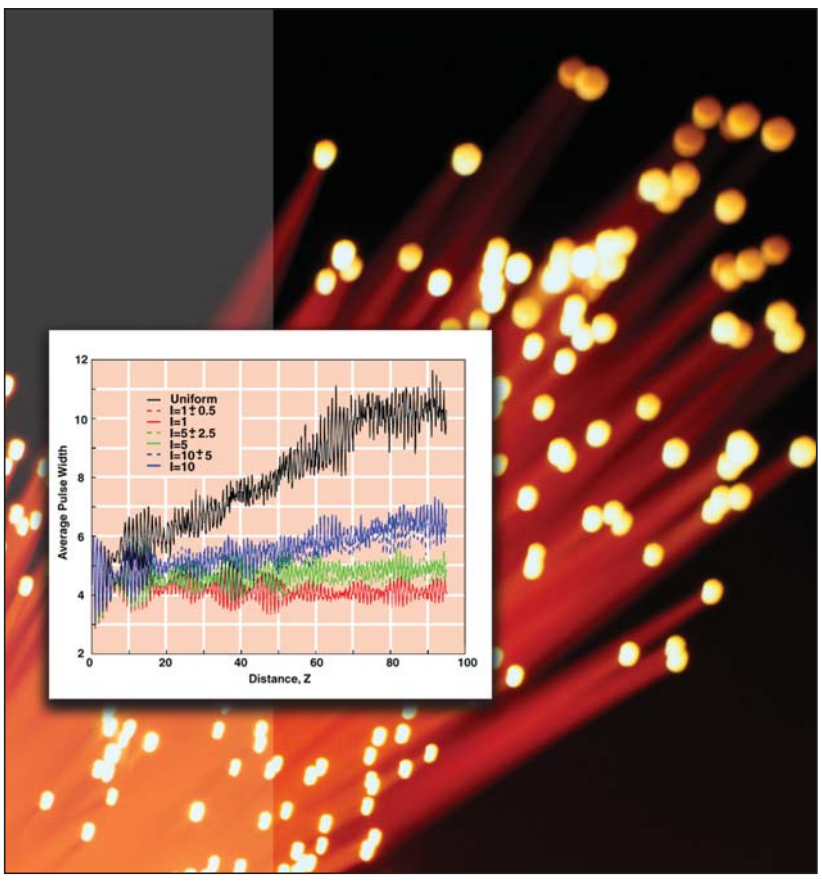


Shown at right are the functional components of IMAGENE. A blue laser, bottom center, scans an optical-waveguide capillary above it. Four parallel capillaries are showing, each joined to fiber-optic cables at their ends. At the top of the photograph, a photomultiplier with filters receives fluorescence data from the fiber optics.



Against a backdrop of illuminated optical fibers, the graph shows data from numerical simulations of ultrashort light pulses propagating in optical fibers. The data trends indicate how disorder management affects pulse spreading over distance. For reliable data transmission, the light pulses should spread as little as possible. The black curve shows that without disorder management, the pulses spread rapidly. As the length of the periodic or quasi-periodic interval over which disorder management is applied decreases, the pulses spread less. For the smallest length tested (red curve), the pulses don't spread at all. The average slopes of the curves are more important than their fine-scale oscillations.

Disorder management of optical fibers for high-bit-rate data transmission

Disorder management removes a major barrier to high-bit-rate data transmission over distances of a few hundred kilometers or more through high-speed fiber-optic communications systems. By reducing the data-transmission errors caused by random variations in the optical fibers' light-transmission properties, those using disorder management can achieve reliable long-distance data transmission at 160 gigabits per second per fiber channel — more than 10 times the rates of existing long-distance fiber-optic systems. Researchers reduce data errors through disorder management, developed with theoretical methods normally applied in statistical physics. Disorder management ensures that future high-speed fiber-optic communications systems will meet the exponentially growing world demand for data-transmission capacity.

High-speed fiber-optic communications systems are used mainly to transmit data across the Internet. High-volume users include national and international stock exchanges, banks, airlines, insurance companies, health services, publishing houses, news agencies, research institutions and telecommunications companies. High-speed fiber-optic communications systems also can be used to network supercomputers separated by hundreds of kilometers or more.

Disorder management is an enabling technique for

- meeting the transmission requirements of future Internet expansion,
- reducing current Internet bottlenecks and sluggishness caused by inadequate bandwidth,
- meeting the demands of emerging bandwidth-hungry Internet services such as video on-demand and
- efficiently networking distributed supercomputers.

Principal developers Michael Chertkov of Complex Systems (T-13) and Ildar Gabitov, Jamison Moeser and Mac Hyman of Mathematical Modeling and Analysis (T-7)

CONTOUR: a new residual-stress mapping technique

CONTOUR is a new technique for making high-resolution maps of residual stress at cross sections within a structural part. It is a simple, cost-effective way to predict, and therefore minimize, the residual stress produced in such parts when they are forged, treated or welded. The technique is less expensive and more versatile than neutron-diffraction methods. It also is far easier to use and has higher resolution and greater accuracy than conventional sectioning. Because it draws on widely available software and tools (wire electric discharge and coordinate measuring machines), CONTOUR could revolutionize the way manufacturers and materials testing labs measure residual stress.

CONTOUR can map the internal residual stresses in

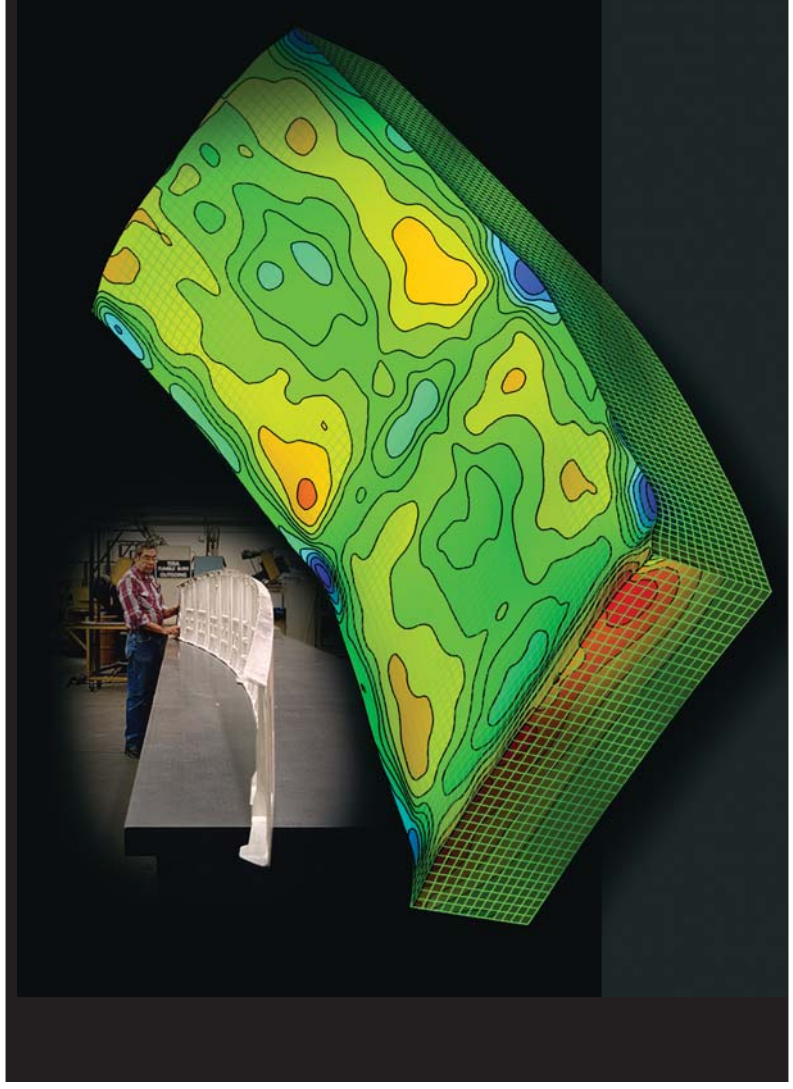
- the structural parts of aircraft, destroyers, steam boilers, rail systems and bridges;
- transmission gears in automobiles;
- jet-engine turbine blades;
- nuclear-reactor control rods and neutron reflectors; and
- welds of any type.

CONTOUR also

- detects residual stresses before they cause catastrophic failure.
- helps to improve the design of structural parts.
- can improve the safety and reduce the cost of national transportation systems, automobiles, jet aircraft and nuclear reactors.
- will improve the strength of welds, which are so common in industrial society.

Principal developer Michael Prime of Weapons Response (ESA-WR)

The color CONTOUR map shows the residual stress at a cross section of a block of the material used to make a bulkhead in a military aircraft (the inset shows the complete bulkhead after machining). Red corresponds to a peak tensile stress of 78 megapascals and the darkest blue to a peak compressive stress of 116 megapascals. Machining this part has released the residual stresses produced during forging and thus warped the part beyond use. CONTOUR measurements can help manufacturers monitor process changes that can reduce forging stresses and, as a result, save millions of dollars in discarded and reworked parts. (In the CONTOUR map, the part's deformation is magnified about 150 times to make it easier to see.)



IMAGENE …

continued from Page 4

It performs

- full sequencing of complete genomes
- expeditious identification of potentially pandemic microorganisms
- accurate discrimination of antibiotic resistance in pathogenic bacteria
- routine diagnosis of predisposition to chronic illness
- forensic evidence analysis that preserves the original evidence
- protein analysis for basic research and biomedical screening
- research — assisting in the accurate completion of genome-mapping projects
- public health — protecting populations from bioterrorism
- medical diagnosis — intervening more quickly in infections and eliminating uncertainty in genetic-predisposition diagnosis
- forensics — reducing the possibility of misinterpreting DNA evidence.

Principal developers José A. Olivares of Michelson Resource Management Group (B-4), Peter C. Stark and Jeff Wheat of Applied Chemical Technology (C-ACT) and Paul Jackson of McClintock Resource Management Group (B-1)

The Polyphase Converter-Modulator (foreground) is the next-generation high-voltage, high-power system — a system that generates 140-kilovolt pulses at 11-megawatt peak power and 1.1-megawatt average power. This system does most of its work at low voltage and generates high voltage only when needed — which significantly improves safety and efficiency.

Polyphase Converter-Modulator: a compact high-voltage, high-power system

The Polyphase Converter-Modulator is a compact, indoor power system that generates 140-kilovolt, 11-megawatt pulses with a 1.1-megawatt average power. The system incorporates three interconnected innovations: (1) the use of low voltage for most of the work (the voltage is stepped up just before output and only when needed); (2) high-power, three-phase conversion (DC to AC to DC) at 20 kilohertz; and (3) the exploitation of electromagnetic circuit resonance for power conversion and voltage multiplication. Key components further developed for this system are from technologies proven in the traction-motor industry (high-speed trains): boost-transformer cores of amorphous nanocrystalline material and high-energy-density, self-clearing capacitors.

This system can provide power or high-voltage pulses for the following:

- pulsed klystron radio-frequency amplifiers for particle accelerators, including the Spallation Neutron Source's linear accelerator, for which the system was developed
- neutral-beam modulators for plasma heating and fueling in fusion-energy research
- flue-gas scrubbers on industrial stacks
- pulsed-discharge equipment that breaks down hazardous biological agents
- DC conversion for coast-to-coast ties between power grids
- shipborne energy-conversion systems for radar applications
- directed-energy weapons using particle beams, microwave energy and free-electron lasers.

In addition, it is

- compact — one-third the size of a conventional system
- safe — low-voltage input, with high voltage produced only when needed and in a single, contained enclosure
- environmentally friendly — no large oil tanks or secondary containment needed outdoors
- fault tolerant — inherently self-protective against short circuits
- quiet — no transformer "hum"
- inexpensive — about one-half the cost of previous technologies.

Principal developers William A. Reass, Dan Borovina, Paul Tallerico, David Baca, David Miera, Jacqueline Gonzales, Marvin Roybal, Sean Apgar, Pete Trujillo, Diego Jaramillo and John Sullard of Radio Frequency (SNS-02); Chris Roybal of the Spallation Neutron Source (SNS) Division; James D. Doss of (NIS-10); Robert F. Gribble of Hydrodynamics and X-ray Physics (P-22); Michael Lynch and Gabriel Roybal of Radio Frequency Technology (LANSCE-5); and Matthew Fresquez of Accelerator Operations and Technical Support (LANSCE-6)

Diana TV — single-channel digital HDTV and analog transmissions

Diana (digital and analog) TV is a method of transmitting TV signals compatible with both digital high-definition television (HDTV) sets and standard analog TV sets in the same channel and is meant for use during the national transition to digital HDTV. The researcher accomplishes this by placing much of the high-resolution digital image data in the letterbox lines that will be imposed on the analog picture by the wide-screen format of HDTV and by

- fitting some of the digital signal in the time between frames of the analog broadcast and
- fitting more of the digital signal in areas of the analog signal that have previously been used inefficiently.

Diana TV broadcasts a fully digital HDTV signal that also is compatible with analog TV sets for entertainment, news, education, teleconferencing and public service. This technology also can be used in a closed-circuit TV system that must provide both analog TV and digital HDTV signals, such as in-house corporate presentation networks, distributed lecturing on university campuses and information/emergency networks in buildings and at factory sites.

Diana TV can have a positive impact upon most of the nation. By implementing this technology, TV broadcasters will be able to

- provide high-quality digital HDTV signals more quickly, cheaply and universally;
- provide superior digital HDTV images in fringe areas while eliminating digital-picture interruption problems;
- encourage more HDTV sets to be sold — reducing per-unit costs;
- allow each household to choose between the two qualities of TV imaging and make the changeover at a time of its choosing; and
- serve the public by freeing bandwidth for expanding the wireless-communications world of pagers, cell phones, business communications, bank transactions and many other services.

Principal developer George of Nickel of Hydrodynamic and X-ray Physics (P-22)

The national transition to digital high-definition television (HDTV) currently requires broadcasters to build a second transmission antenna for the HDTV signal. Diana TV (digital and analog) enables the transmission, within a single channel, of a fully digital signal that is compatible with both HDTV (top inset image) and analog TV (bottom inset image). An analog set will simply display "letterbox" lines to accommodate the HDTV image width. Diana TV's single-channel signal-transmission method eliminates the separate HDTV signal, thereby freeing electromagnetic bandwidth for other uses and eliminating the need for a second transmission antenna (ghosted here in the background). For HDTV viewers, Diana TV also prevents the sudden, total image loss that currently occurs in areas far from HDTV broadcast stations.

Preparing the Lab's R&D100 Award submissions is a team effort that involves many in Information Management (IM) Division and other Lab organizations. The following individuals provided text and graphics used in this issue:

Text provided by Brian Fishbine, Jennifer Graham, Todd Heinrichs, Vin Lopresti, Eileen Patterson, Judy Prono, Octavio Ramos, Amy Reeves and Linda Wood of Communication Arts and Services (IM-1)

Photos and graphics provided by Chris Brigman, Lauryl Eddlemon, Kelly Parker, Pete Sandord, Shirley Veenis of IM-1; and Bob Brewer, John Flower and Richard Robinson of Imaging Services (IM-4)

Industrial Business Development (IBD) Project Coordinator, Cindy Boone

Devaurs new D Division leader

Micheline Devaurs is the new leader for the Decision Applications (D) Division. Devaurs was named to the post in June. She has served as acting division leader since January.

Micheline Devaurs

Associate Director for Threat Reduction Don Cobb said, "Micheline has done a great job in running the division as acting leader, and I know her broad grasp of the division's science efforts will allow her to lead it effectively and with energy and vision."

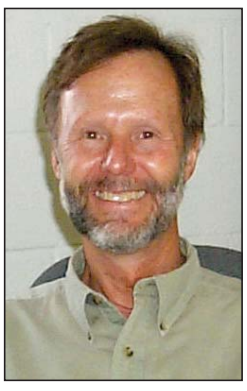
The Decision Applications Division develops state-of-the-art basic and applied simulation science, modeling, systems analysis, systems integration and engineering, simulations of complex systems, statistical science, risk assessment and nuclear systems design and analysis. The division includes eight groups and one program office totaling approximately 270 staff, including 180 technical staff members with about 30 additional contractors and a division budget of $74 million.

A graduate of Utah State University with a master's degree in watershed science and holding a bachelor's degree from the University of California, Berkeley, Devaurs has been a Los Alamos employee since 1992.

Said Devaurs, "I am excited about the present and future opportunities for the division, especially with the announcement of the president's new Department of Homeland Security. I envision growth in the nuclear weapons program support and think the division has major contributions to make in providing technical analyses to support decisions that impact the institution."

Buhl elected AAHP president

Health, Safety and Radiation Protection (HSR) Division's Chief Scientist **Thomas Buhl** has been elected president of the American Academy of Health Physics. His term as president begins in January 2004; he'll serve as president-elect in 2003 and as past president in 2005.



Thomas Buhl

According to its Web site, AAHP is an organization that advances the profession of health physics, encourages the highest standards of ethics and integrity in the practice of health physics, enhances communications among certified health physicists and provides a means for active CHPs to participate in the certification program. All certified health physicists are eligible for membership in AAHP.

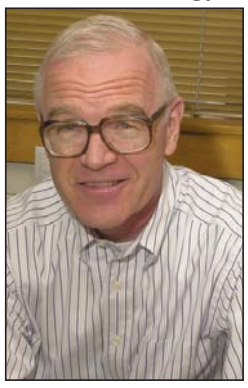
"I feel honored to have been elected to this position. The academy plays a very important role in maintaining high-professional standards in radiation protection, and I feel privileged to be able to contribute to the academy's program by serving in this office," Buhl said.

In his current position, Buhl manages and is an advocate for the division's science and technology development program. This includes radiation protection and industrial hygiene projects and providing technical review for many of the division's programs. Buhl also is the acting leader of the Radiological Engineering team in Radiation Protection Services (HSR-12).

Buhl came to the Laboratory in 1980. In 1983-1984, he served as the head of the State of New Mexico radiation protection program on a leave-of-absence from the Laboratory. He earned a bachelor of science degree in physics from the University of Notre Dame and master's and doctoral degrees, also in physics, from the University of Wisconsin-Madison. Buhl has been a certified health physicist since 1981.

Alvar recently named group leader of NIS-5

Ken Alvar is the new group leader for Safeguards Science and Technology (NIS-5). He has been a Laboratory employee since June 1992. Alvar was the deputy group leader in Health Physics Measurements (ESH-4) and NIS-5 before taking the group leader position.



Ken Alvar

Alvar won the Corinna Borden Keen Research Fellow Award from Brown University while attending graduate school. He held a postdoctoral position at Rutgers University and a medical physics postdoctoral position at the University of Washington. He also was a member of the University of Wisconsin Nuclear Engineering Department.

He received a bachelor's degree in physics from Carleton College in Minnesota and a doctorate in physics from Brown University, Rhode Island.

Kyrala received SPIE's Harold E. Edgerton Award

The International Society for Optical Engineering (SPIE) has presented **George Kyrala** of Plasma Physics (P-24) with its Harold E. Edgerton Award.

George Kyrala

The award is given every year for contributions to high-speed optical techniques, equipment and applications.

Kyrala was recognized for his work on high-speed visible and X-ray imaging of laser-plasma interactions and dynamic material response.

Born in Lebanon, Kyrala graduated from Yale University in 1974 with a doctorate in atomic physics. He said he came to Los Alamos in the late 70s because of the opportunity to conduct state-of-the-art research and because of the scientific atmosphere prevalent at the Lab.

He said he also loves the scientific freedom at the Laboratory and that he always has access to the various tools he needs to conduct his research. In addition, he said he enjoyed teaching science courses at the University of New Mexico, Los Alamos Branch.

Nominations sought for Los Alamos Laboratory Medal

The Laboratory is seeking nominations for the second annual Los Alamos National Laboratory Medal award, which recognizes exceptional efforts on behalf of the Laboratory by individuals or small groups who have made a profound impact on the institution. The deadline for submissions is Aug. 30.

Nomination criteria include contributions that changed the course of science, major enhancements of the Laboratory's ability to accomplish its mission and significant impacts on Laboratory sustainability or the establishment of a major direction for the Laboratory and/or nation. Individuals currently serving in public office are not eligible for consideration.

"A screening committee has been assembled to review all nomination packages. The nomination packages should clearly state what the individual's or group's contributions to the Laboratory are or were," said Allen Hartford, director of Science and Technology Base Programs (STB) Office.

Last year's medal recipients were former Laboratory Director Harold Agnew and Nobel Laureate Hans Bethe.

Agnew received the Los Alamos Medal for his leadership of the Laboratory during its formative years and its ascension to international stature. Bethe received the Los Alamos Medal for his role as a scientific visionary and leader, mentor and role model to the Laboratory from its inception. To nominate an individual for the Los Alamos Medal, send a nominating letter addressed to Hartford at Mail Stop M714. STB will oversee the process on behalf of the Director's Office.

For more information about the Los Alamos Medal award, see an all-employee memo at *http://int.lanl.gov/memos/alldist/LANL_ALL304.PDF* online.

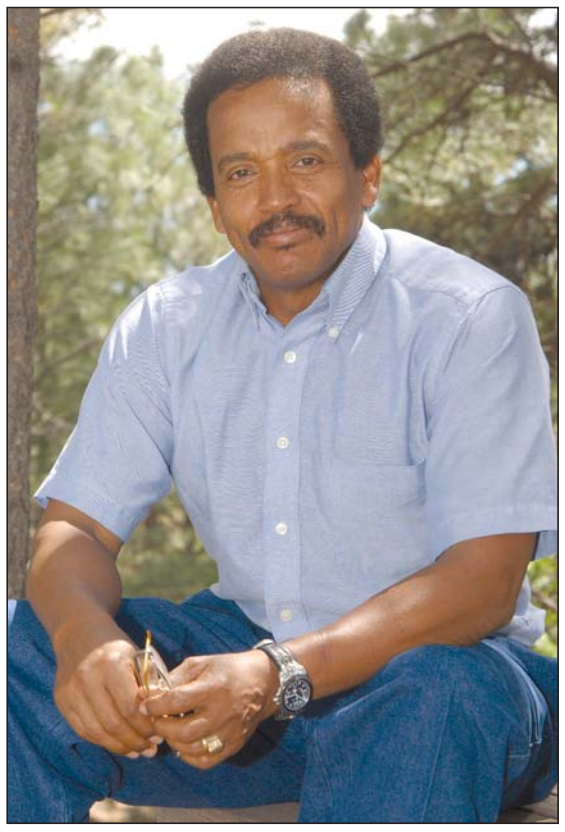
A long, yet fulfilling, journey

by James E. Rickman

Laboratory geologist Giday WoldeGabriel has been a key player in some of anthropology's most significant discoveries, providing geological and paleoenvironmental contexts for the remains of some of human kind's oldest ancestors. He serves as the lead geologist and co-principal investigator with University of California, Berkeley, professor Tim White on the Middle Awash Project, which in the last 10 years has discovered the remains of about half of the known hominid species — fossil ranging in age from 250,000 years old to 6-million-years old.

Somewhat ironically, the foundation for Giday's scientific background — and its subsequent insight into the evolution of the Human Species — can be found in the Lutheran Church.

As a boy growing up in Mai-Misham a village in the Tigray region of northern Ethiopia, Giday saw his life change after missionaries with the American Lutheran Church set up a school in the middle 1950s. Missionaries established the school for a dual purpose: in part to educate the villagers, and in part to teach them about Protestant Christianity as opposed to the traditional Coptic Christian religion that has been practiced in the area for several centuries.



Giday WoldeGabriel

Missionaries selected the village — whose name roughly translates to "anointed waters" — to honor a prominent member of the community who was responsible for the translation of the Bible to Tigrigna, the language of the region, and because of the traditional lore that said visiting saints had blessed the village spring centuries earlier.

Unlike the parents of many other youngsters in his village, Giday's parents elected to send him to school.

"I started my education under a huge ficus tree," Giday said. "We used piled flagstone as seats. The teachers occasionally used local white rocks as chalk."

Giday was a good student who excelled in his studies. But being a student had its drawbacks in the little village.

The local Coptic priests were so vehemently opposed to the teachings of the new Christian religion that "there were these rumors in the village that the people who went to the school ate cats," he said. "So when you were walking to school, people would 'meow' at you."

What's more, another village rumor said that if school children got water from the community spring, they corrupted it; local Coptic priests would be dispatched to bless the spring on a regular basis. At other times, fellow villagers would refuse to give fire to families that sent their children to the school if their fire went out. Matches were unknown in the village at that time.

And although Giday was attending school, there still were plenty of chores to be done at home, as his family relied on subsistence farming for survival. Giday's day's worth of chores were squeezed in between school's end at 3 p.m. until twilight dimmed the red rock cliffs nearby.

Throughout his elementary education (grades 1 to 8), Giday's test scores were so good that he was offered an opportunity to go to a Lutheran boarding school in central Ethiopia about an hour's drive south of Addis Ababa, the capital city. A scholarship and steady summer work at the American Lutheran Church Head Office in Addis Ababa throughout his four years of high school allowed Giday to stay in school to earn his high school diploma and to successfully pass his university entrance examination with distinction.

Staying in school also meant leaving the family farm — an agonizing choice, especially because his father had died and his mother and siblings would have to go it alone. But the promise of a better future that ultimately could help out the family in the long run won out.

Giday graduated from high school at the top of his class and began university study in geology. Then, in 1974, the overthrow of the government resulted in the closing of Addis Ababa University.

"The new regime sent all of us students out to the country to undertake a literacy campaign and distribute land to peasants," he said. "Of course, since university students were the main opponents of the new regime, this action was really to minimize opposition to the new military government."

Opposition also was squashed in other ways.

"The 'Red Terror' was proclaimed by the government in retaliation to opposition," Giday remembered. At night, activists opposed to the military rule would disappear. By daybreak their bloodied corpses would appear in local parks or on the streets, a grim and potent reminder of the price of dissent.

When the university reopened in 1976, Giday was one of only two of the 18 original geology students to return. Death squads claimed the lives of some while others had opted either to join an armed struggle against the military government or to leave the country for good.

In 1977, war rocked the land. Somalia invaded Ethiopia. Times were tense. Students had to participate in compulsory communist indoctrination.

Despite the terrible situation, Giday earned his bachelor's degree in 1978. He was hired on at the university as a teaching assistant and started his master's program, which was taught by Italian and some Russian professors — a consequence of the communist-backed rule of Ethiopia at the time.

It was during this course of study that Giday met preeminent UC Berkeley anthropologist Tim White, Donald Johanson of the Institute of Human Origins at Arizona State University and many of the scientists on the team who discovered the 3.2-million-year-old human ancestor known as "Lucy." White and the late Professor Desmond Clark were conducting digs in the Afar Rift system in 1980, and Giday, who was a lecturer at Addis Ababa University, provided geological information to White during early expeditions. White and his team from the Middle Awash Project, and professors James Aronson and Robert Walter, the geologists who determined the age of Lucy, asked Giday if he would be interested in coming to the United States instead of going to Italy to pursue a doctoral degree.

Giday began a doctoral program in January of 1983 with Professor James Aronson at Case Western Reserve University in Cleveland. He became familiar with New Mexico during a trip to see the famous Valles Caldera at the end of his first semester. But rural America can be as dangerous as a country wracked by war.

During a 1983 trip to see well-known United States geological attractions in the American West, Giday was camping at a national forest not far from the Salt River Canyon near Show Low, Ariz. Thugs crept into the camp at night and savagely beat him with clubs, bashing his head and leaving him for dead locked in the trunk of his friend's car. A fellow student traveling with Giday had hidden in the woods during the fray and later crept back to camp to free Giday. Severely injured, he survived, though doctors at first believed he would not regain sight in one eye.

His visit to the Valles Caldera fueled a desire to return to Los Alamos as a Director's Postdoctoral Fellow. He later collaborated with White and would take part in discoveries of hominid species that drew closer and closer to the sought-after "missing link" — the yet-undiscovered creature that lived at the cusp of the evolutionary division between man and chimpanzee. He is soft-spoken and modest about his accomplishments in the application of geological expertise in the field of anthropology.

In 1992, while in Ethiopia on an expedition with White and colleagues, Giday returned to his home village for the first time in 20 years.

"Most of the huge trees are gone now, and the springs are dry," he says sadly. "People must walk for hours to get water."

Moved by the plight of his peasant childhood friends, relatives and other members of the village community, Giday talks about his ambition to find a more convenient source of water and a clinic for his village and the surrounding communities.

He also hopes to rekindle educational opportunities in the village. The old Lutheran school that provided the foundation of his education was destroyed during the civil war and was in terrible repair in 1992. Today, thanks to resources provided by Giday and some of his colleagues, the school again is partially functioning, reaching grades 1 to 4. The huge tree he sat under as an eager young student may be gone, but Giday is certain that the simple joy of learning still can be found in the hearts of the village school children.

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