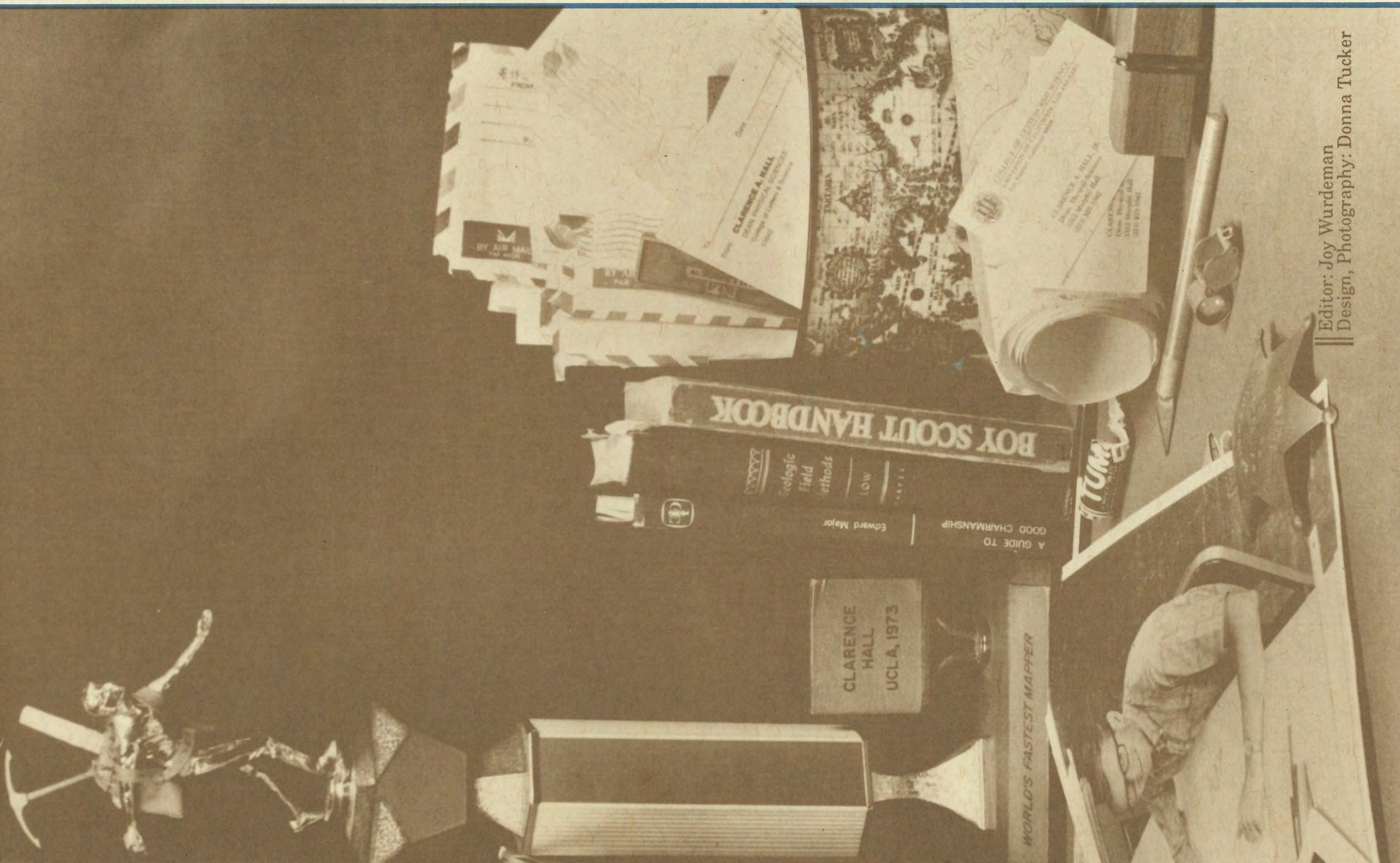
Alumni *November 1993*

NEWSLETTER

EARTH & SPACE SCIENCES, UCLA



Editor: Joy Wurdeman
Design, Photography: Donna Tucker

letter from the chair

It was good to meet some of you at our faculty lecture in February, where faculty and friends gathered to hear Jon Davidson speak on "Volcanic Hazards and Hopes." Jon and the rest of the geochemistry group are now in geochemical heaven with the arrival of the new SHRIMP (Super High Resolution Ion Micro Probe) from CAMECA, Paris. According to Kevin McKeegan, it can measure the compositional variation across a rock at sub-micron resolution. Also, it is the only one of its kind in the USA.

Latest news from the Southern California Earthquake Center is that we are now wired for earthquakes. On the third floor of the Geology Building, opposite the elevator, the Earthquake Center has set up a video screen that plots on a map epicenters of Southern California earthquakes a minute or two after they occur. It is linked into the USGS and Caltech seismic arrays of some 200 stations which measure the waves, locate the earthquakes and broadcast the locations on the PacTel system. You are invited to come in and view it. Since waves travel at 3 km/s some hope that an accelerated version will give real-time warning of approaching waves for locations ~50 km distant from the event.

As mentioned in last year's Newsletter, the Galileo spacecraft flew by the asteroid Gaspra on its way back to Earth for its second flyby last December. That was the first flyby of an asteroid by a spacecraft, and the magnetometer team speculates that the 14 km potato-shaped body has a magnetic field and magnetospheric system in its vicinity. That finding is going to be important in deciphering how strong the magnetic field was in the solar system at the time of formation, why Earth is the only terrestrial planet with a sizeable magnetic field and why meteorites from the asteroid belt are strongly magnetized. Data from another asteroid flyby in August 1993 are still being analyzed.

The Department is hosting a Rubey Colloquium on the Tectonic Evolution of Asia on February 25-27, 1994. Among other topics which will be presented by an international group of experts in the field, An Yin and Mark Harrison will be reporting on their discovery of a new major thrust fault in the Gangdese Mountains in Tibet.

The alumni weekend is scheduled for November 19-21. It will begin on Friday night with a retirement dinner for Clarence Hall, who officially finished his ten-year stint as Dean of Physical Sciences in July. Saturday is the UCLA/USC game at the Coliseum; we will have 30 tickets available at $35 each, including transportation and picnic lunch. Sunday, Ray Ingersoll will lead a field trip following the Los Angeles Aqueduct across the Transverse Ranges.

In May we had a retirement party for Ian Kaplan and Bill Kaula, both of whom donated their cash gifts to the Geology-Geophysics library. Ian Kaplan was also given an immersion device to make his travels more convenient, while Bill Kaula received a CD of Verdi's famous choruses and a book Margy Kivelson had borrowed some time ago.

We're still trying for an endowed chair, so suggestions and support will be appreciated, as always. The state budget worsens, but wewill not discourage your attendance at events by constantly begging for dollars.

Your Department continues to excel. We now have 75 undergraduate majors and 77 graduate students. This year 10 new graduate students joined the Department. Congratulations go to Ian Kaplan on receiving the Alfred Treibs Medal of the Geochemical Society of GSA. The faculty go from strength to strength in obtaining record instructor evaluations from the students as well as in raising grants and publishing fascinating findings. Drop by and visit.

Warmest regards,

Paul

Paul Davis,
Chairman

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The annual Staff/ Faculty Dinner, held at the Bistro of Santa Monica on May 21, honored Ian Kaplan and Bill Kaula.

Bill Kaula and Paul Davis

Ian Kaplan and Bill Schopf

SUMMER FIELD, 1993, was held in the Sierra west of Bishop under the leadership of Professor Ted Reed and TAs George Hathaway and Kim Holland. This year's crew is the fourth to participate in the mapping of the plutonics and metamorphics of this intriguing region. Camp moved this season from the south fork of Bishop Creek northeast to Coyote Ridge and lasted nearly two and a half months, a long time, TA Holland notes, to go with only weekly showers! The rigors of camp were more than offset by the satisfaction of honing mapping skills and contributing to original research.

Michael Fiore as lightning rod on August 4th, 1993, northeast of Brackett Prospect.

Long Lake, June 30, 1993. Steve Diem, Katey Schuyler, David Sarkisian, Gavin Chan, Caroline Carter, Laura Webb, Stephanie Sibbett, Emil Mirzakhanian, and Ted Reed were present; the latter few are not visible here.

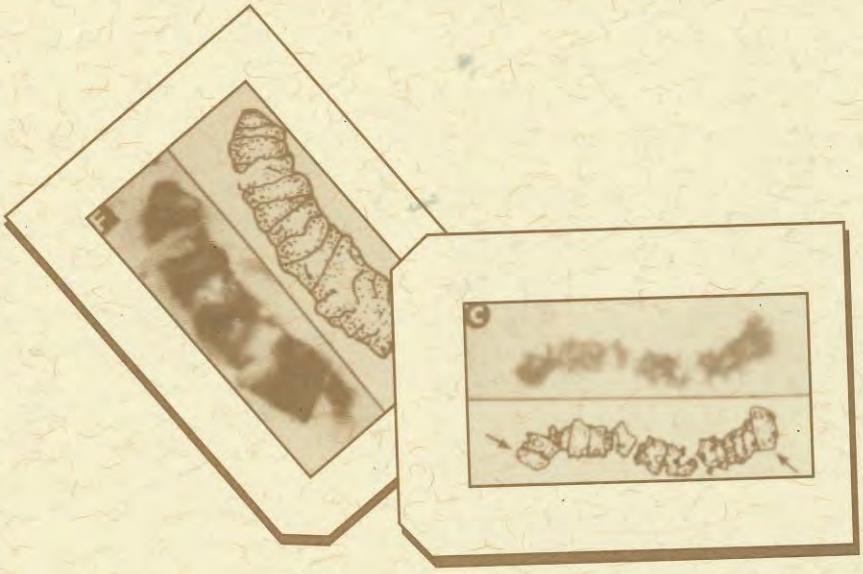
Summer Field photos by Jennifer J. Hulbert

The following article by John Horgan appeared in *Scientific American,* August 1993:

Off to an Early Start . . .

Determining when and how life began is maddeningly difficult. Erosion, volcanism and the ceaseless churning of tectonic plates have obliterated virtually all traces of the Earth's early history. Only by analyzing meteors, which presumably coalesced at the same time as the Earth, have investigators determined that the age of the planet itself is roughly 4.5 billion years.

This situation makes a recent report in *Science* by J. William Schopf of the University of California at Los Angeles, an authority on early life, all the more remarkable. Schopf presents fossils suggesting that microorganisms not only existed but had achieved a significant degree of complexity at least 3.465 billion years ago. The finding narrows the window of opportunity during which mere matter could become animate. It also lends support to a surprising scenario involving the formation of the modern atmosphere and of vast deposits of iron ore laid down billions of years ago.



Schopf's evidence consists of minute, filamentous impressions left by microbes in sedimentary rock from northwestern Australia. The age of the rocks was established by measuring the degree of radioactive decay in their constituent elements. "Life was flourishing back then," Schopf says.

The fossil microbes, which measure one to 20 microns wide and up to 90 microns long, were linked together like beads on a string [see illustrations above]. Based on variations in the size and shape of the individual cells — and particularly the cells capping the filaments — Schopf has identified at least 11 separate species. By comparing the fossils with modern prokaryotic organisms, he has concluded that a majority were probably cyanobacteria. Also called blue-green algae, they convert sunlight into energy through photosynthesis and excrete oxygen in the process.

Various workers, including Schopf himself, have previously reported finding fossils of individual microorganisms and of dense microbial colonies, known as stromatolites, more than three billion years old. Skeptics worried that the alleged fossils may have been improperly dated or even created by non-biological processes. Schopf thinks his new results should put these doubts to rest. "This is very firm," he remarks. "It is the sort of thing that can get into the textbooks and stay there."

Schopf maintains that his data still allow plenty of time for rudimentary life forms to develop. By studying craters on the moon, geologists have determined that the earth was bombarded by asteroids for hundreds of million of years. Investigators believe these impacts may have rendered the earth uninhabitable until at least 3.9 million years ago.

Some reports have even indicated that, given the time required for mere matter to assemble itself into life, the first organisms must have arrived on the earth from elsewhere — that is, from outer space. Schopf rejects this theory. "Four hundred million years is still 400 million years," he says. After all, he notes, the past 400 million years encompass virtually the entire history of vertebrates, including amphibians, dinosaurs, mammals and *Homo sapiens*.

One person delighted by Schopf's results is Kenneth M. Towe, a paleobiologist at the Smithsonian Institution. For years, Towe had argued--based primarily on geologic data--that cyanobacteria caused oxygen to build up in the atmosphere not just two billion years ago, as conventional wisdom has it, but at least 3.5 billion years ago. Towe also suggests that the oxygen in the atmosphere combined with iron in the oceans to form iron oxide, or rust, that eventually settled on the sea floor. This process created iron ore deposits, called banded iron formations, that are found throughout the world.

But another recent paper supports a different scenario. A group led by Friedrich Widdel of the Max Planck Institute for Marine Biology in Bremen has discovered a type of bacteria that employs an unusual type of photosynthesis, which generates iron oxides rather than oxygen as a waste product. Widdel's group speculates in *Nature* that these organisms could have formed the banded iron formations without injecting oxygen into the atmosphere.

On the other hand, the iron deposits may have formed without any help from bacteria, according to James F. Kasting, a paleogeologist at Pennsylvania State University. Ultraviolet radiation, Kasting explains, could have knocked oxygen molecules free from water molecules; the oxygen would then have immediately reacted with iron in the oceans to form iron oxides and thus rust-laden sediments.

Unfortunately, Kasting observes, there are not enough data to prove--or rule out--any of these theories. When it comes to the origin and early evolution of life, some mysteries seem as intractable as ever. ∞

. . . and Off to Hawaii

by Undergraduate Julie J. Norris

This spring, the field geophysics class (ESS 136C) decided to tackle an erupting volcano for their class field trip. Gathering together two magnetometers, two E-field meters, a three-component seismometer, three gas masks, and Professor Paul Davis, the students em-

barked on a nine-day adventure in geophysicist's paradise (normally referred to as the Big Island of Hawaii). Other equipment and adventures unknown awaited the group on Kilauea volcano.

The goal of the field trip and the class in general was to perform an integrated geophysical study of one region. An active volcano is the ideal location for such a study because of the molten lava. Liquid, flowing rock produces large contrasts in electrical and magnetic properties. This is important because most geophysical work is based on minor differences in material properties of rocks. Mother Nature, however, didn't make it easy on the students in the end.

Our first adventure began at LAX, where airport security personnel were very concerned by the three metal cylinders (seismometers) in Mark Benthien's carryon bag. Fortunately, we were able to proceed. The seemingly longest hike of the trip was at Honolulu International Airport as we attempted to find the inter island terminal for our short hop to Hawaii from Oahu.

While at Kilauea, we stayed at the Magma House, a National Park facility for researchers located at approximately 4,000 feet and less than a mile from Kilauea crater. It rained every day that we were there, giving credence to the fact that Hilo receives over 300 inches of rain each year. The resulting thick rain forest of Kilauea's flank is a few steps from the building.

The next day, we saw Kilauea crater for the first time (everyone except Prof. Davis, who did his Ph.D. work on Hawaii). The desolate crater was like a different planet — rough black basalt stretched for miles, and sulfur smoke escaped from cracks. Meeting us were scientists from the Hawaii Volcano Observatory (HVO), with whose guidance we were later allowed to make observations on the month-old and still flowing Lae Apuki lava flow in Kamoamoa Bay. We spent the remainder of the day constructing wood frames to hold experimental static electric field meters, making magnetic measurements on the crater edge, and experimenting with the E-field meters.

The trip onto the lava flow the following day was probably the most exciting and frightening hike I have ever taken or will take in my entire life. Guided by three scientists from HVO, we proceeded past barriers and warning signs threatening arrest to unauthorized persons caught beyond. We wore long sleeves and gloves against the possibility of slipping on the razor-sharp, gnarled and cracked, solidified lava. The lava had flowed down the fault scarp of the east rift zone from the erupting vent, Pu'u O'o, over the pali (cliff), and proceeded to the Pacific Ocean, enlarging the island of Hawaii. Flowing lava has no respect for man's works - the flow covered Rim of Craters Road, an ancient Hawaiian village, and even filled in a small bay. Although most of the original flow had solidified, molten lava was still flowing out to the sea through a series of lava tubes. We climbed up the pali on the roof of the main lava tube as it flowed over the cliff because it was the easiest way up.

Lae Apuki lava flow, southern skylight, April 26, 1993

When we reached the first "skylight," I forgot all my fear. The roof of the lava tube had fallen in, and one side of the caved-in portion glowed an eerie, bright red-orange. Gases escaped from cracks in the side of the lava tube. The solid sides of the tube were also red hot from the fresh lava, so we could not differentiate the sides of the tube from the flowing magma. At a skylight further north, we tossed small chunks of basalt into the skylight to allow our eyes to focus on something and thus see the flowing lava.

April 27, Julie Norris measuring electric field

Our major field area was located at a second skylight farther to the northwest. One of the scientists from HVO had already taken measurements along a profile roughly perpendicular to the lava tube. Over the next several days, the class took measurements on this profile and on others to the north with a VLF (Very Low Frequency) meter, a magnetometer, and an E-field meter. We gathered other data using an EM31 resistivity meter on the lava delta below the pali.

One afternoon we took a break from the lava flow and went to gather magnetic data from an ancient magmatic cone that was thought to have been a direct conduit from the mantle. The result was a small cove with a green (olivine) sand beach about a 45-minute hike from the southern tip of Hawaii (Southpoint). After investigating surface wave action on the members of the class (body surfing), the group hiked out of the cone, running a magnetometer survey up the cliff and onto its buried flanks.

The field trip concluded with a measurement of the Earth's electric field on the top of 13,000-foot Mauna Kea, which is the location of numerous observatories. Unlike her sister, Mauna Loa, Mauna Kea has been dormant for over 4,000 years. The summit of the volcano is dry and barren, with red volcanic dust reaching down to the clouds, which form a skirt around the mountain.

This trip offered unparalleled opportunities to experience Mother Nature in all her wonder and variety. Whether it be the formation of new rock from 1100° C magma, the thick tropical jungle of Kilauea's flanks, the barren peak of Mauna Kea, the balmy calm of Kona, or the rain of Hilo, Hawaii is unique and wonderful, the experience of a lifetime. ∞

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Ten students received Outstanding Student Paper awards for Solar Physics and Aeronomy Section papers they presented in December 1992 at AGU's Fall Meeting in San Francisco. Of these, six were from UCLA, among them our own

Ming Cao
Gregory Crawford
Max Hammond

Ming and Max have since received their PhDs and Greg will file his dissertation shortly.

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*Joseph Murdoch (1890-1973) was a UCLA faculty member in Mineralogy from 1928 to 1959. A graduate of Harvard University, Professor Murdoch joined the recently formed Department of Geology at UCLA, where he conducted mineralogic studies, most notably of the classic mineral locality at Crestmore, California. Professor Murdoch was the author of numerous scientific papers and several books, including "Microscopic Determination of the Opaque Minerals," and "Minerals of California."

Degrees Awarded

Graduates, June 1993

Bachelor of Science

Douglas J. F. Andrews ..... Engr. Geology
Deborah Jean Demoff ..... Geology
Rachel A. Ellisor ..... Geology
Janet Ann Graff ..... Geology
Henry Toshiro Ishigame ..... Geology
Joseph Nuku Mafi ..... Geophysics
Karen Valerie Mitchell ..... Geology
Clifford Jay Nale ..... Engr. Geology
Ashwin Ravindra Vasavada ..... Geophysics
Sean Damian Wilson ..... Geology
Christopher Wong ..... Geology

Master of Science

Jennifer Ellen Bachman — *Correlations Between Quad-Polarized Radar and Forest Biomass* (Professor Paige) Geology

Adrienne Momilani Ono — (By Comprehensive Examination) Geophysics and Space Physics

Doctor of Philosophy

Ming Cao — *On the ULF Waves in the Earth's Dayside Magnetosphere* (Professor McPherron)

Sergio A. Cordero — *Convection in a Rotating Hemispheric Fluid Shell: An Experimental Study* (Professor Busse)

Francis Keoki Chun — *A Statistical Study of Field-Aligned Currents in the Earth's Inner Magnetosphere* (Professor Russell)

Hyunchae Cynn — *Effects of Cation Disordering in $MgAl_2O_4$ Spinel on the Rectangular Parellelepiped Resonance and Raman Measurements of Vibrational Spectra* (Professor Anderson)

Kathleen Ann Devaney — *Provenance Evolution of Upper Paleozoic Sandstones of North-Central New Mexico* (Professor Ingersoll)

Todd Feeley — *Volcan Ollague: Volcanology, Petrology, and Geochemistry of a Major Quaternary Volcanic Center in the Central Andes* (Professor Davidson)

Carl Max Hammond, Jr. — *Planetary Magnetotails: Magnetic Configuration and Nonthermal Plasma* (Professor Kivelson)

Jamshid Hassanzadeh — *Metallogenic and Tectonomagmatic Events in the SE Sector of the Cenozoic Active Continental Margin of Central Iran (Shahr e Babak Area)* (Professors Davidson and Wasson)

Matthew Heizler — *Case History Application of $^{40}Ar/^{39}Ar$ Thermochronology* (Professor Harrison)

Changming Ho — *Plasma Waves in the Nightside Ionosphere of Venus* (Professor Russell)

Linda Joyce Horn — *Wave Structure in Planetary Rings* (Professor Russell)

David VanDyke Kemp — *A Model for the Subduction Mechanics of Flexible Lithosphere and Its Viscous Coupling to the Mantle Using Power-Law Rheologies* (Professor Bird)

Toby Brian Moore — *Micropaleontology of the Early Proterozoic Gunflint Formation* (Professor Schopf)

David James Szumigala — *Gold Mineralization Related to Cretaceous-Tertiary Magmatism in the Kuskokwim Mountains of West-Central and Southwestern Alaska* (Professor Reid)

The 1992 Tibetan Expedition: The Gangdese Thrust

冈 地 斯 逆 断 层

by Professors Mark Harrison and An Yin

Although invested by both eastern and western literature with great mystic allure and home to the most spectacular scenery on Earth, the Himalayan Range and Tibetan Plateau tend to be taken for granted by geologists. Our awareness of the many ancient orogens, coupled with uniformitarian values, suggests that regions elevated to this extent should be the rule rather than the exception throughout geological time. However, even now as the collision of India with Eurasia that began 50 million years ago creeps through middle age, it is still the most substantial occurrence of doubly thickened crust in the last quarter of Earth history. We are fortunate to be able to examine the active Indo-Eurasian collision zone as it is quite possible that the spectacle we enjoy today has only occurred on this planet four or five time over the past 4.5 billion years.

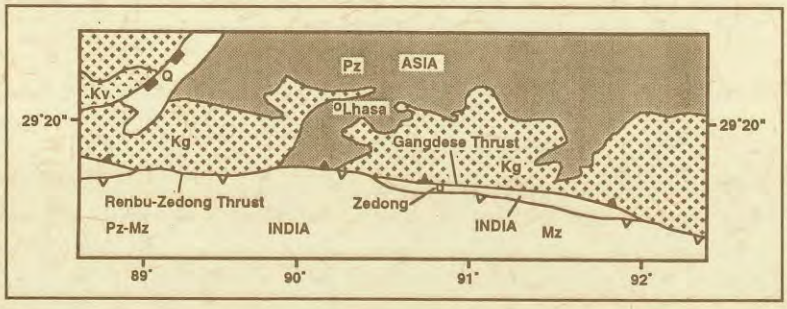
Potala Palace in Lhasa

Because India has been essentially unscathed by deformation related to continental impact, most attention has focused on explaining how Eurasia alone accommodated their convergence. Mechanisms proposed for this include strike-slip faulting (so-called extrusion tectonics), crustal thickening by thrusting, or (as we favor) a combination of the two, but varying in time and space during the protracted collision (see Harrison *et al.*, *Science* 255, 1663, 1992). The component of convergence that has gone into thickening Tibet has been related to underthrusting India beneath Asia, injection of India into the Tibetan lower crust, and horizontal shortening by folds and thrusts that are distributed through the collision zone. Although it has long been appreciated that a portion of this convergence has been accommodated by the major intra-continental thrusts in the Himalaya (for example, the great Main Central thrust in Nepal), no similar syn-collisional thrusts have previously been reported from southern Tibet. Several geologic relationships (in particular the juxtaposition of Indian continental-margin deposits against the Andean-type Gangdese batholith of Eurasia) suggested to us that a south-directed thrust system must also have operated throughout this region. During field studies conducted with Dr. F.J. Ryerson (Lawrence Livermore National Laboratory) during the summer of 1992, we were able not only to confirm the existence of this feature but explain its latter-day detection as well.

Over the course of a month-long field trip, we discovered two major thrust systems: the south-directed Gangdese system and the younger north-directed Renbu-Zedong thrust system. In south-central Tibet, the Gangdese thrust juxtaposes forearc deposits of Asian affinity over Indian continental shelf deposits, whereas in south-eastern Tibet, near the town of Zedong, the fault justaposes the Gangdese batholith on top of those same shelf sediments. One hundred and fifty kilometers east of Lhasa, capital of Tibet, the Gangdese thrust is marked by a thick mylonitic shear zone. The younger Renbu-Zedong fault is observed in one location to overthrust unconsolidated sediments, suggesting that it may still be active. In many locations this fault obscures the trace of the Gangdese thrust, explaining why it has not been encountered during earlier geological surveys. It is only east of Zedong, a region not visited by previous French, British and American expeditions, that we discovered the thrust unambiguously exposed.

The timing of crustal-scale thrusting in the Himalaya has been rather poorly known. $^{40}Ar/^{39}Ar$ thermochronology constrains the timing of movement on the Gangdese thrust to be between 27 and 24 million years, with an average slip rate of 20±10 mm/yr. A displacement on the fault of 60 km is indicated from the length scale of rocks to the north uplifted as a consequence of thrusting. We had earlier observed evidence of Early Miocene rapid cooling in this region and now believe it to reflect rapid erosion that followed crustal thickening and consequent uplift at these locations. Because the sequence of thrust development on the southern edge of the collision zone has been younging toward India (*i.e.*, subsequent thrusts break progressively southward), the age of the Gangdese thrust provides an upper limit of 24 Ma for the initiation of movement on the Main Central thrust. This is consistent with our earlier measurements indicating that thrusting was in progress at 20.9±0.3 Ma, and with the 24 Ma age of the oldest granite thought to have formed as a consequence of thrust-induced heating.

Recognition of the Gangdese thrust puts another piece in the very large puzzle of Indo-Eurasian tectonics into place. Although we now better understand how southern Asia responded to the collision during the Early Miocene, a great deal remains to be learned. It is with a view to assessing the current status of knowledge that we devote the 1994 Rubey Colloquium to the question of "The Tectonic Evolution of Asia." Leading experts on Asian tectonics from around the world will gather at UCLA the weekend of February 26-27, 1994, to discuss cutting edge issues with our undergraduate students. Alumni are more than welcome to attend, and we encourage those interested to contact Donna Tucker at (310) 825-3880 for further details.



Resolution at New Years

by Professor Craig Manning

For the last time in 1992, the sun dropped toward the purple-blue Pacific. We collected on the starboard bow of the *JOIDES Resolution*, a surplus drill ship fitted out for a year-round program of scientific drilling of the ocean crust. Sharks chased silvery tuna, mahi mahi cavorted, and a flock of frigate birds sheared upwind. As the sun slid beneath the horizon, we saw the famous green flash of the equatorial sunset. We needed this New Year's omen: we had made only 150 meters of hole in five weeks, and it was now caving in. The drillers and roustabouts struggled to keep the drill string and bit from binding in the hole 3000 meters beneath us. Twelve hours on, twelve hours off, we'd worked through Thanksgiving and Christmas, and now we would greet the new year with a midnight shift change.

I signed on for the Ocean Drilling Program's Leg 147 to Hess Deep (about 1000 km WNW of the Galapagos Islands) because of my interests in the deep root zones of oceanic hydrothermal systems. At mid-ocean ridges, hot water vents from the sea floor in dramatic gushers called black smokers. These hot springs are probably quite common, and they play a fundamental role in the chemistry of sea water and the oceanic lithosphere. But the waters issuing at the sea floor actually acquire their high temperature and distinct chemistry several kilometers below, where they flow through cracks in recently crystallized dikes and gabbros. Because temperatures at these depths are so hot that drill bits melt, obtaining samples of active systems from these levels is impossible. Our objective in Leg 147 was to take advantage of some complex faulting that exposes young gabbros and peridotites — the deep parts of the oceanic crust and mantle. My hope was that these rocks would show mineralogic and chemical evidence for the passage of the hot waters that we see making black smokers at ridges. By studying the preserved results of water migration, we can infer much about the conditions that exist in active systems today.

The drilling operation is designed to bring a long core of rock up to the ship for scientific study. Drill pipe is extended from the derrick through a hole in the middle of the ship through the water to the sea floor. A hollow drill bit slowly turns and grinds, eroding rock around a one-inch cylinder. The cylinder passes into a catcher inside the drill string in pieces and the catcher is retrieved at intervals using a cable. While drilling, the ship is continuously positioned over the hole with thrusters; their thrumming makes for fitful sleep. Drilling anywhere is hard work; at sea, the swell makes for unsure footing. Stocky roustabouts move over the drill floor with short, choppy steps, ready to fend off or snag an errant pipe.

The drill crew hailed from Newfoundland, Scotland, France, the Philippines, and Texas. We arrived at our site in late November and began drilling at a carefully planned spot. As several shallow test holes showed us we were on target, we started our main hole with great anticipation. After about 12 hours of slow drilling, we retrieved our first samples. It was immediately clear that these gabbros contained abundant secondary minerals that are the hallmark of interaction with hot water. In the next several weeks, steady downward progress revealed complex patterns of flow channels and evidence for unexpectedly high water temperatures. I wasn't alone in my enthusiasm. We were drilling through the top of a cooled mid-ocean ridge magma chamber — the first time this had been done in the Pacific. Each new core contained exciting samples for everyone.

But signs of trouble appeared just before Christmas. First a drill bit broke off. When it was finally extracted, we realized that about 25 meters of loose rock had collapsed into the bottom of the hole. We slowly drilled through it, and on New Year's Eve were poised to get back into bedrock. This was ODP's first attempt to drill lower crust and mantle. We worried that a failure would sour enthusiasm for this risky project.

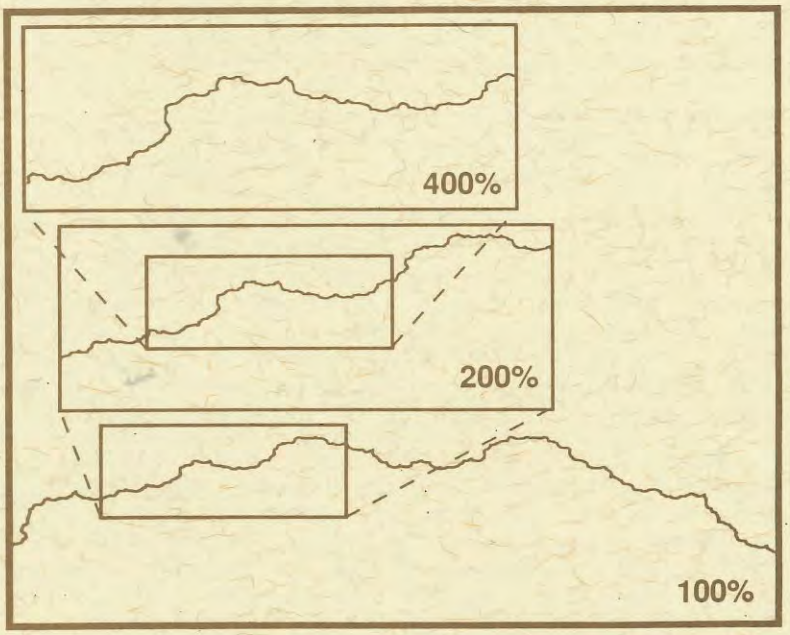
Our shift woke up January first to bad news. Another bit had been lost during the night and it appeared that more caving in had trapped the string. Eventually, it was removed, but the conditions were clearly too risky for more drilling. We had only three weeks before our scheduled return to Panama City. It was unlikely that we could drill any deeper into a new hole in the remaining time, so we decided to try drilling some peridotites in a nearby fault block. They were not our primary objective, but they comprise a large fraction of the oceanic lithosphere and had never been drilled in the Pacific. We moved ten kilometers east and drilled six shallow holes (rather than attempting one deep hole). To our surprise, the variations in rock types from hole to hole showed that the upper mantle is remarkably heterogeneous. We also discovered channels through which mid-ocean ridge magmas rose on their ascent to magma chambers at the ridge axis. These observations provided the first picture of the upper mantle beneath the eastern Pacific Ocean, a welcome piece of good fortune that probably figured in no one's resolutions on New Year's Eve.

Chaos in the Earth and Space Sciences

by Professor William I. Newman

Chaos, although not quite a household word, currently enjoys considerable notoriety in the scientific community. Unknown to many, the history of the subject is deeply rooted in the earth and space sciences. Commonly defined as "A condition or place of great disorder or confusion," chaos has come to mean the sensitivity of a system (and its behavior) to its initial state. The notion first emerged in the context of the orbits of celestial bodies—suppose, for example, we calculate exactly the trajectory of each of the planets around the sun as they travel under their mutual gravitational attraction. Suppose, now, we redo the calculation where we "nudge" the starting position or speed of the sun or one of the planets by a very small amount, say one millimeter. We say that the situation is chaotic if the recalculated orbits begin to diverge from the earlier calculation at an exponential pace. The hallmark of chaos, then, is that any uncertainty that might exist in the system grows very rapidly and ultimately prevents our making any reasoned prediction of its behavior. A useful metaphor for chaos suggested by Robert M. May, a theoretical physicist and biologist at Oxford, is that the fluttering of a butterfly's wings could alter the weather later in time! Although the weather is chaotic, this does not preclude making short-term predictions.

Almost all complex systems in the earth and space sciences satisfy the mathematical definition of chaos and, therefore, introduce stringent limitations on our ability to make even qualitative long-term predictions—but this need not mean that chaotic systems do not contain some measure of order. Our solar system may be from a technical standpoint chaotic (this remains a controversial issue), but that does not mean that the planet Uranus will be whizzing by the Earth in the foreseeable future or that Jupiter will depart for the next galaxy. A system can be chaotic and yet remain stable—for example, when we look at the Great Red Spot on Jupiter, the behavior of individual gas molecules almost certainly is chaotic, yet the pattern presented by this Jovian weather phenomenon has remained fundamentally unchanged since Galileo first used a telescope. Chaos, therefore, can present pattern, often of a very intricate sort. For example, consider convection in the Earth's mantle or of a pot on a stove due to heating from below. As we turn up the heat, convection sets in, producing a convective roll and, as the temperature continues to increase, the roll breaks down into multiple rolls, which further break down into multiple rolls, and so on. This route to turbulent behavior gives rise to a form of pattern where what we see on one scale is statistically similar to all other scales where the physical processes remain unchanged.



Computer-generated outline of a cloud with a fractal dimension of 2.07 corresponding to observed geometrical properties of terrestrial cumulus clouds. Insets are magnified versions of selected regions, and reveal underlying self-similarity of fractal structure--each successively magnified image has the same texture or statistical properties as the former. The observed geometry is the outcome of turbulent convective processes taking place in the cloud itself and could have a significant influence on radiative energy transfer in the Greenhouse Effect.

This is the essence of *fractal* behavior, which is often produced by chaotic dynamics. In geomorphology, we see that topography in many circumstances has this fractal flavor; what we see on one scale is mirrored on other scales. (This, of course, breaks down when we start to look on scales smaller than a grain or larger than tectonic or gravitational scales as well as when different erosional processes take place, etc.) This scaling property has enabled mathematicians to render pictorially images of the Earth's surfaces that are amazingly realistic (within the limitations above). The texture of earth materials is an indication that conventional ideas of geometrical dimension are inadequate—a real surface is more complicated than an ideal 2-dimensional surface, yet it is not a "solid," so we say that it has a fractal dimension between 2 and 3. This "order within chaos" then allows us to extract substantial information from a seemingly random system; but our ability to fully utilize this information or to model the underlying rock physics remains a distant goal. So, chaos need not be without some redeeming order, but is there any hope to working with chaotic systems?

The answer is a measured yes. Earthquakes, for example, are the signature of mantle convection, a chaotic process in their own right, and the interaction of complex fault geometry, which we now know to be fractal. Uncertainties in measurement (as well as in our knowledge of rock physics and other factors) are fundamental obstacles to long-term prediction. But chaotic behavior does not exclude short-term prediction—indeed, the presence of order within chaos presents a sublime challenge. Short-term weather prediction today is highly meaningful, while reliable long-term forecasts will always remain elusive. As we master the signature of chaos in the solid earth, we will be better able to decipher its clues to its dynamical evolution. In the not-too-distant future, we may be able to do for earthquakes what we do today for the weather. ∞

In Memoriam

Reprinted from *The AAPG Bulletin*, v. 76, No. 9 (September 1992), P. 1443-1447, by Richard Hester ('49):

JAMES BURT ANDERSON (1912-1991), a proud American product of well-tempered Scot and Canadian ancestry, was born in Wilton, North Dakota, on August 20, 1912, the son of recent immigrants. The family moved to California in 1924, at first to Eagle Rock, then to Glendale in 1926. James grew to bring to our profession a lucid and inquiring mind aroused by a formidable education in geology. He attended Glendale schools, working in a machine shop and as a mechanic to help pay expenses. He was introduced to the earth sciences when he fell under the spell of a mentor at Glendale College, Clement D. Meserve, in the early 1930s.

At UCLA, Jim studied geology under Drs. Soper, Whitman, Grant and Miller. He graduated in 1937 with a B.A. degree. At this particular time, other geologists were emerging from the world's universities, and these students eventually shared a giant task of creating the earth's early original geologic field and subsurface mapping, worldwide in general and California in particular, and Jim was smack in the middle of the pack. After graduation, he met his future brother-in-law on the ski slopes, meeting Bill's sister later. He and Virginia Sallada were married on December 12, 1941.

Jim first worked for Barnsdall Oil Company from 1937 to 1940 as a field geologist, and then was employed by Continental Oil until World War II, where he served in the army from 1942-1945. After the war, Jim returned to Continental Oil and spent enjoyable years mapping Nevada. With Continental, he rose in the ranks from field to division and then to regional geologist, working such additional areas as the Gulf Coast, San Joaquin Valley, Coast Ranges, Utah, Wyoming, offshore California, and the state of Washington. In 1954 he became senior geologist for Kern Oil, and in 1956, joined the staff of E.W. Pauley, operator, as senior geologist. For Pauley, Jim worked in such diverse areas as the Middle East, Jordan, Mexico, and more of offshore California, while dabbling with Texas, New Mexico, the Rockies, and the Gulf Coast.

My years with Jim began in 1959 when, as chief geologist for Pauley Petroleum, Inc., he came looking for someone to be his assistant. We worked closely for the ensuing 11 years, during which time he moved up to manager of exploration and then vice president; upon retiring, he became a consultant. Our close and delightful association lasted throughout his remaining years. As UCLA graduates, we both took pride in the fact that we had had a major hand in successful exploration efforts that eventually would fund the building of Pauley Pavilion at UCLA and Lawrence Hall at Berkeley.

James Anderson

As a reminder of his basic equanimity, Jim, as a member of the AAPG Professional Advisory Committee, was on an advisory board at the University of Southern California, which aided in the successful and rapid growth of their geology department. In later years, Jim also worked with Ogle Petroleum and Hondo Oil and Gas Company, active into his very last months.

Those of us who worked with Jim thought he was a neat guy who had more nicknames than any other person we knew. We began to suspect that the real clue to the value of a man may well rest in the richness and variety of terms of endearment his co-workers and friends use for him. Jim didn't care for "Andy," but delighted in "JB," "JBA," "Jimmie," "James," or "James B," "Don Jaime" or "Don Diego," and "Hoot Mon," and especially "McAnderson." His talent for corporate survival was unmatched. He could remain detached as a diplomat and see things from a viewpoint others could not. Being a gentleman, he was particularly circumspect in actions and speech, but he never let his intense desire to be "correct," interfere with his ability to have fun.

Jim was a scholar and competent scientist, a teacher, and a complete journeyman. Because of his basic modesty, some of his acquaintances most likely did not realize that he was an expert skier, a skilled sailor, a swimmer and scuba diver, and a consummate mechanic. He was an aficionado of the arts and music — though in music, he did lean a bit more toward Gounod than Goodman, more toward Saint Saens than Shaw, and he preferred Verdi.

On any given occasion he could lapse into a furry brogue, voicing some pointed but quietly obtuse and pertinent Scottish comment he no doubt inherited from his dad or grandpa. His interest in and command of the Spanish language made his tours of duty in Mexico more of a delight than a chore. "They're actually paying me for this!" he would often say.

Clearly, Jim owed much of his deserved success to family ties — his parents, his brother and sisters, Virginia and the children. He and Virginia ran a careful, caring, accident-free family. Virginia was a special wonderful compliment to the basic McAnderson. I think that's the way he planned it.

Jim was the eldest of four children. His younger brother, Colin Edward, died in 1956. Upon Jim's death on December 6, 1991, he was survived by sisters Jean Wheatley and Betty Smith, his wife, Virginia, and daughters Lorraine and Diane, who scattered his ashes at sea.

Submitted to *Geotimes* "About People/Recent Deaths," by Peter Bird on July 9, 1993:

ANDREW J. GRATZ, 31, mineral physicist, Lawrence Livermore National Laboratory. Geology A.B. *summa cum laude*, Princeton 1983; Fulbright Scholar, 1983-4; Earth and Space Sciences Ph.D., University of California Los Angeles, 1990; research geophysicist, Institute of Geophysics and Planetary Physics, Lawrence Livermore National Labs (1990-93).

In 15 papers, he created new experimental techniques for the study of minerals. He proved the impact origin of shocked quartz from the controversial Cretaceous/Tertiary boundary layer. He did definitive studies of the kinetics of quartz dissolution and growth and applied them to problems of solution transfer. He also created the first movies of crystal growth by use of the atomic force microscope in a fluid cell; died June 7, 1993, of cancer, in Livermore, California.

Andy and Anita Gratz

6th Alumni Reunion Weekend!

FRIDAY, 19 NOVEMBER — OPEN HOUSE AND DINNER

Registration and open house will begin at 1:00 p.m. in 3820 Geology. Between then and 5:00 p.m., labs will be open for your inspection.

No-host cocktails at 6:00 p.m., followed by dinner at 7:00 p.m. at Griffin Commons in Sunset Village, the new residential complex on northwest campus. Gary Ernst will conduct a roast honoring Clarence Hall's retirement. If you have pictures, slides or amusing anecdotes about Clarence, please contact Gary: School of Earth Sciences, Mitchell Building 101, Stanford, CA 94305-2210; Phone (415) 723-2544 or FAX (415) 725-6566.

SUNDAY, 21 NOVEMBER — FIELD TRIP

Professor Ray Ingersoll and alumnus Perry Ehlig (PhD 1958) will lead a field trip highlighting the Los Angeles Aqueduct, collapse of the St. Francis Dam in 1928, neotectonics and the San Andreas Fault. We will follow the Los Angeles Aqueduct north from the San Fernando Valley across the Transverse Ranges. Along the route, we will see the dams, reservoirs, filtration plant and aqueduct (actually two). We will see how development of the fastest-growing part of Los Angeles County interacts with the geology, ecology and engineering of oil fields, freeways and water distribution systems. We will spend a few hours at the St. Francis Dam site, where one of the most famous of all dam failures occurred in 1928, with great loss of life and property. The dam failure was the direct result of geological conditions at the site, which we will examine. We will also visit the San Andreas fault and see how the Los Angeles and California aqueducts cross the fault. A full day is planned, with departure from UCLA at 9:00 AM and return by dark, approximately 6:00 PM. Possible weather conditions include sun, rain and wind. Short hikes on moderate terrain are planned. Bus transportation and box lunch are provided.

SATURDAY 20 NOVEMBER — UCLA/ USC FOOTBALL GAME

We will transport you to and from the game at the Coliseum and provide a tailgate picnic. (The exact departure time will depend on when the game starts, which is tentative due to television.) Tickets are limited.

Day	Date	Description	Cost		Persons		Amount
Friday	19 November	Dinner at Griffin Commons	$30	x	_____	=	_____
Saturday	20 November	UCLA-USC Football Game	$35	x	_____	=	_____
Sunday	21 November	Field Trip - L.A. Aqueduct	$35	x	_____	=	_____
		Contribution to Clarence's Gift				=	_____
					TOTAL	=	_____

Checks should be made payable to Lewis M. Morris Fund,
and sent to: UCLA, Earth & Space Sciences
3806 Geology
Los Angeles, CA 90024-1567

**Call (310) 825-3880 for hotel information.*

1938

Robert A. Paschall, B.A., made an epistolary communication alluding to Academician Charles Marshall's linguistic erudition in an ostensibly elocutionary enunciation. [Remember, Bob?]

He also mentioned the possible whereabouts of several lost souls, including **James B. Anderson**, ('37) and **James B. O'Flynn**, ('38), both of whom are, unfortunately, deceased, the latter recently. Bob also sent helpful information about **Tennant Brooks**, **Steven Davies**, **Richard Faggioli**, **Harrison Jamison** and **John Wiese**.

1943

Robert M. Norris, B.A., M.A.1949, Ph.D. 1951, does an occasional article for *California Geology*, visits his grandsons in Pennsylvania and Australia, and recently made a trip to both Greenland and Baffin Island in Canada, as well as a drive to the East Coast. His specialty is goofing off.

1950

Earl W. Hart, B.A., still works for the California Division of Mines, (39 years now) and manages the State's Fault Evaluation and Zoning Program. This unique program was established 20 years ago as a result of the Alquist-Priolo Special Studies Zones Act, which regulates development near active faults. One of the more interesting things he does, besides evaluating faults for activity and zoning, is to map fault rupture after each large earthquake in California.

Last year he was very pleased to receive the Alquist Award from the California Earthquake Safety Foundation for achievement in earthquake safety in California. He is proud to be the first geologist to receive this award. [That's great, Earl! Congratulations from us here in ESS - Ed.]

He is sure UCLA contributed substantially to his success by providing a very solid educational base, his geology professors in the Forties reading like a veritable *Who's Who* — **Crowell**, **Gilluly**, **Nelson**, **Popenoe**, **Putnam**, **Murdoch**, **Tunnel**, **Grant**, **Durrell**, **Axelrod**. Lest he give all the credit to UCLA, he also got an M.A. from UC Berkeley in 1971.

Hy Seiden, B.A., M.S. 1972, wrote that Lost Soul **Kenyon Sills** ('50) passed away some years ago, and that one of his sons, Jeffrey Milton Sills, 34, died December 23, 1992.

1951

Glenn A. Brown, B.A., recently retired from Law/Crandall.

Todd P. Harding, B.A., M.A. 1952, retired from Exxon Production Research Company on July 31, 1992 after 39 years and 9 months of service and is now working on contract for Exxon Exploration Company's Technology Division.

1952

Paul Morton, B.A., also sent an address for lost soul **Joe Fantozzi** ('56).

1953

Don Hagen, B.A., M.A. 1957, retired, is still enjoying skiing, hiking, boating, tennis, swimming, and fishing at his lakeside retreat in Sandpoint, Idaho.

1956

Edward D. Pittman, B.A., M.A. 1958, Ph.D. 1962, retired from Amoco Research in 1989, taught at the University of Tulsa for 5 semesters, and then moved to Sedona, AZ, as a consultant. He is currently working on a project for DOE and coediting a book for Springer-Verlag, *The Roles of Organic Acid in Geological Processes*.

1957

Donald R. Binns, B.A., M.B.S. CSU, and his wife, Patricia, have recently retired from Rocky Flats (DOE Nuclear Weapons Plant), where he was Chief Engineer. They now tour the US and Canada, inspecting outcrops.

Donald R. Lindsay (M.A. 1952) sent this photo of his son Rob, daughter Babs and himself taken in December 1990 in Nepal. The mountain peaks are (L to R): Taboche (21,463'), Everest (29,028'), Lhotse (27,890') and Ama Dablam (22,493').

1962

Jere H. Lipps, B.A., Ph.D. 1966, sent a photo (p. 12) of old UCLAns standing on the shore of the White Sea, an arm of the Arctic Ocean some 1000 miles north of Moscow as they took a break from searching for Vendian (580-600 mya) fossils in the sea cliffs nearby. They found many fossils, including traces of what we all hope are the first metazoans, other than the usual Ediacaran type medusoids and frond animals.

Both Jim and Jere were to have returned to Russia, Jim in April to work at the Institute, and Jere in July to collect more Vendian fossils on the White Sea with a UREP group. Misha will visit Berkeley in the Fall, they hope.

Jere and Jim are now both members of a biology department, where paleontology is a big success amongst both the faculty and students alike. Simply changing departments increased enrollments in their paleo courses by 100+ students easily. But Jim took the early retirement package UC offered; Jere tried to do it but was made Chair of the Integrative Biology department instead. You see they like paleontologists! Or like them not to do paleontology!

1963

Harvey Blatt, Ph.D., located the following lost souls: **Stan Beus** ('63), **Lawrence Frakes** ('64), **Don Preston** ('52) and **John Warme** ('66).

J. James Eidel, M.A., has retired from the Illinois State Geological Survey (ISGS) as Principal Geologist and Head of the Mineral Resources and Engineering Branch. He joined the ISGS in 1985 and is also an adjunct professor at the University of Illinois.

Among his noted accomplishments at the Survey was initiating, developing and guiding the cooperative project of the ISGS and the USGS to analyze the mineral resources in the Paducah Quadrangle that included a large area of Southern Illinois as well as portions of Kentucky, Missouri and Indiana. The resulting maps and cross-sections reflect the most comprehensive analysis undertaken in a Conterminous U.S. Mineral Assessment Program. Speaking of the project, Dr. M.W. Leighton, Chief of the ISGS, said, "This is a landmark study that will stand through the years as a memorial to Eidel's outstanding efforts."

In addition, Leighton noted that Eidel led a determined program to gain added national recognition for the Survey and its personnel in mineral resources and minerals engineering. "Without his perseverance, we doubtless would not be as far advanced in the scale-up of the invention of high-surface-area hydrated lime, one of the most promising developments in clean coal technology to come along through the Illinois Clean Coal Institute's program."

Eidel's conception of and efforts on a proposal for a nine-kilometer, ultra-deep drillhole attracted major attention to the Illinois Basin and its possibilities. He helped the ISGS to focus on major issues in the deeper portion of the basin and also played a significant role in achieving computerized handling of the geological records and well database of Illinois.

His contributions include support for the coal geology program, helping to implement a model program on coal availability with the USGS; editing and significant assistance in completing the American Association of Petroleum Geologists' volume on *Interior Cratonic Basins*; and efforts on behalf of the Survey's oil and gas program, which has received national acclaim.

Prior to joining the ISGS, Eidel worked for Hanna Mining Company nearly 20 years in a variety of positions, including exploration manager and senior geologist throughout North America, Australia and Southeast Asia.

Of his 17 publications since joining the ISGS, Eidel has been author or principal author of 13. Professional activities include vice presidency of and many other offices in the

Society of Economic Geologists and memberships in the Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers; the Geological Society of America; the American Association of Petroleum Geologists; and the International Association of Genesis Ore Deposits.

J. James Eidel

Within the year, Jim and his wife, Alicia, plan to relocate to Carson City, NV. They have two children.

Mary McNeil, M.S., won the 1992 "Best Book of the Year" award from the North American Bookdealers Exchange, an international book marketing organization located in Oregon, for her *Earth Sciences Reference*.

Ms. McNeil is a geoscientist who has worked for a number of major US corporations, among them Kennecott, Lockheed, and Bendix Field Engineering, and has been a consultant to foreign governments. Her most well-known article was "Lateritic Soils," which appeared in *Scientific American* in 1963 and was reprinted in *Planet Earth* in 1974.

Harry W. Green, B.A., M.S. 1967, Ph.D. 1968, was promoted to Director of IGPP and Professor of Earth Science at UC Riverside; his wife, Manuela, was appointed Assistant Professor of Biology.

1965

James C. Dawson, B.A., M.S. 1967, Ph.D., University of Wisconsin, 1970, after serving as Director of the Institute for Man and Environment at SUNY-Plattsburgh (1977-1982), returned to teaching as a professor of environmental science and taught historical geology while developing new courses in public lands policy and wilderness management. Environmental policy contributions and university-level activities saw him promoted to University Distinguished Service Professor in 1991.

During the summer of 1992, Jim served as a the geologist-environmental scientist on the U.S. portion of Russian-U.S. and Mongolian-U.S. teams making recommendations for land use planning for the Lake Baikal watershed in Russia and Mongolia. He was to return to Mongolia on July 15, 1993, for three weeks, to complete that portion of the project.

Recently Jim served as the geologist-environmental scientist on the U.S. portion of Russian-U.S. and Chinese-U.S. teams making recommendations as part of a two-year land-use-planning project for the Ussuri River (an Amur River tributary north of Vladivostok) watershed, home of the rare Ussuri tiger and leopard. Beginning May 14, 1993, Jim spent five weeks in Russia and China. He was glad to have a month stateside between projects.

This spring (1993) the New York State Legislature appointed Jim to a seven-year term on the prestigious NYS Board of Regents, which oversees educational policy from K through Ph.D. in New York State and oversees the professional licensing of 37 professions, Regents College (a liberal arts and professional institution without walls), and all museums and libraries in New York. Jim is fortunate that the SUNY Chancellor is understanding about his time commitment. Recent new courses at SUNY-Plattsburgh include Renewal Resources Policy and Non-renewable Resources Policy, a year sequence that attempts to relate science and institutional arrangements.

Nancy Stehle, M.A., a professional geologist and environmental protection specialist with the Department of the Navy for more than 33 years, retired from government service on June 30, 1992. On that day she received the Department of the Navy Superior Civilian Service Award "for exceptionally meritorious conduct in the performance of outstanding service while part of the Office of the Assistant Secretary of the Navy (Installations and Environment), from March 1990 to July 1992. Ms. Stehle displayed an exceptional degree of personal initiative, drawing upon her outstanding professional knowledge, enthusiasm, and devotion to duty. She has contributed significantly via the development and dissemination of cogent and timely policy guidance regarding issues of serious national and global consequence. Her initiative to pursue recycling programs, including plastics use reductions in packaging, and to reduce the hazardous materials waste stream, will continue to have profound beneficial effects for the Navy and the environment. Ms. Stehle's efforts successfully placed the Navy in the lead for Alternatively and Reformulated fueled vehicles to meet Clean Air Act goals."

Her other work to merit this award concerned use of Navy assets for the study and enjoyment of wildlife and the development of more wildlife habitats and resources using private sector efforts.

1967

Dale Kunitomi, B.S., located lost souls **Jan Marie Blacic** ('71), **Richard S. Dreessen** ('69) and **Joseph H. Fantozzi** ('56). He also sent the sad news of the death of **James B. Anderson** ('37), whose obituary appears on p. 10)

Kenneth H. Lister, B.S., M.S. 1970, in March presented a paper on Hazardous Waste Property Assessment at the 4th Annual West Coast Hydrocarbon Contaminated Soils and Groundwater Conference.

1968

Terry Chriss, B.S., M.S. 1971, Ph.D., Oregon State, 1981, is the owner of Custom Lab Software Systems, a firm specializing in the development of data acquisition, analysis and control software for scientific and engineering applications. Clients range from university scientists to Forbes 500 companies.

1969

Bob Presley, Ph.D., has no real news to report. He's still doing marine pollution research but with the best funding he's ever had.

1970

W.C. Brisbin, Ph.D., writes the following: "I have enjoyed perusing the December '92 issue of the *Newsletter* and compliment you on an excellent job. It was of particular interest to encounter the article on Takeo Susuki, a friend from days gone by in the 50s."

Ed Winter, M.S., Ph.D. 1972, notes that his son, Mike, while attending UCLA as a physics major, took an ESS course. Mike will be doing a junior year at the University of Queensland, Australia.

1973

Michael S. Binder, B.S., Chemistry, laid off by ARCO in October '91, tried to find a job to take him back to California, but circumstances led him to form his own business, consulting on cultural resource management, historic preservation, and environmental problems on military installations. Let's all wish him luck!

1974

Bob Crippen, B.S., Ph.D., UCSB, 1989, made the first visual observation of fault motion from space by comparing SPOT satellite images taken before and after the Landers, California earthquake of 28 June 1992. This was widely reported in newspapers and on television during December 1992. During 1992 he was also fortunate to contribute to the discovery of the "Lost City of Ubar" in Oman, which will be documented on the PBS science program "NOVA" during 1993. He is working on innumerable other projects also, so life is hectic but interesting while working at JPL.

1975

Carol Mankiewicz, B.S., M.S. 1980, and **Carl Mendelson,** Ph.D. 1981, had their first baby on November 12, 1992 — a son, Aaron Edward Mankiewicz Mendelson.

1976

Michael Garcia, Ph.D., saw **Johnnie Moore** ('76)

at AGU. Johnnie told him that he is now helping lawyers to sue mining companies for environmental problems (groundwater contamination), and that he was also a river raft guide for 2 summers. Lucky dog!

1978

Scott C. Budd, B.S., M.D., is completing a year as Chief Resident in Pediatrics at the University of Arizona in Tucson. He's accepted a position as Staff Pediatrician, Mariposa Community Health Center in Nogales, Arizona. "Being a Bruin is dangerous in Wildcat Country."

Tracy Rice, B.S., married Leo Lee on June 29, 1991, and now resides in New Jersey with two sons, Jason (7) and Kenny (4).

1979

Charlie Buckley, B.S., writes that California Environmental, of which he is President, continues to improve the percentage of UCLA graduates on their team. Over the last year, Mr. **Michael Tiffany** ('79) joined the firm, bringing with him extensive experience in asbestos consulting. Seventy-five percent of the professionals working on staff obtained their degrees from the UCLA Geology Department.

1981

Dorthe Bame Carr, B.S., has been working in the treaty verification arena at Sandia National Laboratories since 1985. She married Brad Carr in 1990 and celebrated the birth of Samuel Andrew Carr on November 9, 1992.

1983

Jeff, B.S., and **Diane (Clemens) Knott**, B.S. 1984, wrote in to say that 1992 was a busy year for both of them: Diane finished her Ph.D. at Caltech in the spring and is now concentrating full time on her teaching at CSU Fullerton, where she is an Assistant Professor, a position she has had since Fall '91. Her research interests are in igneous petrology with emphasis on the stable and radiogenic isotopic composition of the lower crust/upper mantle. She is currently working on projects in the western Sierra Nevada and northwest Italy.

inform all of the arrival of their first child, Alexander Clemens Knott. Alex popped in on them after Dad's first week of graduate school on September 26, 1992, weighing 8 lbs., 11ozs. And yes, he is named, in part, for Clem, whom they both remember fondly.

They spoke with **Dr. Steve Chambers** ('84) who is working for an environmental consulting firm in Palo Alto and visited with **Paul Bopp** ('84) and **Dr. David Weintraub** ('82)

*From left to right are 1958 PPRGer Misha Fedonkin (Paleontological Institute, Moscow) **Jere Lipps** and **Jim Valentine** (Ph.D. '57). Jere and Jim are dressed in Russian field gear, while Misha wears stuff bought at an outdoor shop in Chicago. Photo by Yuri Nikolaev, field geologist from Archangelsk.*

Jeff has recently given up the good life working for Caltrans as an engineering geologist and returned to school at UC Riverside to work on his Ph.D.. His field of interest is geomorphology under the guidance of Steve Wells, who relates numerous stories of the legendary **Ray Ingersoll** during their New Mexico days. Jeff completed his M.S. at CSU Los Angeles in Summer '92. His field work was in the Fillmore area, where he met and worked on the property of **Ted Bear**, another UCLA geology alum.

They are also happy to

and family. Earlier, Diane attended the wedding of **Linda Tandy** ('83). In 1990, Jeff and Diane visited **Brian Dodd** ('84) and his family in New Mexico. Also, **Jane Sutherland** ('84) is married and living in Virginia.

Kazue Takahashi, Ph.D., joined the Solar-Terrestrial Environment Laboratory, Nagoya University, as an Associate Professor.

1985

Hakan Ledje, M.S., after receiving his M.B.A. degree from the Norwegian School of Management in Oslo, Norway, in June 1993, started in a new position as exploration Planning Coordinator with ESSO Norge in Stavenger, Norway.

Arndt Schimmelmann, Ph.D., has accepted a research faculty position at Indiana University in Bloomington, to work on stable isotopes in organic matter.

1988

Tom Parsons, B.S., finished his Ph.D. at Stanford in Geophysics and is now at the USGS Branch of Pacific Marine Geology, Menlo Park.

1990

Andrew Gratz, Ph.D. died this year after a protracted battle with cancer, filling all of us who knew him with sorrow. [See In Memoriam, p. 10]

1991

Charlene Montierth, B.S., in a letter that Spring was kind enough to pass on to us, sends "Greetings from the land of the Great Wet North! I love Oregon, but I am starting to mold around the edges a bit. We've had a wet and wild winter; I even awoke on several mornings to the beautiful sight of a snow-covered world outside my windows. Lots of fun to look at but someting of a drag to try to drive in, especially for a Southern Cal native like me. They tell me that spring is here and the entire Willamette Valley is blooming in witness to the fact, but it hasn't stopped raining for a month (well, that may be a bit of an exaggeration, but we have really had some rain every day for the last month). I haven't had a decent tan since I can remember (now there's a legitimate complaint for you!).

"School is going incredibly well for me. I passed my comps last fall (I never thought I'd be able to say that!), and I've fallen into a great dissertation project that has NSF funding. As a result, I've started a two-year R.A.; although I love the teaching that goes with T.A. funding, it is pretty hard to juggle a full course load and teaching assignments with research of any sort. As a result of my R.A. funding, I foresee the possibility of actually finishing my Ph.D. in my lifetime."

Lost Souls List

Afiattalab, Mr. Firooz '79
Arthur, Dr. Carlene '71
Beh, Mr. Richard L. '51
Berkoff, Mr. Eugene W. '54
Berman, Mr. Richard Ernest Lee '77
Blanks, Mr. Bobby Dale '59
Brussell, Mr. A. William '48
Bush, Mr. Gordon Lowell '56
Chang, Dr. Fong Shun '79
Cheng, Mr. Hsueh-Cheng '71
Clements, Mr. James A. '65
Cooper, Dr. Earl L. '39
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