# Vanished Greatness

by Paul D. Spudis

Between 1961 and 1969, the United States chose to compete with the Soviet Union in the initial exploration of another world in the solar system, the moon. This epoch saw the emerging infant technology of space flight boldly pressed into the service of scientific exploration. Don Wilhelms relates this inspiring story from the perspective of both an observer and a participant.

Wilhelms's long career as a geologist for the U. S. Geological Survey (USGS) has been devoted mainly to reconstructing the history of the moon by studying photographs of its surface. He was involved in the geological training of the Apollo astronauts and in the selection of sites on the moon, both for the initial demonstration landings and for the later, more sophisticated scientific expeditions. But his principal scientific contributions are in the area of historical geology, or the natural history of the moon preserved in its layered rocks. Like that of the earth and other rocky planets, the moon's record may be read and reconstructed from photographs of its surface.

The episodic story of how we came to understand the history and processes that have shaped the moon begins with the pioneering work of Grove Karl Gilbert, first chief geologist of the USGS, who marshaled evidence in 1893 that craters on the moon were formed by the collision of asteroidal bodies. The largest of these impacts formed a prominent feature on the front side of the moon, the Imbrium Basin, a crater more than 600 miles across.

Fast-forwarding to 1949, Wilhelms highlights the work of astronomer Ralph Baldwin, whose book *The Face of the Moon* got nearly everything right: that the moon's craters were formed by impact; that the dark maria were volcanic lavas; and that the surface of the moon was old—very old.

After reading this book, Nobel Prize-winning chemist Harold Urey became obsessed with finding out more about the moon, which he believed was a piece of primeval nebular matter, unheated and unmodified since the creation of the solar system, 4.5 billion years ago. Urey campaigned for the scientific exploration of the moon, using the up-and-coming technique of rocketry, which had been salvaged from the ruins of a smoldering and prostrate Germany. Aiding him in this task was Gerard Kuiper, a heretic astronomer who was interested in the planets and who treasured photographs as a source of data.

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TO A ROCKY MOON: A GEOLOGIST'S HISTORY OF LUNAR EXPLORATION, by Don E. Wilhelms. *University of Arizona Press, $29.95, 477 pp., illus.*

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Meanwhile, beginning in 1948, a young, energetic geologist was mapping the uranium deposits of the Colorado Plateau and dreaming of exploring the moon. From that point on, Eugene Shoemaker devoted his career to making geology a part of the burgeoning and nascent lunar exploration program. Such an exploration strategy was far from self-evident: to Shoemaker, more than any other person, Wilhelms gives credit as the founder of an entirely new discipline, planetary geology. Shoemaker went on to establish a branch at the USGS, created specifically to study the geology of other planets in the solar system and charged with mapping the geology of the moon to support the Apollo effort.

The addition of geology into the mix of scientific subdisciplines involved in the exploration of space created an amusing and intriguing conflict of goals and techniques—a conflict that continues to the present day. Wilhelms carefully (and I believe, objectively) recounts the fundamental differences in the thought patterns and methods of those scientists who specialize in the "quantitative" sciences (such as physics and chemistry) and those who work in the "descriptive" sciences (such as geology and biology). Unraveling the complex history of a planet requires both approaches, but it is Wilhelms's thesis (and one that I completely agree with) that our fundamental understanding of the moon came more from the "descriptive" geological approach than from the highly mathematical conjectures of certain physicists and astronomers—Nobel Prizewinners notwithstanding.

Once President Kennedy articulated the goal of a manned lunar landing, a space-faring infrastructure had to be created almost literally from scratch. The story of the engineering involved in this heroic feat is recounted in several recent books (most enjoyably in *Apollo: The Race to the Moon,* by Charles Murray and Catherine Bly Cox, published in 1989 by Simon & Schuster). Wilhelms' great accomplishment is to complement these narratives by adding a perspective of science and scientific planning, including insider accounts of the fights, arguments, exhortations, and contributions of the scientists who were charged with the task of helping men land safely on the moon and then explore it productively.

Although the idea of safely landing on the moon seems obvious to us today, in 1962 perspectives were primitive, to say the least. Like medieval cartographers, some alarmists raised specters of dragons in "bottomless pits of dust" and of lunar soil so chemically reduced that it would explode when it made contact with the pure oxygen of the *Apollo* lunar module.

Project Apollo was not merely a program to land men on the moon, it was a strategy for lunar exploration. Wilhelms

first describes how we prepared scientifically to go to the moon. This preparation involved mapping the moon (because all good explorers need maps), training the astronauts to be precise scientific observers, and sending a variety of unmanned precursor probes to tell us about the nature, composition, and state of the lunar surface. These robotic probes were a boon to lunar science: they mapped, surveyed, tasted, and examined the moon on a variety of scales. They produced data that are still being analyzed as we continue to unravel the moon's secrets. But most importantly, they paved the way for the coming of *Apollo* and proved that the things people had to fear on this epic journey were largely illusory; the moon benignly and patiently awaited them.

Wilhelms next recounts each *Apollo* lunar mission in detail, including that of the hard-luck *Apollo 13,* which exploded on the way to the moon in 1970, nearly costing the lives of its crew. For each mission, he describes the scientific preparations (including the oft-contentious selection of a landing site), the mission itself, what we learned from the mission, and how that information fit into our emerging picture of the history and evolution of the moon.

Each chapter is expertly and carefully drawn, and the scientific controversies are told at a level that makes them easily understood by the general reader. We see through these pages how the Apollo system developed from a minimalist engineering test-bed into a robust and astonishingly capable exploration tool. This emergence was neither a foregone conclusion nor a fortuitous happening, but came about through the determined efforts of a dedicated group of talented engineers and scientists who, in my opinion, gave the American taxpayers the best value for their money that they have ever gotten, before or since.

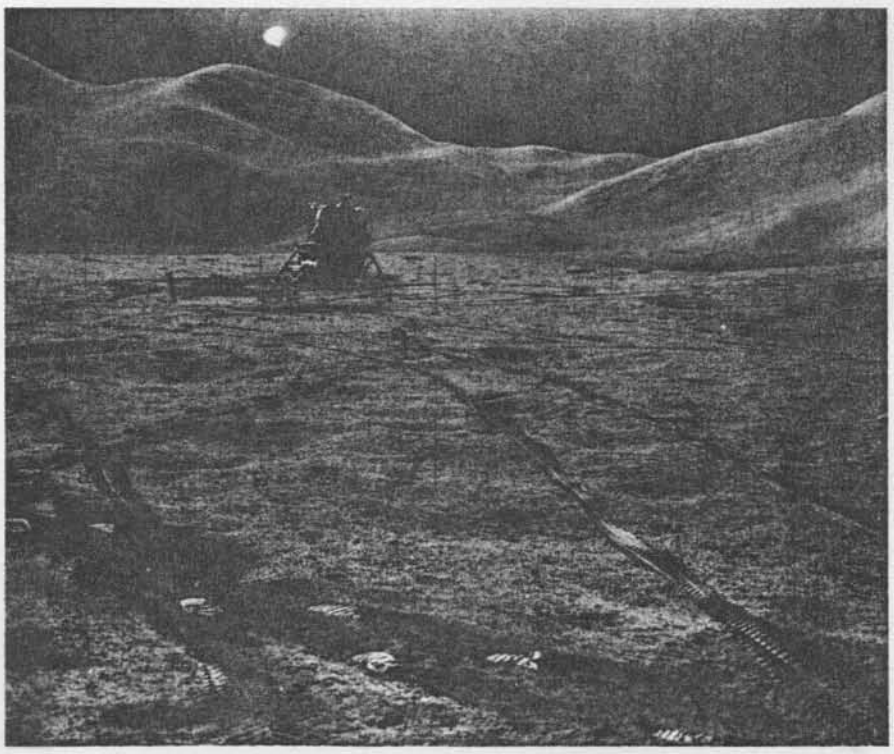
Wilhelms sprinkles his text with many anecdotes. He has a fine eye for the character sketch and a dry, understated wit; both tools serve him well in his description of the myriad characters, eccentrics, and occasional genius that this business seems to attract. We meet, for example, Dan Milton, a geologist who applied for astronaut training, although colleagues who rode in a car with him as driver feared for their lives; Gordon Swann, raconteur and good-ole-boy, who nimbly jumped political minefields and ably led the field geology team for the *Apollo 14* and *15* missions (which greatly increased the scientific capability and productivity of the Apollo system); and the inimitable Hal Masursky, a geologist who ran through obscure airports to yet another meeting (where some momentous decisions occurred) to look after the interests of the geologists.

Some of the sharply drawn portraits are of the men who went to the moon: Neil Armstrong, first man on the moon and one of the best and brightest of the "galvanized geologists," according to Wilhelms; Dave Scott, a test pilot who went bonkers for geology and turned in a stellar scientific performance as commander of the first of the complex "J-missions," the enhanced *Apollo* science missions; and Harrison "Jack" Schmitt, the only professional geologist to go to the moon, who got the chance that Gene Shoemaker missed—to swing his rock hammer on the boulders of the Taurus-Littrow Valley.

The story concludes with Wilhelms's chapter describing what we have learned in the years separating us from the *Apollo* missions. That this can be adequately done in 20 pages (out of nearly 500 for the whole book) is no testament to laziness on Wilhelms's part, but rather a reflection of the pitiable state of lunar exploration during the last twenty years. America has not sent a mission to the moon since *Apollo 17* in December 1972, and the Russians have not done so since August of 1976.

If all goes well, we may see some new lunar data in our lifetimes as the joint Defense Department-NASA mission called *Clementine,* scheduled to be launched in January 1994, will map the distribution of minerals over the entire moon during the course of a two-month period. But this new robotic mission will not be followed by a manned mission—or even any additional robotic probes—in the foreseeable future. In 1989, then president George Bush's attempt to reestablish direction and purpose for our space program by calling for a return to the moon floundered, and then sank, in a sea of media carping, congressional blundering, and parochial whining from the scientific community.

Don Wilhelms has written the definitive history of the scientific exploration of the moon. Its lively and entertaining text informs and stimulates, but there are some slight flaws. The illustrations are not reproduced very well, and the place map of lunar localities used as the frontispiece is quite useless as the guide to craters and maria that it was meant to be. However, don't let these minor problems dissuade you from reading this book; from enjoying and savoring a distant time when America was confident, looked forward to the future, and did not shrink from challenge.



*In 1971, Apollo's lunar-lander Falcon set down near the moon's Apennine Mountains. Vehicle tracks and footprints are visible in the foreground.*
NASA photo AS15-92-12430

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