Geology News

Department of Geological Sciences ▲ University of Colorado at Boulder ▲ Summer 1995

Message from the Chair

The Department of Geological Sciences at CU-Boulder was created 93 years ago. We moved into our present building in 1911, barely a decade after the great antiquity of the earth had been finally resolved. X-rays had only recently been discovered and their utility in studying minerals had not yet been realized. Mass spectrometers, scanning electon microscopes, microprobes, and most of the other fundamental analytical tools that we use today had not yet been invented. So it is not surprising that the original building was not designed to accommodate the tools that form the basis of modern scientific inquiry. Many of our faculty are currently forced to occupy laboratory space in other buildings, simply because our building cannot provide the infrastructure required for modern instrumentation.

The earliest geologists were superb observers of the natural world. And the Department has a proud tradition of producing well-trained field observers. Whenever I talk with alumni, they invariably remember most fondly their field experiences. In fact, one of our finest recruiting tools is the utilization of the field as a classroom. Although the application of sophisticated analytical facilities has fundamentally altered the way we approach our science, the requirement of keen observation remains one of the hallmarks of the discipline. Of what use are precise measurements on poorly collected samples? And at the same time, we will not fulfill our role as educators if we do not show students how to extract the maximum amount of information out of their carefully collected specimens. A new building, capable of housing our expanding array of analytical facilities, will allow us to involve students in the analytical as well as field aspects of the discipline, and in so doing, even better prepare our students for professional careers in the earth sciences.

Geology is an integrating science. We draw on the principles of physics and chemistry, the theories of mathematics and biology, and apply them to real-world situations. As geologists, we have a special responsibility to use those principles to understand the physical aspects of our planet. These responsibilities include evaluating natural resources essential for economic development and understanding the impacts of a growing population so that we can maintain an environment conducive to all life. Broad recognition of the importance of these endeavors has rekindled student interest in the earth sciences: over the last five years, the number of students enrolled in Geology courses at CU-Boulder has more than doubled and the number of majors has more than tripled. A new building will allow us to better respond to the increasing demands from students who want to know more about planet Earth.

Working with our architectural firm from Denver, we have sought to design a new home for the Department that will meet the needs and aspirations not only of the current faculty and students, but of those well beyond the turn of the century. In the long process from vision to construction documents, we have learned more about floor plans, conduits, modular components, value engineering, and the myriad technicalities that are part of any modern building than any of us care to remember. But through this process we have forged a structure that will reflect the discipline and is in keeping with the rural Italian look that characterizes the Boulder campus architecture, while maintaining a distinctive presence. Inside, most of the activities will be located on the four main floors, with a large portion of the basement unfinished for future expansion and a fifth floor housing mechanical support. Orientated along a north-south axis on Colorado Avenue directly across from the Stadium, the building will take advantage of its southern exposure. Faculty/student offices face the new mall, backed by common dry lab space, while the north side houses the laboratory block and most of the classrooms. The heart of the building is a central four-story glass-roofed atrium that defines the building. The library and auditorium open directly to the atrium, with administration being accessed via a grand staircase. All of the introductory classrooms are located on the first two floors and we have purposefully designed windows into the research labs passed by students as they walk to class, in order to provide a flavor of our research activities to potential majors. Built-in lockers and an undergraduate study room were carved out of storage space in response to student input.

Although the new building is foremost in the eyes of most of us, we also had a successful year recruiting new faculty members. We received permission to recruit a structural geologist early in the fall. The search committee, chaired by Paul Weimer, had their hands full, reading through more than 150 applications. Five excellent finalists were brought to campus, and an offer was extended late in the spring to Dr. Karl Mueller, currently a postdoctoral fellow at Princeton University. Karl will arrive in mid-summer and take over the structural geology course and a new structural field course next year. Karl has his work cut out for him: nearly all majors remember structure and field from Bill Braddock.

Meanwhile, INSTAAR was recruiting a new director to replace Mark Meier, who stepped down after 8 years at the helm. Although the new director could have been housed in one of several Departments, the top candidate was a geologist. James Syvitski, from the Bedford Institute of Oceanography in Canada, will become director of INSTAAR and Professor of Geological Sciences this fall. James' specialty is sediment transport from land to shallow marine environments.

Finally, the Department was able to take advantage of funds set aside by the University to recruit protected class individuals to recruit Julia Cole as an Assistant Professor of Geological Sciences. Julia recently received her Ph.D. from Brown University and is an expert on the geological record of El Niño and modeling the global climate system. She intends to develop a climate modeling program in the new building and will be teaching our popular 1000-level global change course.

The only reason we can recruit a new generation of faculty is by retirement of those faculty who have served the Department for many years. At a reception in April we formally recognized those faculty, known to large numbers of alums, who were retiring this year or who had recently retired. These include Bill Braddock, Don Eicher, Carl Kisslinger, Mark Meier, and Jack Edwards. There was a fine turnout of faculty, students, alumni, and friends to recognize the many contributions made by this group. They may be retired, but the emeritus faculty continue to actively contribute to Departmental activities.

The Department initiated an undergraduate mentoring program this year. With funds donated through the CU Foundation, this program allows graduate students, faculty, and postdocs to hire undergraduate majors as assistants in their research, and in return they serve as mentors to the undergraduates. The goal is to enhance the educational experience by engaging the majors in actual research activities and by providing a mentor who can serve as a resource for professional opportunities and graduate school. This year about 30 proposals averaging $1000 each were funded.

There are some special perks associated with teaching at a university. One of my favorites is that we live in a perpetual spring. Every year the campus floods with new students, enthusiastic, optimistic, eager to create their futures and live their dreams. Like spring bulbs they never age. In such an environment it is easy to pretend that we, like the students, remain forever young. And now that the seeds for a new building, planted nearly two decades ago, have germinated and a new building will be a reality, the sense of spring is stronger than ever. Actual groundbreaking for the new building is set for this fall with an 18-month construction phase. Stop by and watch the ground give birth when you are next in town.

—Gifford Miller

Join the Party!

John and Bobbi Harms enjoy a moment at the end-of-semester party. See pages 10, 11, and 15 for more photos.

University of Colorado at Boulder
Department of Geological Sciences
Campus Box 250
Boulder, Colorado 80309-0250

Nonprofit Org.
U.S. Postage
PAID
Boulder, CO
Permit No. 257

News on Courses and New Courses

Mineral Resources, World Affairs, and the Environment

Jack Edwards continues to teach the course and reported on one class excursion during the fall term. The trip was to a drilling gas well in the Wattenberg Field in eastern Boulder County, a well operated by Gerrity Oil and Gas Company. Erie Lipinski, Senior Geologist for Gerrity, explained the operation of the rig and displayed logs and maps showing the objective Codell gas at a depth of 7,000 feet. The gas-oil separator was also visited and its operation explained.

The Wattenberg Field was discovered in 1970 by a well drilled about three miles northwest of Brighton that found gas in the J sand. Development of the gas reserves in the J sand progressed outward in all directions and led to further discoveries in the shallower Sussex, Shannon, Parkman, Niobrara, and Codell zones, as well as in the deeper Dakota. Today production comes from all these horizons, but the majority of gas is from the Codell sand. Although the Codell blanket sand has low permeability, virtually all the productivity is attributable to hydraulic fracturing which allows the oil and gas present in the rock to be released.

How big is Wattenberg? How big will it get ultimately? First, even though drilling has been going on for over 20 years, the outward limits are only roughly defined and the total area today exceeds one-half million acres. Second, economics will dictate the ultimate field size since continued development depends on favorable pricing of oil and gas to allow an adequate return on investment.

This field is part of the Denver-Julesburg (or D-J) basin of northeastern Colorado, southeastern Wyoming, and western Nebraska and encompasses an area of 60,000 square miles. To date, the basin has produced about 1 billion barrels of oil and 2.5 trillion cubic feet of gas. Daily production is now approximately 33,000 barrels of oil and 330 million cubic feet of gas from about 8,700 wells.

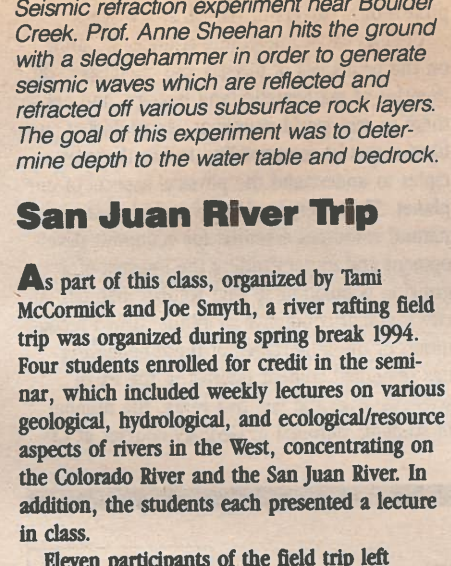
Geomorphology Field Trip

This annual Caine-Pitlick-Birkeland course went to northern New Mexico last spring. For once they beat the cold and snow. Topics observed on the first day were neotectonics of the Rio Grande Rift, origin of desert rock varnish, and processes responsible for the erosion of bedrock canyons. They then moved over to Chaco Canyon and learned about Anasazi archeology and the Holocene alluvial history of the valleys.

Applied Geophysics

This new course was introduced to the Geological Sciences curriculum by Professor Anne Sheehan this past fall as an elective for majors. This course covers theory, field practice, computational fundamentals, and interpretation techniques of geophysical exploration focused on exploration of the shallow subsurface. Geophysical techniques used by resource exploration, environmental, and engineering fields (including seismic refraction and reflection, gravity, magnetics, electrical methods, ground penetrating radar, and surveying) are covered (photos). The lectures are complemented by weekly field experiments and computer modeling/interpretation exercises to give the students hands-on experience with solving real geophysical problems. Several alumni and community contributions have greatly enhanced the course, including the loan of ground penetrating radar equipment from Oyo Geophysical, a visit to a working Lockhart Geophysical vibroseis crew, magnetics exploration at the Caribou/Cross Mine near Nederland and on City of Boulder property, and a groundwater exploration project using seismic refraction and resistivity on property owned by an alumnus in southeastern Utah. An NSF Undergraduate Equipment and Instrumentation Proposal is currently pending to allow the purchase of earthquake seismic equipment in order to add an earthquake hazards component to the class.

*Jack Edwards (that's him on the right) setting up a trilobite display on the first floor. This one is a giant cambrian trilobite (*Acadoparodoxides briareus*) from Morocco.*



Visit to Lockhart Geophysical vibroseis crew (seismic reflection) in southeast Wyoming.

Seismic refraction experiment near Boulder Creek. Prof. Anne Sheehan hits the ground with a sledgehammer in order to generate seismic waves which are reflected and refracted off various subsurface rock layers. The goal of this experiment was to determine depth to the water table and bedrock.

San Juan River Trip

As part of this class, organized by Tami McCormick and Joe Smyth, a river rafting field trip was organized during spring break 1994. Four students enrolled for credit in the seminar, which included weekly lectures on various geological, hydrological, and ecological/resource aspects of rivers in the West, concentrating on the Colorado River and the San Juan River. In addition, the students each presented a lecture in class.

Eleven participants of the field trip left Boulder on March 19. Geology was discussed en route and at occasional stops on the way to Grand Junction. They camped the first night at Colorado National Monument. On the 20th the group traveled through the monument, which includes a monocline of Jurassic and Triassic sediments draped over the northern end of the Uncompahgre Uplift. They took a route to Bluff, Utah, via Unaweep Canyon, a paleovalley of the Colorado River, and the salt anticline of Paradox Valley. This allowed them to discuss the entire stratigraphic section and to examine a wide range of geological processes. In addition, they were able to discuss the ecological aspects of McPhee Reservoir and the salt content of the Colorado River.

There were thirteen participants in the rafting portion of the trip. These included undergraduate and graduate students majoring in Geography, Geology, Environmental Science, and Biology (EPOB), faculty from the Geology Department, Geology alumni, and associates with backgrounds in geology and archeology. Six of these participants had river experience and helped with the logistics of the trip, which was run entirely as a private trip, with the Geology Department contributing the costs of van and raft rental.

They launched from Sand Island, a few miles west of Bluff, on the 21st. The first day included floating through Jurassic sediments, primarily Navajo Sandstone, to their first camp at Butler Wash. They were able to take a two-hour hike to visit sites of archeological and historical significance. Day 2 comprised a stop at the Kachina Wall near mile 4.5 where there are particularly interesting and well-preserved petroglyphs, exploring River House Ruin, an Anasazi site, floating through the steep eastern flank of the Monument Upwarp and a two-hour stop at the Mule Ear Diatreme. They camped just below 4-foot rapid, just west of Comb Ridge. On Day 3 they floated through Lime Ridge and Raplee Anticlines and Mexican Hat Syncline, with spectacular exposures of marine fossils and bioherms in the Pennsylvanian limestones of the Hermosa Group near 8-foot rapid. After resupplying at Mexican Hat, they proceeded through the Goosenecks to camp at the narrowest point, Mendenhall Loop. Day 4 was spent covering 28 river miles to John's Canyon. On Day 5, they stopped for a hike at Slickhorn Canyon and proceeded to camp at Grand Gulch. From there to the takeout at Clay Hills on the 26th, the river traverses the western limb of the Monument Upwarp. This section of the river was flooded by Lake Powell in the 1983 and 1984 high-water years and they got to experience first-hand the effects of increased sediment deposition on the river channel. The group then returned to Boulder via Moab and the river road along the Colorado River.

The New Field Geology

With Bill Braddock's retirement, we had to do some rethinking about the field geology course. We decided to offer it in modules. The introductory course is a 2-credit sophomore course (GEOL 2700) that covers the main skills needed in field geology (describing, measuring, mapping, etc.). About 30 students are enrolled in the course, taught by Don Eicher and Ed Larson (photo). Ed had to tell them how lucky they were to be taught by over 50 years of geological experience! Two afternoons a week are spent on outcrops and areas familiar to many of you—Lee Hill Road, Flagstaff Mountain, Six-Mile Fold, Rabbit Mountain, and North Table Mountain. Pete Birkeland will teach this course in the fall.

One or two years from now students will complete their field requirement by taking advanced field modules with choices such as stratigraphy, geohydrology, structure, ore deposits, and surficial mapping. Many faculty will participate in teaching these courses.

Meanwhile, 411 is being taught for the last time by Alan Lester. This is being done to accommodate the more advanced students in the geology program. Alan (Ph.D., 1992) will teach the sophomore field course this summer. He also teaches Geology of Colorado through Continuing Education and Geological Field Techniques of the Front Range through the Mountain Research Station (old Science Lodge) and Rocky Mountain Nature Association. Alan is one of the premier rock climbers in the region, and enters many competitions on artificial walls.

continued next page

Don Eicher and Ed Larson planning an exercise for the sophmore field class.

Fall Advisory Board Meeting

The Department of Geological Sciences Advisory Board met on November 11-12, 1994, in the Norlin Library Conference Room. Issues discussed included the implementation of the Department's new Strategic Plan, the development of a curriculum for environmental geosciences, the prioritization of new faculty hires, and the utilization of the new geological sciences building.

The schematic design for the new building was presented by the new building committee, which is composed of Giff Miller, Lang Farmer, Suzanne Larsen, and Pam Topping. An EMARC update was presented by Jack Edwards and Paul Weimer. Cirricular issues included presentations by Vijay Gupta on the proposed hydrological sciences Ph.D. program, by John Rundle on the new complexity initiative, and by Jim White on the environmental studies program.

Chuck Middleton, Dean of Arts & Sciences, discussed CU-Boulder in the year 2000 and the role of earth sciences. Finally, Carol Lynch, Dean and Associate Vice-Chancellor of the Graduate School, discussed interdisciplinary research and teaching at CU-Boulder.

New Courses, cont.

Program in the Sciences of Complexity at CU-Boulder

A new program in the sciences of complexity is being proposed at the University of Colorado. A committee led by two faculty in Geological Sciences, John Rundle and Vijay Gupta, was organized to plan the establishment of both a research Center for the Study of Complex Systems and an undergraduate certificate program in the sciences of complexity. The proposal for the Certificate Program has been submitted to the College of Arts and Sciences.

As part of the organizational activities, the Committee was awarded $5,000 from Graduate School funds to bring in a number of distinguished lecturers during the spring semester. These included David Campbell of the University of Illinois; John Hopfield of Cal Tech; James Crutchfield of Berkeley and the Santa Fe Institute; Donald Turcotte of Cornell; and Stuart Kauffman of the Santa Fe Institute.

Within the last two decades, new approaches describing the evolution of complex interacting systems are emerging from fields as diverse as physics, mathematics, population dynamics, economics, biology, earth sciences, and computer science. As they are commonly defined, "complex systems" are characterized by collective properties, associated with the system as a whole, that are nonlinear, often feature feedback or thresholds, and often involve many degrees of freedom. The effects of chance appear generically and often in these systems, requiring the use of tools from probability theory.

The study of complex systems is fundamentally an interdisciplinary activity and must involve personnel from many different fields interacting in a common academic/intellectual setting. Many techniques and ideas for analyzing the behavior of other fields far from the original application are used. For example, numerical simulation techniques used in the study of complex natural systems represent a new way of using computers as laboratories for experimental mathematics. In fact, one need only look to the large and rapidly expanding technical and popular literature on this subject to be assured of the widespread relevance and importance of these ideas in many areas of science, society, literature, and art.

The CU-Boulder campus hopes to take an early national and international lead in developing an interdisciplinary, but focused, teaching and research program in this area. The initiative must integrate classroom teaching from the freshman level to the advanced graduate level. The objective would be to provide students with the tools to understand this rapidly developing field. The research program will be modeled along the lines of the Santa Fe Institute, a private graduate research and teaching institution in New Mexico, and will perhaps lead to the establishment of a research Center for the Study of Complex Systems. This center, should it be established, will play an integral role in the graduate teaching aspect of the program here at CU.

There are a number of advantages inherent in this idea. By emphasizing "generic" teaching and research applicable to many fields, the certificate program will generate an exciting, forward-looking intellectual and research climate at the University; produce students and research products that have wide flexibility and applicability; bring researchers in disparate fields together, reversing decades-long trends toward overspecialization; offer courses that will cross-cut many existing subfields; optimally use faculty resources; and train students and researchers in the rapidly expanding area of high performance computing and communications.

This certificate program will be unique not only along the Front Range, but nationally and internationally as well. To our knowledge, Cal Tech is the only other university in the world currently contemplating anything like this undergraduate program.

Suzanne T. Larsen, Head, Earth Sciences Library, Comments on Jerry Crail Johnson Earth Sciences Library

The Earth Sciences Library will become the Jerry Crail Johnson Earth Sciences Library in the new geological sciences building. The Crail Johnson Foundation was an important source for the funding that made both the Library and the building possible. Several members of the Johnson family have attended CU-Boulder, including Eric who received a B.A. in Geology in 1982. The Library is named in memory of Eric's mother, who was the first woman to receive a degree in geology from Northwestern University and had a lifelong interest in books and libraries.

This expanded Earth Sciences Library has been a dream for many years. The focus of the planning has been to create a flexible, user-friendly facility that will serve CU's earth sciences community many years into the future. With the advent of electronic access to information, the world of libraries today is in a constant state of change. The challenge in planning the new Library has been to try to guess what the future might bring.

Much of the basic planning for the Library has been finalized. It is now possible to describe how the Library will actually look. It will be spread over two levels on the south side of the building, covering over 10,000 sq. ft. This is four times the amount of space we have currently. Windows from the entry level of the Library face out onto a tree-shaded porch area. Eventually there will be a large grassy quadrangle beyond, to the south of the building. The entrance to the Library will be through the atrium, which is the very heart of the building. The first floor of the Library will focus primarily on reference and electronic information access. The LAN (local area network) we currently have will be expanded and enhanced. Access to information and databases in digital spatial format will be provided as well. Current information access will be made easier by locating the current unbound journals and the last five years of the bound journals near this reference area. The Circulation/Reserve desk will be located adjacent to the entrance. There will be some study space on this floor, but the majority of the seating will be on the lower level.

The lower level of the Library is in the basement but has access to natural light from two large openings in the floor next to the windows on the level above. The map collection will move from Norlin Library to the Jerry Crail Johnson Earth Sciences Library and will be housed in this lower level. Compact shelving on this level will be used for the entire collection. Compact shelving uses special shelf units mounted on tracks. There is only one aisle for every 5 or 6 shelf units. The units are motorized so that a press of a button will move them to allow the aisle to be created wherever it is needed for access to the books. (A similar system was installed recently in the new Engineering Library on campus.) This will allow us to finally unite most of the collection by bringing material back from storage in Norlin. Seating, at tables and in study carrels, will be dispersed throughout this level.

Two group study rooms will be available for students needing a place to work together on a project. One of the rooms will double as a room for bibliographic instruction. With the advent of electronic access to information on CD-ROM and the Internet, the need for instruction in the use of these resources has skyrocketed.

The construction of the new geological sciences building containing the Earth Sciences Library between the Engineering Center and Duane Physics will establish a science information corridor on the east side of campus. We will be located between the newly constructed Gemmill Engineering Library and the Lester Math/Physics Library. In addition, a central science library is projected to be built between our building and the Engineering Library on the Campus Master Plan. It will contain chemistry, biology, and the other sciences currently located in Norlin Library.

It is an exciting time. We hope to be greeting you in our new facility by the summer of 1997! In the interim, if you wish to access the University Libraries' new on-line system, Chinook, just use the Internet to telenet to libraries.colorado.edu or 128.138.129.251. I can be contacted at (303) 492-6133 or larsen@spot.colorado.edu if you have any questions.

Some graduates with Suzanne Larsen, Librarian, at a recent gradaution. They are (l to r) Becky Sauer, Kathy Zanetti, Suzanne, Barry Eakins, and Kathy Zelinski.

Department News

Colloquium

The colloquium for fall semester had a wide variety of talks. Here are the speakers and their topics.

Dr. Dennis Eberl (USGS, Boulder): "How mud becomes shale: An example from the Gulf Basin"

Dr. Linda C. Gundersen (USGS, Denver): "Natural radioactivity in earth, air, and water: Environmental concerns"

Dr. Gary Sidder (USGS): Fe-Cu-REE Olympic Dam type deposits in the mid-continent"

Dr. Robert Burrus (USGS): "Fluid inclusion studies: An interdisciplinary approach to crustal fluid histories"

Dr. Yu-Shen Zhang (University of California, Santa Barbara): "Continental dynamics and s-wave velocity structure"

Dr. Geoff Taylor (University of New South Wales, Australia): "Remote sensing tools for monitoring saline soils"

Dr. Ute Herzfeld (INSTAAR): "Geologic history of the Explora Escarpment, Weddell Sea, Antarctica: An application of geostatistics to satellite and shipboard geophysical data"

Dr. David Vanlman (Los Alamos National Laboratory): "Geological controversies at the Yucca Mountain Radioactive Waste Isolation Site in Nye County, Nevada"

Dr. Harley Benz (USGS): "High resolution imaging of the upper mantle using a dense, large-aperture seismic array"

Dr. Douglas S. Robertson (NOAA, NOS, CIRES): "VLBI and modern geodesy"

Charles Patterson (CU-Boulder): "Geochemistry of Boulder Creek"

Dr. Joan Fitzpatrick (USGS, Denver): "Anomalous aspects of Taylor Dome (E. Antarctica) ice core physical properties"

Dr. James Rytuba (USGS, Menlo Park): "Cenozoic metallogeny of California"

Local alums are especially invited to join us at the Colloquium.

This is a view from the "Hill" to the Geology Building. We now get there via a new underpass. Unfortunately, this takes away the challenge of dodging cars, a sport of most students and faculty for decades.

Office staff, from left, are: Kathe Kelley, Lynn Jackson, and Mary Wikoff. Kathe is the receptionist, Lynn works with all the graduate students (by having them stand at attention while she reads the department rules to them!), and Mary does the accounting.

Retirements

We have four retirements to report. For the write-ups on Professors Braddock and Eicher, we are adding to the information in Larry Warner's book about the department, *Profile of a Department: Geological Sciences.*

Bill Braddock

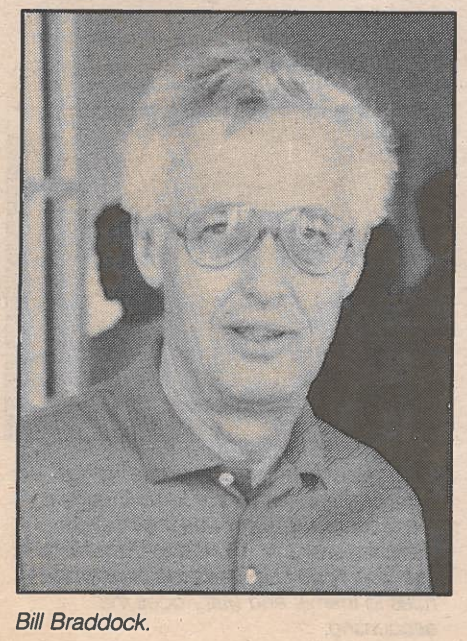
Bill Braddock (photo) completed a B.A. degree with the Department in 1951, worked for two years (1952-1954) with the U.S. Geological Survey, embarked on a doctoral program at Princeton, and was appointed as Instructor in 1956. He achieved professorial status upon completing the Ph.D. in 1959.

Bill's teaching has centered mainly on courses in field and structural geology. His undergraduate courses have been designed mainly to acquaint students with geologic mapping techniques and the geometric analysis of rock structures. Advanced courses have dealt with physical and chemical processes of rock deformation and with microtectonic and petrofabric studies.

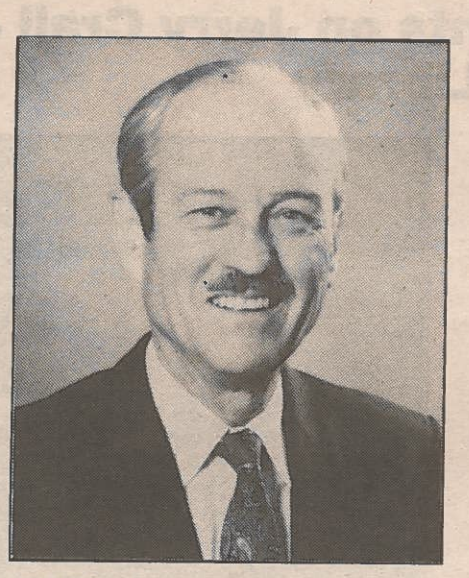
Braddock retained his association with the U.S. Geological Survey and managed to sell the agency on the desirability of working out the structure and petrology of the basement complex in the northern Front Range, a project that has occupied most of his summers from 1956 to the present. He was able to fund student assistants through this work, and some two dozen graduate theses have emerged from his effort. In collaboration with USGS colleagues, Bill was able to show that the Front Range basement has had a long and complex history involving three, and perhaps four, periods of deformation extending over a time interval comparable to the entire Phanerozoic. We (and Bill) are happy to report that the years of mapping have paid off in 16 USGS quadrangle maps (check out GQs 1614-1629). The Table Mountain Quad is Map I-1805 and Rocky Mountain National Park is Map I-1973. This is an exceptional accomplishment and a great legacy for future generations of students in the Front Range.

Beginning in 1968, Braddock developed a laboratory for experimental deformation of fine-grained sedimentary rocks. The equipment is capable of deforming samples at temperatures to 500°C at confining pressures to 2kb. for strain rates in the range 10^{-5} to 10^{-8} per second. It also can be used to perform creep tests at constant axial stress. This work has been supported by the Engineering Geology and Tectonics Branch of the USGS with a view to obtaining data needed to evaluate the possibility of using shales as repositories for toxic wastes. Braddock and his students have carried out experiments, mainly low temperature creep tests, during intervals between field seasons in the Front Range Precambrian.

During Bill's latter years in the Department he became very proficient with geologic applications of computer software. In retirement he will continue teaching this to undergraduates in a lab he built adjacent to his office (where Chris Harrison used to store geophysical equipment).



Bill Braddock.



Jack Edwards.

John D. Edwards

Jack Edwards (photo) retired from the University in December. He has been director of the Energy and Minerals applied Research Center (EMARC) for the past three years.

Jack received a B.S. in Mechanical Engineering from Cornell University in 1946 (the same year he was discharged from the Navy), attended Colorado School of Mines in 1948-49, and in 1952 obtained a Ph.D. in Geology from Columbia University.

He began his geological career as a field geologist with the United States Geological Survey in Mexico. Stratigraphic studies of Tertiary red conglomerates in central Mexico was the subject of his dissertation, published as USGS Professional Paper 264-H. In 1950, he joined Shell Oil Company. From then until 1962, he gained experience in field geology, photogeology, and subsurface interpretation in west Texas, New Mexico, and southern Colorado. From 1962-1966 he worked in Shell's California region, as Division Exploration Manager in Bakersfield and as Area Exploration Manager in Los Angeles. in 1966, after a six-month training assignment in The Hague, he was appointed Chief Geologist for Shell Oil in New York City and later Assistant to the Vice-President of Exploration. He became Exploration Training Manager in Houston in 1974 and in 1979 joined the Shell Oil subsidiary, Pecten International Company in Houston. His final position at Pecten before his retirement in 1987 was Latin American Exploration Operations Manager. He worked principally on exploration ventures in the Brazilian Amazon and offshore.

During his retirement Jack was an AAPG Distinguished Lecturer on the subject of Divergent/Passive Margin Basins and edited AAPG Memoir 48 (1990) on the same topic.

Jack came out of retirement in 1992 to take on the directorship of EMARC. During this time he presented one-week structural geology training courses for International Human Resource Development Corp. in Jakarta, Brisbane, Melbourne, and Rabat. In the Department he taught and helped teach many courses. These included Fold Belts and External Basins, Senior Paper, and Mineral Resources, World Affairs, and the Environment. The latter course is for non-majors and he was able to bring in many local experts as guest lecturers.

Jack has been active in many organizations and performed valuable service. These positions have included acting as Associate Editor of the Geological Society of America Bulletin and AAPG Program Chairman for three annual offshore technology conferences in Houston. He currently is a counselor of the RMAG.

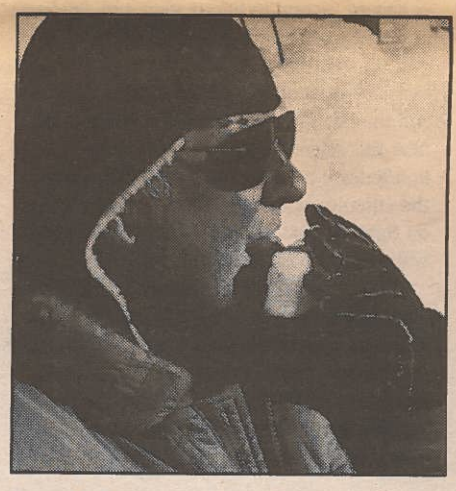
During retirement, Jack will also continue to teach the non-major Mineral Resources and Senior Paper courses. He presents oil-related lectures to classes in Economics and Law. In his spare time he goes on the road to recruit Native American students from Colorado and New Mexico to the Department. Jack is deeply involved in crude oil and alternative energy forecasts for the 21st-century world and USA; it will be submitted to the AAPG soon. At other times, he and his wife have 5 children and 13 grandchildren to keep them busy.

Mark F. Meier

Mark Meier (photo) joined the Department of Geological Sciences in November, 1985, as the new director of INSTAAR. Mark grew up in Iowa, but was attracted to mountains and mountaineering at an early age. He served in the U.S. Navy during World War II, which gave him some knowledge of electronics. He subsequently received a degree in Electrical Engineering at the University of Iowa, but love of the mountains prevailed and he did a Master's Degree in Geology from that university. The outstanding glaciologist in academe at that time was Robert P. Sharp at Cal Tech, so Mark headed for Pasadena, receiving a Ph.D. in Geology and Applied Mechanics. While there he also taught at Occidental College, where he met Barbara McKinley. After a few months cooling his heels on the Greenland Ice Sheet, he and Barbara were married and were off for an academic year (Fulbright Grant) in Innsbruck, Austria, where Mark delved into the field of glaciometeorology.

In 1956 Luna Leopold, then Chief Hydrologist of the U.S. Geological Survey, decided to begin a glaciological research program in its Water Resources Division and hired Mark to set it up. Mark established a group in Tacoma, Washington, a place that offered easy access to mountains and real glaciers. In the ensuing decades this program grew, with research sites established from the Sierra Nevada to the Alaska Range. Mark also became heavily involved in setting up international glaciological programs under the sponsorship of the International Hydrological Decade, UNESCO, and the International Commission on Snow and Ice. Barbara noticed that while she was at home raising kids, Mark seemed to be spending every April in Paris, ostensibly at work organizing these programs, and, of course, spending the summers on various and sundry glaciers. In spite of this, the marriage somehow lasted, and the children are doing well.

Mark and Barbara's move to Boulder was



Mark Meier doing his favorite things, studying and eating snow.

the juxtaposition of a feeling that Mark had accomplished all that he could with the USGS and an offer from CU that he could not refuse. Mark had been on the National Academy's committee that developed the program now known as global change, which also served as the template for the International Geosphere-Biosphere Programme. One of Mark's first initiatives at CU was to begin a teaching program in this new interdisciplinary paradigm; these courses are now quite popular. Under Mark's guidance, INSTAAR grew with a major increase in regular faculty associated with several departments including Geological Sciences, a strengthening of the Mountain Research Station, a five-fold increase in research support, and increasing visibility on the national and international scene. Mark has continued in his free time to do research in the fields of glacier dynamics, the penetration of meltwater into subfreezing snow, iceberg calving, and the effect of glacier wastage on global sea level. He has also been involved in the formation and direction of the Arctic Research Consortium of the U.S., development of the National Ice Core Laboratory, session organization for the Aspen Global Change Institute, and, currently, lead authorship of the Intergovernmental Panel on Climate Change 1995 Scientific Assessment.

Mark's professional activities have received recognition. He was elected president of the International Commission on Snow and Ice, president of the International Association of the Hydrological Sciences, vice president of the International Glaciological Society, fellow of the American Geophysical Union, Geological Society of America, American Association for the Advancement of Science, governor of the Arctic Institute of North America, and honorary member of the International Glaciological Society. Awards have included the Department of the Interior's Distinguished Service Award (gold medal), three medals from the Academy of Science of the USSR, the Seligman Crystal of the International Glaciological Society, several distinguished lectureships, and a valley in Antarctica named in his honor.

It is interesting to note that Mark's position as Director of INSTAAR involved a faculty position to be freed with the retirement of Bill Bradley. In their initial visit to Boulder, Barbara, an avid weaver, came along to learn about the weaving community in Boulder. She was graciously shown around by the then president of the Handweavers Guild of Boulder, Louise Bradley. The 1995 president of the Handweavers Guild of Boulder is Barbara Meier. The new director of INSTAAR, taking over Mark's faculty position, will be James Syvitski. It should come as no surprise then that Diane Syvitski is a weaver.

Mark expects to continue on a part-time basis for several years, advising his graduate students and catching up with research, before stepping down for good.

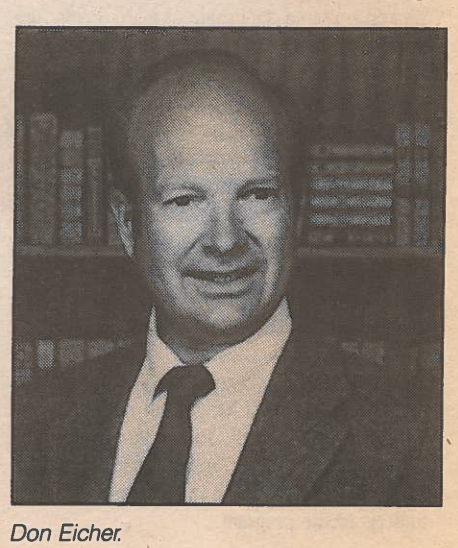
Don Eicher

Don Eicher (photo) arrived in 1958 soon after completing a Ph.D. at Yale. Don was no stranger to the Department, having taken B.A. (1954) and M.S. (1955) degrees at CU. His appointment filled a gap left by the loss of Walter Toepelmen, who taught a course in micropaleontology, Don's special field of interest. Since his arrival on the scene, Eicher has worked steadily, through his teaching and research, to expand and improve the Department's offerings in paleontology, stratigraphy, and historical geology. The success of his effort is attested by the impressive list of his students who are now well-known paleontologists.

Don's research, supported in part by grants from government and industry, has centered primarily on problems related to micropaleontology and stratigraphy of Cretaceous formations in the Rocky Mountain region and adjacent parts of the Cordillera and Great Plains. His publications include three books. One, *Geologic Time*, went through two editions. The last, *History of the Earth*, which he co-authored with Lee McAlister in 1980, has become a widely used text and reference work.

Eicher's professional competence has been recognized by his appointment to offices in well-known professional societies and research groups. Among these are: Founder and Editor, *Journal of Foraminiferal Research*, 1970-73; Chairman, Committee for Advanced Geology Exam, Educational Testing Service, 1975-78; Director of the Cushman Foundation, 1973-present (President, 1977-78); member, JOIDES Planning Panel for Ocean Margin Drilling Program for the 1980s; member, National Science Foundation Review Panel for Deep Sea Drilling Project, 1982; AAPG Membership Committee,

continued next page



Don Eicher.

Emeritus Faculty News

Bill Bradley

Bill (photos) was honored with a major award from the Quaternary Geology and Geomorphology Division of the Geological Society of America. Here follow the official citation and reply at the national GSA meeting in Seattle.

Presentation of the Distinguished Career Award to William C. Bradley

Citation by John Andrews, Peter Birkeland, Nel Caine, and John Pitlick.

We are pleased to announce that William C. Bradley is the 1994 recipient of the Division's Distinguished Career Award. As colleagues of Bill's, some of us for over 30 years, we have always admired the contributions he made to geomorphology through research, teaching, and service to the Division and the Society. It is gratifying that the Division now recognizes the diverse accomplishments of this talented and soft-spoken man.

Bill's first contact with Colorado came when he trained with the 10th Mountain Division at Camp Hale in 1944, near the present location of Vail. After the War, Bill returned from Europe and earned a B.S. degree in geology at the University of Wisconsin, where long-time colleague, Ted Walker, was his TA. This was followed by M.S. and Ph.D. degrees at Stanford University, where Art Howard was his advisor.

Bill gets a laugh at the groundbreaking for the new building.

Bill's research interests spanned a broad range of topics in surficial processes, and his papers stand as models for scientific inquiry in the earth sciences. His published works can be grouped into 4 topical categories. The first has to do with the age and genesis of marine terraces along the California coast. The second includes several papers on longitudinal sediment sorting in rivers. The third category dealt with the development of a variety of weathering forms, from exfoliation to tafoni. The fourth category includes his work on erosion surfaces in the Rocky Mountains, the origins of which have been debated since Davis' time. As part of this work, Bill sometimes conducted laboratory experiments to complement his careful and thorough field observations. His work demonstrates a breadth not only of interests, but of research methodology as well.

Bill agrees that some of his work was almost too powerful to comprehend. For example, in the late 1960s he applied to the NSF for funding to study the fluvial geomorphology of the Knik River and the Lake George, Alaska, jokulhlaups (floods trigged by catastrophic draining of ice-dammed lakes). In Bill's own words, "this must have been the kiss of death," because once funded, the jokulhlaups ceased! From this we can only be relieved that he and then student Vic Baker did not obtain a grant to study the Missoula floods, for who knows what might have happened!

Bill is known for having been a superb and inspirational teacher. Those of us who continue teaching at CU must live with his legacy, often described by students as "the best teacher I ever had." Students from biology, geography, as well as geology were attracted to his classes. Being a superb photographer, he amassed a teaching set of over 19,000 slides that he left with the Department. He loved field trips and was the driving force behind many unforgettable ones with students across the western USA. In 1981, he received the Boulder Faculty Assembly Teaching Award, the highest teaching honor in the University. In his own subtle way, Bill prodded students, leading them steadily along a line of inquiry towards an independent solution to a problem. At the same time, he set the standard of quality for the CU Quaternary-geomorphology program. Students who wanted to learn how to write well and think clearly had Bill on their committee. To put it in a larger perspective, Bill's teaching and advising was of such a quality as to inspire a cadre of students who are now teaching and conducting research in geomorphology in the USA, Canada, and other countries.

Bill did more than his share of committee work outside the University. In the Rocky Mountain Section of GSA, he has been section chairman, technical program chairman, and membership chairman. He has held several positions with our Division, including chairman. He was a GSA Councilor from 1978 to 1980. Bill also chaired the Local Committee when INQUA held its 7th Congress in Boulder in 1965.

Bill is now retired from the University of Colorado and is enjoying life outside academia. With envy, we happily report that he downhill skis 2 to 3 times a week, often with Ted Walker. When Spring comes around and the snow melts, Bill takes to the western rivers and teaches short geology courses with Audrey Benedict as part of raft trips.

Bill enjoyed his life as a scientist and teacher. The citation in Seattle was a slide show depicting the light side of Bill's career. We wanted to include incriminating slides of Bill doing silly things. We contacted many of his former students who were sure they had some, fiendishly sought them, but none could be found. Because it was not difficult to find slides of his colleagues and students doing silly things, we used these instead. It is not that he was above clowning around—he just made sure that it was not captured on film!

All career Awardees are presented with a momento depicting some part of their career. Bill's momento is a gneiss from a local Rocky Mountain erosion surface. One side is cut and polished and the other two are covered with lichens.

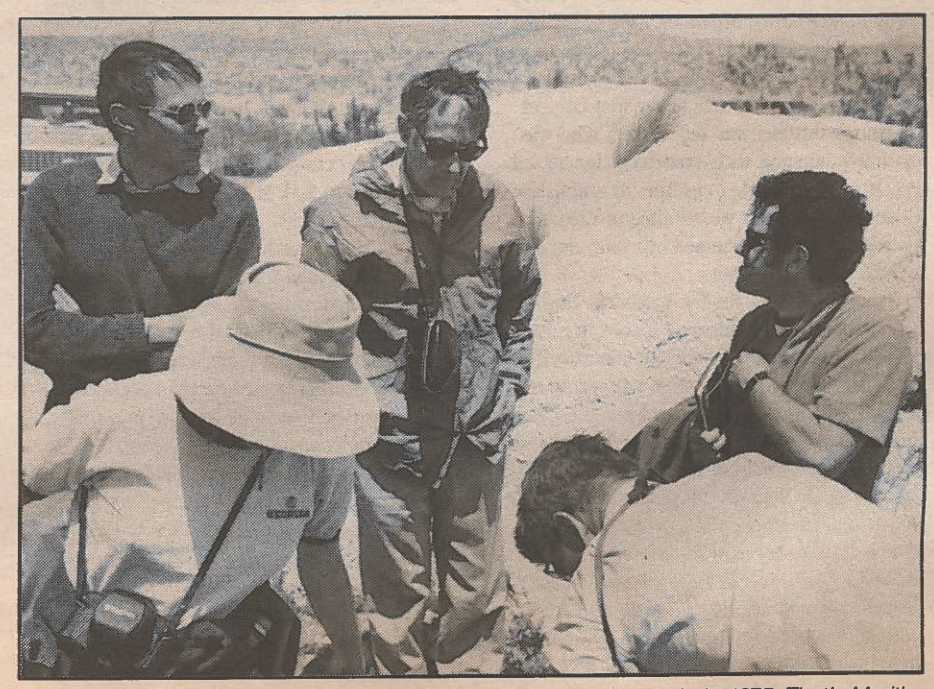
In honoring Bill, the Division also honors the all-around person—that person that personifies the ideal professor's contributions. Bill is a very modest guy, so it was especially gratifying that the group that attended the award ceremony was about twice the normal size. When we asked those in the audience with a CU Connection to stand and honor Bill, it seemed like half of the audience did so, and these included many non-Quaternary types.

Response by Bill Bradley

This award is historical in nature and my response will be similar. I am going to talk about American universities and their geology departments during the period mid-1940s to mid-1960s, the formative years for my career, and some of the people who helped shape that career. Then some closing comments on being at Colorado.

I graduated from high school in 1942, but

continued next page



Bill, Ted Walker, and John Andrew on our classic California desert trip in 1975. That's Marith Reheis (M.S., 1974; Ph.D., 1985) in the Georgia shirt checking out dirt.

Was there a geology fraternity? You bet. It was called Sig Gam. Here are some 1960 photos by Frank Beck. In the top photo the students are enjoying their "last meal" outside the Poorman Mine. Frank lists these students (l to r): Duane Wohlford, Bill Keighin, George Ulrich, Gordon Swann, and Joe O'Connor. After the meal they were blindfolded (bottom photo) and marched into the mine. From left to right, Frank recognizes Jerry Stephens, Hank Holt, Duane Wohlford, Gordon Swann, Bob Butcher, Omar Raup, Bill Bradley (a young prof. thoroughly enjoying this early hazing incident), and John Tramell.

Retirements, cont.

1982-91; Organizing Committee, North American Paleontological Convention (Boulder), 1986; President, North American Micropaleontological Section of SEPM, 1989-90; and President, Association of North American Paleontological Societies, 1988-92. Foreign assignments include a stint as Lecturer in the Geology Department at the University of Edinburgh, 1968; participant in International Micropaleontological Congress, Geneva, 1967; and participant in Sixth African Micropaleontological Colloquium, Tunis, 1974.

Don served as Department Chairman during the period 1975-80, which was a trying time for the University. Faced with a depressed economy, the Colorado Legislature cut the University's appropriation to the bone, forcing a substantial reduction in expenditures for personnel and teaching facilities. Eicher was able to steer a course that minimized losses to the Department during this period.

Don has been re-hired to teach one-half time. This spring he is teaching the new field geology course (with Ed Larson) and Historical Geology.

We are fortunate to have the emeritus professors continue an association with the Department. Stop in and see them some time.

Emeritus Faculty, cont.

postponed going to college because the U.S. Army persuaded me that I would look good in one of their uniforms. Four years later I was back, ready for college, really ready for college, at the University of Wisconsin. The teachers were ready, too. The graduate students and young faculty had also been in service and were eager to get on with their careers. And the older faculty were happy to have students like the returning veterans. It was an exciting time in higher education: able teachers being challenged by a mob of eager students.

At the outset, I had no idea where I was headed. So my oldest brother, Charlie, than a graduate student in geology at Wisconsin said, "Why don't you try beginning geology?" I did, and I was hooked. One reason was the appealing teachers I encountered. For example, the graduate student who taught my first lab and recitations sections was Ted Walker, who was absolutely bursting with excitement for his subject. It was impossible to escape his enthusiasm. A decade later when we reunited in Colorado, his passion had not dimmed one iota, nor did it throughout his career.

Geology attracted me for another reason: it was a masculine profession involving a lot of field work. (It seems incomprehensible now, but in those days women were not encouraged to enter the profession.) I could relate because I had grown up the youngest of seven boys in a macho family that did lots of outdoor activities. And army life was not that much different, aside from the absence of my mother and a change in diet. My father had been an officer in World War I, and he believed a little army discipline would help in raising seven sons. With such a background, you can understand why I felt at home in the geological profession.

As an undergraduate I was interested in all of geology. However, two people at Wisconsin awakened me to the Quaternary. One was Fred Thwaites, an eccentric and underappreciated glacial geologist who nevertheless wrote one of the best books available on that subject. The other was Sheldon Judson, a recent graduate with Kirk Bryan. Shel sought to bring some discipline and judgment to my thinking—so as to avoid going off half-cocked on some ill-conceived idea.

Wisconsin had many fine teachers, as did Stanford which followed. But it seemed to me that the very best of them shared this common ground in their teaching styles: they demanded a lot from their students; they promoted careful observations; and they encouraged thinking that was both logical and creative.

I went to Stanford for the school, but my direction was clearly toward the Quaternary. My mentor there was Arthur Howard, a student of Douglas Johnson at Columbia. I was fairly early in Howard's string of graduates, which began with Troy Péwé and extended through Pete Birkeland. Howard let his students set their own research direction, but he made sure they got certain educational messages along the way, two that were seared into my memory were—read critically and write concisely.

Eliot Blackwelder was also at Stanford. He was retired and taught no courses, but he came in every day, lean and tan, and mounted the stairs two at a time, briefcase in hand. Blackwelder was a giant among American geologists in the first half of this century. He contributed broadly to geology, not just to geomorphology. We chatted many times, and when I left he gave me a set of his reprints, some his last copy.

And who should show up at Stanford on a one-year leave but Shel Judson. His objective was some library research and writing; my objective was a continuation of the counseling begun at Wisconsin.

In 1955 I left for a job at the University of Colorado. Like many other state universities at the time, Colorado was relatively small (9,000 students) and devoted to teaching, especially undergraduate teaching. Normal teaching load was four to six courses a year, and anyone who taught a beginning class also handled one of the lab sections. Such emphasis on teaching suited me fine because I was naturally inclined in that direction. Research programs were small and cheap. The National Science Foundation was only a few years old then; its resources were modest, and people were not yet accustomed to going to it for help. Large, well-endowed research programs were a thing of the future.

For the next decade (that is, up to the mid-1960s) I benefited a lot from contact with a variety of people, far too many to adequately identify here. Nevertheless, I am going to risk unfair omission by naming certain key people. Those whose influence began while I was still at Stanford: Kenneth Emery, Clyde Wahrhafting, and Bob Sharp—and thereafter: Hal Malde, Gerry Richmond, Glenn Scott, Hoover Mackin, Ken Fahnestock, and Rowland Twidale in Australia.

Colorado was a wonderful place to spend a career. The superb local geology helped, but the real reason was the people. I joined a department already known for its congenial, family-like atmosphere—a reflection of the personality of Warren Thompson, then head of the Department. He believed people could do their jobs, and do them well, and at the same time enjoy one another's company. That was his legacy to the Department. Later arrivals carried it on, particularly people like Ed Larson and the Quaternary crowd: Pete Birkeland, John Andrews, Giff Miller, and Mark Meier, along with Nel Caine and now John Pitlick in Geography. And of course the graduate students, always important in faculty continuing-education; my own included Vic Baker (from whom I learned far more than he from me), Debbie Harden, and Dick Baker, and other Quaternary students like Steve Colman. Truly, Colorado's attraction lay in its people: Warren Thompson and Ted Walker and the rest.

I loved my job there. I didn't mind the long hours. But none of it would have worked if it hadn't been for the steadfast and warm support of my wife, Louise. In a very real way, this award honors her too. My friends, I am honored to the point of being overwhelmed.

Faculty News

John Andrews

The 1994 year was busy but largely uneventful. John had no exciting cruises and no encounters with icebergs or other dangerous objects.

His only "field work" consisted of a short trip to Iceland in July where he teamed up with Aslaug Geirsdottir (Ph.D., CU 1988) and Jorunn Hardardottir (current Ph.D. candidate) to look at the area of SW Iceland where the Icelandic group had undertaken a series of lake-coring expeditions in late winter 1994. This effort is part of a jointly funded (USA and Iceland) research effort to study the paleoclimate of Iceland over the last 13,000 years.

The weather was beautiful with clear skies and no rain. Although John had visited Iceland on three earlier occasions (usually at the start of a research cruise), this was the first time he had time to look at the geology, and Aslaug and Jorunn provided expert guidance and opinion. They hope to continue the joint project and expand it to include a marine geology component.

From Iceland, John left for Great Britain where he and Martha spent 6 weeks. Here again the weather verged on the unbelievable—possibly the best summer weather that they had ever experienced.

Martha and John both gave papers at the Annual Geological Society of America meeting in Seattle. Like all the others from Colorado, they were delighted that Bill Bradley's career was honored by the Geomorphology and Quaternary Geology Division. John said that Peter Birkeland did a fantastic job in his slide-illustrated introduction of Bill.

By the way, several of you alums know Martha and we are proud to announce that the Alaskan Historical Society awarded her the 1994 Pathfinder Award for her part in the development of the CD-ROM called "Polar PAC."

W.W. Atkinson, Jr.

Economic Geology is alive and well at CU and living in the basement of the Geology Building! We have a program called "Economic Geology," but the petroleum geologists feel that they, too, are economic geologists, involved in a marketable mineral resource. But to those who do not know Bill, his field is mineral deposits.

There are currently 8 graduate students in mineral deposits. Three have finished "all but thesis," and are working for a living outside the University: John Gray, Michele Murray, and Paul Boni. John works full-time for the USGS, Geochemistry Branch, and is writing a thesis on the mineral deposits in a region he mapped in Alaska. Michele is also working for the USGS as a temp for a contracting company and studying Yucca Mountain. She studied the structural geology of a gold mining area in northern Sonora, Mexico. Paul is our full-time thin-section shop supervisor and is working on the geochemistry of a southern Wyoming trona deposit.

Alex Iriondo (from Spain) is working on the structural setting of gold deposits in NW Sonora, Mexico, studying mylonites and ductile deformation at the edge of the North American craton in the Jurassic. He is looking at the geology on scales of thin-sections, outcrops, and remote sensing.

Sara Martinez (also from Spain) is starting a thesis using remote sensing and field studies in the area of Arizpe, Sonora. She especially remembers the DEATH MARCH they made in her field area last summer with Fred Kruse. They hiked over some mountains along little horse trails and arrived at an interesting altered area about 4 p.m. The fatal mistake was Bill's suggestion to hike to the river valley by a "shorter" route. They got there at 9:30 p.m., and found a farmer who transported them to the next village in a little trailer behind a monster farm tractor. From there, they got back to their base.

Lupe Espinoza (from Mexico) is working on another remote-sensing field thesis, in which he will work on methods of identifying the types of mineral deposits seen in remote images. Armando Zaragoza (also from Mexico) is being sponsored by Penoles Mining Company and will work on a company project for his thesis.

Abbas Sharaky (from Egypt) is leaning toward a study of the chemistry of ore deposition and alteration in the Gold Hill district of Boulder County for his dissertation.

One of Bill's students recently completed his M.S. Craig Bruno worked on a redbed sandstone copper deposit near Ciudad Juarez, Mexico. The deposit was formed by the movement of oxidizing, copper-bearing groundwater through a reduced sandstone. Craig found a beautiful zonation of minerals in the deposit, from hematite near the surface to chalcocite to bornite to chalcopyrite to pyrite replacing detrital magnetite.

Another student, Al Hofstra, recently completed his Ph.D. Al is a long-time permanent employee of the USGS, which sponsored his dissertation. He worked on some of the famous "Carlin Type" gold deposits in Nevada, which contain submicroscopic gold in sedimentary rocks. In his research, Al was able to show that the Jerritt Canyon deposits have no relation to any nearby igneous source and probably were formed by basinal waters moving long distances through the sedimentary rocks. It was a herculean effort, for which Al is already widely recognized.

Bill started off last summer with trips to help students start their theses. He took Sharaky and Sara to Alex's area. The La Choya mine has recently started production in the area. Among the sheared rocks, they had a

continued next page

Ted Walker

Ted Walker (photo) talked several couples into biking through Europe with him during summer 1994. Ted's plan was to fly into Frankfurt, then follow several rivers to the Donau (Danube to some) and take the Donau into Austria. He knew he could only interest geomorphologists in such a trip, so Pete and Sue Birkeland, and John and Becky Pitlick (Geography) decided to join Ted and Barbara.

Ted had found out that much of the trip could be done on bike paths or on roads used mostly by farm vehicles. He bought maps, excellent ones specific for bikers. They first went to Würzburg and then down the Main river. They then turned south up the Tauber river along the Romantic Route. At the medieval town of Rothenberg they left the Tauber and crossed the divide, passed the new Donau-Rhein Canal, and went down the Altmühl river to the Donau. At Passau, on the Austrian border, they met up with Erich, a future German geomorphology student, and his family put on a special Bavarian meal for the group. The next morning, Pete ran into (and bent!) a steel post on a trail and about totaled his front wheel. Erich banged the wheel on the ground, it sprung into a circle and they trued it over the ever-present beer. John and Becky then headed south for Munich.

The remaining four bikers took off for Vienna, and at the 600-mile odometer reading, the Walkers returned to Boulder. Pete and Sue continued on to Budapest in search of Gergely Markos (Ph.D., 1977), but he had been purged from the phone book! They then took a train to northern Slovakia in search of Ralph Shroba's (Ph.D., 1977) homeland, and biked through the mountains south of the Polish border.

This is a classic route for anyone. Many Germans and Austrians accompanied the group along the route. Accommodations were usually in zimmers (rooms in private homes), advertised by signs along the way. The food and beer were great, and it hardly ever rained! John and Pete have real jobs, but Ted and Barbara will bike in southern Germany in summer 1995.

Pete Birkeland and Ted Walker at the town of Solnhofen, type locality for that deforming limestone in your structural geology class. The bike trail here is typical of those along most of the route.

Faculty News, cont.

look at a megabreccia, one with house-size blocks of granite. It turned out that the matrix for the blocks is welded tuff! It looks like Alex has a Tertiary volcanic center, a caldera, in the middle of 2-mica granites and mylonite outcrops.

Bill left Sharaky to help Alex and went with Sara to Tucson to pick up Fred Kruse, her other advisor, and they then traveled to Arizpe, Sonora. Arizpe is a historic old village with a cathedral dating to 1646.

From Arizpe, Bill went to Moctezuma, about 100 miles south of Douglas, Arizona, where he has been working on a long-term research project. The area has a wide variety of gold, silver, lead, zinc, and tellurium deposits, probably all part of one event. The object is to solve the regional structure to find the original levels of deposition of each type of deposit. There have been many adventures there over the years—wild pigs in the landlord's menagerie, Gila monsters, bushels of scorpions, coatimundis, getting stuck in the river, many trips there with students, etc.

After a few weeks in Moctezuma, Bill made a trip to help a Mexican student from the University of Sonora with his thesis. The area is the Taylotita mine, one of Mexico's biggest gold and silver producers. They flew to Durango, then down into the deep canyons ("barrancas") toward Mazatlan on the west side of the Sierra Madre Occidental to a tiny landing strip at the mine, at the bottom of an incredibly deep canyon. This is the kind of deposit where the Mexicans like to give the ore grade in kilos of silver per ton, and their mine levels in the sides of the canyon, and below its bottom, run for kilometers. It was a memorable visit.

Bill returned to take part in a memorial service for Jeff Deen, who was killed in an automobile accident while doing mineral exploration in Peru in July. Jeff was one of his first M.S. students, did his thesis in the Moctezuma area, and married Gussie Walter, another Econ Geology M.S. student. Jeff, perhaps in a moment of premonition, left a fund for a wake to be held in the event of his death, with instructions to hire a mariachi band and to buy lots of food and drink. It was a great party, overshadowed by the deep sadness everyone felt.

In August, Bill got a wonderful consulting job in Spain. The location was Salas, a few km west of Oviedo, on the north coast. The area is practically a rain forest, receiving moisture from the Bay of Biscay to the north. A company is prospecting gold deposits exploited by the Romans, who mined many millions of tons of ore and left many large open pits. The gold is invisible in submicroscopic particles. The Roman method was to crush the rock, then direct water over it, brought in by elaborately constructed ditches winding along the sides of steep mountains. The water would pick up the gold particles and carry them over a bed of fleece, where the lanolin on the wool would capture the gold. This is the ancient method of the Greeks, hence the story of Jason and the Golden Fleece! He also gave a two-day seminar on the geochemistry of gold to the geologists of the project, and spent a couple of days examining drill core from the project. It appears that the source of the gold is from porphyry-copper type intrusions! They have to be Paleozoic ("Hercynian"), formed when the margins of the ancestral Atlantic were being subducted. To his knowledge, nobody has mentioned porphyry copper deposits in Spain before. So here is some fertile ground for research!

Classes began a few days later. Bill taught Geochemistry of Hydrothermal Ore Deposits, with a class of 9, unusually large for such a specialized topic. They took a nice trip to the Calumet mine near Salida and saw the effects of some hydrothermal solutions.

In September, his son and son's wife were blessed with a baby boy—so now Bill is a grandpa!

Bill is on sabbatical spring 1995. He is concentrating on the Moctezuma, Sonora, project, tying up loose ends by solving many local problems in the geology to reach the point where he can write some articles. He has already had the "Trip from Hell" for the year during the month of February. Nothing too unusual, car broke down in Socorro, towed back to Albuquerque, megabucks to repair it, sick most of the month with a cold (caused by pollen allergy), rained out of the field a few days, drove back with a trailer full of furniture to Boulder in a blizzard. June will be devoted to helping students working on theses and other things in Mexico.

Roger Bilham

Neotectonics 1994

Altyn Tagh Fault: Space Geodesy on the Silk Road between the Tarim Basin and Northern Tibet

In August 1994 Roger Bilham and Giles Peltzer (Jet Propulsion Lab) undertook a series of measurements in the Altyn Tagh Mountains designed to determine the rate of uplift and shortening of the mountains and the rate of left lateral shear on the Altyn Tagh Fault. They had six GPS receivers and some 25 points were measured between Urumchi and the northern margin of Tibet. Although re-measurements will be needed in a few years to determine the deformation geodetically (the 10-1000 km long-distance measurements are accurate to 3-7 mm), leveling data from a road crossing the Altyn Tagh Mountains measured between 1956 and 1980 show that the mountains are rising at roughly 3 mm/year. This is similar to the rate that Michael Jackson (Ph.D., 1994) and Roger Bilham found locally to occur in the Greater Himalaya, based on leveling data from Nepal.

Like the Himalaya, the Altyn Tagh fault system is believed to absorb 30%-40% of the north-south convergence occurring between the Indo-Australian plate and the Euro-Asian plate. The Tien Shan Mountains north of Urumchi at this longitude absorb the remainder. CU experiments earlier this year between Bangalore, India, and Kathmandu, Nepal, with former graduate student Roland Burgmann and Jeff Freymuller (Stanford) confirm that the convergence rate between India and Asia is of the order of 6 cm/year. Thus the convergence rate across the Altyn Tagh is approximately 20 mm/year, some of which is absorbed by sinestral slip and some by uplift of the mountains. Assuming that half of this signal is convergence across the Altyn Tagh, they can calculate an approximate dip for a hypothetical thrust beneath the mountains; the crust crops out at the edge of the Tarim Basin. The southward dip on a creeping thrust fault would have to be roughly 15 degrees, implying that a planar thrust intersects the vertical Altyn Tagh Fault at around 40 km depth.

The erosion rate is slow in this part of Tibet, and the display of evidence for recent strike-slip faulting quite superb (photos). While they were on the fault, Pelzer and Bilham collected a number of granite samples from an abandoned, offset, river terrace for Chlorine-36 dating. Sag ponds that would long ago have filled on the San Andreas system still remain. Tension gashes from the last earthquake cross ridges and are barely filled with blown dust. The hand-excavated trenches of a major Chinese initiative to measure the slip rate on the Altyn Tagh Fault remain unfilled and show several paleoseismic events. The Chinese finding is that the last earthquake occurred several thousand years ago and that the long-term rate of slip is 3 mm/year. These rates are almost certainly an order of magnitude too low, and they anticipate that their measurements will confirm a slip rate ten times faster. The presence of sparse vegetation throughout the region, young fault scarps associated with lake sediments, and the dendrochronolgy of sage-like bushes (150-250 years of growth rings on a small sampling) provide numerous opportunities for dating recent earthquakes.

A Chinese engineer at a GPS station in the Altyn Tagh Mountains.

View along the Altyn Tagh Fault. Because vegetation cover is lacking, the fault can be worked out in great detail.

Southward drift of India—you are surely joking?

The cartoon-like journey of India as it sails from the Antarctic to Asia, colliding some 25 million years ago to form the Himalaya is one of the most striking and best understood concepts in plate tectonics. It may therefore come as a surprise that India has been moving southward, certainly for the past 100 years. Its inferred southward rate is roughly 8 cm/year, or twice the rate that you may have thought of as its northward collision with the Himalaya.

The paradox is resolved thusly. For the past 200 years the International Latitude Service has been measuring the latitudes of a belt of observatories surrounding the globe. They stopped doing this a few decades ago when VLBI measurements using radio telescopes were found able to do it 1000 times better. From the ILS measurements we know that the North Pole (the Earth's spin axis) wobbles around but has followed a mean path toward Hudson Bay at 11.5 cm/year. From our point of view (Boulder, Colorado), we are therefore moving toward the North Pole. If we travel to India over the pole, we cross the weakly opening mid-Atlantic ridge, meaning that northern Siberia is moving not only southward, but southward at a slightly faster rate than we are moving northward—let's say 12 cm/year. This means that Tibet is moving south at probably around 9 cm/year (recall that 3 cm/year of convergence is being absorbed by the Tien Shan and Altyn Tagh/Kunlun systems). Since India is colliding with Tibet at roughly 2 cm/year, the net result is that India is moving south at 7 cm/year.

Astrogeodetic data investigated by Fred Blume and Doug Robertson show that the noise level in the early Indian latitude measurements is too high to provide numerical constraints on this southward rate, but the data thus far are quite consistent with this finding.

Why is Asia heading south? The reasons are to be found in the removal of the north American and Fennoscandian ice sheets. Thus, although the rate is high, it has probably been going for less than a million years. If it were to continue (at present at 1 degree per million years!), it would have a major impact on the world's weather, because the Himalaya are a barrier to northward-flowing moist winds in Asia.

Reviewing the unthinkable—a Magnitude 9 Himalayan earthquake in the offing?

Four great earthquakes ($M>8$) have rocked the Himalaya in the past 100 years, enough to make most seismologists confident that eventually the entire arc slips incrementally and repeatedly to accommodate Indo-Asian plate convergence. At 2 cm/year great earthquakes could occur as frequently as every 300 years, or as rarely as every 1000 years. Thus the next place to experience a great earthquake is likely to be in the gaps between the great earthquakes that occurred this century. The largest of these gaps is the 800 km-long region between Dehra Dun and Kathmandu.

Ominously, the historical record is silent for this part of the Himalaya. A huge earthquake killed 30% of the population of Nepal in 1255, and if this was indeed the last earthquake in the region, there may be as much as 15 m of slip available for the next earthquake. Now the interesting thing is that an earthquake with that amount of slip has to have lateral dimensions comparable to the Alaska earthquake of 1964. In other words, it is possible that the entire 800 km-long region could slip in a single great earthquake with a moment magnitude of 9.1. Such an event could occur at any time in the next century.

This result is so unpalatable to the Indian Government that Bilham, Jackson, and Paul Bodin (Ph.D., 1992) have sought scientific arguments to refute this conclusion. That several $M=8$ earthquakes could occur is one possibility, and there is some evidence to indicate that the region may rupture in three smaller regions each with a magnitude of $M=8.3\pm0.1$. Another is that the Himalaya NE of Delhi slips by a process of creep. They find that creep is insufficient to prevent rupture, but can delay it. A final alternative is that slow earthquakes may occur. Either way, it would seem that the remeasurement of the entire northern India geodetic network, installed by the British 100 years ago, would reveal the development of elastic strain, if there is any, and its distribution. Thus, a test for the development of strain suitable to drive a great earthquake is available to those that doubt its credibility. Given that 200 million people are at risk from such an event, there is no doubt that this should be undertaken. Unfortunately, much of the area is close to India's borders where measurements are attended by prohibitive formalities.

continued next page

Faculty News, cont.

Pete Birkeland

Pete continues his work on the origin of some Pacific island soils. They were collected during sabbatical research into the western Pacific, with work on Rota, Taiwan, Mare and Vanuatu (this justified a rather exotic mountain bike sojourn). All soils are oxide and siliceous materials and were collected on rather pure coral reefs. Thus, most of the soils have not formed from the underlying materials. In order to target the source areas (distant deserts of Mongolia and Australia, Pacific volcanoes), Ed Larson and he are looking at rare-earth-element signatures. The marine terrace coral reefs need better dating, and Dan Muhs (former student from Geography) and Barney Szabo, both from the U.S. Geological Survey, have supplied two dates. Pete has slaved in that sweatbox of a lab and, combined with soil data from Rolf Kihl (INSTAAR) and total chemistry data from John Drexler and Fred Luiszer (Geology analytical lab), has come up with interesting results. Basically, the soils on Rota and Mare get totally altered to about 90% clay, 90% Al_2O_3 + Fe_2O_3 and dominantly Al oxide mineralogy in several 100,000 years. Taiwan is much different as the soils there reflect the local geology, and alteration is much less.

Pete has promised Oxford University Press a new edition of *Soils and Geomorphology* as his next writing effort. He will put the above research (and other unpublished stuff) into the new book and make people buy it. Only in this way can he and Sue pay off their new Saturn, their first new car since the 1970 VW!

Bill Hay

Bill Hay was in residence at the University of Colorado during the spring semester. Most of his time was devoted to teaching courses in Introductory Oceanography, Oceanography, and Global Tectonics, the latter shared with Roger Bilham. His research concentrated on sedimentary cycling during Phanerozoic, and working with graduate student John Herzog on analysis of coastal zone color scanner imagery of the eastern tropical Atlantic (supported by NASA), and with graduate Robert DeConto on the effects of geology, local relief, and climate on the chemical loads of rivers (supported by the Petroleum Research Fund of the American Chemical Society). In cooperation with Starley Thompson and David Pollard at NCAR he continued work with the GENESIS climate model and its application to Triassic and Cretaceous climates. A grant from the National Science Foundation provided funds for a Postdoctoral Fellow, Christopher N. Wold, and the two of them worked on development of proxy formation models to compare the results of numerical climate models with geologic data. At the end of the semester he received official notification from the office of the Vice Chancellor for Academic Affairs that his half-time position has been approved as an indefinite appointment, so he plans to be here each spring semester.

Bill spent the summer and fall at GEOMAR, Marine Geological Research Institute of Christian-Albrechts University in Kiel, Germany. There his research was devoted mostly to the evolution of the Central and South Atlantic, and the passage between the developing Atlantic and the Tethys, Pacific and Indian Oceans. Under the auspices of GEOMAR and PETROBRAS, he taught a week-long short course in Paleoclimatology/Paleoceanography at the Universidad de Rio Grande do Sul in Porto Allegre, Brazil. He also conducted research at GEOMAR in Kiel on meltwater fluxes to the Arctic basin and their effect on ocean heat flux during the last deglaciation, deposition of organic carbon-rich sediments now and in the geologic past, Cretaceous paleoceanography, and plate tectonic evolution of the Caribbean region. In August he officially began duties as Chairman of the JOIDES Panel on Sedimentary Geochemistry and Processes. He notes that it will be difficult to follow the excellent job performed in this position by predecessor Judith McKenzie of the Swiss Federal Institute of Technology. In October he taught a short course mostly intended for scientists from Slovakia, the Czech Republic, Poland, Hungary, Romania, Slovenia, Russia, and Austria on Cretaceous Paleoceanography, under the auspices of IGCP Project 362 (Tethyan and Boreal Cretaceous) in Smolenice, Slovakia. In mid-October he chaired the meeting of the JOIDES Sedimentary Geochemistry and Processes Panel in Fukuoka, Kyushu, Japan. During the remainder of the year his research emphasized understanding the distribution of productivity in the ocean, and the temperature-salinity-density structure of the oceans in past geologic times, the history of the last deglaciation, and the role of meltwater discharge into the Arctic Ocean in promoting rapid melting of the northern hemisphere ice sheets. He also continued exploration of the isostatic response of the northern hemisphere continents to loading by ice during the last glaciation in conjunction with colleagues at the Institut für Ostseeforschung in Warnemünde and the Geologisches Landesamt von Mecklenburg-Vorpommern. At the end of November he visited graduate students at the University of Colorado, and attended meetings of the AGU in San Francisco. He ended the year attending meetings on paleogeography of the Cretaceous in Berlin and on the Caribbean in Tübingen, and celebrated Christmas in Switzerland.

Award for LeMasurier

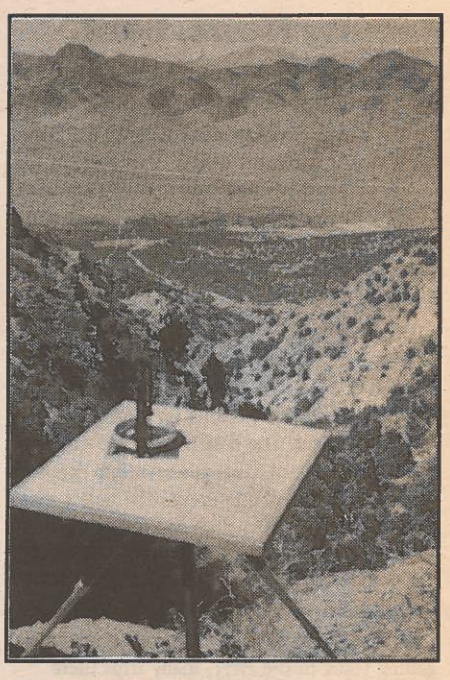
Wes LeMasurier (M.S., CU, '62; Ph.D., Stanford, '65), the man with the most mispronounced name, has been honored with the Chancellor's Lectureship Award at CU-Denver. This is the highest faculty award of the campus and is given for overall scholarly and creative work. This award is a great honor for Wes. A similar award on the Boulder campus has been presented previously only to Phil Worcester and Ted Walker. In April, Wes presented a talk on the campus entitled "Antarctic, a Continent for Science: The Story of Volcanoes and the Ice Sheet."

For those of you that have not kept up with Wes (photo), after he left CU and his study of the folds up by Loveland, he went to Stanford. His Ph.D. dissertation was the study of some volcanic rocks in NW Nevada, and then he taught at Cornell before coming to Denver in the late '60s. He shifted his volcanic interests to Antarctica where he worked out the petrology, history, and interaction of the volcanoes with ice sheets of various thicknesses. The culminating publication was *Volcanoes of the Antarctic Plate and Southern Oceans* co-edited with J.W. Thomson (AGU Antarctic Research Series, v. 48). Vast erosion surfaces are also part of the story, and he and a New Zealand colleague are putting that story together and making a link to similar surfaces in NZ.

As was the custom to honor many of the early geologists working in Antarctica, Wes has a mountain named after him. Mt. LeMasurier is in Marie Byrd Land and consists of Cretaceous rhydoacite. When asked where it is, Wes said if one goes due south of Denver, you leave the Americas near Mazatlan, and the next piece of land one sees is Mt. LeMasurier.

Peter Robinson

During summer '94, Peter Robinson, with the help of Emmett Evanoff (Ph.D., '90) and Paul Murphey (grad student) taught a field course in vertebrate paleontology in the Bridger Basin of SW Wyoming. The focus of the course was on the excavation of the *Omomys* Quarry. *Omomys* was a tarsier-like primate that lived in the Middle Eocene. The quarry has produced the world's best sample of any fossil tarsier-like species, with parts of all the skeleton preserved. Since returning from the field school, the material is being processed and should be finished by April. The fossils so far collected are being studied by seven people.



Young Wes LeMasurier on duty in the mid-'50s with the USGS in Nevada. Looks like he is off to Elko! Wes and Pete Birkeland assisted Jim Gilluly and Hal Mazursky. Basically, they had to run ahead of Jim (no easy task) and set up the plane table.

Anne Sheehan

The Colorado Plateau-Great Basin seismic experiment is a National Science Foundation (NSF)-supported joint project between Drs. Anne Sheehan (photo) and Craig Jones of CU-Boulder and Martha Savage of the University of Nevada, Reno. The goal of the experiment is to better determine the seismic structure of the crust and upper mantle of this region using state-of-the-art broadband seismometers deployed strategically in the eastern Great Basin of Nevada and Utah and the northern Colorado Plateau of Utah. Such instruments have not been deployed in this area to date. These instruments will record earthquakes both from within the study area and from far beyond it. Because they are using natural sources, the equipment must remain in the field for eight months (November 1994–July 1995) so that they can record enough earthquakes from locations suitable for this type of work. A result of this study will be an improved understanding of why the Great Basin is very active seismically and why the Colorado Plateau is much less active; additionally, they will better understand the unusually high elevations in this region, elevations much greater than areas with comparable crustal thickness elsewhere in North America.

Instruments have been made available to their group from the PASSCAL Instrument Center, a consortium that maintains seismic equipment for academic research. Single seismometers have been placed at regular intervals in Nevada and Utah to fill in the gaps between existing stations and previous experiments. The seismographs consist of three primary components: a sensor (seismometer) buried in the ground, recording electronics, and a power system. The seismometer is placed in a hole about 2 feet in diameter and as much as 3 feet deep; burial is required to improve the quality of seismic signals, to buffer the instrument from the variations in air temperature, and to protect the instrument from the elements. The seismometer is buried within a small vault, which is PVC sewer pipe with a trashcan lid. The vault protects the seismometer from moisture and dirt and the airspace provides insula-

continued next page

Anne Sheehan servicing a seismograph station on a snowy November day in central Utah.

In better weather, Anne Sheehan's undergraduate assistant, Noah Hughes, installs a seismograph (in the hole) in SE Utah in fall 1994.

Faculty News, cont.

tion. A small satellite clock antenna (GPS clock receiver) is within a few feet of the recording equipment. The sites are visited approximately once every six weeks.

Several undergraduates have been involved in the project through the assistance of an NSF Research Experience for Undergraduates grant and a CIRES CCHE internship. Undergraduates have been involved in both field work and data management (photo).

Paul Weimer

During fall 1994, Paul taught Applied Sequence and Basin Analysis to 19 graduate students. Several outside speakers talked on sequence stratigraphy topics, including Rick Sarg on carbonates; Frank Brown on offshore South Africa; Andy Pulham on the Cusiana giant oil field, Colombia; David Bowen on the Morrow trend, Southeastern Colorado; and Scott Tinker on reservoir modeling and visualization. During spring semester, Paul taught Topics in Petroleum Geology. Outside speakers included Tor Nilsen, consulting geologist; Robert Goldhammer, AAPG Distinguished Lecturer; Bob Graebner, SEG Distinguished Lecturer; and Ken McClay, AAPG Distinguished Lecturer. Take it from us, Paul also lectures in these courses.

On the research front, lots of things are happening! Fifty people attended the Gulf of Mexico Research consortium meeting in May 1994. Twenty-three companies are sponsors for the consortium, which focuses on the integrated sequence stratigraphic and structural studies in the upper slope region of the Gulf of Mexico. His group has raised $510,000 for the consortium. Mark Rowan and Tomas Villamil worked as research scientists on the project, as well as 2 Ph.D. students (Peter Varnai and Barry McBride) and 5 M.S. students (Zurilma Acosta, Fadjar Budhijanto, Rafael Martinez, Alonso Navarro, Barrett Dixon). Two additional workstations have been added, as well as an administrator and a drafting person.

The new major research program involves the reevaluation of a major geologic feature called the Perdido Foldbelt in the northwestern deep Gulf of Mexico. This foldbelt is analogous to the Appalachian Mountains, but differs in that it rests under 7,500 feet of water. This project comprises a four-company industry consortium (Shell, Texaco, Amoco, Mobil), which leased the mineral rights to the foldbelt during the mid-1980s. The foldbelt has a high potential to hold large volumes of oil (several billions of barrels). The ultimate goal of the project is the drilling of a frontier exploration well based on the results of the research.

With the enormous downsizing of the petroleum industry during the past decade, the oil companies have looked for outside sources to remap and reevaluate features to be drilled. These four companies have pooled their proprietary seismic data bases, donated them to CU-Boulder, and paid us $160,000 for 1.5 years to evaluate the data. With the combined seismic databases, the structure can be remapped in far greater detail than was possible before. The 8,000 miles of 2-D seismic data, worth $5 million, are extremely rare in academia.

Bruce Trudgill and Carl Fiduk have been hired as research scientists to remap the entire foldbelt. The companies will pick a location site for a well that will be drilled beginning in January 1996. The well location will be in water depths between 7,600 and 7,800 feet, making it the deepest well ever drilled.

If the well is a success (historically and statistically, exploration wells of this kind have between 5% and 8% chance of success), this will open an entirely new petroleum province in the United States. A research project of this kind is unprecedented in the history of academia and the oil industry. Never before has industry shared its proprietary data bases and then allowed a university to use them in research. Never before has industry actively recruited academia to become involved with any exploration well, and especially one of this magnitude. If the well is a discovery, new technology will have to be designed to develop the province. What CU-Boulder gets out of this project is (1) the ability to work with state-of-the-art data sets and influence a significant exploration project, (2) the use of seismic data for as long as we wish to continue to do detailed studies of the scientific aspects of the foldbelt, and (3), if the exploration well has success or shows promise for the general trend, we will be involved in the development of an entirely new petroleum province in the United States. Many students theses will be generated from this project, and undergraduate students will be employed to do support work.

The companies have given us permission to advertise the Perdido Project beginning during 1995, so there will be many articles in the local newspaper and trade journals (*AAPG Explorer, Oil and Gas Journal*). The initial results of the research were presented at the AAPG Convention in Houston during March 1995.

Paul became the EMARC director in January. He is developing an advisory board comprising representatives from oil companies, software companies, and geophysical seismic companies. They will serve to advise EMARC on future projects and connections that need to be made. EMARC is in the process of hiring a reservoir sedimentologist.

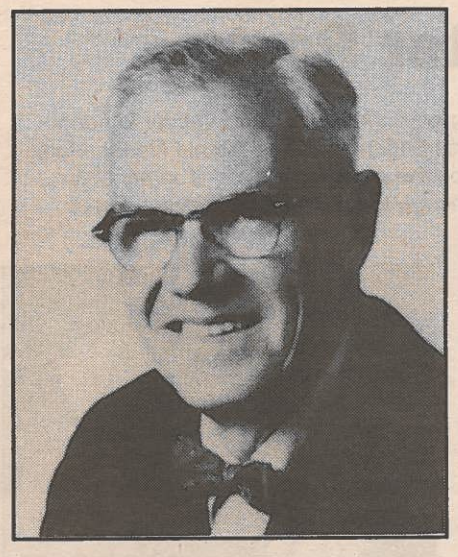
Paul also has been active writing and at meetings. He co-edited "Siliciclastic Sequence Stratigraphy: Recent Developments and Applications" (AAPG Memoir 58), published in May 1994. He and Arnold Bouma (LSU) organized the 1994 Gulf Coast Section-SEPM Research Conference with a program title "Submarine Fans and Turbidite Systems, Sequence Stratigraphy, Reservoir Architecture, and Production Characteristics, Gulf of Mexico and International," and they are editing conference notes. The conference was such a raging success that they asked Paul to run for president of the GCS-SEPM for 1997, which he will do. Let's get out the vote! Tom Davis (CSM) and he are finishing editing an AAPG 3-D Seismic Interpretation Atlas, due at the printer during summer 1995.

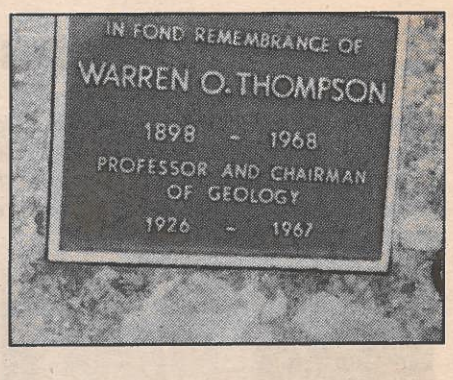
Paul was Poster Chairman for the 1994 AAPG Convention, held in Denver. His group presented eight posters, Barrett Dixon won 2nd prize for his talk ($500), and Rafael Martinez, Zurilma Acosta, and Fadjar Budhijanto won 2nd prize for their poster ($500). In addition, they gave 10 presentations at the 1995 AAPG Convention in Houston. Our students again distinguished themselves. In the student session, Barry McBride won 1st prize ($1,000), and Peter Varnai and Alonso Navarro won 3rd prize ($250).

Finally, Paul chaired the structural geology search committee, which had 143 applicants, and we got a good person to replace Bill Braddock.

A Dedication to Warren "Doc" Thompson

A small park was completed recently at the west entrance of the campus, near such landmarks as The Sink and where the former Spoke bike shop was (now a coffee shop, as is all of Boulder). Irrigation water flowed into a gully there and then made its way to Varsity Lake. The University decided to improve the area and hired Landscape and Irrigation Design to do the job. Bob Thompson, one of Doc's sons and a graduate of the Department, works for the company and was in charge of the field operation emplacing rocks, making spillways, and plantings. The park turned out so well that Bob and Jackie, his wife, decided to add a plaque honoring his father. The owner of the company, Hidelly Kane, agreed and paid for it. Stop by the park the next time you are on campus (photos).

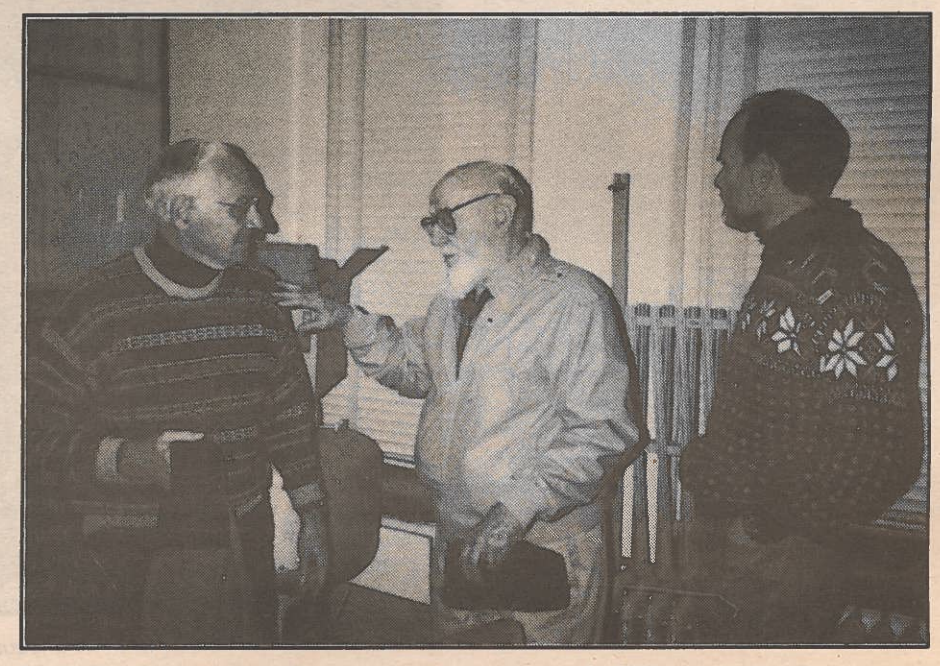




Left: Warren O. "Doc" Thompson. This photograph is on the wall of Room 206, along with all the other former chairs of the Department.

View to the south with the rock and plaque in the right foreground.

View to the north.



Ted Walker, Frank Beck, and John Munoz (l to r) visiting after Bill's party in the Department.
(See Emeritus Faculty News on page 5.)

End-of-Semester Party

At the end of spring semester we had a big party in Koenig Alumni Center to honor retiring professors and the new Bruce F. Curtis Endowment (see Alumni News). Many current students and alumni joined us, and on this page are photos of some. Unfortunately, not all the photos turned out well enough to be included—Birkeland kept shooting into the sun!

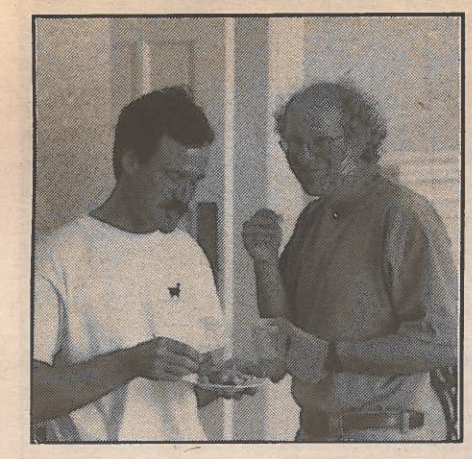
June Brennan.

Mark Meier and Bill Myers.

Phil Murray, Bruce Curtis, and Gene Shearer. Gene is the present Chair of the Advisory Board.

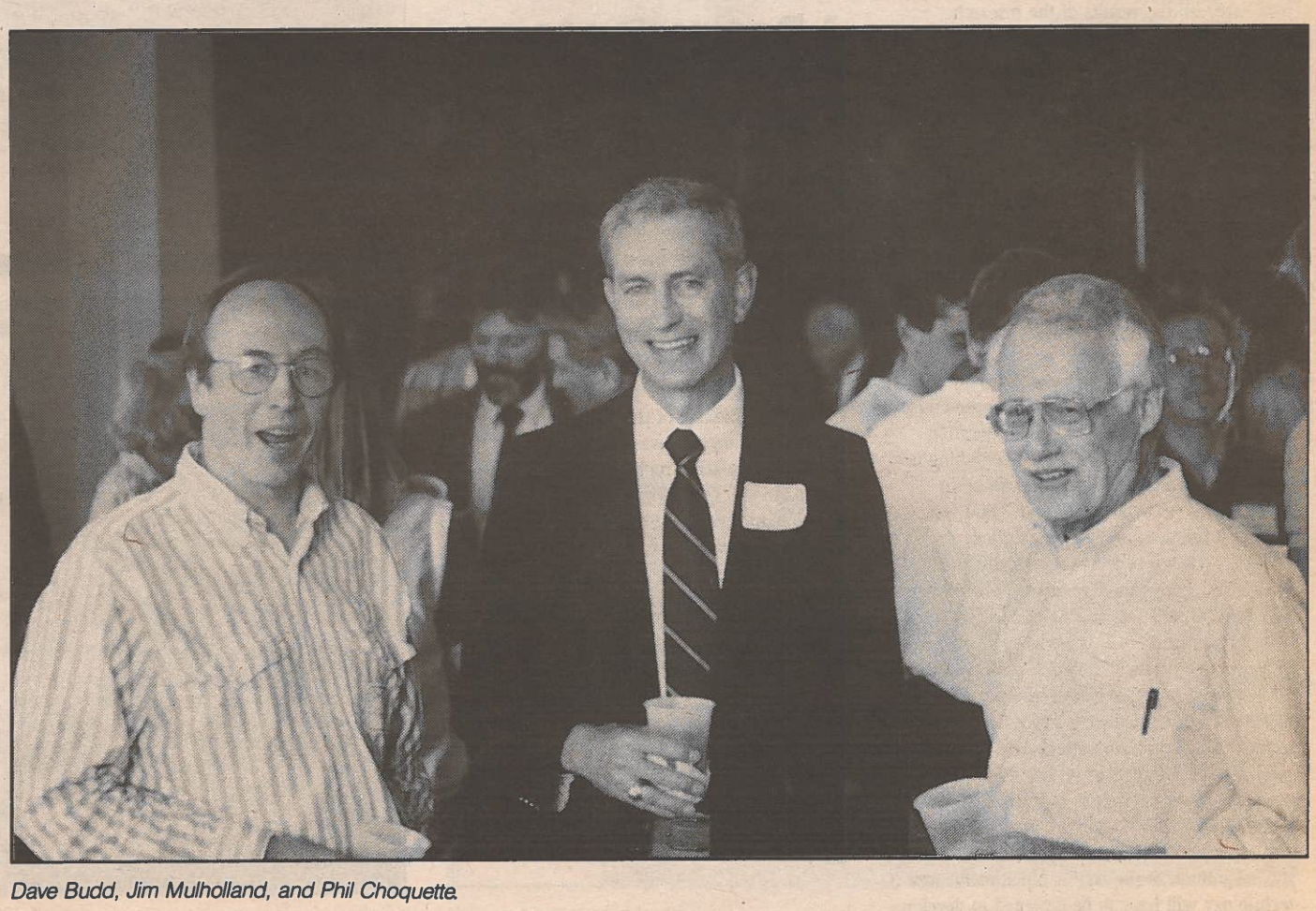
Anne Sheehan, Mark Rowan, and Jane Selverstone. Jane has joined the faculty at the University of New Mexico.

Ed Larson, Jack Dyni, Ted Walker, Bill Bradley, and Bob Giegengack. Bob is serving on the Advisory Board.



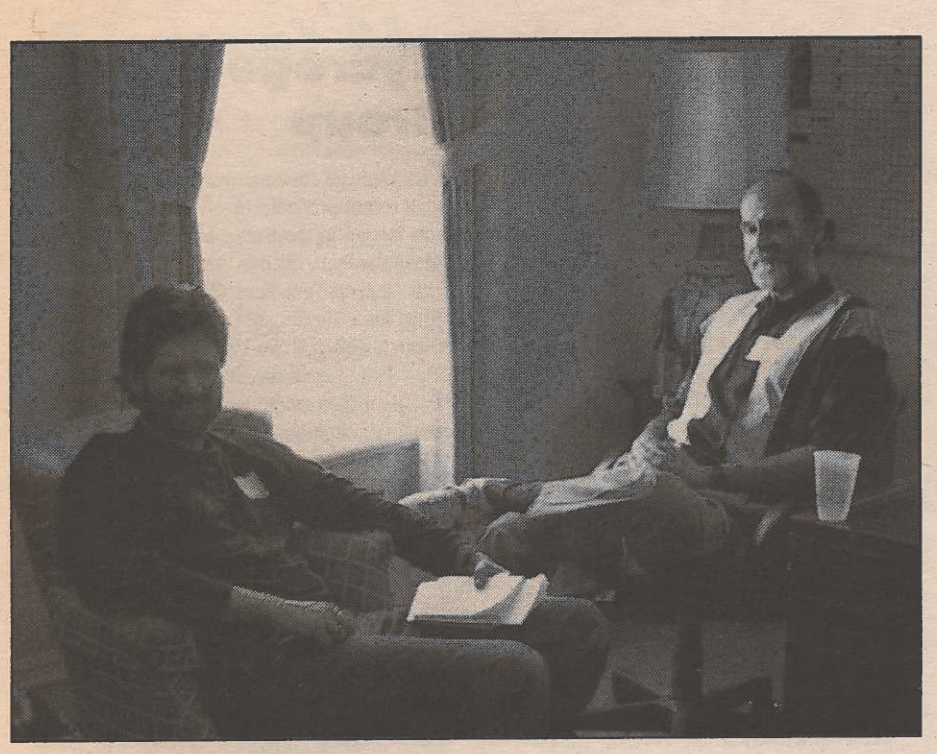
Philip Verplanck and Chuck Stern.

Rich Reynolds, now an Advisory Board member, and Ed Larson.

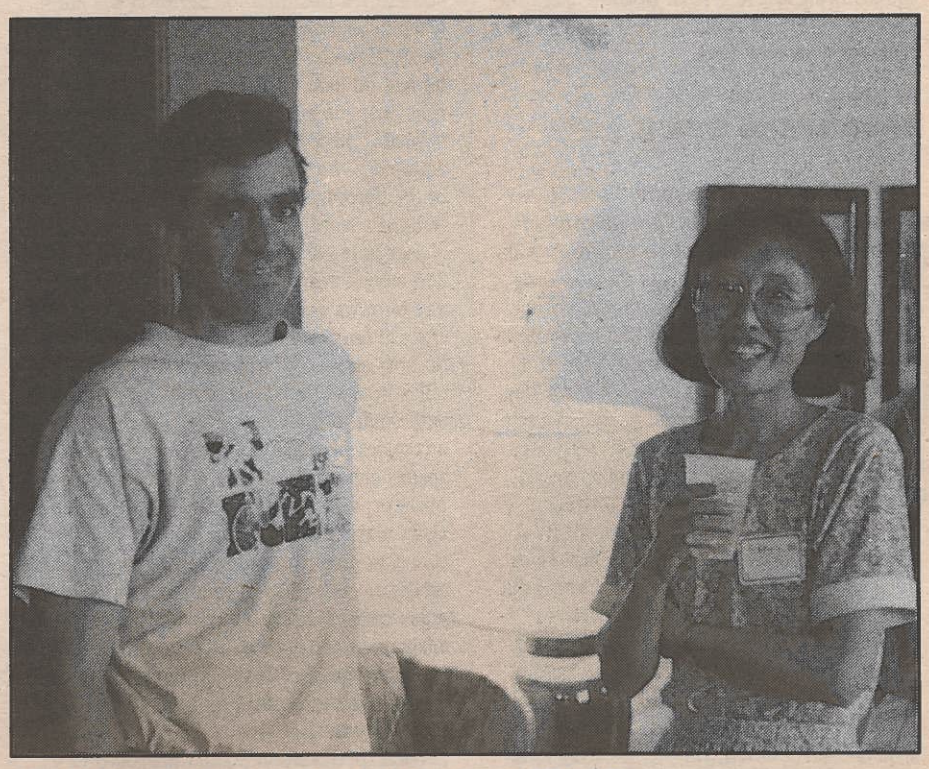


Dave Budd, Jim Mulholland, and Phil Choquette.

GEOLOGY NEWS



Graduate student Jeff Swope and Jim Munoz.



Shemin Ge and her hydrogeology graduate student, Miles Waite.

Wu-Ling Zhao, a post-doc, and graduate student Jennifer Hinds, both part of Shemin Ge's geohydrology program.

Giff Miller addresses the group.

Marcy and Bruce Benson (r) joined the crowd, and Bruce had many complimentary remarks in behalf of Bruce Curtis, as did Don Runnells (center).

Hanna Pavlik and Bill Atkinson.

The Party Continues on page 15

Student News

Steve Hasiotis

Steve is making headlines all over the place. The following article is from *Discover* magazine (January 1995) and is one of their top 75 scientific stories for 1994.

Back to the Sea II

"We take crayfish for granted," says Steven Hasiotis, a paleontologist at the University of Colorado (photo). "People have grown up with them, chased them around, put them in their aquariums, gotten yelled at by their moms for keeping them. I knew two or three people who had to flush theirs down the toilet." But at a Geological Society of America meeting last May, Hasiotis reported a new reason to respect these commonplace crustaceans. Crayfish were once thought to have originated 140 million years ago, but Hasiotis has discovered 220-million-year-old specimens that were almost identical to modern ones. He thinks crayfish may be as much as 300 million years old. That would put them in a class with roaches and sharks as some of the most enduring animals in history.

Crayfish look much like their close relative, the lobster, but they're freshwater animals. They live in burrows in lakes, rivers, and streams; some species can even thrive miles away from a body of water by digging down to the water table. It was burrows that first put Hasiotis on the trail of his ancient crayfish. In the late 1980s he was studying some puzzling tubular holes in 220-million-year-old rocks from southeastern Utah—holes that previous researchers had suggested were lungfish burrows. (Some lungfish tunnel into the mud when their pond dries up.) But Hasiotis couldn't find a single fossilized fish scale or tooth in the rocks. He also noticed the Utah holes didn't look like the simple 3-foot deep shafts that lungfish dig: some were 12 feet deep, others were shallow, interconnected chambers, and still others were U-shaped tunnels. Hasiotis started thinking about crayfish.

At the time, the idea was heretical: the earliest-known crayfish had lived in salty coastal areas 130 million years ago. Most researchers assumed that crayfish had descended from lobsters around that time and gradually made their way inland. "My advisor said, 'You've got a lot of guts saying that. You think you can tell this from the burrows? It's not going to hold water until you find some fossils,'" recalls Hasiotis. For a couple of field seasons he had no luck. "I remember saying, 'Dear God, help me out here, because I really need a fossil.'" In 1989, Hasiotis's prayers were answered—he found a fossil crayfish in one of the burrows. Since then he has found hundreds more.

Just as important, he has found that crayfish 220 million years ago were as varied in body and burrows as they are today. The shape of a crayfish burrow and of the animal itself depend on how close it lives to water. A crayfish a few miles from water uses shovel-like claws to dig a deep shaft to the water table; there it excavates a complex of several chambers in which it spends almost all its time. A crayfish in a pond, however, digs a shallow, simple burrow. Its claws make less impressive shovels, but it has spines to protect itself from fish and amphibian predators, as well as a large, powerful tail for quick escapes. Hasiotis found all these special adaptations and more in his fossils. "If it weren't for being squashed flat and preserved in rocks, they'd look nearly identical to modern crayfish," he says.

Such specialization doesn't happen overnight. Hasiotis believes crayfish must have evolved as early as 300 million years ago, and not from lobsters, which didn't exist back then. In fact, he turns conventional wisdom on its head: he says lobsters may be descended from a crayfish that, for whatever reason, returned to the sea.

Steve has been part of other recent finds in the western U.S. He and Russell Dubiel of the U.S. Geological Survey (Ph.D., 1987) found a Triassic termite nest in Petrified Forest National Park. This pushes the age of such features back another 135 million years. This paleontological duo also found tracks of a herbivorous, turkey-sized dinosaur near Ft. Wingate, N.M., that pushes the age of these creatures back some 12 million years, and the evolution of these critters to at least 240 million years ago. Who says paleontology is dead?

Undergraduate Jeff May (left) looks on as Steve Hasiotis points out the remains of a 400-million-year-old arthropod near Cañon City, Colorado.

Ultimate Frisbee Team Goes to Nationals

The CU women's ultimate frisbee team placed high enough in the regionals in Madison, Wisconsin, to go to the Nationals in Urbana-Champaign, Illinois. The team came in third! This is the highest national ranking of any athletic team associated with the Department in the history of the Department. Two of our students, Sarah Brown Jones and Laura Tripplett are on the 12-woman team. So what is ultimate frisbee? It is one tough sport. Teams run up and down the field for either 1.5 hours or 15 pts, scoring points as they cross the goal line, so it is like football. It is like soccer in that one runs all the time. However, once one catches the frisbee, the person stops and sails it on. It has some affinity to basketball in that the defenses are either zone or woman-to-woman. It is not like any of the above sports in that at Nationals they have to play 4 games a day! Santa Cruz is the national powerhouse and came in first. Congratulations, Sarah and Laura!

Geology Graduates

May 13, 1994

Bachelor of Arts

Allen, Jonathan Hill
Collins, Edwin Wood, Jr.
Daly, Maryjo
Ferris, Jonathan Roy
Fisher, Mark Wayne
Krogstad, Jeffery Bryan
Loken, David Michael
Russo, Joseph Nelson
Smith, William Eric
Zerbe, Jennifer Louise

Master of Science

Breuer, Barbara A.
Johnson, Brenton C.
Shallow, John Michael
Vaughn, Bruce Hickey

Doctor of Philosophy

Apodaca, Lori Estelle, "Genesis of Lode Gold Deposits on the Rock Creek Area, Nome Mining District, Seward Peninsula, Alaska"

Clark, William James, "The Ervay Cycle of the Permian Phosphorian and Park City Formations, Bighorn Basin, Wyoming: Sequence Stratigraphy, Facies, and Porosity Trends"

Jackson, Michael E., "Geodetic Study of Crustal Deformation in the Nepal Himalaya"

Okumura, Terrence Akira, "Palynostratigraphy and Paleoecology of Mid-Cretaceous Formations at Drilling Sites in Weston and Johnson Counties, Powder River Basin, Wyoming"

Vidic, Natasha Jaecks, "Pedogenesis and Soil-Age Relationships of Soils on Glacial Outwash Terraces in Ljubljana Basin, Slovenia"

Villamil, Tomas, "High-Resolution Stratigraphy, Chronology, and Relative Sea Level of the Albian-Santonian (Cretaceous) of Columbia"

August 13, 1994

Bachelor of Arts

Alpha, Kyle Rho
Buck, A.D.
Emerick, Stephen Owen
McCarthy, James Christian
Velzen, Daniel Henry
Von Doepp, Niels Christian

Master of Science

Acosta, Zurilma
Eischeid, Gregory Francis
Jaecks, Glenn Seward
Martinez, Rafael

Doctor of Philosophy

Barlow, Lisa Katherine, "Evaluation of Seasonal to Decadal Scale Deuterium and Deuterium Excess Signals, GISP2 Ice-Core, Summit, Greenland, A.D. 1270-1985"

December 17, 1994

Bachelor of Arts

Braymiller, Daniel Jay
Craig, Michael Brian
Eakins, Barry Wynn
Edmond, Carolyn Camille
Harnetiaux, Jonathan Wendell
Matson, Brent Alan
Oram, Susannah Yost
Sauer, Rebecca Ruth
Turner, Jeremy West
Zanetti, Kathleen A.
Zelinski, Kathryn Ann

Master of Science

Dixon, Barrett Taylor
Kerwin, Michael William
Montour, Maria Rita
Navarro, Alonso Fernando
Noble, Robinson Scott
Wong, Felicity May Yan

Doctor of Philosophy

Aslan, Andres, "Holocene Sedimentation, Soil Formation, and Evolution of the Mississippi River Floodplain, Ferriday, Louisana"

Hofstra, Albert Hugh, "Geology and Genesis of the Carlin-Type Gold Deposits in the Jerritt Canyon District, Nevada"

Hydrogeology Group

The graduate students working under Shemin Ge, a recent professor involved in hydrogeology, have started to meet on a bi-weekly basis as part of the Department's "hydro group." Shemin, with students Feng-Suey Chen, Jennifer Hinds, Minru Liao, Gordon McCurry, Miles Waite, and research associate Wu-Ling Zhao, meet every other Thursday in the third floor hydrogeology lab (the former photo lab). The lab houses Shemin's computing facilities and is where most of her students' research is being performed. During these meetings they update each other on the status of their research, discuss meetings or conferences they have attended, become fimiliar with new software or operating systems in the lab, and share publications of interest. At each meeting a different student has the responsibility of leading the discussion or giving a presentation on the research they are conducting. The meetings have opened up lines of communication within the hydrogeology group and give bi-weekly deadlines to keep the research going.

The hydro students are involved in a variety of research topics. Miles Waite is looking at numerical methods for modeling groundwater flow through fractured media. Feng-Suey Chen is exploring, through the use of computer modeling, how fractals can be applied to hydrogeology. Jennifer Hinds' research focuses on unsaturated flow and the dynamics of perched water in volcanic rocks at Yucca Mountain. Gordon McCurry is focusing on surface water-groundwater interactions, and how water rights transfers could impact baseflow conditions and riparian ecosystems. Wu-Ling Zhao specializes in numerical simulations for geodynamic and fluid flow problems. In a very short period of time, Shemin has made a great impact on the hydrogeology program of the University.

Florida or Bust (Burst?)

Continuing on a recent tradition of Floridan Aquifer studies, Nick Loizeaux spent the summer doing research at the Florida Geological Survey in Tallahassee. His M.S. thesis work deals with the sedimentary and stratigraphic framework of the Ocala Formation and how the framework controls modern-day groundwater transmissivity. Within the same study area, Brent Johnson used groundwater geochemistry to trace mass transfer within the Upper Floridan Aquifer for his M.S. thesis (1994). Both studies were carried out with the cooperation of the local government agencies: the Southwest Florida Water Management Agency and the Florida Geological Survey.

The supervising faculty member, David A. Budd, also had a number of students recently finish graduate work in the same region of Florida. Rob Noble's M.S. thesis (1994) catalogued subareal exposure surfaces within the Suwannee Formation and Ursula Hammes' Ph.D. (1992) comprehensively addressed the Suwannee's stratigraphy, sedimentation, and diagenesis.

A recent campaign to reverse the academic calendar has been launched so future students will not have to bear Tallahassee in the summer months.

Student Awards

Three graduate students were the recipients of Geological Society of America Research Awards. Thirty-six of the awards were singled out as being of exceptionally high merit, conception, and presentation. Three of our students made this list, and they are:

Stephen T. Hasiotis, "Partitioning of the Scoyenia Ichnofacies: A Model Synthesized from Ichnofossil-Bearing Mesozoic and Cenozoic Continental Deposits"

William F. Manley, "Late Quaternary Ice-Sheet Interactions in the Eastern Canadian Arctic: Coherent Climate Changes?"

Peter E. Sauer, "Calibration of the Meteoric Water Isotope-Submergent Aquatic Plant Cellulose Isotope Paleoenvironmental Indicator"

Every year we present several awards to outstanding students within the Department. The awardees this year are:

RMAG Pick Award to top senior, **Nathan Blomgren**

Zena Hunter Andrews Fellowships, **Valerie Sloan** and **Roberta Yuhas**

Association of Women Geoscientists: recognition for excellent academic records

Undergraduate—**Elizabeth Medlin**

Masters—**Claudia Arango**

Ph.D.—**Beverly Johnson**

Alumni News

Claud H. Baker, Jr. (B.A., CU, '59) has recently retired from the Water Resources Division of the USGS, Kansas district. He is now doing some consulting and training workshops.

Fred Barnard (B.A., Univ. of California-Berkeley, '63; Ph.D., CU, '68) is a consulting minerals geologist, stationed in Golden. Various mining companies and the World Bank foot Fred's bills, and during the past year he has worked in Argentina, Bolivia, Mexico, and the U.K. He also has a business selling mining reports on 60 different countries world-wide.

Frank Beck (M.S., CU, '64) is retired in Boulder (photo), actively working on wild flowers in the county. As many of you know, Frank travelled the world, took many exceptional photos and incorporated them into the teaching slide collection that Bill Bradley put together for departmental use (some 19,000 slides!). Periodically Frank goes through his remaining slides and brings them to the Department. Those that are duplicates have been sent on to **Don Rodbell** (M.S., CU, '86; Ph.D., CU, '91), who is a young prof at Union College, NY. Don remarks that every time we send him more of Frank's slides, the departmental collection at Union doubles! Frank has been more than happy to see the slides put to such good use.

David W. Bieber (M.S., CU, '84) is senior operations manager for Genesis Eco Systems, Inc., of Rancho Cordova, California, where he works on soil remediation. He also designs equipment and computer software for analysis of waters and for soil data used for geological, geophysical, and engineering studies. Dave is active in local geological groups, including AAPG, Association of Engineering Geologists, and the Sacramento Petroleum Association. In regards to his family, he went to Africa in 1987, returned with wife Susan, and in 1990 daughter Rebekah was born.

James R. Butler (B.S., Univ. of Georgia, '52; M.S., CU, '55; Ph.D., Columbia Univ., '62) retired in 1993 after teaching for 33 years at the University of North Carolina at Chapel Hill.

Alan Cree (B.A., CU, '53) retired in 1985 after being employed in one fashion or another for 57 years, 47 of which were in geology. Although he attended 6 universities, he states that the best learning conditions were at Science Lodge. He and wife Margaret live among the redbeds of Sedona, Arizona, play golf, and engage in aquasize. She works on genealogy, and he got a computer and has become a writer. He has written hundreds of essays on his experiences in the USA and abroad, and seven novels. He says it's fascinating for a scientist to write fiction. (Hey, we folks in academics do it all the time!)

John M. Cys (B.A., CU, '62; M.S., CU, '65; M.S., Univ. of North Texas, '93) returned to school in the '90s and earned an M.S. in Library Science. This April he became a catalog librarian at Midwestern State University, Wichita Falls, Texas.

Barry Eakins (B.A., CU, '94) and **Jennifer Brown** (B.A., CU, '93) were married on June 17. Congratulations!

Bruce Geller (B.S., Dickinson College, '77; M.A., SUNY-Binghamton, '81; A.M., Harvard, '81; Ph.D., CU, '93) is a consulting mineralogist/geologist, a retail mineral and jewelry dealer, professional mandolinist, as well as secretary for the Denver Region Exploration Geologist's Society. Bruce attended the 1994 New Mexico Minerals Symposium, and currently is trying to revive the Boulder County Metal Mining Association. Children are aging, with Ben near 7 and Nina 4.

Doug Geller (B.A., CU, '82; M.S., Univ. of Vermont, '85) spans the country. He is a registered professional geologist in the state of Oregon, worked in Seattle in '90-'94, and now is a consulting hydrogeologist for Atlantic Geoscience in Gilford, NH. In '91 he married Mary Ann Zock.

Erwin E. (Tex) Grimes (B.A., CU, '49) has his own company doing oil and gas exploration in, you guessed it, Texas.

William R. Judd (B.A., CU, '41) is retired and keeps busy as an Emeritus Prof, an engineering geologist, and finds time to run a small antique and rare book business. He still is receiving awards, and will receive the Hans Closs Medal from the International Society of Engineering Geologists for his outstanding contributions to engineering geology. Lucky guy has to travel to Portugal in September to pick it up. Previously, Bill has been awarded the Distinguished Practice Award for the GSA, a Special Award from the U.S. National Committee on Rock Mechanics (National Academy of Sciences), and been made an honorary member of the Association of Engineering Geologists. He also made major contributions to skiing in Colorado, and for these he is in the Colorado Ski Hall of Fame, and was awarded a Lifetime Membership in the National Ski Patrol System. Bill, as well as other alums, would like to see more alumni news. So would the newsletter, so all you alums out there, please get active and submit something—it all gets included!

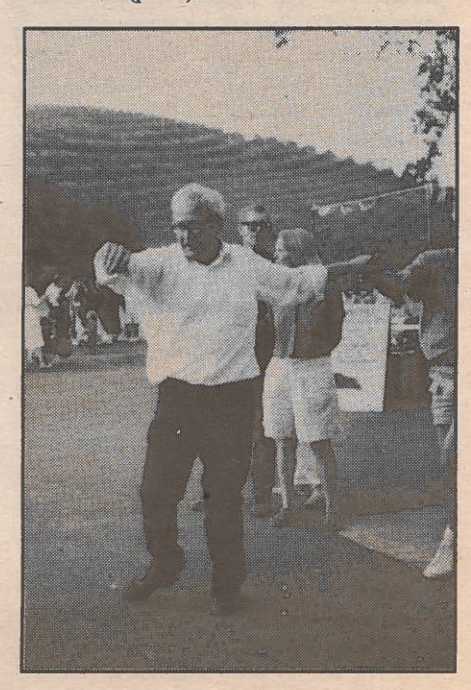
Bob Laughon (B.A., Colorado College; M.S., CU, '63; Ph.D., Univ. of Arizona) retired in '94 and is available for short-term consulting as long as it does not interfere with golf and old car hobby activities. For the last 18 years he has been in radioactive waste management, first with Union Carbide at Oak Ridge, and later with Battelle Memorial Institute; mostly in Columbus, Ohio, where he and Barbara (wife of 38 years!) live. Prior to the waste management business, Bob worked with NASA instructing the Apollo astronauts, later was Associate Curator of lunar samples, and had short stints with Anaconda and teaching at the University of Arizona and the Galveston Branch of Texas A&M. He reports that **Dave Briggs** (M.S., CU, '59) has retired from the USGS, and would like to hear from other friends from the early '60s, for example, George Stone: where are you and what are you doing?

Marith Reheis wins rock lifting contest in the 1975 California desert trip.

Marith Reheis (M.S., CU, '74; Ph.D., CU, '85) (photo) has been honored by being awarded a G.K. Gilbert Fellowship of the USGS. Since her Ph.D. she has been involved in many soil-geomorph-Quaternary projects. The title of her fellowship project is: Boundaries of pre-Middle Pleistocene Pluvial Lake Lahontan—reconstruction of 150- to 300-km-long paleogeodetic level lines. Dating will be done by ashes and some numerical ages. This will test Marith's considerable talents, so good luck! Will she follow Roger Morrison and do it via horseback? She and husband John (recently retired from USGS) have 3 adopted children: Carlos (12) from Peru, Flor de Maria (8), and Elder (6) from Guatemala.

Richard C. Staniland (B.A., CU, '82) is a Senior Oil and Gas Loss Control Specialist with Chubb and Son, Inc. in California, a provider of energy-related insurance produces. He states that he is still single, but has not given up yet.

Philip E. Tubman (B.A., CU, '53) went on to get two master's degrees at the University of Northern Illinois, DeKalb, one in Earth Science (hydrology and soils) and one in Education. He was never employed as a geologist, but instead found his niche as an engineer. He had a very successful career and in 1972 *Time* magazine honored him as one of the Ten Best Engineers in the USA (photo).



Philip Tubman leading a Greek dance at the Vet Hospital, Napa Valley, California, in 1972.

Grove Receives 1993 Bowen Award

(Tim [photos] earned a B.A. degree in geology at the Department in 1971. We knew him as a conscientious student and an animalistic biker. He has served a recent tour on the Department Advisory Board. The article appeared in EOS.)

At the Spring Meeting of the American Geophysical Union in Baltimore, May 24, 1994, Timothy L. Grove of the Massachusetts Institute of Technology received the 1994 N.L. Bowen Award of the Petrology section, which is given for a single outstanding contribution to volcanology, geochemistry, or petrology made during the preceeding 5 years. The award was presented by Edward Stolper of the California Institute of Technology. The citation and response are given here.

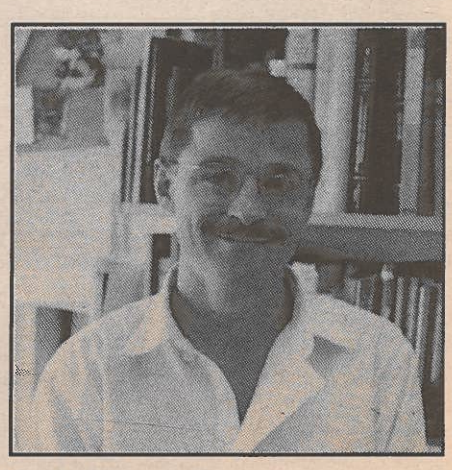
Citation

It is a great personal pleasure to introduce Timothy L. Grove, Professor in the Department of Earth, Atmospheric, and Planetary Sciences at the Massachusetts Institue of Technology, for the 1993 Norman L. Bowen Award. I have known Tim as a friend, collaborator, and colleague for 23 years and can think of no one more deserving of this recognition for his accomplishments. In this brief introduction, my goal is to explain to those of you who do not know Tim and his work what he has done to merit it.

Tim has made significant contibutions to a broad range of topics in volcanology, geochemistry, and petrology. These include the phase equilibria, geochemistry, and petrogenesis of lunar basalts; quantitative studies of the textures of igneous rocks; the microstructures and phase equilibria of the feldspars; field and experimental studies of calc-alkaline volcanic rocks; and field experimental studies of mid-ocean ridge basalts. Although the range of his published work extending over decades is in itself remarkable, I will single out the work on calc-alkaline magmas and on mid-ocean ridge basalt (MORB) petrogenesis.

Given the vast literature on petrogenesis of calc-alkaline magmas, it is remarkable that there could be something new to be written. Nevertheless, through their careful work, Tim and his students have been able to identify clearly and to quantify the roles of intermediate-level fractionation of anhydrous phases, of magma mixing, and assimilation in the liquid line of descent of lavas from the Medicine Lake Highlands and vicinity. They have gone on to extend their phase equilibrium studies to progressively more hydrous conditions and to develop constraints on the role of volatiles in controlling magma composition on the water contents of calc-alkaline magmas. It is difficult to overemphasize the need for quality phase

continued next page



Which one is the 1995 Tim Grove? On the left in Kronhoffer boots with Steve Ludington on top of the Rockies, or on the right?

Bowen Award, cont.

equilibrium studies under these conditions or the importance attached by the community to the contribution Tim and his colleagues are making in this area.

Similarily, given the large amount of work done in recent years on MORB petrogenesis, it may be surprising to those outside the field just how poorly we have understood the melting relations of suboceanic peridotite and the liquid lines of descent of MORB magmas at pressures above atmospheric, and how this poor understanding has limited quantitative interpretation of the chemical trends and variablity of MORBs. Tim and his students have made significant progress in the last few years in upgrading the available data set, and in finding ways to systematize these data for input into quantitative models of compositional trends in MORB magmas. The importance of the data in providing tests of compositions is beyond question.

I want to emphasize that Tim's experimental work is of the very highest caliber. His careful phase equilibrium experiments are impeccable and, to my mind, set a standard against which we will all be judged.

There are few who conduct petrological and mineralogical experiments with the care, thoroughness, and attention to detail that characterizes Tim's work. As testimony to this is Don Lindsley's statement to me that "I would be very willing to base experiments of my own on his results, and I don't give such praise readily." Those of us who know Don know that this is rare and high praise indeed.

In his studies of calc-alkaline magmas and of MORBs, Tim has taken the route of combining solid field work, petrologic and geochemical characterization of sample suites collected in the context of this field work, and phase equilibrium studies at pressures from atmospheric to a few tens of kilobars. In each phase of these studies the quality of the work has been outstanding, but it is their integration that is so distinctive. Tim is almost unique among active, modern petrologists in that he places nearly equal emphasis on his field and his experimental studies. This powerful combination keeps his experimental work properly focused and provides him with a framework within which to plan and interpret petrology; not only is it difficult to be good at both, but it also positions him as a well-rounded geologist. Traditionally, it is such people who have made the most important discoveries in the earth sciences, who are the best teachers, and who best intergrate and synthesize the complexity of geological phenomena, and Tim exemplifies the power of such a combination. The presentation of the Bowen Award to an MIT professor with strength in field and experimental petrology is particularly appropiate given Bowen's background, interests, and contributions. It is with great pride in my friend, and for his lovely family, Ann Marie, Matthew, and Michael, that I present Tim this timely and richly deserved recognition for his contributions to our science and for his potential for continued outstanding work and scientific leadership.

—Edward Stolper,
California Institute of Technology,
Pasadena

Response

I am honored to have been chosen by the Volcanology, Petrology, and Geochemistry Section of the American Geophysical Union for the 1994 Bowen Award. It is always gratifying to receive recognition for one's scientific efforts, but it is also humbling to be singled out among the many excellent scientists in my field. This award has special significance to me for two reasons. First, Bowen's book, *The Origin of Igneous Rocks*, sparked an interest that led to a career in experimental petrology and mineralogy. Those of you who have read this book may wonder how that prosaic document could have set me on a course in experimental studies. It was the idea that one could recreate in the laboratory the pressure and temperature conditions in planetary interiors, produce chemical reactions, measure reaction rates, and then apply these results to understand how chemical differentation in planets takes place. The second is that Bowen received his Ph.D. from MIT for his pioneering experimental studies in silicate melt systems. MIT has continued to graduate distinguished experimental earth scientists and has nurtured strong research programs in physical property and physical chemistry studies of earth materials. I am honored to be part of this group of laboratory scientists that includes Bill Brace, Martin Buerger, Charlie Prewitt, Hat Yoder, Dave Wones, and many others in addition to Bowen.

My career has been influenced by many people. Without their support and guidance I would not be standing here. My parents, Arthur and Janette, endured my obsession with rocks and stones that manifested itself at an early age. They also taught me that there was value in the pursuit of knowledge. Bill Braddock and Jim Munoz got me excited about geology during my undergraduate years at the University of Colorado. Bill instilled in me the importance of making field observations, and Jim showed me how thermodynamics and phase equilibrium data could be used to understand rock-forming processes. At Harvard, Charlie Burnham, Jim Hays, and Jim Thompson were excellent teachers. They provided direction, but encouraged independence and allowed us to to devise and pursue our own research problems. Charlie Burnham guided my thesis research in plagioclase crystallography and helped kindle a continuning interest in what can be learned about geologic processes from the information preserved in minerals. From my fellow Harvard graduate students, John Ferry, Bob Hazen, John Longhi, Ed Stolper, and Dave Walker, I also learned a great deal. Together we unraveled the mystery of what was said in a JBT lecture. We organized social "events" and field trips; helped each other prepare for general exams; and shared ideas and research results. These friendships and intellectual interactions have continued over the last 30 years. At Stony Brook, Don Lindsley and Ted Bence opened up their laboratories to me. From Don I learned much about how to devise a good experiment. Whenever I think about a problem, I worry about what Don would think of the experimental approach. With Ted Bence, I immersed myself in lunar geology and pursued my interests in understanding the significance of mineral textures in igneous rocks.

When I went to MIT in 1979 as an assistant professor, I was filled with excitement at this new opportunity. There I benefited greatly from the support of Bill Brace, Fred Frey, and Stan Hart. Bill Brace provided encouragement and guidance, and as a fellow experimentalist had an appreciation of what it takes to operate a laboratory. Fred has always provided critical input into ideas, and his advice has helped me in significant ways to grow and develop as a professor. Stan generously opened up his laboratory to my students. In the last 5 years

continued next page

In Memoriam

Diana Grunig Catalan

Diana Grunig Catalan was born in Carlisle Barracks, Pennsylvania, on June 12, 1949 to David B. Grunig and Margaret Ritchie Grunig. She died July 10, 1994, in Boulder at the home of her parents. She suffered from multiple sclerosis.

She graduated from Fairview High School in Boulder in 1967 sharing the honor of valedictorian with two other people. She graduated from the University of Colorado at Boulder in 1971 with honors, achieving a B.A. in Geology and membership in Phi Beta Kappa. She later attended the University of Texas.

She worked as a geologist for Twin Arrow and Hayes Petroleum in Rangeley, Colorado. She married Boris A. Catalan, a native of Chile. Survivors include her parents of Boulder; her husband of Dinosaur, Colorado; a son, Eric Catalan of Boulder; a sister, Melissa Pearson of Oklahoma City; and Dr. Steve Grunig of Boulder.

Jeffrey Alex Deen

Jeff (photo) died in a car accident on July 13, 1994, while working in the Peruvian Andes. Born December 9, 1957, we first saw him when he came to the Department in 1980. His M.S., on an ore deposit in Mexico with Bill Atkinson, was completed in 1983. Jeff then pursued the Ph.D. degree under the direction of John Drexler on the use of stable isotopes to model the evolution of a magma that produced an ore deposit. Following graduation in 1990, he worked as an environmental geologist with PTI, where many of our graduates in aqueous geochemistry and geohydrology work. At the time of the accident, Jeff was on leave from PTI in order to work with Rio Tinto Zinc as an exploration geologist.

Jeff had many friends in the Department and in the area. They filled a book recounting the good times, and all joined for a wake at his house in late July. Through his will, Jeff funded the function. He is survived by his father Robert, his mother Marian, his brother Robin, his sister Paula, his brother Justus, and his wife (and former student here) Gussie. A memorial fund has been set up in his honor (see particulars page 15).

Jeff Deen.

Attention Alumni

By completing and mailing in this form, you can help us do a better job of keeping up with you, your whereabouts, and your career or family news. We all enjoy reading about classmates and not-so-close mates who survived Boulder in whatever era! So send us some news, or some recollections—we promise to use them.

Name _____ Date _____

Address _____

Degree(s) _____
before, during and after CU-Boulder

Current Activity/Position/Employer/Location, etc. _____

Publications/Awards/Accomplishments _____

News About Family/Kids/Friends _____

Name/Address of Potential CU Geology Student We Should Contact: _____

Comments, Critiques, Accolades, as Appropriate, About Newsletter: _____

Bowen Award, cont.

Tom Jordan's enthusiasm and insistence on nothing but the best for our department has been an important source of motivation. I have also really enjoyed my interactions with Sam Bowring. He introduced me to his 4-billion-year-old rocks and thereby renewed my interest in understanding igneous processes that shaped the early Earth. Students have been the best part of my MIT experience. They teach you so much. Each one brings new challenges and opens up new ways of thinking about problems.

Bill Bryan and Julie Donnelly-Nolan also broadened my horizons considerably by making it possible for me to bring a perspective of field studies into my experiemental program. Bill and I have collaborated on ocean floor petrologic problems and we have shared several ocean-going expeditions. Julie and I met on Medicine Lake Volcano in the summer of 1979 and decided that it would be beneficial to study the volcano together. Because of her exceptional talent as a field geologist we have been able to learn much about magnetic processes in the Southern Cascades. Over the past 6 months my collaboration with Maarten de Wit and Anton le Roex in South Africa has been very exciting. Maarten's careful field observations in the Barberton Greenstone Belt have provided for new research directions. Anton and Maarten have been gracious hosts with whom we have shared an exciting time of change in the new South Africa. Finally, I thank my family, Ann Marie, Matthew and Michael, who have been very supportive and have always managed to bring me back to the planet Earth and the realities of life. I asked them if there were anything that I could say on their behalf, and they agreed on the following remark. "Ladies and gentleman, fellow Earth scientists, let's party."

—Timothy L. Grove,
Massachusetts Institute of Technology,
Cambridge

New Funding

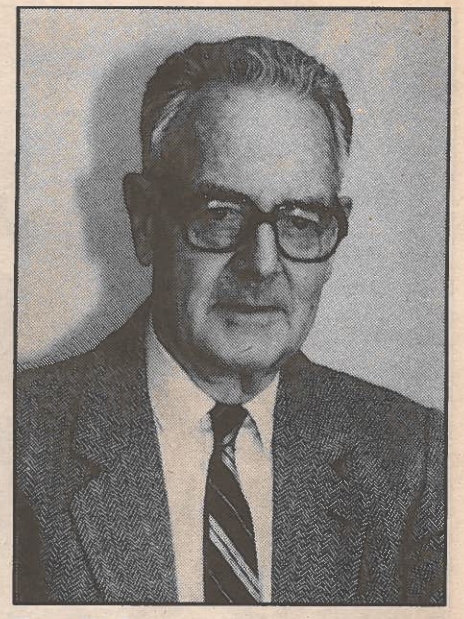
We are always grateful when funding comes in to help the students. Most of you don't realize it but some of their loans equal or exceed what some of us old-timers went into hock for our houses.

Alumni, especially Bruce Benson, have been active in setting up the **Bruce F. Curtis Endowment**. This honors Bruce's (photo) many contributions to the Department and the many students he helped train. The money will go to graduate students in energy resources, environmental geology, and engineering geology. These are the main areas of interest of his students, many of whom went on to earn a good living in geology. At the time of his retirement Bruce was the advisor of 22 graduate students, and only a person as organized as Bruce could have handled such a load.

An **Elaine Bass Parkison Memorial Scholarship** has been set up to recognize outstanding undergraduate and graduate women on the basis of academics and need.

The **Jeffrey A. Deen Memorial Fellowship** Fund also is new. It is to be used to further the education of an outstanding graduate student by making funds available for either research or dissertation preparation. The student's interest has to be in environmental geology, geochemistry, or exploration or economic geology. These match Jeff's broad interests well.

Recently we were pleasantly surprised when an anonymous donor presented the CU Foundation with $100,000 for the Department. This money will be invested by the Foundation and the interest used to support students.



Bruce Curtis.

Alumni Support

The Department of Geological Sciences has several specific accounts to which contributions may be made. Checks should be made payable to the University of Colorado Foundation with a notation indicating which of the following funds the contribution should be used for.

Scholarship Accounts: funds donated to these accounts are put in an interest-bearing account and the Department uses the yearly interest to provide scholarships to students.

Bruce F. Curtis Endowment: energy resources, environmental geology, and engineering geology.

Jeffrey A. Deen Memorial Fellowship Fund: environmental geology, geochemistry, and exploration or economic geology.

Longley-Warner-Wahlstrom Scholarship: economic geology.

Keith Marks Memorial Scholarship: includes need.

Elaine Bass Parkison Memorial Scholarship: recognizes outstanding women.

Contibutions may also be made to the following accounts:

Geology General Gifts: unrestricted funds for use at the discretion of the chairman, including alumni relations.

Warren O. Thompson Graduate Research: funds are used to assist graduate students with their research.

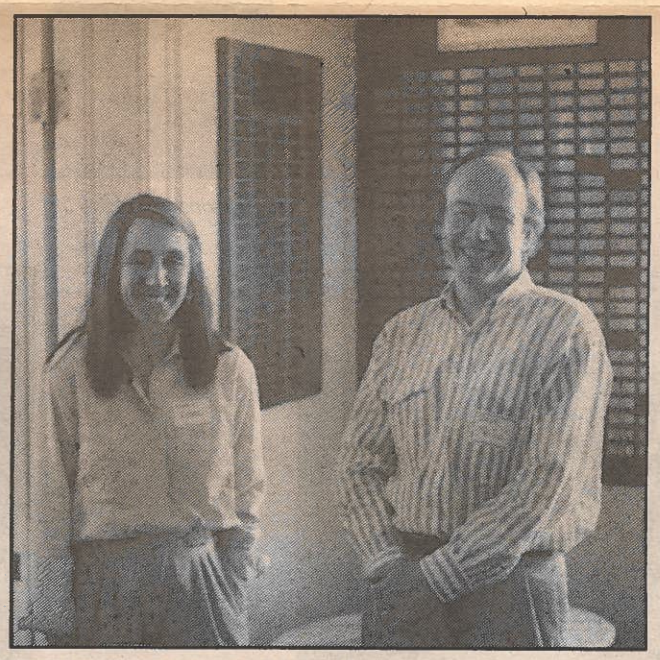
Geology Equipment: funds specifically designated for the purchase of equipment.

Geological Sciences Building Fund: funds specifically designated for the new Geological Sciences Building.

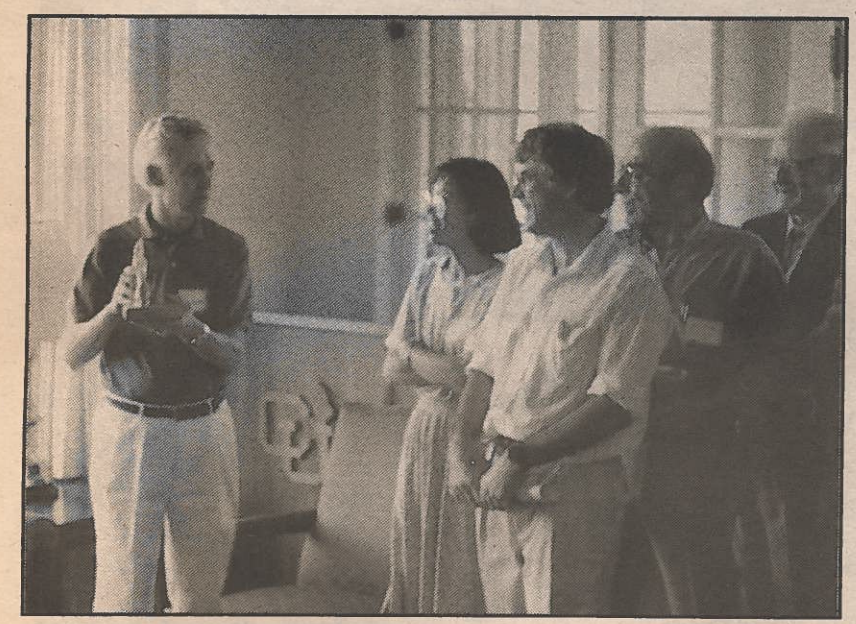
Undergraduate Enrichment Fund: funds specifically designated for undergraduates.

More Party Pics!

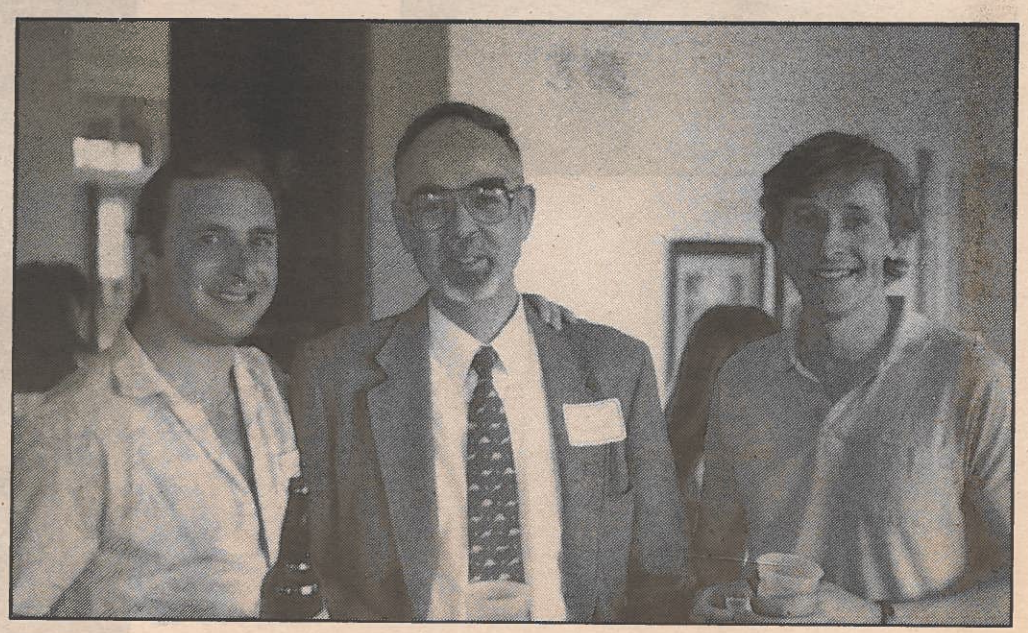
Some staffers! Terrie O'Neal (library), Lisa Edwards (student helping in the office), Dawn Reifsnyder (helping in the office temporarily), and Paul ("Thin-Section") Boni.



Mary Kraus and Dave Budd.

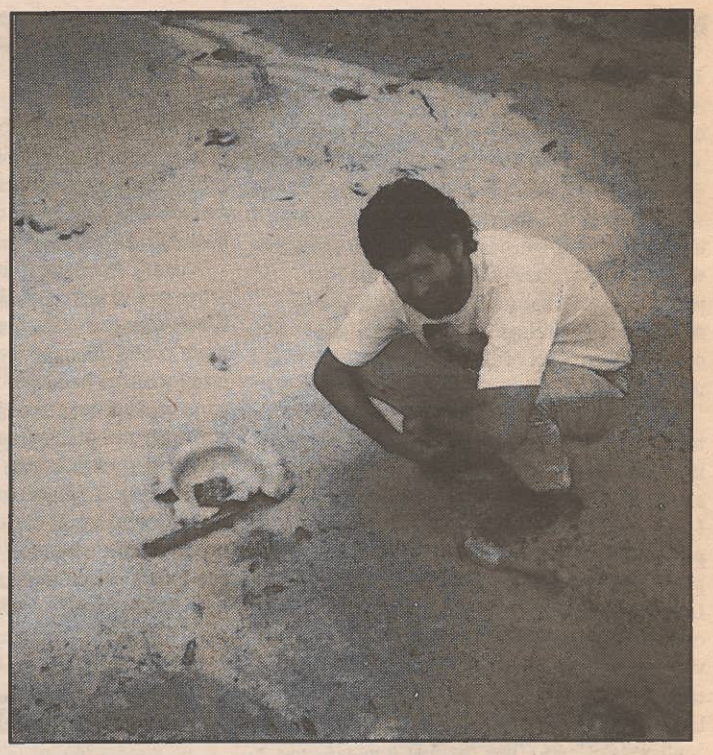


Bill Braddock telling us the history of the polished rock he has just received.



Don Runnells with graduate students Steve Hasiotis (l) and Andres Aslan (r).

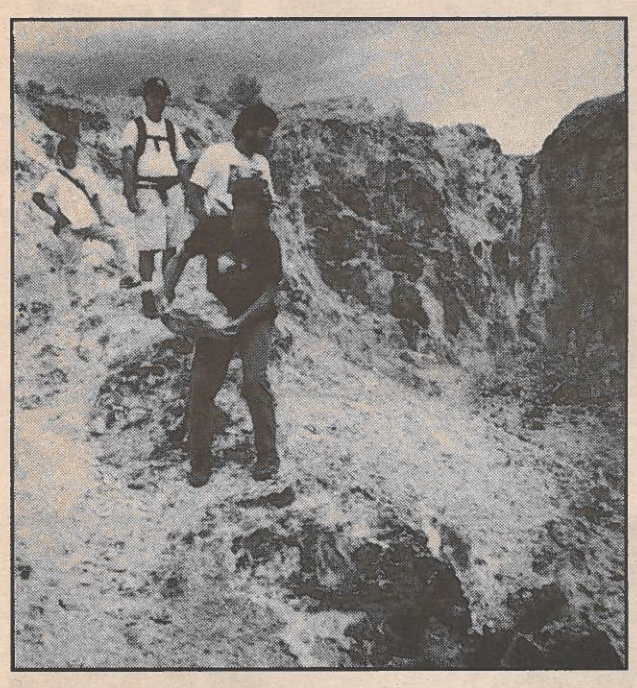
Students and faculty paying attention to Bill.



Jeff Swope measures craters in mud.

FALL FIELD TRIP

Bill Atkinson led the trip.



Fred Luiszer wins the rock toss.

One stop at the Glory Hole near Central City.