G.I.G.O. by John A. Dutton

Advances in information age technology and its evolving impacts on education dramatize the contrast between availability and value of information. Teaching students where to look for mathematical information or physical data has always been part of education in the sciences, and we emphasize the study of primary sources as a key part of careful scholarship in all disciplines.

In the pre-computer era, the transformation of information from source to final form was controlled, at each step, by the student or scholar. Written material was copied in the library from source to notebook, and then quoted or summarized in the manuscript directly from the notes. Data analysis computations were performed on a calculating machine—column to column—and mental quality checks were part of the process, helping to prevent mistakes.

With the advent of the computer age, our relationship to data changed dramatically. The first computers were imposing machines that would run a program we wrote or obtained from someone else, gobble up our numbers, and send forth results in daunting quantity. With the advent of these machines, we could no longer see how the data evolved as the calculation proceeded. Strange things often happened as a result of code errors, and thus without exhaustive checks, we never knew whether the results were right. Hence the wry byword of the computer age: garbage in, garbage out.

Today we still crunch numbers and we have Mathematica to do some of our mathematics for us. We are increasingly addicted to the rapidly growing quantity of information available on the Internet through the World Wide Web protocols. And on the Internet, we often find a stark contrast between availability and value of information.

Indeed, the Internet makes a wide variety of information readily available, including the vast arrays of authoritative quantitative information provided by the government, copious information on weather and financial performance, corporate information on products and services, data and views from advocacy organizations, and a growing universe of privately maintained sites. Some of this ‘information’ is valuable, some is nonsense.

We try to focus on the contrast between availability and value in our EMS First-Year Seminar classes. We try to use the Internet to develop a sense of value, of what is truly important. We try to help the students see how the availability afforded by the Internet allows us to be more discerning, more eclectic. For example, the Internet allows us to put together a PowerPoint module on Isaac Newton, showing a color portrait of him in mid-career, Trinity College at Cambridge where he spent his life, and the statement of the three laws in Latin in the Principia as it was printed in 1687...

LEX I. Corpus omne perseverare in status quo...
LEX II. Mutationem motus proportionalem...
LEX III. Actioni contrarium semper & eaque...

Some students delight in discovering the well-known physical laws hidden in the Latin. For others, the lights stay dim.

Most of these first-year students are talented technological webmasters who have grown up with the Internet. They are at home in the World Wide Web and the stacks of the library are foreign territory. They believe, implicitly, that if you can download it, then it is good—that value, in this age, is proportional to accessibility. The unstated new byword seems to be garbage in, gospel out.

But despite their technical abilities, our beginning students are neophytes in judging the quality of information. A first task is to teach them to differentiate reliable sources from those that are not. We emphasize the value of the primary sources, rather than those easily at hand on the Internet. We urge them to compare opposing views, to trust empirical data rather than emotional claims. We try to dispel the notion that newer or older is necessarily better. We try to show that high quality is intrinsic, that value is timeless, and that both are to be treasured, regardless of how difficult the search to find them.

And we need to remind them, over and over again, that the Internet is just a collection of computers, because wherever there are computers the old byword is valid: G I G O.
On the cover: The CAUSE 2000 students and instructors pose for a photo in front of one of the windmills on a wind farm in Altamont, California. The wind farm was one of several stops the CAUSE 2000 class made on their tour of energy production facilities in the Western U.S. For more on the CAUSE 2000 project see Going to the Source: The CAUSE 2000 Field Trip on page 9 by EMS student Gina Cancelliere.

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Knowledge Workers: Learning for a Lifetime

by Robert G. Crane

At Strategies for a New Era—a one-day conference sponsored by the College of Earth and Mineral Sciences in September 1999—Dean John Dutton, anticipating the emphasis that would be placed on Information Technology, posed the question “how can universities add value in an environment where coursework and instructional materials are all available on-line?”

Three themes emerged from that conference: (1) critical skills that students need to succeed in today’s marketplace, (2) the growing need for lifelong learning, and (3) issues that surround learning in the Information Age.

Any discussion of these topics must take place within the broader discussion of the changing nature of higher education and the role of large public research universities in that context. Having said that, in some respects, Penn State is very different than many other public universities, and the College of Earth and Mineral Sciences is unique within Penn State. So, while some of these broader issues may be relevant to the discussion, most of what I say will focus on the new directions EMS has undertaken in undergraduate education and where the College is headed in the future.

Critical Skills

We can look at the skills that our students need from two perspectives: The first is content related—what knowledge should our students possess? This is typically addressed through the curriculum and the arrangement and availability of courses and programs. The second focuses on more generic issues that cut across programs and encompass a set of attributes that include such factors as communication skills, problem solving abilities, leadership skills, and teamwork skills in a diverse environment.
While the core science and engineering concepts that form the basis of our disciplines must remain a central focus of our educational activities, it is becoming more apparent that student mastery of these concepts is no longer sufficient to ensure success. Gary Weber, assistant vice president for research and technology transfer at Penn State, in his presentation at the Strategies conference said “For every person I have let go, fired, moved aside, whatever, for not knowing enough about metallurgy, or ceramics, or astrophysics, there have been ten let go because they could not interface with people. They couldn’t present. They didn’t know how the financial world worked. They didn’t understand business.” The message is clear and it has been repeated many times by EMS alumni holding leadership positions in both the private and public sectors: A student’s potential for success increases by developing an understanding of how businesses work and an understanding of information technology and its applications.

In its 1999-2002 Strategic Plan Update, the College set forth a plan to broaden the scope of an EMS undergraduate education. EMS activities are located within a matrix defined by Earth and Environment, Energy and Minerals, and Materials on one axis, and Science and Engineering, Information and Simulation Systems, and Global Business Strategies on the other. The College has moved to implement this new vision by introducing two new College minors. The first, Global Business Strategies in the Earth, Energy and Materials Industries, was developed in cooperation with the Smeal College of Business Administration. It emphasizes the leadership skills students will need to succeed in the rapidly expanding global marketplace that is common to many of the industries EMS students enter upon graduation. The second is a joint minor with the School of Information Sciences and Technology (IST). The EMS-IST minor supplements an existing Geographic Information Sciences minor in the Department of Geography.

The second element of Weber’s message, that the ability to work in teams, to communicate, to solve problems and to apply knowledge in a diverse and multi-disciplinary environment is as important for success as gaining the core science and technology skills of one’s discipline, is by no means new to the College or the University. All Penn State undergraduates are required to take a “W” course in their major—a course where at least thirty percent of the curriculum and the student assessment are devoted to writing skills. EMS has taken the writing skills challenge seriously and offers a greater number of writing courses per student than any other college. In addition, more than ten years ago the College hired a full-time writing tutor to help develop undergraduate writing skills. This position has since been endowed by one of our alumni as the Giles Writer in Residence.

While much of the EMS curricula focuses on the theoretical and conceptual foundations of the disciplines, there has also been a strong emphasis on practical applications, either in field and laboratory courses or in the design component of the engineering programs. A practical, hands-on “active-learning” approach to education has always been a significant component of the EMS curricula. However, the focus has traditionally been on the individual and, hence, there is an underlying attitude of competition in the classroom. Only recently have we begun to pay attention to more collaborative and cooperative approaches to education, but already many EMS courses have incorporated team projects into the learning process.

Written and oral communication, teamwork, and problem-solving skills are the focus of the College’s First Year Seminar. This required course for all first year students starting in the College at the University Park campus is taught by senior members of the faculty with a maximum of sixteen students per section. The topics vary, but all sections focus on communication skills and adopt a structure that minimizes faculty lecturing, while promoting student interaction and teamwork. As well as meeting the University requirement for a First Year Seminar, the course also satisfies three credits of the Writing and Speaking skills general education requirement.

The Center for Advanced Undergraduate Studies and Experience (CAUSE) project is a yearlong multi-disciplinary research seminar targeted at the Junior/Senior level. A team of faculty members agrees to coordinate a two-semester research project for a group of about twenty students. There is no single model for how this works, but typically the faculty will select the research area and the students, individually or in teams, develop the specific research questions. They spend the spring semester establishing the expertise that exists in the group, filling in gaps in their knowledge, and developing a research plan. There is a field trip and data collection program in the early summer, and students continue the data collection and analysis in the fall. The results have been presented as group and individual research reports, in colloquia, and in video format. (See Going to the Source on page 9).

Lifelong Learning
That the world is changing is not a startling revelation. Every new generation sees a changing world, but it may be the case that the world is changing faster now than it has ever before. The recent restructuring of what EMS teaches and how it is taught represents only a small part of what must be done to prepare students for this new world. All EMS disciplines have experienced a rapidly expanding body of knowledge. One consequence is an increase in specialization and many EMS
departments offer multiple degree programs and multiple options within degree programs. Until recently, curriculum revisions have narrowed the sphere of knowledge graduates would acquire. This too is changing. As Weber said at the Strategies Conference, "I... assure you that you are going out into an industrial and national laboratory world, and even in academia, where you will not be doing ten years from now what you were originally trained to do."

This is very different from the typical career paths traveled by previous generations. The result is a recognition of the need for lifelong learning and a growing emphasis on what we can do to prepare students for this new workplace. Our response in some fields has been to reemphasize the common core of the discipline by reducing artificial barriers between sub-disciplines. By paying more attention to the communication, teamwork, and problem-solving skills that may be more useful in a student's subsequent career than another three credits in a narrowly focused sub-field, we are providing them with the tools to become lifelong learners.

But we can’t stop there. In the past, a baccalaureate degree provided a solid foundation for a career. When students graduated, they joined a company and stayed there. They received on-the-job training to prepare them for the particular needs of that position and learned from experience as they went along. This is no longer the case. As career trajectories become more diverse, we must avoid the danger that curricula focus primarily on the first job after graduation. If knowledge and specialization continue to increase, and that change to the second job occurs earlier and earlier, then such a baccalaureate degree becomes less and less relevant.

If we want an EMS education to be as meaningful for our future students as it has been for our alumni, we must provide a very different educational experience—one that continues well beyond the baccalaureate degree and is there to supply additional educational needs as careers evolve. Providing this extended educational experience is the primary objective of

**Lands in Transition: An Interactive Learning Experience**

Imagine, for a moment, that you are standing at the edge of the crystal blue waters of Lake Tahoe. Protected from forest fires and commercial logging the surrounding forest has grown dense with lodgepole pine and red fir. A thick carpet of needles, twigs, branches and trunks from dead trees covers the forest floor. Your instincts tell you that this is how the forests here must have looked before humans stepped in to influence the landscape. But you would be wrong.

"People often have strong and different views about how public forests should be managed but they may not know much about those forests, how they developed, or why they are in a condition that might benefit from some type of management intervention," says geography professor Alan Taylor. To increase public awareness and understanding of forest processes and how research can help answer questions important to society about forest ecosystems, Taylor and his colleagues developed *Lands in Transition*—an interactive learning resource (www.gouldcenter.psu.edu/it/) that examines the history of the Lake Tahoe Basin as it explores how forest fires and humans have affected the landscape.

A series of questions with informative feedback loops containing interactive maps, animations and historical images introduce learners to the history of fire and people in the Basin. Then you are asked to assume the role of forest manager. Interviews with experts in atmospheric science, hydrology, fire ecology and forest health provide input as you make decisions about the care and management of the forest. Should fires be allowed to burn unchecked? Will logging negatively affect the balance of tree species in the forest? What should be done about insect pests? These are all questions that must be weighed and considered as you perform the role of forest manager.

The data behind this new learning resource was culled from Taylor's work on the natural and human disturbances that affect forest structure and dynamics. Using tree-ring dating from 120-year-old undecomposed tree stumps in the Tahoe Basin, Taylor has described the original composition of the forest (which was clear-cut in the 1860s and 70s during the silver rush) as well as the role of fire and fire suppression strategies in altering vegetation patterns and forest diversity. Taylor has used similar methods to study forest dynamics in the Giant Panda habitat of Sichuan, China.

For more on Alan Taylor's work visit his page on the geography Web site (www.geog.psu.edu/physical/taylor.html). *Lands in Transition* was produced by the Peter R. Gould Center for Geography Education and Outreach.

The USDA Forest Service Region 5, Lake Tahoe Basin Management Unit, provided financial support for *Lands in Transition*. You can order a CD copy of *Lands in Transition* from the Forest Service by e-mailing Mark Johnson (mgjohnson@fs.fed.us).
Penn State’s World Campus. The College’s first move into this new arena is a World Campus post-baccalaureate certificate program in Geographic Information Science (GIS)—a sequence of four ten-week courses taught by the Department of Geography, but offered entirely over the Web.

A much more ambitious program is currently being considered in Petroleum and Natural Gas Engineering (PNGE). While we have not yet settled on a final plan, at present we are examining a series of web-based certificate programs, offered through the Department of Energy and Geoenvironmental Engineering in cooperation with the EMS e-Education Institute and International Human Resources Development Corporation. Students would take each certificate program as needed, and those that complete the full sequence would receive a Master of Engineering degree. Every baccalaureate graduate from any institution in the petroleum and natural gas industries is a potential customer for these certificate programs. If successful, it is quite possible that the web-based post-baccalaureate certificate and degree programs will be a more significant component of the PNGE educational program than the present residential baccalaureate and graduate degrees.

Learning in the Information Age
While this new model of a life-long educational program may be easier to visualize in some EMS departments than in others, it is quite possible that it will be the model for higher education in the future. But in addition to providing further education when it is needed, we must also provide it where it is needed. If job changes occur every seven to ten years, students will not be coming back to campus for a year or two between every change—hence the focus on distance education and web-based programs. It is difficult to find accurate estimates of web usage, but according to Howard Stauss in the July/August 1999 issue of Educom Review, approximately 200 computers hosted Web servers in August 1981. By July 1998 there were more than 36 million Web servers and Lucent Technologies estimated that examining the more than 830 million URLs—at a rate of one per second—would take approximately 27 years. By 1999 more than 150 million people were using the Web.

A few years ago, the Web was simply an additional medium for distributing information. After information was produced in its traditional form—a book of policies and rules, the catalog of courses—it was also placed on the Web if time and resources were available. Today the situation is reversed. The official Penn State Baccalaureate Degree Programs Bulletin is not a blue-covered book that sits on your desk, it is accessible only via the Web. The Web has also become the primary medium by which we tell the world who we are and what we do. For most new students, their initial perceptions of the College are shaped by what they see on the EMS Web site. Electronic systems and, increasingly, Web-based processes are now the primary administrative tool at Penn State. Within a short time, they will also be one of our most important educational tools.

Although professors tend to think that we teach what a student needs to learn, this is not strictly true. In practice, we take the body of knowledge that we know to be important, and we teach the subset that is possible, given the constraints of time, location and technology. For all of us who teach, there are processes and concepts that we understand and can visualize simply because of experience and long familiarity with the subject matter in general, but which we cannot explain in fifteen minutes to an auditorium full of students using a blackboard. Consequently, we either do a poor job of teaching that topic, or, if we can get away with it, we simply leave it out. A large, fixed-seat auditorium is also not conducive to working on team projects and, given the busy and very different schedules of our students, finding time for even small teams to meet out of class is often difficult. Furthermore, while most of us have adapted to teaching material in 50-minute chunks three times a week, it is not necessarily the way we would choose to structure our classes if we had more options. While information technologies may not be the answer to all of our problems, they do give us an additional set of tools that enhance the learning experience for students.

These technologies are predominantly being used in four different ways. Some instructors have adopted them to their existing course structure and teaching style: slides and overheads are converted to computer presentations, handouts and course packets are posted on the Web, grades are calculated on a spreadsheet and exported to a Web page, and students communicate with each other and course instructors using e-mail. Such use of technology requires little investment on the part of the instructor; course materials are easy to maintain and update, and the use of e-mail frequently increases the contact between the instructor and individual students.

Going a step further, the technology can be used to foster learning by changing the way a course is taught. Here the technology has found most extensive use as an additional medium for communications, providing new ways of promoting teamwork, sharing materials, facilitating student discussion, and furthering interaction among students and between students and the instructor. Thirdly, the technology has enabled a few instructors to actually change what they teach. The concept that could not be conveyed readily on the blackboard may be much easier to explain with the use of a multidimensional dynamic or interactive ‘visualization’ that can be sliced, diced, and animated on the computer screen. Where this ‘visualization’ is an interactive simulation model that can be made available in a computer lab or on a web site, students can use the...
e-Education Institute: Innovative Education for Life-Long Learning

It started with e-mail. Then came e-banking, e-commerce, e-business. Now the College of Earth and Mineral Sciences has established the e-Education Institute.

What is e-Education? David DiBiase, director of the EMS e-Education Institute says “e-Education is teaching and learning mediated by networked computers.” The EMS e-Education Institute is a way for the EMS community to work together to improve the quality and accessibility of EMS education through creative use of inter-networked computing. “In much the same way that electronic commerce creates new opportunities for businesses and their customers, e-education has the potential to benefit teachers and learners by making the learning experience more student-centered and more accessible,” DiBiase adds.

One way the e-Education Institute is accomplishing that mission is to help EMS instructors foster active learning. The World Wide Web provides a teaching medium that can overcome the constraints of time, space and equipment that can stifle creativity. Virtual field trips, self-assessment tools that provide instantaneous feedback and interactive visualization of data and concepts are all possible using the Web.

Even the most engaging and effective lecturer can use e-education tools to benefit his students. Evan Pugh professor of geosciences Richard Alley receives rave reviews from the students in his Geosciences 10: Geology of the National Parks course. But Alley came to the e-Education Institute to discuss ways that his course could be improved. “The problem with Alley’s class,” says DiBiase “was the way in which students were being evaluated.” As is typical of large enrollment general education courses students take three multiple choice “scan-sheet” exams for which they prepare in evening review sessions with a TA who tries to hint at what is on the exam without giving away the answers to the test.

To make test preparation more powerful, over the past year, David Howard, an instructional designer with the e-Education Institute, designed and developed an interactive on-line practice exam for Geosciences 10 that provides feedback to any answer—right or wrong. Preliminary data indicate that most of the students in the course used the practice exam to prepare for their first test. “It’s like providing every student with a one-on-one review session with the instructor,” says DiBiase. He is convinced that on-line practice exams are the most valuable resource that e-Education can provide for most general education courses.

A second aspect of active learning is teaching students to express the impact of their education through on-line portfolios. All Penn State students receive free Web accounts, but e-Education Institute surveys show that fifty percent of University Park undergraduates have not activated their accounts and most Penn State instructors don’t expect students to publish their work on the Web. “The message we are giving to students is that it is sufficient that they be mere consumers, not producers, of knowledge,” says DiBiase. “I believe, and I think many will agree, that our expectations should be higher.”

This year, the EMS Information Technology Tutor, Tim Robinson, began teaching students in the first year seminar how to develop portfolios—helping them to become producers of Web-based information and enabling them to demonstrate their accomplishments to peers, family, instructors and potential employers.

Today, more than half of the 15 million students attending colleges and universities are age 25 and over. Many of these students live away from campus, have returned to college to prepare for a career change, or simply need a refresher course to update their skills. “Education is becoming a life-long activity for many,” says DiBiase. “By the end of the current decade, most adult learning will be mediated by networked computing in one way or another.” For these “lifelong learners” with busy schedules that are not well suited to the typical one hour, three-times-a-week course regimen, educational offerings must be tailored to meet their goals and available at their convenience. With that in mind, Penn State launched its “World Campus” in 1998.

As a partner with EMS departments, the e-Education Institute is working to develop and deliver new on-line programs for adult learners away from campus. Currently, the Department of Energy and Geo-Environmental Engineering is working with the e-Education Institute to develop an on-line master’s degree in natural gas engineering. And a new general education course in meteorology that will be offered entirely on-line to students at University Park and beyond is being developed for launch in the spring of 2002.

Whether it’s preparing current students to become active learners or providing returning students with additional training, the EMS e-Education Institute is improving the quality and accessibility of a Penn State education.

For more information on the Institute, visit its Web site: www.e-education.psu.edu.
"Twenty of us were together"—undergraduates, two instructors, and three graduate students to help with the driving—"for 24 hours a day, for two weeks," says student Kate Darby. "By 7 am, we had to be out and ready to go for a long day."

The CAUSE 2000 students traveled through Colorado, Nevada, Arizona, Utah, and California to explore all different kinds of energy use. "We didn't gather data on the tour, which made us different from the other CAUSE trips, but we did see almost every kind of energy conversion out there," explains instructor Derek Elsworth.

They saw photovoltaics—solar panels—at the Department of Energy's National Renewable Energy Lab (NREL) in Colorado. They met with energy consultants at the Rocky Mountain Institute (RMI) to discuss ways to make Penn State itself a more sustainable community using renewable forms of energy. "There was kind of a cult following among the CAUSE students when we were at RMI," says Elsworth, grinning. At the Hoover Dam along the Arizona/Nevada border, they saw the production of hydroelectric energy. They toured Yucca Mountain in Nevada, a potential nuclear waste storage facility. The Department of Energy is currently conducting tests to determine whether it's feasible to store radioactive waste within the mountain.

"It was like pulling hair to get some of the students to visit Yucca Mountain," Elsworth says. "But they learned that there's some good science being done there. Important considerations are being confronted head on. Garrett Fitzgerald, one of the students in the group, said a very poignant thing. He said, 'You know, the Yucca Mountain guys have the most important job. They have to protect us.'"

In California, the group saw hot springs, a nuclear plant, and wind farms—fields full of windmills harvesting energy from breezes that blow through mountain passes. "One of our goals was to get them to think in terms of doing back-of-the-envelope calculations," Elsworth explains. "If we want to go from nuclear power to windpower, how do we do it? How many people are we supplying energy to? How many windmills do we need? How much area do we have to cover?"

Both Eser and Elsworth believed that statistics on energy use—very easy to attain from the Internet—would be extremely difficult to gather in person. As an experiment, they asked the students to perform an energy audit of the town of Glenwood Springs, Colorado. The expectation: "Man, they're going to fall on their faces," says Elsworth. The students were let loose to gather as much energy information as possible from whatever source they could penetrate—utility companies, officials in the mayor's office, townspeople. They had to figure out the types of energy used in the town, the main suppliers of energy, and ways to make energy use in Glenwood Springs greener.

One group went down to the hot springs to gather information: What is the temperature of the springs? What are the flow rates? How much energy could the hot springs supply to the town?

After running around all day, the students returned with lots of data on energy use in Glenwood Springs, proving Eser and Elsworth wrong. "You know, our opinions aren't so correct," says Elsworth. "We can't run around finding data, but students will."

Overall, Elsworth says, "the travel was perfect." The experience, he adds, gave the instructors "a semblance of youth. We covered a lot of ground socially, geographically, and intellectually."
model outside of class. As Dutton noted in his Bulletin editorial (68:1) the “creation and study of virtual systems will enhance understanding of the actual systems and better prepare students to cope with the chaotic complexity they will encounter during their careers.”

Alistair Fraser is an excellent example of someone who has devoted considerable time and effort to integrating all of these applications of technology in his courses (EMS Bulletin 64.1). However, while Fraser’s focus has been on residential education, the one area where all three information technology components have to come together is in distance education. This represents the fourth area in which technology is being used—as a new medium for course delivery. Here, the objective is to provide a rigorous, high-quality educational experience that retains the benefits of a residence education, while meeting adult student demands for service, flexibility, and value. The GIS certificate program exemplifies one successful approach to structuring this type of distance education course. The certificate consists of a four-course sequence, with each course lasting ten weeks. Most distance education courses are designed to be asynchronous (available anytime anywhere). While providing flexibility, the asynchronicity removes the possibility of teamwork and the advantages that accompany cooperative learning are lost. The GIS program is asynchronous to a large degree, but each course has a specific beginning and ending date and students go through the course as a cohort. Students can complete the weekly assignments at any time during the week and the course Web site is used for student discussions and the presentation of student projects.

While courses such as these are not yet common, there is considerable evidence, from here and elsewhere, that student learning is as good if not better than in the equivalent residential education course. Student interaction is increased and, quite frequently, the interaction between the students and the instructor increases. Contrary to most expectations, and because of the information technologies now available, it appears that there are elements of the educational experience that may actually work better in a cohort-based semi-synchronous distance education mode than they do in the classroom. There are now people looking at what works well in this type of distance education model, and thinking about ways of integrating this into a residence course.

How will this happen in EMS? As usual, it will happen as faculty—individually or as a department—decide that investing resources in this area is a worthwhile move. To assist in this process, the College established the EMS e-Education Institute to assist faculty and departments as they make these critical transitions (See e-Education Institute on page 8.)

The consequence for the future will be a blurring of the distinction between residential and distance education. Partly, this will take place in terms of the mix of courses in a student’s curriculum—as more high quality distance education courses become available on the Web, it is likely that some students will take advantage of these within their residence program. The blurring will also take place in terms of the technology and pedagogy used—which leads us back to Dutton’s question, “how can universities add value in an environment where coursework and instructional materials are all available on-line?”

This is not a new question in many respects. Much of what is taught in a classroom has long been available simply for the price of a library card. The difference is that the Web makes it easier to find the information. However, if a textbook or a Web site of course notes are perfectly good substitutes for coming to class, it would suggest that there was very little value being added in the classroom anyway.

One way in which we add value is through a socialization process. By being on campus, taking part in research and interacting with faculty in the classroom, students are introduced to a particular professional culture. This is a specific objective of the First Year Seminar, but it takes place to a greater or lesser degree in all of our courses. From a different perspective, we can regard the increasing role of technology not as removing the need for residential education, but as increasing the value of that education. This comes about in part because of the possibility of a lifelong educational association between a student and the College, and also because it will allow us to change the way we teach. Where course content is relatively straightforward or factual it makes sense to put it on-line and not to waste valuable class time covering material that students can just as easily read for themselves. Instead, we can devote more time to answering questions, exploring additional issues that arise out of the readings, and assisting students in discovering knowledge for themselves through the use of modeling and simulation systems.

With much of the course content on-line, students will use the technology to communicate and collaborate with each other and to explore and experiment for themselves. Rather than gathering sixty students in a large room three times a week, we may meet twenty at a time in a seminar room once a week. The time in class will be more profitably spent, and the overall educational experience may well be much more rewarding for both faculty and students. The classroom will not disappear, but we are changing the way it is used.

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EMS Faculty Members Honored

Alley Author of Book on Climate Change
Richard Alley, Evan Pugh professor of geosciences, is the author of a new book published by Princeton University Press (www.pup.princeton.edu). In *The Two-Mile Time Machine, Ice Cores, Abrupt Climate Change, and Our Future*, Alley relates the story of the Greenland Ice Sheet Project 2 and explains, in terms for the general reader, how the history of climate change on Earth is stored in the two-mile long ice cores drilled from the center of the Greenland Ice Sheet. The ice cores also provide clues to the mechanisms of climate change that have abruptly switched the Earth from icy to hot and back again over the past 100,000 years. And Alley discusses how the history of Earth’s climate reveals what may be in store for the future, how humans are contributing to the mechanisms that drive Earth’s climate and what we still need to learn about those mechanisms.

Alley is also co-editor, with Robert A. Binschadler (NASA/Goddard Space Flight Center), of *The West Antarctic Ice Sheet, Behavior and Environment*. The book summarizes the past thirty years of research on the collapse of the West Antarctic Ice Sheet. It is part of the Antarctic Research Series published by the American Geophysical Union (www.agu.org).

DebRoy Presents Once-in-a-Lifetime Lecture
Tarasankar DebRoy, professor of materials science and engineering, presented the 57th Comfort A. Adams Lecture, during the American Welding Society’s (AWS) Convention and Exposition in April 2000. The lectureship is one of the most prestigious recognitions that can be bestowed within the $40 billion welding industry. DebRoy’s talk was on “Computer Modeling—A Path to Understand the Science of Welding.”

DebRoy is internationally known for his work on transport theory and chemical processes associated with arc and laser welding. He is an AWS Fellow and has made significant contributions to the understanding of weld metal geometry, chemical composition, and structure.

Glasmeier Authors Book
Amy K. Glasmeier, professor of geography and director of the Center for Regional Research and Industrial Studies, is the author of a new book that chronicles the global watch industry over the past 200 years. *Manufacturing Time: Global Competition in the Watch Industry, 1795–2000* uses the story of watch manufacturing—from the “cottage industries of Britain” to the factories of Switzerland and the United States, the high tech plants of Japan and the sweatshops of Hong Kong—to examine issues ranging from regional economic development, national trade policy, the forces that shape decisions made by corporations, and how technological change is thwarted or advanced.

Glasmeier’s current research interests focus on community impact of globalization, regional development, alleviating poverty and industrial change. She is a 2000-2001 fellow of the CIC Academic Leadership Program.

Messing Honored by Ceramic Society
Gary L. Messing, professor of ceramic science and engineering and director of the Materials Research Laboratory, received the American Ceramic Society’s 2000 Robert B. Sosman Award. The award is the highest recognition of scientific accomplishment given by the Basic Science Division of the Society for outstanding achievement in an area that results in a significant impact on the field of ceramics. Messing was recognized for his work on tailoring ceramic microstructures through templated grain growth.

Redwing Receives Young Author Award
Joan M. Redwing, assistant professor of materials science and engineering, received a Young Author Award from the American Association for Crystal Growth at the 12th American Conference on Crystal Growth and Epitaxy in August. The award recognizes Redwing’s scientific contribution to the understanding of chemical vapor deposition-based growth of
group III nitrides and its application to device structures. Her work on crystal growth ranges from fundamental studies of metalorganic vapor phase epitaxy (MOVPE) gas phase chemistry to epitaxial wafer production. Specific projects include tungsten CVD for medical X-ray target fabrication, MOVPE growth of high electron mobility transistors and light emitting devices for ultraviolet emitter development.

Lecture Named in Honor of Della Roy
The Cement Division of the American Ceramic Society and Elsevier Science Publisher have joined together to create the Della Roy Lecture in honor of Della Roy, professor emerita of materials science. The lecture-ship celebrates Roy’s completion of her thirtieth year as editor of *Cement and Concrete Research* and her extensive contributions to cement and concrete science. Under Roy’s guidance, *Cement and Concrete Research* has become one of the premier journals in its field. H. F. W. Taylor presented the inaugural lecture at the American Ceramic Society’s 2000 Annual Meeting.

**Roy Elected to Russian Academy of Sciences**
Rustum Roy, Evan Pugh professor emeritus of the solid state and professor emeritus of geochemistry, has been elected as a foreign member of the Russian Academy of Sciences. He was inducted in a ceremony in the fall of 2000. The Russian Academy of Sciences is one of the oldest scientific academies in the world. Roy was elected to the U.S. National Academy of Engineering in 1973 and has since been elected a foreign member of the National Academies of Sweden, Japan, and India. Roy was recognized as a chemist for his leadership in inorganic materials synthesis and processing.

**Tormey Receives Award for Distinguished Service**
Brian Tormey, associate professor of environmental sciences at Altoona College has received the Distinguished Service Award for 2000 from the Eastern Section of the National Association of Geoscience Teachers. The award recognizes Tormey as “an exceptional academic leader and professor who has brought innovation and commitment not only to his students . . . but to his colleagues at Penn State.”

**Zelinsky Awarded Cullum Medal**
Wilbur Zelinsky, professor emeritus of geography, has been awarded The Cullum Geographical Medal from the American Geographical Society—the oldest professional geographical organization in the United States. The award, established in 1896, honors those “who distinguish themselves by geographical discoveries, or in the advancement of geographical science.” Zelinsky joins 65 previous recipients of the award.

**Geography Professor Takes Ashby Prize**
Melissa Wright, assistant professor of geography and women’s studies, received a 1999 Ashby Prize for her paper “The politics of relocation: gender, nationality, and value in a Mexican maquiladora.” The Ashby Prizes are given by the editors of *Environment and Planning A*—one of the most respected journals in the field—for the most innovative papers published in the journal.

For more information on Wright’s research activities, see New Faces in EMS on page 14.
Elsworth Named Associate Dean for Research

Derek Elsworth, professor of energy and geo-environmental engineering, was appointed the College of Earth and Mineral Sciences' associate dean for research effective September 1, 2000. Elsworth replaces Peter T. Luckie, professor of mineral engineering, who had served the College as associate dean for research since July 1, 1986. Luckie retired from the University on December 31, 2000.

As associate dean for research, Elsworth will be responsible for all activities related to managing the $30 million of externally funded research conducted annually by EMS faculty and staff. "We will be working to make the research endeavor a continuing vital part of the College," says Elsworth. "Research is really the heartbeat of EMS." He plans to assist faculty by targeting private sector funds as a growth opportunity for EMS research funding. College research accounting practices will also be upgraded and streamlined.

Elsworth was a member of the University's task force on Research Administration and Technology Transfer that spawned the Office of Strategic Research Opportunities. The new office has been instrumental in establishing several University-wide EMS initiatives including the Penn State Astrobiology Research Center, BRIE, and the Quantitative Imaging Center.

Before joining the College, Elsworth was a consulting engineer in Calgary, Canada, and on the faculty of the Department of Civil Engineering at the University of Toronto. He earned a B.Sc. with honors in engineering geology and geotechnics from Portsmouth Polytechnic in England; an M.Sc. in engineering rock mechanics from the Imperial College in London; and received his Ph.D. in engineering from the University of California, Berkeley. He joined Penn State in 1985 as an assistant professor of mineral engineering and was promoted to professor in 1997.

Elsworth has published more than 100 papers and lectures frequently across North America, Europe, and Asia. His main research interests in recent years concern describing fluid flow, fluid transport, and deformation and failure behavior of porous and fractured geological media. The general research findings can be applied to problems ranging from the impact of mining on groundwater resources to geothermal energy, high-level radioactive waste disposal, and the processes controlling flank and dome failure of volcanoes.

Luckie Retires after 25 Years of Service in EMS

After more than 25 years of service, Peter T. Luckie has retired from the University as professor emeritus of mineral engineering.

Luckie was no stranger to Penn State when he joined the faculty in 1979 and was appointed chair of the Mineral Processing Section in the Department of Mining Engineering. He had earned all three of his degrees—B.S. in fuel engineering, M.S. in mineral preparation and Ph.D. in mineral processing—from Penn State and has served as an adjunct professor in the College for three years.

In 1986, Luckie was appointed associate dean for research for the College of Earth and Mineral Sciences and served in that position for fourteen years—stepping down in September 2000 just prior to retiring. During his tenure the level of funding EMS faculty receive from government and industry doubled to more than $30 million per year. The number of research centers and institutes also grew as new initiatives in energy, regional assessment, the environment and recently Astrobiology took shape.

During his tenure and throughout the myriad changes that occurred during this period of tremendous growth for the College, Luckie served with an excellent sense of humor. He will be remembered with gratitude and appreciation for his dedication and loyalty to the College.

EMS Students Awarded NASA Fellowships

Five graduate students in the College of Earth and Mineral Sciences were recently awarded NASA Space Grant Fellowships by the Pennsylvania Space Grant Consortium. The fellowships are awarded to outstanding students in fields that promote the understanding, assessment or utilization of space of NASA strategic enterprises.

Jennifer Eigenbode (geosciences), Beth Pratt (geosciences) and Barbara Tobey (meteorology) received fellowships for the 2000–2002 academic years. John Rogie (geology) and Elizabeth Wood (meteorology) are receiving the second year of a two-year award.
New Faculty Join EMS

Kenneth Davis studies the interactions between terrestrial ecosystems and the atmosphere and their influence on weather and climate. He is particularly interested in the carbon dioxide budget of the atmosphere and is one of the founders of a research site in northern Wisconsin where meteorologists, ecologists and hydrologists are investigating the net storage of carbon dioxide by northern forests. The goal is to determine why these forests are storing carbon dioxide, why the atmospheric carbon dioxide budget varies from year to year and how these biogeochemical processes are altered if climate changes. Davis is planning to expand results of the Wisconsin study to a continental scale in order to determine the net carbon dioxide budget of North America. Davis is also studying the atmospheric boundary layer and the interactions between turbulence and ozone chemistry in the boundary layer.

Davis joined the College as an associate professor of meteorology in August. Before coming to Penn State, Davis was an assistant professor in the Department of Soil, Water and Climate at the University of Minnesota. He earned his A.B. in physics from Princeton University and a Ph.D. in Astrophysical, Planetary and Atmospheric Sciences from the University of Colorado.

Jerry Harrington joins the College as an assistant professor of meteorology after three years at the University of Alaska Fairbanks. Harrington held a joint appointment there as a member of the Atmospheric Science Research Group with the Geophysical Institute and a physics department faculty member. His research work has centered on modeling of clouds, radiation, and dynamic interactions within boundary layer clouds. In particular, Harrington has developed unique parameterizations of cloud and radiation processes for use in detailed cloud and mesoscale models and has made significant contributions to developing the Regional Atmospheric Modeling System (RAMS). At the University of Alaska Fairbanks, Harrington focused on cloud properties and influences over the marginal ice zone. He is expanding those efforts to include coupling observational data sets to modeling studies and determining how to properly scale up detailed modeling/observational studies for large-scale model parameterizations.

Harrington received his B.S. in physics from the University of Iowa and earned both M.S. and Ph.D. degrees in atmospheric sciences from the University of Colorado.

Marek J. Mrugala has joined the Department of Energy and Geo-Environmental Engineering as an associate professor of mining engineering. He comes to the College after thirteen years in industry as a geotechnical engineer with expertise in design and construction of underground structures, and acoustic emission studies. As the lead geotechnical engineer for Parson's Brinkerhoff, Mrugala was involved with the design and analysis of the Department of Energy's Yucca Mountain Waste Repository in Las Vegas, Nevada and its Exploratory Shaft Facility in Deaf Smith County, Texas. From 1991 to 1994, Mrugala worked on the Superconducting Super Collider Project in Texas and was responsible for ground control analysis and design and the numerical modeling of two large cut-and-cover excavations. Recently he has turned his efforts to projects related to underground oil and gas storage problems and salt solution mining.
At Penn State, Mrugala will be studying numerical modeling as well as both theoretical and practical aspects of acoustic emission technology in rock mechanics to solve ground control problems. Mrugala earned his Ph.D. in mining engineering from Penn State in 1985. He also holds an M.S. in mining engineering from the Academy of Mining and Metallurgy and an M.S. in mechanical engineering from the Technical University, both in Krakow, Poland.

Melissa Wright joined the College in August as an assistant professor of geography and women’s studies. Her research explores how local cultural processes affect and are affected by technological changes in multinational firms. Wright is especially interested in how technological changes inside firms intersect with cultural understandings of gender, nationality, race and ethnicity. She has conducted research in Mexico, the Mexico/US borderlands and Latin America and also in southern China. She uses Marxist and poststructuralist theories to study exploitation, particularly as it manifests in the devaluation of people and their labor. She has drawn on studies from the industrial reaches of northern Mexico where violence against women outside of the workplace informs the organization of production within it. She is now working on papers based on fieldwork from the export-processing zones of southern China and Hong Kong.

Wright comes to Penn State from the University of Georgia where she was an assistant professor in the Department of Geography and Women’s Studies. She received an A.B. in social studies from Harvard-Radcliff College in 1987. She earned a Ph.D. in geography and environmental engineering from The Johns Hopkins University in 1997.

MacKenzie “Mac” L. Keith

MacKenzie L. Keith, professor emeritus of geochemistry, died November 6, 2000. He was 88.

Keith began his career as a lecturer and assistant professor at Queens University in Kingston, Ontario. In 1947 he moved to the United States and worked as a petrologist at the Geophysical Laboratory of the Carnegie Institute in Washington, D.C. While there, Keith became interested in high temperature phase equilibria studies related to experimental petrology and refractory materials. He continued the work after joining Penn State in 1950. It later became the basis for the development of synthetic garnets used in industry for ferrimagnetic crystals and lasers. In 1958 Keith was named director of the EMS Mineral Conservation Section and resumed studying mineral resources and factors that control their distribution. He retired from the University in 1978.

MRL–MRI Merger

Penn State’s Board of Trustees approved the merger of the Materials Research Laboratory and the Materials Research Institute at its November meeting. The merger will occur on July 1, 2001 and the new organization will be known as the Materials Research Institute.

The institute builds on the success in materials research at Penn State, including the activities associated with the Materials Research Laboratory, which helped found and develop the interdisciplinary field of materials in the early 1960s.

The number of Penn State faculty now engaged in materials education and research has grown to more than 150 and includes representatives from the Colleges of Agriculture, Engineering, Earth and Mineral Sciences and the Eberly College of Science. This year, *U.S. News & World Report* ranked Penn State seventh nationally in materials in its issue on America’s Best Graduate Schools 2001.

University-wide, total research funding for materials is now more than $50 million annually. Recent, major successful funding efforts include: the state-supported Center for Innovative Sintered Products (CISP); the NSF-supported National Nano-Fabrication User’s Network (NUNN) facility; the W. M. Keck Foundation-supported facility for fabrication of Smart Materials and Devices; and the NSF-funded Materials Research Science and Engineering Center (MRSEC) on Collective Phenomena in Porous Hosts.

The merger is designed to capitalize on and to spearhead the continued growth in the materials field at Penn State.

The reorganized MRI will promote and support interdisciplinary materials research throughout the University by maintaining state-of-the-art characterization facilities. The Institute will nurture new initiatives in materials research and education, provide a focal point for students, government and industry, and enhance the visibility of Penn State’s materials activities.
Penn State analyses of the continental slope about 100 miles off the northern New Jersey coast show that water trapped in sediments there is highly pressurized and, if expelled violently, could cause undersea landslides which can produce tidal waves.

Peter B. Flemings, associate professor of geosciences and director of the research team, says, "Our analyses focused on the layered sediments and we found a potential for water trapped there under pressure to surge out and cause landslides or to seep out slowly. We have not calculated the probability of tidal waves. However, undersea landslides are known to cause tidal waves and we agree with recent reports from other researchers that there is potential for expulsive events in the continental slope along the East Coast. We offer a new, alternative explanation for the cause of expulsive events not only off New Jersey but around the world."

Flemings explains that the continental slope is a narrow region of steeply angled sea floor that connects the continental shelf, where the water is hundreds of feet deep, to the deep ocean floor where the water depths exceed many thousands of feet.

In their analyses, Flemings and graduate student Brandon Dugan showed that the slope off New Jersey may be only marginally stable as the result of the water trapped under high pressure in the layered sediments there. Even small shaking, from a mild earthquake, for example, could trigger release of the pressurized water and produce significant landslides. More importantly, the possibility exists that the water trapped under high pressure could trigger landslides independently, without an earthquake, and without warning.

Other researchers recently identified cracks in the continental slope off the Maryland, Virginia and North Carolina coast and cautioned that the rifts there could set off undersea landslides and subsequent tidal waves. In newspaper interviews, these researchers attributed the cracks to violent explosions of gas trapped under layers of sediment on the continental shelf. The Penn State researchers offer another possibility—water trapped under high pressure.

The researchers detailed their methods and results in a paper, "Overpressure and Fluid Flow in the New Jersey Continental Slope: Implications for Slope Failure and Cold Seeps," published July 14, 2000 in the journal Science. The authors are Brandon Dugan, a doctoral candidate in geosciences, and Flemings who is also director of both the Penn State GeoFluids Consortium and the Penn State Petroleum GeoSystems Initiative.

In their study, the researchers used a computer simulation they developed and the techniques and analyses commonly used to help the oil industry predict the location of zones where water is trapped under high pressure in undersea sediment layers. When crews conducting undersea oil drilling sink a well into one of these areas, the high pressure can cause "blowouts" that send water and sediment up to the sea floor or up to the drilling platform.

The researchers used data gathered by Flemings and other researchers during an expedition aboard the research ship D/V JOIDES Resolution in 1997. They were trying to study the history of sea level and climate change recorded in the layers of sediment in the continental shelf and slope. They bored holes in the shelf and slope and removed cores which showed the pattern of sedimentation caused by changing sea levels over millions of years.

Later, Flemings and Dugan used the sediment data and their computer simulation to estimate how the pressures evolved over the last million years. The simulation showed that water under high pressure in some of the lower layers of sediments could suddenly force its way out, laterally, through the slope face, creating undersea vents, cracks or landslides in the process. The same high-pressure zones that cause drilling problems for the oil industry could also unleash a landslide on the slope.

On the other hand, Dugan notes that the water trapped in the high pressure zones can also seep out slowly rather than exit forcefully. These seep fluids, he says, "may be rich in nutrients and provide energy for a variety of undersea life."

The Penn State researchers have not done calculations to predict when the high pressure zones could cause failures off New Jersey. Flemings says, "our contribution here is to recognize high fluid pressures in offshore New Jersey and present a quantitative model that describes how these fluid pressures could contribute to slope instability and fluid expulsion. We have not tried to predict the probability of a significant failure but recognize that further research is warranted."

Support for the Penn State study came from an Ocean Drilling Program grant, the National Science Foundation, and the Penn State GeoFluids Consortium, an association of companies in the oil industry. Dugan is supported by a Joint Oceanographic Institutions/U.S. Science Advisory Committee Ocean Drilling Fellowship.
Lard-fired Boiler Cleaner than Fuel Oil

Pork producers who pride themselves on using every part of the pig except the oink, have seen the use of lard in cookies, chips and other foods decrease. In search of alternative outlets should the lard become unmarketable, a team of Penn State researchers has found that lard and choice white grease can replace No. 4 and 6 fuel oil in a process steam boiler with little or no retrofitting.

“Today, the lard produced when processing a pig is used in restaurants, bakeries and cosmetics while the choice white grease is used in animal feedstuffs and as chemical feedstock,” says Bruce G. Miller, associate director of The Energy Institute in the College of Earth and Mineral Sciences. “The market for both edible lard and non-edible choice white grease is changing and Hatfield Quality Meats investigated new options for their products.”

A butchered hog is sixty percent meat and forty percent other products. Of that forty percent, twenty percent becomes products like processed lard and the other eighty percent becomes animal feed, including choice white grease. In 1998, Hatfield was processing about 7,000 pigs per day averaging 250 pounds per pig. If the markets for lard or choice white grease should substantially decrease, then they could incur heavy costs for waste disposal if alternative uses are not found.

“Currently, all the choice white grease and lard products are being sold at a price higher than the per gallon cost of fuel oil,” says Mark W. Badger, director of the analytical research group of The Energy Institute. “It would not be profitable to burn lard now, but Hatfield is looking toward the future.”

The researchers, working closely with Hatfield and John Larsen of Lehigh University, and supported by the Ben Franklin Partnership of the Commonwealth of Pennsylvania, compared the combustion properties of semi-finished lard and finished lard No. 6 fuel oil. Hatfield currently has three boilers operating on Nos. 4 and 6 fuel oil in their main processing plant.

Pig fat contains essentially no sulfur or sulfur compounds and so produces no sulfur dioxide when burned. The study showed that both pork products produced about one-third the nitrogen oxides produced by No. 6 fuel oil. Because the lards are processed, they produce almost no ash as well. While pig-derived fuels produce slightly less energy per gallon than No. 6 fuel oil, they are cleaner. The tests were run on a boiler adjusted for No. 6 fuel oil producing slightly more carbon monoxide from the pig-derived fuels, but this could be eliminated with proper adjustments. The same fuel handling systems was used with all fuels.

“Therefore, lard and choice white grease are semi-solid at room temperature, this poses no problem because typically No. 6 fuel oil is heated before burning,” says Miller. “We preheated the oils to 120 degrees Fahrenheit and the lards and grease became nicely liquid.”

In the processing plant, the edible and inedible fats are processed separately. The inedible fat is rendered and becomes choice white grease. The edible fat goes from the cutting room floor to the melt tank, is heated, centrifuged to break it down and liquefied in a heat exchanger to remove the solids. This produces semi-finished lard, which is as good for fuel as finished lard. The extra expense of finishing the lard by putting it through a separator that removes small insoluble solids and some of the water would be unnecessary should it be used as boiler fuel.

“Production at the Hatfield plant produces almost nothing as waste,” says Miller. “If the current demographics of lard consumers changes, these products make very good fuel.”
Ancient South African Soils Point to Early Terrestrial Life

Remnants of organic matter in ancient soil more than 2.6 billion years old may be the earliest known evidence for terrestrial life, according to a team of Penn State astrobiologists.

“Our work shows that the organic matter in this soil very probably represents remnants of microbial mats that developed on the soil surface between 2.6 and 2.7 billion years ago,” says Dr. Hiroshi Ohmoto, professor of geochemistry and director of The Penn State Astrobiology Center. “This places the development of terrestrial biomass more than 1.4 billion years earlier than previously reported.”

Evidence that microorganisms flourished in the oceans since at least 3.8 billion years ago exists, but when these microorganisms colonized on land is not clear. The oldest undisputed remnants of terrestrial biomass have been 1.2 billion-year-old microfossils found in Arizona.

Examining samples taken from Mpumalanga Province, South Africa, using a variety of geochemical methods, the researchers report in the journal *Nature*, that a paleosol dating to between 2.6 and 2.7 billion years ago contains organic carbon that was neither created by high temperature fluids nor is the remnant of later petroleum migration, but is in-situ biological in origin.

A paleosol is a layer of ancient soil, in this case buried and preserved where it formed. Because the 55-foot thick layer of soil found at Schagen is located between a layer of 2.7 billion-year-old serpentine and a 2.6 billion-year-old quartzite bed, the researchers can date the soil to between 2.6 and 2.7 billion years ago. Showing that the carbon in the soil is biological in origin and that it accumulated during soil formation is much more difficult.

The researchers, who include Ohmoto; Yumiko Watanabe, Ph.D. candidate at Penn State and at Tohoku University, Sendai, Japan; and Jacques E. J. Martini, Geological Survey of South Africa, evaluated three possibilities for the formation of reduced carbon in the soil.

The first of these was that the carbon was graphite crystals created when the underlying serpentine formed under high temperatures. The graphite then was concentrated during the soil formation.

“The crystallinity and hydrogen/carbon ratios of the organic matter suggest it is not of igneous or hydrothermal origin,” says Ohmoto.

The second possible origin of reduced carbon is liquid hydrocarbons introduced after the soil formation ended. Materials introduced after formation should show up along fractures in the rocks.

“The organic matter is almost always concentrated in clay-rich parts of the rocks paralleling the ancient surface,” says Ohmoto. “Organic matter and clays are so intimately mixed together that the size and morphology of individual ‘grains’ of organic matter can only be recognized under electron microscopes.”

The researchers conclude that the reduced carbon was not produced by high heat and then incorporated into the soil as it formed nor was it deposited after the soil formed by migrating petroleum. The third possibility then is that the organic carbon represents remnants of biomats developed on the soil surface. The researchers found that the organic-rich clays in the upper portion of the paleosol appeared as seams between fine-grained and coarse-grained layers of quartz.

“These features suggest that the organic matter in the uppermost soil zone is an indigenous remnant of microbial mats that developed on the surface of clay-rich soil during the rainy season,” says Ohmoto. “The mats were blanketted by aerosol deposits laid down during the dry season.”

In the lower portion of the paleosol, things are less clear because the effects of seeping water and the dissolution and precipitation of materials suggest some decomposition. While identifying the organism in the microbial mats is difficult, the researchers are certain that they were not photosynthetic sulfur bacteria as there is no sulfur present. Photosynthetic blue-green algae, however, are a likely possibility for the mat formation because the ancient remnants have nearly identical carbon isotope ratios as modern blue-green algal mats in fresh water.

The researchers are also certain that the mats formed on land, not in the oceans, because the carbon isotope values for the carbon in the paleosol are distinctly different from the organic carbon found in marine sedimentary rock.

“Although terrestrial bacterial communities were predicted by previous researchers, this is, to our knowledge, the first study presenting several lines of evidence for an extensive development of microbial mats on soil surfaces in the Archaean,” says Ohmoto. “Our finding may then imply that an ozone shield developed before 2.6 billion years ago.

“The ozone shield would have protected land-based biological forms from the effects of cosmic radiation. Development of the ozone shield requires an oxygen-rich atmosphere. Our finding of ancient biomats on land is an important addition to a growing line of evidence suggesting that the rise of atmospheric oxygen took place more than 2.6 billion years ago.”
Atmospheric Chemistry Key to Global and Local Air Pollution

The chemical cycles in the troposphere along with pollutants of human and natural origin can alter the composition of the air and affect local, regional and global environmental quality, according to William Brune, professor and head of the meteorology department.

The troposphere—the area of the Earth's atmosphere from the surface to ten miles above the surface where weather exists—is also where pollution becomes a problem. In the atmosphere, a complex series of chemical reactions can alter some pollutants so that they rain out as aerosol particles or acid rain and clear the air. Other compounds remain in the air, changing, and changing again as other chemicals cause reactions.

“Pollution from megacities and biomass burning, including precursor gases to hydrogen oxides such as acetone and formaldehyde, lofted into the upper troposphere, can become the dominant hydrogen oxide source and result in efficient ozone production,” says Brune. “These compounds can also be transported great distances before descent, possibly influencing the chemistry of remote regions.”

Ozone is complicated. In the stratosphere it serves to protect life from the detrimental effects of the sun’s ultraviolet radiation. At ground level, it is a pollutant implicated in respiratory problems and eye irritation. Sunlight breaks ozone apart resulting in the creation of the very reactive hydroxyl radical which begins the process that removes some pollutants from the air. However, when hydroxyl radicals break down some compounds, they produce other hydrogen oxides, which react with other pollutants and form ozone.

“The hydroxyl radical drives atmospheric oxidation by reacting with chemicals emitted from Earth’s surface, thus creating new chemicals that are more easily scavenged and removed by aerosols, clouds and rain,” Brune told attendees at the annual meeting of the American Meteorological Society in Albuquerque, New Mexico.

“But in the oxidation process, hydroperoxyl radicals form and combined with the industrial pollutant nitric oxide produce ozone. The sun then breaks down this ozone, creating hydroxyl radicals and starting the cycle all over again.”

Brune is part of ongoing studies to measure the amounts of hydroxyl radical and hydroperoxyl radical in the atmosphere over various areas of the globe during different times of the day. So far, using airplane-mounted equipment, they have tested air over the south Pacific near Hawaii, Fiji, Tahiti and Easter Island, over the North Atlantic flight corridor, and are preparing for flights over the western pacific from Hong Kong and Tokyo. Measures of hydroxyl and hydroperoxyl radicals reflect the outflow of air carrying pollutants off China and other industrialized nations. The study over the North Atlantic flight corridor assessed the contribution of air travel to this type of pollution. Brune has also tested air from ground towers in lower Michigan and Houston, Texas.

To measure these radicals, special equipment samples the air and uses a laser to excite the hydroxyl radicals so that they fluoresce. The hydroxyl count is proportional to this fluorescence. The researchers count hydroperoxyl radicals by releasing nitrogen oxide that rapidly reacts with hydroperoxyl to form the hydroxyl radical. They then count the hydroxyl and subtract the hydroxyl that was there before the nitric oxide.

“The Michigan environment was dominated by trees that produce an organic compound called isoprene,” says Brune. The hydroxyl radical reacts with isoprene to form a hydrocarbon oxide radical. Whether the next reaction produces or reduces hydrogen oxides depends on the amount of nitrogen oxide in the air.

“Isoprene, a naturally occurring compound, in the presence of nitrogen oxide produced by power plants is very reactive and can create a lot of ozone,” says Brune. “We want to test the understanding of the basic chemical reactions for isoprene.”

The complex nature of the chemistries of ozone, the hydroxyl radical and the hydroperoxyl radical is not always as simple as sunlight and human-produced pollution. Even naturally occurring organic compounds, like isoprene, under the right circumstances can produce unexpected results. Observations of hydrogen oxide levels, nitrogen oxide levels and other meteorological factors over areas as different as an urban city, a rural forest and the Pacific ocean shed light on the fundamental relationships among atmospheric oxidation, ozone production, nitrogen oxide and hydrogen oxides.

“The major thrust of atmospheric research is tied into the Earth science,” says Brune. “We look at things locally, then regionally and globally. It all comes back to affecting us locally.”
Deep Mantle Volcanic Plumes Cause of Atmospheric Oxygenation

If the initial rise in the Earth’s atmospheric oxygen occurred between 2400 and 1800 million years ago, as most researchers agree, but oxygen-producing bacteria existed more than 300 million years before that, Penn State geologists wonder what caused the delay?

“Oddly enough, the rise of oxygen seems to be linked to what may have been Earth’s first glaciation,” says Dr. Lee R. Kump, professor of geosciences. “After the glaciation that occurred 2.4 billion years ago, the amount of oxygen in the Earth’s atmosphere may have been about the same as it is today. Prior to that glaciation, the amount of oxygen was essentially zero, far below the amount necessary to support oxygen-breathing life.”

Kump and James F. Kasting, professor of geosciences and meteorology, together with their Australian colleague Mark Barley, have developed a conceptual model that suggests vulcanism caused a rapid change in oxygen content and the glaciation, but this was a different type of vulcanism than had occurred up until then.

“Previous to 2.4 billion years ago, volcanoes spewed hydrogen, carbon monoxide and methane into the atmosphere because their magma source from the near upper mantle, was very reduced,” Kump told attendees at the November 15 meeting of the Geological Society of America.

Cyanobacteria produce oxygen from photosynthesis, but none of that oxygen remained in the atmosphere because the hydrogen, carbon monoxide and methane rapidly reduced it. These reducing gases produced a strong greenhouse effect keeping the Earth warm. The action of water, which contains oxygen, on the iron in basalts emerging from mid-ocean ridges, set up the potential for a more oxygenated atmosphere. The iron in basalt rusted in contact with the water. The hydrogen produced escaped to the atmosphere but the rust—iron oxide—deposited on the ocean floors. This oxygen rich layer eventually was subducted and accumulated at the core-mantle boundary, far from the area generating volcanic magmas.

“The likelihood that these deep mantles would rise as plumes of oxygenated magmas increased as more and more iron oxide rich magma was buried,” says Kump. “What we do not know is why these deep plume volcanoes appeared on three or four continents at the same time.”

The rising plumes began to spew carbon dioxide and water, rather than methane and hydrogen, and this allowed the oxygen levels to rise.

“The weaker greenhouse caused by lower methane and carbon monoxide levels allowed glaciation to occur,” says Kump.

Once carbon dioxide built up in the atmosphere, its greenhouse warming potential would melt the glaciers.

“Geological observation shows that the same sequence of events occurs around the world at this time,” says Kump. “There is evidence of reduced iron deposits, then glacial deposits and then oxidized sandstones indicating an oxygen-rich atmosphere in Africa, Canada and Australia.”

Kump, Kasting and Barley believe that their conceptual model of rapid oxygenation of the atmosphere by deep magma plume volcanoes is self consistent and ties together a series of occurrences on different continents.

For more stories on the science and research activities of faculty members in the College of Earth and Mineral Sciences, visit the EMS Web site at www.ems.psu.edu/NEWS/research/.
Alumnus Supports EMS Initiatives with $1 Million Pledge

Donald F. Harris, a 1948 graduate of the EMS petroleum and natural gas engineering program, knows what it takes to be successful. His 46-year career in the petroleum industry took him around the world—from Chile and Panama to Japan, Hong Kong and Singapore. When he retired in 1994 from his position as coordinator with the Kuwait Petroleum Corporation he left a company that owns one of the largest oil complexes in the world.

Today, Harris is active as a volunteer for Carnegie Hall in New York and the Institute for International Education. Wanting to give something back to the College of Earth and Mineral Sciences, while at the same time recognizing his parents for their role in his success, Harris pledged more than $1 million to support several innovative programs that the College of Earth and Mineral Sciences has developed to enhance the educational opportunities it offers EMS students.

The Donald Harris Academic Excellence Fund in Global Business Strategies will support a recently developed minor, Global Business Strategies in the Earth, Energy and Materials Industries, developed in cooperation with the Smeal College of Business Administration, will receive $400,000. The minor is designed to encourage leadership and entrepreneurial management skills in EMS students and the gift from Harris will provide a new level of support for the program. In particular, the College will use the endowment to integrate the global business strategies curriculum into a CAUSE problem-based experiential format.

The remaining $600,000 of the Harris pledge will endow the Donald F. Harris Fund for Excellence in Education. The fund will be used to directly support the Center for Advanced Undergraduate Studies and Experience (CAUSE) program.

Harris is enthusiastic about supporting a program that allows students to take an active role in their own education. The real-world problems that previous CAUSE programs have addressed range from examining the demise of the coral reefs in the Florida keys and the effects of natural disasters in New Zealand to the impact of global warming on rural Pennsylvania and the connections between economics, health and the environment in Appalachia.

In recognition of Harris' gift, the CAUSE classroom in Deike Building was officially renamed the Myrna Hill and Fred Samuel Harris Interactive Learning Center in honor of Harris' parents to whom he attributes his professional success. At the dedication ceremony, Harris expressed his appreciation for the education he received from EMS. With his support, future EMS students will have many more opportunities to achieve success in their own careers.
EMS Alumni Recognized with Fellow and Achievement Awards

Government Official, CEOs Selected as 2000 Alumni Fellows

Three alumni of the College of Earth and Mineral Sciences visited University Park during September to be honored as Alumni Fellows. They are D. Ray Booker, Rosalyn G. Millman, and Gregory J. Yurek. The Alumni Fellow award is the most prestigious award given by the Penn State Alumni Association.

The Alumni Fellows returned to the College for several days to interact one-on-one with students, share their expertise with faculty and serve as a role model of excellence in their respective fields. While on campus, the EMS Alumni Fellows presented lectures, met with students in formal classroom settings and small social gatherings, and exchanged ideas with faculty and graduate students.

Ray Booker ('62, '65 meteorology) founded his first company, Weather Science, Inc., while he was a graduate student at Penn State. It was the first of his several successful companies that have provided weather support for the Armed Forces in Vietnam, support for the missile test range in the Pacific, global measurements of cloud parameters, and instrumentation of manned aircraft and drones. Today Booker's primary role is as founder and CEO of Aviation Technologies, a company that leases aircraft for special mission applications. In addition to his successful entrepreneurial career, Booker has been active in civic organizations, government affairs, and as a mentor and philanthropist in support of underprivileged students.

Rosalyn Millman ('83 geography) was named deputy administrator of the National Highway Traffic Safety Administration (NHTSA) in September 1999 and served as acting administrator from October 1999 to May 2000. Prior to her appointment as deputy administrator, Millman served for six years in the U.S. House of Representatives as a transportation economist for the Democratic staff of the Committee on Transportation and Infrastructure. While working for the committee she had a significant impact on highway safety as she developed many of the policy provisions found in the Transportation and Equity Act for the 21st Century. Among her other legislative accomplishments are drafting of the National Highway System Designation Act of 1995 and the Interstate Commerce Commission Termination Act. She holds a master's degree in economics and public policy from Princeton University.

Greg Yurek ('69, '70g metallurgy) is president, CEO, and chairman of the board of American Superconductor Corporation, which he founded in April 1987 with three fellow MIT professors. The company was established to commercialize a new family of high temperature superconducting (HTS) materials that will have a significant impact on applications ranging from medical diagnostic equipment to electric power storage and transmission. From 1976 to 1988, Yurek was co-director of the H.H. Uhlig Corrosion Laboratory at MIT where he was professor of materials science and engineering. His work there on the development of corrosion-resistant alloys led to the invention of technology now used in manufacturing HTS wires.

Environmentalist Honored by EMS Alumni Society

John M. Stilley ('72 mineral economics, '75 mining engineering management) received the 2000 GEMS Alumni Achievement Award from the College of Earth and Mineral Sciences at the Obelisk Society Dinner in September.

Stilley is the president, founder and owner of Amerikohl Mining—one of the top five surface mining coal producers in Pennsylvania. Each year the company produces nearly one million tons of coal, providing quality fuel to utility companies in Pennsylvania, Ohio, West Virginia, and New York.

In addition to mining activities, Amerikohl Mining’s reclamation efforts have restored thousands of acres of abandoned surface mines that once again can be used for farming, pastureland, forestland, or housing. In total the company has received more than forty awards for its reclamation efforts.
Alumni Notes

EMS Alumni: Let us know what's happened to you since graduation. Have you gotten married, had children, been promoted or started a new career? We'd love to hear about it and so would your former classmates. Send announcements to gems@ems.psu.edu. Or fill out the form at www.ems.psu.edu/GEMS/updateform.html.

Ceramic Science

Todd Lobaugh '89 <usa-ros@fast.net> "recently founded Refractory One Source, Inc. (ROS), which owns www.USA-ROS.com—the ‘first’ and primary on-line clearinghouse and information source for the refractory industry. This site creates a place where professionals, such as, engineers, purchasing personnel, project managers, contractors, and various end-users can exchange information in an open forum."

Stephen Anthony Dynan '92 <SDynan@ltdceramics.com> is living in San Francisco Bay area working at LTD Ceramics on high purity ceramic materials and components for the semi-conductor industry. Anyone interested in working for LTD Ceramics should send him a resume.

Energy, Environmental and Mineral Economics

Ellis S. Bergey '43 <avieellis@qwest.net> writes “My best wishes to all GEMS Officers and Board Members, and I will look forward eagerly for the next Gems Up-date.” Bergey served in the U.S. Navy from 1943 to 1946. In 1946 he was joined the Philadelphia Electric Co. and working in gas operations for forty years until his retirement in 1986. He is living currently in Scottsdale, AZ.

Kay Allen Keller '62 <gkeller@lmf.net> is operating a railroad car repair and locomotive leasing firm and would like to hear from any '62 fuel science grads.

Geography

Carlee J. Britsch Shultz '95 <carlee@hockeymail.com> is working at ALK Associates in Princeton, NJ. She writes, “On November 4, 2000 I married Robert A. Shultz (’82 ENG). Bob is a technical leader in the nuclear division of GE Medical. We have a house in Warrington, PA and are planning to start a family in the next year or two. We recently returned from a great honeymoon in Hawaii. Hi to all former Irvinites.”

Elizabeth Fleming '96 <iswimbikerun5@yahoo.com> relocated to sunny Newport Beach, CA from Philadelphia, about 6 months ago and lives a half mile from the beach. “I joined the Orange County PSU Alumni Association and we get together to watch the football games. I am going to try to make it back next year for a game. GO PSU!”

Geosciences

Robert L. Folk '46, '50, '52 is an emeritus professor of geology at the University of Texas. He writes, “Thanks to the Penn Sate professors, especially P. D. Krynine. I received the Penrose Medal of the Geological Society of America in Reno, NV in November 2000. This medal recognizes my accomplishments in sedimentary petrology—prior to my digression into nanobacteria. This discovery in 1990 led to the squabble over ‘life on Mars and in space’ and is impacting biology and mineralogy despite the dogmatic objections of the ‘just say NO’ crowd of biologists who need to start reading the Geological literature.”

Jerry Kashatus '84 <jerry_kashatus@urscorp.com> writes “Hi to all GEMS! I've been pretty busy recently working as a program manager at URS in Rockville, teaching at the University of Maryland and enjoying life with my wife and children.”

Claudine Orloski '91 <claudine.e.orlosky@pwglobal.com> is working as an attorney at Pricewaterhouse Coopers in Harrison City, PA.

Tom Potteiger '81 <twpot@juno.com> or <thomas.w.pottieger@lmco.com> is working at Lockheed Martin, flying production/test flights and instructing the C-130J navigation system, digital map, radar, and flight planning system to pilots. He writes “This is my 19th year as an airforce navigator (active duty/reserves). Also, I reached 5000 flight hours in the C-130. Most of my airforce time spent in the Far East.”

Pierre Zippi '78 <biostrat@home.com> is living in Garland, TX.
**Materials Science**

Alfred J. Babecki ’53 writes, “Since graduation in May 1953, I have worked as a metallurgist in the general labs of ACF Ind., in Berwick, PA; then as a welding metallurgist at the US Naval Research Lab in Washington, DC; then as an Aerospace Technologist (materials) at the Goddard Space Flight Center in Greenbelt, MD. During this period I took graduate courses for a MS in Materials Science at the University of Maryland.”

Michael Basca ’94 recently married Belinda Bell (’95 Edu/Sci). Basca received his MBA and MS in electric engineering and ceramic science from MIT and is working as a product manager for Intel.

Brendan Burns ’78 was selected to attend Army War College.

Alan M. Hart ’67 <hartpegg@aol.com> retired from Dow Chemical Company on Dec. 31, 2000 after 33.5 years of service. His work experience includes steel plant refractory, engineering ceramics, electronic ceramics and advanced coating systems research. Hart was named an EMS Centennial Fellows in 1996!”

James J. Hummel ’95 <hummelj@apine.com> is working for AEP Industries in Plains, PA and married Melissa Brady on Oct. 28, 2000.

Kirwan Magdano ’90 <kirwanandcarla@juno.com> and wife Carla Giver (’91 LIB) have moved to Germantown, MD.

William U. Pursell (Bill) ’62 <wpurs469@swhell.net> (home) or <bpursell@usbolt.com> (work) “I changed jobs from a large oil tool manufacturing company where I was vice president of manufacturing to a very small, privately-owned manufacturing company that makes hot forged fasteners for critical applications on off-shore oil and gas wells and rotating equipment that generates electricity. Both our sons are petroleum engineers from Texas A & M University. We have seven grandchildren. Not planning on retiring for awhile.”

Rosalia N. Scripa ’72 is the associate dean for academic and student affairs in the School of Engineering at the University of Alabama, Birmingham. She was also named associate provost for undergraduate programs.

Richard M. Wardrop, Jr. ’68 is the chair and CEO for AK Steel. He received the National Safety Council’s first Green Cross for Safety Medallion. He and wife Jeanette live in Springboro, Ohio.

Robert C. Creese ’72g <uld05490@mail.wvnet.edu> is a professor of industrial and management systems engineering at West Virginia University. He has co-authored/authored two books: Estimating and Costing for the Metal Manufacturing Industries (1992) and Introduction to Manufacturing Processes and Materials (1999), both published by Marcel Dekker. He teaches manufacturing process, engineering economy, advanced engineering economy, cost engineering, materials and processing systems design and solidification and advanced manufacturing processes courses. Creese plans to take a sabbatical in the spring of 2002 and visit Aalborg University in Denmark. Creese also holds a B.S. in industrial engineering from Penn State.

Mark Alan Shehan ’90g <mshehan@ford.com> works for Ford Motor Company. He writes, “I am doing ride and handling development—developing tires, wheels, springs, shocks, stabilizer bar, steering (etc.) for Ford’s TH NK fuel cell vehicle program. Heather and I were married August 28th, 1999. No children yet—two dogs and two cats.”

**Meteorology**

Elizabeth Gherlone Callahan ’89 <yellowrose@lazerlink.com> has relocated to State College.

David D’Arcangelo ’94, ’00g and wife Stephanie Lobritz (’94 HHD) reside in Boalsburg, PA, and on February 15, 2000, had a son: Benjamin John.

Kristen A. Egan ’87 “I earned another Penn State degree this year—M.Eng. from Penn State Great Valley. After almost 12 years as an environmental consultant I decided to join the ranks of industry. In September I accepted a position with Merck Co. Inc. at the West Point, PA facility as part of the Site Environmental Engineering Department. I will miss the meteorological aspects of my old job, but I am looking forward to the new challenges and opportunities. Live in Lansdale, PA with husband John and daughters Katherine and Gabrielle.”

Constance Kissinger ’86 and husband Christopher Haga (’86 EDU) had a son, Paul Robert on May 10. They live in Frederick, MD.

Daniel Rembert ’92 <daniel.rembert-1@ksc.nasa.gov> writes “I have had more than my share of changes in the last six months.” He and his wife, Amy, had their second girl—Jordan Marie—on May 4 and then relocated from Pittsburgh to a new job at the Kennedy Space Center, Florida, on the May 12. Rembert is an air quality specialist with Dynamac Corporation and supports the Environmental Programs Office of NASA.

Michael Schlesinger ’90 <michaels@wew.com> writes, “Hello PSU grads/GEMS. Just wanted to say ‘Hi.’ I’m now working the 5:00 and 10:00 pm weathercasts at CBS44 in Evansville, Indiana. So used to doing ‘mornings,’ it’s a new challenge. Drop me a line or email me.”
Herb Stevens '75 lives with his wife Christine Rowader Stevens ('84 BUS/LIB) and children Kelly & Brett in North Kingstown, RI.

Karen Urbanik '77 <kurbanik@mindspring.com> writes, “I have not worked in the meteorology field for 14 years (too busy raising kids). I have done career days at the middle school, taught weather to third graders, and been a merit badge counselor for the weather merit badge. I keep active as a substitute teacher and volunteering in the church, school and town community. Perhaps I’ll get back to the weather business someday.”

Stephanie Walker '98 <wxgirl98@hotmail.com> is working as a broadcast meteorologist at WVTM NBC 13 in Birmingham, AL.

**Mining Engineering**

Craig Adams '00 <cta106_ford@yahoo.com> recently moved to Connellsville, PA. He is a mining engineer for Consol Energy.

Kevin P. Arceneaux '79 is director of environmental affairs for the Louisiana Power & Energy Authority. He, his wife Jan and their nine-year-old son Sean live in Lafayette, LA.

Charles W. Stickler, Jr. '37 writes, “Member of faculty “Mining” about 50 years ago. Now have many children/grandchildren graduates of PSU. Also grandchildren current students at PSU. Major accomplishment—21 grandchildren and great-grandchildren.”

**Petroleum & Natural Gas Engineering**

Frederick L. Converse '43 writes from Gibsonia, PA, “My wife Eleanor Bennett ('46 Ed) died September 24, 2000.”

James Roma '86 is a senior product engineer for B. Braun Medical in Barto, PA. He and his wife Cynthia Sestito ('87 Bus) had a son, Quinton on May 23.

Lt. Col. Christopher R. Zelez '82 is no longer on active duty in the USMC. He graduated in June 1999 from Li Se University in Marietta, GA with a doctorate in chiropractic. “Go state, and have your spine checked monthly by a chiropractor.”

R. Karl Zipf, Jr. '88g, joined Spokane Research Laboratory as branch chief of the Catastrophic Failure Detection and Prevention Branch. In addition to his Ph.D. from Penn State, Zipf received a B.S. in civil engineering from Lehigh University and an M.S. in mining engineering from the University of Arizona.

Zipf is a registered professional engineer in Colorado and an expert in rock mechanics, mining methods and mining safety and health. As branch chief he will be responsible for guiding projects involving “rock bursting” problems in deep underground mines such as those in the Silver Valley of North Idaho.

**Deceased**

Merle L. Billig '51 Ceramics
Donald Broadbelt '34 Metals
John F. Crum, Jr. '44 Metals
Gordon K. Dunsmore '58, '61g Ceramics
Guy Ervin, Jr. '49g Ceramics
Leon J. Gajecki '41 Fuels
Walter H. Glasgow Jr. '36 Mining
David G. Lambert '50 Geosciences
Benjamin Levine '38 Metals
Charles W. McClintock '54 PNGE
George H. Rowe, III '44 Metals
Jude W. Stauffer '85 Ceramics
Lester J. Trout '47 Metals
Robert Winslow '50 Mineral Economics
Nicole Wittenburg-Russe '98 Polymers

2001 EMS Events Calendar

May 17
GEMS Reception
Washington D.C.

May 23
GEMS Reception
Houston, TX

June 1
Traditional Reunion Weekend Luncheon,
Nittany Lion Inn
Assembly Room—Noon

July 14
Arts Festival Breakfast

September 21-22
Obelisk Dinner and Tailgate

November 3
GEMS 10th Anniversary Tailgate

For more information on any of these events, contact the EMS Director of Alumni Relations, Colleen Swetland at gems@ems.psu.edu.
Summer 2000

A total of 61 degrees were granted by the College of Earth and Mineral Sciences at the University's 2000 Summer Commencement in August: 25 bachelor of science degrees, 36 advanced degrees. Following is a list of the advanced degree recipients and titles of their theses or papers.

Fuel Science: Peter Jarod Pappano, M.S., Graphitization Studies of Pennsylvania Anthracites

Geography: Jimmy Omoniyi Adegoke, Ph.D., Satellite-Based Investigation of Land Surface-Climate Interactions in the United States Midwest; Michael Brannan Degennaro, M.S., Mapping with Chorodots: An Examination of Methods and Their Effects on Geographic Data Interpretation; Amy Louise Griffin, M.S., paper, Feeling It Out: The Use of Haptic Visualization for Exploratory Geographical Analysis and Factors Affecting the Performance of Bayesian Inference Network Classifiers; Nathaniel C. Hersh, M.S., Landrace Adaptation and Andean Farming Systems: Specialization of OCA Tuber Varieties in Peru; Jennifer Ann Kluber, M.S., Twentieth Century Vegetation Change in Chiricahua National Monument, Cochise County, Arizona; Kaori Nomura, M.S., Consumption and Transgression: Geographies of Youth Culture in Kobe's New Towns; Chris Francis Ryan, M.S., Local Climate and Global Change: Implications for Climate Change Mitigation; Beth Ann Zeleny, Ph.D., Gendered Space in Afghan Refugee Camps

Geosciences: Peter Giles Burkett, M.S., Ice Fabric and Active Seismology: An Investigation and Interpretation of Central West Antarctica; Shannon Lee Greenan, M.S., Strain Histories from the Eastern Central Range of Taiwan: A Regionally Extensive Change in Shear Dissection; Nathan Petteys Mellott, M.S., Evolution of Surface Roughness with Aqueous Corrosion of Alkali and Alkaline-Earth Aluminosilicate Minerals and Glasses

Materials: Craig Howard Frankel, M.S., Toward the Deposition of Cubic Boron Nitride Thin Films of Functional Thickness; Shanthi Ganesan, M.S., Structure-Property Relationships in High Energy Electron Irradiated P(VDF-TrFe) Copolymers; Pablo Ivan Rovira, Ph.D., Real Time Stokes Vector Spectroscopy and Its Application to the Characterization of Inhomogeneous Thin Films; Jindong Zhang, Ph.D., Miniaturized Flexextnsional Transducers and Arrays

Materials Science and Engineering: Mahmoud Hassan Abd Elhamid, Ph.D., Mechanistic Analysis of the Hydrogen Evolution and Absorption Reactions on Iron; Mustafa Anik, Ph.D., Electrochemical Aspects of the Chemical Mechanical Planarization of Tungsten; Anne Elizabeth Fickinger, M.S., Laboratory-Scale Coking of Coal/Petroleum Mixtures; Ming Guo, M.S., Hydrogenation of Naphthalene Over Noble-Metal Catalysts at Low Temperature in the Presence of Sulfur; Jingyan Shao, M.S., Hydrogenation of 1-Naphthol Over Supported Noble Metal Catalysts for the Production of Jet Fuel Stabilizer; Matthew Edward Stahley, M.S., Glass Substrate and Stoichiometry Effects in Sputter-Deposited Tin Oxide Films; Eric Ray Twiname, M.S., Inductor Materials in Low Temperature Co-fired Ceramic Packaging: Inductors in Integral Substrates; Fan Zhang, M.S., Carbon Deposition on Heated Alloy Surfaces from Thermal Decomposition of Jet Fuel

Mineral Economics: Chunsheng Shang, M.S., Assessing Responses to Electricity Lifeline Disruptions Following an Earthquake in Los Angeles: A Computable General Equilibrium Analysis

Mineral Processing: Andrew Paul Pinkerton, M.S., Evaluation of a Solid-Bowl Centrifuge for Ultrafine Size Separations

Petroleum and Natural Gas Engineering: Gilberto Eduardo Antonini, M.S., Non-Isothermal Compositional Hydrodynamic Modeling of Gas and Condensate Flow in Pipelines; Muge Erdogmus, Ph.D., Development of a Modified Patel-Teja Equation of State; Craig Anthony Graham, M.S., Effect of Wellbore Damage on Productivity of Perforated Completions; Abimbola Abiodun Solaja, M.S., Two-Dimensional Modeling of Transient Flow in Natural Gas Pipelines

Atmospheric Oxidation by Measurements of Hydroxyl and Hydroperoxy Radicals; Urszula Joanna Jambor, M.S., Case Evaluations of NWP Model Ice Clouds by Comparison to Retrieved Ice Cloud Properties Using Arm Data; Joseph Paul Koval, M.S., Computer Training for Entrepreneurial Meteorologists; Trent Louis Schindler, M.S., Synthetic Spectra of Simulated Terrestrial Atmospheres Containing Possible Biomarker Gases; George Tsakralides, M.S., A Climatology of Organized Convection over the Americas, the Atlantic Ocean, the Pacific Ocean, the Indian Ocean and South Asia

Meteorology: David Lee D'Arcangelo, M.S., Forecasting the Onset of Cloud-Ground Lightning Using Layered Vertically Integrated Liquid Water; Ian Christopher Falona, Ph.D., A Study of
Fall 2000

A total of 104 degrees were granted by the College of Earth and Mineral Sciences at the University’s 2000 Fall Commencement in December: 74 bachelor of science degrees, 30 advanced degrees. Following is a list of the advanced degree recipients and titles of their theses or papers.

Fuel Science: Peter Lawrence Rozelle, Ph.D., *The Effect of Fuel and Sorbent Properties on their Partitioning between the Flyash and Bottom Ash Streams in Fluidized Bed Combustion*

Geography: Laura Geller, Ph.D., *A Social Geography of the Battered-Women’s Movement*

Geosciences: Erin Mary Griggs, M.S., *The Fate of Wastewater-Derived Nitrate in the Subsurface of the Florida Keys: Key Colony Beach, Florida; Chris Anthony Guzofski, M.S., *Thermal-Petrologic Response of the Northern California Crust to Triple Junction Migration; Jeffrey Scott Marshall, Ph.D., Active Tectonics and Quaternary Landscape Evolution Across the Western Panama Block, Costa Rica, Central America; Thomas David Olszewski, Ph.D., Testing for a Relationship between Paleocommunity Recurrence and Taxonomic Turnover Using a Sequence Stratigraphic Framework; Byron Richard Parizek, M.S., Thermomechanical Flowline Model for Studying the Interactions between Ice Sheets and the Global Climate System; Michael A. Scanlin, Ph.D., A New Tectonic Model for the Appalachian Plateau Detachment Sheet of Southwestern Pennsylvania*


Meteorology: Benjamin Adams Cash, Ph.D., *Dynamical Processes of Low-Frequency Anomalies; Jan Frederik Dutton, Ph.D., Regional Simulation of North American Interannual Climate Variability; Drew Michael Jackson, M.S., paper option, Survey of Penn State Meteorology Program for Post-Graduates Specializing in Weather Communications and/or Weather Forecasting; Patrick Andrew Jones, M.S., *A Mixed Layer Model of the Quiescent Dryline; Hyun-Kyung Kim, Ph.D., The Role of Baroclinic Waves in the Zonal Mean General Circulation*

Mineral Economics: Xiaoyan Cao, M.S., *Forecasting Daily Electricity Prices in Deregulated Electricity Markets*

Mineral Processing: Shawn William Musselman, M.S., *Molecular Structure–Property Relations for Controlling Wetting and Dispersion; Michael Leigh Turek, M.S., *The Effects of Ultrasonic Treatment on Dense-Medium Cycloning of Fine Coal Refuse*

Petroleum and Natural Gas Engineering: Ronaldo Vicente, Ph.D., *A Numerical Model Coupling Reservoir and Horizontal Well Flow Dynamics*

Requests to borrow theses may be made through the borrower’s community, company, or University library. Libraries should address requests to: Interlibrary Loan Service, Pattee Library, The Pennsylvania State University, University Park, PA 16802.
College Alumni Society Celebrates 10th Anniversary in 2001

The EMS Alumni Society, GEMS, is celebrating its 10th Anniversary in 2001. So mark your calendars because the GEMS Board of Directors is hosting a special 10th Anniversary Tailgate for all EMS alumni and their families on Homecoming Weekend—that’s November 3, 2001.

The College has reserved the Ag Arena (across Park Avenue from the new Visitor Information Center and Beaver Stadium) for a day-long event beginning two hours before game time. Tailgate food and famous Penn State Creamery ice cream, a big screen TV to watch the game indoors for those without game tickets, and postgame activities are all on the agenda.

For more information on the 10th Anniversary Tailgate, check out the GEMS Web site at www.ems.psu.edu/GEMS/ or send e-mail after August 1 to gems@ems.psu.edu for specific details about the event.