PENROSE MEDAL

Presented to
Paul F. Hoffman

Paul F. Hoffman
Harvard University (Emeritus)

Citation by Raymond A. Price

I am pleased and honored to present the citation for GSA's 2011 Penrose Medalist, Paul F. Hoffman. The Penrose Medal is *"awarded in recognition of eminent research in pure geology, for outstanding original contributions or achievements that mark a major advance in the science of geology"*. Paul Hoffman is an eminent world leader in the elucidation of the Proterozoic evolution of the continents, and also of Proterozoic paleoceanography and paleoclimatology, particularly the Neoproterozoic "Snowball Earth" episodes of global glaciation. Paul's outstanding original research contributions mark major advances in the science of geology. His insightful interpretations are firmly rooted in meticulous geological mapping and related field and laboratory studies, as well as in a broad and deep understanding of how the Earth system works. He knows how to read the rocks.

Paul Hoffman went to McMaster University to study geology; but also, at the invitation of the track coach, to train as a marathon runner. Inspired by his teachers, and by summer work on field parties of the Ontario Geological Survey and the Geological Survey of Canada, Paul flourished academically, graduated at the top of his class, and moved on to The Johns Hopkins University for post-graduate studies. Following the dictum of one of his undergraduate professors, that orogenic belts should be studied from the outside in, he set out to study and map one of the best exposed and most accessible belts of Paleoproterozoic sedimentary rock in the Canadian Shield, the region around the East Arm of Great Slave Lake, between the Slave Province, an Archean craton, and the deformed Paleoproterozoic rocks of the Churchill Province. He expected to find a south-facing continental terrace sedimentary wedge and overlying foreland basin along the southern margin of the Archean Slave craton, comparable with those of Paleozoic age in the Appalachian foreland belt. Instead he discovered and documented a west-facing failed rift arm, the Athapascow aulacogen, containing a wedge of shelf, slope, and ocean basin deposits, overlain by foreland basin deposits that recorded a reversal in paleocurrents and sedimentary provenance. This pointed him toward a north-trending collisional orogenic belt between the western Slave Province and the Paleoproterozoic rocks of the Bear Province. Paul had demonstrated that the stratigraphic, sedimentologic, and tectonic concepts and techniques used for deciphering the tectonic evolution of Paleozoic rocks of the Appalachians are just as effective in rocks that are about four times as old. However, he also had shifted his quest for a Paleoproterozoic collisional plate boundary from the south side to the west side of the Slave Province. There he subsequently demonstrated the presence of a Phanerozoic-type orogenic belt that he named the Wopmay orogen.

While working on his Ph.D., Paul Hoffman became the third all-time fastest Canadian marathon runner; spent several months investigating Holocene stromatolites in Florida, the Bahamas, Western Australia and Abu Dhabi; and spent a year teaching at Franklin and Marshall College in Pennsylvania. After completing his thesis, Paul joined the Geological Survey of Canada and began the systematic exploration and mapping of the Wopmay orogen.

During this long-term project, Paul and his student-assistant collaborators convincingly documented the role of plate tectonics in the Paleoproterozoic evolution of the northwestern Canadian Shield. In a dozen years, eight 1:250,000 scale geological maps and a very large number of scientific papers and Ph.D. theses were produced, documenting the tectonic evolution of the foreland thrust-and-fold belt, the metamorphic internal zone and the volcano-plutonic arc of Wopmay Orogen, and also two associated aulacogens, and the Great Slave Lake intracontinental transform shear zone. This work provided a conceptual framework for using aeromagnetic anomaly maps, Bouguer gravity anomaly maps, and radiometric dating of borehole samples for plate tectonic interpretations of Precambrian rocks that are concealed by overlying Phanerozoic strata within the interior of the North American continent. It led to Paul Hoffman's masterful review of the Proterozoic tectonic history of North America, published in two GSA Decade of North American Geology volumes and in Paul's classic review paper: "United plates of America, the birth of a craton".

After he left the Geological Survey of Canada in 1992, Paul Hoffman's main research focus shifted to Neoproterozoic global tectonics and glaciations and to Earth system evolution. As Sturgis Hooper Professor of Geology at Harvard University, he launched an ambitious fifteen-year field program in Namibia. There his careful documentation of structural and stratigraphic relationships provided the geological framework for important geochronologic, tectonostratigraphic and chemostratigraphic investigations of Neoproterozoic glaciations. In collaboration with his graduate students and academic colleagues, these investigations were extended to Svalbard, Arctic Alaska, northwest Canada, Mauritania, Mongolia, and several parts of Australia. Paul's ensuing elucidation of the Kirschvink model of a Neoproterozoic Snowball Earth has provided important new insights on the nature and significance of the abrupt shifts in the global climate system between protracted intervals of global "icehouse" conditions followed by global "hothouse" conditions that occurred during an important interval in the evolution of the Earth system: -- the interval encompassing the break-up of the supercontinent "Rodinia" and the emergence of the first multicellular animals in the fossil record.

Paul Hoffman's articulate and skillfully illustrated oral presentations and publications are characterized by a combination of succinct, insightful observations, and elegantly innovative interpretations, and by an uncanny ability to integrate scientific data and concepts across disciplinary boundaries.

These scientific achievements have been recognized with major honors and awards from the European Union of Geosciences, the Geological Society of London, the Geological Society of Namibia, the Geological Society of South Africa, as well as from many organizations in Canada and the U.S.A., and now with the Penrose Medal.

Response by Paul F. Hoffman

My first geological conference was a Northeastern Section Meeting, my first talk was at a GSA Annual Meeting, a Penrose Conference was my international debut, and my first Plenary Lecture was at The Decade of North America Geology (DNAG) Meeting in Denver. GSA is my home Society. This high honor is therefore unique.

Thank you, Ray, for bringing the past back to life. Thanks to all those who wrote letters of support, and the selection committee that decides who waits.

Three excellent geology departments fashioned my early development—at McMaster a hobby became a nascent urge to decipher the tectonics of the Canadian Shield, at Johns Hopkins I learned from "the most elegant mountain range on earth", and at Franklin and Marshall I experienced thrills in teaching I never quite managed to recreate elsewhere.

My catapult as a geologist was a thesis project sponsored by Geological Survey of Canada (GSC). The east arm of Great Slave Lake is packed with more interesting geology than anywhere else its size. My thesis led to fifteen years of 1:250K-scale mapping in northern Wopmay orogen with GSC. Mapping entire orogens dovetailed perfectly with a comparative approach to tectonic change over geologic time. It bred familiarity with sedimentary, structural, metamorphic and igneous geology. Thesis projects by some of today's leading geologists fostered academic-government symbiosis. Some were by U.S. nationals, which did not always sit well north of the border. Our student assistants included women, an innovation that quickly spread. We practised 'non-stop' mapping to cope with aerial haemotrophy, the price of admission to the Canadian Shield in summer.

Bert Bally and John Wheeler invited me to participate in the DNAG project. Wopmay write-up was curtailed, but I had summer months in Ottawa when my son Guy was a child. Being at the office, however, didn't relieve the burden on his mother Erica of having two Hoffmans to support. Synthesizing the Precambrian of North America was surprisingly like mapping a 250K sheet—published maps, reports, theses and papers being outcrops. Like any map-sheet, the structure of Laurentia is rudely truncated at its margins, so formerly adjacent continents must also be known. This led naturally to Rodinia and the grand procession of supercontinents—Nuna, Rodinia, Pangea and Amasia.

Strange to say, mining and fossils fuels were seen as 'sunset' industries for most of the '80's and '90's. Support for geological mapping and teaching sank, tracking the price of oil. McMaster and GSC were among the victims. Accepting Chris Barnes' invitation to University of Victoria, I began another mapping project in newly-independent Namibia, with an eye on the problem of Neoproterozoic low-latitude glaciation. After Mike McElroy beckoned me to Harvard, my grasp of the issues blossomed thanks largely to geochemical oceanographer Dan Schrag and our respective graduate students. Our stand in favor of Snowball Earth caused consternation, but next to all the observations our interpretation is conservative.

The first forum on Snowball Earth was a Pardee Symposium, at the 1999 Annual Meeting.

Thank you, GSA, for a lifetime of support.

View the images along with the full text from Paul Hoffman's Gold Medal Lecture at http://www.geosociety.org/awards/11speeches/GML-Penrose.pdf