Barringer Medal Citation for Graham Ryder

Graham Ryder, an extraordinary lunar scientist whose accomplishments revolutionized our understanding of lunar processes and history, passed away on January 5, 2002 as a result of complications from cancer of the esophagus. In his few years studying the lunar samples, Graham made fundamental discoveries and came up with new insights that changed the way we look at the Moon and its history.

Graham was born on January 28, 1949 in Shropshire, England. He received his B.Sc. from the University of Wales (Swansea) (1970) and his Ph.D. from Michigan State University (1974), specializing in the petrology of igneous rocks. He did post-doctoral work with John Wood's group at the Smithsonian Astrophysical Observatory and was subsequently employed by Northrup Services Inc. in the Lunar Curatorial Facility (NASA Johnson Space Center). Since 1983, he had been a staff scientist at the Lunar and Planetary Institute in Houston.

Graham started working in lunar science around the time that the initial study of Apollo samples had been completed. With the cream of preliminary work nicely skimmed, making fundamental advances in this field required not only technical excellence but imaginative insight. Graham provided both of these qualities in abundance. His first work with lunar samples was as part of the "Imbrium Consortium," a study group led by John Wood with the aim of identifying ejecta from the Imbrium basin, a prime sampling target of at least two Apollo missions. Graham's work on the petrology of highland breccias was exemplary. He was the first to recognize what is still our best example of impact melt from the Imbrium basin—samples 15445 and 15455. Noting the unusual, Mg-rich character of these melts, he developed, with Wood, a model for the crust of the Moon that became more mafic with depth and related this crustal model to samples derived from both the Imbrium (Apollo 15) and Serenitatis (Apollo 17) impacts. This paper still stands as an outstanding example of strong, imaginative science—a tribute to the post-Apollo "synthesis" stage of lunar studies.

In 1976, Graham (with Jeff Taylor) noted, in yet another paper ahead of it time, that a then-current lunar science dogma—that mare volcanism began after the last of the major basins had formed—was not only not required by the observational data, but in fact, was contraindicated by it. They carefully catalogued a wide variety of lunar sample evidence for ancient mare volcanism on the Moon, from clasts of mare basalt in highland breccias to augitic pyroxenes found in fragmental breccias from North Ray crater at the Apollo 16 site. Ryder and Taylor argued that volcanism on the Moon began well before the last basins, a concept now widely accepted and graced with the non-euphonious term "cryptomaria." This paper helped to establish a lifelong Ryder tradition—the insistence of observational evidence's superiority to theoretical argument.

One of Graham's lasting contributions to the community of lunar scientists was the work he conducted in Houston for over a decade, preparing new catalogs of the lunar samples returned by the Apollo 15, 16, and 17 missions. The lunar sample catalogs not only described the nature of over 20,000 individually numbered lunar samples, but collated all the published data (with full bibliographic references) into a handy compendium that both guided existing projects and spurred new research throughout the 1980s. In the waning phases of his work on the massive *Catalog of Apollo 15 Rocks* (Curatorial Branch Publication 72, JSC 20787, 1985), Graham and I worked together on a study initiative on the geology of the Apollo 15 landing site. As part of that effort, he came to visit me in Flagstaff for a week in 1985. We spent part of that week together with Dave Scott, the Apollo 15 mission commander, and Gordon Swann, the mission Geology PI, and reviewed the videotapes of the EVAs from that mission. Spending those days living and working on the Moon (as near as we could come to it) reawakened in both Graham and myself a latent interest in the philosophy and practice of field geology, an issue that was becoming important as part of a projected "Return to the Moon" program. Graham began to devour works on the history of geology, particularly the excellent books by Martin J. S. Rudwick and James Secord on the early history of geology, and specifically, the subdivision of the lower Paleozoic in the England-Wales borders, near his beloved Shropshire. Graham enjoyed discussing arcane stratigraphic boundary problems in the British Silurian as much as he did last week's episode of Monty Python's Flying Circus.

As Graham continued to explore the early history of the Moon, he became intrigued by the unusual clustering ages of lunar impact melts—virtually all of them date to around 3.8 Gyr. Although the idea of a "cataclysm" on the Moon actually dates to an influential paper published by Gerry Wasserburg and coworkers in 1974, the idea had lain fallow for 20 years, a problem without explanation, but one which no one seemed to worry about very much.

Graham did. He published a provocative statement of the cataclysm in *Eos* and unleashed a debate in the planetary community the effects of which are still with us (and NASA's future exploration plans) to this day. Graham noted that, even after 20 years of searching, virtually no impact melts had been found in the lunar samples older than 3.9 Gyr, even though we supposedly went to a number of highland sites that should have yielded melt ejecta from many different near side basins. Either we failed to sample any events but a few, or our understanding of early lunar history was wrong. And, if we had gotten the early history of the Moon wrong, what did we really know about the early planets in general? (All of our impact chronologies ultimately tie back to the lunar example, where we have radiometric ages of rocks from a [more or less] known context.)

For Graham, the lunar cataclysm was an observational fact, not an arcane theory. He was unmoved by theoretical objections to it; he believed in looking at data and deciding on the scientific validity of something on the basis of its correspondence to the known facts. The fact that models could not account for a cataclysm bothered him not one whit—models have to be consistent with data, not the other way around.

Graham was interested in all aspects of the Moon and avidly read and digested papers in many different areas. Although a petrologist by training, he eventually became conversant enough with trace-element geochemistry to do his own analyses in this field. Graham and I knew each other from the time that I was a graduate student, and he was always keen to understand photographic evidence and remote-sensing data. He could discuss (and argue!) on all sorts of topics remote from his own discipline, from dynamical issues of lunar origin to the effects of "space weathering" on the regolith. When it came to the Moon, Graham was indeed a "Renaissance Man."

Such a wide ranging intellect could scarcely be contained solely to lunar science. Graham loved to apply his knowledge of planetary science to other problems. He made significant contributions to our understanding of terrestrial impact and volcanic processes, a natural enough extension of his first love—the Moon. Graham became involved in the early controversies on the origin of the KT extinction and was a coauthor of one of the initial papers on the petrology and age of the Chicxulub melt breccias. Graham's extensive experience with the chemical and physical effects of hypervelocity impact helped to establish the impact origin of Chicxulub. He remained interested in the environmental effects of the KT impact for many years, a natural enough outgrowth of his longstanding interests in paleontology and stratigraphy, which fed from his interests in the history of geology.

I find it amazing that two people as different as Graham and I were became friends, but we did. We found that we had many non-scientific interests in common—the history of 19th century military campaigns, the history of geology and of ideas, Sherlock Holmes, the Beatles, Monty Python, Flashman, and a hundred other silly things that clutter the lives of two baby-boomers. Both of us were lucky enough to do the thing that we loved as our life's work.

Graham loved the rough-and-tumble of debate, and attending scientific sessions with him was always an interesting experience. He would argue and contradict and debate and scold. But even at his most intense, there was always a puckish, sly humor that tempered his razor-sharp tongue. You could be exasperated by an encounter with Graham, but you could never stay angry with him.

The only Lunar Science Conference that Graham missed was in 1983—the 14th LPSC. He was here in Germany working with Dieter Stöffler at the University of Münster. Nevertheless, this was the year that the first lunar meteorite was discovered and Graham had already had a good look at it. Ever fertile with new and innovative ideas, he wrote an abstract proposing that it had been ejected from the Moon as a result of an impact that created the crater Giordano Bruno, a very prominent, fresh ray crater on the lunar far side. Unfortunately, he did not have money to fly to Houston and attend the conference, so his paper was presented in absentia by Dieter on Thursday morning, March 17, 1983.

In the special session on Lunar Meteorite 81005, Dieter Stöffler gave Graham's paper on the meteorite and Giordano Bruno as its source crater. Dieter began by announcing, "Today I have the privilege of being the voice of Graham Ryder. . . ."

I wrote Graham in Germany recounting this event, and I suggested to him that if Dieter was *really* to be the voice of Graham Ryder, he would get up and make sarcastic comments after each talk on the program. Graham wrote back:

"Dieter and I discussed this before he left for the conference—perhaps he should carry a tape recorder and after each talk, he would get up and play the tape 'Your model is incomplete!' or 'What about the Sm content?—you haven't accounted for that!' or the ever-popular, 'That's just stupid!' But finally, we decided against it."

Unfortunately, I'll never hear Graham pronounce an idea "stupid" again. And we're all the poorer for that. But, in presenting his well-deserved Barringer Medal to his beloved daughter, Abby (Graham was probably one of the proudest fathers in the world, yet another thing that he and I share), I remember and honor his work, his ideas, his vision, and imagination. Creativity, wit, intelligence, and tenacity are rare in any field and we miss him. Someday, we'll go back to the Moon and we will all see just how good our educated guesses were. My bet is that Graham's guesses will be among the very best.

It is fitting indeed that Graham Ryder receive the Barringer Medal for 2003—for his contributions to lunar and planetary science, contributions that still resonate in our field today.

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