GEOSCIENCE NEWS

for the Alumni and Friends of the
Department of Geological Sciences
University of Michigan, Ann Arbor, Michigan

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Alumni Advisory Board

Standing (left to right): David Rea, Don Medwedeff, Al Levinson, Steve Bohlen, Tom Tinker, Henry Pollack; Seated: Jan Kappmeyer, Bob Haag, Bob Basse. *See article on page 9.*

In this Issue:

Greetings from the Chair

Dear Friends of the Department:

This issue of our newsletter has a general theme of Earth Science education running through it. Let me tell you about some of the fish in this river (with apologies to Don Peacor). Dave Mogk, an alum who recently concluded a tour as program manager in the Education and Human Resources Division of the National Science Foundation has been active in issues of Earth Science education for a number of years and has continued to be a leader in that field since he returned to the Big Sky country. In this issue of the newsletter Dave highlights the newly adopted National Science Education Standards, a series of goals for K-12 education that have as the ultimate objective a scientifically literate citizenry. In this document, published under the aegis of the National Research Council of the National Academy of Sciences, the venues of achievement include for the first time Earth and Space Science as a separate category, equal in stature to physical science, life science, and science and technology. I am delighted to see the geosciences, at last, assigned equal importance to our sister sciences. We have come a long way since my high school freshman earth-physical science class was a chore assigned to the newest assistant football coach. In addition to just being good sense, this new national goal offers opportunity to geology departments around the country to help train the K-12 teachers of the 21st century in the Earth Sciences they will be presenting to our children and grandchildren in their classrooms.

In a second article, another alum Liza Finkel describes developing and teaching a high-school science course using an integrated science approach. This idea is partly based on the idea that in the real world the sciences don't sort themselves out in a particularly neat and orderly fashion. When we look out the window we don't see only physics going on, or only chemistry or only biology. Further, to give high-school students a good introduction to all the sciences in three or so years, every basic science needs to be covered every year. The best way to see the fundamentals of biology, chemistry and physics at work is in a natural geological system and Liza has chosen the local brook to study. Creeks, rivers, ponds and lakes are in the common experience of high school students and using them as teaching tools will be a good way to develop future environmentally conscious citizens.

Our department is also reaching out to high school students in the midwest and elsewhere. In the past few years faculty member Larry Ruff has spearheaded a program he calls MichSeis. Under this program he places a seismograph and accompanying computer in high school classrooms and works with both teachers and students to understand what earthquakes tell us about the Earth. This program takes advantage of the fact that students who otherwise might find science "boring" commonly are excited by the idea of earthquakes. Larry is now reaching out to a number of locations with his equipment and software, including Camp Davis last summer and hopefully soon at the Cranbrook Museum, where it will be incorporated into their new natural science display.

In early November I attended a weekend meeting in Washington, sponsored by the American Geophysical Union, for the chairs and heads of Earth and Space science departments. The topic of the meeting was the future of research and teaching in the geo (earth, ocean, atmospheric) sciences. We were addressed by representatives of the various federal agencies who either employ or fund those trained in the geosciences, by representatives of foundations and teachers directly involved in revitalizing both K-12 and undergraduate teaching, and by those who have concerned themselves with the betterment of graduate education. Most of the meeting was devoted to issues of teaching and training. There are lots of new reports and brochures on the results of recent efforts along these lines. The National Science Foundation's "Geoscience Education: A Recommended Strategy" lists both Dave Mogk and Ted Moore of our faculty among the participating working group members. It is now our turn to sort through all these reports and suggestions and demonstrations and determine what will work for us and for our students and classes in Ann Arbor. We are fortunate to have several faculty in our department who are interested in enhancing the teaching/training experience among our students, so I am confident of good progress on these fronts.

Sincerely yours,

David K. Rea

David K. Rea
Professor and Chair

Earth Science Education

In this issue we are focusing special attention on aspects of earth science education that several of our alumni (and faculty) have been active in around the country. Articles that follow have been contributed by Liza Finkel (MS '86), a secondary school teacher in Maine, David Mogk (BS '75), a professor of geology at Montana State University and chair of the Geological Society of America's Education Committee, recently on leave at the National Science Foundation, and Larry Ruff of the Department faculty. Additionally, we reprint a condensed version of a Geotimes article about David Nash's integration of his research with classroom activities, effectively engaging the entire class as research assistants. Dave (MS '73, PhD '77) is a professor of geology at the University of Cincinnati.

Engaging the National Science Education Standards

by David W. Mogk (BS '75), Chair, GSA Education Committee
Reprinted from GSA Today, September 1977.

At the start of this new school year, we look forward to our educational mission with high hopes and great expectations. It is a time of new opportunities and challenges — and it is also an appropriate time to assess priorities and responsibilities. With the publication of the National Science Education Standards (NSES; National Research Council, 1996), the geoscience community has a remarkable opportunity to promote geoscience education in the nation's K-12 schools and beyond. Through the NSES, the earth and space sciences have attained parity with other physical and life sciences in recognition of the importance of our disciplines in achieving scientific literacy for all citizens. This is an opportunity that the geoscience community cannot afford to miss. All geoscientists have something to offer in response to the goals of the NSES, and as a community, we all have much to gain.

BACKGROUND

The NSES were developed in response to a national mandate from professional societies and governmental agencies to improve scientific literacy across the nation. The National Research Council (NRC) was commissioned to coordinate the development of the NSES. The NSES build on the recommendations of earlier projects such as publications of the American Association for the Advancement of Science Project 2061, Science for All Americans (1989) and Benchmarks for Scientific Literacy (1993), and the National Science Teachers Association Scope, Sequence and Coordination Project. Input to, and review of, the NSES was solicited from the breadth of stakeholders in science education.

GOALS

The goals of the NSES are to "educate students to experience the richness and excitement of knowing about and understanding the natural world; use appropriate scientific processes and principles in making personal decisions; engage intelligently in public discourse and debate about matters of scientific and technological concern; and increase their economic productivity through the use of the knowledge, understanding, and skills of the scientifically literate person in their careers."

The NSES have been developed to provide quality science education for ALL students. The national goal of a scientifically literate citizenry requires both excellence and equity in science education. The NSES state that all students should have "the opportunity to learn science...[with] access to skilled professional teachers, adequate classroom time, a rich array of learning materials, accommodating work spaces, and the resources of the communities surrounding their schools." The NSES call for major changes in how we teach science to our children, recognizing science as an active process, going beyond "hands-on" activities, and most important, incorporating inquiry at the core of our science education activities. The NSES provide criteria by which to judge the quality of science education at many levels — the quality of what students should know and be able to do; the quality of science programs; the quality of science teaching; the quality of the systems that support science teachers and programs; and the quality of assessment practices and policies." The NSES also provide criteria for local communities to judge which curricula, staff development, or assessment activities are appropriate to meet local needs and expectations. The NSES bring coordination, consistency, and coherence to the overall improvement of science education across the nation.

AREAS OF EMPHASIS

The NSES encompass six important areas requisite for quality science education: science teaching, professional development, assessment, science content, science education programs, and science education systems. The content standards may be of particular interest to the geoscience community. It is recommended that in grades K-4 all students should develop an understanding of properties of earth materials, objects in the sky, and changes in earth and sky; grades 5-8, structure of the Earth system, Earth's history, and Earth in the solar

system; and grades 9-12, energy in the Earth system, geochemical cycles, origin and evolution of the Earth system, and origin and evolution of the universe. It must be emphasized that the NSES do not require a specific curriculum (i.e., prescribed organization of content). The content standards can be organized and presented with different emphases and perspectives according to local needs, opportunities, and resources.

HOW TO HELP

Given the breadth and scope of the NSES, there is clearly a lot of work to be done. To reap the benefits of broader exposure of the geosciences through the NSES, the geoscience community must be actively engaged in their implementation. The first important step is to acquire firsthand knowledge about the NSES. Copies of the standards can be ordered directly from the National Academy Press bookstore (www.nap.edu/bookstore/). The Geoscience Education Division will sponsor the symposium "Engaging the National Science Education Standards" at the GSA Annual Meeting in Salt Lake City. Speakers include those who have been engaged in the initial development of the NSES, development of new instructional materials and methods, effective use of the standards in the K-12 classroom, and supporting activities on college campuses and government agencies.

Whatever your role as a geoscientist, you can help to expand public awareness about the geosciences through your personal involvement with implementation of the NSES. Earth science teachers and administrators in the K-12 schools are clearly at the forefront; these colleagues must be confident in their ability to master content and utilize effective practices in the classroom. College and university faculty have a special obligation to contribute to the preparation of future teachers, who compose a large student clientele in our introductory courses, by working with colleagues in education departments to make sure appropriate content is used in science teaching methods courses, in advising students about career possibilities in earth science education, and as we revise our college curricula in anticipation of enrollment of students who have experienced K-12 standards-based science education. Researchers can work to translate exciting new scientific discoveries into effective classroom activities. Government and industry workers can mobilize resources (host field trips, provide materials, serve in a mentoring capacity for teachers and students) to facilitate implementation of the NSES. GSA and other professional societies can promote the NSES through their own educational programs, as is being done in GSA's Science Awareness through Geoscience Education (SAGE) program (e.g., Earth and Space Science Technological Education Project, Technology Learning Center, Geoscience Education Through Intelligent Tutors). Geoscientists who are parents can regularly review their children's classroom activities related to the Earth sciences to ensure that they are coherent with the goals of the NSES, and we can all take an active role in the review of policies related to science education in general, and to the Earth sciences specifically, at the local, state, and national levels.

To effectively promote the NSES, collaborative efforts of the entire geoscience community will be needed. GSA's Partners for Education Program (PEP) is a great place to get started (visit the Education Center at www.geosociety.org). Membership in PEP is free and is open to all education and geoscience professionals. PEP maintains a database of scientist and educator partners, and enhances communications between members through newsletters and access to information for materials and workshops; an e-mail partner program is being developed. The frequency and nature of partnering activities is completely left up to the individual members, depending on need and time available. True partnerships between educators and geoscience professionals is key to improving geoscience education, and PEP provides excellent materials with tips for effective collaborations. Our colleagues in K-12 education bring a wealth of experience of how students learn best, a sense of which activities are age-appropriate for students, and ways in which new topics can best be integrated into existing curricula, and our teacher colleagues are also enthusiastic students. Professional geoscientists bring a world of knowledge and experience that should be shared through a variety of educational experiences. We all benefit from these partnerships — students and teachers, the geoscience professions, and the general public.

There are great opportunities and challenges ahead for geoscience education. The NSES provide a national framework for revitalization of K-12 science education, and the geosciences have a central role to play. GSA is responding proactively to the standards, through the numerous education programs that it supports. We hope that the general membership of GSA will also make personal commitments to become informed about the standards, and to work toward their effective implementation in our own life settings.

Integrated Science Programs: Reforming Science Education in the Public Schools

by Liza Finkel (MS '86)

"Since the intellectual challenges of daily work and living do not divide themselves neatly into categories of the traditional academic disciplines, students need help in developing a broader view of the contributions that various disciplines offer to their thinking and problem-solving."

—Maine's Curriculum
Framework for Mathematics
and Science, 1995, p. I-3

The opening quote is just one of the many that echoed in my mind as I began to plan the curriculum that I would use with my ninth grade science students this year. It is also one of the reasons that I, along with many other science teachers in Maine (as well as elsewhere), have chosen to design curricula that integrate material from several science disciplines instead of focusing on just one. Referred to by names ranging from "integrated science" to "Every Science, Every Year" (ESEY), this approach to science teaching is seen as a means to help students learn science in a more meaningful way, as well as to ensure that students who may complete as few as two years of science in high school are introduced to a wide range of science disciplines in those years.

Teachers who are working to develop integrated science courses usually do so for one, or both, of two reasons. The first focuses on making sure that all students are exposed to all science disciplines by the time that they graduate. Teachers find that some students skip freshman science classes altogether (freshman science is often the only Earth science class taught in high school) in their hurry to complete biology, chemistry, and physics and still have time for at least one advanced placement class in science. On the other hand, other students take the minimum number of required science classes and never get beyond Earth science and biology. As a result, both groups of students miss out on key science concepts. If teachers hope to achieve the goal of "science for all Americans," it is important that all students have the opportunity to study all disciplines of science, and the current "layer cake" model of science teaching does not ensure that.

This first concern has lead to the development of ESEY programs which guarantee that all students study all disciplines before they graduate. Schools have done this by creating two-year course sequences in which students rotate from one discipline to the next, first focusing, for example, on Earth science, then chemistry, then biology, and then physics. Programs may be set up so that students spend one quarter on each discipline each year, or one semester on each discipline over two years.

The second reason for adopting an integrated science approach centers on helping students learn science differently. Teachers are concerned that most students don't see science as interesting or engaging, and they find that an integrated curriculum lends itself more readily to the teaching of science through authentic problems that are relevant to their students. They find that this approach helps students come to see science as more meaningful to them and to their lives outside of school. The goal of making science more relevant to more students, then, can also be more easily met with an integrated science curriculum than it can with a traditional, discipline-by-discipline approach.

This second concern has lead to the development of another kind of ESEY or integrated science curriculum. In programs which attempt to make science learning more relevant, students study science through the completion of a series of projects in which knowledge from several science disciplines is integrated. The primary purpose of these classes is to help students come to see the ways in which scientific thinking and scientific information can be used to solve authentic problems; problems that they may encounter in their lives outside of school or problems that they can connect with other subjects they may study in school. In this model students work to solve realistic problems which require the application of scientific knowledge from several disciplines.

These two models of ESEY implementation are based on different premises and require different degrees of curriculum reform. In the first case, students are given the opportunity to study scientific disciplines which they otherwise might not encounter in high school through the rearrangement and restructuring of the sequence of science classes. In the second case, a more fundamental change is required, as teachers rethink the ways in which students learn science and design integrated projects which incorporate multiple science disciplines as well as provide authentic science experiences for their students.

This second approach is the one I have adopted for my ninth-grade science class at Noble High School. Noble is a public high school in Maine where, despite the state requirement of two years of science from graduation, all students are required to complete four years of science before they graduate. I don't worry that my students will not be exposed to a range of

scientific disciplines; I do worry, however, about them finding the study of science useful to them beyond school. In order to address this problem, I have designed an integrated science curriculum that focuses on a series of broad questions and projects through which students learn to apply ideas and methods from a range of scientific disciplines. The following description is of one of the long-term projects I engage in with my students. This is a project that I began developing in 1994 with a group of teachers at Ann Arbor's Community High School, and I owe considerable thanks to them for their many contributions to its current form (see Heubel-Drake, Finkel, Stern, and Mouradian, 1995, for a more detailed description of our work together).

When my ninth-grade students arrive in the fall, we begin our work together with a study of a nearby stream, Worster Brook. The stream, located a five-minute walk from our classroom, provides a context for students to explore concepts from the Earth sciences (e.g. the ways that the Earth's surface can be changed by weathering and erosion, and, a look at the water cycle which includes the role of both surface and ground water); the life sciences (e.g. the ways that living and non-living things depend on each other and on their environment, and, the impact of human activities on the lives of other organisms); and chemistry (e.g. ways to evaluate water quality based on a series of chemical tests such as pH level, nitrate and phosphate content, and dissolved oxygen saturation). At the same time, students develop strategies for studying Earth science, life science, and chemical processes in a natural setting.

My students and I begin our exploration with a walk to the stream, a trip that results in the development of a list of questions for further study. These questions are used as the basis for library research on different aspects of freshwater ecosystems, and then as the basis for another list of questions used to help students design investigations into different aspects of stream formation, stream water quality, and/or the impact of human activity on the stream. Interspersed with this project-based work are a series of activities designed to help students develop a number of key skills, including library research skills; skills associated with graphing and other modes of representing scientific information; collection and classification of macro-invertebrates, plants, and rocks and minerals; and skills associated with designing, carrying out, and interpreting data from scientific investigations.

This project is followed by two others in the fall, one on the development of the model of plate tectonics and one on space exploration. Both of these projects, as well as the four others we will conduct in the spring semester, all allow students to apply knowledge from several different science disciplines as they investigate authentic scientific issues. In addition to this integration, all of these projects encourage students to see science as something that is of use to them in the world outside of school, and help them apply the knowledge that they develop to solving other problems that they may identify at later points in their lives.

Educational reform in the public schools is a complex problem, and integrated science or ESEY programs are not a panacea capable of solving all of the recently popularized problems in science education. These programs are, however, one approach that teachers around the country are beginning to use to address gaps in the science education received by many American high school students, as well as to help more students come to see science as meaningful. If we are to continue with efforts to increase scientific literacy for all students in American schools, and especially in our quest to help students find science relevant to them, and therefore worthy of further study, it is essential that teachers be given the support they need to develop authentic, integrated projects designed to both teach students science content, and help them see its relevance in their daily lives.

References

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MichSeis

by Larry Ruff

MichSeis is a cooperative digital seismographic network that encompasses three activities: education, research, and the public service of earthquake monitoring. MichSeis has grown over the past three years, from the initial collaboration between Larry Ruff at U-M and Richard Ensign at Crestwood High School to the current participant list of three high schools, five additional universities, and one museum. During this time, we have developed the hardware and software for the system. In addition, we have established contacts with interested teachers, mostly through presentations sponsored by MESTA (Michigan Earth Science Teachers Association), and through our web interface. While the research and earthquake monitoring aspects are important, the educational facet of MichSeis is a new and exciting endeavor for the Seismological Observatory and the Department. Most people, including students of all ages, are fascinated by earthquakes. Thus,

seismology provides an easy entry into Earth Sciences. In addition to learning something about seismology, MichSeis also exposes students to many concepts: physics and electronics (how the seismometer works); geography (places that have earthquakes); geology (why earthquakes occur where they do); and computer networking (how we share information). MichSeis provides the "telescope" for students to see the Earth in a dynamic "light." The students see that science itself is a dynamic topic, and they feel that they are part of a greater scientific enterprise, as the seismograms recorded on their school's instrument are used by other to do research.

MichSeis stations are fairly inexpensive, and they can run on a table in a high school classroom. A MichSeis seismographic station consists of hardware: A Macintosh computer; an A-to-D card; a seismometer; a GPS clock; and a communications connection, either a modem or the internet; and software; *SeismoGraf* (written by L. Ruff), this program works 24 hours a day doing the routine seismographic tasks; *SeismoView*, the companion program to view and analyze previously recorded seismograms; and *SeismoLog*, an open structure hyperCard data base that allows students and teachers to add earthquake data and analysis modules; and standard commercial programs for communications, spreadsheets and graphing. Any description of the MichSeis hardware and software is rather boring by comparison to the activities which the system enables. To emphasize what students can do, let us tell you a "story":

Imagine that you visit a high school classroom. Students sit down at a computer and use the *SeismoView* program to scan a graphics image that shows seismic wave activity recorded by the school's seismograph in the past 24 hours. The students notice that large amplitude waves rumbled across Michigan just three hours ago, thus they "double-click" on the relevant seismogram file to display the characteristic wave pattern of a faraway earthquake. The students perform some analysis. They pick the arrival times of the P and S waves, and they measure the amplitude of the surface waves. They feed this information into *SeismoLog* (a hyperCard stack that they obtained as part of the MichSeis software package), and they calculate the magnitude for this earthquake. Their magnitude estimate is 7.0, which means that this earthquake could be a serious catastrophe, or felt by no person, dependent on exactly where it occurred. For example, the terrible destruction at Kobe, Japan, on January 16, 1995, was caused by an earthquake with magnitude 7.0, yet many other magnitude 7 events occurred the same year with no serious impact on people and their activities. To further investigate, the students "double-click" on a web browser program to go out on the *Internet* and connect to the MichSeis home page at the University of Michigan ("http://www.geo.lsa.umich.edu/MichSeis"). With just a couple of "clicks," the students have access to other seismograms collected by the MichSeis central server. With this additional data, they quickly obtain an approximate epicentral location that is somewhere around the western coast of South America. The students look at a map, either on the wall or on the computer screen, and realize that the population density is highly variable along coast of Peru and northern Chile. Thus, it now matters *exactly* where the epicenter of this earthquake is located. The students go back out on the *Internet* to connect to the on-line earthquake epicenter catalog provided by the NEIC (National Earthquake Information Center, a government facility with the duty to detect and locate earthquakes around the world). Since it has now been almost four hours since the event occurred, the students see that NEIC just posted the preliminary epicenter. The students download these epicentral coordinates, and use the MichSeis world-wide-web home page to automatically produce a map of South America with the epicenter plotted. Finally, with some relief, the students see that the earthquake is located beneath the coast in a sparsely populated spot of northern Chile.

While the students are plotting the epicenter and measuring P waves from other MichSeis seismograms, they keep an eye on the "real-time" ground motion that is displayed in a graphics window by the *SeismoGraf* program. All of a sudden, one of them notices that another earthquake is coming in NOW! That is always very exciting! With more students from the class looking over their shoulders, they quickly go through the steps to show that it is a magnitude 5.5 aftershock of the preceding event. The students are already excited about writing up a report on their efforts, and they ask their teacher to use some of their results on the Chilean earthquake in a presentation to be given at the next MEST meeting. Later that afternoon, another student notices that more seismic waves are arriving, and those students go off on another global adventure

This "story" has already happened a few times in those few schools that already participate in MichSeis, but we hope that it will happen many more times in the future as more schools join MichSeis.

One new and exciting element of MichSeis is museum installations. In cooperation with the museum staff, we have been running a "hands-on" seismographic station in U-M's Exhibit Museum (partially supported by a local foundation). This test has been quite a learning experience for us (it is quite difficult to keep a stand-alone digital seismographic station operating when the public is allowed to "interact" with it!), but we are ready to deploy the "state 2" system. Cranbrook Museum is now interested in operating a "hands-on" seismograph, and we think this aspect of MichSeis will grow into an important component of the outreach to the general public.

This past summer, Prof. Peter van Keken ran a MichSeis station at Camp Davis. This experimental project was supported by alumni gifts, and the station did record a "local" earthquake while at field camp. This project seeks to provide a broader educational experience for our field camp students.

We should mention that a seismology graduate student and an undergraduate student have been involved in some aspects of MichSeis — in particular maintaining the world-wide-web site and our *SeismoLog* data base. Undergraduate and graduate student participation in the MichSeis program is beneficial to all concerned. It provides a mechanism for university students to contribute to K-12 education.

To conclude, MichSeis "outreaches" from faculty and students at the University of Michigan to other universities, to K-12 teachers and students, and to the general public. While the basic system is operational and there are participants and activities at all educational levels, there is still much to do!

Rivers: No Two Alike

The following article has been extracted from GEOTIMES (April 1997). It discusses the work of David Nash (MS '73, PhD '77) and his students.

Floods—even the floods that wreaked havoc on dozens of communities in the Pacific Northwest last December or along the Red River this past spring — are essential to the long-term health of a river system. A recurrent cycle of flooding helps to ensure that nature's pattern of sediment deposition and transport remains in equilibrium over time.

The classic assumption among environmental engineering, hydrogeologists, and others involved in water-resource management is that floods (or bankfull discharge), occurring roughly twice during a three-year period, are responsible for moving most sediment and determining river morphology. This pattern is known as "effective discharge." But Dr. David Nash, professor of geology at the University of Cincinnati, has challenged this rule of thumb, stating that analyses of water-resource data during the past 20 years, conducted by him and his students, lead to an entirely different conclusion.

Nash asserts that there is no universally applicable recurrence interval for effective discharge, and the assumption that most of a river's sediment is carried by the rare floor, or bankfull discharge, is decidedly not the case. Instead, rivers display highly individual characteristics and the impacts of floods are "all over the map." In many cases, says Nash, some discharge occurs about once a month—considerable more often than the dramatic bankfull flooding event.

Twenty years ago, Nash began asking students in his classes on geomorphic processes to study records of daily river discharge and sediment transport, obtained from the U.S. Geological Survey, as class assignments. As the semesters rolled by, Nash and his students collected information on 55 rivers, primarily those that were about to be impounded or had been impounded. "Daily sediment discharge records are not kept on every stream," says Nash. "But data are collected on rivers that have been disturbed."

As the data accumulated, Nash began looking for patterns, and what he discovered had not been predicted. Most sediment in large rivers like the Mississippi was transported very slowly over a long period of time. But sediment deposited in smaller rivers came in pulses. "What you see is virtually no sediment movement for years and years and then a sudden enormous pulse," says Nash.

The pulse pattern was particularly apparent in arid regions such as New Mexico and Arizona, but some rivers in more humid, temperate zones also displayed the same characteristics. "Probably the most dramatic example of this [pulsing] is the Eel River in California, in which over half the sediment was delivered in a couple of days—and that record stretches back more than 30 years."

Many river systems are substantially altered by changing land uses such as reservoir impoundments, dams, recreation activities, and outtakes for municipal use. Managers of federal lands are required to maintain or restore rivers to "original use" condition, their natural state prior to man-made disturbances. "The goal for today's water managers is to move the same amount of sediment, using considerably less discharge," explains Nash. To do so, they must understand the river they're dealing with.

Perhaps the most important lesson learned by Nash and his students during the past 20 years is that no two rivers are the same. A river's sediment-transport rate, for example, usually increases at one-and-a-half times the rate at which the discharge increases. But on the Eel River, the sediment-transport rate increase is three-to-four times the discharge rate increase, resulting in very rapid channel incision. A combination of steep terrain, soft rock, and a humid, temperate climate along the Eel can trigger massive landslides, which is exactly what happened during catastrophic flooding in 1964.

"There are almost as many riverine behaviors as there are rivers," says Nash. "That makes water management a very empirical science."

Alumni Board News

by Al Levinson

In the last **Alumni Board News** column I told you that you would "meet" the 1997-1998 Board in this issue of *Geoscience News*. This is a result of our desire that all alumni know who is on the Board and what the Board does.

Let me introduce you to them:

Robert A. Basse (BS '75)
Celsius Energy Company *Denver, Colorado*
Steven R. Bohlen (BS '77, PhD '79)
U.S. Geological Survey *Reston, Virginia*
Robert D. Haag (BS '76, MS '79)
Haag Environmental *Van Buren, Ohio*
Jeffrey R. Huspeni (MS '81)
Newmont Exploration Ltd. *Denver, Colorado*
Janet Kappmeyer (MS '82)
Cypress Environmental *Sunnyvale, California*
Alfred Levinson (BS '49, MS '49, PhD '52)
University of Calgary *Calgary, Alberta*
Donald A. Medwedeff (BS '81)
ARCO Oil and Gas Company *Plano, Texas*
Joaquin Ruiz (MS '80, PhD '83)
University of Arizona *Tucson, Arizona*
Clarence N. Tinker (BS '54, MS '55)
Shell Oil Company (ret.) *Houston, Texas*

You can see that the Board members are diverse not only in their geographical distribution but also in their affiliations. There are representatives of government, the petroleum industry, the mining industry, environmental firms, academia, and the wonderful world of retirement. Further, the years of their Michigan degrees range from 1949 to 1983. Clearly, the Board represents as complete a spectrum of the geological sciences, with a breadth of experiences, as is possible to assemble for a reasonably sized group.

In view of our limited space for this issue, I will report to you briefly only on the events of our 1997 annual meeting held on October 10. These included:

1. A report by Department Chair David Rea on the highlights of the year from the point of view of the Department (e.g., three new appointments);
2. A discussion of aquatic sciences (which are taught in several faculties across the campus), including oceanography and Great Lakes studies in the Department;
3. A presentation by Dean Edie N. Goldenberg of the College of Literature, Science and the Arts in which she expressed great satisfaction with the international reputation of the Department and presented insight into future trends in the University (e.g., encouragement of interdisciplinary studies);
4. A report by Mr. Frank Potter of the Development Office on fund raising matters of a general nature.

Discussions accompanied all the above topics and there were vibrant and sincere exchanges of ideas with the sole objective of at least maintaining, but preferably improving, the very high international status of the Department.

On behalf of the 1997 Geological Sciences Alumni Board, I respectfully submit the following "Summary Statements," prepared at the October 10 meeting.

The Board:

1. Observes that the preparations for this meeting of the Board, and the agenda, were exemplary. We express our thanks to Dave Rea, Henry Pollack and other responsible persons, for their efforts.
2. Recognizes that the University is struggling with the status and organizational aspects of the broad field of Aquatic and Marine Sciences. Research and teaching of these subjects are widely dispersed among several schools, colleges and field stations. We can offer no advice, but recognizing that Michigan is the Great Lakes state, we do encourage the Department with its significant technical expertise in aquatic and marine sciences, to assist in efforts to generate a university-wide, long term strategy in this area.

Dean Edie Goldenberg discussing interdisciplinary activities in LS&A.

Jim O'Neil in heated discussion with Turner Lecturer Alexandra Navrotsky.

3. Appreciates having had the opportunity to hear first-hand of the research and other activities being carried out in the Department's Oceanography group. We were surprised how well this research group integrates with the overall direction of the Department (because we had the mistaken belief that this group was "peripheral" to the mainstream of the Department). We strongly support the continuation of the aquatic component of the Department, ranging from the Great Lakes to the oceans.

4. Wholeheartedly supports the Department's decision to fill a tenure track position with a geohydrologist as geohydrology is a cornerstone of any environmental geology program.

5. Recognizes the enhanced opportunity for undergraduates to inter-relate with the faculty under the UROP (Undergraduate Research Opportunity Program) and hopes that the Department continues its successful implementation.

6. Notes with pleasure the appointments of Professors Lithgow-Bertelloni, Stixrude, and Ewing to the faculty during 1997, and we wish all of them great success in their careers at the University of Michigan.

7. Encourages the Department to make a specific effort to establish additional distinguished lecture series (preferably "named"). An important goal of such lectures should be to introduce students to a broad spectrum of career opportunities.

8. Is encouraged by the improved employment opportunities for graduates in the private sector, particularly in the energy area, as evidenced by the return of recruiters from many major companies. This has stimulated several members of the Board to consider the feasibility of seeking funds for a Chair in "Resource Geology" in view of the historical reputation of the U of M in this area.

9. Appreciates the opportunity to have heard directly from Dean Edie N. Goldenberg about the University's efforts in developing interdisciplinary studies, e.g., environmental engineering. We believe that this concept is very positive as it builds bridges and interrelationships with other Departments, including Geological Sciences.

10. Expresses its sincere thanks to Robert D. (Bob) Haag for his dedication to the Board over the past five years. His thoughtful insight into many subjects, and his clairvoyance particularly with respect to the Environmental Geology program, are particularly noteworthy.

Bob Basse and Steve Bohlen sharing stories from the '70's.

Further details on the Board meeting are available, and we will be placing the following on the Department web page: the agenda; the Minutes of the meeting; and the "Summary Statements" that the Board sent to the Department for its consideration.

I encourage you to contact me on any matter concerning the Board and its activities or alumni relations with the Department. You are guaranteed a reply!

On behalf of the Alumni Advisory Board, I wish you all a very happy holiday season.

Alfred (Al) A. Levinson, Chairman
Geological Sciences Alumni Advisory Board
Department of Geology, University of Calgary
Calgary, Alberta, Canada T2N 1N4.
e-mail: levinson@geo.ucalgary.ca

Alumni News

1930's

Donald H. Chapman (AB '27, MA '28, PhD '31) is in his 93rd year and is living happily in a retirement home in Exeter, New Hampshire. He is no longer capable of field work, but he travels when he can. Currently, he has at least two dozen families in Norway with whom he corresponds. These are mostly former students or colleagues from two Fulbrights in Norway in 1950 and 1965.

1940's

Helen L. Foster (BS '41, MS '43, PhD '46) is still fascinated by the geology of the polar regions. She had a brief introduction to Spitsbergen this year — made 80º10'N

Richard Strong (BS '45, MS '48) writes of two recent publications: Morroda Mina Manganese Mine, Brazil, Skillings Mining Review, Vol. 85, No. 8, February 24, 1996, pp. 4-13 and COMILOG Manganese Mine, Gabon, Skillings Mining Review, Vol. 86, Nos. 13 & 14, March 29, 1997, pp. 4-19 and April 5, 1997, pp. 4-19.

Eugene H. Walker (faculty '46-'48) and **Mary Morris** (MA '49) met at Michigan. They were married August 27, 1947, fifty years ago! They vacationed for three weeks in central Ontario this summer where Gene had good luck at fishing and Mary enjoyed seeing the Canadian Shield rocks. Mary worked on several of her botany projects. In winter they go down to Anguilla in the Lesser Antilles for a couple of months. Gene paints and reads "great books" and Mary studies the plant life.

1950's

Ed Dibble (BS '55, MS '56) is now retired from 3M/COMTAL, where he had been developing the requirements for an image processing workstation. In retirement he is busier than ever, enrolled at Georgia Tech in their graduate program in water resource management. He also has his own company, Advanced GIS Technology, in the mountains of north Georgia in the Lake Rabun area. He saw the article about the passing of Prof. E.N. Goddard and remarked "What a really true gentleman he was."

Robert H. Dott, Jr. (BS '50, MS '51) and **Nancy Robertson Dott** (BS '51) spent August in Britain occasioned by the Bicentennial Hutton-Lyell Conference (Hutton died and Lyell was born in 1797). The Lyell portion was in London and Hutton in Edinburgh with excellent excursions for each part. Bob presented results from his "new" chapter in the history of geology—namely about Lyell's lectures and travels in America in the 1840s, and he was asked to present summary remarks for the Hutton conference. The weather was atypically beautiful. Nancy uses her geology by giving geology programs to elementary-age school classes.

William W. Easton writes with great sadness the deaths of three of his best geology buddies. They are **Gene Hinton** (BS '52), oil company scout in Wyoming, who won two varsity letters in football at U-M; **Orville Van Eck** (BS '51), geologist with state of Iowa; and **Philip Lamberton** (BS '51), mining geologist in Tennessee. Lamberton and Easton worked together in uranium on the Colorado Plateau.

Walter O. Kupsch (PhD '50) on the 90th birthday of the University of Saskatchewan was one of nine recipients of an LL.D. Why the presentation of a law degree to a geologist as an honor remains a mystery.

Digby McLaren (PhD '51) writes from Ottawa, Canada, that he still keeps an interest on problems of population and global changes.

Edward H. Poindexter (BS '52, MS '53, PhD '56) transferred to Army Research Laboratory's new physical sciences facility in Maryland in May, 1997, and is no longer associated with Fort Monmouth.

Chuck Wheeler (BS '54, MS '55) wrote from Littleton, Colorado "Many thanks for the fine tribute to E.N. Goddard which appeared in the July issue of Geoscience News. For the past century and a half Michigan has been privileged to have its share (some might say more than its share) of truly renowned earth scientists on its faculty. I feel sure that in the opinion of many Ed Goddard would be counted as part of the cream of this distinguished group. Goddard was much more than a brilliant structural geologist and map editor. He was a warm and caring person who gave a lot of help to his students. He personally went out of his way for me to see that I made it through graduate school successfully. He was a great role model."

1960's

Don Byron (BA '56) dropped by the Department for a visit on the Friday before the Michigan-Ohio State football clash. It seems that Don, a former U-M athlete, had important business that brought him to Michigan just coincidentally at the time of the big game! Don is in the industrial abrasives business, making everything from roofing granules to custom-mixed concrete to ship ballast of specified density. In Michigan he is processing slag deposits from the White Pine mine in the UP near Ontanagon. His regular base of operations is south of Tucson, Arizona, where his company has projects in some of the Arizona mining districts and in the Mojave desert. Don recalled his work under Jim Zumberge (U-M faculty, 1950-62), and courses with Eddie Goddard. Don last saw Jim at the Department's 150th birthday party at Camp Davis in 1989.

Denzel (Denny) Cline (BS '55, MS '61) travels to Michigan from Puyallup, Washington, once or twice a year to visit and

help his mother, who lives alone, and to see relatives and friends. His wife Dorothy had her knee replaced in April, so she didn't travel with him when he came in early June. He went to his 50th high school reunion in East Lansing while here. Denny did sight-seeing of national parks, historic sites, and caves, arriving back home in late July. In August they had a family reunion at Whistler, British Columbia, for a week.

David G. Darby (BS '59, MS '61, PhD '64) retired as Chair of the Department at the University of Minnesota in Duluth in 1991. For the next five years he and his wife sailed the Atlantic. They came back to the U.S. in 1996 and settled in Santa Fe, New Mexico.

Al Fagerstrom (PhD '60) writes from Corvallis, Oregon, that he is finishing up a four-year study of the paleoecology and origin of the Permian upper Capitan Limestone in Texas and New Mexico. Four manuscripts are contemplated: one has been accepted, one is in review, one almost ready for submission, and the last only in outline form. He has been spending nearly half of the year in New Zealand, in the Geology Department at Canterbury University in Christchurch. He says he is pretty tired of winters in Michigan and Nebraska, and so is following summer back and forth between the hemispheres. He's had no winter since '95!

Ronald E. Seavoy (BA '53, MA '69, PhD '65) sends some news from Bloomington, Indiana. He was a member of the delegation of the Mid-Andes Field Trip sponsored by the Society of Economic Geologists in November 1996. They visited mines and prospects in Bolivia, Argentina, and northern Chile. He attended the first offshore annual meeting of the Society of Economic Geologists in Lisboa, Portugal, in May 1997 and was a member of the Iberian Pyrite Belt (late Devonian age) field trip.

Charles Swithinbank (Research Associate and Lecturer 1959-1963 who worked with Jim Zumberge). He has just published his memoirs of the three U-M expeditions to the Antarctic that he led: *An Alien in Antarctica: Reflections on Forty Years of Exploration and Research on the Frozen Continent*. Blacksburg VA, McDonald & Woodward (800-233-8787), 1997. ISBN 0-939923-43-2 (10 maps, 56 color plates, 15 black and white, references, index, hardbound, $49.95).

1970's

Steven Catlin (BS '78) is still working at Groundwater Technology (now merged, so it's Fluor Daniel GTI). He will probably look for a teaching job (community college or smaller four-year school) in 1998. He took a three-week vacation to Turkey in November with his wife and an old friend. Steve republished his book *Work Less and Play More* and it's beginning to get into bookstores, but meanwhile any bookstore can order it. Also, it can be gotten from Kimberlite Publishing in Ventura, California.

Tom Davis, a student at Camp Davis in the mid 70's, sent the following note: "A few summers ago I climbed Gannett Peak in the Wind Rivers, where the last ~2000 vertical feet is a long ridge of un-roped scrambling. I gradually pulled away from my two partners, but every time I stopped to rest I noticed another climber pulling away from his much larger group and gradually closing the gap between us. I topped out a minute or two before he did, and while we were catching our breaths, we were taking in the 360 degree panorama and both noticed some shiny specks off to the NNW (Camp Davis cabins, of course). Turned out the other climber was a 101-er the same summer that I took 440, and he was leading a Colorado Mountain Club Group. I still have a black and white group shot of both classes that I need to dig out some time."

1980's

William S. Bartels (MS '81, PhD '87) is Professor and Chair of the Geological Sciences Department at Albion. He has won "Teacher of the Year" twice and "Researcher of the Year" once in his eleven years there, rising from new PhD to Full Professor the fastest in the history of the college. He was appointed Chair in 1996. He received a $140K NSF-REU grant to conduct undergraduate studies in Geology and Paleontology of the Early-Middle Eocene transition in the Green River Basin, Wyoming. His research group (with Gregg Gunnell of UMMP) gave seven papers at the Society of Vertebrate Paleontology meetings in Chicago in October.

A.J. Koerts Birkbeck (BS '83, MBA '85) writes from Oak Park, Illinois, that he has finally started his own law firm with offices in Chicago and San Jose and Hayward, California. They specialize in legal issues associated with soil and groundwater contamination. His twin daughters are already rock hounds at 1-1/2 years—the toughest part is getting the rocks out of their mouths.

Jeffrey R. Johnson (BS '88) is back at the USGS in Flagstaff, Arizona, after a two-year post-doc at the University of Hawaii. Jeff has been designated the first Eugene M. Shoemaker Planetary Geology and Geophysics Fellow, named in honor of the late Gene Shoemaker who died in an automobile accident in Australia this past summer. Jeff has been heavily involved with the Mars Pathfinder mission, and even garnered the allotted 15 minutes of fame on CNN during a press conference in July. Jeff still likes U-M football and was delighted with the team's 11-0 record this season.

Mark Taylor (MS '82) has become a member of the management team of The Fletcher Group in Greenville, South Carolina. He is nationally recognized as an environmental consultant to natural resource based industries. Mark was recently named to BTI's select "A-Team" of top consultants. His expertise includes solid waste management, beneficial use of waste materials, and RCRA.

1990's

Steven A. Hovan (BS '86, MS '88, PhD '93) writes that he has married Susan Palmisano. They are both teachers at Indiana University of Pennsylvania; Steve in the Department of Geoscience, Susan in the College of Fine Arts

George Ireland (BS '90) is a partner in a private investment fund which specializes in investing in mining and oil and gas stocks. They take positions on both sides of the market: "long" for stocks they think will go up and "short" for stocks they think will go down. Steve Kesler's courses on economic geology have been a great help in all of his current doings.

David Palais (postdoc research scientist '91-'93) worked in environmental consulting from 1993-1996. He is currently employed as Springs Manager for the western division of Perrier Group of America and is responsible for managing the existing spring portfolio for western trademarks (Arrowhead Mountain Spring Water, Calistoga Mountain Spring Water, Ice Mountain Spring Water, Oasis Mountain Spring Water) and exploration and development of new spring water sources. Dave resides in Rancho Cucamonga, California.

Gabrielle Tenzer (MS '94) writes from Washington, DC, that she was amused to read in the newspaper that the JOIDES *Resolution* was just off the New Jersey coast and that on board as part of the scientific staff was our very own Gerry Dickens (MS '93, PhD '96). Gab is a legislative assistant to the U.S. Representative from her home district in New Jersey. She encourages everyone coming to Washington to look her up.

New faculty Join Department

Carolina Lithgow-Bertelloni

recently joined the faculty as an assistant professor after spending two years as an NSF-postdoc at the Carnegie Institution of Washington in Washington, DC. Carolina received her BS (magna cum laude) in Geology at the University of Puerto Rico at Mayaguez in 1987. The complicated geology of the Greater Antilles and a love of tectonics spurred her to continue a career in the Earth Sciences by going to graduate school at the University of California at Berkeley. After a brief interlude doing fieldwork in Italy, she joined the ranks of the laboratory and computer-bound to become a geodynamicist. Her thesis work on the "History and Dynamics of Plate Motions" with Prof. Mark Richards fulfilled an undergraduate dream of combining geology and geophysics. During this time Carolina also had the privilege of becoming intimately acquainted with sticky floors by performing many long fluid dynamic tank experiments with over 90 gallons of corn syrup. After finishing her PhD in Geology in 1994, she spent 1 1/2 years in Gottingen, Germany at the Institut fur Geophysik (the oldest geophysics institute in the world) working with Professor Uli Christensen. In 1995 she returned to the United States as an NSF-postdoctoral fellow. Carolina's research interests are geared towards understanding the connection between the dynamics of the Earth's interior and their surface expression. Recent research efforts and projects in development include investigations of the forces driving plate tectonics during the Cenozoic and the cause of major plate rearrangements; the origin, consequences and evolution of intraplate stresses; the uplift and subsidence history of continental masses and their relation to relative sea-level.

Since joining the faculty of the department in July of this year, she has been setting up her research and teaching program at Michigan. On the research front this includes building a fluid-dynamics laboratory to study subjects that vary from plume-ridge interactions to magma chamber dynamics; establishing a high-performance computing center for geophysics in collaboration with Lars Stixrude and Peter van Keken, and participating in the many exciting graduate seminars offered by the department. On the teaching front she will be involved in the introductory geology courses and first-year seminars as well as in the development of new courses at the undergraduate and graduate level.

Lars Stixrude

joined the faculty in July after spending five years as an assistant professor in the School of Earth and Atmospheric Sciences at the Georgia Institute of Technology. Lars received his BS in Geology and Physics from the University of Delaware in 1985. He received his PhD in geophysics from the University of California at Berkeley in 1991. At Berkeley, he was able to combine his fascination with the Earth and our natural environment with his love of the rigor and beauty of physics in his thesis work on the atomic structure and thermodynamics of silicate liquids and implications for magma genesis and transport. He then went on to complete a one year post-doctoral fellowship at the Geophysical Laboratory at the Carnegie Institution of Washington before moving to Georgia Tech. In 1994, he spent a year as a Humboldt Foundation Fellow at the Institut fur Geophysik at the University of Gottingen in Germany.

Lars' research seeks to apply a fundamental understanding of the physics and chemistry of earth materials to the unraveling of complex geologic processes such as mantle convection and plate tectonics, the origin of magmas, and the nature of the geomagnetic field. His methods include state-of-the-art numerical solutions to the Schrodinger equation in condensed matter as a way of understanding the behavior of minerals and melts and of predicting from first principles their behavior under the extreme pressures and temperatures that characterize the bulk of our planet. These demanding theoretical calculations are made possible by the new super-computational facility that has been built in the department in collaboration with Carolina Lithgow-Bertelloni and Peter van Keken. Since moving to the University of Michigan, Lars has embarked on new research directions. In collaboration with Donald Snyder, a research fellow in the department, he is currently building a laboratory facility that will use the diamond anvil cell to study the nature of fluids and magmas under the conditions of the Earth's lower crust, lithosphere, and upper mantle. These experiments represent a new window into the Earth's interior, allowing us to see, often for the first time, the behavior of magmas at the high pressures and temperature under which they are born.

Linda C. Ivany

joined the department this fall for a three-year tenure as a Michigan Society Fellow, sponsored jointly by the Museum of Paleontology and the Department of Geological Sciences. She received her doctorate in Geology last spring from Harvard University, her Masters from the University of Florida in 1990, and did her undergraduate work at Syracuse University. Her research interests have focused on the complex interplay between organisms and their environments through time, particularly at the ecosystem level. Her work in the past has included studies of modern and ancient marine ecosystems, ranging from biofacies distribution in modern deep-water communities off the west Florida coast, to seagrass community paleoecology and paleobiogeography, to the evolutionary and paleoecological history of Eocene molluscan faunas from the US Gulf Coast. She has also published on carbon isotopic profiles across the Cretaceous/Tertiary boundary and their implications for global carbon cycling during the extinction event.

While at Michigan, she will continue her work on faunal change in the Eocene and how the resulting patterns may affect our understanding of ecological and evolutionary theory. The fossil record suggests that some ecosystems are capable of resisting environmental change up to some threshold level, showing stability on the order of millions of years between short pulses of dramatic and near-complete turnover. If this pattern of "coordinated stasis" is widespread, a reassessment of the importance of threshold responses in both faunal and environmental change will be needed, as well as an examination of the potential influence that ecosystem structure has on the long-term stability of those systems. Dr. Ivany is investigating these issues through paleoecological analysis of large field collections of fossils together with oxygen isotopic analyses of otoliths (fish ear bones) that will provide a record of changes in temperature and seasonality through the Eocene Gulf Coast section.

Honors, Awards, Kudos

Jennifer Jubenville (BS '97) won the Virginia Voss Award of the College of Literature, Science and the Arts for her senior Honors thesis.

Henry Fricke (PhD '97) was awarded an NSF Postdoctoral Fellowship which he is enjoying at the Geophysical Laboratory of the Carnegie Institute of Washington.

Ruth Blake (PhD '97) has been awarded the first Bateman Postdoctoral Fellowship at Yale University.

Jeff Johnson (BS '88) has been awarded the first Eugene M. Shoemaker Planetary Geology and Geophysics Postdoctoral Fellowship at the USGS in Flagstaff.

Neil Hurley (PhD '86) has been appointed to the 1997-98 Executive Committee of the American Association of Petroleum Geologists. Neil, now a professor at the Colorado School of Mines, serves as Editor of the AAPG Bulletin.

Karen Boven, a current grad student, won an award from GSA's Division of Engineering Geology for her research proposal "Stable Isotope Systematics of Municipal Waste Landfills: Landfill Dynamics and Groundwater Contamination."

Other winners of GSA Student Research Grants were

David L. Fox, "Stable Isotope Ecology of Proboscideans from Port of Entry Pit, Oklahoma (Early Hemphillian)"

Stephen D. Keane, "Trace Element Thermo-barometry: Zr and Ti in Garnet"

Donna M. Surge, "Paleoecology and Geochemistry of Bivalve Shells: Implications for Pre-disturbance Environmental Conditions of Three Estuaries, SW Florida"

Liping Wang, "Fe-Mg Order-Disorder Experi-mental Studies on Orthopyroxenes"

The Michigan Bookshelf

The bookshelf is chock-full for this issue of the Geoscience News. *Five titles illustrate the wide variety of writing that U-M geotypes are engaging in. Let's have a look at what's on the shelf:*

Ron Merrill (BS '59, MS '61) and **Mike McElhinny** (U-M Adjunct Faculty), along with Phil McFadden, sixteen years after the first edition in 1983, have now published a second edition of their book *The Magnetic Field of the Earth: Paleomagnetism, the Core, and the Deep Mantle*. This new edition, published by the Academic Press, is an up-to-date integrated treatment of almost the entire subject of geomagnetism and paleomagnetism.

Carlton Brett (MA '75, PhD '78) and Gordon Baird have edited a volume titled *Paleontological Events: Stratigraphic, Ecological, and Evolutionary Implications*. The subject of paleontological events, whether sedimentologic or biologic in nature, is an important contemporary topic in the study of earth history, particularly with regard to the tempo and nature of sedimentologic and biologic change. *Paleontological Events* is published by the Columbia University Press.

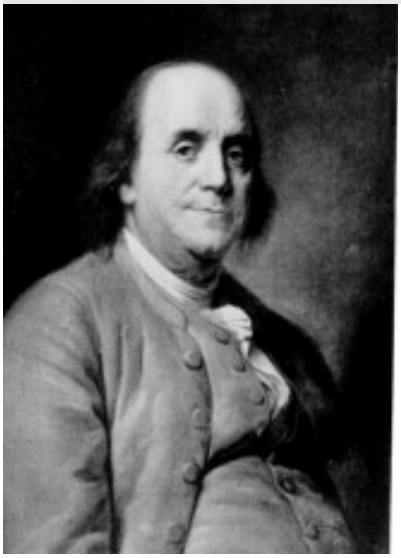
Steven Catlin (BS '78) has just re-published *Work Less and Play More*, a humorous and insightful book on putting one's business and private lives into more productive yet peaceful balance. The major hurdle to overcome in this process is learning to distinguish between needs and frivolous wants; this book offers guidance in that direction without insisting the fun be taken out of life. One review describes the book as a wonderfully useful and complete roadmap for anyone struggling to balance the demands of their job with the desire to live a happy and fulfilled life. The publisher is the Kimberlite Press (almost assuring that the book is at least a diamond in the rough).

Karen Rose Cercone (PhD '84) has just published *Steel Ashes*, an historical mystery set around Pittsburgh at the turn of the century. The characters in *Steel Ashes* are working class people in steel mill neighborhoods, Karen's own family background. In her day job Karen is on the faculty of Indiana University of Pennsylvania, where she teaches historical geology, geochemistry and hydrogeology. Before turning to mystery writing, Karen wrote in the science fiction genre, producing several Star Trek books under the *nom de plume* L.A. Graf.

Ken Hamblin (PhD '58) and his daughter Laura Hamblin contributed an article titled Fire and Water: The Making of the Grand Canyon in the September 1997 issue of *Natural History* magazine, published by the American Museum of Natural History. The article focuses on the Toroweap section of the western Grand Canyon, where the canyon cuts across a volcanic field that has been the site of repeated eruptions during the last two to three million years. Many of the lava flows temporarily dammed the Colorado River, giving rise to immense waterfalls that were soon sliced through by the erosive power of the river. Rafters traversing the canyon today see the remnants of these flows at the Lava Falls rapids. The article is a popular version of Ken's GSA Memoir 182, *Late Cenozoic Lava Dams in Western Grand Canyon*, published by the GSA in 1994. Ken is a professor of geology at Brigham Young University.

Charles Swithinbank (Research Associate and Lecturer, '59-'63) has just published his memoirs. The title is *An Alien in Antarctica: Reflections on Forty Years of Exploration and Research on the Frozen Continent*. Included are summaries of the three U-M expeditions that he led to Antarctica, as well as decades of further activities with the British Antarctic Survey.

Poor Richard's Theory of the Earth



Portrait of Benjamin Franklin by J. S. Duplessis

This article on Benjamin Franklin was contributed by Michael Jackson (MS '84, PhD '86). It first appeared in The Institute for Rock Magnetism Quarterly and is reprinted with permission.

"...might not, in ancient times, the near passing of some large comet of greater magnetic power than this globe of ours have been a means of changing its poles, and thereby wracking and deranging its surface...?"

Founding father, statesman, publisher (*Poor Richard's Almanack)* and inventor (bifocal glasses, the Franklin stove, the lightning rod, and the glass harmonica, an instrument for which music was composed by such luminaries as Mozart (*e.g.*, K. 617)), Benjamin Franklin was also a highly regarded scientist, remembered primarily for his pioneering experiments and theories on electricity. Less well known, but equally fascinating, are his views on the formation and history of the Earth, and on terrestrial magnetism. Franklin's remarkable ideas on these phenomena are expressed in two letters written in the 1780's (at about the same time as Hutton's *Theory of the Earth*) and later published in the Transactions of the American Philosophical Society.

Like Hutton, Franklin attempted to explain the evident vertical mobility of the continental crust, evidenced by the occurrence of marine fossils in the highest mountains. Hutton's approach was that of a classical field-oriented geologist, relying heavily on direct observation and speculating no further than the observations warranted: "*We only know that the land is raised by a power which has for principle subterraneous heat; but how that land is preserved in its elevated station, is a subject in which we have not even the means to form conjecture...*" In contrast, Franklin, the "compleat geophysicist," felt at liberty to "*indulge imagination in supposing how such a globe was formed...*" In so doing, he touched on such notions as terrestrial accretion and differentiation, rock deformation, earthquakes, planetary magnetism, and true polar wander, in a marvelously inventive "*Theory of the Earth*" that to a modern earth scientist sounds both quaint and prescient.

Conjectures concerning the formation of the Earth, &c.

"*Does not the apparent wrack of the surface of this globe, thrown up into long ridges of mountains, with strata in various positions, make it probable, that its internal mass is a fluid; but a fluid so dense as to float the heaviest of our substances?*"

"*...part of the high county of Derby being probably as much above the level of the sea, as the coal mines of Whitehaven were below it, seemed a proof that there had been a great bouleversement in the surface of that Island, some part of it having been depressed under the sea, and other parts which had been under it being raised above it. Such changes in the superficial parts of the globe seemed to me unlikely to happen if the earth were solid to the centre. I therefore imagined that the internal part might be a fluid more dense, and of greater specific gravity than any of the solids we are acquainted with; which therefore might swim in or upon that fluid. Thus the surface of the globe would be a shell, capable of being broken and disordered by any violent movements of the fluid on which it rested.*"

"*Do we know the limit of condensation air is capable of? Supposing it to grow denser within the surface, in the same proportion nearly as we find it does without, at what depth may it be equal in density with gold?*" "*...as air has been compressed by art so as to be twice as dense as water,... and as we know not yet the degree of density to which air may be compressed; ... possibly the dense fluid occupying the internal parts of the globe might be air compressed. And as the force of expansion in dense air when heated is in proportion to its density; this central air might afford another agent to move the surface, as well as be of use in keeping alive the subterranean fires...*"

"*If one might indulge imagination in supposing how such a globe was formed, I should conceive, that all the elements in separate particles being originally mixed in confusion and occupying a great space, they would ... all move toward their common centre: That the air being a fluid whose parts repel each other, though drawn to the common center by their gravity, and rarer as more remote; consequently all matters lighter than the central part of that air and immersed in it, would recede from the centre and rise till they arrived at that region of the air which was of the same specific gravity with themselves, where they would rest; while other matter, mixed with the lighter air would descend, and the two meeting would form the shell of the first earth, leaving the upper atmosphere nearly clear. The original movement of the parts towards their common centre, would naturally form a whirl there; which would continue in the turning of the new formed globe upon its axis, and the greatest diameter of the shell would be in its equator.*"

"... may we not suppose, that when we consume combustibles of all kinds, and produce heat or light, we do not create that heat or light; but only decompose a substance which received it originally as a part of its composition? Heat may thus be considered as originally in a fluid state, but attracted by organized bodies in their growth, becomes a part of the solid. ...I can conceive that in the first assemblage of particles of which this earth is composed each brought its portion of the loose heat that had been connected with it, and the whole when pressed together produced the internal fire which still subsists."
"Is not the finding of great quantities of shells and bones of animals (natural to hot climates) in the cold ones of our present world some proof that its present poles have been changed? Is not the supposition that the poles have been changed the easiest way of accounting for the deluge, by getting rid of the old difficulty how to dispose of its waters after it was over? Since if the poles were again to be changed, and placed in the present equator, the sea would fall there about 15 miles in height, and rise as much in the present polar regions; and the effect would be proportionable if the new poles were placed anywhere between the present and the equator." "If by any accident ... the axis should be changed, the dense internal fluid by altering its form must burst the shell and throw all its substance into the confusion in which we find it."
"Might not a wave by any means raised in this supposed internal ocean of extremely dense fluid, raise in some degree as it passes the present shell of the incumbent earth, and break it in some places, as in earthquakes? And may not the progress of such wave, and the disorders it occasions among the solids of the shell, account for the rumbling sound being first heard at a distance, augmenting as it approaches, and gradually dying away as it proceeds?" "...such a wave is producible by the sudden violent explosion... happening from the junction of water and fire under the earth, which not only lifts the incumbent earth that is over the explosion, but impressing with the same force the fluid under it, creates a wave that may run a thousand leagues lifting and thereby shaking successively all the countries under which it passes."

Queries and Conjectures relating to Magnetism

"I will not trouble you at present with my fancies concerning the manner of forming the rest of our system. ...I will just mention that your observation of the ferruginous nature of the lava which is thrown out from the depths of our volcanoes, gave me great pleasure." "Has the question of how came the earth by its magnetism, ever been considered?"
"It has long been a supposition of mine that the iron contained in the substance of this globe, has made it capable of being as it is a great magnet. That the fluid of magnetism exists perhaps in all of space; so that there is a magnetical North and South of the universe as well as of this globe, and that if it were possible for a man to fly from star to star, he might govern his course by the compass. That it was by the power of this general magnetism that this globe became a particular magnet. In soft or hot iron the fluid of magnetism is naturally diffused equally; when within the influence of a magnet, it is drawn to one end of the iron, made denser there, and rarer at the other, while the iron continues soft or hot, it is only a temporary magnet: If it cools or grows hard in that situation, it becomes a permanent one, the magnetic fluid not easily resuming its equilibrium."
"Perhaps it may be owing to the permanent magnetism of this globe, which it had not at first, that its axis is at present kept parallel to itself, and not liable to the changes it formerly suffered, which occasioned the rupture of its shell, the submersions and emersions of its lands and the confusion of its seasons." "...as the poles of magnets may be changed by the presence of stronger magnets, might not, in ancient times, the near passing of some large comet of greater magnetic power than this globe of ours have been a means of changing its poles, and thereby wracking and deranging its surface, placing in different regions the effect of centrifugal force, so as to raise the waters of the sea in some, while they were depressed in others?"

...the fluid of magnetism exists perhaps in all of space; so that there is a magnetical North and South of the universe as well as of this globe, and that if it were possible for a man to fly from star to star, he might govern his course by the compass..."

"Such an operation as this, possibly occasioned much of Europe, and among the rest, this mountain of Passy, on which I live, and which is composed of lime stone, rock and sea shells, to be abandoned by the sea, and to change its ancient climate, which seems to have been a hot one."
"I do not know whether I have expressed myself so clearly, as not to get out of your sight in these reveries. If they occasion any new enquiries and produce a better hypothesis, they will not be quite useless. You see I have given a loose to imagination; but I approve much more your method of philosophizing, which proceeds upon actual observation, makes a collection of facts, and concludes no further than those facts will warrant. In my present circumstances, that mode of studying the nature of this globe is out of my power, and therefore I have permitted myself to wander a little in the wilds of fancy."
The idea that the Earth's interior could consist of compressed air is a "fancy" apparently unique to Franklin. Some of the other ideas contained in the letters are, however, less fanciful than they may appear, when viewed in the context of 18th Century natural philosophy. Franklin's notion of magnetism as a fluid was in keeping with post-Newtonian views of "imponderable fluids" such as phlogiston and the ether, which were postulated as mediating agents in the phenomena of optics, gravity, heat, and (in Franklin's influential theories of the 1740's) electricity. According to Harman [1993], Euler and Bernoulli also advanced fluid theories of magnetism (and of fire) in the 1740's, based on the Newtonian ether, and Hutton himself published a unified ether theory in 1792 (*Dissertations on different subjects in natural philosophy).* Franklin's notion of a "universal" magnetism strongly resembles the conception of the ether as a universal primary inertial system, fixed with respect to the "fixed stars," a view that survived until the famous Michelson-Morley experiment of 1887, which ushered in the age of relativity.
There is an interesting (though nonmagnetic) geophysical footnote to Franklin's experiments with lightning and his

invention of the grounded protective lightning rod. The idea of equipping buildins with a device that could actually attract lightning strikes met with considerable (and perhaps understandable) resistance, and Franklin's invention was slow to replace more traditional methods of protection, such as ringing church bells to ward off "evil influences" (a practice which resulted in the electrocution of no small number of bell ringers—Cohen gives numerous examples). Nevertheless by the mid 1750's numerous lightning rods had been installed on churches and municipal buildings in Boston and Philadelphia. One November 18, 1755, one of the strongest earthquakes ever feld in New England took place, and lightning rod opponents, led by Rev. Thomas Prince, suggested that it was caused by the build-up of excess electrical fluid collected by Franklin's devices in the Boston area. Harvard professor John Winthrop, a Franklinist, rebutted that (in essence) the earth was too good a conductor and any electrical excess would be rapidly and harmlessly dispersed; nevertheless, the controversy lingered and possible relationships between lightning and earthquakes were given serious scientific consideration for some time afterward.

Heilbron numbers Franklin among "the most important natural philosophers of the Age of Reason," chiefly for his work on electricity. Cohen includes among Franklin's major scientific contributions the law of conservation of charge, the distinction between conductors and insulators, and the first theoretical explanation of the Leyden jar (capacitor). But from the perspective of a post-Enlightenment rock magnetist, Franklin is at his best in giving "a loose to imagination" and "wandering in the wilds of fancy," in attempting to explain a wide variety of geologic phenomena through a unified model of the globe and its history, in much the same way as our modern paradigm of plate tectonics. That he was in fact wrong about nearly all of it is immaterial—it is not his theory but his creativity of thought that stands the test of time.

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Readership Survey Results

Last summer's *Geoscience News* contained a Readership Survey which many of you were kind enough to fill in and return to us. It was our intention to use the data obtained to see if the newsletter was meeting your expectations, and if not, to redirect our energies toward serving our readership better. For those who responded, it appears that the content of the *Geoscience News* is meeting your expectations. What follows is a general summary of your responses.

Who responded: 58% of the respondents were male, and 19% female; the remaining 23% chose not to specify their gender. The distribution by degree indicated 40% have doctoral degrees, 28% masters, and 26% bachelors. Almost half of the respondents have e-mail, with access to the World-Wide-Web, but only 19% had visited the Department's Web Site (www.geo.lsa.umich.edu).

What you thought of us: Scoring of articles and features was generally positive, with only two regular features qualifying as "only somewhat of interest."

Among the regular articles, the Alumni News ranked first, followed by the Faculty, Staff, and Student News, Greetings from the Chair, In Memoriam, Awards, Degrees, The List of the Lost, and finally the Campaign for Michigan Donors.

Among feature articles, the highest scores went to articles which reflected issues or occurrences which were being covered in the media at about the same time. These include the discussion of life on Mars, the tale of the near-loss of a research vessel, and the CO_2 limnic eruption in Cameroon. Lowest scores went to articles of more narrow interest, such as the grand opening of the Radiogenic Isotope Geochemistry Laboratory, and news from Camp Davis.

Quite a few of you had suggestions to make about the content and structure of the *Geoscience News*. Several commented that the *Geoscience News* could be added to our Web Site, thus saving printing and distribution costs. However, the *Geoscience News* is already available on-line; thus it would appear that we need to publicize this fact more aggressively. However, because many readers do not have access to the Internet, the *Geoscience News* will continue to be produced and distributed on paper, at least for the foreseeable future.

Faculty, Staff, and Student News

Jeff Alt spent a week in Yellowstone Park this summer studying hydrothermal springs that vent into the bottom of Yellowstone Lake. He was part of an addition to a group of microbiologists and biochemists from the Center for Great Lakes Research in Milwaukee (University of Wisconsin, Marquette University) that included several people from the USGS in Denver and Washington to provide a more geological perspective to the study of hydrothermal influences on the chemistry and biology of the lake. The group has been using a tethered ROV (remotely operated vehicle) from Eastern Oceanics to observe and sample vents at water depths up to 400 feet and temperatures up to 120ºC.

Jeff gave invited presentations at a meeting about the Subsurface Biosphere in oceanic crust at the AGU headquarters in Washington and at a short course on volcanogenic massive sulfide deposits in Ottawa. He will spend much of the fall in the springtime of the southern hemisphere as part of an Ocean Drilling Program cruise to sample lower oceanic crust in the southwest Indian Ocean. **Damon Teagle** presented results of his work with Jeff on strontium isotopes in submarine hydrothermal systems and on the TAG hydrothermal deposit at a meeting of the Geological Society in London. He also spent a week with Mike Bickle in Cambridge and completed a couple of projects. Post doc **Anna Martini** (PhD '96) has been working on the chemistry and stable isotopic compositions of carbonate veins in oceanic basalts as part of a larger scale project determining geochemical fluxes in altered ocean crust with Jeff and Damon.

Eric Essene has just returned from a four-day field trip around Lake Huron with undergraduate non-major students. The northern lights were once again spectacular, and the weather was great! Everyone seemed to like the trip. **Allan Treiman** (PhD '82) just visited Ann Arbor from the Lunar and Planetary Institute in Houston. He gave an interesting petrology seminar on the evidence for and against life in Martian meteorites (cf. the Newsletter of last fall for a summary by Allan on this subject).

Peter Tropper is continuing his dissertation work on eclogites from the Western Alps, including experiments on glaucophane stability and on sphene solid solutions with Craig Manning (UCLA). **Donggao Zhao** and **Liping Wang** are making good progress on their thesis research related to mantle assemblages found in kimberlite pipes with **Youxue Zhang** and Eric. **Meg Streepey** continues structural and petrological research on the Carthage-Colton line in the Adirondacks with **Ben van der Pluijm**, **Chris Hall** and Eric. **Grigore Simon**, **Steve Kesler**, and Eric have just published a second paper on variations in Se and S fugacities of selenide-bearing ore deposits in *Economic Geology*. **Ed van Hees**, currently on a predoctoral postdoc at the University of Missouri, Columbia, absolutely guarantees **Jim O'Neil**, Steve, and Eric that he will finish his dissertation on Archean gold deposits this fall. A new student, **Casey Donohue** has arrived from the University of New Hampshire to work with Eric to continue the investigation of trace element partitioning in Garnets that was begun by **Steve J. Keane** (MS '97), research that has just been funded by NSF. Casey may also work with Ben and Eric on the Atlantic City area of the Wind River Range in Wyoming as a part of his thesis. This is the same field as mapped by 440 students at field camp ever since it was introduced by **Bruce Clark** and **Bill Kelly** about 30 years ago. Another new student, **Eric Tohver**, has arrived from Brazil to work with Ben and Eric on Proterozoic and Archean rocks in the Upper Peninsula, yup!

Some employment notes: **Klaus Mezger** (U-M Postdoc '89-91) has taken a prestigious appointment as Professor in Muenster University (Germany) and has been in residence there since this spring. **Jerry Magloughlin** (U-M postdoc '95-96) has been at Colorado State University as Assistant Professor for a year. **Teri Boundy** (PhD '95) has just moved to an Assistant Professor job at Ball State University. **Zach Sharp** (PhD '87) is soon leaving the University of Lausanne to join the University of New Mexico as a Professor. **Mike Cosca** (PhD '89) is still holding down our U-M connection at the University of Lausanne as a Research Scientist. That's all, folks!

In June, four of us toured part of the northeastern Tibetan Plateau in western China. **Rob Van der Voo** (paleomagnetics and tectonics), **David Rea** (paleoclimates), **Catherine Badgley** (vertebrate paleontology), and **Xaiozhong Luo** (geochronology) were hosted by Professors Jijun Li and Xiaomin Fang of Lanzhou University in Gansu Province. The trip included presentations at Lanzhou University, an introduction to the thick sequence of interbedded loess and Yellow River terrace gravels in the vicinity of the city of Lanzhou, and then an eight-day trip west into Qinghai Province, mostly on the Tibetan Plateau..

Our goal was to examine several neogene sequences as possible sites for future field work, in order to evaluate the timing and rate of uplift of this part of the plateau and the effects of uplift and isolation on the mammalian fauna. Among the sequences that we saw, we were especially impressed with the exposures of alluvial sediments in the Guide Basin, now at an elevation of 3200-3600 meters. This basin has extensive, accessible exposures and a fossil record of high-quality mammalian remains indicative of late Miocene through Pliocene time. Folding and a low-angle unconformity within the sedimentary sequence of the Guide Basin suggest an alternation of sediment accumulation and deformation during the basin's history.

Xiaozhong Luo, Xiaomin Fang, and Rob Van Der Voo lost in the field.

Sediments in the Guide Basin.

Highlights of the trip included a night at Qinghai Lake, Holocene sand dunes at 3700 meters, yaks-yaks-yaks, drinking yak-butter tea with Tibetans in their tent, a tour of a Tibetan monastery, driving over the vast planation surface at 3500 meters, and visiting the courtyard of a farmer (who mines "Dragon Bones" for folk medicines) with over 300 fossil mammal skulls on display. Some of us will try to go back for more.

Now that **Bill Farrand** is semi-retired (i.e., no more teaching or committees), he feels busier than ever. The Exhibit Museum's opening of its biggest exhibit ever on the evolution of whales will finally be up and running by the time that you read this. It's been two years or more in the making. Otherwise, Bill was in back in the field, digging in caves in northern Spain and southwest France in July '96, and shipping more dirt back to Ann Arbor. He is wondering, however, where is that time he was supposed to have for writing?

As we all know, springtime in Michigan means mastodons, and this past spring brought them out in spades, and buckets, and dumptrucks, enough to keep **Dan Fisher** more than busy. Most remarkable, however, was a pair — an adult female and a calf — both of which appear to be victims of human hunting, both butchered and cached at the bottom of a late Pleistocene pond. The adult's pattern of tusk growth suggests she had a calf about two years before death, and the calf seems about two years old, so it is at least plausible that the calf was her calf. And yes, you quick-thinking geologists, elephants do nurse their calves for at least this long, and maintain contact with them even longer. Of course, no single site represents the full range of processes at work in a given time period, but predation on mothers and calves would certainly heighten the impact of human hunting. And speaking of hunting, the forces of stratocladistics and cladistics confronted each other this fall in a special symposium on use of stratigraphic data in reconstructing phylogeny, at the annual meetings of the Society of Vertebrate Paleontology. This was essentially a public extension of a debate that has been simmering for over a year, and that is undoubtedly not over yet, but stratocladistics and stratigraphy came out very well indeed. The merits of incorporating stratigraphic data in phylogenetic analyses were further demonstrated by a paper given by **David Fox** and co-authored by Dan and **Lindsey Leighton** , in the following day's plenary session. We look forward to more tests and applications of these methods.

Phil Gingerich spent November and much of December 1996 in the field in southwestern Punjab, Pakistan, searching for whales in the middle and late Eocene there. The most interesting find was a complete vertebra of Basilosaurus, a 50 foot whale well known from Egypt and the southeastern U.S. but not previously known from Asia. This prompted a more critical look at the alternation of deeper and shallower marine environments in Pakistan, and their tie to global sea level change—lithological changes observed in the field fit expectation based on global sea level change remarkably well, indicating northwest Indo-Pakistan subsided passively through the whole of the Eocene. Reports of collision with Eurasia in the Paleocene or early Eocene appear doubtful. A preliminary report was published in the Museum's Contributions series this fall, and Philip talked about this at GSA. Field work in Baluchistan in May yielded new early Eocene land mammals living on a subaerially-exposed slab of obducted Tethyan sea floor shedding sediment south and eastward toward the Indian subcontinent. The first report on this new fauna will appear in the next *Journal of Vertebrate Paleontology*, with a discussion of its paleogeographic and biogeographic significance. Philip, recent PhD **Will Clyde**, and graduate student **Jon Bloch** are returning to Pakistan to follow up on both of these projects in November and December 1997. Happily, Philip has just received a 3-year NSF grant to continue research on archaeocete whales of Eocene Tethys.

As a part of the global database project of borehole temperatures and climate reconstruction, **Shaopeng Huang** has taken two trips abroad this year. One was in March to Praha of the Czech Republic for acquisition and processing of a European data set collected by Dr. Vladimir Cermak and his colleagues of the Geophysics Institute of the Czech Academy of Sciences; another trip was to China in August for the borehole data archived in the Institute of Geology of the Chinese Academy of Sciences (IGCAS). Shaopeng maintains strong links to the IGCAS with which he affiliated for more than 10 years before he came to the States. In addition to the busy exchanges with his old friends and colleagues in the IGCAS during his two week stay in Beijing, Shaopeng presented a paper "Aggregate global scale analysis of relationship between heat flow and heat production" in the 1997 Symposium on Deep Processes and Continental Dynamics for Chinese Young Scientists and delivered an invited lecture "Geothermal Record of Global Change" at the Institute of Atmospheric Physics of the Chinese Academy of Sciences. Upon invitation by Mr. Wei Dawei (U-M Visiting Scholar, 1984), he also visited the Institute of Geochmechanics of the Ministry of Geology and Mineral Resources as a consultant to their geothermal program. The main project that Shaopeng has been working on here at U-M addresses surface temperature trends in the interval of time prior to the establishment of meteorological observatories. So far subsurface temperatures from more than 1,000 boreholes over the world have been acquired for climate reconstruction. The database is expected to be available on the Internet by the end of the year.

During the last few months, **Steve Kesler** worked with students on several ore deposit projects. The first one involved a quick

survey of the newly-discovered Elena gold-silver deposit in the Camaguey area of Cuba, which was mapped this summer by **Grigore Simon**. Grigore's work shows the deposit to be a classical epithermal vein system, even though it is directly adjacent to a deeply eroded batholith. Age measurements with Assistant Research Scientist **Chris Hall** are underway to determine relation between Elena mineralization, the batholith, and regional patterns of uplift and erosion. Chris is also working with Grigore on efforts to determine the age of micron gold deposits in Nevada, and he presented some of this work at the Society of Economic Geologists Field Conference on Micron Gold Deposits in Elko, Nevada, just before the GSA meeting. The ages that Chris and Grigore obtained at Twin Creeks are based on adularia, an easily dateable mineral that has not been found before in these (very hard to date) deposits, and they are the first to be clearly related directly to the gold in the deposits. Also attending the meeting were Grigore Simon, who presented his results (obtained by Jim Penner-Hahn and Hui Huang of our Chemistry Department and Stephen Chryssoulis of Amtel in London, Ontario) on the mineralogical setting of gold in these deposits, and **John Fortuna**, who followed up on the work by **David Stenger** (MS '96) on the causes of gold deposition in these deposits. At the GSA meeting, Chris and Grigore made further presentations on related work, and **David Borrok** (MS '97) presented results of his work at the Vergenoeg deposit in South Africa. Sue Duly stayed home to work on her thesis and help Chris and Grigore on the first part of an effort to obtain Ar-Ar ages on Romanian epithermal and porphyry mineralization. In the meantime, Steve is trying to get up to speed as in-coming President of the Society of Economic Geologists, which is expanding its meeting and field conference schedule at an impressive pace.

Jim O'Neil was appointed an Associate Editor of *Terra Nova*, a journal that has recently undergone a complete and very positive revamping of staff, style and audience. **Mark Brandriss** (recent Postdoctoral Fellow) is now at Williams College but plans to return to our Department for extended periods to continue his oxygen isotope studies of laboratory cultured diatoms. **Sang-Tae Kim** (MS '96) is managing the new stable isotope laboratory in the Department of Earth and Environmental Sciences at Korea University of Seoul. He has recently succeeded in synthesizing aragonite in apparent isotopic equilibrium with aqueous solutions and will return to Ann Arbor this winter to put some finishing touches on this important work. **Ruth Blake** (PhD '97) has made some exciting breakthroughs in our understanding of mechanisms and biological controls on oxygen isotope exchange reactions between biogenic phosphate and aqueous fluids. Early work on these systems earned Paul Boyer of UCLA the 1997 Nobel Prize in Chemistry.

Some kudos for the stable isotope crew: **Ruth Blake** (PhD '97) has been selected as the first winner of the Bateman Postdoctoral Fellowship at Yale University. **Henry Fricke** (PhD '97) was awarded one of the coveted NSF Postdoctoral Fellowships and has taken up residence at the Geophysical Laboratory in Washington. **Jennifer Jubenville** (BS '97**)**, now a graduate student at Pennsylvania State University, was presented with the Virginia Voss award for her senior honors thesis entitled "Oxygen Isotope Variations in Mammalian Tooth Enamel and their Use as Paleoclimatological Indicators." **Karen Boven**'s proposal to the GSA on stable isotope variations in fluids collected from municipal landfills was among the top 34 proposals funded. At their luncheon at the GSA Meeting in Salt Lake City, the Division of Engineering Geology presented Karen with an award for this proposal.

In the past months the most interesting and educational event that **Dave Rea** experienced was a two-week trip to the interior of China. The trip was arranged with Prof. Xiaomin Fang of Lanzhou University by **Rob Van der Voo**, and we were joined by **Catherine Badgley** and graduate student **Xiaozhong Luo**. The trip involved meeting scientific dignitaries in Beijing, formal presentations at Lanzhou University, and, most especially, an eight-day field trip to the northeastern Tibetan-Qinghai plateau and adjacent Neogene basins. Dave is especially interested in the record of Tibetan uplift that may be in these basins, as the late Cenozoic elevation of the entire Himalayan-Tibetan region may be an important driver of global climate change. The sight of Pliocene mudstones standing on end does wonders for those interested in questions of late Cenozoic uplift. More news regarding this trip appears elsewhere in this issue.

Early this fall **Dave Dobson** defended his doctoral thesis, done under the guidance of Dave and **Ted Moore** on "Tropical Climate Variability on Tectonic, Glacial, and Interannual Timescales" in September. He has taken an Assistant Professor position at Guilford College in Greensboro, North Carolina, and is doing a lot of teaching this fall. **Leah Joseph** has finished her MS work with Dave and **Ben van der Pluijm** in the late spring, working on interpretation of depositional environment of deep water clastics using a combination of particle grainsize distribution patterns and magnetic fabric analysis. She has already started her doctoral work on the changing environment of the Antarctic continent based on the materials that continent has shed into the ocean. **Libby Prueher** continues her work on sorting out the North Pacific sedimentary record of volcanism and (associated?) climate changes. **Holly Godsey** is working with Ted Moore and Dave on the detailed early Holocene climate records preserved in the varved sequences of the Great Lakes. In October she presented her first talk at a major meeting at the GSA Meeting held in her home town of Salt Lake City—and did a wonderful job!

Ben van der Pluijm just returned from co-convening a Geological Society of America Penrose Research Conference on the Tectonics of Continental Interiors (September 22-28). Over 100 scientists from around the world offered contributions that varied from Archean signatures in continental interiors, to quantitative modeling of mantle-plate interactions, to modern seismicity, while covering all major continents. Delayed remodeling in the meeting's venue at Brian Head, Utah, rekindled the departmental renovation spirit for Ben upon arrival. After resolving that inconvenience (we moved to another meeting place), we had the rare experience for Utah to be visited by the tale of a hurricane. Aspen trees are no good when it comes to strong winds, and we were left without power for one night and morning.

Breakfast with candlelight, and talks with projectors fueled by emergency generators reinforced that geologists are a pretty flexible crowd. The rest of the time things went very well, including two wonderful fieldtrips led by Michigan alum George Davis (PhD '71) to the western edge of the Colorado Plateau.

After a summer that included fieldwork in Spain, Norway and Maine, two new students joined the Structure/Tectonics group this Fall. **John Kollmeier** will work on the determination of early stress/strain patterns in the Cantabrian orocline using calcite twinning. **Rob Van der Voo**, who is on sabbatical in the Netherlands, co-

advises John's project. While Rob is on sabbatical, his teaching duties are covered by Visiting Professor **Matt Nyman**. **Eric Tohver** will work with Ben and **Eric Essene** on a new project in major faults in the Penokean belt. Also, **Nei-Che Ho** returned this term to complete his dissertation work with Ben and **Don Peacor** on phyllosilicate fabrics in a variety of mica-rich rocks. Finally, research scientist **Josep Pares** has returned to Michigan to work on magnetic fabrics, and just this week (early October) two other visitors from Spain arrived for work in U-M's rock and paleomagnetic laboratory. All in all, it again promises to be a busy and vibrant year.

Lynn Walter spent the spring semester on sabbatical, her first in 15 years of faculty life! The freedom from daily university activities permitted her to undertake a field expedition to Panama where she and graduate student **Tim Ku** investigated modern marine carbonate and siliciclastic sediment diagenesis in nearshore environments. Along with colleagues from the University of Chicago (Susan Kidwell and Mairi Best), they took over the remote field station at San Blas and attempted to reconcile shell preservation styles with pore water and sediment geochemistry. The Smithsonian San Blas field station lacks running water and had only intermittent solar power, but somehow, the geochemical lab protocols (nitrogen-filled glove bags and pore water centrifugation) were maintained to make it a very successful (and unique!) field session.

While Lynn and Tim were away, research associates **Joyce Budai** and **Ann Martini** were putting the final touches on the Antrim Shale Report for the Gas Research Institute. This report marks the conclusion of a 3-1/2 year study on the source and hydrogeochemistry of the natural gas deposits in the Antrim on a basinwide scale. Lynn, Anna and Joyce made tag team presentations at a state-wide industry conference in late March to showcase the final report to local gas producers.

Joyce, Lynn, Tim, graduate student **Kia Baptist**, undergraduate geo major **Gabriel Bowen**, and EAGL laboratory research assistant **John Hansen** have all been keeping busy sampling and analyzing soil and ground waters in a large-scale project funded by the EPA of carbon flow in northern Michigan forested watersheds. The project is unusual for the Department in that it links faculty from Biology, School of Natural Resources, and Environmental Engineering in a team effort to understand how the carbon sequestered in forests is moved through the soil zone to regional groundwaters. This is of especially timely significance because mid-latitude forests are a likely near-surface reservoir for fixing the CO_2 yielded from fossil fuel burning.

While **Dave Rea**, **Catherine Badgley**, and **Rob Van der Voo** were off traipsing around the edge of the Tibetan plateau, **Ted Moore** looked after the other project that Dave helped get funded: an exploration of Lake Nicaragua to see what kind of sedimentary record of climate it might contain. This project was actually started at the suggestion of Paul Colinvaux of the Smithsonian Tropical Research Center in Panama and the Center for Great Lakes and Aquatic Sciences here at the U of M. Paul had taken on a graduate student from the Biology Department here and trained him in the recognition and interpretation of tropical pollen records. That student (now Dr.), Jerry Urquhart, had done considerable field work in the Nicaragua area and had developed a detailed climate history from the swampy area on the country's Caribbean shores. Dave and Ted agreed with Paul that Lake Nicaragua (the largest lake between Titicaca in Peru and the Great Salt Lake) might contain a sedimentary record of climate that integrated the tropical climate of western Nicaragua and went farther back in time than the swamp records. There had been very few published studies of the lake, and the most recent study of its surface sediments was done in 1966. No cores from the lake have been reported in the literature. We invited Tom Johnson of the University of Minnesota-Duluth to join us and provide the needed seismic gear to see what the sub-bottom sediments looked like.

Lake Nicaragua is located in what appears to be a graben structure surrounded by, and containing, volcanoes associated with the Mid-Americas Trench. It drains into the Caribbean by the San Juan River, but is located only a few tens of kilometers from the Pacific coast. In the lates 1880's the U.S. Congress, spurred by tales of pirates sailing up the San Juan river to raid towns on the Lake, considered the Lake and its connecting river as the top candidate for a Pacific to Atlantic canal. Their enthusiasm is reported to have cooled after the Post Office issued a stamp showing two large (and smoking) volcanoes sitting in the lake. Apparantly Congress was in awe of natural phenomena even then - or maybe it was the discovery of sharks in the lake water!

Being the old hand in the region, Jerry Urquhart arranged all of the logistics. Through him, we made contact with scientists of the Nicaraguan Centro para la Investigacion en Recursos Acuaticos de Nicaragua (CIRA), who were a great help to us in receiving equipment shipped to Nicaragua and in getting it all in (and back out of) the country. The five participants from Minnesota and Jerry and Ted all met in Granada, Nicaragua, where we purchased all the necessary cruise supplies that had not already been shipped down. Jerry rented us a large ferry boat and arranged for alterations that allowed us to deploy an air gun and hydrophone streamer and to take gravity cores. Having shipped down pipes, plastic core liner, core catchers, climbing rope, and a small electric winch, as well as the air compressor, air gun, streamer, and recorders, we had all the necessary gear. Jerry also hired a cook (the captain's sister). She showed up with all her children, and we ate well!

The ship had ample space to house the equipment, but berthing was confined to the benches in the upper deck house of the ferry. Below decks were a bit too steamy for comfort. The ship was very dependable and the crew were enthusiastic helpers whenever we stopped for a station. We had a GPS navigation system along as part of the seismic system; thus, it hardly mattered that the ship was without radar or a gyro compass, and that the magnetic compass seemed to have a variable error ranging from 15° to 50°. We just made an initial estimate of the correct heading and corrected it later after a few fixes from the satellite came in. We surveyed the first few days and then surveyed at night and took cores during the day. We managed to cover the entire lake area fairly well. At night the air was filled with small gnats that were attracted to lights. They did not bite, but they managed to quickly spot the navigation chart to the point that you could not tell the difference between our position and the gnat bodies. Other than this minor inconvenience, we had a truly enjoyable tropical cruise around the lake, stopping at a few places far from the normal tourist route.

We had some real successes, a few failures, and a few surprises. We took a half dozen cores, up to 2.2 m in length. We left some of the sediment samples with CIRA scientists, who joined us for the second half of the six-day cruise and took their own measurements of chemistry and plankton at our sampling stations. *(continued on page 27 . . .)*

Degrees Granted

PhD

Ruth Blake "Experimental Investigations of Organic and Microbially Mediated Reactions of Aluminosilicates and Phosphates"

David Dobson "Tropical Climate Variability on Tectonic, Glacial, and Interannual Timescales"

Henry Fricke "The Oxygen Isotope Ratios of Biogenic Phosphate as Indicators of Change in Continental Climate Variables at Different Time Scales"

MS

Kelly H. Fuks "Quaternary Sedimentation in Two Northwestern Michigan Estuaries"

Arlo B. Weil "Kinematic Constraints of Multi-phase Fold-thrust-belt Development: A Detailed Paleomagnetic Analysis of the Cantabria-Asturias Arc, Northern Spain"

In Memoriam

Suzanne Takken

Suzanne Takken died November 9, 1997, in Santa Rosa, California, on her way to Oklahoma City from her vacation home in Sea Ranch, California. As an undergraduate student Suzanne assisted Professor George V. Cohee with his research, an experience which strongly influenced her choice of careers. Following her graduation from U-M with her BS in geology in 1947, Suzanne began her 50 year career as a petroleum geologist, initially with the Magnolia Oil Company (Mobil Oil) in Oklahoma City. Her work with Mobil ranged widely, in the mid-continent, Atlantic Coastal Plain, and the Rocky Mountains. She retired from Mobil Oil in 1970 and continued working as a consulting geologist until her death. Her expertise comprised regional structural and stratigraphic aspects of the Anadarko Basin, detailed waterflooding studies, and the development of oil and gas prospects. She was awarded Honorary Lifetime Membership in the Oklahoma City Geological Society in 1982 after serving in many offices, including President and Editor of the *Shale Shaker*. She was an active member of the AAPG, a charter member of the American Institute of Professional Geologists, and the Association of Women Geoscientists (AWG). She served as President of AWG in 1989-90. AWG honored her in 1990 by naming the Suzanne Takken Encourage Award in recognition of her work as role model and mentor for younger women geoscientists. She received the AWG Distinguished Service Award in 1993. Her father, Russel E. Takken, Chief Engineer for Cleveland Illuminating Co., died in 1947. Her mother, Clara Elrich Takken, a suffragette well-versed in the arts and social issues, died in 1974. Suzanne is survived by a cousin, Janet Sharp, of Grosse Pointe Woods, Michigan, with whom she traveled extensively.

Eugene B. Gross

Dr. Eugene B. Gross died at his home in Tucson, Arizona, on Sept. 6, 1997. He is survived by his wife, Ruth Atherton Gross. Gene received his B.S. in geology and an M.S. in mineralogy at the University of Colorado. After interludes with the U.S. Geological Survey and the Atomic Energy Commission, he returned to school at U-M where he was awarded a Ph.D. ('62) in mineralogy. While in Ann Arbor, he became the first student to be awarded a grant-in-aid two years consecutively from the Rackham Memorial Foundation. In later life he was a geochemist for the California Division of Mines and Geology, San Francisco. Best known for his work with uranium and vanadium minerals of the Colorado Plateau, he also worked with trace-element minerals and those of southern California in the White Mountain area. Together with other people he described five new minerals, among them heinrichite and abernathyite. His professional associations included memberships in Sigma Xi, The Mineralogical Society of America, the Mineralogical Association of Canada, and the Mineralogical Society (Queen's Gate, London).

Geoalumni Information Form

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Degree _____ College or University _____ Year _____

Degree _____ College or University _____ Year _____

Spouse _____
Year of Wedding

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Name Birth Date Name Birth Date

Child _____ Child _____
Name Birth Date Name Birth Date

Child _____ Child _____
Name Birth Date Name Birth Date

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(. . .continued from page 23)
The sediments are relatively rich in organic carbon (5%-(8% TOC) and have abundant diatoms and pollen. We have since opened and sampled the cores for Jerry's studies to be completed here as part of his Smithsonian postdoctoral research fellowship. Radiocarbon dates will be taken on at least three of the longer cores.

We also discovered that the deepest parts of the lake (30-40 m water depth) are active hydrothermal springs. The sediments in these holes are altered to a bluish, crumbly clay stone with iron-manganese crusts. Grab samples in the deeps recovered abundant gastropods and bivalves - apparently representing an active hydrothermal community or invertebrates. We tried taking a core in the deep holes, but the stiff clay stone allowed only a few centimeters penetration of the core and only the elasticity of the 1000 lb-test climbing rope allowed us to eventually work the nose of corer free.

Our only real disappointment was with the seismic data. Apparently ash layers are so prevalent in the lake sediments that they form highly reflective horizons just below the lake floor. These horizons reflected back nearly all of the energy emitted by the small Geopulse airgun, allowing only a few meters of sonic penetration. To actually get through these layers we would have needed a full-blown marine seismic system - and even then there are no guaranties that we would have penetrated very deeply into the section.

We also sampled a few of the smaller crater lakes around Granada and Managua from rowboats; however, sediments from these smaller lakes were so thin, no good cores were recovered. In spite of these things that did not work out as we hoped, this reconnaissance trip turned out very well. We did get good sediment cores from Lake Nicaragua on which we can work over the next year and use to determine the rate of deposition and the likely length and resolution of the sedimentary record. After experiencing several quakes, visiting the nation's volcano park, and sampling the hydrothermal vent communities, we are impressed with the potential for future seismic and tectonic studies in the area. We are also very impressed with the ease of working in the country and with the caliber and openness of the Nicaraguan scientists.

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