Moon

Exhibition Catalog

July 20 - December 20, 2019

University of Arizona Libraries Special Collections

Curated by Molly Stothert-Maurer, Archivist & History of Science Curator and
Christopher Cokinos, Associate Professor of English

Introduction

It is always there, at least in our lives, the Moon, lit or dark, seen or not, a cold dead rocky globe of pits and rubble, of mountains and scars, our helpful companion in gravity and evolution, symbol, territory, night light during its days' long lunar morning, silent siren for nocturnal predators, werewolves, lovers, geologists, for a time and perhaps again, perhaps for good, the astronauts, new lunar denizens.

The Moon is visually sublime and scientifically compelling. It's up there whether you live in the city or out in the country. With your own eyes, with binoculars, with a telescope, you can set sail for it. For stargazers and astronomers, the Moon is sometimes a bane bleaching out the fainter and far-flung gray-green galaxies and nebulae one might otherwise see in the eyepieces of backyard telescopes or on the computer screens of professional observatories. But we are rediscovering the Moon's capacity to instill wonder, especially because it is not the barren place we once thought. Water ice exists on the Moon, water is locked up in its surface, and some researchers have suggested the early Moon had warm surface oceans in which microbial life might have evolved.

At a time when we are looking back at the 1960s' race to the Moon, we should also look ahead to what our scientific and even cultural future with the Moon might be. Space agencies and entrepreneurs have reinvigorated interests in our nearest celestial neighbor, for its own sake and as a testing ground for human missions to Mars.

The Moon is back—though it never left.

Take a look . . .

-Christopher Cokinos, 2019

About the exhibit

Explore the science, history and culture of the Moon and how we view it. Learn about the early art of mapping the Moon from sketches to photography, see early books by Copernicus and Galileo and explore Moon themes in sci-fi books and poetry.

Commemorating the 50th anniversary of the Apollo 11 Moon landing on July 20, 1969, this exhibit draws from a new acquisition of papers from Ewen Whitaker, Associate Research Scientist at the University of Arizona Lunar and Planetary Laboratory and expert on the surface and physical features of the Moon. The Whitaker collection features extensive maps, photographs, books, correspondence and other academic works related to lunar studies. The exhibit also features items on loan from the Lunar and Planetary Laboratory, the Museum of Optics at the University of Arizona College of Optical Sciences, University of Arizona Museum of Art and the Learning Games Initiative Research Archive.

The exhibit is curated by Molly Stothert-Maurer, Special Collections Archivist & History of Science Curator and Christopher Cokinos, Associate Professor of English; with assistance from Tim Swindle, Director of the Lunar and Planetary Laboratory, Mary Guerrieri, Manager, Academic Affairs at LPL; and Maria Schuchardt, Program Coordinator of the Space Imagery Center.

The Making of the Moon Exhibit

By Molly Stothert-Maurer

The “Moon” exhibit at the University of Arizona Libraries Special Collections centers around one story—the only place to begin a journey into the history of the Lunar and Planetary Laboratory (LPL) and its prominent role in lunar science. The place to start is exactly the way Melissa Sevigny begins her book *Under Desert Skies: How Tucson Mapped the Way to the Moon and Planets*:

In late August 1955 at the Ninth General Assembly of the International Astronomical Union (IAU) in Dublin, Ireland, the Dutch-born astronomer Gerard P. Kuiper circulated an unusual memo: would anyone help him create an atlas of the moon?

The Whitaker Collection

In the exhibit, if you can manage to walk past the 1610 copy of Galileo's *Sidereus Nuncius,* one of the first artifacts you'll see is the letter written by LPL astronomer Ewen A. Whitaker to Kuiper, the founding director of LPL, expressing his eager desire to work on the atlas project. Directly next to it you will find Kuiper's equally enthusiastic reply. Special Collections is fortunate to have extensive manuscript collections from both scientists and about a dozen more prominent scientists from LPL, a lab that Kuiper founded in 1960. Whitaker's collection is the heart of the exhibit.

Whitaker's passion was selenography, the study of the surface and physical features of the Moon; the name comes from the Greek word *Selene*, goddess of the Moon. You will find Whitaker's Moon maps covering the walls, his collection of photographs peppering most display cases, and his original lunar drawings and other graphics. One of my favorite pieces is a presentation slide Whitaker made of Kuiper debating his rival Harold Urey on the origins of the Moon.

It has portraits of both men with speech bubbles arguing back and forth and shows Whitaker's sense of humor. In the middle of the Moon maps you'll also find a cartoon about "luna-sea" that he included in his book *Mapping and Naming the Moon,* 1999.

Whitaker's scientific work resulted in the first compositional maps of lava flows on the Moon and played a critical role in early lunar missions including Ranger, Surveyor, and Lunar Orbiter. Whitaker famously pinpointed the location of the Surveyor III landing site and chose the Apollo 12 landing site adjacent so that the astronauts could retrieve the equipment.

Centuries-old texts

The exhibit also draws upon an important collection of early texts authored by giants such as Galileo and Copernicus and printed around the time modern science

was born. The books were purchased by the University of Arizona Foundation in the early 1970s. This is the first time they have been on display since 2000 when Special Collections held the exhibit "Heavenly Manuscripts: The Renaissance of Astronomy." Galileo's *Sidereus Nuncius* or *Starry Messenger* is the text that announced his discoveries in 1609 and 1610 made with the newly invented telescope, including mountains and valleys on the face of the Moon, the four satellites of Jupiter and the stars of the Milky Way. The book is displayed alongside a telescope from the early 1700s borrowed from the Museum of Optics at the College of Optical Sciences.

Copernicus' 1543 book *De Revolutionibus Orbium Coelestium* or *On the Revolutions of the Heavenly Spheres* contains the earliest representation showing the Sun as the center of the solar system and represented a major shift in human thought-- heliocentrism. The general response from visitors is a dumbfounded "Is that thing real?" It is a real pleasure to then say it isn't even the oldest book in the exhibit.

Carl Burkhout, professor emeritus of English, brought to my attention that we have an extraordinary incunable – a book produced in the earliest years of printing, before 1500 -- that is a revised Ptolemy text printed in 1496. *Epitoma in Almagestum Ptolemaei,* or *Epitome of Ptolemy's Almagest* is a treatise begun by the Austrian astronomer and mathematician Georg von Peurback and completed by his student Johannes Regiomontanus. This is a Latin abridgment, with important corrections, from the original Greek *Almagest* by renowned astronomical authority Claudius Ptolemy of Alexandria, who lived from about A.D. 100-170. Most notably, the book calls Ptolemy's position that the Moon sometimes appears up to four times larger than its usual size a fantasy. Copernicus later used his own copy of this edition in rejecting Ptolemy's lunar and geocentric theories. The book is open to a gorgeous woodblock print featuring portraits of both authors, a sun and a moon. Two of the Moon's impact craters, Purbach and Regiomontanus, commemorate this book's authors. When not on display, these books live in a climate-controlled vault.

Curating "Moon"

As the Curator for the History of Science collections, it is my great privilege to work with these materials and the personal and professional papers of important modern scientists. The strong relationship Special Collections has with the Lunar

and Planetary Laboratory is built upon a legacy of accomplishments processing collections and making them available to researchers thanks to former archivists Crystal Carpenter and Maurita Baldock and Library Information Associate Deborah Weller.

The relationships also go straight back to Kuiper and Whitaker. When Kuiper passed away suddenly in 1973, he left a great archive containing unpublished scientific research and a wealth of correspondence, audiovisual materials, reports and notes. These dated back to his work at Yerkes Observatory at the University of Chicago where, among other things, he was a PhD advisor to Carl Sagan.

Whitaker rose to the challenge to steward this collection. He became an amateur archivist, joined archival organizations and did his best to organize, describe and provide access to the collection. Whitaker invested a good deal of his time, even in retirement, to this endeavor. He was also the unofficial LPL historian. His lengthy and detailed definitive history titled *LPL: Its Founding and Early Years* written in 1985 is still linked prominently on the LPL website.

After his passing, Whitaker's daughter, Fiona, arranged for us to gather the rest of his professional materials. I was part of a four-person team that loaded three full loads into an 18-passenger cargo van. When it was time to organize the materials and write the collection guide it was nice being able to visualize how they were previously stored.

Processing the collection took the better part of a year and led to some valuable collaborations. When English professor and science writer Christopher Cokinos got wind that Special Collections had the Whitaker papers he came over to help me out with the organization. It was nice having an expert help bring the collection to life. Every once in awhile he'd get excited about something he'd found and bring it to my attention—like a folder titled, "Crank Science," with a lengthy article about termites on the Moon. Cokinos agreed to help curate the exhibit and contributed the powerful text that introduces the exhibit and the detailed lunar timeline that masterfully weaves together cultural and scientific milestones.

Unfortunately, I didn't get to meet Whitaker. He was known for his delightful personality and as a skillful hobbyist in historic clock repair. His last public appearance was April 25, 2016, on a panel talk in Special Collections titled, "How

Tucson Mapped the Way to the Moon and Planets," alongside groundbreaking scientists including William Hartmann, founder of the Planetary Science Institute, a non-profit corporation and the largest employer of planetary scientists in the world. Hartmann was a graduate student under Kuiper who worked with Whitaker and others on the lunar atlases in the 1960s. He co-authored a groundbreaking paper on the giant impact origin theory of the Moon based on features discovered during the creation of the Rectified Lunar Atlas.

The 'strange egg' that mapped the Moon

The precision hemisphere located at the center of the *Moon* exhibit is the original artifact, on loan from LPL, used to create the Rectified Lunar Atlas at the Lunar and Planetary Laboratory in the 1960s. It looks like a strange egg until you turn on the projector and watch it transform into the surface of the near side of the Moon. The projected image is a ground-based telescope photograph from 1946 taken by the Lick Observatory on Mount Hamilton, California.

Part of Kuiper's Moon-mapping program of the late 1950s and 1960s, the *Rectified Lunar Atlas* was created in collaboration with Whitaker, Hartmann and Harold Spradley, another LPL astronomer. This large-format, bound atlas showed each limb area as seen from directly overhead. Since this was made before lunar orbiters flew it was necessary to create it by projecting telescopic images of the Moon onto a large white sphere and then rephotographing the sphere from directly over the area of interest.

In doing this Hartmann discovered the multi-ring structure of Mare Orientale and other basins which shaped his theories around the origins of the Earth's moon. In 1974, Hartmann and UA alumnus Don Davis proposed that the Moon formed when a Mars-sized planet struck Earth and flung the top layer of the Earth into space, where the debris recombined to form the Moon. The Giant Impact Theory withstood 45 years of scientific scrutiny and is currently in flux with several modified scenarios.

The exhibit also features a treasure trove of Moon-themed video game ephemera including "Moon Tycoon," "Lunar Pool," "Lunar Lander," "Moon Patrol," "Lunar Golf" and "Lunar Rescue." Also on display are a miniature replica arcade game and two Nintendo controllers cast in cement.

The icing on the cake of the exhibit is a fantastical painting by renowned space artist Robert McCall. On loan from the UA Museum of Art, *Visitation* is at first glance a futuristic Tucson replete with saguaros and floating space stations under the embrace of a giant moon. Looking closer, you'll find that you're standing on the future state of Mars with Earth looming large and Earth's moon tucked neatly at the left like a small ear.

Selected Catalogue of Exhibit Items

Books

Sidereus nuncius (The Starry Messenger), 1610. Galileo Galilei, 1564-1642
Galileo Galilei observed the Moon through a telescope of his own design and manufacture. His observations were scientific in nature, resulting in drawings that show the Moon's rough terrain, including valleys, high mountains and circular depressions. Galileo also discovered the satellites of Jupiter and vast new swaths of stars visible only with magnification. His book *The Starry Messenger* is a best-seller and is an important text in the long struggle between science and the Church. Galileo, a faithful Catholic, would be censured by the Pope in the years ahead for his scientific truths. His discoveries would thus disprove the prevailing view, in part derived from Aristotle, that the Moon is a perfectly smooth sphere. The nature of the lunar surface, including possible life, and the origin of its features would be debated for centuries.

De revolutionibus orbium coelestrium (On the Revolutions of the Heavenly Spheres), 1543. Nicolaus Copernicus, 1473-1543
This work argued that the Earth and the other planets orbit the Sun. It remained in Copernicus' hands until his death. Then it went to the collection of George Joachim Rheticus (1514-1574), astronomer, and Copernicus' pupil. Rheticus occupied himself with publishing and spreading the thought and work of his master.

Epitoma in Almagestum Ptolemaei, 1496. Edited by Giovanni Abiosi. Published in Venice by Johannes Hamman for Kaspar Grossch and Stephan Römer

This treatise was begun by the Austrian astronomer and mathematician Georg von Peurback and completed by his student Johannes Regiomontanus. This is a Latin abridgment, with important corrections, from the original Greek *Almagest* by renowned astronomical authority Claudius Ptolemy of Alexandria (circa 100-170 AD). Most notably the book calls Ptolemy's position that the Moon sometimes appears up to four times larger than its usual size a fantasy. Copernicus later used his own copy of this edition in rejecting Ptolemy's lunar and geocentric theories. Two of the Moon's impact craters, named Purbach and Regiomontanus, commemorate this book's authors.

Tabulae astronomicae, 1727. Philippe de La Hire, 1640-1718
Born in Paris, La Hire became active as an astronomer after his nomination to the Académie Royal des Sciences in 1678. He produced tables of the movements of the Sun, Moon, and planets. He studied the instrumental techniques and particular problems of observation and installed the first transit instrument in the Paris Observatory.

Tables astronomiques du soleil, de la lune, des planèts, des ètoiles fixes, et des satellites de Jupiter ed de Saturne, 1740. Jacques Cassini, 1677-1756
Second of four generations of eminent astronomers. Jacques studied at the Academe des Sciences and later was a member of the Royal Society. He specialized in astronomy and geodesy and was manager of the Paris Observatory. He also was magistrate in the cour de justice.

Maps from the collection of premier selenographer Ewen A. Whitaker

1. Apollo 17 Landing Site Panorama, U. S. Geological Survey, 1972
2. Map of Near and Far Sides of the Moon, Antonín Rükl, Cartographic Publishing House, Prague, 1971
3. Lunar Designations and Positions Compiled by D. W. G. Arthur and A. P. Agnieray, Lunar and Planetary Laboratory, University of Arizona, University of Arizona Press, 1967
4. United States Air Force Lunar Reference Mosaic, United States Aeronautical Chart and Information Center. Compiled by D. W. G. Arthur and E. A. Whitaker, Edited by Gerard P. Kuiper, 1962 (left), 1966 (right)

5. Relief Map of the Moon, Copernicus Crater size comparison in the corners, Falk Verlag, Germany, undated
6. Lunar Polar Chart, with annotations and drawings by E. A. Whitaker, NASA, 1970
7. Apollo 15 Imaging Coverage Map, circa 1971
8. Detail maps with correspondence from the U. S. Geological Survey to E. A. Whitaker, 1979, With annotations and drawings by E. A. Whitaker, Lunar Topographic Orthophotomap (LTO), Lunar and Planetary Institute, circa 1979
9. Map of Near Side of the Moon, Russia, 1967
10. Mosaics, Lunar Topographic Orthophotomap (LTO), Lunar and Planetary Institute, undated
11. Picard Crater, Topographic map, NASA, 1980

Photographs

Apollo 11 commander Neil Armstrong inside the lunar module following the historic first moonwalk, 1969. Taken by Buzz Aldrin, courtesy of NASA. Print from the Charles P. Sonett papers.

Apollo 11 astronaut Buzz Aldrin with the Passive Seismic Experiment equipment designed to detect lunar “moonquakes” and provide information about the internal structure of the Moon, 1969. Photographed by Neil Armstrong, courtesy of NASA. Print from the Charles P. Sonett papers.

American flag and astronaut footprints, Apollo 11, 1969. Because the Moon has no atmosphere, the footprints are still there! Image courtesy of NASA. Print from the Charles P. Sonett papers.

Eclipse photograph, undated. From the Ewen Whitaker papers

Ewen Whitaker (top) with Raymond Heacock, Ranger 7 mission, Jet Propulsion Laboratory, Pasadena, California, courtesy of NASA, 1964

Gerard Kuiper (right) Primary Investigator of the Ranger 7 Mission and Ewen Whitaker, courtesy of NASA, 1964

Graphic with location of Surveyor III and the distance from the Apollo 12 landing site, 335.4 meters. The astronauts, Charles Conrad and Alan Bean walked this distance to retrieve the equipment. They were the 3rd and 4th men on the Moon, 1969

Controlled Degradation of Arial Photography, Studies in Planetary Photography, California Institute of Technology, 1963-1964

Physiographic and geological interpretation. Degraded photographs of Little lake, California

Nuclear impact craters in Nevada studied to better understand crater formations on the Moon. Photographs and correspondence from the Lawrence Radiation Laboratory, University of California, 1964

Correspondence and Manuscripts

Correspondence (copy) from President Richard Nixon to Ewen Whitaker congratulating him on locating Surveyor III and picking the Apollo 12 landing site, December 30, 1969

Ewen Whitaker reply to letter from President Richard Nixon (copy), January 6, 1970

First correspondence between Whitaker and Kuiper in 1955.

Engraved sketchbook with detail drawings of Newton, Aristarchus and Herodotus crater, 1948-1949 by D. W. G. Arthur. From the Ewen Whitaker papers.

Stereoviewer, made by Ewen Whitaker with glass plate positives over binoculars to create a three-dimensional view of the Moon, undated

Nomenclature lists from Whitaker’s papers circa 1980.

Dickert Moon Model Photograph (reproduction). Security guard with Dickert Moon model, Field Museum of Natural History in Chicago, 1898

Dickert Moon Model illustration from a contemporary magazine (Illustrirte Zeitung, No. 589, 14 October 1854).

Publication, Dickert Moon Model, 1854. From the Ewen Whitaker papers.

Correspondence copies between Kuiper, Whitaker and Turner related to the creation of scientific models.

Original lunar drawings by Ewen Whitaker

Southeast edge featuring the Birt crater. Made from a reference photograph taken at Mount Wilson in 1919, 1956

Chart of the south, south-east limb regions of the Moon with profile of the Doerfel Mountains, 1956

Southern region of the Moon with Curtius and Simpelius craters in the foreground, circa 1956

Oblique view of the southern limb region with the Schomberger crater at center, 1954

On loan from the Lunar and Planetary Laboratory

Precision hemisphere, used in the creation of the Rectified Lunar Atlas, circa 1960

Moon globe, Sky and Telescope, circa 2007

Rectified Lunar Atlas: Supplement No. 2 to the Photographic Lunar Atlas. E. A Whitaker, G. P. Kuiper, W. K. Hartmann, and L. H. Spradley. University of Arizona Press, 1963

On loan from the Learning Games Initiative Research Archive

Collection of Moon-themed video games and ephemera, Replicade Miniature Atari Tempest X Arcade Machine, 2018, Cast Cement NES Controllers, 2016.

On loan from the Museum of Optics, College of Optical Sciences

Terrestrial telescope, Italy, early 1700s. Three-draw velum-covered telescope with horn fittings. 10x Magnification (Galileo's telescope was 30x).

Graflex Super Speed Graphic large format view camera, manufactured between 1956-1973

On loan from University of Arizona Museum of Art

Robert McCall (1919-2010). *Visitation*, 1991. Oil on Masonite. Gift of Robert T. and Louise H. McCall, 2007