John Costain – Life and Times

Professor John Costain succumbed at the age of 85 years to a brief illness in March of 2015. Just hours earlier he was vigorously preparing his response to reviewers’ comments about two manuscripts he had submitted for publication. This vigor and enthusiasm was central to his life. At this time John was Emeritus Professor of Geophysics in the Geosciences Department of Virginia Tech in Blacksburg, Virginia.

In his youth John had no intentions to be a scientist. While growing up in Boston, MA he saw himself as a language translator perhaps in the United Nations, and studied Spanish language and literature during his first university years. But this ambition was changed by a fascinating introductory geology professor. Two years later in 1951 he graduated with a BS degree in geology from Boston University. He was immediately employed by an oil company, Socony Mobil. He became the observer (instrument man) on a seismic reflection crew in the hinterlands of Venezuela, operating the analog recording apparatus long before the age of digital processing. Here his fluency in Spanish proved particularly useful for supervising a crew which understood little or no English.

After three years in Venezuela, and with considerable knowledge of the practical aspects of seismic surveying, John decided to seek more education. In 1954 he enrolled in a Ph.D. program in the Geology Department of the University of Utah. Here his program of study included an interesting mixture of advanced physics courses in conjunction with other courses focused specifically on bedrock geology. His dissertation involved bedrock geologic mapping of the complex Basin and Range terrane of the Gilson Mountains in central Utah. His discovery of heretofore unrecognized faults resulted in significant revision of geologic history of this region. This program was completed in 1960 when he received his Ph.D. degree.

During these years John was not completely devoted to study and research. There was time for romance. A delightful woman, Rose Wilkerson, entered his life, and they married in 1956, raised a fine family of three children, and were happily married for 52 years until the time of her passing in 2008.

In 1959 prior to completing his Ph.D. program John accepted a 1 year position in the Physics Dept. at San Jose State College in California. Here he taught courses Physics, Astronomy, and Groundwater Hydrology, and also found time to complete his dissertation.

Fortuitously, a position opened just at this time in the Geophysics Department at the University of Utah. He applied, was accepted, and became an Assistant Professor of Geophysics. Here he designed and taught six different courses: Elementary Geophysics, Exploration Seismology (2 terms), Geodynamics, Geomagnetism, and Geothermal Energy. With timely revisions and updating John continued teaching some or other of these courses for the next 37 years.

While on the University of Utah Geophysics faculty John soon became very active in seismological monitoring of nuclear weapons testing, an aspect of research which then involved many US seismologists. At the same time he became interested in geothermal energy, a relatively new field of research. With National Science Foundation support he initiated a research program for measuring geothermal heat flow, an effort which he continued in one form or another for the rest of his career. This included development of state-of-the-art apparatus for measuring thermal conductivity and radioactivity properties of rock cores, and also involving an abundance of time in the field logging wells.

John was one of the early faculty members to become involved with the newly developing digital computing opportunities. He soon learned ALGOL and then FORTRAN, and created sets of programs for processing seismic and geothermal data. His programming efforts included inventive ways for processing exploration seismic reflection data, and he established close contacts with research seismologists in the oil industry which he maintained for the rest of his career. Also, John introduced the students in his courses to digital computing, requiring them to write and modify software. By now, John’s research efforts were well established and expanding. He was supervising several graduate students with thesis projects in seismology and geothermal heat flow. In 1964 the University of Utah rewarded John for his efforts and success by promotion to the rank Associate Professor.

Unexpectedly, a few years later John and a faculty colleague, Edwin Robinson, were invited to consider accepting geophysics faculty positions in the Geosciences Department at Virginia Tech. Although reasonably satisfied with their current positions, the opportunities at Virginia Tech were too compelling. The NSF would permit John to transfer his entire heat flow project including equipment, and financial support for his graduate students. The move to Blacksburg, Virginia was undertaken during the summer of 1967, and his geothermal research continued almost without interruption. Soon after coming to Virginia Tech John was recommended for promotion, and was advanced to the rank of Professor in 1969. John remained with the Virginia Tech Geosciences Department for the remainder of his career, and continued a close relationship with the department after retiring from the teaching faculty in 1997.

During the middle 1960’s the state of Virginia was undertaking a large expansion of higher education facilities. When John Costain and Edwin Robinson arrived, they were joined by another new faculty member, Gilbert Bollinger, an earthquake seismologist. Together, they set about to establish an educational program offering courses leading to B.S, M.S., and Ph.D. geophysics degrees within the Geosciences Department. As this program prospered another earthquake seismologist, Arthur Snoke, joined the geophysics faculty in 1976. The faculty expanded again with the addition of Cahit Coruh, an exploration seismologist who collaborated closely with John for the remainder of his career. John Costain’s activities contributed significantly to the growing recognition of the Geosciences Department. Recruiters from major petroleum and mining corporations visited the campus regularly. In national academic rankings the geophysics program was included in the top 20 similar USA academic programs.

With his geothermal energy research well underway, John also put considerable effort into reflection seismology, acquiring multi-channel recording equipment and data processing equipment and software. Soon he and his graduate students were applying modern exploration seismology to stratigraphic and tectonic problems in the Appalachian Mountains, and the bordering piedmont and coastal plain terranes in eastern United States. Increasing concern during the 1970s about long term energy availability led to increases in funding for geothermal energy research. In addition to his NSF grants, John was able to obtain support from the U. S. Department of Energy (DOE) and U. S. Geological Survey (USGS). In 1976 John together with two faculty colleagues in the Geosciences Department, L. Glover and A. K. Sinha, initiated a large multi-year project supported by the DOE to target and evaluate geothermal resources in the southeastern United States. An important aspect of this project was to locate large buried granite masses by means of seismic and gravity surveying, then to drill into these intrusions to obtain rock cores, and to measure the geothermal gradients. The cores were processed to ascertain the content of radioactive constituents, and to determine the heat generation capacity.

With the DOE support John was able to purchase core drilling equipment capable of reaching depths of over 500 m (~1640 feet). He was also able to employ a full-time drilling crew. In addition, DOE funds were used to purchase a complete multi-channel Vibroseis reflection seismic system, laboratory data processing equipment including a Vax 11-780 computer, and to employ a crew to carry out a full time seismic reflection surveying operation for approximately five years. Not only John’s graduate students, but also all students in his seismology classes and ground water hydrology classes, had the opportunity to directly observe modern core drilling procedures and multichannel seismic data acquisition.

John certainly had a full schedule of teaching and research. But he also knew how to manage his time. Weekends were for family and friends. He very much liked to spend those days at picnic tables high on the nearby mountain sides. Then, in mid-life he became enchanted with sailing. With the same enthusiasm as characterized his research and teaching he seized the opportunity, bought a fine sailboat, and thereafter spent countless Saturdays and Sundays fighting with the wind on a nearby lake. One time he and Lyn Glover, similarly addicted to sailing, took their wives for a few weeks of sailboat island hopping on the Caribbean Sea, a few times reaching sheltered waters just hours ahead of heavy storm winds.

The 1980s saw an increase in efforts to investigate crustal structure in North America by means of Vibroseis reflection surveying. New procedures made it possible to record reflections from as deep as the Mohorovicic Discontinuity and into the upper mantle. John Costain had the expertise and the field equipment and processing facilities to become a major participant in this effort. With support from various federal agencies, some oil companies, and academic consortiums, John together with Cahit Coruh supervised the acquisition and interpretation of an abundance of seismic reflection data from the eastern piedmont and bordering Appalachian Mountains.

During these years of collaboration John and Cahit began thinking about another serious undertaking, combining their knowledge of exploration seismology in a book. Because of their other commitments this would be a long term project. They persisted through the years, and finally succeeded with the publication of “Basic Theory of Exploration Seismology” by Elsevier, Ltd. in the year 2004.

In additional to his considerable experience in seismology and geothermal heat flow John was also very knowledgeable in ground water hydrology. He began teaching this subject in 1960 during his year on the San Jose State University faculty. In Virginia he was involved in seismic measurements of aquifer characteristics on the Virginia coastal plain, and the geologic setting, hydrology, and origin of the Appalachian thermal springs in the western part of the state.

Then, in the mid-1980s John together with Gilbert Bollinger began examining the ground water hydrology in local zones of seismicity previously identified by Bollinger. This led to the hypothesis that seismicity was influenced by increases in ground water pore pressure. They called this hydroseismicity! This energized John for the rest of his life. Long after his retirement in 1997, he continued studying the occurrence of earthquakes, and aquifer recharge by rain and stream drainage. On his last day, with his computer running, and seismicity charts spread about on his bed, John was editing two scientific papers he had submitted for publication with his son Jim and Ed Robinson at his bedside. Then, the next morning, after some breakfast John just died…..while making other plans. Should we all have such fascination and zest for life!

EDWIN S ROBINSON