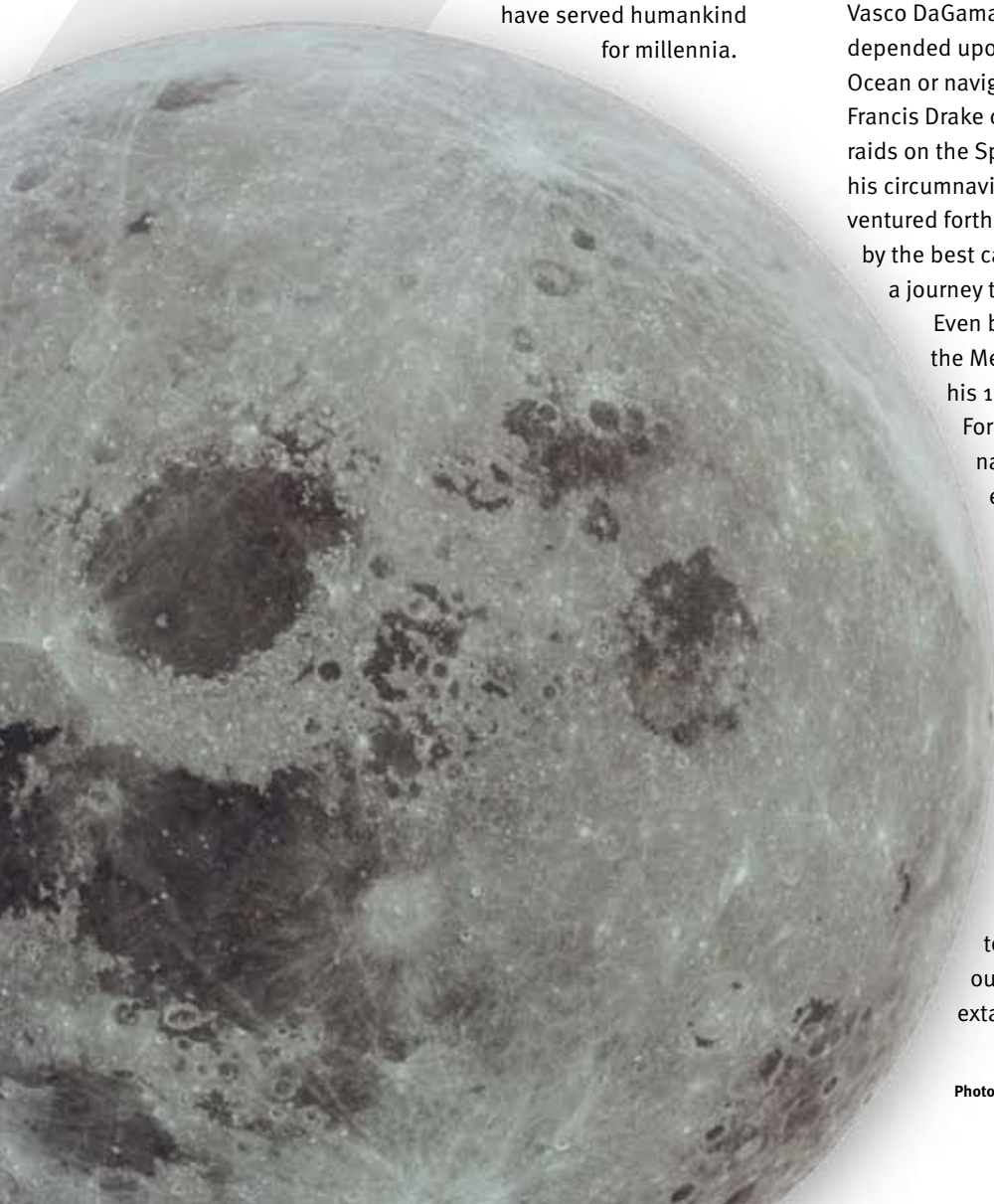
Lunar Cartography Informed Early Space Program

By Dr. Gary E. Weir

Before anyone can show the way, he or she must know the road ahead. During the Renaissance and the Age of Exploration in the 14th and 15th centuries, only cartographers and the navigators they supported dared venture beyond the horizon. They had knowledge available to only the fortunate few. This knowledge, rendered in maps, enabled discovery and communicated in a useful and often beautiful way the secrets of a mysterious and unknown world. While we often find photographic images more arresting, maps possess symmetry, beauty, familiarity, and great practical utility. These qualities have served humankind for millennia.



With cartographers and their tools, the world seems manageable, discovery and safe return seem possible. Indeed each journey of discovery usually had the making of maps as part of its purpose: discovering landmarks, locating great natural phenomena, measuring distance and relating everything observed one to the other. Maps impose a necessary and comforting order on the unknown.

The cartographer Martin Waldseemuller named North and South America for a fellow cartographer and explorer, Amerigo Vespucci. Prince Henry the Navigator, Vasco DaGama, Christopher Columbus and John Cabot depended upon maps and charts for sailing the Atlantic Ocean or navigating the length of Africa's coastline. Sir Francis Drake depended upon maps to accomplish his raids on the Spanish Empire in the new world as well as his circumnavigation of the globe in 1580. They never ventured forth without the best maps and charts drawn by the best cartographers. Explorers with their eyes on a journey to the moon proved no different.

Even before Alan Shepard became the first of the Mercury Seven astronauts in space during his 1961 suborbital flight, both the U.S. Air Force and the U.S. Army concluded that national discussions about space and exploration required venturing well beyond the still barely defined goals set for the Mercury Program. Beginning in 1957 and 1958, respectively, the Air Force Aeronautical Chart and Information Center (ACIC) and the Army Map Service (AMS) initiated efforts to collect telescope observations and photographic data with an eye toward composing maps of the moon. With this step, the cause of lunar mapping enlisted for the first time the services of professional cartographers experienced in the production of terrestrial maps of the highest quality. The outcome of their effort quickly surpassed all extant lunar cartography.

Photo by Getty Images

ACIC and AMS, absorbed in July 1972 by the Defense Mapping Agency, an NGA predecessor, provided the agency with deep roots in discovery and the manned space program. Without ACIC, AMS, DMA, and NGA, NASA would not have at hand and portable the particular knowledge of the moon so necessary to the American manned space missions.

In 1957, the Air Force Cambridge Research Laboratory worked under contract with the University of Chicago's Yerkes Observatory in Wisconsin to collect the best available photographs of the moon. The planned publication of these images would offer a baseline of the best 281 lunar photos from over 1,200 prints collected. Many sources contributed images to the effort including Yerkes: the observatory at Mt. Wilson in Pasadena, Calif.; the Lick (San Jose, Calif.) and McDonald (Fort Davis, Texas) observatories; and France's Pic du Midi Observatory. The resulting Air Force Lunar Reference Mosaic appeared in 1960 under the aegis of the University of Chicago Press. ACIC assembled the final draft and took charge of government distribution.

As frequently as we rely on images of the moon from television and in the glossy press, sometimes we forget how early ACIC published the final version of the Lunar Reference Mosaic, or LEM-1 (Lunar Earthside Mosaic). It had a diameter of 27 inches at both 1:500,000 scale and 1:10,000,000 (LEM 1-A). The ACIC, led by cartographer Howard Holmes, produced the LEM and worked to update the product in three different scales in 1962 when more precise imagery became available. As a direct result of the LEM effort, ACIC became involved with NASA in the autumn of 1959, a full decade before the moon landing of Apollo 11, to support both the planned Mercury Program and more ambitious lunar mapping requirements.

As the ACIC developed the LEM, it worked simultaneously on the Lunar Astronautical Chart (LAC) in an effort to combine all of the imagery and data available into the best possible guide to the moon's surface. ACIC adopted a 1:1,000,000 scale, or 16 miles to the inch, because this method conformed to both the best image resolution available from then-current cameras and a particular set of Air Force charts published under the series title, World Aeronautical Chart.

Howard Holmes, Jerry Higgins and Charles Moore began work on the project in October 1959, dividing the moon into 144 areas of 22-by-29 inches each. Many of the shapes and dimensions attributed to lunar surface features relied heavily on shadow measurements and data taken at the time of image exposure. The actual charts appeared in two projections, Mercator and Lambert Conformal Conic, with the planned third, a polar stereoscopic, never actually going to press. Each chart carried the name of the most

The array of photographs offered here portray the entire spectrum of the lunar mapping experience from assembling spacecraft imagery photo mosaics, to data collection and confirmation via telescope, to collaborative efforts with observatories like Pic du Midi in France.

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prominent feature available or that of a pioneer in space science. Thus, names such as Kepler (LAC-57), Copernicus (LAC-58) and Mare Vaporum (LAC-59) appeared in the series.

The first of these charts to emerge from the press, LAC-58, appeared in February 1960 with the cardinal directions set according to standard terrestrial cartographic norms. This flew in the face of the 18th and 19th century practice that placed south at the top of the compass rose reflecting the inverted image of the moon provided by optical sets of that era used in northern hemisphere telescopes. ACIC also established an official Air Force Observation Unit at the Lowell Observatory in Flagstaff, Ariz., to keep pace with the best and highest-resolution telescopic imagery available. At one point in the mid-1960s, ACIC also entered into a relationship with the University of Manchester in the United Kingdom to establish a lunar photographic program at the Pic du Midi Observatory. ACIC supplied an Air Force K-22 camera suitable for work with the French observatory's 24-inch refractor. This provided approximately 60,000 time-lapse photos from 1961 through 1966. Every 9-inch roll of film was returned to ACIC in St. Louis, Mo., for processing. In June 1961, ACIC published with the University of Chicago Press a lunar atlas, now in NGA's historical collection, based upon the 144 charts of the LAC.

In a more ambitious effort, ACIC produced the first 16-inch NASA Lunar Globe, also part of NGA's collection. Howard Holmes designed the globe at 1:8,533,150 scale. The 30-degree section drawings for the globe came from the pen of scientific illustrator Jay Inge working at the ACIC office at the Lowell Observatory. Inge rendered the far side of the moon by using photographs from the Lunar Orbiter satellite program that began in 1966. Earth-side particulars came from LAC renderings and telescope photographs. All features appeared on the globe as if captured from a spacecraft approaching the moon in a morning descent.

Like the work of Amerigo Vespucci, these maps made the next step possible, and all of this lunar mapping work supported the planned Apollo program journeys to the moon. As with our first maps of the new world in the 15th century or the first detailed map of the ocean bottom by Bruce Heezen and Marie Tharp in 1977, we always remember the first time a cartographer reveals the unseen, makes it understandable and permits all of us with a sense of adventure to take the next step. ACIC, one of NGA's predecessor agencies, gave us the moon and showed us the way. ⊓

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