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LOS ALAMOS NATIONAL LABORATORY
WHERE SCIENCE MAKES A DIFFERENCE

DATELINE
LOS ALAMOS

U.S. DEPARTMENT OF ENERGY
UNIVERSITY OF CALIFORNIA

# BLUEBIRDS OF ECO-HAPPINESS

## LAB TRACKING BIRD HEALTH AS INDICATOR OF ENVIRONMENTAL HEALTH

The bluebird carries the sky on his back, says Henry David Thoreau, but what it carries in its body is what concerns Laboratory researchers.

Laboratory biologists are studying the health of bluebird adults and nestlings to track environmental pollution at Los Alamos. Laboratory biologists placed more than 400 nesting boxes on Laboratory property or near old research facilities to study how contaminants may be affecting the wildlife.

➔ A brood of nestlings. Researchers are studying Western Bluebirds to track environmental pollution.

Western Bluebirds are easy to study, according to wildlife ecologist Orrin Myers, because they nest in cavities. The nest boxes are hinged for easy access and easy to reach, involving no dangerous tree climbing or lengthy hikes. The study is nonlethal, no killing of the birds is necessary, says Myers.

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Western Bluebirds can be found in the Southwest and all along the West Coast of the United States. This species is generally residential but moves to lower elevations for the winter months. Western Bluebirds breed in open habitats with scattered trees and on the edges of open coniferous and deciduous forests, such as those found in Los Alamos.

Western Bluebirds feast on a variety of invertebrates, including caterpillars, grasshoppers, beetles, ants and snails and may ingest as much as five percent of soil particles as a digestion aid for their stomachs, similar to a domestic chicken or turkey. In winter, their diet includes wild berries.

The breeding biology can begin from early April to early May. Females build their nests in the natural cavities of snags or rotting trees, in woodpecker holes or in nest boxes. The nest is a loose collection of grasses, weed stems and, sometimes, hair and feathers.

Myer's colleague Jeanne Fair opens the nest boxes and takes blood samples from the young, ranging from three to six birds per nest. The ecologists study the blood for parasites, antibodies and the amount of packed red blood cell volume in the blood. After their study is completed in a year or two, the researchers will study how contamination may weaken the immune system and how stress factors may influence populations.

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# DATELINE: LOS ALAMOS

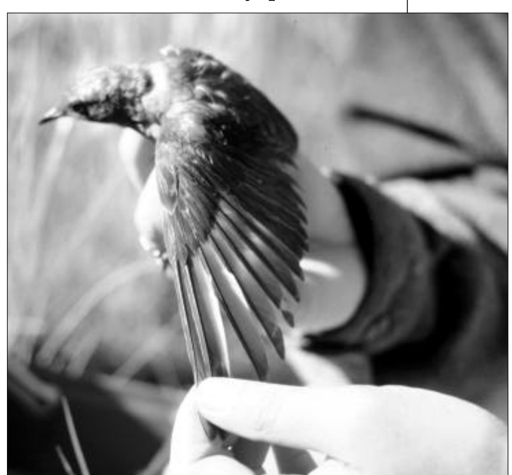
A researcher uses a caliper to measure wing web thickness to estimate immune response.

The wildlife specialists also study how much food the birds consume, how they forage and how many contaminants are in the nesting areas. Studies include three factors: nesting success, growth rates and various physiological and structural responses.

The researchers are developing a database to investigate an exposure response. After they accumulate the data, the wildlife biologists will develop a graph. With fledgling success on one axis and the amount of contaminants on the other, there is a point where contaminants do affect the health of the young and success of the nest starts to drop.

If there are dead birds within a nest, the researchers may perform a necropsy — an animal-equivalent autopsy — to determine the cause of death.

An adult Western Bluebird gets a wing check.



Because this is the first year of the study, Myers and Fair have not accumulated the data yet, but they are hopeful that the bluebirds can be indicative of the overall health of Laboratory cleanup sites.

This initial data will be used by Myers and Fair to support Los Alamos environmental project cleanup decisions.

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DATELINE: LOS ALAMOS

# A DIFFERENT NUCLEAR MISSION

## ARCHIVING PROJECT PIECES TOGETHER DATA ON AGING WEAPONS, TECHNOLOGIES

Old age makes a car a classic. But finding an original owner's manual can command a hefty price. Similarly, finding the original plans, designs or documentation for a 20-year-old nuclear weapon can be a daunting task.

Scientists responsible for ensuring the current nuclear stockpile works the way the weapons were originally intended have found that the people who originally designed, built and tested the bombs are retiring.

Further complicated by the nuclear test ban, the new generation of weaponeers must revalidate old test data, review old records and plans, and ensure that the aging process hasn't significantly changed any weapons components. Researchers must use computer codes with the old data without the benefit of further validation that nuclear testing brings.

Between 1986 and 1992, Charlie Miller's life was a blur. Miller is a Los Alamos radiochemist who analyzed nuclear test core samples and isotopic signatures of weapons tests. He currently is leader of the Nuclear Weapons Archiving Project, sponsored by the associate laboratory director for nuclear weapons.

"On any given day, the radiochemistry team might be analyzing data from the last test and working with the weapons engineers and designers on the next test," said Miller. "For the designers, engineers and diagnosticians across the Laboratory, the pace of life was frantic in support of the ongoing test program."

But when weapons testing ended, so did data analysis and documentation.

There is no formal database or central location for weapons data, engineering data sets or non-nuclear explosive test records. "For the most part," says Miller, "records are kept within the offices that were responsible for a part of the test. In some cases, the only formal documentation we might have is a set of viewgraphs that the scientists used to brief their peers or government officials. Final shot reports were more of an oddity than the norm."

Between the spotty documentation and the retirement of the older weaponeers, researchers feared they were in danger of losing valuable expertise. How do you certify a nuclear weapon in the absence of nuclear testing? How did you conduct a nuclear test? How did you perform diagnostic experiments? How can you continue to use information from past testing?

Proposed by weapons designer Dawn Flicker and many of her colleagues throughout the Laboratory, the archiving project aims to preserve data on past experience in the nuclear weapons program to make it easier to validate expectations of future performance of the stockpile.

Old data isn't necessarily a bad thing.

"We have better diagnostic tools now. When we input old numbers or review old records many times we can get more out of the data than we did originally," Miller said.

Part of the problem with the old data is that the equipment that created it no longer exists. Most everyone can remember the state of computer technology 15 or 20 years ago. Now those computers are out of date, and old computer disks may not be read by modern computers. Old technologies that require even larger hardware, such as magnetic tapes and punch cards, may not be read at all.

Other old data-gathering techniques may have created information that was too cumbersome to use in its original form. New tools may be able to use great amounts of data with benefit.

Historically, a common method of inspecting weapons parts created strip charts. The manufacturer would measure the part while different colored pens recorded markings on a roll of paper, similar to the way a seismograph records bumps and jolts during an earthquake.

These marks recorded whether or not the component was within the design specifications. When the paper was removed from the drum, it came off in a long strip. A few readings were made from the strip chart to characterize the shape of the part.

The challenge has been to computerize the data and reanalyze it. Using new tools in DX Division, the strip charts can be scanned into modern computers and become rich digital data.

The beauty of digitizing this data lies in new computer programs that can quickly analyze the lines on the chart. The entire record can be used, not just the points that were selected originally. This brings historic data to the same level of quality and quantity that is presently available with digital inspection machines.

Another historic way of storing data was to photograph sections of weapons drawings or plans that were up to 4-feet by 20-feet long. The Department of Energy's standard storage procedure for these drawings was to take a photograph of the drawing and mount a single frame of transparency film in an IBM punch card. Los Alamos has tens of millions of these aperture cards in storage.

Working with others at the Laboratory, including the team from the recently signed LANL-Xerox CRADA (see Page 12 of this issue), the archiving project is working toward making this information more readily available for use.

Another emphasis is creating easy desktop access to information for designers and engineers. In ESA and X divisions, online vaults have been created. Researchers can access the secure local area networks and use keywords to search for documents. Associated electronic archives provide nuclear and non-nuclear test data, with more information flowing in on a daily basis.

The scattering and smattering of old records is not unique to Los Alamos. Other sites in the DOE's nuclear weapons complex have similar archiving projects. Cooperatively, they are working toward appropriate information access across the entire complex

At any time more than 100 people are recovering records and reviewing the data at Los Alamos. Miller says the project is like a mystery novel. "We try to follow all the clues and put them into a coherent picture of what happened in the past and what might happen in the future."

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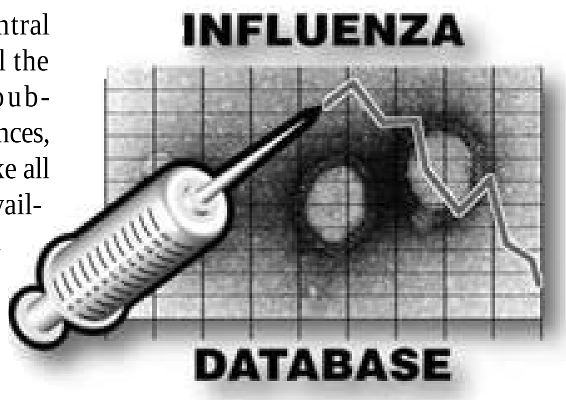
DATELINE: LOS ALAMOS

# NEW DATABASE TRACKS FLU BUGS

## CENTRAL COLLECTION POINT WILL AID IN THE DEVELOPMENT OF VACCINES

Medical researchers can now tap into the world's most comprehensive collection of genetic information about the influenza virus. Los Alamos' new Influenza Sequence Database will help scientists understand how the flu bug mutates and will aid in the development of vaccines.




"Unless there is a central collection point for all the published and unpublished influenza sequences, there is no way to make all the necessary data available to the research community," said database manager Catherine Macken. "With an international repository, we can conduct cohesive analysis rather than patchwork research around the world."

A sequence is the blueprint of the genetic code of the virus. The database contains viral sequence data, results from immunological studies and information on viral protein structures. Sequences are collected continually in many countries, but much of this valuable information is not published.

Researchers now can contribute to and use the flu sequence database, allowing them to compare older viral species and strains with those currently in circulation.

Los Alamos is working with the University of California and the Centers for Disease Control and Prevention to expand the database. Currently the Los Alamos database holds all the influenza sequences published in GenBank, a database managed by the National Institutes of Health that contains sequences published in scientific journals.

DATELINE: LOS ALAMOS

After verification and annotation, unpublished sequences collected around the world will be added.

The database is a model for the type of tool that also would be useful in tracking the spread of more deadly diseases, whether they are naturally occurring or the result of intentional biological releases.

More than just a library of gene fragments, the new database is annotated to include essential background information about the sequences. For example, researchers need to know how a virus was grown before it was sequenced, because growth methods introduce mutations that may affect analysis.

The database will allow in-depth study of the ever-changing structure of the flu virus. To analyze telltale patterns in the sequences, Macken and her colleagues are developing software tools to visually and statistically assess the variation in sequences.

Armed with information about what forms of the flu are appearing or moving around the world, researchers will have a better chance of identifying new strains and advising health officials on where to commit limited resources. Researchers can study a newly reported virus, and, if it appears to be very different, that knowledge will help the World Health Organization choose the annual vaccine.

Los Alamos is building on expertise and accompanying analytical tools from its NIH-funded HIV Sequence Database and HIV Molecular Immunology Database.

Access to Los Alamos' Influenza Sequence Database is available on the World Wide Web at http://www-flu.lanl.gov.

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DATELINE: LOS ALAMOS

# SIZE DOES MATTER

## SHOCK WAVE SIMULATIONS SHOW HOW ATOMS SLIP

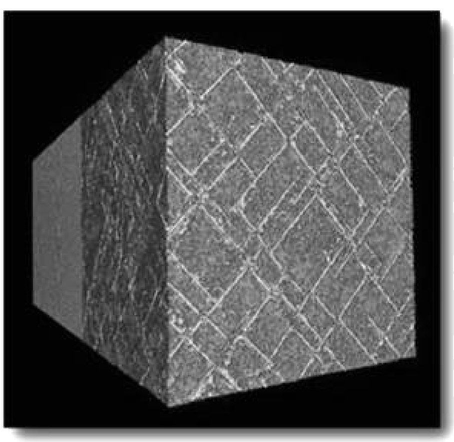
A computer model is giving researchers a new way to explore and understand material properties as it reveals what happens, atom by atom, when a shock wave moves through a metal.

In a paper published in a recent issue of the journal *Science*, researchers at Los Alamos describe a 10-million-atom, three-dimensional simulation that shows how a shock wave moving through an idealized crystal leaves behind a mosaic of intersecting faults. The simulation provides valuable insights for materials design and engineering codes.

"We are at the stage now that our molecular dynamics simulations are large enough that we can provide serious guidance to experimentalists," said physicist Brad Holian. "We are on the threshold of bringing experiment and engineering together to provide insight into the fundamental physics of materials."

Holian and his colleague Peter Lomdahl slam an idealized cubic structure against what they call a "momentum mirror" that sends a shock wave along the internal lattice points of the crystal. Atoms respond according to Newton's equations of motion.

The model shows how the atoms slip at an angle to the face of the crystal along preferred directions. As the stress is relieved, the slight slippage leaves behind planes that appear to be one notch out of arrangement. Slight fluctuations lead the shock along four planes, leaving cubic fault lines.



➔ An image of a shock-wave simulation. As the shock wave moves through an idealized crystal it leaves behind a mosaic of intersecting faults.

Molecular dynamics studies, especially the effects of shock waves, are fundamental to improving the physics and engineering codes necessary for the nation's nuclear weapons stockpile stewardship program.

While previous calculations modeled one tiny corner of a cube and hinted at a single slip fault, the new model represents a large enough cross-sectional area to see definitively the mosaic pattern of slippage.

Advances in computing power and the molecular dynamics code developed at Los Alamos recently have made large, 3-D simulations possible. Even with available massively parallel computers, the current model represents a wave passing through a cube just under a millionth of a meter across in less than a nanosecond.

Nevertheless, the calculations bring physicists one step closer to marrying computation and engineering.

"We've looked at perfect crystals and shown they will yield in this interesting manner when the shock strength is above a threshold value," Holian said. "We've shown pre-existing defects can trigger and affect the slippage. Now we need to run models of samples made with grain boundaries and different orientations that will respond at various speeds, directions and plasticity changes."

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# PULSED-POWER MACHINE GETS GREEN LIGHT

## ATLAS WILL SIMULATE PRESSURES INSIDE NUCLEAR WEAPONS FOR STOCKPILE STEWARDSHIP PROGRAM

The Department of Energy recently authorized Los Alamos to begin construction of Atlas, a 30-million-ampere pulsed-power machine that will be used for the nation's nuclear weapons stewardship program as well as basic scientific research.

As part of the Laboratory's Science-based Stockpile Stewardship Program, Atlas will use powerful magnetic fields to simulate extreme pressures inside nuclear weapons, allowing researchers to study aging effects on nuclear weapons and the physics of what goes on inside them.

Atlas will use multiple banks of capacitors to deliver an intense burst of electrical current to a small target. The energy will cause the target to implode, compressing samples to high pressures.

Atlas also will be used for basic research, materials science, ultra-high magnetic field experiments, plasma physics and geophysics. The total project cost is $43 million.

The Atlas team consists of 40 people from Los Alamos' Engineering Sciences and Applications, Dynamic Experimentation, Business Operations, Facility and Engineering and Physics divisions, plus staff from Scientific Applications International Corp. and Allied Signal Corp.

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## BRIEFLY ...

LABORATORY OFFICIALS AND XEROX CORP. HAVE SIGNED A COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT TO DEVELOP A KNOWLEDGE MANAGEMENT SYSTEM TO MEET THE NEEDS OF LOS ALAMOS' CHANGING NATIONAL SECURITY MISSION. Los Alamos has taken over from the Rocky Flats facility near Denver and the Mound plant in Ohio records and responsibilities related to nuclear weapons surveillance and production, adding literally millions of documents to Los Alamos' stores. In addition, millions of weapons-related documents already exist at Los Alamos. Currently those documents reside at six different locations at the Laboratory. The document management system that will be developed under the agreement with Xerox will contain hardware, such as scanners and repositories, but the focus of the development project will be the software for knowledge capture, organization, access and reuse. (See related article on Page 4 of this issue.)



## IN THIS ISSUE:



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