2002 MEDALS AND AWARDS

PENROSE MEDAL

Presented to Walter Alvarez

Walter Alvarez

Citation by Eldridge Moores

President Naldrett, Vice President Burchfiel, ladies and gentlemen. It is my privilege and honor to introduce to you Walter S. Alvarez, the 2002 GSA Penrose Medalist. Walter is a true renaissance man who has made outstanding contributions to the field of geology.

Walter and I go way back—we were graduate students together at Princeton in the early 1960s; we got married within a week of each other, and we had a joint bachelor party, a subject on which we have a mutual pact of "omertà" (the Italian word for the Mafia's "code of silence").

In the 35 years since receiving his Ph.D., Walter has been a prolific researcher and writer on a variety of subjects. His geologic work includes contributions to South American geology, Mediterranean tectonics, structural geology, magnetostratigraphy, and, of course, impacts. Walter's Ph.D. work was on the Guajíra peninsula, Colombia, the northernmost tip of South America. He was one of the last students of the Caribbean Research Project of Harry Hess and John Maxwell (1963 and 1974 GSA Presidents, respectively). After receiving his Ph.D., Walter worked for a time for the American Overseas Petroleum Company, exploring in the Mediterranean and North Sea regions. Out of this work came several contributions to the tectonics of North Africa, Sicily, and Corsica-Sardinia, one of which was a co-edited book entitled *The Geology and History of Sicily*.

Walter moved to Lamont-Doherty Geological Observatory in 1971 and to UC Berkeley in 1977. During this time Walter continued his work in the Mediterranean with a series of important papers on paleomagnetism, magnetostratigraphy, Cretaceous-Tertiary stratigraphy, and upon structural features observed in the complexly deformed rocks of Italy and the Alps. Walter was one of the first workers to document the rotation of Corsica and Sardinia during the Neogene, a work which presages the now well-known complex microplate interactions that characterize the entire Alpine-Himalayan belt, as well as other collisional plate margins. His work on the application of fold distortion to transport direction determination and on the origin and significance of solution cleavage stand as landmark contributions. More recently he has worked on the Quaternary volcanic province around Rome.

Walter's research on Cretaceous stratigraphy and magnetostratigraphy in northern Italy led to his discovery with his coworkers, his father Luis Alvarez, Frank Asaro and Helen Michel, of an iridium-rich layer at the Cretaceous-Tertiary boundary. When they published this discovery in 1980, they provocatively suggested that the layer resulted from a meteorite impact that caused the mass extinctions at the end of the Cretaceous. This originally revolutionary, controversial hypothesis has been corroborated by an enormous amount of detailed field, laboratory, and modeling work. An iridium layer at the Cretaceous-Tertiary (K/T) boundary reportedly has been discovered in more than 100 sites around the world, as has the "smoking gun"—an impact site in Yucatán, and "splash" deposits around the Gulf of Mexico and in the Atlantic east of Florida. Several other extinction events in earth history have been ascribed to impacts.

The original paper has been cited more than 1100 times. Four interdisciplinary, so-called "Snowbird" conferences have focused on the subject of global catastrophes and earth history. The first two of these conferences were held in Snowbird, Utah, in 1982 and 1988, the third in Houston in 1994, and the most recent in Vienna in 2000. (All these conference proceedings have been published as GSA Special Papers.)

Walter has been directly involved with much of this work. It has been interesting to watch him handle the notoriety, as well as the controversy, that this issue has generated. He has become a master of what he calls "the gentle art of scientific trespassing." This he defines as working in a profoundly interdisciplinary field and overcoming the problems caused by differences in the training of one's co-workers, different scientific cultures, and different perceptions of a scientific hierarchy or pecking order, not to mention judging the quality of work in different fields and overcoming the barriers of disciplinary-specific jargon. Through it all, Walter has remained a cheerful, hard-working, extremely versatile, imaginative, and very well organized geologist. This work has placed Walter at the forefront of a revolution in geology every bit as important as the plate tectonic revolution of the 1960s; that is, the planetary revolution—our ideas of Earth's place in space. We now know that there have been and will be periodic catastrophic collisions between the Earth and asteroids or comets. And these collisions have significantly af-

fected the evolution of the Earth and its life.

Walter has received many awards and recognitions for his work, including membership in the National Academy of Sciences and the American Academy of Arts and Sciences. In addition, he is the recipient of the G.K.Gilbert award of the GSA Planetary Geology Division, and an honorary citizenship of the towns of Gubbio and Piobbico, Italy.

Walter is a man of many talents and interests. He is a multilinguist, speaking Italian, Spanish, German, and French. He is an accomplished pianist, a pilot, and an enthusiastic raconteur.

In summary, I believe that Walter Alvarez's contributions have been of great importance in a number of fields including Caribbean and Alpine-Mediterranean geology, structural geology, and magnetostratigraphy and global impact events. His impact work has fundamentally changed the way we view the history of the Earth and its life. He is highly deserving of this award. Ladies and Gentlemen: Walter Alvarez.

Response by Walter Alvarez

Thank you so much, Eldridge. It is such an honor to receive the Penrose Medal not only from a lifelong friend, but from someone who has done as much for our science and our Society as you have. And my deep thanks to GSA, as represented by President Tony Naldrett and Vice President Clark Burchfiel. And to so many other friends and colleagues that I could not begin to name them all.

I grew up in northern California, where the occasional geological violence of the San Andreas fault and the incomprehensible confusion of the Franciscan mélange contrasted with the benign climate and the subtle, almost imperceptible seasons.

All that changed — reversed, even — when I went off to college at Carleton, in Minnesota, where the horizontal Paleozoic strata and the glacial deposits are orderly and well behaved. But in exchange, Minnesota taught me about seasons, and especially about winter, where two-week stretches of 20-below-zero reminded us that the glaciers were not long gone, and would soon be back.

In a certain sense, it was then the winter of Geology as well, and as a student, I absorbed two venerable dogmas that held our science as icebound as the upper Mississippi in January. The continents, I learned, have always been exactly where they are today, and there was no merit in the foolish ideas of an eccentric German meteorologist named Alfred Wegener. And I also acquired a reverence for the doctrine of uniformitarianism — the view that nothing in the past has ever happened at a faster rate, or by a different process than we can observe today.

In 1962 I went to Princeton as a new grad student. Through an uncommonly fortunate blind date, I met Milly, a most remarkable young woman from Virginia, and we fell in love in Washington DC, where she was a grad student, among the blossoming cherry trees that brighten the banks of the Potomac in the spring.

Springtime was bursting forth in geology as well, and Princeton was its source. During my first year there, Harry Hess published his revolutionary paper with the very first statement of sea-floor spreading. By good fortune I became Uncle Harry's grad student, and was able to do my doctoral research in the Guajira Peninsula of Colombia, following in the footsteps of older grad students Bill MacDonald and Jack Lockwood. Milly and I had our honeymoon there, living in the back room of a desert trading post run by a Guajiro Indian named Robertico, who was in the smuggling business. And I discovered that I had married the perfect geologist's wife — the worse the conditions, the better she liked it.

Uncle Harry's idea of sea-floor spreading was gaining support, and the springtime of a new geology was sweeping across the world. I simply watched from my ringside seat at Princeton. But friends of mine made major contributions, like my roommate Eldridge Moores, whose studies of Mediterranean ophiolites convinced Harry Hess that ocean floor was made of basalt, not of serpentinite, as he had originally proposed.

I emerged from Princeton in 1967, into the summer of a revitalized geology, fully merged with geophysics, and pouring forth a stream of new discoveries about a dynamic Earth on which continents move about, just as Alfred Wegener had said they do. In the summer of young adulthood, Milly and I lived an adventurous life, first in Holland and then in Libya.

And then, to follow up on a growing interest in Mediterranean microplates and archeological geology, we moved to Italy, which soon became a second home. There, for many years, I have found the fascination of the Apennine Mountains matched only by the kindness of the geologists of Italy, who took me into their friendship and shared their country and its geology with me. I have the fondest memories of what the Italian geologists call "geogastronomic excursions," in which hard days of field work are followed by dinners in little mountain villages, after which we would sit around in the evening, singing the old traditional songs of the Apennines and the Alps.

In the Apennines, around Gubbio and Perugia and Assisi, we stumbled onto the pelagic limestones that provide the best record anywhere of 150 million years of Earth history, from the Jurassic to the late Tertiary. By

then I was based at Lamont-Doherty Geological Observatory and, while trying to do tectonic paleomagnetism, my Scottish Lamont colleague, Bill Lowrie and I serendipitously discovered that the pelagic limestones of the Scaglia Rossa contain a complete record of the reversals of the Earth's magnetic field.

That record matched the pattern of sea-floor magnetic anomalies, in rocks packed with planktic forams that allowed us for the first time to date the reversals. Bill and I joined forces with Al Fischer, Giovanni Napoleone, Isabella Premoli Silva, Mike Arthur and Bill Roggenthen, and for several summers in the 1970s we systematically dated a hundred million years worth of geomagnetic reversals. It was finally a contribution to the plate tectonic revolution that Uncle Harry had started, which had broken the stultifying grip of continental fixism — one of the two dogmas of my early student days.

But plate tectonics was a decidedly uniformitarian theory, with continents separating at about the rate your fingernails grow. Geologists were so fascinated by plate tectonics that few paid any attention to the impact research of Gene Shoemaker and Bob Dietz, or the evidence for impact at Sudbury that Tony Naldrett has just described, or the results of lunar exploration, where the evidence of non-uniformitarian, catastrophic impacts was becoming undeniable.

Little did I imagine that the Apennine limestones would hold the clues that would demolish the uniformitarian dogma as well. But Isabella taught me to recognize the Cretaceous-Tertiary boundary in the field, and Al Fischer pointed out the crucial significance of the KT extinction in the history of life on Earth. In the summer of 1977, Terry Engelder and I carefully collected a sample of the thin clay bed sandwiched between top Cretaceous and basal Tertiary Scaglia limestones, and I took it with me when Milly and I moved to Berkeley. Using the sample as bait, I lured my physicist father into an unaccustomed interest in geology. We decided to use iridium, depleted in the Earth's crust, as a measure of cosmic dust, to see if the clay layer had been deposited quickly (thus incorporating little cosmic dust) or slowly (so that there would be substantial dust-borne iridium).

Our Berkeley colleagues Frank Asaro and Helen Michel made the measurements in their neutron activation lab, and to our shock, they found far more iridium than either scenario could explain. It was the second serendipitous discovery in the Apennine limestones. We finally concluded that the unexpected iridium anomaly was due to the impact of a 10-km asteroid or comet at the time of the Cretaceous-Tertiary extinction — what became known as the Berkeley Theory.

In Holland, quite independently, Jan Smit had just received chemical data on a KT boundary section he had discovered in Spain, which immediately confirmed our results, so I have long thought of Jan as the co-discoverer of the iridium anomaly.

The impact theory flew in the face of uniformitarian doctrine, enraging a large number of geologists and paleontologists. The debate was intense and exhaustive, as it should be in science. Together, Jan and I and a growing number of colleagues and friends, including my Berkeley postdocs, Sandro Montanari and Philippe Claeys, defended our catastrophic challenge to uniformitarianism through the decade of the 1980s.

Finally, in the early 1990s, the Chicxulub Crater, in the subsurface of Mexico's Yucatán Peninsula, was recognized and shown to date from precisely the KT boundary. Hard-core, absolutist uniformitarianism was finally dead. Today no geologist doubts that much of Earth history did take place through slow, gradual processes, but now Earth scientists are free to consider catastrophic events, like impacts, when the evidence supports them.

But now it is autumn. The days are shorter, the air is a little chilly, and the leaves are turning to colors on the misty slopes of the Apennines.

Of the two dogmas I learned as a student, I have watched as one was demolished, and participated in correcting the other. Their demise has made it possible for geologists and paleontologists to acquire a deep, rich understanding of Earth history, inconceivable when I was a student.

And although new challenges await, perhaps it is a good time to pause and breathe in the fresh, cool air of October, to thank you all for the honor of the Penrose Medal, and then perhaps to gather up Milly and a few old friends, and go and find the Italian geologists in a little trattoria, in some village way back in the Apennines. The day's field work is done. The local wine is waiting, the pasta sauce with the freshly gathered fall mushrooms fills the air with its irresistible aroma, and sausages are sizzling on a grill in the fireplace.

And if you listen, you can hear the soft, sweet harmonies of an old Italian song the geologists like to sing, in the evening.

ARTHUR L. DAY MEDAL

Presented to Richard G. Gordon

Richard G. Gordon

Citation by Kenneth P. Kodama

The defining paradigm of how Earth works is plate tectonics. Clearly, the development of the plate tectonic model is a fundamental achievement of the earth sciences. Richard Gordon, the 2002 Arthur L. Day Medalist, has been and is a major contributor to our understanding of the plate tectonics that is occurring now and has occurred in the distant past. Richard's achievements have been in two main areas. His earlier work involved using paleomagnetism to study plate tectonics while his more recent work has evolved to give new, important understanding of the plate tectonic paradigm using a variety of geophysical data.

One of Richard's first contributions, as a graduate student, was to develop a method by which paleomagnetic data can be used to determine the minimum velocity of a plate or continent at times in the past. This method gave the new insight that continents had moved rapidly in the past; hence, the slow motion of continents today is only an accident of present-day plate geometry. This work lead to one of Richard's most important contributions as a young professor, paleomagnetic Euler poles (PEP). With his co-authors, Allan Cox and Scott O'Hare, he developed a method for analyzing paleomagnetic apparent polar wander paths to determine all three components of past plate motion. This approach can give the past positions of a plate in both latitude and longitude, rather than just paleolatitude that results from standard analysis of paleomagnetic data.

Richard has also contributed to a better understanding of true polar wander. He and his colleagues have shown that the hotspot and no-net-rotation-of-the lithosphere reference frames are very similar. His work supported work by others that hotspots have moved in latitude, but went on to show that the Hawaiian hotspot has moved relative to the paleomagnetic and spin axes, an indication of true polar wander. Unraveling the history of true polar wander has important implications for understanding the dynamic behavior of plates and Earth's mantle, as well as interpreting apparent polar wander for paleogeographic reconstructions.

Richard has intensively studied the kinematics of the Pacific plate and furthered understanding of Pacific basin plate tectonics. He has developed mathematical techniques for combining and analyzing heterogeneous paleomagnetic datasets to determine pole positions for Pacific plate apparent polar wander. He has also developed rigorous techniques for analyzing inclination-only data from marine sediment cores and the shapes and amplitudes of marine magnetic anomalies to further constrain past Pacific plate motion. In this work, and in all of his work, one of Richard's hallmarks is his attention to rigorous propagation of errors through his analyses. This attention to error analysis has allowed him to test different hypotheses much more quantitatively than previous workers. Richard worked with co-authors David Engebretson and Allan Cox on a widely cited, award-winning paper that carefully reconstructed the Euler poles describing the motion of Pacific basin plates with respect to the bordering continental plates during the Mesozoic and Cenozoic. This paper has been extremely important to those studying the consequences of plate interactions at the edges of the Pacific basin and is still used today to explain the motion of far-traveled tectonostratigraphic terranes.

Richard's research focus has evolved from ancient plate dynamics to present day plate tectonics. Working with Seth Stein and graduate students, he has developed NUVEL-1 that describes "instantaneous" plate motions of the 12 major plates. This model of instantaneous plate motion is based on a massive dataset comprising spreading rates from marine magnetic anomalies, directions of relative plate motion from transform fault trends, and seismic slip vectors. It is a threefold increase over earlier datasets. NUVEL-1 has given new insights about current plate motion.

NUVEL-1 has had other implications for Richard's research. In defining plate motions over the past 3 m.y., Richard and his colleagues recognized that India and Australia could no longer be assigned to the same large plate. A diffuse plate boundary needs to be located between the two continents in the Indian Ocean. This realization has lead to important and extensive work that has recently redefined our understanding of the plate tectonic paradigm. Richard has suggested a modification of the plate tectonic model in which he defines composite and component plates. The simple lithospheric plates of plate tectonics are now envisioned to be composites that are made up of component plates separated by diffuse plate boundaries. This modification provides new insights about basic assumptions of plate tectonics; it is showing exactly how rigid the lithosphere is.

I've known Richard since he and I were graduate students together at Stanford. He's always shown an intensity and strong dedication to his work, but beyond that to Earth sciences and to science, in general. He actively promotes

the recognition of other scientists for their contributions. It's an honor to be his citationist today.

Using geophysical observations, Richard Gordon has made many important, significant contributions to our understanding of how the Earth works. He has been at the forefront of collecting new data sets that illuminate our understanding of plate tectonic processes, but more importantly he has framed scientific questions about plate tectonics in new ways. He is well-deserving of the Arthur L. Day Medal.

Response by Richard G. Gordon

If I was allowed to be so presumptuous as to pick any one honor I might receive in my professional life, the Arthur Day Medal would be it. It pleases me enormously to be recognized for the application of physics to the solution of geologic problems (I make no pretense about the chemistry part), and it's humbling to see the list of past medalists, which includes a great many of my personal heroes in geoscience. I am thrilled to be receiving this award.

My interest in active tectonics and geoscience may have its roots in having grown up in the foothills of the Diablo Range in California, between the Calaveras and Hayward faults, and as a 12-year-old having gone on several eye-opening and memorable natural history field trips along the California coast, in the Mojave Desert, in the Sierras, and in the Basin and Range. My interests in Earth remained dormant, however, until I made a short move to the west of the San Andreas Fault to attend the University of California at Santa Cruz, where as a junior I took an introductory geology class from Casey Moore and introductory geophysics classes from Rob Coe and Eli Silver. I was hooked, and still am. I next crossed back over the San Andreas fault to do graduate work at Stanford, where I learned much both from the faculty and from my fellow graduate students.

As scientists, to separate what we know from what we think we know can be a delicate endeavor, and has been a task with which I have often been confronted in my research. I was fortunate at Stanford to be able to see how Allan Cox, my thesis advisor, thought both rigorously and creatively about data, especially paleomagnetic data . Allan, who himself received the Day Medal while I was his student, also set a high standard, through his example, of how to write clearly about complex subjects. I learned much from him, but probably not as much as I should have. One lesson, which I had to wait a few more years to learn is that it is not enough to have convinced oneself that one is right—to be effective you also have to convince nearly everyone else. This has caused me to try to further raise the level of rigor, documentation, and clarity in my papers. Seeking these higher standards has also caused me on occasion to realize that I wasn't as right as I initially thought that I was. I hope that receipt of this award indicates that I've at least had some partial success, however.

The Day Medal recognizes a body of work and thus recognizes the contributions of the many scientists with whom I have collaborated and without whom I wouldn't be receiving this honor. My own former students with whom I have published papers being recognized today include Laurel Henderson, Phil Bryan, Gary Acton, Katerina Petronotis, Alice Gripp, Dezhi Chu, and Jim Lemaux. I want particularly to acknowledge two outstanding former students with whom I have had long-running and enormously productive collaborations—Donald Argus and Chuck DeMets. For the determination of the NUVEL-1 set of relative angular velocities of the plates, Don was the lead worker for the Atlantic Ocean and Chuck for the Pacific and Indian Oceans. The two of them literally divided and conquered the globe.

I have had the good fortune to collaborate with David Engebretson, who is a very creative scientist and was a fellow graduate student at Stanford. I first learned about the deformation in the equatorial Indian Ocean from Seth Stein, a colleague of boundless energy with whom I collaborated for many years. I have enjoyed synergistic collaborations on Cenozoic and Cretaceous global plate motion with Donna Jurdy and Roy Livermore. During the past decade my main collaborator, aside from my students, has been Jean-Yves Royer, who is a master of the art of quantitative plate reconstructions. It is with sadness that I acknowledge another wonderful colleague, Stephen Zatman, who died three months ago at the age of 30 in an automobile accident. Stephen and I, in part with Mark Richards and Mark Jellinek, made some real progress in understanding various aspects of the dynamics and rheology of diffuse oceanic plate boundaries during Stephen's last two and one-half years.

Before I conclude, I want to give special thanks to my citationist Ken Kodama. As he mentioned, he and I were in graduate school together. What he diplomatically did not tell you was that, to complete his thesis work, Ken had built an oven for the thermal demagnetization of paleomagnetic rock samples. Ken graciously loaned me his oven to demagnetize some of my own rock samples. One evening I left it overnight to run at a temperature higher than it had been used before. In the morning I discovered that it had caught fire. Fortunately the fire died out without triggering the sprinklers that would have ruined the entire laboratory. Unfortunately, however, Ken's thesis work was delayed several months until I was able to rebuild the oven. That Ken nominated me for this award probably means that he has forgiven me, at least I hope so.

The past 25 years have been an exciting time to be a geoscientist, and I am looking forward to the next 25. I

thank my family and loved ones, my students and colleagues, the scientists who took time from their busy schedules to write supporting letters, the committees responsible for selecting the Day Medalist, the GSA, and all of you.

YOUNG SCIENTIST AWARD (DONATH MEDAL)

Presented to Ariel D. Anbar

Ariel D. Anbar

Citation by Heinrich D. Holland

It is always a pleasure to present a former student for an award. The pleasure is particularly keen when the honored student has become a personal friend and a valued colleague.

While Ariel Anbar was an undergraduate at Harvard in the late eighties, I was struggling to determine whether solar ultraviolet light played a role in the origin of banded iron formations. At that time, the response of manganese to ultraviolet light promised to be a useful clue to the puzzle. Unfortunately, Ariel's senior thesis demonstrated very clearly that it did not.

After this demonstration, Ariel moved to Caltech for graduate work. There Gerry Wasserburg taught him how to make very difficult measurements very precisely. This led to his doctoral dissertation and to the first determinations of the concentration of iridium in natural waters.

Since 1996, Ariel has been on the faculty of the University of Rochester, first as an assistant professor and now as an associate professor. The years at Rochester have been very fruitful. Ariel's Caltech expertise blossomed first into the use of iridium anomalies in sediments to define the habitability of the early Earth. Subsequently, he has been among the pioneers in using new mass spectrometric methods to explore the stable isotope geochemistry of transition metals, particularly iron and molybdenum. His iron isotope research demonstrated the importance of inorganic chemistry for this isotope system. His exciting, ongoing study of the isotopes of molybdenum in carbonaceous shales promises to resolve long-standing questions regarding the oxidation state of the oceans during the Proterozoic Era. He has supervised an impressive number of undergraduates and graduate students, has taught a wide range of courses, and has acquired a burgeoning family. We at Harvard are fortunate to have him as a member of the NASA Astrobiology Institute team, which has its center of gravity in Cambridge.

Ariel Anbar is clearly a bright young star in the geological firmament. It is a privilege Mr. President, to present to you this outstanding scholar, teacher, and mensch for the Society's Donath 2002 Medal.

Response by Ariel D. Anbar

It is especially meaningful to me that this award comes from the Geological Society of America, and that Prof. Holland gave the citation. I became a geoscientist because I was fascinated by the history of the Earth and of life, and their "coevolution". Such topics have a home in the GSA. And Dick Holland and Gerry Wasserburg, the most influential mentors in my academic life, profoundly affected their study.

Historical research requires that we struggle with a sparse geologic record, particularly in the Precambrian. This means developing new analytical tools to get old rocks to tell new stories. My early career has been devoted to this effort, most recently focusing on the stable isotope geochemistry of transition metals. I am fortunate that Francis Albarède and Alex Halliday pioneered the technologies that opened this door just as I arrived on the scene. As revealed by my group and by others, Fe, Mo, Cu, Zn, Cr, Cd and even Tl isotopes commonly fractionate in nature. With Ken Nealson, Sue Brantley and Mukul Sharma, we have studied mechanisms of Fe isotope fractionation in hopes of revealing new biosignatures. This is a difficult but worthy challenge. With Andy Knoll and Tim Lyons, we are using Mo isotopes to study changes in ocean redox, notably in the Proterozoic. Initial results are very promising. It is an exciting time to be a geochemist!

I am fortunate to have a supportive setting at the University of Rochester, which gambled on a brash young scientist with a dissertation still warm from the copying machine. Asish Basu and John Tarduno secured resources, gave wise counsel, encouraged my odd isotopic and geobiological interests, and reinforced my aspirations through their exceptional research. They enliven my professional life, as do Udo Fehn, Bob Poreda and the rest of the faculty. After living in Cambridge and Pasadena, it is a privilege to have colleagues who demonstrate every day that high-impact science is possible even in a city that does not have a high cost of living.

In the lab, I am indebted to Jane Barling for keeping standards high. Jo Roe, Gail Arnold, Karen Knab, Matt Polizzotto and Erick Ramon gracefully endured my experiments in mentoring while doing the really hard work. They made this award possible.

I am also grateful to a long list of mentors and colleagues from whom I draw inspiration. I cannot give proper thanks in the time allotted, but will do what I can.

I owe an incalculable debt to my first mentors, my parents, Michael and Ada, and my brother, Ran, who encouraged me by their examples to follow my interests. When they learned I was going to pursue a career in geoscience rather than medicine, they never asked, "but how are you going to make a living?" It is true that you can't choose your family, but I would choose them if I could.

At Harvard, Prof. Holland rescued a discontented chemistry major by teaching me to combine chemistry with "back of the envelope" calculations to learn about the Earth. Suddenly, chemistry seemed relevant, and geoscience the most exciting application. I promptly changed my major!

Prof. Holland steered me to Caltech, where I was drawn into Gerry Wasserburg's orbit. I arrived just as the "Lunatic Asylum" revolutionized geochemistry for the umpteenth time, leading to my work on Re and Ir in seawater. From Dr. Wasserburg with the help of Dimitri Papanastassiou and Rob Creaser, I learned to practice science with honesty, rigor, and attention to detail, but without getting lost in trivia. I also learned to pursue novelty without flights of fantasy. If I have avoided both trivia and fantasy and if I continue to do so in the future, it is because Dr. Wasserburg taught me to strike the right balance.

Others also helped make Caltech a magical experience. From Sam Epstein and Yuk Yung, I learned about the power of informed intuition. From George Rossman, the value of exploration without clear destination. From Lee Silver, the elusive goal of integrating field and lab. During his Pasadena visits, I was inspired by Karl Turekian's enthusiastic creativity. Many other faculty, fellow students, postdocs and staff helped me learn the ropes, made the good times better, and the hard times easier. Mark Allen, Per Andersson, Rosemary Capo, Yigal Erel, Laurie Leshin, John Holt, Hari Nair, Don Porcelli, Brian Stewart, Kim Tryka and Laura Wasylenki head a list too long to complete.

In more recent years, as part of the Harvard/MIT astrobiology group, I regularly visit Cambridge. There, I am inspired by the abilities of Sam Bowring, Ed Boyle, John Hayes, Stein Jacobsen, and Roger Summons to turn analytical expertise into geoscience knowledge, and Paul Hoffman's ability to see the big picture. From opposite ends of the country, Andy Knoll and Ken Nealson patiently tutor me in biology, and humanity. From the other side of the planet, Roger Buick emphasized the value of fieldwork, and of "colorful" language. Greg Ravizza, generous to a fault, is the unsung hero of Mo isotopes and much else. Tom Bullen, Rosalind Grymes, Munir Humayun, Steve Mojzsis, Mark Rehkamper, Kevin Zahnle and many others have helped make most days fun and productive. I hope for many more such days, with many more such people.

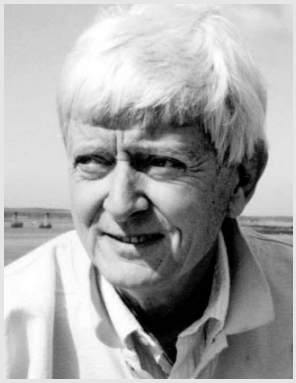
Clair Patterson once told me that while money may be the source of all evil, it is surely the source of all science. And so I thank the NSF and the NASA Astrobiology Institute for supporting my efforts.

Above all, I thank my wife, Marni, for nearly twenty years of loving friendship that words cannot describe, and my son, Nathaniel, who constantly reminds me that science is not really a career, but an attitude of constant curiosity.

Again, thank you for this honor.

GSA DISTINGUISHED SERVICE AWARD

Presented to Samuel S. Adams, David E. Dunn, and John W. Geissman



Samuel S. Adams

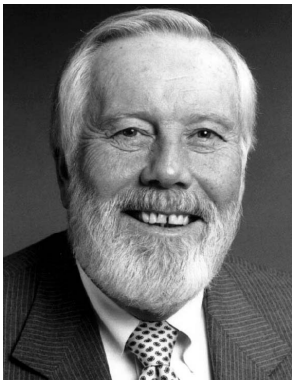
Citation by Anthony Naldrett

Samuel S. Adams, Sam to his friends, has had and continues to have a long and distinguished career within the earth sciences. His roots are set firmly in New England, with degrees from Dartmouth and Harvard, and from there he entered the mining industry, first working in industrial minerals, and then in metal mining for 10 years with the former Anaconda Company. After another 10 years as a consultant, he joined the Colorado School of Mines, where he headed the Department of Geology and Geological Engineering, before returning to the private sector. Sam has been president of the Society of Economic Geologists and continues to play a major role in that organization. He has served as president of the American Geological Institute and is currently editor in chief of *Geotimes*. His services in earth sciences have been recognized by many awards, too many to mention today. He has also volunteered his time in support of numerous organizations in New Hampshire; most recently the National Alliance for the Mentally Ill. Sam has served on no fewer than 12 GSA committees, becoming chair of the majority of them. He has served on Council, and for one year was the council member at large on the Executive Committee. There can be very few GSA members who have contributed so much of themselves to our Society, and I am delighted that Sam has been chosen to receive one of this year's Distinguished Service Awards.

Response by Samuel S. Adams

Thank you for your kind introduction. I am flattered and appreciative that this organization would choose to honor me in this manner. Lord knows, there are numerous members among you here today who have volunteered for GSA through the years in a variety of ways and on a variety of occasions. It is precisely for that reason that I prefer to think of this award as a recognition of GSA volunteerism, especially the many among us who have pitched in as the opportunities have occurred. Since my name begins with "A" it seems I got chosen for some of the "pomp and circumstance".

In his thought-provoking book, *Bowling Alone; The Collapse and Revival of American Community*, Robert Putnam identified a disturbing trend that started in the mid 1960's in our country and which relates to volunteerism in GSA. Simply put, even though membership, and in some cases philanthropic giving, may have risen for an organization, attendance at meetings and voluntary service for most are decidedly down. We are tending to invest less of our time and ourselves in organizations and activities, preferring a more limited interpretation of "paying our dues" than we used to. Increasingly our activities are more solitary. What does this mean for GSA? Without volunteers GSA is an anachronism. Perhaps *the* most important single benefits a scientific and professional organization provides to its members is the opportunity to learn how to serve selflessly in pursuit of a common vision. This exposure and training is critical to GSA achieving its mission and to earth scientists learning how to define and achieve theirs. The GSA staff is there as much to facilitate members' growth into service and volunteerism as it is to provide professional services to us. Membership is first a contract for services, but more deeply a covenant rooted in shared visions and opportunities for shared experiences. With the hope of contributing in some way to the strength of this covenant I gratefully accept this honor



David E. Dunn

Citation by Sharon Mosher

David Dunn's service to the society has been truly exceptional. Until a year ago, David was treasurer, an office he held with distinction for nine years. During this time, he served with three executive directors and provided much needed financial continuity and sage advice at the leadership level. As part of his responsibilities he chaired the Budget Committee and served on the Audit, Investments, Global Review, and Executive Committees. As a councilor over that

time, he played an active and influential role in shaping the society, mentoring new council members, and providing a much needed corporate memory of past councils. David's most important contributions are mostly invisible to the membership, but his impact on the society as a whole has been significant. David also has a long history of contributions to GSA, and he has been a Fellow since 1962. David was a founding member and a chair of the Structure and Tectonics Division, GSA's largest division. David's more than 20 years of service include being General Chair of the 1990 Annual Meeting, being on the *Geology* Editorial Board, and serving on the Short Course and Nominations Committees and on the Committee on Committees. David now serves as a member of the GSA Foundation Board of Trustees and brings his wide experience with GSA's finances to the Investment Committee. He is extremely deserving of GSA's Distinguished Service Award.

Response by David E. Dunn

Mr. President, fellow honorees, friends and colleagues, ladies and gentlemen: During the 16 years I was affiliated with GSA Council in one capacity or another, I was privileged to serve under, and learn from, Presidents Reds Wolman, Brian Skinner, Gary Ernst, Jack Oliver, Bert Bally, E-an Zen, Bob Hatcher, Bill Dickenson, Dave Stephenson, Eldridge Moores, George Thompson, Vic Baker, Gail Ashley, Mary Lou Zoback, Sharon Mosher, and Tony Naldrett. What an incredible array of talent and dedication! I am grateful for the learning experience and for the opportunity to have served. It has been a labor of love that has greatly enriched my professional life. Thank you.

John W. Geissman

Citation by Sharon Mosher

John Geissman has been a dedicated GSA volunteer who over the years has contributed to the society in many capacities. John served as editor of *GSA Bulletin* from 1994 to 2000 where he made numerous contributions to GSA publications in addition to fulfilling the duties and responsibilities of editor. He was the driving force behind having GSA's Data Repository available electronically, instituting a reasonable page charge policy, and establishing the staggering of Science Editor terms—hence, his extra two years of service in this time-consuming endeavor. John also has co-chaired two, combined Rocky Mountain–South-Central GSA section meetings in Albuquerque, one in 1991 and one in 2001. John's contributions continue to this very week. He is the Technical Program Chair for the Denver 2002 Annual Meeting and was responsible for scheduling and overseeing the entire technical program. This position is key to the meeting's success and is the most important and time-consuming of all jobs related to the meeting. John will continue to serve on the Annual Program Committee to help advise the next Technical Program Chair. We hope and expect that his contributions and dedication to the society will continue throughout his career. John has dedicated a tremendous amount of time and energy to GSA and is very deserving of the Distinguished Service Award.

Response by John W. Geissman

Greetings.

I remember an experience, decades ago, in my parents bedroom, watching my mom pack a suitcase for my dad, for one of many professional society-related trips. And I of course asked "why"? She responded, "that's what he does"; later (because I asked why again?) he responded with something like "professional societies are the essence of science and engineering, without them and people actively participating in them, we'd be lost." At the time, it sort of whizzed over my head. Since, illumination has allowed me to understand his remark (and question why a spouse should pack a suitcase for another).

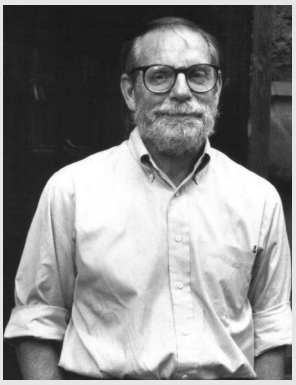
I thank the many members at GSA Headquarters, notably Nancy Carlson, Larry Bowlds , Faith Rogers, Melissa Cummiskey, and Jon Olsen. Very importantly, my family, graduate and undergraduate students, editorial assistants Cathy Ratcliff and then Mary Simmons, and UNM colleagues suffered through occasional rantings and ravings while *Bulletin* Editor, and TPC for this meeting. To Lynn Walter and Allan Glazner; thanks for the opportunity to work with you. Art Sylvester's 1987 phone call, saying "say, I just noticed your mug in *Eos*, for an Editor's Citation; I need you on the *Bulletin* AE Board, and you have no choice" was the beginning.

To relatively young (whatever that means) members of GSA, your time devoted to a professional society only enhances your appreciation of the wonderful science, and the way in which it is done, of which you are an integral part. To Frank Rhodes, thanks for the best class of my life, 32 years ago, in the nat sci building, at dear old Michigan.

And to all of you, I hope you find this meeting as stimulating and rewarding as I have found my experiences working with the many dedicated GSA professional staff and volunteers. Thanks.

GSA PUBLIC SERVICE AWARD

Presented to John A. McPhee



John A. McPhee

Citation by Eldridge Moores

John McPhee is one of, if not the, greatest living American non-fiction author. In fact, he has been called one of the best nonfiction writers, ever (see The Globe Corner Bookstore, www.globecorner.com/a/596.html).

Born and raised in Princeton, N.J., John was educated at Princeton and Cambridge Universities. Since 1965 he has been associated with the New Yorker magazine as a staff writer. I first met John in November 1978, as a result of a telephone call from Ken Deffeyes of Princeton University. Ken informed me that McPhee was beginning a study of the roadcuts of I-80 and asked if I would help with California. While I had never heard of McPhee, I readily agreed, as the project sounded interesting, and it was along a route that I had used many times for student field trips. Thus began the long road to "Assembling California."

McPhee arrived on a Friday afternoon, and we went out in the field. Our *modus operandi* was for me to drive the pickup he had rented. As we careened from roadcut to roadcut, I kept an eye peeled for the California Highway Patrol (we never did get busted). I tried to explain the geologic mess of the Sierra Nevada and Coast Ranges, while McPhee pelted me with questions from the passenger's seat and wrote furiously in one of his many notebooks.

In person, McPhee is a soft-spoken, gentle, considerate, compassionate, invariably polite person. He's a really nice guy. He is also the most formidable interviewer I have ever encountered. John soaks up knowledge like a sponge. He can quietly, gracefully, and skillfully extract from an unsuspecting interviewee the most arcane details of whatever subject is under discussion. The process is hard work and occasionally dangerous if you are driving. I remember at the end of one day in our early travels together, I blurted out "I'm exhausted. You've really put me through the wringer." He responded, "How do you think I feel? This stuff is all new to me."

A few years later we went to Cyprus and northern Greece, and subsequently to Arizona. We revisited California sites a decade later, and we traveled along part of the San Andreas fault after the 1989 Loma Prieta earthquake. Over the course of these travels, our relationship blossomed into a lifelong family friendship. I certainly feel enriched, personally, by knowing him.

John's assembled work on geology, *Annals of the Former World* was a best-seller and won the Pulitzer Prize for General Nonfiction in 1999. He worked on this book on-and-off over a 20-year period during which four of its sections were published in *The New Yorker* magazine. Two of these parts, "Basin and Range" (on Nevada and New Jersey), and "Assembling California" were themselves best-sellers.

John is a hugely talented wordsmith, who is able to grasp difficult concepts—in a field in which he was never trained—and make them come alive. For example, in "Assembling California" John was able to juxtapose the history of the California Gold Rush and the Loma Prieta earthquake with intricacies of California geology in a way eminently accessible to non-geologists and useful to geologists at the same time. He is a master at putting his subject out front, and himself in the background.

McPhee's geology works form only a small part of his efforts. Over the years, he has published and received awards for some thirty books on such diverse subjects as nuclear hazards, the Swiss Army, the New Jersey Pine Barrens, Scotland, orange-growing, traveling on a freighter, and most recently, *The Founding Fish* (on the species American shad). However, McPhee has developed a deep understanding of geology, and a remarkable ability to translate that understanding in terms accessible to the layperson. Four of his other books deal partly or largely with geologic themes: *Coming into the Country* (on Alaska), *The Control of Nature* (on human attempts to modify natural processes), and *Encounters with the Archdruid* (travels with the late David Brower), and *Irons in the Fire* (a collection that includes a long piece on forensic geology).

John has brought geology alive to a public thirsting for more knowledge of the Earth. The reactions to McPhee's writings demonstrate the hunger his readers have for knowledge about the Earth and the landscape around them.

Through his many writings, John has made "geology" a household word. I cannot think of a more deserving recipient of the GSA Public Service Award. We are lucky that such a talented writer got interested in geology. It

gives me great pleasure to introduce him to you. John McPhee.

Response by John A. McPhee

Thank you, Eldridge. Thank you, GSA. Last spring, I was asked to write a formal acceptance speech for this occasion, and acceptance is exactly what I wish to mention in more than one sense. For me, this is an unparalleled opportunity to register my gratitude to the geological community as a whole for your acceptance of my presence among you and for your unending patience in teaching me, guiding me, encouraging me, and correcting me in a project that must have seemed quixotic to those of you who were close enough to judge. For example, Anita Harris, of the United States Geological Survey — on the first day of my first field trip with her, in 1979 – was walking upsection through the Delaware Water Gap, pointing out the nuances in the Silurian quartzites. I said, "Do you ever get tired of teaching ignoramuses?" She said, "I haven't worked on this level since I don't know when."

Academically, about all I had behind me was an undergraduate degree in English literature. In college and in high school, I had taken various introductory courses in physics, chemistry, biology, and geology, but only out of idle interest or to discharge distributional requirements. As a forty-seven-year-old professional writer, I was attracted to geology, I guess, by the humanistic implications in its scientific facts, the marvels and the metaphors in its descriptions of the world. Among the mangled ripple marks in quartzite, an affection for marvels and metaphors will not get you very far in figuring out which way is up. On that first outing with Anita, I scribbled a large quantity of notes, and when I typed them up a few days later I did not know what they meant. My own notes were over my head. In the course of time, and further dialogue with Anita and other geologists, those notes gradually became clear. Anita, like every other geologist I would talk to, understood what I had set out to do, did all she could to help me get there intact, and devised ways to communicate with my innumerate mind. She and everyone else in the profession had no difficulty understanding that a piece of writing can take forever. When I met Eldridge Moores, he had just turned forty. His children were so young you could see the scuff marks where they crawled on the rug. Over the years, as I made field trips with Eldridge, his children grew up, went to college, and soared on into the world while the guy with the notebook, who first appeared in their home in 1978, had still written nothing about their father, his ophiolites, and his beloved California. With the late John David Love, of the USGS, my lag time was only eight years — eight privileged years of learning from him – and the intervals were analogous with Karen Kleinspehn, now of the University of Minnesota, and Randy Van Schmus, of the University of Kansas. At the outset, before I had so much as collected Rock No. 1, Kenneth Deffeyes, of Princeton University, volunteered to shepherd me through the whole of it, recommending and introducing other geologists, going with me himself across the Basin and Range, and enlisting into the advisory process most of Princeton's Department of Geosciences and members of this profession in many parts of the United States, England, Scotland, and Canada. Because my work as a non-fiction writer has been delimited and defined only in its being about real people in real places, I have ventured into highly varied fields of endeavor, experiencing, as you might guess, highly varied levels of welcome. In the federal and state surveys, in the academic world, and in private companies large and small, the acceptance that I have felt coming my way from geologists has been warm to an unexcelled extent, and this evening I have — as noted — the best chance I'll ever have to express my heartfelt appreciation.

As I have occasionally remarked in the past, it has not been my purpose to write for a scientific audience but my purpose would be defeated if my work were not acceptable to scientists. The corroboration implied in this award is an award in itself.