TREE-RING TIMES

Spring 2004

Newsletter of the Laboratory of Tree-Ring Research

THE UNIVERSITY OF ARIZONA®

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Director's Note

Just as some of our old walls are literally tumbling down (see photos on page 7, and Steve Leavitt's column) our new walls are figuratively going up. On January 23, the Arizona Board of Regents formally approved funding for planning the construction of the new building – Environment and Natural Resources Building II – which will house the Laboratory of Tree-Ring Research, along with two other University of Arizona departments and a large contingent of U.S. Geological Survey scientists.

After 67 years of waiting for our new building, this news is – to say the least – exciting!

There are more approval steps ahead and detailed design work to do, but the best estimate is that ground breaking will occur later this year, and we should move in by October 2006. You will no doubt be reading and seeing much more about this momentous development in the coming two years within the pages of Tree-Ring Times.

During the course of the planning and building phase we will be working hard to raise additional funds that may be used for elements of the building related to our needs and future use of the building. We are extremely grateful to all who have given to our building fund, science and education programs. Your generosity is helping us build new foundations and raise new walls!

For anyone who wishes to join in this endeavor, please see our gift envelope at the center of this issue.

Best wishes,

Thomas W. Swetnam

COVER:
Tree-ring researchers core a larch tree in the Qinling Mountains near Foping, China. The collaborative project between the Laboratory of Tree-Ring Research and China's Xian Laboratory of Loess and Quaternary Geology used ring widths, wood density and isotopic analysis to reconstruct the environment of these mountains, a panda reserve. LTRR professors Steve Leavitt and Malcolm Hughes headed the project.
Photo by Steve Leavitt

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LTRR Director: Thomas W. Swetnam, Ph.D.
Editor: Melanie Lenart, Ph.D.
Production: Darla Keneston
AHSC Biomedical Communications

Recognition & Awards

The Laboratory of Tree-Ring Research continues to benefit from the generosity of friends and donors. Here we thank those whose 2003 contributions to LTRR programs and scholarships were not reported in the summer issue of the Tree-Ring Times.

- **Malcolm Weiner** provided support for a project to understand the connection between "frost rings" in trees and volcanic explosions.
- **David R. Wilcox** donated to the Agnese N. Haury Fellowship Fund that helps scholars from overseas come to the LTRR for hands-on learning.
- **Eileen Ferguson** contributed to the Bristlecone Pine Student Endowment, designated for students involved in research on the bristlecone.
- **The Eastern Sierra Interpretive Association of Bishop, California** made a substantial gift to the Bristlecone Pine Student Endowment. This check was gratefully received by LTRR Director Tom Swetnam at the 50th Anniversary celebration of the discovery of the ancient bristlecone pine near Bishop.
- **Bruce and Ruth Balmat** contributed to general lab programs.
- **Alan Klier** contributed a telescope.
- An **anonymous donor** gave a generous gift for continuation of the bristlecone pine field and lab research led by Thomas Harlan.

The Tree-Ring Lab thanks all of these generous donors!

LTRR professor Steve Leavitt is the incumbent editor of the journal Tree-Ring Research, and an elected member of the American Quaternary Association (AMQUA) council. He represents paleoclimatology, the study of past climates, for the council.

LTRR Director and Professor Tom Swetnam was appointed by Arizona Governor Janet Napolitano to the Arizona Forest Health Advisory Council. The Council provides advice to the Governor on science and policy matters pertaining to forest fires, forest health and management.

University of Arizona student Diana Chandler, an LTRR volunteer, placed second for a poster and presentation in the Agriculture and Environmental division of the Student Showcase in November.

Making Fire History

Paleofire database puts fire-scar and charcoal data on-line

• *By Melanie Lenart*

For the first time in history, records of prehistoric fires developed from tree rings and lake-sediment cores are freely available, even for those lacking connections to fire historians. All it takes is an internet connection.

The International Multiproxy Paleofire Database (IMPD) made its debut earlier this year on the website operated by the National Oceanic and Atmospheric Administration (NOAA). The "multiproxy" in the name captures the spirit of cooperation between those who reconstruct proxy records of past fire events from fire scars and other tree-ring evidence, and those who develop proxy records based on charcoal layers in the cores of lake sediments.

The paleofire database grew out of interactions during a weeklong workshop in Tucson during the spring of 2002, when 65 fire ecologists and climatologists gathered to consider how to merge the results of these two different ways of assessing pre-historic fire regimes. The workshop was co-organized by Laboratory of Tree-Ring Research Director Thomas Swetnam and Cathy Whitlock, a University of Oregon Professor and leader in charcoal-based fire history studies.

"I think the workshop really brought to everyone's attention how much data are available now," Dr. Whitlock said. "We're hoping the various labs will be willing and enthusiastic to contribute their data to this international effort," she added.

So far, 146 records based on tree rings and 4 records based on lake sediments have been submitted, according to database organizer Michael Hartman of NOAA. Hartman said he hopes to add another 25 charcoal-based records soon, once he gets permission from the principal investigators involved.

Although the database effort has made remarkable progress in the year and a half since it was first proposed, it still has a long way to go. More than 450 tree-ring based and at least 50 sediment-based fire records have been cited in the North American literature, according to a 2002 proposal put together by the database organizers.

"Actually the biggest part of the task is to get people to submit," Professor Swetnam said. "There are some barriers that I think need to be broken down. I think 99.9% of fire research is funded with public money. People need to have the ethic that once they have published they should submit their data so they are really available to the public."

The effort might be assisted by a recently developed policy of some prominent scientific journals. *Science* and *Nature*, for example, both now require their authors to make their raw data publicly available, either on the journals' own websites or by posting them on another site, such as the IMPD.

Connie Woodhouse, an LTRR alumnus who now works for NOAA's Paleoclimatology Program and is the principal investigator for the database work, agreed that it's a challenge for researchers to find the time to submit data.

"We're trying to tackle that in as many ways as we can," Dr. Woodhouse said.

For example, NOAA recently sent Hartman to the lab of one researcher to assist in the organization of many fire-history files for submission to the database. Also, some funds will be available in April that potentially could be used to provide graduate student support to organize data and metadata.

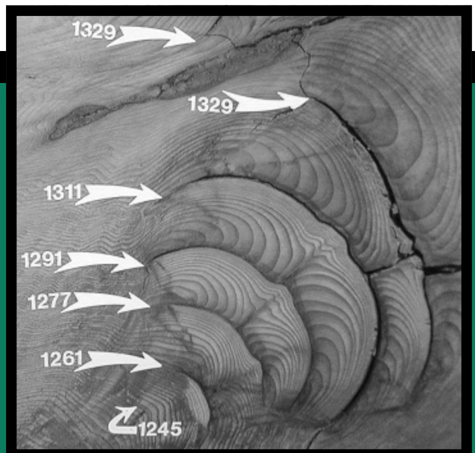
Efforts to make the database more "usable" may receive additional NOAA support in the future, Woodhouse indicated.

"NOAA is interested in finding ways that climate data can be useful, and since there's a fire/climate relationship, this includes information about fire and climate," she explained. "The intent is to try to connect the paleodata to our modern data, and also to make our data more useful to forest managers and other land managers like those at the BLM (Bureau of Land Management)."

With the cooperation of the U.S. Forest Service, the database organizers plan to make the database more "manager-friendly" in the future by allowing web-users to zoom in and access maps of past fire occurrence based on fire history data as well as modern fire records.

The interactions between fire and climate are complex, and influenced by other factors as well, as previous research by Dr. Swetnam and his students and colleagues has highlighted.

Like the charcoal-layer researchers, they have related increased fire frequency to independent records indicating drought. But they also found a relationship between area burned and wetter-than-usual conditions a couple of years before big fire years, which they attributed to a build-up of fuel from unsustainable lush growth. Fire suppression in U.S. forests during the last century also has limited the surface fires that clear out the small trees and logs that are considered "fuels" in firefighter parlance.



Arrows point to dated fire scars in the sampled stump of a giant sequoia that died in the 1950s. The information helped reconstruct the fire history of the Giant Forest, Sequoia National Park. The scars were created by low intensity surface fires that burned near the base of this tree during the indicated dates.

"We may be seeing the fuel dam bursting," Swetnam said. "We've had dry years before in the 20th Century, but we haven't had fires this big. The 2002 fire season broke all records."

Swetnam and others are eager to have as

Continued on page 6

‘Medieval Warm Period’ Pales by Modern Standards

• *By Melanie Lenart*

So these three guys walk into a bar. They sit down and one of them orders a bottle of wine. Then the bartender says, “Good thing you lads waited until now to place your order. We haven’t had homegrown wine in this region for centuries, until now.”

Admittedly, this is no joke. But neither is it a joke that the mild climate required for vineyard production had eluded England since Medieval times, until the global warming of recent decades.

Did global temperatures during the so-called Medieval Warm Period rival the modern warming, which many scientists believe stems from the release of greenhouse gases into the atmosphere? That’s a question Professor Malcolm Hughes and colleagues continue to challenge, using tree rings and a variety of other natural archives.

Professors Hughes, a dendroclimatologist with the Laboratory of Tree-Ring Research, addressed this question in an Oct. 17 commentary in the prestigious journal Science, written with colleagues Raymond Bradley of the University of Massachusetts and Henry Diaz of the National Oceanic and Atmospheric Administration. Dendroclimatology is the science of interpreting climatic variation from tree-ring records.

Their perspective piece cited a variety of research using tree rings and other proxy records to estimate that at the height of the “Medieval Warm Period,” between about 1000 and 1200 A.D, the Northern Hemisphere’s mean temperature appears to have been identical to that of the modern time frame of 1901-1970. In both cases, this would be about 0.6 degrees Fahrenheit cooler than the Northern Hemisphere’s mean temperature of the past 30 years.

This contrasts with a few recent declarations in the journals that the medieval climate was warmer, or at least not detectably different, than today’s climate. In one notorious case, the authors counted records of droughts and floods as well as higher temperatures in any 50-year period between 900 to 1300 A.D. as evidence of a “Medieval Warm Period” that was warmer than today’s climate.

The claims “might seem innocuous,” Dr. Hughes and his colleagues wrote in their perspective. “But for those opposed to action on global warming, it has become a *cause célèbre*: If it was warmer in medieval time than it is today, it could not have been due to fossil fuel consumption.”

Dr. Hughes has spent much of his career grappling with such climate questions. In 1994, he and Dr. Diaz argued in a Climatic Change article that there were warmings and coolings at different times, in different seasons, in various regions around the world.

“This does not constitute compelling evidence for a global ‘Medieval Warm Period,’” they concluded.

“The issue of synchroneity brings us right back to (LTRR founder) Andrew Douglass and dating—the importance of getting the years right,” Hughes added later during an interview in his University of Arizona office. An analysis done for the Science piece showed that the only major cluster of 30-year warm events registered by two dozen proxy records of temperature over the past millennium falls in the 20th Century.

Mean Northern Hemisphere temperature was higher during the late 20th Century than at any other time during the past millennium, Hughes reported in 1998 and 1999 in papers co-authored with Dr. Bradley and lead author Michael Mann of the University of Virginia. They based their conclusions on a multivariate statistical approach that produced one temperature timeline that combined results from tree-ring chronologies with other annual-scale proxy records, such as ice cores and corals.

When the instrumental record was superimposed on their timeline, it showed an accelerated warming since the mid-1970s with annual mean temperatures in the 1990s that surpassed those recorded for the past 1,000 years.

Their work was cited by many, including the Intergovernmental Panel on Climate Change (IPCC), as providing evidence that

An Issue of Synchroneity

The warmest 30-year periods in 23 reconstructed temperature records based on tree rings, ice cores, lake cores, cave deposits, and historical documents were plotted by Raymond Bradley, Malcolm Hughes and Henry Diaz. Timelines are shown in white. Color intensifies as more than one 30-year warm period lines up in time. Timelines extend through 1970, so the intensification in global warming that started in 1976 is not captured in this image. Even so, more records showed their maximum in the 20th Century than in medieval times. For more details on these records, see the Oct. 17 issue of Science.

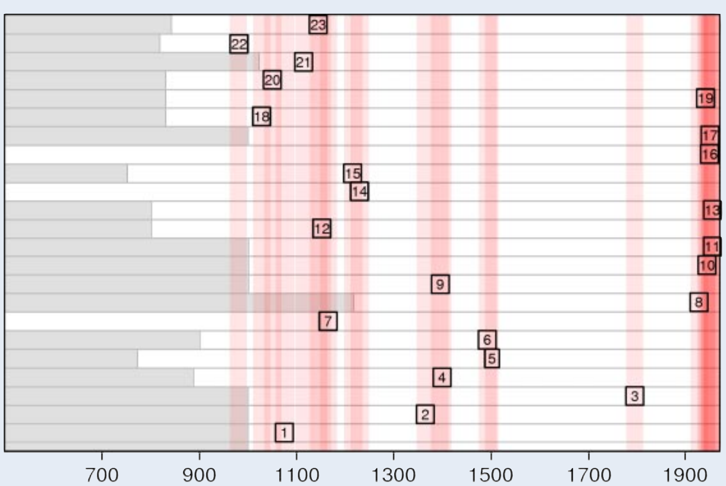
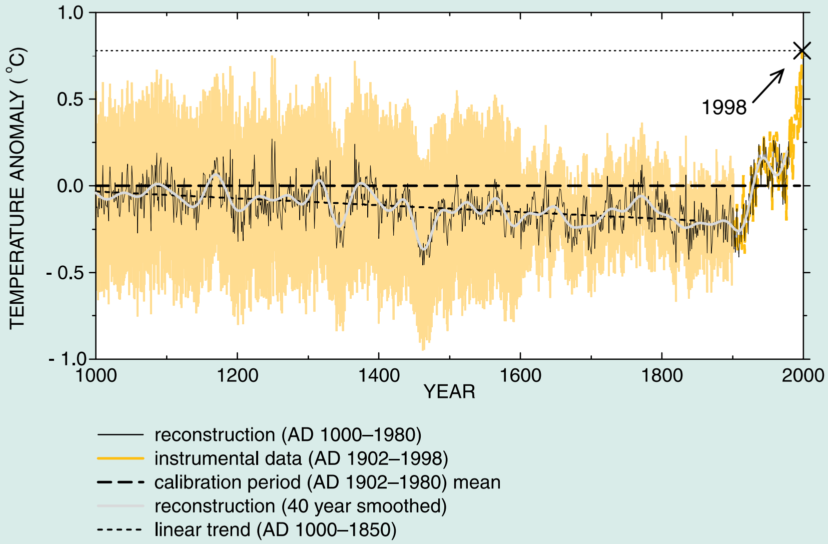


Figure excerpted with permission from *Science* 302: 404-405. Copyright 2003 AAAS and adapted by Martin Munro



A temperature reconstruction by Michael Mann, Raymond Bradley and Malcolm Hughes shows the recent period of warming in the northern hemisphere followed a downward trend. The record, based on tree rings, ice cores, coral reefs, and sediments, was published in the March 15, 1999, issue of Geophysical Research Letters.

Graphic adaptation of the timeline was done by Martin Munro.

humans have contributed to a global warming through greenhouse gas production. Since then, close to a dozen other researchers have published similar results. The IPCC and others have used the findings to make a case for curbing greenhouse gas emissions from industry and automobiles.

While Professor Hughes recognizes the political implications of his research, he considers them secondary to getting to the truth of the matter.

"Our job as scientists is to address the scientific questions," he maintains.

To that end, the research trio of Mann, Bradley and Hughes continues to push their famous timeline backward and forward and test its veracity, with assistance from others, including LTRR Research Associates Fenbiao Ni and Kurt Kipfmueller. The proxy records used for their earlier papers typically began near or after 1000 A.D., and most of the records ended around 1980, well before a series of record-breaking years in the 1990s.

"We've got a lot more records now that come out to the late 1990s," Professor Hughes said, adding that preliminary results indicate the warming trend registered by the instrumental record is reflected in the natural archives.

"Also, we'll be able to do a better job of the last millennium, maybe go back another few centuries," he explained. "We'll see how far back we can go before error explodes."

Potential error, a statistical measure of variation, increases as the number of individual records contributing to a timeline shrinks.

Another statistical concern involves accounting for variations that are related to something other than climate. For instance, annual rings tend to be smaller when a tree is old because of growth trends, while annual ice core layers tend to be smaller when the ice is old because of compaction.

The method used to "standardize" the data to remove these non-climatic trends can be controversial, however. Professor Hughes noted that the research team is testing different methods of standardizing the data, including age banding, to make sure the observed climatic trends transcend the type of standardization applied.

Age banding involves lumping timelines from similar-aged individual trees together before applying the statistical maneuvers that remove the typical decline in ring width that occurs as a tree ages and becomes more massive. Some researchers recommend this approach, developed by Keith Briffa of England's University of East Anglia, when trying to distinguish climate trends for a timescale longer than the life of the average tree in the record.

Even when considering all these issues carefully, however, creating a temperature timeline of the past millennium poses challenges because it requires working in previously uncharted territory.

"Until 20 or 30 years ago, studies of past climate were pretty much the province of geologists and oceanographers," Hughes explained. "They were working on big changes—large-scale changes in boundary conditions of the climate system. When a change is that big, where the whole Earth is moving in one direction, you can capture it in a few records."

Climate records derived from ocean sediment cores, for example, tend to consistently show the ups and downs of global temperature during the large-scale ice ages and interglacial periods of the last 2 million years.

"We're starting from the other end in regard to time," he continued. "We're accustomed to working with small global changes and large local ones."

> "The issue of synchroneity brings us right back to Andrew Douglass and dating—the importance of getting the years right."
>
> –Malcolm Hughes

Tree-ring records, for example, excel at detecting temperature or precipitation changes at the scale of the mountain or watershed where the trees live. Often these local changes can be related to larger scale patterns of atmospheric circulation.

"A change of that size is not big enough to make every place change at the same time," Professor Hughes said, adding, "The question of the slow change of the last millennium falls right between these two ways of looking at climate."

Even so, there is evidence beyond these types of proxy records that the climate warming occurring in modern times exceeds any occurring in the past millennium and more, he said. For instance, ice core records confirm that tropical glaciers in Kilimanjaro and the Andes have remained at below-freezing temperatures for thousands of years.

"Some of those places are not staying frozen now," Hughes reminded. "The ice is melting and disappearing. That strikes me as being evidence that something is changing, at least at 6,000 meters and up in the tropical latitudes."

Photo courtesy of Wally Woolfenden

Further Tales of the Bristlecone Pine

By Linah Ababneh
Graduate student

It is surprising what trees can reveal about their growth conditions. The science of tree-ring analysis, called dendrochronology, provides a unique tool for better understanding environmental changes that affect the growth patterns of trees.

A number of Laboratory of Tree-Ring Research scientists have explored the growth patterns of very old bristlecone pines (BCP), a conifer found at higher elevations in the Great Basin and Rocky Mountains.

In a 1984 paper, Valmore LaMarche, Donald Graybill, Harold Fritts and Martin Rose described an increase in tree-ring widths of BCPs since 1850. Because their study involved older trees, they encountered BCPs that had lost portions of their bark, leaving the wood underneath (sapwood) exposed and dead, a condition known as "strip-bark." Although a part of the tree is dead it still lives and maintains growth every year.

LaMarche, *et al.*, however, did not address the strip-bark phenomenon, but focused on the increase in tree-ring widths in these strip-bark trees, attributing it to increased atmospheric carbon dioxide, which has doubled since 1850, and called it the "carbon fertilization theory."

A subsequent paper written in 1995 by Donald Graybill and Sherwood Idso proposed a different theory. After conducting similar studies of the same BCPs, Graybill's and Idso's findings suggested a possible correlation between the observed increase in tree-ring width and the existence of strip bark in older trees.

My research follows from the previous two studies but includes a significantly higher number of old BCPs. Furthermore, I am analyzing variability in tree-ring widths of BCPs, specifically the observed increase in tree-ring widths and the physiological condition of the tree (strip-bark vs. full bark) in relation to soil type (dolomite and sandstone) and difference in elevation over a defined period of time.

The study of the effect of one factor at a time, i.e. bark condition, soil type, and elevation, allows me to better assess Graybill's and Idso's theory of a relationship between tree-ring widths and strip bark in older trees. Assessment of LaMarche and colleagues' proposed carbon fertilization theory would require further research.

The preliminary results of my research indicate that elevation and soil type have different effects on the BCPs' growth. In addition, it seems that moisture levels in different soils may have an impact on the growth pattern. For example, dolomite and sandstone, the soil types in my research, have different moisture levels. I am also finding differences in tree-ring widths that relate to differences in elevation. More conclusions are still to be drawn, as the final stages of research are progressing.

This work is being accomplished by the generous support of the University of California, San Diego and Davis, Sigma Xi, and Mary DeDecker Grants, as well as the Laboratory of Tree-Ring Research's Agnese N. Haury Fellowship Fund and the Bristlecone Pine Student Endowment.

Fire History

CONTINUED FROM PAGE 3

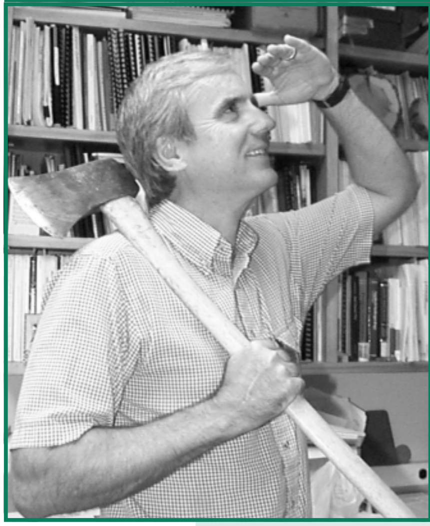
much data as possible to work with as they tease out the effects of climate—and climate change—from that of fuel build-up. Other research at the LTRR and elsewhere has documented an increase in Northern Hemisphere temperature since about the mid-1970s. (*See related story on page 4*.)

"There may be increasing signs that what we're seeing is really climate-driven. That debate is really warming up," Swetnam said. "But it's too early to say whether the warming is causing regional fire changes."

The director likened the development of the paleofire database to that of the International Tree-Ring Data Base. The ITRDB was set up, also on a NOAA website, following a 1974 meeting in Tucson that set the tone for tree-ring research on climate for decades to come.

"That's been extremely successful. Different scientists working at different institutions around the world could link arms," he said. "The same thing could be done for fire history through the IMPD."

BEHIND THE WOODSHED



An irreverent microanatomical view of life at the LTRR

By Steve Leavitt

The Walls Come Tumbling Down

In August of this year, the department lost an old friend—the Berkowitz Apartment building, better known to people associated with the Laboratory of Tree-Ring Research for the last 30 years as the "White House."

It served faithfully by providing much-needed space variously for faculty, staff, researchers, graduate students, and storage, including the departmental library. Our humble introduction to the White House was through rental of one of its four units around 1972 when it was privately owned.

By 1975, the LTRR was occupying three of the four units, and not long thereafter the University owned it and LTRR had the whole enchilada, driven in large part by the rapidly expanding research programs of Professors Hal Fritts, Chuck Stockton and Val LaMarche. The new space demanded furnishings, some of which were purchased new, and others of which were hand-me-downs from the Optical Sciences Annex and the Administration Building.

By 1984, however, LTRR Acting Director Bill Robinson was actively seeking new space for the lab and wondered if it could be found in time for us to "abandon the (White House) before it abandons us." By that time, door and window security issues and termite problems were already recognized, and not long thereafter problems emerged with the ailing roof, floors and climate control (evaporative cooler and furnace). Estimates within the last two years indicate it would have cost $50,000 to $100,000 for repairs necessary to bring it up to standards, which most agree would be the epitome of throwing large-denomination bills down the flea market rat-hole coin toss.

The White House had been living on borrowed time. Its fate was further sealed over the last 15 years as this little island of squalor was encroached on by construction of the shiny new Recreation Center, parking lots, and a Parking and Transportation field compound.

The proud and mighty building did not go down without a fight, and it held out for a surprising number of nanoseconds against the onslaught of incessant blows by the wrecking ball (actually big shovel). The result was never in doubt, however, like the inevitable outcome to the overconfident young man impressing his girlfriend by accepting the barker's challenge at a flea market elephant-wrestling promotion.

Yes, the White House seemingly had its insurmountable problems, but there were startlingly few complaints by the actual occupants. Now it can be revealed that the benign outward appearance of that building belied its ostentatious amenities, of which our brethren departments throughout the egalitarian University of Arizona can only dream.

For example, the White House had an underground parking garage with free valet parking for all faculty and staff. For those who chose to walk or ride bikes, there were showers with gold-plated fixtures and redwood hot tubs in the basement.

The attic had a fully stocked faculty club to encourage recreation, camaraderie and informal interactions. Its revolving rooftop restaurant provided spectacular panoramic views of the city over the course of each gourmet meal and looked down on the lowly stadium skyboxes.

Campus planning might do well to take a page or two from these White House amenities, but then again, some may not be worth perpetuating. I never did take a liking to the White House complaint desk to which I was referred many times, and for that matter, why was I seemingly always the only one to be directed to the whine cellar?

Come to think of it, my brusque treatment at that dump at times can only be compared to that given a health inspector at the flea market gravy and pie buffet.

LTRR's Hirschboeck Wins Teaching Award

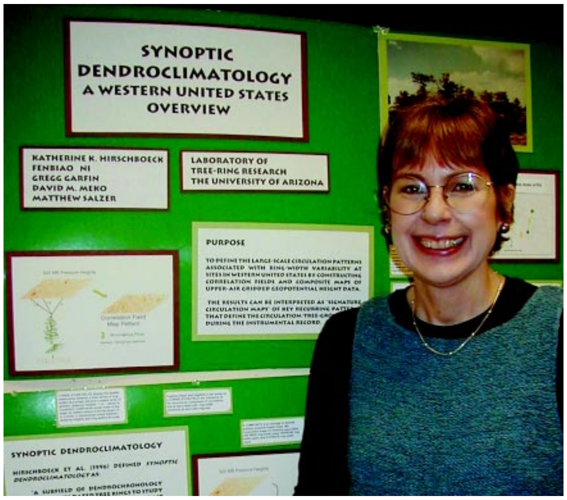
LTRR Associate Professor **Katherine Hirschboeck** won the prestigious 2003 Provost General Education Teaching Award for her innovative methods in teaching natural science courses.

As a pioneer and leader in innovative teaching methods and use of new teaching technologies, Hirschboeck is known for implementing programs that use collaborative group learning; immediate feedback in examinations; and student/peer evaluation tools.

"Her exemplary teaching, her dedication to her students, and her university-wide influence as a role model for general education curriculum development, innovation and assessment are compelling reasons to grant her this award," wrote Planetary Sciences Professor Harold Larson in his letter of nomination, one of many sent to the selection committee.

About 500 faculty and administrators attended the awards ceremony to honor Dr. Hirschboeck and the seven other faculty members who received teaching awards for the year.

During the 2001-02 University-wide General Education Committee "Best Practices for Improving Student Learning" retreat, Hirschboeck's presentation was recognized as the "Best of Show" in terms of its organization, completeness and adherence to all of UA's general education guidelines and requirements.



Dr. Hirschboeck sits with one of many small groups formed to facilitate discussion in her "Introduction to Global Change" class.

Hirschboeck's teaching team (above) strategizes on how to teach 150 students to plot, crossdate and test hypotheses using tree-ring samples. At left, students carry out the planned exercise in class.

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