

SCIENCE

ORNL's atoms make top journal's cover

ORNL researchers **Steve Pennycook** and **Matt Chisholm** led a group of STEM colleagues in capturing the first images distinguishing individual light atoms. Their research is heralded as the cover story of the March 25 issue of *Nature*.

The ORNL images were obtained with an aberration-corrected, Z-contrast scanning transmission electron microscope (STEM). Individual atoms of carbon, boron, nitrogen and oxygen—all with low atomic numbers (Z-values) of five, six, seven and eight, respectively—were resolved on a single-layer boron nitride sample.

“This research marks the first instance in which every atom in a significant part of a non-periodic material has been imaged and chemically identified,” says Materials Science and Technology researcher Steve Pennycook.

He and colleague Matt Chisholm were joined by a team that includes Sokrates Pantelides, Mark Oxley and Timothy Pennycook of Vanderbilt University and ORNL; Valeria Nicolosi at United Kingdom's Oxford University; and a team from Nion Company, which designed and built the microscope.

The new high-resolution imaging technique enables materials researchers to analyze, atom by atom, the molecular structure of experimental materials and discern structural defects in those materials. Defects introduced into a material—for example, the placement of an impurity atom or molecule in the material's structure—are often responsible for the material's properties.

The group analyzed a monolayer hexagonal boron nitride sample prepared

at Oxford University and was able to find and identify three types of atomic substitutions—carbon atoms substituting for boron, carbon substituting for nitrogen and oxygen substituting for nitrogen.

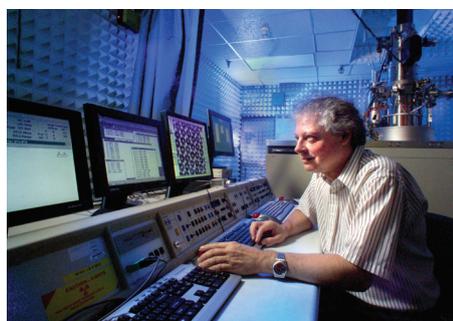
The annular dark field analysis experiments were performed on a 100-kilovolt Nion UltraSTEM microscope optimized for low-voltage operation at 60 kilovolts.

Aberration correction, in which distortions and artifacts caused by lens imperfections and environmental effects are computationally filtered and corrected, has been made possible by advances in computing. Aided by the technology, ORNL's Electron Microscopy group set a resolution record in 2004 with the Laboratory's 300-kilovolt STEM.

The recent advance comes at a much lower voltage, for a reason.

“Operating at 60 kilovolts allows us to avoid atom-displacement damage to the sample, which is encountered with low Z-value atoms above about 80 kilovolts,” Pennycook says. “You could not perform this experiment with a 300-kilovolt STEM.”

Armed with the high-resolution images, materials, chemical and nanoscience researchers and theorists can design more accurate computational simulations to predict the behavior of advanced materials, which are key to meeting research challenges that include energy storage and energy efficient technologies.—*Bill Cabage* 🌿



Pennycook adjusts STEM controls.



“This research marks the first instance in which every atom in a significant part of a non-periodic material has been imaged and chemically identified.”

Table of Contents

ORNL's atoms make top journal's cover	1
Profile: Alex Zucker	2
Irradiated bugs	3
Benefits Q&A	4
Treasures from the archives . . .	6
Thom's thoughts	7
Secretary of Energy Chu visits the Lab	8

Alex Zucker; steering Lab on energy course



In June 2003 Alex Zucker presents a plaque to then-ORNL Director Bill Madia in appreciation of UT-Battelle's support of the Oak Ridge Civic Music Association. The next year, Alex hosted Leonard Slatkin during the National Symphony Orchestra's American Residency concert in Oak Ridge.

“It is one of the functions of a scientific laboratory to discover the unexpected, to develop new ideas, and to explore in an unfettered way areas that may not show much promise to the casual observer.”

Reporter is published for retirees of ORNL, which is managed by UT-Battelle for the U.S. Department of Energy.

Deborah Barnes
Editor
 (865)576-0470
 barnesds@ornl.gov

Bill Cabage
Contributing Editor
 (865)574-4399
 cabagewh@ornl.gov

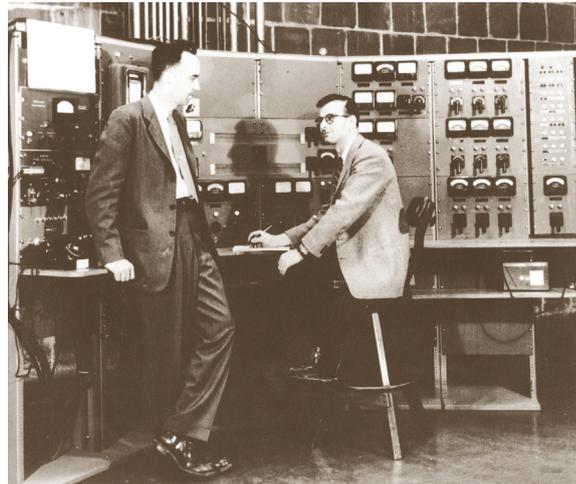
The Atomic Energy Commission was developing the hydrogen bomb in 1950 when Alex Zucker arrived in Oak Ridge as a newly hired physicist, fresh from Yale. The overriding question was, “Will the atmosphere burn when the bomb detonates?”

Zucker joined a team that designed a cyclotron to answer that question. “We built the 63-Inch Cyclotron specially designed to accelerate triply charged nitrogen ions to 25 MeV (million electron volts),” Alex said. “When these collided with normal nitrogen atoms, we measured the cross section of the reaction. The experiments showed there was no danger of burning up the atmosphere with the hydrogen bomb.”

Disaster thus averted, Alex became associate director of the electronuclear division, which moved to the X-10 site and built a new sector-focused cyclotron—the Oak Ridge Isochronous Cyclotron, a variable energy, multi-particle accelerator completed in 1962.

In 1972 after two years on a federal government advisory board, Alex returned to ORNL as associate director for physical sciences. He strongly emphasized materials research, and one of his first responsibilities was to oversee the construction and ultimate operation of the Holifield Heavy Ion Beam Research Facility.

Alex then turned his focus to the High Temperature Materials Laboratory.



Robert S. Livingston and Alex Zucker confer at a bank of cyclotron controls during the early 1950s. Always the scientist collaborator, Alex, along with Michelle Buchanan, was instrumental in ORNL's being recognized as a National Historic Chemical Landmark in 2008.

“I had to convince the folks in Washington that materials research tied in with high temperatures was the way to go,” Alex said. “The opening of the HTML led to many research opportunities at the Lab that still exist today.”

Zucker also lent an administrative hand to acquiring funding for the Laboratory's proposed new research reactor, the Advanced Neutron Source, and supported the renaissance of computing power at ORNL.

After Herman Postma left the ORNL director post, Alex served more than a year as acting Laboratory director.

He later served as associate director for nuclear technologies before becoming a special advisor to Clyde Hopkins, who was then president of Martin Marietta Energy Systems.

“Materials define the limits of technology.”

After retiring from ORNL in 1993, Alex became a professor of physics at the University of Tennessee. UT physics students elected him Physics Teacher of the Year in 2007.

“I was very honored to have earned that award,” Alex said. “The fact it came from the students was especially gratifying and something I will always cherish.”

—Fred Strohl 🌿

Irradiated bugs

Microorganisms in toxic groundwater fine-tuned to survive

Microorganisms can indeed live in extreme environments, but the ones that do are highly adapted to survive and little else, according to a collaboration that includes ORNL, the Joint Genome Institute (JGI) and the University of Oklahoma.

A metagenomic study of a “stressed” microbial community in groundwater near a former waste disposal pond site on DOE’s Oak Ridge Reservation revealed microbes with an overabundance of genes involved in DNA recombination and repair and other defense mechanisms for dealing with contaminants and other environmental stresses.

The studies, says ORNL researcher David Watson, are ultimately aimed at developing biologically based methods for reducing the level of the contaminants in the groundwater, which at the ORR site includes nitrates, solvents and heavy metals, including uranium.

“We are looking to better understand the evolution of microbes in the groundwater plume,” David says. “The microbes that can break down nitrate into nitrogen can have a long-term benefit toward attenuating the plume.”

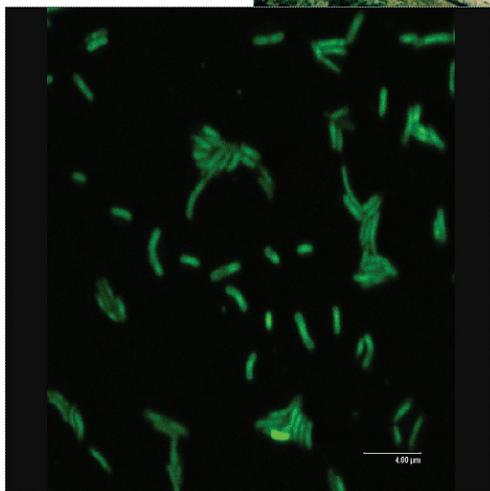
Watson added that researchers particularly want to better understand the genetic makeup of microbes that can metabolize oxidized forms of uranium into a form that is only slightly soluble and thus easier to precipitate and remove from the groundwater environment.

Watson was joined in the study by the University of Oklahoma’s Jizhong Zhou and Christopher Hemme; Joint Genome Institute Director Eddy Rubin; and a team that included researchers from ORNL’s Environmental Sciences Division, the University of Oklahoma’s Institute for Environmental Genomics, Montana State University, Michigan State University and Lawrence Berkeley National Laboratory.

They found that the naturally occurring populations of microbes in the polluted groundwater—which consisted of only a few cell types—had “very simple” genetic structures tuned primarily to overcoming the stresses presented by the toxic soup, which has a highly acidic pH level of 3.5.

The accumulation of genes involved in resistance and responses to stress appears to be a basic survival strategy that has left the microbes with a marked loss in metabolic diversity.

The waste ponds, which are now part of the Oak Ridge Environmental Remediation Sciences Program Integrated Field Research Center, have been out of use for decades and were capped in 1983.—*Bill Cabage* 🌱



Researchers want to know more about the genetic makeup of “stressed” microbes (left) that live in groundwater contaminated by old waste ponds (above).

Club ORNL events

Here’s a list of events Club ORNL has planned over the next few months. Get the details and latest news online via <https://info.ornl.gov/sites/clubornl>. From this site, ORNL retirees can request an XCAMS account, which will allow you to participate in these events. Lara James, the retiree point of contact, can be reached at 576-3753 or jamesla@ornl.gov.

- May 17** Chef’s Wine and Dinner
- June 6** “Joseph and the Amazing TC Dreamcoat” Play
- June 10** Vintage Car Show
- June 12** Smokies Baseball vs. West Tennessee
- June 14** Spring Golf Tournament
- July 17** White Water Rafting
- July 24** IJAMS Nature Center
- August 14-15** Fall Creek Falls Overnight

Separation of administration of Y-12 and ORNL benefits

The joint administration of the benefits program is the last remaining connection between ORNL and Y-12, and dates back to the 1990s when both facilities were managed by the same contractor. Today Y-12 and ORNL have different missions. In the future both companies will need greater flexibility to meet the different needs of their employees and retirees. Because we cannot do this under the current joint administration arrangement, ORNL and Y-12 will separate the administration of health and welfare benefits along with the pension and savings plans in late summer of 2010.

Your benefits are not changing and no action is required from you. Below are some frequently asked questions about the separation of the benefits administration.

Q Why are we separating the administration of the benefit plans for employees and retirees of Y-12 and ORNL?

A The joint administration of the benefits program is the last remaining connection between ORNL and Y-12, dating back to when both facilities were managed by the same contractor. Today Y-12 and ORNL have different missions, and in the future both companies will need maximum flexibility to meet the different needs of their employees and retirees.

Q Will retiree pension benefits be reduced as a result of the separation?

A No.

Q Will the health and welfare benefit plans change?

A For both ORNL and Y-12 employees and retirees, the plans you are currently enrolled in and your level of coverage will stay the same.

Q Will the administration of the current health and welfare plans change?

A Yes. Y-12 will continue to administer the benefit plans for Y-12 employees and retirees. ORNL Benefits will assume responsibility for administering all of the benefit plans for ORNL employees and retirees.

ORNL will contract with an Administrator to perform some of the day-to-day administrative activities that Y-12 currently provides for ORNL employees and retirees. After the separation ORNL staff and retirees will contact a new ORNL Benefits Service Center. As the transition date draws nearer, we will provide information, including phone numbers, for the new center.

Q When will the administration of the plans actually separate?

A We expect that the change will take place later this summer for all health and welfare benefits and for the pension and savings plans. We will provide updates in the weeks ahead.

Q How will the change in administration be handled?

A The transition activities will be a joint

effort between the Y-12 and ORNL transition teams. Both companies are working closely together to make the change as simple as possible.

Q What should I expect during the transition period?

A The transition has been planned to ensure no interruption of service.

We ask for your patience if you happen to encounter a delay in receiving an answer to a question or other service difficulty. We will assist you with any issues as promptly as possible.

Q Who should I contact for personal assistance after the transition?

A The only change ORNL employees and retirees should experience is that they will have separate contacts for assistance. Instead of the Y-12 Benefits Service Center, ORNL employees and retirees will contact the ORNL Benefits Service Center or the ORNL Benefits office. We will provide all the contact information when it becomes available.

Y-12 employees and retirees will continue to contact the Benefits Service Center at (865) 574-1500 or 1-877-861-2255 for assistance.

Q After the transition, who will I contact if I have questions or concerns about my benefits?

A As always, all employees and retirees should contact the appropriate provider such as CIGNA, United HealthCare, Medco, MetLife, etc., to resolve questions about specific claim-related or payment issues. ORNL employees can find contact information on the ORNL Benefits website and Y-12 employees may find this information by accessing the Benefits Information website.

ORNL employees and retirees will contact the ORNL Benefits Service Center, or the ORNL Benefits staff at (865) 574-7474 instead of calling the Y-12 Benefits Service Center about benefit coverage, enrollment questions or concerns.

Y-12 employees and retirees will continue to call the Y-12 Benefits Service Center at (865) 574-1500 or 1-877-861-2255 about benefit coverage, enrollment questions or concerns.

Q Where will the benefits offices be located after the change in administration?

A For ORNL employees and retirees, the main office will likely relocate to 1060 Commerce Park (across the street from Tech 2020). There will also be a benefits office located on the main ORNL campus to serve employees. More information will be communicated once these locations have been finalized.

For Y-12 employees and retirees, the Y-12 Benefit Service Center will remain in the New Hope Center on Scarboro Road.

Q How can I keep up with what is happening during the transition?

A ORNL employees and retirees will receive periodic progress updates and notices of important information in the ORNL Reporter, ORNL Today, the ORNL Benefits website, (<http://benefits.ornl.gov/newsupdates/>) and home mailings.

Y-12 employees and retirees will see progress updates and important information primarily in YSource, The Y-12 Times, and the Benefits Information websites. The employee website is <https://home1.y12.doe.gov/benefits/>, The website available to retirees is <http://www.y12.doe.gov/jobs/benefits/notices.php>.

Q Who can I contact if I have questions or concerns about the administration change?

A So that questions and the responses can be documented and shared with all staff, ORNL employees and retirees can email questions or concerns to ORNL Benefits at benefits@ornl.gov.

Y-12 employees and retirees may use Benefits@Y12.doe.gov for questions or concerns.

Q Will there be a layoff in staff at Y-12 as a result of the separation?

A Some employees currently supporting benefits accounting, administration and management may be transferred to ORNL or reassigned to other duties.

HEALTH AND WELFARE BENEFITS

Q Will I have to do anything to my health and welfare benefits plan as a result of the separation?

A We do not anticipate that employees and retirees of Y-12 and ORNL will need to do anything as a result of the separation.

Annual open enrollment will be held as we do now to enable employees and pre-65 retirees to change benefit elections.

Q Will my health and welfare benefits change?

A For both ORNL and Y-12 employees and retirees, the plans you are currently enrolled in and your level of coverage will stay the same.

Q Will the separation of administration affect the amount of my premiums or how I pay them?

A We do not anticipate any significant cost impact as a result of the separation of administration. Premiums will continue to be based on separate claims experience for participants at ORNL and Y-12.

Premiums that are currently deducted from payroll or pension payments will continue to be deducted as they are now. ORNL participants who pay premiums from invoices will make payment to the Administrator.

Q Will I or anyone in my family have to change doctors as a result of the separation?

A No.

Q Do I need to do anything to continue my current prescriptions, medical services, or other benefits for me or my family?

A No. Our providers are aware of the transition, and their systems are set up to serve both ORNL and Y-12 participants with no interruption in service.

ORNL employees and retirees will be issued new medical, prescription drug and Delta Dental ID cards when the separation is complete. MetLife does not issue ID cards.

Q After the change in administration, can I start over on any benefit limits I have reached such as orthodontics or physical therapy?

A No. The limits for benefits you currently are receiving will continue as if the administration change did not occur.

Q How will the administration change affect us if I work at Y-12 and my spouse works at ORNL (or vice versa), and one of us carries our insurance?

A If the spouse carrying your insurance works at Y-12, you will continue to contact the Y-12 Benefits Service Center for assistance. If the spouse carrying your insurance works at ORNL, you will begin contacting the ORNL Benefits Service Center after the administration change. As always, you will be able to change which spouse carries your insurance during the annual open enrollment.

Retirement Plans

Q How do I know my retirement benefits (pension and savings plans) are secure?

A Both companies have secure pension plans with which to pay benefits and the administration change will have no impact on the security of those plans. The administration of the retirement plans will continue with the same level of diligence and fiduciary oversight that currently exists.

Q Will either of the pension plans be changed as a result of the separation from the other company?

A No. The change in administration will not affect the current pension plan design.

Q Will the administration change affect management fees for the retirement plans?

A We do not expect that any change will have a significant cost impact on participants in the two plans. Fees paid for the management of the savings plan may increase slightly because after the current plan is divided between ORNL and Y-12, each company will be a smaller client of the management company. You will receive additional information once further details are known.

Q Will employees who change employment between ORNL and Y-12 continue to carry their company service with them?

A Employees who voluntarily leave employment at either site to accept employment at the other site will no longer carry their company service credit with them. Within the Oak Ridge Reservation there are provisions that allow for transfer of company service credit under special circumstances among some contractors. This is determined on a case-by-case basis.

Long-Term Disability/Leaves/COBRA/Displaced Defense Workers

Q Will the change in administration affect my benefits?

A No. The change will have no effect on the benefits you receive or how you pay for your benefits. You will continue to pay your benefit premiums as you have been. ORNL employees and COBRA beneficiaries will send payments to the Administrator.

Retirees

Q Will my pension payment be affected?

A No. There will be no effect on your pension except that the payment for ORNL retirees will be made by Northern Trust and not Y-12. Y-12 retirees will continue to receive their check from Y-12.

Q Will the separation affect my spouse's benefits if something happens to me?

A No. The change will have no effect on any benefits your spouse may be entitled to receive.

Q How will future benefit management issues be handled after the transition?

A The ORNL Administrator or ORNL Benefits office will handle benefit issues for ORNL employees. The Y-12 Benefit Service Center will handle benefit issues for Y-12 employees.

Contact Information

For ORNL, contact the manager of ORNL Employee Benefits at 865-576-8844 or the ORNL HR Director at 865-574-4189. General questions for Y-12 can be directed to the Manager, Benefits Management at 865-576-2518, the Manager, Benefits Service Center at 865-574-9078, or the Y-12 HR Vice President at 865-574-1612.

You may send questions by e-mail to: benefits@ornl.gov for ORNL and benefits@y12.doe.gov for Y-12.

From the Lab Director

Secretary of Energy Steven Chu's visit on March 23 was a great day for the Laboratory.

The Secretary's announcement that UT-Battelle has been granted a five-year contract extension means that we can go forward with a number of long-range plans to broaden our research portfolio and build on our momentum.

I would like to express my gratitude to the DOE Oak Ridge Office and Manager Gerald Boyd for their support and confidence during the decision process. I am also grateful to the University of Tennessee and to Battelle, who together make up one of the most successful partnerships in the national laboratory system.

Most of all, I am grateful to the extraordinary staff at ORNL who in the end were responsible for delivering DOE's science mission. That includes those of you who have retired since 2000, and those who laid the important groundwork before we arrived. It may be hard to imagine how far the Laboratory has come since UT-Battelle's first day in April 2000. The following are just a handful of examples.

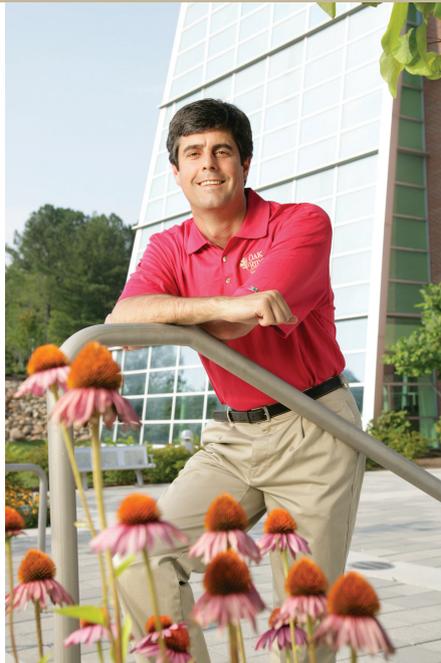
- What we know today as the "Quad" was a massive parking lot, with a chain link fence surrounding an old and expensive to maintain infrastructure. A \$350 million modernization has transformed ORNL from one of the oldest labs into the most modern in the DOE system.
- We not only delivered the Spallation Neutron Source on time, scope and budget, we also developed a program of high-performance computing that today boasts two of the world's top three machines located in a state-of-the-art facility.
- In April 2000 climate and bioenergy were small parts of the lab agenda. By leveraging our partnership with UT and the state of Tennessee, ORNL is today among the national leaders in these two emerging fields of research.

As proud as I am about our success over the past ten years, I am even more excited about the future for UT-Battelle and ORNL. Our partnership with the UT and the state continues to mature. Likewise, we are part of a Battelle family of labs that offers an increasing range of opportunities for collaboration and growth with an emphasis on moving our science and technology into the marketplace.

In some respects, we have set a new bar of performance. The challenge to UT-Battelle, and to each of us who work at ORNL, is to meet this higher standard in the delivery of our scientific mission, the operation of our Laboratory, and our leadership among the local community.

Thomas Mason

Thom Mason



“As proud as I am about our success over the past ten years, I am even more excited about the future.”



Top: Thom in front of completed Quad, 2007



Center: Thom with accelerator at Spallation Neutron Source (SNS), 2003



Bottom: Erin Hotchkiss collecting switchgrass tissue for molecular marker analysis



 Oak Ridge National Laboratory
Reporter
P.O. Box 2008
Oak Ridge, TN 37831-6266

PRSR STD
U.S. Postage
PAID
Permit # 37
Powell, TN

Secretary of Energy Chu visits the Lab

Secretary of Energy Steven Chu's focus during his visit to ORNL on March 23, as might be expected from a Nobel laureate, was on the Laboratory's contribution to the DOE science mission.

Gov. Phil Bredesen, Rep. Lincoln Davis and Rep. Zach Wamp joined Secretary Chu during the Lab visit, during which he announced a five-year extension of UT-Battelle's contract to manage the Laboratory.

"We concluded that we need not go into a competition because of [ORNL's] being managed so very well," Chu said.

The news of the contract extension came at a morning meeting of ORNL, DOE and contractor staff members, and preceded Chu's presentation titled "Meeting the Energy and Climate Challenge."

Dr. Chu's visit, his first as DOE Secretary, included visits to the Spallation Neutron Source, the Leadership Computing Facility (home of Jaguar, the world's fastest supercomputer) and the EVEREST visualization center. Several Lab researchers gave presentations on topics from biofuels research and climate modeling to high-temperature superconducting materials and the Lab's efforts to reduce its carbon footprint.

He, Gov. Bredesen and Congressman Davis also met with members of the news media to discuss the progress of the "shovel ready" Chemical & Materials Sciences Building construction project, now making rapid progress thanks to a boost from Recovery Act funds.

Chu, Claude Cohen-Tannoudji and William D. Phillips shared the 1997 Nobel Prize in Physics for their development of methods to cool and trap atoms with laser light. Chu was director of Lawrence Berkeley National Laboratory when President Obama appointed him Secretary of Energy.

Director Thom Mason discusses the contract extension on page 7. 



Secretary Chu walks between Jaguar, the world's fastest computer, and Kraken, third fastest.