Great things are happening between Geosciences and communities in Northern Sonora since the geology club trip to Northern Sonora in 1999. A world-class vertebrate fossil site was discovered. A study of the 1887 Earthquake Fault Scarp was initiated. The Universidad de la Sierra opened in Moctezuma, Sonora. And we just submitted the Students Across Borders proposal to NSF (www.geo.arizona.edu/SAB) requesting funds for a program that will involve Hispanic students and other minorities from southern Arizona high schools and Sonora in a summer field trip to Northern Sonora and university residence experience at the UA. We are especially excited about our growing affiliation with communities in Northern Sonora.

**Terapa Fossil Site**

It all began with a Society of Earth Science Students (SESS) field trip to Northern Sonora during spring break in 1999. The field trip was featured on *Desert Speaks*, a series produced by KUAT, a National Public Broadcasting Station on the UA campus (www.geo.arizona.edu/news/Sp99/sss.html). The following year we headed back to Northern Sonora with ecologist Yar Petryszyn and friends to explore the lava flows around Moctezuma and trace sections of the 1887 Fault Scarp near Bavispe. Thanks to a citizen of Moctezuma, we were introduced to the community of Terapa and visited with Don Santiago Garcia, a community leader. Santiago and Ramon, a young boy, showed us some spectacular large bones and teeth that Yar tentatively identified as mastodon. A few weeks later we showed photos of these fossils to Vance Haynes who relayed the images to Jim Mead, Director of the Quaternary Studies Program at Northern Arizona University. Jim contacted Arturo and headed down to investigate the Terapa fossil site.

Much preliminary field work has been done at Terapa and the site is now recognized as a world-class vertebrate fossil locality. Excavations will be continued during spring break in March 2003. Jim and Arturo Baez are counting on Geosciences to get involved. A proposal for a multiple year project at Terapa is in the works. Local people, like Hector Ruiz and Mayor Zagasta, have been very supportive in facilitating preliminary work at the site. Federal and State permits for excavation were granted thanks to support from INAH (National Institute of Anthropology and History), especially Dr. Joaquin Arroyo Cabrales from Mexico City and Dr. Fernando Tapia from Sonora.

**Pitaycachi Fault Zone**

In the fall of 2001, several members of SESS helped conduct a near-surface seismic reflection/refraction survey across the Pitaycachi normal fault of northeastern Sonora, Mexico, to image shallow subsurface structures and, perhaps, to better constrain recent fault activity. What made the Pitaycachi fault an interesting target for a SESS field trip...
From the Department Chair

These are turbulent times at the University of Arizona as the University is embarking on some major changes in order to respond to severe state budget cuts.

President Peter Likens has stated “We are living in an era characterized by long-term, worldwide shifts in the financial responsibility for higher education from public to private resources.” Like many state universities, we are enduring serious budget cuts as the state economy continues to falter. President Likins and Provost George Davis are responding with major changes based on a vision of “focused excellence” characterized by three essential elements: managed growth, focus on fewer academic programs, and prioritizing based on excellence, which includes diversity as the primary criterion.

As a guide to focused excellence, Provost Davis is “committed to defining academic leadership themes in the form of a relatively small number of university-scale academic emphases that will embrace some of our most compelling cross-college and cross-departmental strengths in research, teaching, and outreach.” These themes include Astrophysics, Earth and Space Sciences, and Environmental Quality and Sustainability including Global Change. This plan also involves eliminating and merging programs and units in order to focus on our strengths. This will require very difficult decisions by the administration, but it is essential for the University to move forward.

The Department of Geosciences is very prominent in the focused excellence themes and is recognized by the University as an outstanding department. Although the next few years will be difficult, I am optimistic that we are on a path that will eventually improve the University of Arizona and the Department of Geosciences.

On a more positive note, we have had another productive Summer and Fall semester in the Department. We have made some changes to the newsletter that I hope you will like. In addition to updating the visual appearance, we have added a section that highlights recent activities of our faculty and researchers, and we are trying to include more articles from emeritus faculty. In this issue, Bill Bull writes about identifying past earthquakes in New Zealand and California.

Our graduate student program continues to excel. We had seven PhD and eight MS students graduate over the summer with five more students graduating by December. And we are on track to offer our undergraduate summer field course next June after not offering it last year due to low enrollments and budget cuts.

The next GeoDaze will take place on April 10 and 11, 2003. Graduate student chairs Allison Drake and Rebecca Walker are busy organizing the event which will be held in the new Student Union now that construction is done. It should be a much better venue than we have had the past few years. Emeritus faculty Bill Dickinson has agreed to lead the post GeoDaze field trip on Saturday, April 12, so mark your calendars for these events!

We have seen increased support from our alumni for graduate student scholarships, in particular the John and Nancy Summer fund and the summer field camp.

We had our first annual Tucson Alumni Happy Hour. We hope to see more of our Tucson alumni at the next event.

In conclusion, I want to thank all of our Geoscience alumni and friends for their continued interest in and support of the Department. We hope to see you in April!
Regional Tectonics Field Trip to California
By Mihai Ducea

Mihai Ducea, George Gehrels, and George Zandt took the Fall 2002 Regional Tectonics class on a week-long trip to California during October. The purpose was to complete a regional cross-section through the North American Cordillera and visit some world-class outcrops in California, ranging from Precambrian miogeoclinal rocks to the modern plate boundary of the San Andreas fault. John “Ozzie” Chesley joined the group and contributed useful insights. Jason Saleebey from Caltech, John Langbein from the USGS, and Liz Holt from CalState Bakersfield also shared information at specific stops along the way. Thirteen students participated and did a great job of summarizing various subjects which helped make the trip a great success.

We started in Owens Valley, one of the world’s greatest modern rifts. We examined extensional and strike slip faults and young volcanic features from basalts to rhyolites. We stopped at one of the better mantle xenolith-bearing basaltic flows in the valley (left). We also got acquainted with the Long Valley caldera and its furious past, and the surreal volcanic landscape near Mono Lake (far right).

We then crossed the great Sierra Nevada batholith through Yosemite (center), where some of the largest plutonic complexes in the world formed within a very short period of time in the late Cretaceous, by a process that has yet to be understood. Jason Saleebey spent a day leading the group through the ophiolites of the western Sierra and Great Valley. We marched up and down fragments of oceanic crust, and occasionally stepped down below the Moho in the oceanic mantle (left).

A full day was dedicated to studying active tectonic features along the San Andreas fault, including stream offsets and other features. We also focused on California’s famous controversial origin of Salinia. We decided to conduct a detrital zircon (DZ) provenance study of key metasedimentary units of Salinia and the Franciscan. During the last day of the trip, students collected DZ samples and made detailed observations at outcrops. Back in Tucson, the samples have been processed and ages will soon be determined. The final product will be a paper that all the participating faculty and students will submit to a scholarly journal by the end of the semester. A paper with twenty-one authors!

We camped and spent every other night at UC research reserves. This was an experiment designed to give us the availability of classrooms where we spent hours debating the geology we had seen. We even had access to computer projectors. Overall, this was a great opportunity to examine spectacular geology featured in many textbooks. We learned how all the pieces fit together and how tectonics today requires field knowledge of many disciplines: petrology, structure, stratigraphy, and geomorphology. We also became aware of how many unanswered questions remain to be addressed even in this well-studied part of the world.

Many thanks go to ExxonMobil for financially supporting this field trip and making this incredible, hands-on learning experience possible.

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Northern Sonora cont’d...

and seismic experiment was the fact that this fault was the source of the largest historical earthquake in the southern Basin and Range Province, which occurred on May 3, 1887. The so-called Bavispe earthquake, with an estimated magnitude of ~7.4, caused significant damage in the region and was reported to have knocked large boulders loose from the walls of Sabino Canyon on the north edge of Tucson.

The Pitaycachi fault extends roughly north-south for over 100 km, with fault-scarp exposures from the 1887 earthquake of up to two meters. Analysis of the seismic data collected by the SESS group shows, not surprisingly, that unconsolidated near-surface sediments on the up-thrown side of the fault are thin (~1 m), but that unconsolidated near-surface sediments on the down-thrown side of the fault are greater than six meters thick. The greater thickness of sediments on one side of the fault results from continued fault activity over a long period, with trapping of more sediment against the growing, eroding, and evolving fault scarp. Based on previous correlations of basalt flows exposed along the mountain front, total offset on the fault in the past 23 million years has been estimated at over 4,000 meters.

Another factor of interest for field-trip participants was the fact that the Pitaycachi fault zone is similar to Quaternary fault scarps flanking numerous basins in southern Arizona; together, many recently-active fault zones throughout northern Mexico and southern Arizona provide evidence of continued crustal extension in the southern Basin and Range Province. In addition to the hard work provided by the SESS undergraduates Evan Adams and York Lewis, several UA graduate students, including Frank (Trey) Wagner, Casey Hagbo, and Andrew McCarthy, also helped with the experiment; we even had the help of Chris Johnson, a sophomore at Canyon del Oro high school. Faculty members included Peter Kresan, Roy Johnson, and Jon Pelletier from Geosciences, and Yar Petryszyn from Ecology and Evolutionary Biology.

Students Across Borders Program

Recently Bob Butler, Peter Kresan, and Jon Pelletier from Geosciences, Paul Sheppard from the Tree-Ring Lab, and Don McCarthy from Astronomy submitted a proposal to NSF requesting support of a major new initiative in science education called the Students Across Borders Program. Other core people involved with this effort are Chris Donovan from Sunnyside School District, Gracie Rendon-Coke from Cibola High School in Yuma, Floyd Gray from the USGS, and Arturo Baez. If funded, the Students Across Borders Program will welcome Hispanic and other minority high school students in their sophomore and junior years to Earth science studies of their natural environment. The program is designed to nurture the Earth science interests of these students, mentor them through the college application process, and a successful undergraduate career. The Students Across Borders Program is a year-long program, followed by continued alumni advising and support. The major elements of the program are:

Spring Semester Spin-up on Earth, environment, and professional skills to build competence and confidence for field work, communication skills, and teamwork.

Summer Two-Week Workshop featuring:

• A field trip during which student/teacher teams are engaged in inquiry-based investigations of Earth and environmental sciences in Northern Sonora, Mexico, and southern Arizona.

• A university residence experience that familiarizes students with college life plus provides skills and guidance for success in higher education.

• A two-day field trip to examine the geology and ecology of the Santa Catalina sky island with telescopic viewing of the moon from the summit.

Fall Semester Service-Learning Projects in which student/teacher teams use acquired science skills and showcase their discoveries for friends, family, and community. A team of instructors combines university faculty experienced in science education outreach with accomplished high school Earth science teachers from districts with dominantly Hispanic student populations.

The Universidad de la Sierra

The Universidad de la Sierra has just commenced its first year of operation in Moctezuma. Dr. Samuel Ocana Garcia is President of the university. Faculty and administrators are excited about the educational possibilities offered by our connection with their university. The degrees offered at present are business administration, systems engineering, and biology. Degree offerings may expand in the future. We hope our proposed Students Across Borders Program will help enhance the likelihood that Sonoran high school students will continue with their education and graduate from schools like the Universidad de la Sierra.
Students Across Borders Program is the summer field trip to Northern Sonora. In fact, it was during a field trip to Nacozari, Moctezuma, Aconchi, and Arizpe this last June that we became convinced that Northern Sonora provides a wondrous physical, ecological, and cultural landscape for the Students Across Borders Program. The field group included Arturo Baerz, Bob Butler, Peter Kresan, Floyd Gray, Chris Donovan, and Gracie Rendon-Coke.

Staging a major part of our field experience in Northern Sonora recognizes the cultural background of the high school students we seek to attract. Student and teacher teams from Arizona will work closely on field projects with student and teacher teams from communities in Sonora. The Sonoran experience will provide an opportunity for students and teachers to share the Northern Sonora lifestyle while expanding awareness and knowledge of the natural history. This experience can also be a small step into the global economy for participants in our Students Across Borders Program.

The proposed Sonoran field experience cannot occur without endorsement and participation by civic and educational leaders in Northern Sonora. During our visit we met with an impressive array of these people who are excited about this educational exchange. They include mayors, mine directors, geologists, businessmen, and professors. Dr. Samuel Ocana Garcia, president of Universidad de la Sierra, feels that what we are doing is “unique in all ways and sets a standard to look into for his University.” Students Across Borders could serve as a model for international cooperation in science education.

Northern Sonora offers the possibility of highlighting many disciplines, including regional and economic geology, geomorphology, ecology, hydrogeology, seismology, paleontology, and geochronology. An active, accessible, and very modern Mexican Copper open pit copper mine, smelter, and electro-refining plant is located near Nacozari. The mining operation offers many lessons concerning science/technology/society connections. Jim Mead, with the Quaternary Studies Program at NAU, is directing excavations of fossils from the Terapa paleontology site near Moctezuma and is enthusiastic about this site being used as part of our field program. We are very excited about the prospects of holding the Students Across Borders field program in Northern Sonora, and we look forward to working with our friends and colleagues in Northern Sonora to enhance science education in both Arizona and Sonora.

Awards and Honors

Julio Betancourt, Bob Webb, and Waite Osterkamp, the three USGS-WRD project chiefs on Tumamoc Hill, received the Department of Interior’s Meritorious Service Award in September.

Bob Downs was elected a Fellow of the Mineralogical Society of America in October.

Bill Bull, Emeritus Professor, received the 2002 Distinguished Career Award presented by the Quaternary Geology and Geomorphology Division of the Geological Society of America. The quality of Bill’s contributions to the Geosciences Department is indicated by past awards as well. In 1991 he was awarded the Neil Miner Award of the National Association of Geology Teachers. When his book Geomorphic Responses To Climatic Change won the Kirk Bryan Award of the Geological Society of America in 1993, Bill became the first person in the Geosciences Department to win national awards in both teaching and research.

Guillaume Dupont-Nivet received the 2002 Sedimentology Student Research Award from the Sedimentary Geology Division of the Geological Society of America.

David Lowell, one of the world’s most successful exploration geologists, was inducted into the American Mining Hall of Fame at the 20th Annual Banquet held in Tucson during December. Dave received a BS degree in mining and engineering from the UA in ‘49, and an MS in geology from Stanford University in ‘57. He also received a Professional Engineer degree from the UA in ’59 and honorary degrees from the Universidad Nacional de San Marcos in Peru in ’98 and the UA in ’00. As a geology specialist in porphyry copper, he was elected to the National Academy of Engineering in ’99. He has also received the SME Jackling and Robert Dryer Awards, the AIME Earl McConnell Award, the SEG Silver Medal, and the MMSA Gold Medal.

Charlie Prewitt, Geosciences newest adjunct professor, was awarded the Roebling Medal in October. This award is the highest honor given to a mineralogist. We are indeed getting a very outstanding addition to our faculty.

Jay Quade received the 2002 Farouk El-Baz Award for Desert Research. This award was established in 1999 by the GSA Foundation and given annually through the Quaternary Geology and Geomorphology Division of the Geological Society of America for a body of outstanding work in the field of desert research by an earth scientist(s). Jay was selected from a list of seven qualified applicants.
Earthquakes and Evolution of Mountainous Landscapes

By Bill Bull, Emeritus Professor

Life as an Emeritus Professor continues to be interesting and diverse for me and my wife Mary. Like snow-bird tourists, we spend the winter months in Tucson, and then we journey to the Southern Hemisphere for winter. We live in the small fishing village of Kaikoura on the northeast coast of the South Island of New Zealand. We gaze up at the snow-capped Southern Alps from a home that is 300 m from the beach. The winters are delightful in this frost-free location. One can’t resist fishing for salmon and trout at local beaches and streams.

Kaikoura is one of the few places in the world where spectacular alpine mountains meet the sea. It is a paradise for any Earth scientist interested in active tectonics. Much of my time is spent writing two books: “Tectonic Geomorphology of Mountains” and “Fluvial Tectonic Geomorphology.” Progress on these manuscripts is interrupted by an interesting flow of visiting Earth scientists and classes from New Zealand, England, and the US. I continue to teach by participating in undergraduate and graduate-level field trips from Earth Science departments at the University of Canterbury and Lincoln University. I give an occasional guest lecture, and I am an external reviewer of theses and dissertations.

I teach a lichenometry short course each year for the purpose of introducing Earth scientists to this precise, accurate, surface-exposure dating method. Short courses have been taught in New Zealand for the past three years, but emphasis is shifting to the US. In September 2002, I taught the first short course in Kings Canyon National Park, California. It was a superb site for instructing 14 graduate students, postdocs, and faculty from the University of California at Santa Cruz and at Santa Barbara. Two short courses will be taught in Santa Cruz in early October 2003, just before and just after the Friends of the Pleistocene field trip.

All this sounds rather esoteric until one realizes the potential of this new tool in paleoseismology for making scientific breakthroughs. Freshly exposed surfaces of rocks that tumble down hills during earthquakes, and at other times, are colonized by slow growing and fast growing lichens. We calibrated the rate of growth of these lichens in New Zealand, California, and Sweden by measuring lichen sizes at historical sites like rock-fill dams, and prehistorical landslides that we date with tree-ring analyses.

Our work reveals that most rockfalls occur as synchronous events throughout plate boundary mountainous regions. These peaks in the abundance of lichen size correspond to times of known historical earthquakes, and are used to accurately date times of prehistoric earthquakes during the past thousand years. Not only can we date earthquakes more precisely than with radiocarbon methods, but regional variations in the sizes of lichen-size peaks provide the first-ever maps depicting the intensity of seismic shaking for prehistoric earthquakes. Simply put, more rocks tumble down hills near earthquake epicenters. This new method for studying earthquakes promises to resolve several significant problems in paleoseismology.

I will seek grant funds to support students and faculty at the UA, and elsewhere, for three projects. Using a sufficiently large data set in New Zealand, we will make seismic-shaking maps for all magnitude Mw >7 earthquakes since 1200 A.D. A second project will focus on tree-ring dating of Alpine fault earthquakes. A third project will be in Southern California and will compare maps showing seismic shaking caused by historical San Andreas fault earthquakes with maps for prehistoric earthquakes. Previous studies of historical earthquakes show that these maps are of the same quality as Mercalli intensity maps. Lichenometry may be the best tool to address a long-standing question in the Pacific Northwest. Was the great subduction thrust earthquake of 1700 A.D. a single surface rupture that extended from British Columbia, to Canada, to Northern California, or was it the result of two or more major earthquakes? I encourage similar studies in the Andes of South America and along the Anatolian fault zone in Turkey.

Yes, the life of a retired geologist can be fun and productive. I savor life as a New Zealand geologist. Mary and I revel in a lifestyle that provides superb variety to living in Tucson.
You are invited to become a member of the GALILEO CIRCLE to support excellence in the sciences at The University of Arizona.

I invite you to become a member of the GALILEO CIRCLE at the University of Arizona. The GALILEO CIRCLE is a society of close friends who support continued excellence in the sciences at the University of Arizona through their annual membership and scholarship contributions, and their advocacy of the sciences.

Our members are given special opportunities to attend seminars, lectures, and special events—including our unique GALILEO CIRCLE science trips which range from exploring our own Sky Islands in the Santa Catalina Mountains to touring Galilean cities in Italy this fall!

Those who join the GALILEO CIRCLE at the $1,500 level are designated GALILEO CIRCLE Scholar’s Patrons and $500 of that contribution goes directly to support a student in a College of Science department of your choice. You will also have the opportunity to meet your scholar at our annual spring GALILEO CIRCLE Scholars Luncheon. The remainder of your contribution is placed in the Dean’s Fund for Excellence to support students, outstanding young researchers, and stellar faculty in the College.

For more information regarding joining the GALILEO CIRCLE and supporting a student in the Department of Geosciences as a GALILEO Scholar, contact Bo Baylor at 520-621-4060 or bbaylor@u.arizona.edu. Bo served as Graduate Program Coordinator in Geosciences for 12 years before moving to the COS Dean’s office. Bo would be delighted to hear from you!

The College of Science at the University of Arizona is one of this country’s leaders in conducting innovative research. Therefore, receiving a Galileo Circle Scholarship was an extreme honor for me. I feel very fortunate to be one of the few chosen to receive this award and be admitted to the Galileo Circle of Scholars.

My research interests focus on using marine mammal bones on the Colorado River Delta for conservation and paleontological purposes.

- Can bone assemblages be used as a tool to inventory marine mammal populations currently living in the upper Gulf of California?
- What preservational biases might affect the fossil record of marine mammals?

The answers to these questions are important because marine mammal populations are difficult to survey. Good population data are needed to develop conservation strategies that can be used to protect existing populations. And understanding the preservational biases will affect the interpretation of fossil faunas. The following items will be addressed by conducting a thorough survey of Colorado Delta beaches in order to:

- estimate the minimum area needed to inventory current populations,
- determine the northern distribution limit of the vaquita, an endangered porpoise,
- examine biases in the preservation of bone types, and
- estimate the time-since-death of the bones.

Last December, members of the Delta Lab in the Geosciences Department and I conducted a preliminary survey of marine mammal taphonomy on the Colorado River Delta. We surveyed 4 km of shoreline, approximately 3% of the delta’s area, and found three carcasses, 28 skulls, and 442 post-cranial elements. We found 8 of the 18 species previously sighted in the upper Gulf of California. Skulls were the best estimator of minimum number of individuals. All other elements were underrepresented. The variation in the degree of bone weathering indicated that the bones were temporally mixed. Most remains were probably transported to the beaches as part of a carcass in varying stages of decay. The lack of bite marks on the three carcasses we found suggested that scavenging did not play a large part in bone destruction, in contrast to terrestrial mammals.

When complete, my study will provide information on the composition and distribution of marine mammals in the northern Gulf of California. I hope this information will then be used for conservation purposes. I look forward to seeing what other cutting-edge, research endeavors the Galileo Circle supports in the future.
Twenty-One Years Of Radiocarbon Dating Using Accelerator Mass Spectrometry

By Tim Jull

At the University of Arizona, radiocarbon dating has a long history which goes back to early counting systems set up in the 1950s by Professors Emil Haury and Paul Damon. Radiocarbon dating is a well-known technique which has wide applicability to many aspects of the Earth sciences, as well as to archaeology and anthropology. Carbon-14, which has a half-life of 5,730 years is used widely for dating geological and archaeological materials from the last 50,000 years.

Since 1978, accelerator mass spectrometry (AMS) has gradually taken over most radiocarbon measurements because of the possibility of dating samples of less than a milligram of carbon. AMS machines all operate using similar principles of radionuclide measurements using mass spectrometry coupled with a high-voltage accelerator which serves to strip ions from negative to positive charge states. This makes it possible to detect radiocarbon and other radionuclides down to the level of about one atom in 1,000 trillion.

One of the first purpose-built AMS machines was installed at the UA in 1981, as a result of a successful NSF proposal submitted by Paul Damon (Geosciences) and Doug Donahue (Physics). The first radiocarbon dates were obtained in the summer of 1982. We now operate two AMS machines. In 1998, the NSF provided funding to purchase a second machine, installed in the Spring of 2000. These machines are located in the basement of the Physics building, and the laboratory is jointly operated by the Geosciences and Physics Departments. Most samples run in our laboratory are for radiocarbon measurements, though we have developed applications using $^{10}$Be and $^{129}$I. We have measured over 52,000 radiocarbon samples for a wide variety of applications.

The variety of samples for radiocarbon dating is immense. Samples come from all over the world, in all possible forms. Our lab is funded by NSF to provide a service to other scientists and users, and to continue research that will improve our methods for a variety of applications. Our laboratory now comprises six researchers, nine staff members, and seven students. The AMS Laboratory is lead by Dr. Tim Jull, senior research scientist in Geosciences. Dr. Jull has been here since the first machine was installed in 1981. Other scientists working at the lab include George Burr, Warren Beck, Greg Hodgins, Lanny McHargue, and Nat Lifton.

Many famous artifacts have been dated in our laboratory. These include the Shroud of Turin, the Dead Sea Scrolls and the Vinland Map, to name a few. We also do routine Earth science samples of many kinds, which range from local groundwater to lunar samples. The lab's research covers a wide range of topics; we will highlight a few here.

Calibration

In order to get “true” ages, we need to calibrate the radiocarbon time scale with “real” years. This was originally done by comparing the raw “radiocarbon age” with the known age of tree rings. The current version of the calibration, encompassing tree-ring data back to 11,857 calibrated years before 1950 AD and sparse coral data back to ~24,000 years, was published in 1998. These calibration curves are updated about every five years by an international committee of experts, and a new “calibration” will appear in the next two years. Corals have formed part of this record since 1993.

George Burr is working on extending the coral chronology (see more details on his work below). Other records, such as speleothems, were proposed at the 12th International Radiocarbon Conference by a South African scientist, John Vogel. Vogel's idea took a decade or so to come to fruition. In the past few years, there have been studies using such diverse records as speleothems, aragonite deposits from the Dead Sea region, and attempts to cross-correlate marine foraminifera from Icelandic sea sediments with ice cores. Warren Beck, a research scientist in Geosciences and Physics, is working on the extension of the radiocarbon calibration using a new record found in stalagmites from the Bahamas. Many of these records show broad agreement during the period covered by the tree-ring chronology and large fluctuations in $^{14}$C during the period of 25-45ka.

George Burr has spent the last five summers in the field, working to locate and sample fossil corals. This work is related to improving the calibration curve and trying to understand
ocean-circulation history. This last summer, George (who prefers to be called “Burr”) spent a month in Papua New Guinea leading a field team to drill fossil corals. Last year, Burr was prospecting for corals in the Solomon Islands and PNG. The samples he has collected with his colleagues from University of Texas are helping us to better understand the past ocean, as well as firm up the calibration curves.

A New Kind of Dating

Nat Lifton is working on improving a novel dating method called “cosmogenic nuclide dating.” This work uses the ¹⁴C produced directly in silicates by high-energy cosmic rays which reach the surface of the Earth. Hence, it is distinct from the radiocarbon produced in the upper atmosphere, which is the ¹⁴C used for radiocarbon dating. This novel “dating” method grew out of early work done in our lab on this method by Tim Jull and Nat Lifton. This method allows us to estimate erosion rates, and in combination with other nuclides, the exposure time of rock surfaces. These methods for ¹⁴C and other radionuclides have only developed since the early 1990s and have revolutionized geomorphology.

Extraterrestrial Samples

Tim Jull’s research interest has always included extraterrestrial samples. He has worked on a number of projects to date the terrestrial residence ages (the time since they fell to Earth) using ¹⁴C and ¹⁰Be in lunar samples. We have studied meteorites from many arid and polar regions of the world. We have shown that meteorites can survive much longer in cold, polar regions than in hot deserts. We also have studied ¹⁴C produced directly in lunar surface soils and rocks by the action of both solar and galactic cosmic rays. This work is useful to understand the variation of the cosmic-ray flux in the past.

Assistance to Other AMS Labs

Staff at our lab are constantly in demand for technical assistance to new AMS facilities and to many users who wish to prepare their own samples. Todd Lange (senior research specialist) has built sample-preparation lines for a number of labs in Mississippi, and Reno, and he has advised others on their construction. Nat Lifton visited Scotland last year to advise on the design of a system for extracting in-situ ¹⁴C from rocks. Tim Jull was part of an external review team which advised the AMS lab of the Institute of Physics in Bhubaneswar, India, last February. Tim Jull and George Burr visited Xi’an, China last September to advise on technical issues related to their possible purchase of a new AMS machine. We have also advised many other new and existing labs on many aspects of AMS techniques.

One Japanese group, when specifying their equipment to be ordered, stated “the machine should be exactly like the one at the University of Arizona.”

Forest-fire Frequency

The frequency of forest fires is of great importance, and there is more and more evidence of a connection to climate. Tim Jull has done these studies in collaboration with scientists from New Mexico and British Columbia. We have studied the recurrence of forest fires in Yellowstone National Park and showed an interesting periodicity of ~1,000 to 1,500 years. It is interesting to speculate if this is related to climate cycles on the millenial scale, which have been observed by oceanographers. Some have argued that this periodicity is associated with solar cycles. New results from paleofires in British Columbia suggest a similar periodicity. Before one can postulate how climatic change might affect the frequency of forest fires, there are some cautionary notes. Forest fires may incorporate burning of already dead trees (the “in-built age” of the wood which was burnt) and fires may be set deliberately by humans, so the record may be more complex than it first appears.
Stephen DeLong Receives H. Wesley Peirce Scholarship

I am grateful to have received the H. Wesley Peirce Field Scholarship in support of my research on landscape evolution in the Southwest and its relationship to climate and tectonics. Our department has an unsurpassed tradition of Quaternary and geomorphology research, and I am fortunate to be a part of the next generation of this research. In particular, Emeritus Professor Bill Bull has advanced our understanding of the complex relationships between climate, tectonics, and landscapes in the Southwest and beyond. My advisor Jon Pelletier and I continue to investigate these subjects with a combination of field, geochronological, and quantitative modeling methods.

I spent much of this past summer investigating the Quaternary alluvial deposits of the Cuyama Valley, California. I am using traditional Quaternary field mapping techniques in combination with the latest geochronological techniques to evaluate the dynamics of successive alluvial deposits as well as to evaluate the three-dimensional, time-transgressive nature of alluviation within individual alluvial deposits. My goals are as follows.

1) I am working toward the creation of a high-resolution chronological data set that will complement and expand our understanding of the relationship between climate change, slope processes, and channel response. This will be accomplished through field sampling and AMS radiocarbon dating of organic material and by attempting to validate the application of optically stimulated luminescence dating to dryland fluvial sediments.

2) I am testing the hypothesis that climate change produces vegetation changes on hillslopes that progress systematically upslope with time and are directly recorded as a wave of channel aggradation initiating in downstream reaches and progressing to higher channel reaches through time.

3) I plan to apply my analytical and field results to quantitative numerical models of landscape evolution. Jon Pelletier has advanced our ability to model the interactions between drainage basin evolution and alluvial fan deposits, and I hope to further develop this model and apply it to alluvial river systems.

In addition to those who have so generously donated to the H. Wesley Peirce Scholarship Fund, I also owe a debt of gratitude to the following people for sharing their expertise and/or facilities in support of my research: Jon Pelletier, Jay Quade, Tim Jull, Phil Pearthree, the USGS SCAMP project and the Oxford University Luminescence Dating Laboratory.

H. Wesley Peirce Endowment

Wesley “Wes” Peirce devoted his career to studying the geology of Arizona and informing the public about the impact of “things geologic” on their lives and their communities.

He coined the expression “things geologic,” and he used the term in his public environmental education activities in place of the more formal word “geology” because it permitted the selective development of ideas, principles, and concepts regarding interrelationships among non-living things, processes, and life. And life is fundamentally dependent upon and influenced by the non-living components of the environment.

Wes was Principal Geologist Emeritus of the Geological Survey Branch which is now the Arizona Geological Survey. As a consummate field geologist and meticulous writer, he published more than 80 reports, maps, abstracts, and non-technical articles on Arizona geology. Wes had a passion for teaching, and he eagerly gave of his time and talent to teach teachers, students, and interested citizens about “things geologic.”

Wes died in November 1994 at the age of 70. His family and friends established a scholarship fund in his name to help students studying Arizona and Southwestern geology finance the fieldwork required for a thesis or dissertation.

The H. Wesley Peirce endowment is awarded to one or more graduate students each year. You can help this scholarship fund grow by contributing to the Peirce endowment. In that way, your donation will help support a Geosciences student year after year in their study of “things geologic.”

If you would like to contribute to the H. Wesley Peirce endowment, you can mark the appropriate box on the envelope provided in this newsletter and send your contribution to the Department of Geosciences, or you can contact Lesa Langan DuBerry at telephone 520-626-8204 or email lesa@geo.arizona.edu.

Steve DeLong relaxing in the White Mountains after a summer of dissertation fieldwork in the desert.
Summer Work Updates
From Faculty and Researchers

Julio Betancourt, Jay Quade, and graduate student Amanda Reynolds went on a sampling trip to continue characterizing strontium isotopic variability in ponderosa pine growing in mountains surrounding the San Juan Basin. The results will be used to determine the provenance of ponderosa beams at Chaco Canyon (this has already been done for spruce and fir beams) and to specify the exact scale of geographic variation in the strontium isotopic composition of regional atmospheric dust. They spent part of the trip sampling plants of different life forms growing on late Quaternary basals and cinders at El Malpais National Monument. This material will be analyzed to evaluate the importance of atmospheric dust vs. local weathering products for both soil fertility and genesis. They submitted a proposal to the Western National Parks Association to continue their work at El Malpais, Chaco Canyon, and Aztec National Monument. Later, Julio and Camille Holmgren led a team of students on an expedition to collect packrat middens from the Peloncillo Mountains near San Simon, Arizona. Julio and Jay were awarded funds from NSF-Earth System History to continue their paleoclimatic work in the Atacama Desert.

Bob Butler spent a week in Sonora with Peter Kresan, Arturo Baez (College of Agriculture staff and Geosciences undergraduate major), Floyd Gray (USGS Tucson), Chris Donovan (Sunnyside School District), and Gracie Rendon-Coke (Yuma School District) developing a Summer Geology Program for Hispanic high school students. He also spent two weeks with Pete DeCelles, Kurt Constenius, and graduate student Jan Conder in central Utah collecting paleomagnetic samples from the Charleston-Nebo Salient. They hope to determine the distribution of vertical-axis rotations that took place during tectonic development of this major salient in the Sevier Fold/Thrust Belt. Bob, George Gehrels, and graduate student Chris Butzer spent two weeks in southeast Alaska on a vintage tugboat doing paleomagnetic and geochronologic sampling of Cretaceous and Cenozoic igneous rocks. This project is a paleomagnetic, geochronologic, and geobarometric transect of the Late Mesozoic-Early Cenozoic continental magmatic arc.

Owen Davis started the summer with a lecture on “The Holocene Record of Humans and Environment in the Southwest” at the Department of Geological and Environmental Sciences at Stanford University. From there, he traveled south to Encinitas, California, to pick up some samples from ASM Affiliates, Inc. who had funded the collection and dating of five cores in the area. Owen and graduate student Melissa Trout spent the remainder of the summer in the lab processing the pollen and plant fossils from these cores. Studies of two cores from the Santa Margarita river drainage have been completed. Like cores from the Los Angeles area, the studies record a decline of coastal forests after 10,000 yr B.P., with a potential continuation of large herbivore populations until after 8,500 B.P. During the last ca. 4,000 yr B.P., chaparral and woodland have expanded in these settings. Evidence for human presence begins in the early Holocene and continues intermittently throughout the Holocene into the historic transformation of the landscape.

Mihai Ducea is in the second year of a xenolith study across the western US aimed at understanding the nature of the upper mantle and regional processes such as slab segmentation, root delamination, and continental breakup. Mihai and graduate student Andrew McCarthy are working on quantifying water in nominally anhydrous mantle assemblages and understanding the role of water on upper mantle deformation. A test project aimed at determining single grain garnet Sm-Nd ages is now close to successful completion. This project, conducted in collaboration with Jiba Ganguly, former student Erin Rosenberg, and Jon Patchett, involves a new technique that allows quantitative reconstructions of exhumation paths of metamorphic rocks. More projects are underway in Salinia, Mexico, Hawaii, Carpathians, and Pамиrs. See Mihai’s web page at www.geo.arizona.edu/tectonics/Ducea for more details and a list of recent publications.

Chris Eastoe finished his long-term isotope project on Tucson Basin groundwater and a long-awaited paper is forthcoming. He also began a new groundwater isotope project in collaboration with Karl Flessa spent one week conducting research on the tidal flats of the German North Sea. He worked with colleagues at the Universidad Autonoma de Baja California (UABC) in Ensenada, Mexico. He presented a paper at the annual meeting of the Society for Conservation Biology in Canterbury, England. And he chaired a National Research Council committee on The Geologic Record of Biosphere Dynamics, a key to understanding the biotic effects of future environmental change.

Vance Holliday moved to Tucson from the University of Wisconsin-Madison, where he was a professor in Geography for sixteen years with an adjunct appointment in Geology. Here at the UA, he has an appointment in Geosciences and Anthropology, filling the geoarchaeology slot vacated by Vance Haynes. Vance is the Executive Director of the Argonaut Archaeological Research Fund (AARF), a research endowment focused on the geoarchaeology of the earliest human occupations in the southwestern US and northern Mexico. He started some AARF fieldwork in the basins of west Texas and along the Rio Grande Rift in central and south-central New Mexico. He is finishing up some NSF funded studies on the late Quaternary history of the small playa basins that dot the High Plains of northwest Texas and eastern New Mexico.
**Summer Work Updates cont’d…**

**Paul Kapp** traveled to Tibet where he initiated three new projects. In the first project, Paul and Pete DeCelles started graduate students Shundong He and Andrew Leier on a study of Cretaceous rocks in southern Tibet, with the goal of constraining the deformation history and paleogeography of Tibet prior to the Indo-Asian collision. Paul started a preliminary mapping project of Tertiary basins in central Tibet to strengthen a proposal with Bob Butler and Brian Horton to explore a potential link between basin development and lower crustal processes and to provide a framework for John Volkmer’s fieldwork next summer. Paul and George Gehrels hope that U-Pb detrital zircon signatures of Mesozoic and older sandstones collected this past summer will help determine whether blueschists in central Tibet represent an in-situ suture zone or were underthrust from a suture >150 km to the north.

**Pete Kresan** traveled to Northern Sonora with Bob Butler and friends (see Bob Butler’s entry and the article on page 1). They are very excited about the “Hands Across the Border Program” that will engage high school students from Tucson and Yuma with students in Northern Sonora in a geosciences field experience. Pete, Bob, and others are seeking NSF funding for this program. The goal is to identify interested high school students from diverse backgrounds and help them find majors in geology, engineering, and other sciences. Pete also attended a Spanish Language immersion program at the Institute for Central American Development Studies (ICADS) in San Jose, Costa Rica. It was a superb language program, and he had lots of time to explore Costa Rica with friends and fellow geologists. Pete continues to exhibit his photographs. One of his prints was shown in the “Small Works” show at the Davis Domingeuz Gallery in Tucson with over twenty other Tucson artists. He also had four photo prints on exhibit in the “Cool Waters” show at the Tohono Chul Park Gallery. If you would like more information about the “Hands Across the Border Program,” please contact Pete at pkresan@geo.arizona.edu. He would like to communicate with alumni about ideas and plans.

**David Kring** and undergraduate student Jake Bailey worked on the Chicxulub Scientific Drilling Project in the Yucatan, Mexico, in the Spring of 2002 where they recovered the first continuous core from the impact crater linked to the Cretaceous-Tertiary mass extinction event. Core analyses began during the summer. David and Dan Durda published a paper showing how debris from the Chicxulub impact crater was able to ignite wildfires in North America, central South America, central Africa, and the Indian subcontinent. David also resampled K/T boundary core from the impact crater linked to the Cretaceous-Tertiary mass extinction event. Paul and George Gehrels hope that U-Pb detrital zircon signatures of Mesozoic and older sandstones collected this past summer will help determine whether blueschists in central Tibet represent an in-situ suture zone or were underthrust from a suture >150 km to the north.

**Jonathan Overpeck** spent most of the summer in the lab or in the office catching up on papers, which included new results on what makes the Asian Monsoon system tick. He traveled to China and then to Colorado to work on developing a new community research program focused on abrupt climate change. Graduate student Tim Shanahan and research specialist Winston Wheeler (now in graduate school at Stanford) carried out a multi-week field season at Lake Bosumtwi in Ghana while Peck applied for funds to drill the impact crater lake.

**Jon Pachett** spent most of the summer in Europe taking care of family business. He also traveled to Calgary, Canada, where he worked with collaborators at the Geological Survey on papers about research on isotopes and sedimentary provenance in North America.

**Judy Parrish** worked on a project in two national parks in Alaska. In Katmai National Park, she collected data to establish the stratotype for a new Late Cretaceous-Early Tertiary formation that contains fossil leaves and wood. The formation represents incised-valley fill into Jurassic sedimentary rocks overlooked in previous mapping because only a remnant remains after Pleistocene glacial incision. In Aniakchak National Park, she collected data to characterize the ecosystem of the Chignik Formation and found a preserved fossil forest. Judy just returned from Argentina where she has a project in the Triassic Ischigualasto Basin which includes information on vertebrate and plant taphonomy.

**Steve Richard** completed geologic maps from last field season for the Suizo Mountains and the Durham Hills area on the north side of the Tortolita Mountains. He also worked on Geologic GIS databases for 24K and 100k Map data between Tucson and Phoenix. Steve also submitted a manuscript on a Geoscience conceptual model for a GSA special paper on geoinformatics.

**Eric Seedorff** spent much of the summer working to establish the Lowell Program in Economic Geology. He spent some time in the field in southern Arizona studying porphyry copper deposits and extensional tectonics. He also prepared courses in Physical Geology for the Fall semester, and a new course in Volcanology for the Spring semester.

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**Memorials**

**Hugo Dummett**, president of the Society of Economic Geologists (SEG), was killed in a car accident in South Africa last August while driving at night to an African Minerals’ project after having returned from China. Hugo was a great leader with a warm personality. He was a strong supporter of the department. He was instrumental in sending many students our way and seeing that they were supported. The Geosciences Department at the University of Arizona has lost a true friend.

**Jim Lughry** of Tucson passed away in October. Jim grew up in New York. He received degrees from Dartmouth College and the University of Arizona. His career in mining took him from the Northwest Territories to southern Peru, but his first love was the economic geology of the Southwest. He was an active member of the Society of Economic Geologists, Arizona Geological Society, Society of Mining Engineers, and the Mining Foundation of the Southwest.

**Don Clay**, MS ‘60 and PhD ’70, passed away. Don was a faculty member in the Department of Geology at Arizona Western College in Yuma. His area of expertise was stratigraphy. At the University of Arizona, he worked under Willard Pye and Joe Schreiber.
Oil Company Recruiters
Visit the Department

T his fall, BP Corporation, Chevron-
Texaco, ConocoPhillips, and Exxon-
Mobil each sent two recruiters to visit
the department, interview students, and
talk with faculty.

During their two-day visits, company
representatives gave a general intro-
ductive session followed by individual
interviews. Twenty-seven students
participated in the interviews. Some
students were new to the department,
while others were close to completing their
academic programs. The visiting recruiters also met with
various faculty members to talk
about current issues in the oil
industry as well as research
trends in the department.

BP Corporation, Chevron-
Texaco, and ExxonMobil all
sent one UA alumni as a
recruiter. Each of these
companies also made a generous financial contribution to
the department.

During these times of budget cuts
and economic hardship, their
generosity is greatly appreci-
ciated by faculty
and students alike.

Our thanks go
to each company
and their visiting
representatives for
their interest in
our students and
their continued
support of the University of Arizona’s Department of Geosciences.

Other Department News

Retirements

Elizabeth O’Leary retired in June after over 20 years of
dedicated service as the Antevs librarian. She held the
position longer than any other librarian since the library
was created in 1973 by an endowment from
Geosciences Adjunct Professor Ernst Antevs. After her
official retirement, Elizabeth came in on a volunteer
basis to “tie up loose ends,” but she now states
that, “I’ve gotten tied up in being retired.” Her new
interest is adopting greyhounds from local racetracks.

Jan Price, program coordinator for the Desert Lab on
Tumamoc Hill, retired in July after 14 years of service.
Jan plans to leave Tucson and go to Uganda where she
will be running a children’s orphanage. Best wishes
with your new adventure and responsibilities Jan!

SGE Field Trip

In an effort to widen the scope of Geosciences graduate
students’ experiences, the Sigma Gamma Epsilon (SGE),
a national honor society for graduate students in
geology, is starting a new tradition of planning and
organizing geological field trips around the world.
This coming spring break, students will be traveling to
Hawaii to view the creation of an ocean island through
active volcanic processes and its destruction through
mass wasting.

SGE students have undertaken a variety of fundraising
projects in an effort to defray the costs of this trip.
They are now seeking alumni sponsors; if you would
like to help by making a donation, please contact SGE
president Andrew McCarthy at phone at 520-408-0627
or email mccarthy@geo.arizona.edu.

Mark Your Calendars

GeoDaze 2003 will be held on April 10th and 11th at
the University of Arizona in Tucson. The event will take
place in the new Student Union. Bill Dickinson will host
a field trip on Saturday, April 12th. Please plan to join
these activities.

The Geosciences Advisory Board will have their annual
meeting on April 10th and 11th as well.

Tucson area alumni will be invited to attend a GeoDaze
wrap-up social event on April 11th. Watch the mail for
your invitation/RSVP!

Alumni Drawing Winner

Terry Gerlach (PhD ’74) with the USGS in Vancouver,
Washington, won a Geosciences T-shirt for sending in
his updated contact information.
### Spring & Summer Degrees 2002

**Bachelor of Science**

Barbara Brandt • Beth Christine Duschatko • Melissa Giovanni  
Beverly Marie House • Sara K. McNamara  
Anne Marie Paquette • Marie D. Renwald

### Master of Science and Doctor of Philosophy

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**Congratulations to all of our graduates, and best wishes in your new pursuits!**
1950s

Don Layton (BS ’56, MS ’58)
I have beat the odds – retired more than ten years. Fifty years ago, I was smoking up the campus, now I’m on oxygen. A few names in your newsletter still catch my eye such as Wes Pierce, Neal McClymonds, Ed McCullough, Bernie Pipkin, Spence Titley, and Dee Trent. Being a married vet at the time, I was more familiar with Polo Village than the Student Union.

Arthur Mirsky (MS ’55)
On April 20, 2002, Dr. Arthur Mirsky (BA ’50 University of California, MS ’55 University of Arizona, and PhD ’60 Ohio State University) Professor Emeritus of Geology, Indiana University-Purdue University Indianapolis was awarded the 2002 Lifetime Achievement Award from the Professional Geologists of Indiana. The citation for the award said in part:

Beginning in 1967…you initiated the teaching of Geology at the very small regional campus of Indiana University. Using a vision of what could be, and with many hurdles to overcome, you constructed a full-fledged Department of Geology, which is now a major part of a unique education institution: Indiana University-Purdue University Indianapolis. That Department has now educated tens of thousands of students, and graduated hundreds of geology majors. Of the geology majors, some have gone on to obtain advanced degrees in geology and pursued college-level teaching and research, while many others have successfully entered the ranks of industry, government, or consulting. And at the same time, you continued your research….And while many others have successfully entered the ranks of industry, government, or consulting. And at the same time, you continued your research.

Barry Watson (MS ’61, PhD ’64)
I am still working full-time as a consultant for US Borax (Rio Tinto organization). I am now past normal retirement age, but still in good physical condition. I love the job, and I am still welcome with Borax after 31.5 years. Most of my work is in the Mojave and Death Valley regions. I’m still a huge Wildcat basketball fan and a Lute Olson “rebounder.”

1970s

Jeff Wynn (PhD ’74)
Jeff is currently a research geophysicist for the US Geological Survey in Reston, Virginia. In February 2002, he was elected President of the Environmental and Engineering Geophysical Society. He was awarded the 2000 Pan Am Championships medal in Combat Sambo (Russian Martial Art) and a black belt in Budoshin Jujitsu. He also teaches self-defense classes at the Reston YMCA. In November 1999, the International Astronomical Union designated a asteroid as “9564 Jeffwynn” For more details see http://minerals.usgs.gov/east/wynn. Jeff was one of George Davis’ students. Jeff said “He was the best instructor I ever had.”

1980s

Mohamed Essa (BS ’80)
Thanks for sending me the Geosciences Newsletter. It is a great honor for me to get news from the University.

I am now married with three children. I am working in the oil industry in Oman. I am in the exploration department, and I am currently looking for hydrocarbons in the Lower Paleozoic sediments. I will soon be a team leader. Cheers and all the best.

Hamdi El Ghonemy (MS ’88)
I have recently accepted a new position. I am now a Technology Manager at British Nuclear Fuels in the UK. I am responsible for providing technical direction on all issues related to hydro-geological investigations, development of conceptual models for risk assessment, and negotiations with regulatory authorities for the disposal of nuclear waste.

1990s

Lesley Perg (BS ’95)
I visited the UA in October to give a talk, "Life’s a beach: Cosmogenic nuclides along an active margin coastline;" to talk with Jon Pelletier about research and teaching geomorphology; to talk with Karl Flessa about the Sloan Minority Fellowship program; to recruit potential graduate students; and of course to see my former professors (and now colleagues).

Shannon Mack (BS ’98)
Shannon left Tucson and is now working as a librarian for Raytheon in Goleta, California.

2000s

William (Ed) Wright (PhD ’01)
Ed accepted a two-year fellowship at Lamont Doherty at Columbia University, New York.
Please update your contact information!

We are especially interested in your E-mail address as we hope to produce electronic news bulletins in the future.

Name ________________________________________________________________

(Circle the address that you prefer as a mailing address.)

Home Address
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Business Address
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Phone: _____________________________

E-Mail: _____________________________

Employer and Job Title: ___________________________________________________

New job? Kids? Back in school? Retired? Attend national meetings? See a classmate? Take a trip? Send us your news for future newsletters (please include a photo that will be returned).

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Send your information by US mail or E-mail!