AGI MEDAL IN MEMORY OF IAN CAMPBELL

Presented to Harrison H. Schmitt

Harrison H. Schmitt
Geologist, Apollo 17 Pilot and Astronaut, and former United States Senator

Citation by Clive R. Neal

I first met Dr. and Astronaut Harrison Hagan "Jack" Schmiatt in 1992 at the workshop on The Geology of the Apollo 17 Landing Site. Before being introduced to him, I was (of course) in awe of one of the chosen 12 who have walked on the Moon, especially as he is the only trained geologist to do so. Jack's easy going and friendly demeanor immediately put me at ease and little did I know that this gentleman would be pivotal in my career by, for example, giving me the opportunity to serve at the Chair of the Lunar Exploration Analysis Group (LEAG) during a time when NASA was gearing up to go back to the Moon under President Bush's Vision for Space Exploration, and also as a letter writer for my various promotions at Notre Dame. Jack Schmitt's experience and enthusiasm for the geosciences, and specifically lunar geology, is infectious, and his uncanny ability to "think outside the box" enables him to be a visionary for space exploration.

I will diplomatically state that Jack was born a "few" years before me in Santa Rita, NM! He married Theresa Fitzgibbon of Los Alamos, NM, in 1985, and their marriage continues to flourish 26 years later. He received his B.S. in Science from Caltech in 1957 after which he worked for the Norwegian Geological Survey, the U.S. Geological Survey in New Mexico and Montana, and for two summers as a geologist in southeastern Alaska. He became a teaching fellow at Harvard in 1961, where he assisted in teaching a course in ore deposits, and received his doctorate from there in 1964. As a civilian, Jack received Air Force jet pilot wings in 1965 and Navy helicopter wings in 1967, logging more than 2100 hours of flying time. Before joining NASA, he was with the U.S. Geological Survey's Astrogeology Center created by Gene Shoemaker at Flagstaff, AZ. He was project chief for lunar field geological methods and participated in photo and telescopic mapping of the Moon.

Selected for the Scientist-Astronaut Program in 1965, Jack organized the lunar science training for the Apollo Astronauts and represented the crews during the development of hardware and procedures for lunar surface exploration. He also oversaw the final preparation of the Apollo 11 Lunar Module Descent Stage, and served as Mission Scientist in support of the Apollo 11 mission. After training as back-up Lunar Module Pilot for Apollo 15, Jack flew in space as Lunar Module Pilot for Apollo 17, which commenced at 11:33 p.m. (CST), December 6, 1972, and concluded on December 19, 1972. After landing the lunar module "*Challenger*" at Taurus-Littrow (located on the southeast edge of Mare Serenitatis) Jack and Eugene Cernan activated a base of operations facilitating their completion of three days of exploration. This last US manned mission to the Moon broke several records set by previous flights and include: longest manned lunar landing flight (301 hours, 51 minutes); longest lunar surface extravehicular activities (22 hours, 4 minutes); largest lunar sample return (an estimated 115 Kg, 249 lbs); and longest time in lunar orbit (147 hours, 48 minutes). Apollo 17 ended with a splashdown in the Pacific Ocean approximately 0.4 mile from the target point. As one of the last men to walk on the Moon, Jack has been inducted into the International Space Hall of Fame (1977) and the Astronaut Hall of Fame (1997).

In July of 1973 Jack was appointed for 2 years as one of the first Sherman Fairchild Distinguished Scholars at the California Institute of Technology. This appointment ran concurrently with his other activities in NASA. In February 1974, he assumed additional duties as Chief of Scientist-Astronauts and was appointed NASA Assistant Administrator for Energy Programs in May 1974. This office had the responsibility for coordinating NASA support to other Federal Agencies conducting energy research and development and for managing NASA programs applying aeronautics and space technology to the generation, transmission, storage, conservation, utilization and management of energy for terrestrial applications.

In August of 1975, Jack resigned his post with NASA to run for the United States Senate in his home state of New Mexico. He was elected in 1976, where he served a six-year term in the U.S. Senate beginning in 1977. Senator Schmitt, the only "natural scientist" in the Senate since Thomas Jefferson was Vice-President of the United States and President of the Senate. As senator, he worked as a member of the Senate Commerce, Banking, Appropriations, Intelligence, and Ethics Committees. Jack also held the position of Chairman of the Commerce Subcommittee on Science, Technology, and Space and of the Appropriations Subcommittee on Labor, Health and Human Services, and Education. He later served on the President's Foreign Intelligence Advisory Board, the President's Commission on Ethics Law Reform, the Army Science Board, as Co-Chairman of the International Observer Group for the 1992 Romanian elections, and as Vice Chairman of the U.S. delegation to the 1992 World Administrative Radio Conference in Spain. Jack became a consultant to the Fusion Technology Institute at the University of Wisconsin in 1986, advising on the economic geology of lunar resources and the engineering, operational, and financial aspects of returning to the Moon. In 1994, he was appointed as an Adjunct Professor of Engineering at the University of Wisconsin. His affiliation with Wisconsin has stimulated interesting research into the use of Helium-3 as an energy source (a resource that is rare on Earth but is relatively abundant on the Moon), and he also teaches a course on "Resources from Space". He is the author of "Return to the Moon" (2006, Springer-Praxis) that describes a private enterprise approach to providing lunar Helium-3 fusion energy resources for use on Earth. In 1997, Schmitt cofounded and became Chairman of Interlune-Intermars Initiative, Inc., advancing the private sector's acquisition of lunar resources and Helium-3 fusion power and clinical use of medical isotopes produced by fusion-related processes.

In November 2005, Jack became Chairman of the NASA Advisory Council and served until October 2008. [It was during Jack's tenure as Chair of the NAC, that he approached me to become the Chair of the LEAG.] He led the Council's deliberations

on issues related to Aeronautics, Audit and Finance, Biomedicine, Exploration (human flight systems development), Human Capital, Science, and Space Operations. It was in 2006 that he encouraged Brad Jolliff (Washington University) and I to organize the "NASA Advisory Council Workshop on Science Associated with the Lunar Exploration Architecture", which was held in 2007 in Tempe, AZ. Learning from his experience with Apollo, Jack wanted to make sure that science was involved at the start of this new era of lunar exploration! The workshop results have been incorporated into the Lunar Exploration Roadmap produced by LEAG.

Jack now consults, speaks, and writes on policy issues of the future, the science of the Moon and Planets, history of space flight and geology, space exploration, space law, climate change, and the American Southwest. He presently is Chair Emeritus of The Annapolis Center (risk assessment) and is on the staff of the Institute for Human and Machine Cognition of Pensacola, Florida. Current board memberships include Orbital Sciences Corporation, Edenspace Systems Corporation, PhDx Systems, Inc., and The Heartland Institute, and, as a retired Director, he continues as an emeritus Member of the Corporation of the Draper Laboratory. He also has served as a member of the Energy Department's Laboratory Operations Board.

Among Jack's many honors and endeavors are the following:

- NASA Distinguished Service Medal (1973); Honorary Fellow of the GSA (1973);
- Fellow of the AIAA (1977);
- Honorary Member of the AAPG, Norwegian Geographical Society, New Mexico Geological Society, and Geological Association of Canada (1977);
- Engineer of the Year Award, National Society of Professional Engineers (1981);
- NASA Distinguished Public Service Medal (1982);
- The Public Service Award, AAPG (1982);
- The G.K. Gilbert Award, Planetary Geology Division, GSA (1989);
- The Aviation Week Legend Award (2002);
- American Association of State Geologists Pick and Gavel Award;
- Honorary Fellow of the GSA; American Institute of Mining, Metallurgical and Petroleum Engineers; and Geological Society of London (2008).

In recognition of past service, the U.S. Department of State in July 2003 established the Harrison H. Schmitt Leadership Award for U.S. Fulbright Fellowship awardees. In 2007, Schmitt was awarded the first Eugene M. Shoemaker Memorial Award by Arizona State University and is the first recipient of the National Space Society's Gerard K. O'Neill Memorial Space Settlement Award. He was also awarded the inaugural Columbia Medal by the Aerospace Division of the American Society of Civil Engineers in 2010.

In closing, I have to conclude that Harrison Hagan "Jack" Schmitt is a national treasure. He is still involved in science and space policy, and continues to publish in the scientific literature, where he is never shy in questioning established paradigms and makes us all think carefully about our science. For example, in lunar science Jack continues to point out inconsistencies with the origin of the Moon by a "giant impact". He continues to keep us all honest! He has been selfless in inspiring the next generation of scientists and engineers, as well as the general public, to "reach for the Moon and beyond". I am deeply honored to give this citation and it is very fitting that Jack Schmitt is receiving the AGI Medal in Memory of Ian Campbell for Superlative Service to the Geosciences.

Response by Harrison H. Schmitt

Thank you, Clive, for that history as well as the wonderful embellishments. Teresa and I have enjoyed very much being with the members and friends of the American Geological Institute and its affiliated Societies.

Following in the footsteps of many friends who have received the Institute's Campbell Medal, including Dick Jahns, Dallas Peck, and Sam Adams, this evening comes as an unexpected and humbling experience. Ian and Kitty Campbell will always be treasured friends of memory.

Harrison A. Schmitt's GSA associate, our collective great friend and former GSA and AGI President, the late Ian Campbell, served as my undergraduate advisor at Caltech in the 1950s. In many ways, Ian provided a major push along a path that led to some remarkable opportunities. In addition many childhood learning experiences created by my father and mother, Ethel Hagan, Ian set my first, post-college milestone by suggesting during the sophomore year to start considering applications for a Fulbright Fellowship. By the time senior year arrived, I had to apply for the Fulbright because he just would not let up.

Exposure to the principles of field geology began with working as my mining geologist father's field assistant and plane table operator. I recall going down old shafts near Hachita New Mexico inside an ancient ore bucket with Dad straddling the rim while holding on to the rope from a windless…being warned of possible javelina and rattlesnakes coming out of old desert mine adits at Hilltop and Silverbell, Arizona…taking channel samples across veins exposed in numerous tunnel workings from Mogollon to Vanadium, New Mexico… cleaning and filling the ubiquitous carbide lamps of the time…finally being chased out of operating underground workings around Hanover, New Mexico by union rules… hand splitting hundreds of feet of drill core for assays…operating a plane table alidade on maps Dad had begun in the 1930s over the famous Pewabic Mine…hand coloring copies of report maps using colored pencils and carbon tetrachloride-soaked stubs. Maybe that carbon-tet explains some of my problems today.

Extensive course work in basic principles of field geology provided by Dick Jahns, Barkley Kamb, and Bob Sharp followed this early exposure to mining geology. The names Bouquet Canyon, Tick Canyon, and Sacramento Mountains will be familiar to many of you, as well as to Mike Duke, Larry Griffiths, and Robert White my fellow classmates. While at Caltech, I also spent many highly instructive months with Neil Irvine mapping the ultramafic layered intrusives of Duke Island in Southeastern Alaska. Later, Harvard's Hugh McKinstry would add an ore deposits and mine evaluation perspective to this background.

Receiving a Fulbright to Norway in 1957, with subsequent work there on the Pre-Cambrian metamorphic rocks of the western Basal Gneiss region added immeasurably to experience in the field. This detailed mapping project, largely concerned with the origin of eclogites, proceeded under the research guidance of Harvard's Jim Thompson and the cultural guidance of Norsk Polar Institute geologist Tore Gjelsvik. We picked Norway for the Fulbright because of Ian's and Dick Jahns' strong respect for petrologist Thomas Barth and Norway's extensively glaciated surface that encouraged highly detailed field investigations.

Studies of the Eiksundal eclogites of clearly metamorphic origin raised conflicts with some formidable colleagues of the time who believed these same eclogites had been plucked off the Earth's mantle. Additionally,

a layered laccolith of ultramafic to noritic composition now largely changed to eclogitic assemblages, included rhythmically layered hydrous mineral suites. This layering suggests that pulsating pressure release at a cotectic could be an important factor in producing rhythmically layered plutonic rocks. This stay in Norway also coincided with Sputnik and drew my attention to the implications of space flight for human civilization.

Geologist in Space

In November of 1964, during the first few months of working for Gene Shoemaker in his Geological Survey Branch of Astrogeology, an announcement appeared on the bulletin board stating that NASA and the National Academy of Sciences wanted applicants for the first selection of scientists to become astronauts. I thought about 10 seconds, decided I would regret not applying if someone actually went to the Moon, and sent in my application. Gene strongly encouraged me to apply, having wanted nothing more than to also apply if he could have. It turned out, of course, that Gene would chair the initial selection committee for the Academy.

Out of about 1400 applicants, the Academy selected 16, only four of whom were geologists. NASA down-selected to six based on physical and physiological criteria. Successful completion of jet and helicopter pilot training were the next hurdles. Assignment to a flight mission, of course, constituted the final barrier to getting a geologist on the Moon. NASA Deputy Administrator George Low became the most important person in overcoming a professional pilot bias in crew selection and making a mission assignment of a pilot-geologist possible.

Having a geologist inside the Apollo Program to land on the Moon, an open response to the Soviet Union's challenge during the first Cold War, offered many opportunities to add to the scientific return of that program, as well as to contribute to its operational success. Most importantly, field geological experience made possible the internal development of a focused, mission simulation approach to training natural pilot observers in field observation, rapid synthesis, critical sampling, and verbal and photographic documentation. As you all are aware, only time spent on coherent field projects can develop the experience and confidence necessary to carry multiple working hypotheses to a satisfactory conclusion. Although that time was not available for specific Apollo missions, the week-a-month field training on real geological problems provided to the Apollo 12 through 17 crews took advantage of their natural talents and enthusiasm and produced an unbelievably rich suite of samples, observations, photographs and geophysical data. This talent and enthusiasm is clearly illustrated by Neil Armstrong's spontaneous addition of a large amount of lunar regolith to a partially filled Apollo 11 sample container before he sealed it and Jim Lovell's willingness to have Apollo 13 lead the way with the new geological training plan.

The treasure horde of samples and data from Apollo continuously produce major new findings about the origin, evolution and structure of the Moon with increasingly significant implications about the early history of the Earth. Most recently, the discovery of significant indigenous water in the Apollo 17 orange pyroclastic glass samples has re-invigorated consideration of alternatives to the giant impact hypothesis of the origin of the Moon. Immediately after this latter hypothesis was proposed, previous indications of deep reservoirs of indigenous lunar volatiles made further objective testing necessary, but difficult given the unfortunate "consensus" that developed around it.

After I was selected as one of the first scientist astronauts in 1965, by the way, Ian created the GSA's "First Extraterrestrial Field Geologist" Award, embodied by a beautiful, Lucite encased and illuminated cluster of amethyst crystals. Then, after the field exploration of the Valley of Taurus-Littrow, Ian thought that the best way for the GSA to recognize that a geologist had explored a part of the Moon was to bestow the designation of GSA Honorary Fellow - the logic being that, like other Honorary Fellows, these field studies had been conducted outside the United States! **Made sense to me.**

Geologist in the Senate

Having a geologist in the Senate may not have been as productive as it had been in the Apollo Astronaut Office. Footprints on the Moon will last a couple of million years – footprints in Washington, not so much. An overly full plate there included science and energy policy, healthcare appropriations, regulatory restraint, immigration, defense, intelligence, federal patent policy, telecommunications, Senate ethics, retirement and health security reform, and strategic materials. That adventure in politics would be hard to beat as a personal learning experience. Success might have been greater if there had been more than two or three others in Congress genuinely interested in solving major problems rather than in surviving the next election by only treating the symptoms of those problems. Most people can't run their lives that way, nor can a country do so in the long term.

On the other hand, I probably was not very good at politics. A field geological heritage of standing above a field area to see the big picture led me largely to take on major issues of the future with less emphasis on more achievable, near term goals. Examining a Dick Jahns' Pacoima roadcut structures from the opposite side of the road; looking across Storfjord in Sunnmöre, Norway at the Eiksundal eclogite complex exposed on the opposite cliffs; or scanning the valley of Taurus-Littrow from the side of the North Massif tends to impress one with the value of perspective.

Geologist in Education

Having a geologist involved in education, and one with experience in the Apollo Program, provides a special opportunity to help stimulate new thoughts among young people. There have been over 45 years of lectures and Q&A with students from K-12 to graduate students to public audiences of all kinds around the world. The most intense of these activities occurred as a Fairchild Fellow at Caltech, while an Adjunct Professor of Engineering at the University of Wisconsin-Madison, and during extensive domestic and foreign travel.

Discussions with students and the public have covered everything from describing a trip to the Moon, to lunar and planetary science, to lunar helium-3 fusion energy, to space policy. The best part of this has been the questions I could answer, such as "How do you go to the bathroom in space?", "Did you eat the salmon salad they gave you?, and "How fast could you run on the Moon?" Equally interesting have been the questions I could not answer, such as "Why did you use pizzas for the Lunar Module's landing pads?", "How big was your boot?", and "What is the origin of the Moon?" The most often asked question has been "What was it like on the Moon?" and that is the most difficult to answer because "being there" is the essential human ingredient to such an experience.

One role I have assumed in work with undergraduate and graduate students has been to encourage their questioning of prevailing hypotheses that may have reached a "consensus" in acceptance but that still have some important contrary evidence to explain.

As many of you know, the hypotheses for which I have suggested contrary explanations are those related (1) to the origin of the Moon by giant impact on the Earth, (2) a short inner solar system cataclysm as an explanation for concentration of Apollo sample and lunar meteorite impact ages around 3.85 billion years, and, (3) of course, that recent slow global warming is due to the burning of fossil fuels. Capture of an independently accreted Moon; multiple cataclysms of planetary impacts with an age bias toward the last of these; and natural causes of climate change, respectively, appear to be at least as strong if not stronger hypotheses in those three cases.

Actually, consensus should have no place in science. Ian Campbell and his colleagues taught that science always should be about developing hypotheses and then trying to disprove them. Unfortunately, many students are being taught only "consensus" hypotheses such as lunar origin by giant impact and climate change by human activities. They are encouraged to conduct research that assumes those ideas are correct. Rather, students should be encouraged to be "skeptical" about consensus hypotheses until they have stood the rigorous tests of all relevant data and logic long enough to warrant being "theories". Astrophysicists understand this best as they continue to test even Einstein's Theory of Relativity.

Geologist in Management

Management of a NASA Energy Program Office, two biomedical research entities, NASA's Advisory Council, a state energy department, and many Board committees always present special individual challenges. Management success requires the ability to recognized and correlate as much available information as possible that is relevant to the solution of a problem or to seizing an opportunity. Sampling and synthesizing all data and ideas available and determining on the best solution to a problem worked well for Apollo and has served others well since. Sounds just like the key to success in geological field studies to me.

Geologist and the Constitution

When jobs were scarce in 1963 and '64, I almost decided to see if a scholarship could be found that would permit a geologist to study constitutional law. Gene Shoemaker save me from that fate by offering a job with his Astrogeology Branch in Flagstaff. Over the last two years, however, I have migrated back to looking at the Founders' view of the Constitution; but also looking at that document and related writings as a deposit of recoverable resources that provide guidance to solutions for national problems we face today. Anyone interested in seeing the on-going results of that exploration project should visit a web site called "America's Uncommon Sense."

The common theme in all this past activity seems to be that Field Geologists look at the discernable facts and synthesize those facts in to working hypotheses. They continually test, revise, discard, and add to those hypotheses based on available information and the reason that grows with experience. We need more field geologists! Everywhere!

Thank you, again. I am deeply honored by the American Geological Institute's Campbell Medal.