

2009 MEDALS & AWARDS

PENROSE MEDAL

Presented to **B. Clark Burchfiel**



B. Clark Burchfiel
Massachusetts Institute of Technology

Citation by Gregory A. Davis

It is my pleasure and honor to compose this citation for the Society's 2009 Penrose medalist, Burrell Clark Burchfiel of the Massachusetts Institute of Technology, my friend of 50 years. Our early careers in the Earth Sciences were closely intertwined with joint research on Cordilleran tectonics, but despite following his scientific accomplishments since then, I was "blown away" as I read, for the first time, Clark's remarkable CV. It documents his lifetime of contributions to our science, and in the words of R.A.F. Penrose Jr. his "eminent research in pure geology" and his collective achievements in advancing the science of tectonics. Why was I so surprised to learn the enormous totality of Clark's scientific and professional contributions to the earth sciences? Because he does his research, writes his papers, guides his students, and serves this Society and others without fanfare or personal self-aggrandizement. He is truly an admirable man.

The Penrose Medal was intended to encourage and to recognize original work in pure geology. In Clark's case, this work is in continental tectonics. It is not unusual for tectonicists, in the broadest sense, to receive past Penrose Medals. The list in just the last two decades illustrates the wisdom of past Penrose committees with awardees like Hamilton and Dickinson, Dewey and Crowell, Oliver and Ernst, and, most recently, Burk and Thompson. Clark, in my opinion, stands equally tall amongst them, but differs from most in a fundamental way.

For five decades the foundation of his tectonics studies has been field mapping and field-related research — on the slopes of Everest, the deserts of the US Southwest, the Appalachian forests, the Scandinavian Caledonian arctic, the Carpathians, the ethnically-conflicted Balkan states, and the Tibetan Plateau and its transitional margins. At the ripe young age of 74 his fieldwork continues, most currently in Greece. I know of no earth scientist who has walked and climbed across more of the Earth, measured its outcrops, mapped its structures, sited GPS stations to measure its strains, and then sat down to write up his discoveries. Many of us "field types" use our fieldwork as an excuse for not writing large numbers of papers — an excuse Clark has never found appropriate. He has published some 180 papers, half of them as senior or first author. This is a remarkable legacy.

Clark's internationalism has landed him positions on editorial boards of publications from Norway, Turkey, Switzerland, China, and the US. Mention of this service is not in itself Penrose support material, because the medal is not awarded for administration or service. It is, however, meant to be a measure of the scientific impacts that Clark's research has had on different continental regions. For example, in recognition of his pioneering work in Tibet and China, beginning in the early '80s he was made a Foreign Member of the Chinese Academy of Sciences (one of only two American geologists so honored).

Specific scientific contributions? To list only a few among many that have influenced our understanding of continental tectonics: the recognition of the pull-apart origin of Death Valley (1966); early studies on the Appalachian Brevard zone (1967); recognition of the US Cordilleran orogen as being tectonically two-sided and the first plate tectonics interpretation of it (1968 and 1972, respectively, both with this writer); the geology of Romania (1974 and 1976); modes of extensional tectonics (1982, with his student Brian Wernicke); north-south extension within the convergent Himalayan region and a dazzling explanation for the Cordilleran Antler Orogeny (1985 and 1991, respectively, and both with Leigh Royden); the tectonic evolution of the US Cordillera (1992, Burchfiel et al); tectonics of the Longmen Shan (1995, with others; when the disastrous Wenchuan earthquake struck the region in May, 2008, Clark's pioneering work in the region supplied the geological and geophysical framework for understanding this tragic event); mid-crustal strain-partitioning in

the Norwegian Caledonides (1996, with C. J. Northrup); and various multi-authored GPS-related papers on the crustal flow of Tibet (ca 1995 to the present).

The latter example introduces another facet of Burchfielian tectonics. I have emphasized his years of superb fieldwork, but Clark is not one-dimensional in his scientific practice. He uses whatever evolving techniques and technologies in geodetics, geophysics, geochemistry, and tectonic modeling he can find to augment his field studies. He was the first earth scientist to see the importance of establishing a GPS network along the eastern and northeastern margins of Tibet. As such, he mentored a cadre of Chinese earth scientists in funding and setting up the network that has led to strikingly new theories about the rheology of the Tibetan thickened crust and its response to continent-continent collision.

My final words celebrate the scientific/academic extension of Clark's remarkable contributions and abilities through his graduate students. Teaching is also not a criterion for the awarding of a Penrose grant, but recognition of the consequences of his advisement of 85 students, first at Rice University and then at MIT, might be! Imagine the collective advances of continental tectonics through the work of his students — 50 of them doctoral — some of whom may one day themselves qualify for a Penrose Medal. The list is impressively long and includes many whom have become professors and have passed on to their students Clark's foundations of civility, science and scientific methodology.

In closing, Clark Burchfiel, is profoundly worthy of Penrose Medal recognition for his "eminent research in pure geology and for his outstanding original contributions and achievements" that have marked decades-long major advances in our understanding of continental tectonics. His impact on the earth sciences has been genuinely enormous!

Response by B. Clark Burchfiel

"A Time for Gratitude and Reflection" *from Gold Medal Lecture Series*

I want to thank Greg for his wonderful citation. He and I have been close friends and colleagues for more than 50 years, and our fieldwork together in the Cordillera has been some of the most pleasant memories that I have in my scientific career.

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GSA has been my societal scientific home for nearly half a century, and it was perhaps the most rewarding experience in my career to learn that I was awarded the Penrose Medal. It makes one reflect as to how this was possible, because my academic career certainly did not have a sterling beginning. In high school the only things of importance were surfing and athletics, and I got through my classes in unspectacular fashion. Everyone was amazed when I was accepted at Stanford, although on a football scholarship, where my first two years were also less than spectacular as I had to take bonehead English 4 times before I passed.

As I look back, it was the Stanford undergraduate education that changed my thinking and started me on my career trajectory. Introductory geology courses were well taught with a touch of humor and on the field trips I found that geology took me outdoors where I could climb mountains at the same time as doing science. In the last two years at Stanford my whole life changed to one in which academics along with field studies became my major interest. Mentoring by faculty was very important. Si Muller took the time to select a field area to study even before I had taken the field geology course, and he visited Bill Travers and me on several weekends in Coalinga, California. More importantly, I still recall when Hubert Schenck, my masters thesis advisor, asked me what would I do after my Masters degree. I said I would go into the oil business, an interest I had having worked on drilling rigs for Shell Oil Company for 4 summers while at Stanford. He said, "No, you are going to Yale to study for a PhD with John Rodgers". Looking at my less than sterling early academic record, I didn't think that was possible. What I didn't know was that Schenck had been an army general in WWII and Rodgers worked for him during the reconstruction of Japan's mineral resource base. I still believe, but no one admits it, that there was some pulling of rank that got me to Yale.

A second major change in my interests and motivation was at Yale. John Rodgers, a Penrose medalist (1981), introduced me in his courses to the geology of the world and instilled in me that you had to look carefully at the rocks from the outcrop to regional scale to unravel geological history. John often said he was a poor teacher, but nothing could be further from the truth as he taught by example and it changed my interests to field-based tectonics and regional geology. I had the great fortune to have for one year, Professor S. W. Carey as my major professor while John was

on sabbatical leave. Even though Professor Carey was a proponent of earth expansion, he had a global view and continued my introduction to regional tectonics and inspired even greater interest in global geology.

Upon graduating from Yale with my PhD in 1961, I faced a job market that is not unlike today. I had one job offer from an oil company, where my early interests lay, and one from Rice University. Because of my change in interests during my graduate studies at Yale, I chose the position at Rice University, hired by Carey Croneis, a geologist, but also one of the most wonderful administrators I have ever worked for. Rice was a wonderful school and a great place to begin an academic career where I received significant support for my field studies from the University (very early NSF days).

In my second year at Rice (1962) I was accepted to go on the first NSF-sponsored AGI Foreign Field Conference that was to the Alps. The six weeks trip into the Alps was conducted by several giants of geology, Rudi Trumphy, Augusto Gansser and Heili Badoux, whose explanations of the geology showed how detailed field study by several generations of geologists could unravel the finer details of mountain building processes. It was my first foreign trip, as it also was for my citationist Greg, and we were both inspired by the excitement of seeing how detailed geological understanding can be used to interpret the geology of orogenesis. Trumphy and I became good friends and every summer for about a decade following the field conference, he invited me to return to Switzerland when he visited students in the field so I could learn more about the Alps. But I wanted to work there, and in 1967-68 I received a Guggenheim Fellowship for one-year study at the University of Belgrade to study the Dinarides in then Yugoslavia. It was during the early 1960's that I was inspired to not only climb the mountains to do geology, but when you got to their summits to reflect on what you had studied, but also to see what was on the other side of the mountain. It showed me the way to future study and I still use this as a metaphor for a guide to future research. Looking east from the mountains of the Swiss Alps I could see the wonderful geology of the Alpine system stretching as far as I could see and beyond into SE Asia. That year in the Dinarides allowed me to study one of the most poorly known segments of the Alpine chain and also to read extensively on all of the eastern European part of the chain. From 1968 to today I have not been able to stay away from it and have worked in the Carpathians, Dinaride-Hellenides and Turkish parts of the

orogen. This gave me the opportunity to not only work on some fantastic geology, but to work with a host of wonderful geoscientists.

Looking on the other side of the mountain in 1968 led me to arctic Scandinavia because my students in metamorphic geology needed to have a place to work where the rocks were well exposed, after two of my first students labored in the forests of the southern Appalachians. I was blessed with an outstanding group of graduate students over a 25-year period to complete a cross section of the northern Caledonides. Although we did not realize it in the beginning, it became apparent that here was a deep level of an orogen exposing the subduction boundary down-dip for 200 km across the orogen, one that has possible analogs to the deep structure beneath the modern Himalaya.

While research in Eastern Europe and Scandinavia were in progress I was invited in 1976 by Frank Press to join the Department of Earth and Planetary Sciences (now the Department of Earth, Atmospheric and Planetary Sciences) at MIT. This was another boost to my career to join a larger and more multidisciplinary group of scientists. This opened the doors to a wider range of interaction in many different areas of Earth Science research. I have often said that the department at MIT is a place I could never leave because of the stimulating multidisciplinary research and cooperation that is possible and, I would add, in a very friendly environment. The work in Eastern Europe and Scandinavia continued and in 1980, I had the opportunity to see on the other side of the mountain in China, where Peter Molnar opened the door for me. I had the opportunity to begin a wholly new series of studies that have lasted to today. Peter introduced me to Quaternary Geology and Neotectonics as a part of geology that is more than just the dirt that covers real bedrock. China offered the opportunity to work on geology that has many aspects different and on a much larger scale from the Alpine system of Europe and Turkey. For nearly 30 years, Chengdu and Beijing have been a home away from home from which I could select field projects that I considered of regional and global significance. From Beijing, in cooperation with Deng Xidong, we worked on active tectonics on the Haihuan fault and on the flanks of the Tien Shan. From Chengdu in a cooperation with Chen Zhiliang, with whom I have worked for 25 years, we went to the Himalaya to work on the South Tibetan detachment, the Longmen Shan and adjacent regions, and more recently on the Cenozoic

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I have worked briefly in other parts of the world, but the Western United States, Eastern Europe, Scandinavia and China have been the most long-lasting.

All these areas of research have involved four groups of people who have been the major influences on my career. There are the mentors whom I have mentioned above, and all of us in the academic business should be aware of the powerful influence mentors have. Second, are the graduate students with whom I have worked. All 50 PhD's and 35 MSc's have been great fun to work with and even though there was a teacher/student relationship I must admit I often learned just as much from their fertile and unencumbered minds as they learned from me. To watch them grow to become leaders in our science after they left Rice and MIT has been a continuing source of satisfaction and pleasure, and remains the most long-lasting

legacy of teaching. Third are colleagues. My colleagues both at Rice and MIT have been very influential in opening my eyes to new ideas, technologies and ways of thinking. I can single out two in particular, Peter Molnar and Leigh Royden, both of whom have great physical insight and taught me much about the physics of the Earth and new ways to think about geotectonic processes. Bob King and Rob van der Hilst have collaborated on our projects and helped me to understand how modern geodesy and geophysics can be used to help solve major geological problems. No thanks for the Penrose Medal would be complete without expressing my deep appreciation to Greg Davis for both his friendship and geological discussions beginning more than 50 years ago, from our time as fellow undergraduate students at Stanford. The fourth group of scientists who have greatly influenced in my studies are my foreign colleagues, almost too many to name. They have also given me new insights in

geological thinking that often do not infiltrate into North American thinking. The ones I have worked most closely with have been Rudi Trumpy, Knut Heier, David Gee, Frank Horvath, Mircea Sandulescu, Kosta Petkovic, Boris Sikosek, Dimitios Papanikalou, Tsako Tsankov, Radoslav Nakov, and last but not least Celal Sengor, the only one of these people whom I have know as both a student in class as well as a fellow research scientist and about whom I could tell numerous stories, but perhaps only in private conversation.

Every one whom I have heard give thanks for receiving the Penrose Medal offers very similar thanks to all those who have influenced their careers, and it is clear that no one stands alone in receiving this award.

For the future while I am still healthy I plan to continue to do field geological research as long as the body is willing for this is much to see on the other side of the mountain.