The Geologic Division Retirees Newsletter

Number 69

Summer 2014

An organization of retirees of the Geologic Division, U.S. Geological Survey, who seek to keep in touch with each other and with their former Agency.

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ABOUT THE COVER: Integrated science before we called it that: three members of Regional Geochemistry Branch and one WRD geochemist sampling west of Denver, June, 1976; upper left, Jim Erdman, plants; upper right, Ron Tidball, soils; center, Rich Ebens, rocks; and lower left, Gerry Feder, water. Photo by Robert Gantnier.

From the President

Progress Toward a New Director, and A Few Good Books

On May 13 the Senate Energy and Natural Resources Committee held a confirmation hearing for Suzette Kimball to be the 16th Director of the U.S. Geological Survey. Suzette got more questions than is usual in such hearings, which was good because it gave her a chance to demonstrate some of the valuable contributions of Survey programs. Our partnership with the state Water Resources Institutes, our management of the Landsat program, work on critical minerals, wetlands research, strategy for national landslide hazards mitigation, and funding for our stream-gauging network were all items of interest. The Committee voted in favor of Suzette's nomination on June 18, and her confirmation now awaits final approval by the full Senate. Suzette previously has served as Associate Director for Geology (formerly called Chief Geologist), as Director for the Eastern Region, and as Deputy Director. She has been Acting Director since the departure of Marcia McNutt last year. Her research background is in coastal geology and specifically in barrier islands sedimentation. Before coming to the Survey, in addition to her research career, she managed programs at the Virginia Institute of Marine Science and the National Park Service, where she was Research Coordinator for their Global Climate Change Program.

The article by Jim Burns in our last Newsletter started me thinking about other members who have published history, biography, novels, or other types of books, in addition to scientific works, in retirement. Jim's *The Cold Coasts* is a good example Just off the top of my head, here are a few others. Wally Hansen published *Greenland's Icy Fury* in 1994, a fascinating account of his WWII service at a weather station in Greenland. Jim Moore's *King of the 40th Parallel*, the subtitle of which is Discovery in the American West, is a broad-ranging review of the history of earth science in the West. The prolific Wendell Duffield has published several books since retiring, including *Chasing Lava* and *From Piglets to Prep School*, titles hard to resist. Former Survey geologist Sarah Andrews has published a series of 11 forensic geology mysteries, beginning with *Tensleep*, and I know many of you are fans of her novels. John Behrendt's account of his work in Antarctica is of interest especially to others who have worked there. I am including one suggestion from a non-USGS author, but one that, if you have not read it, you should definitely place at the top of your list. Martha Sandweiss, a Princeton history professor, in 2005 published *Passing Strange*, the story of Clarence King's life after he left the Survey. It is a truly amazing narrative. My purpose in this short note is to encourage any of you who know of other books from Survey authors to suggest additions to our list. No doubt there are a number of other good books out there that we might enjoy.

One last note: opinions published in the Newsletter are those of individual authors and are not necessarily those of the organization.

John Keith

Treasurer's Report and Membership Statistics

This report summarizes the financial situation of the Geologic Division Retirees as of the end of 2013. Our present financial health is excellent because we have found a printer for our newsletters and directory who does a good job at a much lower cost than our former printer. We currently have a large surplus and added to that surplus during 2013, even though we decreased dues to $6. At current levels of expenses, the current surplus could fund the organization for four years. If the surplus continues to grow, we will have to decrease dues further, but for the present, we are leaving dues at $6 per year.

Net worth, January 1, 2013	11,238.15
2012 Income	
Dues and contributions received	
Dues for 2012 and prior years	298.00
Dues for 2013	1,450.00
Dues for 2014 and beyond	544.00
Contributions	509.00
Total income	2,801.00
2012 Expenses	
Dues notices (envelopes, postage, labels, ink)	258.49
Preparation and mailing	
of newsletters and directory	2,411.13
Bank charges	26.25
Total expenses	2,695.87
Net increase in net worth	105.13
Net worth, December 31, 2012	11,343.28
Assets December 31, 2012	
Checking account, Wells Fargo	12,385.28
Undeposited dues & donations	0.00
Uncashed payments for fall newsletter	- 1042.00
Total assets	11,343.28

Notes

Comparison with 2012: The amount received for dues in 2013 is $367 less than in 2012, primarily because of the dues decrease, and the amount received as contributions is $10 less. Dues billing cost $73 less (this cost varies considerably from year to year because of advance buying of envelopes and labels in some years).

Escrow for future dues: Of the assets at the end of 2013, $1204 represents advance dues payments and must be regarded as funds in escrow for 2014 and future years.

Dues billings: For 2014, dues notices were sent out in a single batch. Members who have not paid dues since 2011 will be dropped from the active membership list if they do not pay within a few months of receiving the 2014 dues notice. They will no longer receive newsletters, and their names will no longer be listed in the directory.

2014 finances:

Because this newsletter is appearing so late in 2014, we have already received nearly all our income for the year, even though we have not yet sent out any newsletters or the directory as of the time of preparation of this report (Sept.27, 2014). Thus far for 2014, we have received $2128 in dues income (93% of that received in 2013) and $663 in donations (130% of those received in 2013), for a total of $2791 (96.7% of 2013 total income). As total 2013 expenses were $2696, and we have a sizeable reserve, we are in excellent financial condition as of the writing of this report. In fact, we may be forced to decrease dues again for 2015, to decrease our reserve to a more reasonable value. We appreciate your donations, but they are not really needed at present.

Membership statistics:

At the end of 2013, we had 407 members (compared to 579 at the end of 2004, 555 at the end of 2005, 531 at the end of 2006, 519 at the end of 2007, 504 at the end of 2008, 484 at the end of 2009, 453 at the end of 2010, 434 at the end of 2011, and 414 at the end of 2012). Until 2013, on average, the net loss of members per year was about 21, but our current president, John Keith, has been actively recruiting new members, resulting in a net loss of only 7 members in 2013. Of our members at the end of 2013, 67 were in arrears, 192 were paid up through 2013, and 145 were paid up through 2014 and beyond; 3 are life members. All members who have not paid dues since 2010 have been dropped from the active membership list. About 102 of our members are currently Emeritus geologists with the USGS.

Odette James
Secretary/Treasurer

Essays, Anecdotes, and History

(Warren Hamilton has contributed the following essay, based on a lecture he delivered recently. – Ed.)

ANTHROPOGENIC GLOBAL WARMING

Anthropogenic global warming (AGW) affects far more than the atmosphere, and its long-term consequences likely will far exceed the relatively minor, but damaging, changes thus far. There is no significant scientific debate on the reality of AGW as a result of the greenhouse gases (GHG), particularly CO2, that we are adding to the atmosphere. Both physics and voluminous data support the near-total general consensus by involved scientists. The public, however, has been deliberately misled by a well-funded campaign that claims a major scientific controversy where none exists, and that has successfully limited widespread awareness to the small atmospheric part of the signal and damage. In order to block regulation of production and use of carbon fuels, industry-front institutes, which generate no data or science, target anti-science and anti-government politicians, journalists, and voters with misrepresentions of both data and physics, and with denunciation of warming as a hoax by myriad dishonest scientists and agencies. This worsens political gridlock and hostility to science.

GHG are tri-atomic and larger gas molecules (notably H2O, CO2, N2O, and CH4, but not O2 and N2) that absorb and re-emit thermal energy. They form an atmospheric blanket that keeps Earth's surface ~35 ℃ warmer than it would otherwise be with solar heating. The extra retained heat due to anthropogenic GHG—currently ~40 billion metric tons per year of CO2, plus important quantities of CH4 and N2O, largely from fuel production and combustion—mostly warms the oceans, but warming the air, warming land, and melting ice each absorb about 2%. The disinformation industry discusses only the tiny atmospheric fraction as though it were the total effect, and cherrypicks out-of-context details from that to provide illusory bases for false statements.

Heat and CO2 move in both directions between atmosphere and oceans, and complications such as natural and anthropogenic aerosols render uneven the small annual accumulation of heat in the atmosphere due to anthropogenic GHG. The great oceanographic oscillation between El Niño (warm equatorial Pacific) and La Niña (cool) is erratic in periods, magnitudes, and details, but has near-global oceanographic and climatic effects. Niño water warms the air whereas Niña water absorbs more atmospheric and solar heat. 1998 had a more powerful Niño than any year since (though another is cautiously predicted for late 2014), and the for-hire science-deniers say Earth's climate has been stable since 1998, and therefore there is neither global warming nor a CO2 greenhouse effect. This

disregards physics, the 45x greater heat that continued to increase in the oceans, and the exponential decrease of summer-minimum Arctic Ocean sea ice by 65% since 1998.

The concentration of anthropogenic warming of land and air and melting of sea ice is concentrated in high northern latitudes, which decreases atmospheric temperature and pressure gradients southward to mid latitudes. The jet stream flows primarily along these gradients. Its velocity has decreased 15% in the last 15 years, and it has tended to be more fixed in position and configuration, or more fragmented; and air masses and their bounding fronts have increasingly stalled. The marked increases in extreme weather events are clearly linked to these changes, and hence presumably to the decreasing gradients, although the causative physics is debated. The Arctic Ocean is headed irreversibly for nearly ice-free summers and warmer water, which will much further decrease the southward gradients, and will also decrease the southward flow of subsurface cold water into the Atlantic that drives the compensating warm, shallow Gulf Stream that makes Britain, Iceland, and Norway habitable.

The superb Quaternary paleoclimatic, chronologic, and GHG data from ice, sediments, and other sources demonstrate lags of centuries or millennia in the full effects of natural exchanges of GHG between oceans and atmosphere. Feedbacks, thresholds, the inertia of melting or accumulating ice, and the sluggishness of marine re-equilibrations preclude prompt major responses. Most of the heating by what we have already added would still lie in the future if we stopped adding more today, and ultimate effects of further additions would be little changed by merely slowing carbon combustion. (The lack of geologic perspective minimizes effects predicted by many legitimate investigators.)

Warming Antarctic water has thinned previously grounded Amundsen Sea ice, which long buttressed much of the West Antarctic ice sheet, to floating thickness, and runaway melting, spread over several centuries, is probably irreversible. Weddell Sea buttresses of another West Antarctic ice sector are thinning fast, and melting of the Greenland icecap is accelerating. Land-ice melting already in the pipeline may alone produce a sea-level rise of ~4 m.

The ice-core record shows that pre-industrial atmospheric CO2 did not exceed 300 ppm during at least the last 400,000 years. The last major deglaciation, mostly from 18,000 to 12,000 years ago, was driven by a total increase of 70 ppm of CO2, to <300 ppm, released from oceans warming slowly in response to Milankovic orbital and axial cycles, raised sea level ~120 m. We have added another 100 ppm of CO2 in little more than a century, but the atmosphere has yet warmed on average no more than ~1 ℃, so much more is coming. Pre-sapiens men made stone tools starting ~200,000 years ago, but the entire rise of civilization, including even most of the Neolithic, took place within the last 12,000 years of benign climate, stable sea level, and 280-300 ppm CO2. Thanks to us, CO2 is now 400 ppm, rising ~25 ppm/decade, and likely will exceed 600 ppm if carbon fuels last long enough. The last time even 400 ppm was reached was probably in the Pliocene warm period, when sea level was ~15 m higher than now.

Only 45% of anthropogenic CO2 stays in the atmosphere, and 55% acidifies the oceans, "the other CO2 crisis." Most of the CO2 combines with water to produce HCO3- (bicarbonate) and H+ ions (chemical purists refer instead to H3O+ ions). Anthropogenic CO2 has already increased the acidity of near-surface water by an average of about 30%., and variably affected deeper water. This requires invertebrates to invest more chemical energy in precipitating CaCO3 needed for hard parts, and inability to immediately provide this energy from residual egg mass kills entire generations of larvae in some regions. This may be the main factor that has already killed ("bleached") a third of large coral reefs, including most Caribbean reefs and half of the Great Barrier Reef of Australia. Acidification also decreases fixation of nitrogen, needed by the planktonic microplants that are the base of the oceanic food chain and the producers by photosynthesis of half of the world's O2.

The duration of carbon-fuel use is limited by the fast-increasing energy cost of its extraction, and is unlikely to be nearly as long as implied by the hyped current claims for coal and for OPEC and shale oil. Whatever the carbon-fuel era does to climate and oceans, at the end of it our descendants will still have to cope with the development of sustainable substitute sources of energy—and the carbon industry is fighting to minimize such development because it competes for short-term profit.

A PDF file of a 2-lecture slideshow illustrating data and physics behind the preceding statements, covering much more in addition, and noting specific references, is available on request from *whamilto@mines.edu.*

Warren Hamilton

A SPANISH LESSON IN TIME

Helped Me Translate a Clever Rhyme

[I hope readers of this essay won't be put off by the truly cutting nature of its punch line. As a kid who grew up with all the activities of a typical family farm of the 1940s, this kind of cutting (sometimes accomplished by knife and sometimes by rubber-band constriction) was part of the annual cycle of animal life. And as a human who is aware of the macho image that males of our species often project, I can appreciate the back story that gave rise to my language lesson in Mexico.]

When I was a geology graduate student at Stanford

University in the mid 1960s, the successful candidate for obtaining the PhD degree was required to demonstrate moderate proficiency in two foreign languages. Although the level of proficiency in the one-and-only foreign language I brought with me to Stanford was well above moderate, Latin was not accepted by the Geology Department. Lack of pertinent geologic literature in that tongue was the purported reason, although naturalists of the Roman Empire wrote many learned treatises about rocks and such centuries before Leland Stanford even thought to honor his son by establishing a top-notch university named for that lad. Sigh!

One of the early Roman scientists, who unfortunately witnessed the 79 A.D. eruption of Vesuvius at a lethal distance, would have the explosive style of that and many similar eruptions elsewhere named Plinian in his honor. But though I was on an educational track that would eventually lead me to study many Plinian volcanic deposits, my Latin was still not up to Stanford standards. So, I enrolled in one-semester crash courses of German and Spanish. These were specifically designed to help graduate students like myself successfully clear the language hurdle. And they served that purpose for me and my classmates.

Within a few weeks of the course's termination, I forgot virtually all of the German that helped me jump the deutsch hurdle. But serendipitously my PhD thesis field area was in Baja California, Mexico. And in the lead up to my first south-of-the-border field season of mapping and collecting rock samples for lab studies, I practiced my rudimentary classroom Spanish through tapes and books, and by talking with Perfecto Mary, the Geology Department's rock-lab expert. Señor Mary was a native of Spanish-speaking South America. Our conversations were brief and quite repetitive. All these years later the one sentence I remember was his daily plaint "Tengo mucho trabajo, pero poco dinero" followed by loud resounding laughter. Still, the inflections and cadence of his speech helped train my ear for a relatively clear comprehension of what were strange sounds for someone who had never before been out of country. My only previous exposure to Spanish came from watching the Cisco Kid on TV.

So, armed with the sad story of trabajo and dinero, plus several other handy phrases mostly about the weather and such trivia, I drove south into the back country of Baja alone. I set up camp, a tent that served as home and office, forty miles south of the Mexican border town of Tecate (beer drinkers should recognize this name) at the middle of an extensive body of igneous rock, which I was to study. My only human neighbors within a several mile radius were Señor and Señora Amador and their fourteen children. The oldest child, Domingo, was forty. His name would be assigned to the first cat that my wife and I would soon adopt back in Stanford student housing. The youngest Amador was four. Obviously the father of this brood was quite the amador, with living evidence of considerable fertility and staying power.

The family welcomed me onto their cattle-ranch land. I often encountered a couple of the older vaquero male children (who were much older than me) during my daily on-foot traverses across the landscape as I mapped and collected rock samples. Our conversations were necessarily brief and mundane. They knew no English and my Spanish was still rudimentary. So talk was limited to hello, how are you, nice weather and such. Then they would trot away on their caballos as I hefted my rock-filled backpack. The Amador family and I parted ways at the end of that first field season with embraces and my clumsy attempts to say that I would return the following summer.

Back at Stanford I continued studying Spanish through tapes, books, and conversations with Perfecto Mary. My vocabulary expanded beyond weather and how-do-you-do. I began field season two with confidence of perhaps meaningful conversations with my Mexican friends.

Be patient. I'm getting to the punch line of this tale. It came on a day when I met Domingo and Eugenio, the next-to-oldest son, during one of my rock-collecting cross-country traverses. Remember that they knew me as a young adult living alone for weeks and weeks and weeks. As they broached that day's topic, I sensed their puzzlement of the fact that I hadn't yet visited two similarly lonesome young señoritas who lived at a neighboring ranch. After a couple of repetitions, I came to realize that they were asking why I didn't seek out some female comfort, or whatever their words were to express this idea. I knew what they meant. They were two of fourteen products of the topic being explored.

Wanting to impress my friends with my use of their language, I silently recalled that the Spanish verb estar (to be, in English) generally carries a connotation of uncertainty. By contrast ser (also, to be, in English) carries a connotation of certainty. So I proudly announced "Soy casado!" hoping to have said that I was married and indeed I intended to truly stay that way. My pronouncement triggered high decibel laughter. In loud unison came their rapid boisterous rejoinder of "Pero no capado," again followed by raucous laughter. And I got it. My vocabulary included a verb whose English translation was a significant part of my childhood upbringing on farms. So we all had a good laugh.

When I arrived back at Stanford where my wife Anne held forth, I related the entire tale. And of course I emphasized the reason for my use of the Spanish verb ser!

Wendell Duffield

New Members

Cynthia Dusel-Bacon

John H. DeYoung, Jr.

Janet D. Fletcher

Toni Karas

Robert Rowland

Bob Ryder

Scott E. Tilley

S. Jefress Williams

New From Retirees

Wendell Duffield: Following a dozen years of spending summers at a lovely Wisconsin lake and winters in Flagstaff, AZ, my wife Anne and I moved to Whidbey Island in Puget Sound in May of 2013. So far, we have absolutely no regrets. Our new (but actually quite old) home sits atop the headwall of a prehistoric landslide scarp. The near-sea-level elevation and high humidity seem to have solved Anne's problem with asthma in Flagstaff, and our westward views across the main shipping channel into Seattle, with the Olympic Mountains as the backdrop, are daily mind blowers! I continue to peck away at the keyboard to produce essays and short stories on a variety of topics. For a sampler one can visit my blog http://www.waduffield.wordpress.com. I no longer have earth science research projects underway, although I try to keep my finger in the geology pie via memberships with AGU and GSA and by giving the occasional talk about volcanoes to various local groups. Also, two retired geologist colleagues from my past (Grant Heiken and Sue Kieffer) live nearby here on Whidbey, and some professional topic invariably sneaks into conversations at social gatherings.

Cynthia Dusel-Bacon: After 39 years as a geologist with the USGS, I retired on January 3rd. I'm continuing with my research activities related to mineral resources in Alaska as a scientist emeritus and so far have come in to work almost every day since retiring. I realized that my transition still had a ways to go when I was happy to observe an upcoming holiday indicated in red on my government wall calendar. I'll get better. I am enjoying more time dedicated to my passion of playing chromatic harmonica in a jazz sextet (I'm the only harmonica player in the group).

Janet Fletcher: Boyd and I live at the summit of North Mountain and have a spectacular view of two+ mountain ranges and two valleys. We enjoy reading –- sitting by our wood stove – birding, and playing with our six Shetland sheep dogs. We do travel some. We took a trip to Hawaii in April of 1990 and take off for Provo, UT, once a year where we own a "condo," and once a year we go to the "ocean" where we own a time-share unit. I love gardening and gathering wild flowers here on our own mountain top. I dry them and enjoy them all year long. I do as little house cleaning as I can get away with, and also enjoy playing the piano. I'm taking lessons again after a hiatus of 40+ years. We both enjoy certain programs on TV. We belong to the Sheraton Sports Club here in Martinsburg where we go swimming, since we have no pool here. We do miss our pool! But not the cleaning of it! We've made friends here and have kept in touch with those we had in Baltimore and Washington. One of our sons and family moved to Stephens City, VA, not far from us so we enjoy him and our grandchildren (3 girls). We are relaxed and happy but would like to see old friends from the Survey. I miss them and sometimes my work too. Come up to see the view from our tower!

Wally Hansen couldn't resist contributing these little ditties (written several years ago – see Roger Colton's memorial).

ROGER [COLTON] THE DODGER

An eager old codger was Roger the dodger
    Who is known for his knowledge of maps
From the plains far off in Montana, perhaps
    To New England's rocky shore
Yes, multiple maps by this rascal
    Grace many an office drawer
And from Greenland's icy mountains
    To the flesh pots of Nevada
Great stacks of vital data
    All appear on Roger's maps
(Tho' his work once took him to Vegas,
    He never succeeded at craps.)

NEWFOUNDLAND ICE

An iceberg from Greenland crashed down to the sea
    Beset by the tides of the ocean
And when it appeared off the Newfoundland banks
    It caused quite a bit of commotion
For who could foresee that ice in the sea
    Propelled by the sea's locomotion
Could incite in those "Newfies" who sail those seas
    An onrushing crush of emotion.

Dorothy Hutchins: I loved the last Newsletter, especially the history of Pick and Hammer shows! I was in one in

1969? (I think) when GSA was in D.C. at the Wardman Park Hotel.

Norrie Robbins: That nice 7-year-long NSF funding finally ran out September 30 for my reservation-based Science Explorers Club. I subsequently cut my activities from 11 to 6 reservations, where I am outdoors with 300 kids monthly doing exciting activities such as digging for water, the great lizard hunt, the Southern California Shakeout, and World Water Monitoring Day. In October, I joined another NSF-funded project called the Art of Science Learning; it's run by a group of cognitive neuroscientists and entrepreneurs who sold the idea that scientists don't have much training in using our right brains. So we are a group of 100 volunteers who are tasked to come up with some creative products to meet Southern California water challenges; to help do this, they have led us in dancing, sculpting, drawing, and singing water. Yeah, it's weird, but I will let you know if anything useful comes of this concept. I continue to volunteer periodically at the USGS Water Science Center here in San Diego where hydrologists are drilling for subsurface information, especially looking for ground-water storage capacity. Research-wise I am working on my part of a medical geology abstract with a friend at the Geo. Survey Tanzania for the next Colloquium of African Geology.

Robert Rowland: I'm still working on contract for the USGS on Law of the Sea claims.

Ed Sable: Greetings Fellows and Fellowesses: Since retirement in 1990 and Emeritus until I was booted in 2005, quite a lot of water has flowed. I and my wife, Vera (Ve), did quite a lot of traveling after retirement– Europe, Africa, Australia, New Zealand, and the good old US of A. Ve passed away a few years ago – still greatly missed. I live in an assisted living facility near Denver, still collect (and sell) gems and minerals and CDs. Am now nearly 90, still with good health. Having spent most of my professional career in Arctic Alaska, I still miss the "Tundra Tromping" greatly, as well as the many USGS friends and colleagues of yesteryear--bittersweet memories!

Al Taylor: He wobbles and falls a lot, even sober. He likes to read the GD Newsletter but wishes the USGS still had a publication like the Cross Section. Al completed four 1:100,000 geologic maps in southwestern Virginia that were digitized by the Virginia Division of Geology and Natural resources by 2008 but has lost track of them.

Scott Tilley: Scott and spouse Joanna have dedicated their lives to giving back to others, as they have been very blessed. They are very involved with their United Methodist Church, Habitat For Humanity (building homes), Compassion International (adopting of children in other countries – Kenya, Africa), Goochland County Family Services, Goochland, VA, teaching and library programs. And they love to travel as time permits.

Toni Watkins: All is going very well for me – my numerous children (6), grandchildren (20), and great-grandchildren (20), and I are about to celebrate my 90th birthday!

S. Jeffress (Jeff) Williams: Jeff works from his home office or goes into the Woods Hole office two to three times a week and is still active, giving interviews and talks and doing journal reviews on topics of coastal and marine geology and climate change impacts such as sea-level rise. Recent publications include the 2013 U.S. National Climate Change Assessment on Coastal Impacts and a paper on Sea Level Rise Effects on Coasts published in the Journal of Coastal Research. Jeff divides his time between Cape Cod and Kailua, HI.

Memorials

E-an Zen died on March 29. As a memorial, we are printing the following biographical notes which he wrote in 2008. – Ed.

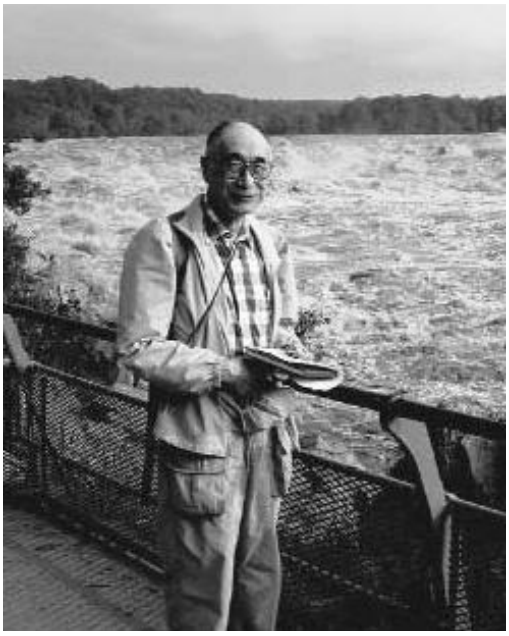
E-AN ZEN'S BIOGRAPHIC SKETCH:
MOSTLY PROFESSIONAL

Born in Beijing, China, May 31, 1928. Father, Hung-chun Zen, mother, Sophia Heng-chi'h Chen Zen. Father trained as chemist (B.A. Cornell, 1916; A.M. Columbia 1917) (he chose this as a way to make bombs as an anti-Manchu revolutionary; nowadays he'd be called a terrorist) but spent nearly his entire professional life in science administration and higher education. Mother trained as a historian (B.A. Vassar 1918; M.A. Chicago 1919) and spent most other life as a social commentator, education reformer, and essayist after an early career as a history professor.

Early years spent in Peking with one-year stay in Chengdu (1935-36) during the period when Father was President of National Sichuan University. When war with Japan broke out in 1937, family left for points south and west, ahead of the advancing Japanese army. The resort mountain of Lushan, 1937-38 (marvelous and fondly remembered winter); Hong Kong, 1938-39; Kunming (when Father was Director General of Academia Sinica and also Director of Institute of Chemistry of AS) 1939-41. One night during that period, living in the country, we experienced harrowing robbery but miraculously nobody was killed.

Mv mother, older sister E-su and I went to Hong Kong December, 1941, en route to Shanghai, where Mother wanted to be to avoid her hated Szechuan and to be near her childhood home. We never got there; Pearl Harbor found us in transit in Kowloon. It was a very foolish thing to do but we children had no say, of course. After six months or so of effort by Mother, by primitive means of transport we

did return to "Free China" during the summer of 1942, and the family, without the oldest sister E-tu, who was in the USA, lived in Chungking 1942-46.



After the war, we returned to the east coast (Shanghai, where we resided in a confiscated Japanese research compound, in a house of tatami and chest-high, bed-sized storage closets which we used as beds). To USA in July 1946 on converted troop ship SS General Meigs. Spent summer at Oakton VA on a farm; then Cambridge High and Latin. Graduating in 1947, my first full year of formal schooling (prior to that, a few abortive attempts at 2nd, 4th, and 10th grades; otherwise, learning through tutors, parents, elder sister, and self-teaching). Considering that I was a freshly-landed foreigner and arrived in school about a month late, I consider it not a bad record to have received top prize in German and in chemistry, among the four subjects taken! This was a crucial year because I got over the fear of math, found algebra easy whereas previously I could never pass any math test. I did well enough to enter college on a scholarship. My fourth subject taken was college English.

Cornell, 1947–51. I wanted to study physical geography (interest in earth sciences started by a love for maps–any maps). A friend during the war years lent me a book on physical geography of China and a book on geomorphology (in 1944) but majored in geology as the nearest available discipline. Thanks to the arrangement made with the chemistry department by Bill HoIser, who was a fresh instructor, I was able to take a lot of advanced chemistry at the same time with my chemistry cohorts. This stood me in good stead. I had enough chemistry, in fact, except for organic chemistry (obligatory for majors) to graduate as a chemistry tutor. In the summer of 1950 I attended field camp in Philips, Maine, as part of Boston University program -against tradition and faculty advice to attend the department's own field camp in Pennsylvania -because I wanted to learn about mapping metamorphic rocks (I don't think I learned much of anything other than some local geology, which was useful in my later life). Happily, I don't think the professors held that against me. At the start of my senior year I was invited to join a group called the Telluride House, an off-campus house funded by some rich industrialist for students of certain academic ranking with free room and board. It was tempting as that would relieve me of my constant and real money worries. However, I declined after some soul searching because I did not want to be part of a closed and elite group. I remain proud of that decision. I graduated with all honors. I was on the Dean's List 8 semesters, junior Phi Beta Kappa, and senior Sigma Xi Associate. My father had always touted how two of his Chinese college friends, "really bright students," did this at Cornell in the mid '10's and used this to guide me. For the first time in my life, I think, he began to think of me as something more than a servant's material.

Harvard, 1951–55. I declined a twice-as-good scholarship from Columbia, which was not an easy decision because I was constantly strapped for money; a special-delivery letter from Columbia was also very flattering to a young and uncertain prospect. However, I am glad to have gone to Harvard, as that gave me a professional turn that I have enjoyed. I began with an experimental project with George Kennedy on crystallizing basaltic melts in a reduced atmosphere (in an open furnace under a bell jar using acetone as reducing agent at (1100°C!), but ended up with Jim Thompson as major advisor. I got a MA in 1952 as I wasn't sure then whether I could stay on for immigration and financial reasons (remember the time: 1952. The cult of McCarthy was in full power and anybody from China was suspect. In fact even still at Cornell I was subjected to a 3 hour interrogation by the FBI, but that is another story).

I was TA for Thompson 1953–55. This was the first time I got over constant financial worries since entering college. Wanted to do a thesis on something independent, so on the advice of Thompson and Marland Billings, I chose the problem of the Taconic klippe as it was a difficult intellectual challenge. I ended up studying the phase petrology of slaty rocks as that topic was then poorly studied (and remains so).

At that time, the reality of the Taconic allochthon was not accepted universally, the controversy was intense but it was driven more by emotion than fact; there was no local proof of its existence, and there was no accepted internal stratigraphy, so there was no handle by which to delineate the allochthon. I was able to establish a reproducible stratigraphy half way through my second field season (the last before my thesis was completed). Well I remembered the morning, on a hill east of north end of Lake Bomoseen, when I found another, then the westernmost, outcrop that carried tiny specks of chloritoid. The previous winter I had

noted on the map the occurrence of this mineral, wondering if there's a pattern and what it might mean; with this last outcrop the pattern suddenly emerged, though not one that I had expected. I then realized I had a hook-shaped structural pattern that agreed with the data I had gathered, so there had to be a large internal nappe as well as a mappable stratigraphy. What exhilaration! To discover what was on the ground, the first time ever, despite all the big name geologists prior to that! Sometime later I was able to recognize and map the refolded nappes on another hill, where the expected but as yet unverified geometric relations and structural elements based on the nappe idea were all laid out on the ground. That too was a good feeling. In both events, about an hour's work time was lost in silent gloating, but it was fun.

I was invited to take my Ph.D. qualifier toward the end of my first year, but I (wisely, I think) declined. I took it between semesters the second year, about 1 year sooner than average. I chose to take the three-hour oral, and I passed okay. The strange thing was that the Department urged me to take this exam in the absence of my major advisor, James B. Thompson, who was abroad. I was in the midst of finals too that week, and after that experience could not face exams again, and the last one I took, spring term, on Statistical Mechanics with Paul Doty, was a grim effort (I did okay).

There followed three years of post-doc at WHOI through arrangement by Bernie Kummel. He wanted someone to look at the sediments from the Peru-Chile Trench that he and Henry Stetson were collecting using the Atlantis 1. I needed an income and thought studying modern sediments could help me interpret the metamorphic rocks such as those I studied for the thesis. Probably not a bad decision, though understanding of the trench was to wait another 15 years or so, when plate tectonics came along. During these 3 years I was able to do x-ray diffraction study of only about 113 of the core samples. The rest were not even opened, and all were later thrown out by Harvard. For doing this study I had to learn something about x-ray clay mineralogy, and Bill Bradley of Illinois Survey took me kindly under his wings. I wanted to model clay mineral transformation during sedimentation and diagenesis using phase-equilibrium methods. Nowadays the reactivity of clay minerals is received wisdom, but not then: Ralph Grim's idea of inert clay minerals was the standard wisdom. I was once sat down by a group of eminent clay mineralogists at a clay minerals annual convention where I went to give a paper. These people kindly but firmly warned me to leave my errant ways because everybody knew that clay minerals were not transformed by short term processes!

Next came a year as visiting assistant professor at Chapel Hill, a nearly disastrous year for personal reasons as well as from departmental philosophical differences. A junior in my mineralogy class – Ben Morgan – later became the Chief Geologist of the USGS. It was a lonely year there. When Pres Cloud asked me during one of my visits to Washington if I would be interested to work for the USGS (he was no doubt prompted by my concerned friends), I jumped at the chance, and at his bidding wrote a precis of what I thought could be done on sedimentary phase petrology. Must have been well enough done because he instituted the procedure to hire me even as a foreigner. Eventually I was hired into the Geophysics (later Theoretical Geophysics) Branch with old graduate school friend Bill Diment as Branch Chief and Gene Robertson as my project supervisor (others on his project were Fred Barker and Dick Robie). My first project was an experimental study of the gypsum-anhydrite equilibrium -highlighted in my precis, then a subject of some interest and debate because of Gordon McDonald's thermodynamic study which challenged then existing experimental (and thermochemical) results. I wanted to test myself: see if I could do competent experimental work. This study satisfied me, though I didn't find this sort of work exciting, so opted to go on to other activities. Anyway, I stayed with USGS from 1959 to the end of 1989, resisting numerous blandishments from universities. I did find it refreshing and replenishing to go on "sabbatical" once a decade, and followed that practice in the spring of 1962 to Cal Tech; spring of 1972 to MIT, which was a bit of a disaster because there was nearly zero interaction with the faculty there, socially or professionally, thanks in part to the layout of the vertical Green Building; spring of 1981 to Princeton which was one of the happiest times of my life because of warm personal friendships that lasted for decades.

I find my first creative work to be a synthesis of the Taconic problem. I stayed with the problem after the thesis was done (though the thesis, truth be told, did not include the mapping project, only a geologic map that I had completed up to then). With other workers in the area, including Don Potter, Bob Shumaker, George Theokritoff, and Bill Berry, we had frequent and intense creative intellectual discussions during the field seasons, and I started to see enough of a larger pattern to devise tests. This was a happy time for me.

I remember clearly: it was in 1960, on the way back from IGC in Denmark, aboard SS Rotterdam, that, on a typewriter borrowed from the ship's purser, in my tiny cabin I wrote out an outline of the solution (which is on the flash drive of my computer; 1960TAC). But then I realized that to understand fully the literature required my knowing what every use of every stratigraphic name by various authors of Taconic geology meant, so this led me to do a textual study (a new twist which I wanted to try my hands on) and thorough review of what's been published. This led to a monographic study, "Taconic stratigraphic names: definitions and synonymies," and set the stage, as a charcoal sketch for an oil painting, for the full regional time-space synthesis that was published in 1967 as a GSA Special Paper,

"Time and Space Relationships of the Taconic Allochthon and Autochthon."

I suspect this study got me into the National Academy some nine years later . I established the dichotomous allochthonous and autochthonous aspects of Taconic rocks and solved the northerner versus southerner bias of whether an allochthon exists. I showed that there is a widely applicable stratigraphy within the allochthon once the nomenclatural mess is cleared up, that there are several independent slices each with its stratigraphic packet and structural style, and that the whole thing fits into the sedimentary and structural evidence and chronology of the region and is a record of the Taconian subduction (we didn't know that then) and deformation event. Nowadays people take the allochthon for granted and refine the internal stratigraphy and thrust structure, but I put forth a new paradigm. It's probably my best piece of work.

My next most satisfying work was on the topology of phase diagrams. It's awkward, but that's because I had no paradigm to guide me. Again, these days multisystem networks are the norm, but I think I contributed to its understanding (simple things like: how many invariant points and univariant lines may surround any given divariant field? How does one explain Ostwald's rule of what we would today call successive metastability?). I regret I never found any collaborator to work on the topological group theory aspect of the problem. I still think that is the way to reach a general solution for n components and p phases.

I chose for my second field area (and first with the USGS) the southern end of the Taconics in Massachusetts. The geology there needed a modern study; it gave me first-hand experience near the southern terminus of the allochthon when I was doing the regional synthesis. I failed to work out a stratigraphy within the allochthon except in the crudest way, but did get to look at its metamorphism and to work out the supposedly "unworkable" internal stratigraphy of the Stockbridge Limestone, which helped to resolve the intricate structure in the carbonates, a stratigraphy that remains useful to this day and by others. This work also contributed to my understanding of the difference between what was then dubbed the "low Taconics" (the slate belt) versus the "high Taconics": we now know they are the near-craton versus the more distal (and early rift) facies of the accretionary wedge in the Iapetus Ocean.

I chose my third and final field area in Montana in order to get away from the Appalachians for something entirely different. I found the stratigraphy pretty cut and dried except for the basal Paleozoic units; I also had to fight the intransigence of some USGS mappers who were more interested in pigeonholing than expanding the horizon. I focused on the igneous rocks, then known only as "Mesozoic quartz-monzonite." This led to my interest in granite. My background in metamorphic phase petrology served me because I asked questions about the phase assemblages of igneous rocks, which, even though certainly mostly diachronous, stilI retained some interpretable early history. This inquiry gave me the head start to ask about igneous geobarometry which I would call my next major creative work. This research project led to granitic rocks in Idaho, Oregon, Washington, British Columbia, and on to southeastern Alaska, in studies partly in collaboration with Dave Brew and Jane Hammarstrom.

A number of things converged to make me retire from the USGS at the time I did, including a wish to create space for young people: I felt that I should put my money where my mouth was. If I could not be part of the solution, I did not want to be part of the problem and outlive my moral welcome. As I got ready, I wrote a "farewell" letter for the Geologic Division's internal newsletter, The Cross Section; I told the editor that he was free to refuse, but if he published it, I would insist that nothing is changed. He was most supportive, and got Chief Geologist Ben Morgan's permission to proceed. I hope it got people to think about their own career paths. I was invited by the faculty of the Department of Geology, University of Maryland, to be an adjunct faculty there, when they learned I was retiring. This was most welcome to me, and I have been pleased with that association, effectively until 2007, with gratitude.

Retirement meant new opportunities: I got curious about potholes in the Mather Gorge area of the Potomac River, and wondered if all were formed the classical textbook ways and broached by later erosion. They just didn't look like that. This led me to measure them and in a short while I came up with the idea of lateral potholes formed on the sides of channels, with an entirely different paleohydraulic implication. Then I wondered if they formed a pattern on the ground and might be formed during a long history of gorge cutting, and so I started mapping them. This led naturally to a project to decipher the gorge history which was then extended to pre-gorge history in time, and to the entire North Branch of the Potomac River in space. Lacking funds and resources to prepare final reports, I put in a series of USGS Open File Reports. I think I have come up with a chronology that is a contribution.

I became a naturalized U.S. citizen in the winter of 1963. I had pretty well decided by then that I was to stay in the United States, and the closeness of the 1960 election between Kennedy and Nixon made me realize that a single vote might make a difference, so about 1961–2 I started the process. I now feel a stranger about China. I do not regret it.

I was married to Tina Silber in 1967 after a four-year courtship. It was a happy event for several years, then slowly, imperceptibly, things went bad, and we divorced in

1979. I regret this outcome very much, but I am grateful that we have remained close friends. My faithful friend and companion of the past 25 years is Alta Walker, whom I love very much.

People ask me, how did I manage to get out of administrative assignments in the Survey? The only one I drew was to be the head of the Massachusetts Cooperative Project, which was then in a state of anarchy and lack of strong purpose, program, or leadership, and I was asked (and I was told right at the start that I was their second choice),to lead it out of wilderness. I managed to do so, thanks to the unstinting support and confidence of Norm Hatch (then Branch Chief) and Jack Reed (then Office Chief). We had a program of making two State maps, one bedrock and one surficial. I headed the bedrock effort myself, and I persuaded Dick Goldsmith, Peter Robinson, Rolfe Stanley, and Nick Ratcliffe to be the principal compilers. We were a congenial and productive group and we finished almost on schedule. The surficial map, I regret to say, was sidetracked after I left the project and has never seen the light of day even though it was only a year from final compilation when I left the project. It was an interesting experience, and I had to make some tough decisions, but I think I served well. The job extended from the summer of 1975 to 1977. The fact is, however, that I was never asked to serve as a Branch Chief or Program Manager until around 1983, when I was asked to take over Doug Rankin's place as Eastern Regional Branch Chief. By then my career has grown past that stage. Later I was invited to be an Office Deputy, which was easy to turn down. I wonder myself why I was not asked much sooner with my age-cohorts for these jobs. "You weren't ready" was one answer given me by a colleague. I resented the answer because it is so reminiscent of pat answers during the Voting Rights debate. Perhaps the management was protecting me from the mundane administrative tasks, so I should be more uncharitable and less complaining.

I tried to act as the conscience of the Division and of the Survey for many years since I gained enough professional recognition and prestige to carry that pretension. The Survey needs people who speak up on issues, with no obvious self-interest. Bitching in private serves no good. The seriousness of one's purpose is measured in part by one's willingness to place his own future on the line. In this vein, I was proud to have been, along with Gene Robertson, Tina Silber, and Doug Rankin, one of the only 4 people who refused to buy Johnson's obligatory War Bonds during the Vietnam War and who did so with a memo to the then Chief Geologist, Hal James, explaining our reason. Later – knowing I was the ringleader– he talked with me about this and kindly assured me that it would not affect my possible promotion; that was when the light dawned on me of why people might not speak up.

People ask me occasionally how I got involved in science education. Part of it may be latent "in my blood" as both my parents devoted a good part of their life to education. My father formal – hierarchical, high level and within the system; my mother less formal – non-hierarchic, reformist, a free spirit, a rebel. Ironically, she put much effort into trying to water down the school-level math curriculum, which in China was pretty rigorous in the 1930s, and she had a phobic reaction to math. She imparted that same emotional response to me until I was in 12th grade – my first full year of uninterrupted formal education in fact – in the United States in 1946, within a different context and away from the apron strings. Now I am trying to upgrade math and science.

When I served on the National Research Council's Geological Sciences Board (which became eventually the Board on Earth Science and Resources), there was a move to have the Board look into the state of earth science education in secondary schools. I was a member of that team, and by elimination the only one not refusing to serve as its chairman. We spent much effort to learn the state of affairs and to write a NSF proposal for a conference. The proposal came to naught, but I was hooked at least at the cerebral level. In 1983 at the Indianapolis GSA meeting there was a symposium on the topic of earth-science education in public schools. I was particularly taken by an eloquent plea by Preston Prather, and I was impressed by the dedication of this small band of brothers who, despite the professional disdain then prevailing about the low-class topic of education, were willing to continue their frustrating effort to do something. So I was getting involved emotionally – a vital step toward commitment.

The next step was when I served as a GSA Councilor. I proposed that GSA get involved in K-12 earth science education, and spearheaded an effort to get a committee going within the headquarters. The ground for this new direction was prepared by the report of the Path to Year 2000 Committee, chaired by Brian Skinner, which was approved by the Council. After much cliffhanging discussion, my suggestion was approved but promptly put on the back-burner by the administration because of other, more pressing tasks (as seen by the decisionmakers). In frustration, I appealed privately to Jack Oliver, then President, to bring education back into life again, and l owe Jack much for his active support. I chaired the ad hoc geoscience committee of the Council and later served on the permanent committee. Members included active teachers, and they gave me the sense of urgency needed to continue with the effort. So this service was a formulating step for me. Visits that Pete Palmer, then the part time coordinator of education for GSA, and I undertook to various scientific and teacher organizations helped me to get into the network, and I was suddenly part of the group, no longer an outsider.

The final step of the emotional commitment was after

I retired from the USGS. I worked with Jim Sproull, then a master teacher (and Presidential Award winner, hence he had some independence and clout) at McLean High School in Virginia. Jim taught 9th grade earth science, and for a semester I spent one morning a week as his informal aide. He had four classes in the same subject, two regular and two honors. I would appear and do whatever I was asked to. Some days I would just observe; other days Jim would pounce on me upon arrival to take over the class discussion on the subject of the day. I would have to wing it, and learn as I went from the first to the fourth class. I acquired a deep respect for teachers, what they had to face, and what miracles they perform daily. I never regretted this decision.

I hope my professional colleagues will recognize that working as an aide to a teacher is a richly rewarding experience, not "beneath our dignity." There is no way one can speak about K–12 education with any real appreciation of the implications without some kind of first-hand knowledge. Professors have the luxury of dealing with specifics according to their own schedule, in ways that can be precise and accurate. Teachers cannot do so because they have to teach the entire group, not just a few; nor do they have the luxury of alterable time tables or the knowledge background to draw upon. So public school teachers have to fight the intellectual battle of making compromises between what can be conveyed in generality that is learnable by the group and what basics must be preserved in order not to destroy the correctness of what is taught. This choice is not as easy or as obvious as one might think. I learned not to blame teachers for giving partly correct answers to the students.

I have also been deeply involved in human rights activities through service on the Committee on Human Rights of the National Academy (CHR). This came about after I attended a symposium organized by CHR. One of the speakers, a Nobel laureate, talked about the future prospect of respect for human rights in China through capitalism which he was an active promoter. I wrote to the Chairman, Torsten Wtese, to dispute that thesis, and the next thing I knew I was on the Committee. I became naturally a point man on matters concerning China. After my service ended I remained as an emeritus member and stayed active and led a Committee effort to make some proper statements on the U.S. violations at Guantanamo and other "black sites." I am proud of these actions, though my name never appeared, being not a regular member of the Committee at the time.

On a totally different subject, one of my long-term contributions, I hope, is to have bought some land in Sugar Hollow in Pittsford, VT, and turned it over to the Nature Conservancy as a preserve. This was feasible because, being without children, I had funds that would otherwise have gone to college education. Tina and I worked together on this, and we are both proud of the accomplishment and the support we were able to gamer from the local community. I have turned over the material dealing with this preserve to the Pittsford Historical Society.

When I was President of GSA (a tenure extended by being the Acting President during Doris Curtis's terminal illness and death, from May to November of the preceding year), my first act was to appoint a blue-ribbon committee to recommend what GSA should do to further the long-term welfare of the Earth's future (nowadays we say sustainability). This group evolved into the Critical Issues Committee (now Caucus). We have a group of bright, innovative, and caring people, and the composition is not fixed. This concern with the Earth's future has focused my mind for the past decade or so. I hope we did some good; certainly, we did no harm. It has been an intellectually rewarding experience and brought me to interact with some marvelous people. I am proud to have been the cause of its existence.

I would like to think that I was more often lighting candles than cursing the darkness; I feel sorry for those who do not. I would like my epitaph to be "He tried."

Chronological markers:

Born May 31, 1928. Left Beijing July 18, 1937. Left China, arriving in the United States July 18, 1946. Graduated from Cornell University, 1951. Ph.D. from Harvard, June 1955. University of North Carolina at Chapel Hill, 1958-59. U.S. Geological Survey, 1959-89. Adjunct faculty, University of Maryland, 1989-2007. Elected to the National Academy of Sciences, 1976. Elected to the American Academy of Arts and Sciences, 1982. President, Mineralogical Society of America, 1975-76. President, Geological Society of America, 1991-92; Acting President, 1991. President, Geological Society of Washington, 1973.

Thomas A. (August) Steven died on 17 October, 2013, at his home in Lakewood, Colorado, from congestive heart failure. He leaves behind his wife Grace, his daughter Barbara Steven, grandchildren Kristy Morrison and Heather Streweler, and great-grandchildren Dylan Morrison, Trent Morrison, Paige Streweler, and Makenzie Streweler. He was predeceased by his son James.

Tom was as good a field geologist as ever wielded a rock hammer, and when this talent was combined with his keen intelligence and curiosity, a work ethic that relished scaling mountains and writing, and common sense, he mastered many fields of geology and made significant contributions in all of them: geologic mapping, economic geology, volcanology, structural geology, interpretation of geophysical and isotopic data, and geomorphology. His primary area of expertise was the intermountain West, especially Colorado and Utah.

Tom was born on 14 October 1917 on a backwoods

ranch near Dryden, southwest of Grants Pass, Oregon, along the eastern margin of the Siskiyou Mountains. His father was Thomas S. Steven, a "buckaroo" in Tom's words, and his mother was Nina, a former schoolteacher.

Gravel roads, commonly one-lane only, connected Grants Pass for nearly 100 miles—many of them intimidating—southwest across the Siskiyou Mountains to Crescent City, California, and then southward along the coast to the Klamath River, where a ferry carried the traveler to the north end of the Redwood Highway. When Tom was two years old, his family moved southwest along this early road to a ranch east of Crescent City. His father trailed cattle and horses, and his undersized mother drove a four-horse team, pulling a covered wagon with Tom, his five year-old sister Ellen, and all possessions aboard. The tie to the pioneers was clear cut. The first decade of Tom's life was marked by several other moves, mostly rural and partly in search of better schools, within Del Norte, California's northwestern-most county. A shy child, he spent much time exploring the mountains, at times on horseback. A later move (1929) to Los Gatos, California, led to his first experience with "modern" education at Los Gatos Union High School, followed by four years at nearby San Jose State College (now University) for a bachelor of arts diploma in 1939. On a whim, he took a physical geology course in his second year at San Jose, resulting in a "sudden mental explosion" whereby geology became his focus and obsession. Tom's graduate studies at the University of California, Los Angeles began in 1939, but were interrupted for a decade by financial circumstances, World War II Strategic Mineral studies with the U.S. Geological Survey (USGS) (1942–1944), naval duty (1945), a return to USGS employment (1945) to study fluorspar deposits in Colorado (1945–1950), and concurrent scholastic studies at UCLA (Ph.D., 1950). He was a busy boy. That included, while exploring the Black Hills for mica—needed in wartime radar systems—in 1944, a detour when he "intersected paths with a beauteous lass fresh off a prairie farm." Grace Dosland, born in Lemmon, South Dakota, became his wife and life's companion on 21 September 1945. Daughter Barbara and son James followed in time. Tom and Grace lived in the Denver area from 1952 onward.

The years 1950–1952 were spent in Washington, D.C., tasked with administrative chores, done well although reluctantly by a natural-born field man. This resulted in Tom accepting a wonderful assignment as project chief to map and decipher the Summitville and then the Creede mining districts in the San Juan Mountains of Colorado, the largest and one of the most rugged Cenozoic volcanic fields in the U.S., yet now considered a mere erosional remnant of the vast Southern Rocky Mountain volcanic field. Perhaps many would view this assignment to be quite a challenge for a man who considered his Ph.D. training primarily that of a geomorphologist. Yet what started as a moderately sized assignment expanded by success into regional studies that fortuitously joined and became major contributing partners in explosively expanding worldwide programs in volcanology and ore deposits. Tom recollected that "at its height, what was determined one day made the previous day's work obsolete. I was professionally ecstatic."

Tom realized that the two districts were caldera controlled. The study of their mineralization and geologic setting continued for years and included colleagues Jim Ratte', Paul Barton, Phil Bethke, and Bob Rye. With recognition of the importance of calderas, in 1964 the project was realigned to focus on mapping the entire Durango 2-degree (1:250,000 scale) sheet, which covered nearly all of the San Juans. Tom ran the project with many colleagues, notably Pete Lipman. Bill Hail compiled most of the sedimentary rocks, Fred Barker compiled most of the Precambrian rocks, and Bob Luedke concentrated with Tom and Pete on the igneous rocks. The project fleshed out the details of the caldera concept, following the initial work on the Valles caldera of northern New Mexico by Bob Smith and Roy Bailey, by discovering and recording the map geometry of what was later determined to be about a dozen of the largest calderas and subsided areas in the country (the largest caldera has a maximum diameter of 45 miles) and their 20 large ash-flow sheets, then explaining how the calderas formed and how they controlled ore deposits in a series of reports and USGS Professional Papers. Insights and discoveries were made in processes of pyroclastic eruption, caldera subsidence and resurgence, megabreccias, caldera walls, igneous petrology and geochronology, ore deposition, etc. Only by geologic mapping, much of it detailed yet necessarily at a rate of one 7.5-minute quadrangle per week to meet deadlines, were they able to make these advances.

The caldera project was a gold standard in investigating volcanic fields, and the scientists' reports set off a spate of studies of volcanic fields across the world. Greater understanding of volcanic-hosted epithermal ore deposits led to greater exploration worldwide. In fact, at Creede alone, Tom and Ratte' were directly responsible for flagging the exploration potential along the Bulldog fault and vein system that subsequently produced 9-digit dollar values, for developing the geologic framework for Barton and Bethke to build on, and for finding several thick caldera-filling tuff sheets that documented caldera collapse! The publication productivity was spectacular because Tom believed that the products, especially on economic aspects, had to be made available ASAP to the taxpayer. In 1970, Tom added the Montrose 2-degree sheet that showed the rest of the volcanic field, although more detailed parts were not released until 1989 as the Montrose 1:100,000-scale map. Maps and reports on the San Juans by Tom and others continued to roll out as late as 1995, yet major summary reports by others are still in the works.

By 1974, as he completed his San Juan work, Tom began the study of the second largest Cenozoic volcanic field in the U.S., that of the Marysvale field in southwest Utah. By 1977, the project was fully under way, with the ultimate goal the Richfield 2-degree sheet, which contained most of the field, then continued west almost to the Nevada border. Again, many colleagues worked with Tom, most notably Skip Cunningham, Hal Morris, Bob Rye, Pete Rowley, Dave Campbell, John Anderson, Chuck Naeser, and Harald Mehnert. To date, well over 200 publications have resulted. The entire geometry of this field, which unlike the San Juans is dominated by stratovolcanoes, was worked out. The mapping also found three large calderas (maximum diameter of the largest, 17 miles) and a small caldera, and detailed a fourth previously hypothesized large caldera. In addition, the study uncovered several new ore deposits, reported on new concepts of ore processes and causes for known ore deposits, and defined the basin-range fault geometry and history. Virtually the entire field was mapped as 1:24,000 quadrangles, then as 1:50,000 and 1:100,000 summary maps, plus the 2-degree sheet. All discoveries trace themselves to the mapping. Perhaps not surprisingly, some of Tom's later fieldwork in the San Juans and much at Marysvale was done on his mare, Samantha (Sam). This was not for the romance of it all; Tom had a bad hip that was eventually replaced, and he needed horse help

Tom officially retired from the USGS in 1985, but San Juan and Marysvale publications, among other topics, are still coming out, some coauthored by Tom, as well as many other publications where he is acknowledged as the person who initiated the idea. In retirement, Tom and Grace enjoyed traveling to Hawaii, Alaska, and many countries in Europe. They also adored their grandkids and great-grandkids, and Grandpa and Grandma were equally loved in return. Not well known are Tom's post-retirement studies and incomplete published record, which provide insight into the young (modern) deformation of the Colorado Front Range and adjacent piedmont, based on interpretation of geomorphology. This work, with Dan Shawe and Dan Knepper, refutes the conventional wisdom that the Rockies are of Laramide age. A few abstracts that describe the young uplift of the Front Range, and a 2008 report in the Mountain Geologist on possible young faulting in the piedmont of north-central Colorado by Shawe, Steven, and Knepper are the only published items. Tom's passing as these studies were in bloom would seem to prevent a fuller development of his remarkable insight into the history of the Colorado Rocky Mountains, but the baton is being picked up by others.

During his career, Tom had more than 150 publications, not including abstracts. Of the publications, more than 40 were geologic maps (twenty 7.5' quadrangles, five 1:50,000 maps, three 1:62,500 quadrangles, six 1:100,000 quadrangles, and three 1:250,000 quadrangles). Of the publications, he was senior author of five USGS Professional Papers and junior author on four others, he was senior author of six large USGS Bulletins and junior author on five others, and he was the senior author of six long articles in major journals and junior author on ten others. Clearly, his legacy is extraordinary productivity of high-quality publications. And perhaps as important, one of his strengths was that he was willing to publish promptly what had been learned (despite recognized uncertainties), so that others could build on it. Therefore his productivity was much higher when we consider the overall publications of the projects he managed and spawned, due to this willingness and his great leadership and mentoring abilities. He reached out to others in academia, the USGS, the minerals industry, and state geological surveys, even when their interests were only marginally related. For example, he offered to have geologic studies done by Professors Lehi Hintze and Myron Best of Brigham Young University published by the USGS as part of his project, and therefore maps and reports of even larger parts of western Utah were facilitated. Clearly he was a master at skillfully coordinating multidisciplinary work by diverse folks. This facilitation included technical and colleague reviews that were detailed, commonly insightful, and always positive, and suddenly now that report was well written, too.

Tom never worried about the glory of first discovery or senior authorship. He and colleagues jointly discovered things and jointly authored the products; nearly all of his publications are multi-authored. The many field trips that Tom led were particularly exciting because—as with his projects—he shared all incompletely documented ideas and urged that others flesh them out and publish them. GSA Special Paper 346 on ancient Lake Creede, published in 2000, was dedicated to Tom for the many germs of ideas that others took up and ran with. In a Christmas greeting to many friends in 2000, he modestly noted that "I never, ever, produced the last word on anything I ever worked on. I never even tried to. All I ever attempted was to build a geologic context for the next generations to use in whatever diverse ways they could." Ideas sprang from him night and day; the ones after 1985 were as important as those from when he was younger.

Tom was one of the profession's best writers. After retirement from the USGS, he discovered that he had talent as a poet, and he authored two volumes of poetry. Most poems would make you laugh, some would make you cry, and all provided the reader with Tom's keen insight and a glimpse into his immense inner resources. Tom was modest and soft-spoken, a gentleman of the highest integrity and standards, for he lived by the golden rule. Yet his influence was far more than fostering the geologic growth of colleagues, for he also personally impacted all persons he met. He was one of the spiritual or mystical ones who possess a great deal of self-knowledge and seem to know

when it is important to share it. Tom also had a delightful sense of humor, much of it self-effacing. Whenever Tom was in the field, he was having fun, and it was infectious to his colleagues. He also was a Fellow of GSA and the Society of Economic Geologists, had a 1987 GSA Rocky Mountain Section symposium dedicated to him, received the Department of the Interior Meritorious Service Award, was the 2000 Dibblee Medalist for Geologic Mapping, and was a past president and honorary member of the Colorado Scientific Society. Yet he doubtless considered these career triumphs to be much less important than his legacy, that of the growth and development of his family, colleagues, friends, and science in general.

We thank Grace and Barbara Steven for their many forms of help with this memorial. Ralph Shroba of the USGS reviewed our manuscript. This tribute was published in GSA Memorials, v. 43, May, 2014:13.

Pete D. Rowley, Pete Lipman, Skip Cunningham, Tom Casadevall, Dan Shawe, Bob Rye, and Bill Spence

Roger Burnham Colton
January 1, 1924–December 14, 2013

Roger B. Colton, in his 90th year, passed away in the company of family, following a long history of heart problems. He was born in Windsor Locks, CT, to Charles Colton and Edith Marte. Roger entered Yale University in 1942 on an accelerated program, which was cut short when he enlisted in the Army in 1943, serving in the Corps of Engineers, 3rd Engineers Special Brigade. When his German language and drafting skills were discovered, he was transferred to the Headquarters Intelligence Section. He served on Goodenough and Biak Islands in the South Pacific, at Finschhafen New Guinea, and on Luzon Island in the Philippines.

After the war he returned to school, graduating from Yale University with a master's degree in geology. Soon after, he met and married Dolores Fehr (they divorced in 1972). Roger moved to Golden, CO, in 1949. He went to work full time for the U.S. Geological Survey, where he worked until retiring in 1988, becoming an Emeritus volunteer until 2012. In 1973 he married Eva Tucker (Adlfinger). Much of his life was spent "in the field" mapping landslides and glacial flows throughout Montana, Nevada, North Dakota, Connecticut and Colorado. He published many important maps during this period.

For many years he volunteered his time as a Scoutmaster. He enjoyed travelling, photography, painting, collecting seashells, genealogy, and reading. He is survived by his wife Eva, sons Steve and Tim, stepsons Scott and Daniel, daughters in law Arlene, Jan, Lois and Ericka, six grandchildren and two great-grandchildren.

Eve and Rog Colton

Byron (Barney) Berger
1944--December 10, 2013

Barney earned BA degrees in both geology and economics at Occidental College and an MS in geology from UCLA. His early career (1971-77) was spent in industry at the Minerals Exploration Department of CONOCO where he focused on gold exploration in Nevada and was the project chief at their Getchell gold mine. A chance encounter with a USGS field crew headed by Ralph Erickson led to a job offer at the Survey. He entered on duty in September 1977.

Barney's early USGS work focused on using a variety of tools including geology, geochemistry, and geophysics to conduct assessments for mineral deposits. He led a major effort in Montana and was later involved in similar studies in Idaho, California, Colorado, and Nevada, as well as Central America and Hungary and in Central Asia. He was able to generalize from his experiences in these studies and, along with colleagues, helped establish methods to conduct and quantify mineral resource assessments. As his career expanded he was involved in a wide range of ore genesis research; he wrote or co-wrote nearly 50 papers on the geology and geochemistry of ore deposits. Several of these papers involved groundbreaking insights into ore genesis in the context of spatial and temporal geologic evolution of the western United States. He brought fresh perspectives on how faulting and fracturing at a range of scales are tied to fluid flow and ore formation. His research defined how features such as small-scale banding of minerals in a vein could be related to the evolution of crustal stress and faulting. His most recent work in collaboration with his Australian colleague Dick Henley focused on vapor phase transport of ore constituents; insights that once again were able to clarify how fine details of mineral textures are linked to the geologic context of ore formation. Some of his work will be published posthumously. Recently, Barney was instrumental in placing USGS remotely sensed hyperspectral data from Afghanistan into an economic geology context. He also brought his combined geologic and economic expertise to the table for a project to characterize the 'life cycle' of rare earth elements from mining to utilization to disposal.

In addition to his role as a scientist, Barney played a large role in the science leadership of the Minerals Program. He served as Branch Chief of the Exploration Geochemistry Branch and later of the Geochemistry Branch for a total of 6 years. He shepherded these groups through major transitions involving melding of the Branches of Exploration Geochemistry and Regional Geochemistry with Analytical Laboratories. Along the way he was able to add top economic geology talent to the personnel mix that quickly led to a leadership role for his branch in economic geology.

Throughout his distinguished career Barney brought a powerful combination of talents to the table. He was the consummate field geologist; a master at recognizing and interpreting the complex geologic context of ores. He linked these field skills with an impressive ability as an integrative thinker by combining his field observations with data that crossed the disciplines of geology, geochemistry, geophysics, and hydrology to address major issues in economic geology. A significant part of Barney's ability to assimilate earth science information was his ability to think across scales. He could utilize data collected at the microscope, local and regional scales and understand how it all fit together, Many of these characteristics were reflected in constantly evolving stacks of maps and papers piled high in his office.

Marty Goldhaber

John Roswell Donnell
September 2, 1919–November 14, 2013

John Donnell passed way at the age of 94 on November 14, 2013, in Centennial, CO. Born in Norwood, MA, to Charles and Alice Louise Donnell, he graduated from high school in Norwood, received a B.S. degree in geology in 1942 from the University of Alabama, and thereafter engaged in graduate studies in geology at Stanford University. He served in the military during World War ll in the South Pacific Theater. In a career spanning more than 50 years as a member of the U.S. Geological Survey, John gained international renown as an authority on the geology of oil shale. His USGS Bulletin 1082-L, published in 1961, was the first comprehensive description of the oil shale deposits in the Piceance Basin of Colorado. John was presented a Meritorious Service Award by the U.S. Department of the Interior in 1979 for his many accomplishments concerning oil shale, coal, and uranium ore.

He is survived by his wife of 66 years, Hazel Traquair Donnell and by his children Jack, Chuck, and Olivia Donnell, and Alison Browne.

Rog Colton

Helen Pakiser
December 24, 2013

Denver native Helen Pakiser passed away few weeks short of her 95th birthday in Denver. She will be remembered for her gracious, thoughtful, and cheerful nature. She married Lou (Louis C.) Pakiser in 1938, when they both were 19 years old.

We know that Helen was tough as well as very loving, to be married to Lou for 62 years, until his untimely death from a fall in 2001. Because much of Helen's life was tied to Lou, one might imagine her very significant supporting role during Lou's exemplary career in scientific research and management. Two issues very important to both Lou and Helen were the education of young people and the promotion of rights of minorities. The proceeds from Lou and Helen's estate will be used to establish an endowed chair in geophysics at Colorado School of Mines.

Bill Spence

John S. "Jack" Pomeroy has died at the age of 85. Jack started with the Survey in the mid-50s as a photogeologist in Military Geology, then joined the Alaska Branch to work in SE Alaska. He subsequently worked on the USGS-Kentucky state geomap coop; most of the rest of his career focused on land stability problems in the mid-Atlantic states. Jack retired around 1990 and moved to Escondido, CA, where he was very active in the community, leading local geological and related field trips, earning considerable acclaim in the local press.

Hank Berg

Other Recent Deaths

Marjorie Doe

Gordon L. Dolton

Warren Finch

Dorothy Glasby

Anita Harris

Virginia Hemley

Blair Jones

Bill Rambo

Ed Ruppel

Diane Schnabel

George Walker

Adel Zhody

RETIREE PUBLICATIONS

RETIREE PUBLICATIONS MOSTLY 2011 – 2014
(PLUS SOME OLDIES)

Note: The references below are compiled from information available as of 17 July 2014. These references are "new" since the Fall 2013 Newsletter (Number 68) but also include some pre-2011 publications not previously listed in prior Newsletters. However, an effort is made to compile **ALL** known publications (whatever year) by Geologic Division Retirees (GDR) for inclusion in the Master List of GDR Publications (now being maintained and updated by Bob Tilling). Please send complete references for any new publications (**but not those still "in press"**) to Bob (e-mail: rtilling@usgs.gov or volkno@earthlink.net), with cc to Odette James (e-mail: o.b.james@verizon.net) as back-up, for listing in the next Newsletter and for updating the Master List.

DAVID A. BREW publication:

Brew, D.A., Tellier, K., Lanphere, M.A., Nielsen, D.C., Smith, J.G., and Sonnevil, R.A., 2014, ***Geochronology of plutonic rocks and their tectonic terranes in Glacier Bay National Park and Preserve, southeast Alaska*** *in* Dumoulin, J.A., and Galloway, J.P., eds., Studies by the U.S. Geological Survey in Alaska, 2008–2009: U.S. Geological Survey Professional Paper 1776-E, 18 p. http://dx.doi.org/10.3133/pp1776E.

(JOHN) DAVID BUKRY publications:

Bukry, J. D., 2008, ***DSDP Memory Lines***: Geologic Division Retirees Newsletter, Number 58, Spring 2008, p. 3-5.

Barron, John Authur, Bukry, David, Heather Cheshire, Heather, 2012, ***Surface Water Conditions in the Central Gulf of California During the Past 52 Kyrs Based on Diatoms and Silicoflagellates: Implications for Monsoonal Moisture Transport***: 2012 AGU Fall Meeting Abstract, ID# 1490559, 1 p.

Barron, John, Bukry, David, Field, David B, and Finney, Bruce, 2013, ***Response of diatoms and silicoflagellates to climate change and warming in the California Current during the past 250 years and the recent rise of the toxic diatom Pseudo-nitzschia australis***: Quaternary International. 310, p.140-154.

Wells, Ray, Bukry, David, Duncan, R.A., Friedman, R.M., Haeussler, P.J., Pyle, .G., and Wooden, J.L., 2013, ***Siletzia, a Large Igneous Province in the Oregon and Washington Coast Range – Correlation to the 2012 Geomagnetic Polarity Timescale and Implications for a long-lived Yellowstone Hot Spot***: Geological Society of America Abstracts with Programs. Vol. 45, No. 7, p. 361.

Barron, J.A., Addison, J.A., Bukry, D., and Kusler, J., Heusser, L. E. and Finney, B. P., 2013, ***High-resolution paleoclimatology of the coastal northernmost California during the past 7,400 years***: AGU Fall Meeting Poster PP33A-1902, 1 p.

Barron, John A., Bukry, David, and Cheshire, Heather, 2014, ***Response of diatom and silicoflagellate assemblages in the central Gulf of California to regional climate change during the past 55 kyrs***: Marine Micropaleontology 108, 28-40. http://dx.doi.org/10.1016/j.marmicro.2014.02.004.

JOAN WILLIAMS HOOVER publications:

Hoover, J.W., 2014, ***The History of the Cosmos Club Associates: The First 25 Years, 1988-2013***: published as a booklet.

KEITH A. HOWARD publications:

Howard. K.A., John, B.E., Nielson, J.E., Miller, J.M.G., and Wooden, J.L., 2013, ***Geologic map of the Topock 7.5-minute quadrangle, Arizona and California***: U.S. Geological Survey Scientific Investigations Map SIM-3236 (1:24,000), with pamphlet, 60 p. Online, http://pubs.usgs.gov/sim/3236/.

Howard, K.A., Bacheller, John, III, Fitzgibbon, T.T., Powell, R.E., and Allen, C.M., 2013, ***Geologic map of the Valley Mountain 15-minute quadrangle, San Bernardino and Riverside Counties, California***: U.S. Geological Survey Map GQ-1767 (1:62,500), with 17-p. pamphlet. http://pubs.usgs.gov/gq/1767/.

Howard, K.A., Jagiello, K.J., Fitzgibbon, T.T., and John, B.E., 2013, ***Geologic map of the Lead Mountain 15' quadrangle, San Bernardino County, California***: U.S. Geological Survey Geologic Quadrangle Map GQ–1766, scale 1:62,500, with 17-p. pamphlet, http://pubs.usgs.gov/gq/1766/.

Stone, Paul, Stevens, C.H., Howard, K.A., and Hoisch,

T.D., 2013, ***Stratigraphy and paleogeographic significance of the Pennsylvanian-Permian Bird Spring Formation in the Ship Mountains, southeastern California***: U.S. Geological Survey Scientific Investigations Report 2013–5109, 40 p.,†http://dx.doi.org/10.3133/sir20135109.

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Ferguson, C.A. and Howard, K.A., 2013, ***Early Miocene Silver Creek caldera as a strain marker in the Colorado River extensional corridor, USA***: Geological Society of America Abstracts with Programs, v. 45, no. 7, Paper 253-13 (Abstract No. 233596).

Howard, K.A., House, P.K., Dorsey, R.and Pearthree, P.A., 2013, ***A major Pliocene fluvial aggradation along the lower Colorado River and its implications for Colorado River evolution and tectonics***: Geological Society of America Abstracts with Programs, v. 45, no. 7, Paper 97-8 (Abstract No. 224601).

KEITH KVENVOLDEN publication:

Kvenvolden, K.A., 2012, ***Fifty years of IMOG (International Meetings on Organic Geochemistry)***: Organic Geochemistry, v. 53, p. 5-7.

KARL S. KELLOGG publication:

Kellogg, K.S., Lee, Keenan, Premo, W.R., and Cosca, M.A., 2013, ***Geologic Map of the Harvard Lakes 7.5' Quadrangle, Chaffee and Park Counties, Colorado***: U.S. Geological Survey Scientific Investigations Map 3267, scale 1:24,000, with 25 p. pamphlet.

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Milici, R.C., 2011, ***Assessment of the Devonian gas shales of the Appalachian basin – a critique***: The Society for Organic Petrology twenty-eighth annual meeting Program & Abstracts v. 28, p.43-44.

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Milici, R.C., Coleman, J.L., and Kirschbaum, M.A., 2013, ***Assessment of the Marcellus Shale, Utica Shale, and East Coast Mesozoic basins in the eastern United States – a review***: Canadian Society of Petroleum Geologists, Geophysicists, and Well Drillers GeoConvention 2013, Calgary, Canada (Abstract for Keynote talk); http://geoconvention.org/archives/2013abstracts/032_GC2013_Assessment_of_the_Marcellus_Shale.pdf

Milici, R.C., Coleman, J.L., Rowan, E.L., Cook, T.A., Charpentier, R.R., Kirschbaum, M.A., Klett, T.R., Pollastro, R.M., and Schenk, C.J., 2012, ***Assessment of undiscovered oil and gas resources of the East Coast Mesozoic basins of the Piedmont, Blue Ridge Thrust Belt, Atlantic Coastal Plain, and New England Provinces, 2011***: U.S. Geological Survey Fact Sheet 2012–3075, 2 p. (Also available at http://pubs.usgs.gov/fs/2012/3075/.)

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Robbins, Eleanora, and Rubin, Penni, 2012, ***Science Explorer's Club on Indian Reservations in San Diego County, California*** (abs.): 34th International Geological Congress, Brisbane, Australia, p. 1538 (on CD).

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ROBERT I. TILLING publications:

MariÒo, J., Rivera, Marco, Thouret, Jean-Claude, Cacya, Lourdes, Siebe, Claus, Tilling, Robert, Ch·vez, Antonio, Salas, Guido, and Z·Òica, Sebasti·n, 2006, ***EvaluaciÛn De Peligros Volc·nicos Y ElaboraciÛn Del Mapa De Peligros Del Volc·n Misti (Arequipa)*** [Extended Abstract]: XIII Congreso Peruano de GeologÌa. Res·menes Extendidos, Sociedad GeolÛgica del Per·, p. 673-675. [Previously unreported].

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Moser, S.C., Williams, S.J., and Boesch, D.F. 2012, ***"Wicked" challenges at land's end: managing coastal vulnerability under climate change***: Annual Review of Environment and Resources, p. 51-78.

Williams, S.J., Flocks, J., Jenkins, C., Khalil, S., and Moya, J., 2012, ***Offshore Sediment Character and Sand Resource Assessment of the Northern Gulf of Mexico, Florida to Texas***: Journal Coastal Research, Special Issue No. 60, p.30-44.

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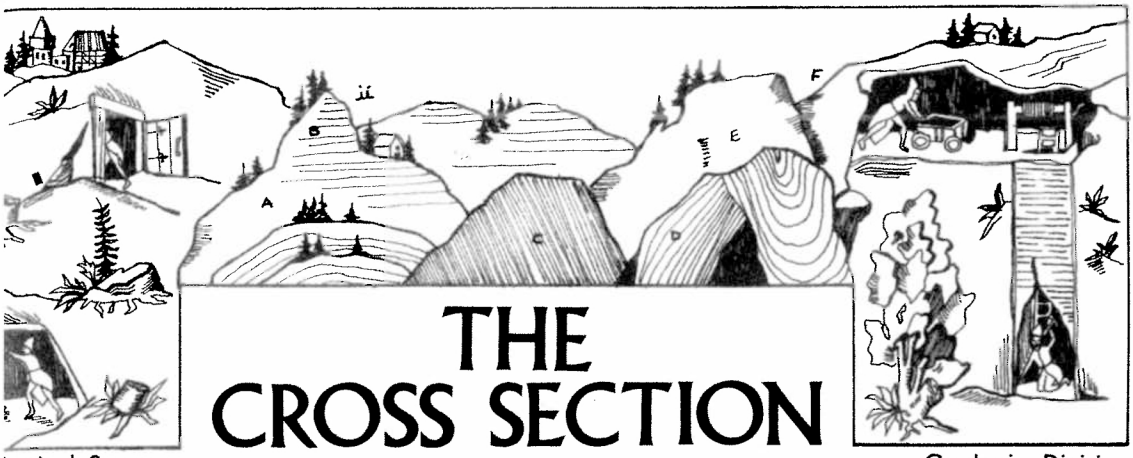
USGS Old-Timers (1963-70) - Flagstaff Field Center 50th Anniversary

Gerry Schaber Carol Breed McCauley Larry Soderblom Ivo Lucchitta George Ulrich Hugh Thomas
Baerbel Lucchitta Ginny Hall Keiper Carolyn Shoemaker Ray Jordan Ed Wolfe Pat Bridges
Yolanda Valdovino Bill Tinnin 7/26/13

Last year the Astrogeology Team in Flagstaff, AZ celebrated its 50th Anniversary. The discipline of Astrogeology, later called Planetary Geology, was founded by Eugene Shoemaker, and in 1963 he and a number of early members of the Branch settled in Flagstaff. It was a good location for the anticipated exploration of the Moon because there were telescopes at Lowell Observatory for viewing the Moon, volcanic features for astronaut training, and the impact structure Meteor Crater. Not least of all, Gene liked the idea of living in Flagstaff. Eventually Flagstaff became a major center for training the astronauts and for planning the scientific exploration of the lunar surface during the Apollo missions.

As part of the annual picnic of the Astrogeology Team and to celebrate the anniversary, we organized a reunion of retired Astro members who still live in the vicinity of Flagstaff. The effort was successful and we rounded up nineteen "old-timers". Fourteen are shown in the attached picture, taken by George Ulrich. Not shown are Eric Eliason, Henry Holt, Jim Torson, Juanita Velasco, and Wes Ward. We all had a great time until a violent thunderstorm, common in Flagstaff in July, put a rapid end to the celebration. It was fun to see so many venerable people mingle with the crop of "young" scientists and staff of the current Flagstaff Science Center.

Baerbel Lucchitta



THE CROSS SECTION

logical Survey
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Geologic Division
May 1971

Geologic lunar rover, known as Glover

Articles below from Cross Section, October, 1970

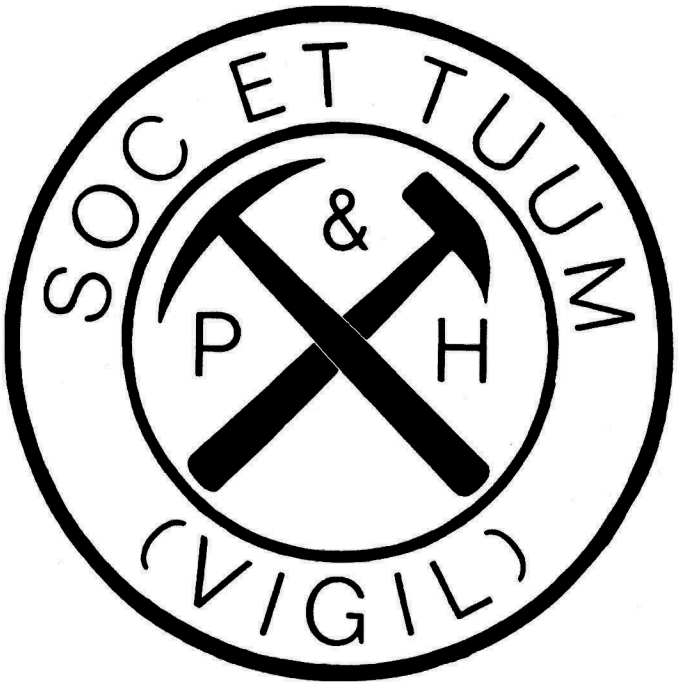
Cratering for Astronauts

D. J. Roddy reports that 13 astronauts participated as part of the U.S. Geological Survey project in the Dial Pack 500-ton TNT crater experiment at the Defense Research Establishment, Suffield, Alberta, Canada. They included: G. P. Carr, C. M. Duke, Jr., R. F. Gordon, Jr., J. B. Irwin, W. R. Pogue, D. R. Scott, A. M. Worden, J. W. Young, J. P. Allen, V. D. Brand, A. W. England, F. W. Haise, Jr., and H. H. Schmitt. Roddy and Dr. G. H. S. Jones, Maritime Command, Canadian Government, gave a pre-shot technical briefing to the astronauts and conducted the field examinations of the crater.

The field observations by the astronauts immediately after the explosion offered them an unusually good opportunity to observe the entire formation history of a large "fresh crater" that has many of the surface characteristics of the lunar craters at the Apollo landing sites. They were taken to the crater within five minutes after detonation and were able to construct a relatively complete sequence of cratering events from direct field observations. Numerous lunar analogs such as the blocky overturned flap, central uplift, fused material, concentric ridges and fractures, and raised rim were correctly described and placed in their proper cratering sequence of formation.

Walking vs. riding at Marius Hills

E. W. Wolfe, and G. E. Ulrich prepared a brief document comparing predicted results of a walking vs. riding Apollo 16 mission to Marius Hills at the request of A. W. England, mission scientist for that mission. The study showed that a walking mission provides fewer stations with longer average station times but adequately meets only two out of six primary geographic objectives. The riding mission permits substantially more stations but shorter average station times; it achieves five of six primary geographic objectives by permitting a range of 7½ km from the landing site and a lower astronaut energy consumption while traveling.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