PICTURES BY PROXY: IMAGES OF EXPLORATION AND THE FIRST DECADE OF ASTRONAUT PHOTOGRAPHY AT NASA

by

Jennifer Levasseur
A Dissertation
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of
Doctor of Philosophy
History

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Fall Semester 2014
George Mason University
Fairfax, VA

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Jennifer Levasseur
Master of Arts
George Washington University, 2002

Director: Paula Petrik, Professor
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DEDICATION

So much of this process, especially at the end, took away precious time with my husband, Ben. This project is just as much about his dedication to our family as it is about my dedication to my subject. He, more than any other person, deserves to have this project dedicated to him – he is my other half, picking up so much slack when I could not.

This dissertation is also dedicated to my colleagues in the Department of Space History at the National Air and Space Museum for their endless supply of wisdom, encouragement, and moral support.

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In my mind, no project worth doing can be done alone, even a dissertation. And while this was a personal journey, I want to thank my entire family for checking in on me when times were tough and cheering me on, especially my husband Ben and our boys Remi and Drew. Remi and Drew were two reasons this took me so long, but were more than worth the delay to this project. My friends never wavered in their support of me, for which I will always be grateful. To my work colleagues, who are all friends, especially those regular attendees of Writer's Group – you held the flashlight for me when I felt lost. Most especially, I need to acknowledge Dr. Margaret Weitekamp, Dr. David DeVorkin, and Dr. Roger Launius for their unending supply of comments, encouragement, critiques, challenges, and confidence when I needed it most. Margaret, you were always that voice of reason sitting on my shoulder telling me, "a good dissertation is a finished dissertation," and, "I've seen people who will finish and those who won't finish…you're one that will finish." I am pleased to say this: you were right!

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LIST OF ABBREVIATIONS

Advanced Spacecraft Technology Division	ASTD
Apollo Lunar Surface Experiment Package	ALSEP
Applications Technology Satellite	ATS
Center for Earth and Planetary Studies	CEPS
Command Module	CM
Command Module Pilot	CMP
Commander	CDR
Command-Service Module	CSM
Department of Defense	DoD
Experiments Program Office	EPO
Extravehicular	EV
Extravehicular Activity	EVA
Extravehicular Life Support System	ELSS
Extravehicular Mobility Unit	EMU
Flight Crew Support Division	FCSD
Goddard Space Flight Center	GSFC
Instrumentation and Electrical Systems Division	IESD
Johnson Space Center	JSC
Kennedy Space Center	KSC
Langley Aeronautical Research Center	LARC
Lunar Module Pilot	LMP
Lunar Module	LM
Lunar Orbit Insertion	LOI
Lunar Receiving Laboratory	LRL
Lunar Roving Vehicle	LRV
Manned Spacecraft Center	MSC
Mission Elapsed Time	MET
National Advisory Committee for Aeronautics	NACA
National Aeronautics and Space Administration	NASA
National Air and Space Museum	NASM
National Oceanographic and Atmospheric Agency	NOAA
National Reconnaissance Office	NRO
Office of International Affairs	OIA
Office of Space Science and Applications	OSSA
Photographic Technology Division	PTD
Photographic Technology Laboratory	PTL

President's Science Advisory Committee..PSAC
Public Affairs Office..PAO
Royal Geographical Society ....RGS
Service Module..SM
Service Propulsion System ....SPS
Scientific Instrument Module .... SIM
Space Sciences Division .... SSD
Space Task Group ....STG
Super Wide Angle..SWA
United States Geological Survey .... USGS
United States Information Agency.. USIA

ABSTRACT

PICTURES BY PROXY: IMAGES OF EXPLORATION AND THE FIRST DECADE OF ASTRONAUT PHOTOGRAPHY AT NASA

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The first decade of hand-held camera use by astronauts provided tens of thousands of images and a valuable resource for better understanding the astronaut experience. More than just words on television or quotes in a newspaper article, the photographs evoke a sense of space known by so few but fascinating to so many. From the iconic to the mundane, these photographs became the most significant part of the broad collective memory of early human spaceflight, especially those that touched on visual themes present throughout the history of exploration photography. Analyzing the story of astronaut photography meaningfully augments existing scholarly inquiries regarding visual culture, exploration, technology, and public memory, particularly in regards to the period of the 1960s. Astronaut images share numerous characteristics with previous exploration efforts, efforts that used photography as a scientific, documentary, and public relations tool. They are also unique in ways that require investigation.

Technology plays a significant role in the ability to record human experiences in extreme conditions, so cameras and training given to astronauts needed to provide flawless functionality to men trained as pilots and engineers first. Along with the astronauts using the cameras were those on the ground, who laid out the systematic plans for photography and created scripts to follow, all the while allowing for spontaneous crew-selected work. When returned to Earth, interpretation of images fell to multiple audiences, who used the photographs for often-unforeseen purposes, and with results that have found their way into the collective memory of this country. This story is about not only astronaut photography and the historical challenges of imaging in extreme conditions, but also technological choices made along the way, training test pilots to act as surrogate photographers, and how audiences perceived the results as part of the larger cultural experience of the 1960s.

INTRODUCTION: INTERPRETING ASTRONAUT PHOTOGRAPHY

> *"The unique scientific aspect of the flight of Apollo 8 was the exposure of man and his accumulated training and experience to an environment previously examined only through the programed systems of unmanned spacecraft. This was an opportunity for the observation of another planetary surface in a situation that combined continuously varying viewing geometry and lighting with the exceptional dynamic range and color discrimination of the human eye. Add to this the potential of the experienced human mind for both objective and interpretive selection of data to be recorded."*
> -William Anders, James Lovell, and Frank Borman, 1969[1]

Two of the most famous Americans in aviation history attended the launch of Apollo 8 on December 21, 1968: Charles and Anne Morrow Lindbergh. Anne, a fine pilot in her own right as well as a prominent writer, recorded her observations of meeting the astronauts the day before the launch, viewing the Saturn V, and analyzing the implications of what was arguably the most meaningful result of the Apollo program—humans seeing Earth from beyond orbit. In the essay first published in newspapers and then in book form, Anne reflected on the *Earthrise* photograph that dominated reactions to the mission: "Through the eyes of the astronauts, we have seen more clearly than ever before this precious earth essence that must be preserved. It might be given a new name borrowed from space language: Earth Shine." [2] (Figure 1)

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[1] Anders, William, James Lovell, and Frank Borman. "Visual Observations." In *Analysis of Apollo 8 Photography and Visual Observations, 1969*. Washington, D.C.: NASA, 1969, p. 1.

[2] "The Heron and the Astronaut," Lindbergh's essay on Apollo 8, appeared in *Life* Magazine's issue from February 29, 1969. Her publisher combined it with her "Immersion in Life" essay from *Life*'s October 21,

Lindbergh's essay captured the unspoken and sometimes unexpected benefits of the Apollo program: the spiritual, environmental, and inspirational aspects of the distant view of Earth. The story of the photograph, quickly titled *Earthrise*, symbolizes the culmination of almost a decade of photographic activity at NASA. Over those years, a community of pilots and engineers trained intensely to carry out missions with exacting precision, endured the intense forces of launch, and followed intricately choreographed plans for doing everything from rehydrating food to maneuvering in spacesuits to collecting lunar samples. *Earthrise* became one of only a handful of defining visual moments of Apollo, combining the technical and mechanical with the ethereal and emotional. It expressed, in a single frame, the successful engineering expertise of a politically driven nation and the sense of awe people felt from such a sublime experience. *Earthrise*, while the cause of a decades-long controversy between the astronauts themselves over who took the color version of the Earth "rising" from behind the Moon,[3] became the single best visual expression of traditional notions of American cultural ideas during the so-called long '60s. Americans travelled to the Moon and returned, "conquering" the space "frontier."

1966, issue into a single bound volume later in 1969; Lindbergh, Anne Morrow. *Earth Shine*. New York: Harcourt, Brace & World, 1969, p. 45.

[3] Anders captured this color image as the spacecraft traveled around the Moon near its equator, and the photograph reflects his position in the spacecraft relative to the Moon and the window he used to view the Earth. The first photograph of this sequence, a black-and-white shot, shows the Moon oriented horizontally. As the spacecraft continued to rotate and move around the Moon's center, Anders waited for a color magazine. His body also rotated, and Anders himself says his view at the time had the Moon on the left in his view. While able to take a photograph from virtually any positions, published versions of the images appear in multiple orientations. None are right or wrong since there is no up or down in space. The images displayed throughout this study are oriented as the photographer composed them or feel best represents their point of view.

Set against the backdrop of some of the most tragic stories in American history such as the assassination of the Kennedy brothers and Dr. Martin Luther King, Jr., nation-wide race riots, and highly unpopular war in Vietnam, NASA's successes in launching humans into space served as contrast, providing a sense of national pride and prestige. One of the Apollo 8 astronauts even received a letter from an American woman who thanked him for saving 1968.[4] The Cold War itself provided a perfect foil for the space effort: an intense rivalry played right into public desire to maintain the U.S.'s role as the preeminent space superpower. A critical method for conveying space successes, this study contends, are the photographs created by participants in the experiences of leaving Earth. This may be, in part, associated with what W. J. T. Mitchell has called the pictorial turn, when American culture moved from reliance on the printed word for news information to visual media.[5] But, in any case, images astronauts returned from space became vital contributions to public memory of early U.S. human spaceflight as well as critical pieces of evidence for scientific research.

Images that come to mind when talking about the heroic age of human spaceflight may include elements like the darkness of space, the vivid blue of Earth's surface, and the bright silver soil of the Moon. Those characteristics do not instantly reveal the means by which the photograph was captured, whether human or robotic. The vast majority of early astronaut photographs contain only abstract features such as space and planetary surfaces. What sets astronaut photography apart from other images is the appearance of

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[4] Chaikin, Andrew. *A Man on the Moon: The Voyages of the Apollo Astronauts*. New York, N.Y: Viking, 1994, p. 134.

[5] Mitchell, W. J. T. *Picture Theory: Essays on Verbal and Visual Representation*. Chicago: University of Chicago Press, 1994, p. 11.

people in some images. I contend that through the presence of people – in various forms and representations – and only through that, can audiences beyond the scientific community absorb some sense of the spaceflight experience. We can put ourselves in the shoes of those we see, no matter the strangeness of their clothing, means of transportation, or surroundings. From the first images of Ed White floating outside the Gemini IV spacecraft to those of Gene Cernan traversing the Taurus-Littrow valley of the Moon, the appearance of astronauts in photographs put us in space. There are notable exceptions to this rule, two outliers to this theory about the need of human figures to understand spaceflight: two of the most iconic photographs of the 20th century, *Earthrise* and *Whole Earth*. Taken on the first and last Apollo missions to visit the Moon, they do not feature astronauts, but were interpreted as views that depicted all people. As well-publicized and oft reproduced first and last views of home, those photographs hold a special place in our shared cultural memory of the early period of human spaceflight. But to contextualize any of these images in a historical way, however, means creating a framework for interpreting the photographs, their creation, dissemination, and reception.

Three broad historiographical themes frame this argument: interpreting astronaut photography requires analysis in terms of visual culture, exploration using technology, and public memory. These serve as threads followed throughout each of the chapters. The topics have well-established historiographies, but few works, even unrelated to space history, attempt to all examine photography using these themes. Recent conference presentations by scholars such as Michael Robinson and Anders Houltz touched on the long history of visual rhetoric generated by exploration projects. Robinson alluded to the visual connection between public memory of Arctic exploration and the space program, but remained focused on artwork. [6] Anders Houltz developed a line of inquiry about Hasselblad's involvement in showing the world what astronauts saw, but failed to make a compelling argument for how astronauts, with their high tech cameras, became crucial to the visual legacy of Apollo.[7] My study extends the work of these two ventures to interpret the importance of astronaut images through examining the production of images, the audiences who consumed them, and reactions to the photographs. These visual products, created by our proxies, became a significant point of departure for American culture during the Cold War, symbolizing a psychological victory despite other great tragedies of the period.

The importance of photographs in comprehending distant lands did not start with the space program. To understand the importance of astronaut photography to the story of the 1960s, we must examine this period in light of its similarities and differences from previous explorations that used photography as a scientific, documentary, and public relations tool. Whether in the challenging terrain of the unexplored American West in the 1870s or on voyages to the treacherous polar ice caps, photography in extreme conditions required adequate technology for recording those human experiences. This story about astronaut photography takes shape through an examination of the historical challenges of imaging in extreme conditions, but goes into depth on the most drastic points of departure

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[6] Robinson, Michael F. "Lessons from the Last Frontier," Keynote Address at "1961/1981: Key Moments in Human Spaceflight" symposium. April 26, 2011. Washington, D.C. http://www.ustream.tv/recorded/14289321 (accessed June 29, 2012).

[7] Houltz, Anders. "Selling the Space Camera." Society for the History of Technology Annual Conference. October 17-21, 2007. Washington, D.C.

from historical case studies. Making technological choices in terms of equipment, training test pilots to do work typically performed by professional photographers, and the audiences for images and their reactions to the visual results that emanated from NASA are the major topics examined in this study.

Visually and rhetorically, those inside the space program and outside it have consistently identified space exploration as a core part of American culture, steeped in the character of expeditions carried out in by-gone eras. Taking photographic equipment through the challenging Western landscape of the late nineteenth century certainly compares to launching it aboard rockets where mission engineers scrutinize every gram of cargo. Protecting camera equipment against the fierce cold of the Polar Regions relates in many ways to modifying astronaut cameras to operate outside a spacecraft where temperatures can swing 250 degrees Celsius between sunlight and shadows. In both earlier periods of exploration, using those photographs as tools to influence the sentiments of policymakers and the public alike reflects the interpretive nature of photography despite what it took to produce the images. As a tool for public relations, engineering documentation, scientific investigation, and recording the experience itself, astronaut photography, much as with these earlier examples, opened the door to a new way of understanding our home planet.

This investigation suggests preconceived notions of the frontier and triumphal American ideals guided early understandings of astronaut photography, but readings of the images challenge the use of such rhetoric in relationship to space exploration. NASA refrained from assigning grand meanings to astronaut photographs in the information provided with the release of images, choosing to supply basic information in captions and press releases. Notably, social commentators including Archibald MacLeish and James Dickey wrote essays about the implications of astronaut photography from time to time.[8] Through the images, people could feel as though they participated in a historic moment that only a handful of Americans experienced, circling the Earth or Moon in spacecraft barely the size of a Volkswagen Beetle. Guiding audience reactions to the photographs were the needs that drove their desire for them in the first place. The public, however, had no such expectations for visuals returned from human spaceflight and were to some degree guided in their understanding of the images by writers such as McLeish and Lindbergh, coming to understand astronaut photography in terms other than those NASA perhaps expected. With such a wide set of potential influences to shape the products and reactions to astronaut photography, and literally thousands of images available for analysis, the direction of this study must be defined by only the most relevant historiographical considerations.

Some boundaries are in order for any historical work. Any study of an aspect of a visual medium could go on endlessly, covering the subject from a variety of theoretical, semiotic, rhetorical, or technical angles. Unpacking this subject using a single historiographical context such as visual culture, technology, exploration, or public memory too narrowly defines the study, though all four used equally would not take into account the nature of resources and documentation that are available. Some secondary studies published since the Apollo program engage with astronaut photographs on some

[8] Cosgrove, Denis. "Contested Global Visions: One-World, Whole-Earth, and the Apollo Space Photographs." *Annals of the Association of American Geographers*. Vol. 84, no. 2. June 1994: p. 283.

level, but typically only as illustrations of a point about a larger part of the program. The gap that exists in the current literature I wish to fill requires drawing conclusions using documentary, photographic, and technological evidence to understand the cultural significance of astronaut photography. By incorporating a wide set of materials in this study, including a close visual reading of key photographs, I aim to move the narrative to a point beyond but inclusive of intellectual monographs, fetishized and narrow technological histories, and journalistic studies that take little note of primary sources and do little to push the historical understanding of the space age any farther.[9]

Framing theme: visual culture

Within the visual evidence produced during the space program lay three general media types available for examination: moving, still images, and art. To maintain consistent and focused terminology, technology, and evidence, selecting one medium is necessary. Scholars including Kathy Keltner and Ann Goodyear address creating visuals during the early space program, but their primary focus is not the production, dissemination, and reception of images as a complete visual narrative.[10] Still photographs, distributed broadly via global, national, and local news outlets in printed form, make for a sufficiently narrow but interesting study. Television and movie footage, in the form of broadcast signals and film, provided visual media for specific television

[9] Poole, Robert K. *Earthrise: How Man First Saw the Earth*. New Haven: Yale University Press, 2008; Steven-Boniecki, Dwight. *Live TV from the Moon*. Burlington, Ont: Apogee Books, 2010.

[10] Keltner, Kathy. "From Myth to Metaphor to Memory: A Rhetorical Analysis of Televised Representations of Project Apollo, 1968-2004." Dissertation. Ohio University, 2007; Goodyear, Anne Collins. "The Relationship of Art to Science and Technology in the United States, 1957-1971: Five Case Studies." Dissertation. University of Texas at Austin, 2002.

and movie production teams to display space accomplishments for a fleeting moment. Over the long haul, moving images were more difficult to reproduce and provide to the public, resulting in a less permanent place in public memory. Historian David Lubin makes an excellent case for how iconic images become so entrenched in public memory because of their ability to recall previously seen images of related things, a process not necessarily possible for more than just a mental snapshot of a filmed event.[11] The ease of obtaining printed reproductions of photographs in newspapers or magazines meant they often served as commemorative items of these historic moments.

The reach of still images and the ease of reproducing them also extended the possibilities for dissemination and impact across the globe, far beyond the reach of art or moving images. Photographs distributed by NASA appeared in newspapers around the world, on a national and local level, and the United States Information Agency (USIA) used them as a tool for conveying the beneficial nature of the U.S. space program to all people. In an interview that played on CBS the day after Apollo 11 landed on the Moon, July 20, 1969, former president Lyndon B. Johnson mentioned that one of his last acts as president was to pen letters to leaders of every nation on Earth, with an enclosure of a reproduction of the iconic Apollo 8 *Earthrise* photograph.[12] He characterized the response from world leaders to the letter and photograph as amazing, noting that Ho Chi Minh's thanks were particularly meaningful to him. By selecting an astronaut photograph

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[11] Lubin, David M. *Shooting Kennedy: JFK and the Culture of Images*. Berkeley: University of California Press, 2003, p. xi-xiii.

[12] "A Conversation about the U.S. Space Program with Former President Lyndon B. Johnson." Broadcast during *Man on the Moon: The Epic Journey of Apollo 11*. CBS Television Network, New York, NY. 21 July 1969, p.3. Records of the U.S. Information Agency, RG 306, Entry A1 42, Box 4. National Archives and Records Administration, College Park, MD.

to connect his presidency and legacy to that of the American space program, Johnson revealed not only his pride in the accomplishment, but also the enduring, wordless power of photographs in global communications.[13] This wordless power, as historians Robert Hariman and John Louis Lucaites explain, gives some astronaut photographs special status: “Iconic photographs provide an accessible and centrally positioned set of images for exploring how political action (or inaction) can be constituted and controlled through visual media.”[14] The iconic subset of astronaut photographs gave NASA a source of visual power, but the bulk of the images offered longevity and a legacy to the agency and its professional audiences.

The example of Johnson’s use of *Earthrise* as a public relations tool is one clue of the importance of images to the space program as a whole, but also the influence they could have on global opinion and national prestige. As John Tagg points out, however, the camera is never neutral.[15] The U.S. government and particularly NASA seemed to sway public opinion with stunning photographs taken by astronauts. But in reality, even images could not bring support for space exploration much beyond the fifty percent mark

[13] Johnson reportedly also kept a framed copy of *Earthrise* in the Oval Office, which he left for his successor, Richard Nixon. Shortly after his arrival to the office, the photograph no longer appeared in photographs of the office: John Logsdon, “Richard Nixon and the American Space Program,” Lecture at the Space Policy and History Forum, National Air and Space Museum, September 22, 2014.

[14] Hariman, Robert and John Louis Lucaites. *No Caption Needed: Iconic Photographs, Public Culture, and Liberal Democracy*. Chicago: University of Chicago Press, 2007, p. 5.

[15] Tagg, John. “Evidence, Truth, and Order: A Means of Surveillance,” in *Visual Culture: The Reader*. Jessica Evans and Stuart Hall, eds. London: Sage in association with the Open University, 1999, p. 244-245.

at the height of the program in the late 1960s.[16] Apparently, even the seeming unimpeachable status of photographs did not convince a majority of politicians that space deserved a bigger piece of the budgetary pie once NASA surpassed Kennedy's lunar goal. Visual, scientific, and technological benefits proved too little in comparison to the risks and other social, economic, and political needs of the 1970s.

Nevertheless, what makes astronaut photography such an interesting topic is both its deep penetration into American culture and its global spread as a means of communicating the accomplishments of NASA engineers, scientists, and astronauts. Roland Barthes explains that some visual evidence requires no language or key because, "…for all the kinds of images only the photograph is able to transmit the (literal) information without forming it by means of discontinuous signs and rules of transformation."[17] While the audience for astronaut photography may be broad, the photographer-astronauts were by no means artists. The results of their photographic work do deserve analysis in terms of visual culture. It was, after all, the images they took far more than their words that became the literal focal point for many, perhaps most, memories of the space program of the 1960s and 1970s.

For historians, astronaut photography presents a more complex problem. Historical research material often takes the form of the written word in the form of diaries, memos, letters, and other printed matter. The wordless nature of images makes them less familiar territory. Reading an image for information, as art historians and visual

[16] Launius, Roger D. "Public Opinion Polls and Perceptions of US Human Spaceflight," *Space Policy*. Vol. 19, no. 3. August 2003, p. 163–75.

[17] Barthes, Roland. "Rhetoric of the Image," in *The Visual Culture Reader*, Nicholas Mirzoeff, ed., London: Routledge, 2002, p. 136.

culture experts do, is an acquired skill, and the potential for multiple interpretations can frustrate the best historians. In the case of astronaut photography, scholars from a range of backgrounds have engaged with the images as both evidence and art. I seek to forge a path through the middle, engaging with the material in terms of the visual and the historical.

By examining astronaut photography in terms of visual culture, my study seeks to expand our historical and cultural understanding of the early space program. Photographs both moving and still add richness, texture, and dimension to life otherwise captured in impressions made through words on paper or in memories saved in our minds. Sigmund Freud called a photograph the screen onto which we project visual memories.[18] Similarly, as theorist Siegfried Kracauer posited, photography is an attempt to capture a spatial continuum while history captures the temporal continuum.[19] The generation of a spatial concept of a historical moment, one passed but not necessarily experienced personally, required accurate photographs and information, especially for a public already immersed in the visual documentation of life during the 1960s. Seeing events around the world documented on the nightly news or in the pages of daily newspapers and weekly magazines brought the possibility of remembering global events with associated visuals, not in only those words generated by journalists or historians.

Scientists investigate the issues of space explored: geology, atmosphere, microgravity and the like. Historians address issues of politics, technology, management,

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[18] Freud, Sigmund. *The Standard Edition of the Complete Psychological Works of Sigmund Freud* . Vol.III. London: Hogarth Press, 1953, p. 303-322.

[19] Kracauer, Siegfried. "Photography," trans. Thomas Y. Levin. *Critical Inquiry*. Vol. 19, no. 3. Spring 1993, p. 421–36.

and the labor force. Between the data gathered scientifically and information made explicit in documents exist photographs. They weave together data and narrative into a multi-dimensional impression of the space program. Images are historical evidence. They are also data, and as Kracauer described, a means of capturing the spatial element otherwise lost when historians and scientists do not consider images in their analysis. Whether gathering images for photogrammetric studies, geological reference, or documentation of the technical elements of missions, the human presence behind the camera provided a perspective otherwise absent in data and documents. Through them, we can mentally construct an understanding of the experience of space travel.

In many ways, early astronaut photography cannot be viewed as a purposeful effort to create art. For the most part, astronauts did not behave as artists or professional photographers—using the techniques, technology, and planning professionals would use to create an image. The primary function of the astronauts was to complete a mission successfully. Documenting their voyages, in visual or even written documents, was down the list of priorities, certainly coming after the engineering requirements of operating the vehicles, testing new equipment, and making scientific discoveries. Astronauts were removed from many of the critical elements of artistic photography, including processing the images and shaping their reception by audiences. Their work has more in common with amateur photographers, who may possess high quality equipment, but not the training, practice, or techniques that would qualify them as artists or even professionals.

From the perspective of at least one person, Richard Underwood, who trained astronauts in photographic techniques during the 1960s, the quality of astronaut photographs was the key to their “immortality” as explorers.[20] Photography may well be the source of permanently fixing in public memory the success of the U.S. space program of the 1960s. While it is a truism that many remember astronaut achievements more than those of the hundreds of thousands of people who enabled their flights, I point out here that even the astronauts are disconnected from public memory in their photographs. Rarely do astronauts appear in their photography, and often those seen outside the spacecraft are for purposes of scale, not typically posed or planned. (Table 2) Some exceptions to these observations are the images more likely recognized by the public: Ed White spacewalking with the backdrop of the Earth (Figure 2); Buzz Aldrin facing the camera (Figure 3) or looking at the U.S. flag he and Armstrong planted (Figure 4); and John Young leaping in the air with the lunar module behind him (Figure 5). But while astronaut photographs in a few cases do document the human presence in space, I would argue for a general disassociation of personally specific details and images with general impressions and understandings enduring through public memory. Many people may think of a vague fact like “humans did it,” not Gene Cernan was commander of Apollo 17, the last human mission to the Moon. Underwood’s statement about immortality then adheres to the images, not the astronauts.

Surveying the images taken by astronauts, a very important fact becomes clear: the overwhelming majority of images taken by astronauts were for scientific and technical purposes. For example, of the over 18,000 frames of still images taken during the Apollo missions, only about a thousand of them feature a human being, a shadow, or

[20] Underwood, Richard W. Interviewed by Summer Chick Bergen. October 17, 2000. Interview Transcript, NASA Johnson Space Center Oral History Project, Houston, TX, p. 19.

a boot print. The calculation, though based on fewer images returned per mission, is nearly the same for Mercury and Gemini photography. Recent projects to scan all original flight films at high resolution bring the human-less fact of astronaut photography into vibrant color and clear focus. Based on a quantitative analysis the photography, those images scheduled and written into the mission plan, the public outreach use of photography had less to do with pre-planning than it did with opportunities discovered when the images became available to non-technical eyes. According to a NASA document outlining the purpose of photography, the public relations use of images does not even register in the outlined purposes: technical review of operations, information for later missions, discover where cameras could replace people, and as tools of scientific investigation.[21]

From its establishment in 1958, NASA officials sought to explain to the American public how their tax dollars accomplished worthwhile goals. Accordingly, the agency undertook significant outreach efforts, focusing on the competition with the Soviet Union in the human exploration of space. The Moon was the prime target. The Apollo 8 mission, the first to travel around the Moon, showed off the technical capabilities of the American space agency, and how far along it was in fulfilling the goal set by President Kennedy of reaching the Moon by the end of the decade. The mission not only reassured the public about spaceflight following the tragic Apollo 1 fire in January 1967, but also reinforced NASA's human spaceflight policies. Apollo 8 connected the ideal of space

[21] Conversations regarding the priorities for photographic work were ongoing prior to Apollo amongst NASA managers for science, public affairs, flight crew operations, and engineering. Documentation regarding these priorities is discussed in depth in Chapters 2 and 3.

travel to existing American mythology of the frontier through the publication of *Earthrise*. Through both words and images, NASA could connect its projects to an idealized era of exploration and those who accomplished what in the 1960s was still largely perceived as the heroic taming of the American West. Cowboys became astronauts. Desolate prairies and rocky landscapes became the bleak lunar surface.

On top of, or at least at the end of the production process came two critical elements in the process of bringing the vision of spaceflight to audiences: disseminating the images and opening up the opportunity for reactions to the visual information collected. Dissemination is in part a process of reviewing images within the NASA-determined (or national security determined) structure for publicizing missions. Image processing was a regular routine, run through the Photographic Technology Laboratory at the Manned Spacecraft Center (renamed the Lyndon B. Johnson Space Center in 1973). Many layers existed between the processing and the printing in public formats: in television broadcasts, in newspapers, magazines, or books. Photos had to clear a security screening when of Earth, but also a Public Affairs Office process to determine which images had the potential for visual impact on the public audience (national and international) and Congress. While keen to release images demonstrative of astronaut activities, success, and major program milestones, the insertion of Public Affairs representatives in the process meant that other than releases to scientists, few people viewed the breadth of astronaut photography and space experiences. Understanding spaceflight underwent mediation by those within NASA and the government for reasons of national security and shaping public views of human spaceflight.

Because the audience in the broadest sense viewed the images, the range of possible reactions was wide open. Those who financially supported expeditions may find satisfaction in the economic development possibilities seen in images, such as potential mineral deposits or other natural resources seen in photographs of western American regions. Michel Foucault addressed this in his discussions on power, explaining that one expression of power is the control of images. In the case of astronaut photography, both NASA and the astronauts wielded power as the arbiters of image content.[22] Institutions define many of the rules by which these elements of the cultural process occur, but the interpretation of images remains in the minds of the audiences. Their needs shaped the ways in which the photography was distributed. In each case examined here, however, the broadest version of the public audience was not the intended primary consumer of the photographs but rather those who chose intentionally to employ them for their own purposes. With so many audiences, interesting and dynamic possibilities for reaction and interpretation existed.

Photographs, accurately or not, imply a sense of reality unencumbered by the filter of the human mind. The presumed "truth" of images, a long debunked view of photography, applies to astronaut photography: people expected that the photographs were spontaneous documents of the experience, not planned or staged. Anyone knowledgeable about large government programs knows planning was at the core of producing results. I describe how the scripting of a mission from launch to landing took months and sometimes years. Photography took up only a small portion of time, but the

[22] Foucault, Michel. "Panopticism," in *Visual Culture: The Reader*. Jessica Evans and Stuart Hall, eds. London: Sage in association with the Open University, 1999, p. 61-71.

centrality of images as a source of information for distribution to various audiences meant listing each required image in flight plans with an allowance for other targets of opportunity and crew-selected subjects.

Using Barthes' theory of images, my study also examines the symbolic and literal messages (connoted and denoted, in his terms) of astronaut photography. Reading these images brings forth a variety of impressions, associations, and memories. Literal messages in spaceflight are obvious: a rock was in a specific position when collected by an astronaut. These denoted messages convey information in similar literal ways as those seen in scientific or medical photographs. Connoted messages vary by the subjective attitudes, beliefs, and other psychological filters used by humans when analyzing information. To read an image, to process information from it in a strategic way, requires a level of interpretation that brings forward elements seen as more dominant or important and pushes to the side deemed less significant.[23] This dissertation seeks to explore the production of these symbolic and literal messages within the historical, cultural, and political contexts of this early period of human spaceflight.

What is essentially a visual culture study set within the context of historical examinations of human spaceflight requires looking outside of space history literature to secondary works that can guide this study towards a place in wider historiographical narratives. Studies abound of the meaning of photography of newly explored places and the function of photography in culture. Strategies used by visual historians such as

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[23] Barrett, Terry. "A Theoretical Construct for Interpreting Photographs." *Studies in Art Education*. Vol. 27, no. 2. January 1, 1986. p. 52–60; Henny, Leonard. "Trend Report: Theory and Practice of Visual Sociology," in *SAGE Visual Methods*. Jason Hughes, ed. London: SAGE, 2012, p. 20-21.

Martha Sandweiss, James Ryan, and Elspeth Brown, who examined photographic work in the American West, Africa, and industrial America of the early twentieth century respectively, shape how my dissertation places astronaut photography firmly within their same scholarly circles. [24] To focus my work, the emphasis narrows in on what is essential to the narrative of astronaut photographic reception, situating all of these issues within a framework established by other histories of exploration photography. At its core, astronaut photography is the imaging of exploration by humans, but not by professionals in this case; a visual record created by the few who made the journey for those who did not. Across the scope of exploration projects over the last century and a half, these experiences stand as key moments in which ideas of success, failure, pride, and discovery depend on a visual record.

Framing theme: exploration and technology

Within the history of exploration photography, the use of technology offers the opportunity to chronicle a journey as a scientific, documentary, and public relations device. Exploration tends to imply a harsh working environment, with potential pitfalls and situations the explorers cannot predict. Photographic work in such conditions presents additional challenges, whether the conditions are the diverse terrain of the unexplored American West in the late nineteenth century, the treacherous Antarctic ice cap around the turn of the twentieth century, or the cold vacuum of the space between

[24] Sandweiss, Martha A. *Print the Legend: Photography and the American West*. New Haven: Yale University Press, 2002; Ryan, James R. *Picturing Empire: Photography and the Visualization of the British Empire*. Chicago: University of Chicago Press, 1997; Brown, Elspeth H. *The Corporate Eye: Photography and the Rationalization of American Commercial Culture, 1884-1929*. Baltimore: Johns Hopkins University Press, 2005.

Earth and the Moon during the late 1960s and early 1970s. Documenting experiences of explorers, a process undertaken by professionals and non-professionals alike, involves the additional issues of rhetoric, funding sources, and visual messages, all shaped intentionally or not by the needs of participants in the overall project (i.e. audience, governments, explorers, photographers, scientists, etc.). Expeditions, with varying environmental and technical challenges to overcome, are marked by the success of the images in conveying a message to a multitude of audiences.

My study is about not only early astronaut photography and the related historical situations of imaging in extreme conditions. It also examines the process: the technological choices made along the way and the process of training test pilots to do work typically done by professional photographers. Prior expeditionary projects, those to the American west and Antarctic regions, employed trained photographers, men who by trade knew their technology and how to maximize issues of lighting, exposure, and composition. In the case of astronaut photography, the position of photography in the grand scheme of mission planning fell far from the top of the list of duties. While professional photographers employed by NASA assisted in selecting camera equipment, training the astronauts in camera use, and developing the films post-flight, the art of making a well-composed and elegant photograph was not an intended aspect of astronaut-photographers: time and location usually did not allow for much flexibility. None of the hallmarks of what define a professional artistic photographer other than capturing images with a camera is present in the experiences of the astronauts responsible for memorable views of our first forays into outer space.

In many ways, the topic of astronaut photography also fits loosely within the discipline of the history of technology. Specialized histories of spaceflight technologies abound, including a few focused on cameras specifically,[25] but nothing approaches the serious contemporary scholarship currently reshaping the direction of the history of technology. Of particular interest in the area of space technology are monographs by Phillip Scranton on a community-based approach to the history of technology, and David Mindell on the human-machine interface as seen with the development of the Apollo computers.[26] These multi-disciplinary approaches to the history of technology delve into the more complex stories behind the creation of technologies as opposed to the focused, fetishized histories written previously, histories that focused on what Scranton calls the "mastery of technology." A history of astronaut photography, here to include the cameras selected and used during flight, offers a unique opportunity to see, in the literal sense, a type of technology as a fundamental part of how American culture and memory continue to represent and understand the spaceflight experience.

Coupled with these nuanced examinations of spaceflight history, broad technological histories help shape the direction of this dissertation. Specifically, David Nye's *American Technological Sublime* offers a well-reasoned framework for how the actual sight of technological achievements shaped the American view of them. In tune with Nye's characterization of how such experiences can bind a society together, I would

[25] Steven-Boniecki, *Live TV from the Moon*.; Freytag, Heinrich. *The Hasselblad Way; the Hasselblad Photographer's Companion*. London: Focal Press, 1973; Lazzarini, Alain. *Hasselblad and the Moon*. Granville, France: self-published, 2011.

[26] Scranton, Philip. "Behind the Icon: NASA's Mercury Capsules as Artefact, Process, and Practice," in *Showcasing Space*. Martin J. Collins and Douglas Millard, eds., Vol. 6. London: Science Museum, 2005; Mindell, David A. *Digital Apollo: Human and Machine in Spaceflight*. Cambridge: MIT Press, 2011.

argue that this process was made possible in the space age through the images captured by the astronauts: everyone could see what astronauts achieved.[27] Marrying Nye's conception of the spectacle with that of Guy Debord, who stated that, "…the spectacle is a social relationship between people as mediated by images…and the primary product of present-day society," best describes the power of spaceflight images in American culture.[28] We now live in a society that expects amazing technological achievements as the norm, and we need visuals to believe them. In the fast-paced Twitter-ized culture of the early 21st century, one might ask if even photographs, so often scrutinized today for signs of surreptitious Photoshopping, will remain the gold standard as evidence of the spectacles of space exploration.

Framing theme: public memory

While American history scholars still tend to neglect spaceflight and astronaut photography as a serious topic within general studies of its era, ongoing usage and consideration of the images reflects their cemented place in public memory. The formation of those memories, as argued by Maurice Halbwachs and numerous memory scholars since he began writing on the subject in the 1930s, involves the mixing of individual and socially constructed memories, one informing the other either intentionally or not.[29] Fundamental to keeping the memory of early human spaceflight alive, memory

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[27] Nye, David E. *American Technological Sublime*. Cambridge: MIT Press, 1994.

[28] Debord, Guy. "The Society of the Spectacle," in Mirzoeff, *The Visual Culture Reader*., Paragraphs 4 and 15, p. 142-144.

[29] Halbwachs, Maurice. *On Collective Memory*. Chicago: University of Chicago Press, 1992.

scholars would suggest, is a constant source of reminders about the events. In the case of the efforts that lead to the first person walking on the Moon, NASA, through the media, still provides consistent visual reflections. These, more frequently than not, feature astronaut photography.[30] Collective remembrance scholarship since Halbwachs even engages with how when individual memories do not exist (for example, in the case of those not alive when Armstrong's first steps took place), an ongoing commemoration of the past can serve to reinforce collective memory.[31] The ease of duplicating images, then as now, means that the perpetual republication of astronaut photos in commemoration of early human spaceflight keeps the memory of that period alive and well, revived through the years especially during significant anniversaries. The photographs inscribed upon NASA and the astronauts an emotional and indelible link to public memory Richard Underwood predicted in his preparation of astronauts for their photographic work.

Photography by astronauts throughout the space program and well beyond the end of the Apollo program were devices for stimulating and reviving positive feelings about the successes of human spaceflight. Companies across the U.S., and a few in Europe who contributed technological elements to NASA's programs, capitalized on that success easily. Through advertisements and press kits, those companies used publicly accessible

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[30] On the significance of media use of photographs and forming public memory, see: Garde-Hansen, Joanne. *Media and Memory*. Oxford: Oxford University Press, 2011.

[31] For a selection of scholarship since Halbwachs that problematize his theories further, see: Billig, Michael. "Collective Memory: Ideology and British Royal Family," in David Middleton and Derek Edwards, eds. *Collective Remembering*. London: Sage Publications, 1990; Assman, Jan and John Czaplicka. "Collective Memory and Cultural Identity," *New German Critique*. No. 65. April 1, 1995, p. 125–33; Confino, Alon. "Collective Memory and Cultural History: Problems of Method," *The American Historical Review*. Vol. 102, no. 5. December 1, 1997, p. 1386–1403.

astronaut photographs to depict their role in a visually compelling way.[32] Such connections linger even today with the Omega watch brand, Hasselblad cameras, General Motors, and Plantronics using effective visual references to their involvement in the Apollo lunar program.[33] For print media especially, the availability of a wealth of stunning imagery meant a nearly endless ability to access the good will that still connects public memory with the early space program of the United States.

Despite astronaut photography serving to connect current public memory with early human spaceflight, our cultural literacy about this period is open to question. Is it possible human spaceflight, in spite of its visual character, never really penetrated deeply into the American cultural subconscious? Is public memory of early human spaceflight linked only to the standout iconic moments easily recalled through images still used to represent the program today, or is there a more substantial connection to exploration rooted in our collective memories? As time since those triumphant moments increases and generations with no personal memories of the Cold War Space Race make decisions about the shape of space exploration, the power of astronaut photography as a means of perpetuating public memory should become more apparent.

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[32] Scott, David Meeman and Richard Jurek, *Marketing the Moon: The Selling of the Apollo Lunar Program*. Cambridge: MIT Press, 2014, p. 34-53.

[33] A particularly memorable use of the visuals of Apollo in marketing was a 2011 advertisement from Plantronics, makers of astronaut headsets that posed the question, “what if our wireless headset wasn’t available for those first steps on the Moon.” The visuals follow a “Neil Armstrong” having to use a corded phone to say his famous first words, which are cut off when the cord pulls him back towards the lunar module.

Chapter summaries

The chapters that follow provide the supporting historiographical and documentary evidence for my thesis that astronaut photography created a resource for the cultural assimilation of human spaceflight during the Cold War. Framed by relevant photographs and anecdotal stories, each chapter serves to support a larger vision of the role of astronaut-produced photography in American culture and memory. Chapter 1 situates NASA astronaut photography in the context of exploration photography over the course of a century, both inside and outside U.S. borders. It will establish the technological, visual, and rhetorical traditions of exploration photography. How well do these inform and provide context for the NASA experience through the Mercury, Gemini, and Apollo programs? It will also show similarities presented by the physical challenges and motivations for photography during expeditions by intrepid explorers like those who participated in the Four Great Expeditions to the American West in the middle to late nineteenth century, and exploration of the Antarctic by those like Walter Scott and Ernest Shackleton in the early twentieth century. My approach in this chapter is intentionally non-linear because after brief introductions to each expedition, the areas of thematic similarity are understood best when examined together through time as opposed to laying out each experience and its themes separately.

Chapter 2 turns the focus more squarely on the production of images by detailing NASA's actions in making technological choices and training astronauts to take photographs. NASA selected photographic devices of the highest quality for the types of images needed. This relatively chronological section follows the process from Mercury and Gemini and then into Apollo, addressing how the conditions of space influenced camera choice like no expedition before. Who made the choice of cameras? How did that affect photographic results? And why were so few American companies included in the camera technology at NASA? This chapter analyzes the decision-making on camera brands, with the specific goal of better understanding how an American program rarely found an American solution to its camera requirements.

That said, people needed to operate the cameras wherever manufactured, and with some level of skill. How did astronauts, typically trained in engineering and aviation, learn how to use the cameras so effectively? Previous expeditions to extreme environments utilized professional photographers as integrated members of the expedition. Most notably, journies to the American West and Antarctica necessitated heavy equipment and a professional to operate and compose images. By the time of serious attempts to conquer Mount Everest and deep ocean locations in the 1950s, photographic technology no longer required a professionally trained hand or eye to capture still images of the unexplored terrain. This section examines the process and prioritization of training astronauts in photography by professional photographers hired by NASA to manage photographic planning for the space program, and technicians who ensured each camera and accessory would not fail in space. This chapter concludes by looking at how astronaut contributions to photography influenced the perception of photographic work and cache of images available to audiences.

The return of still photography from space missions was only the beginning of the process in making the experiences come alive for audiences hungry for visuals.

Technicians at NASA needed to develop those film magazines, hand them off to the appropriate offices for distribution, and allow for interpretation of those images. Chapter 3 sets up the conditions under which different audiences interpreted photographs, and the issues of authenticity, power, time, and memory play a role in what results are seen (or not) by audiences. Distributing images is partly about having a product to work with, but also about selecting recipients and distributing the images. In the case of astronaut photography, technicians, managers, outside security agencies of the U.S. government, and the Public Affairs Office at least stood between the photographs and the upper tier of non-NASA distributors. Once in the hands of scientists, engineers, media outlets, and the public, other more specific and intentional decisions were made in what images were seen and how. With still images going through numerous “filters” before reaching audiences, how has putting those “hands” on the photographs influenced how we think about the Moon and space exploration?

By the late 1960s, NASA’s successes and failures shared space on newspaper front pages and magazine covers with other news events of the times. With public support waning for space exploration even by the time of Apollo 8’s circumlunar mission in December 1968, NASA had to compete visually with the tragedies of civil unrest, political assassinations, and the war in Vietnam. Chapter 4 examines the larger context for audiences viewing images from the space program, which includes identifying the recipient audiences, the politics in place that mediated their access to images, and how images were used in initial publication and distribution and later their reuse, reprinting, and repurposing. The ease of reproduction alone gives a long life span to images, allowing them to outlast those who collected them, and supports the idea stated here that the images and not the identities of astronauts (with a few limited exceptions) gained an "immortal" status in American culture.

Looking at photography beyond Apollo, both in the follow-on Skylab and Apollo Soyuz Test Project and the later space shuttle program, brings changes already occurring during the late Apollo program into focus. Camera types expand, scientific uses explode, and the results most certainly change because the astronauts were limited to Earth orbit. Wrapping up the dissertation requires some reflection on the lasting influence of astronaut photography, both in those successor programs and within public memory. Additionally, other projects using robotic explorers coincide with these post-Apollo programs. What does the fact that humans see these things through mechanical eyes, through signals sent from space and not imprinted on film, mean for how we understand visualizing space? Most notable on this issue is the work of scholars such as Elizabeth Kessler, who examined Hubble photography as an extension of our existing understanding of and connection with landscape painting from the nineteenth century. Does the fact that a human is not present really make a difference in the public's understanding, or are we willing to accept robots and remotely operated telescopes as our surrogates?

My goal is to not only address the specifics of mission photography leading to specific iconic astronaut photographs, but also examine them within the context of photography, the power of images, and their ongoing cultural resonance. The visual culture approach seeks to relate astronaut photography to existing works within the history of photography and exploration. It provides a framework in which to analyze the production, dissemination, and reaction to astronaut photography and significantly, assists in determining what the photographs mean in American culture, from the turbulent years during which we went to the Moon through to the present.

Space photography relates visually and rhetorically to prior exploration efforts, which, like space exploration, were costly, in both financial and physical terms. Because the images themselves reveal historical and intellectual connections between organized expeditions by groups or governments to places such as the American West, the Antarctic, and space, making visual connections forms the core of my effort to identify what images have meant in the broad understanding of those places experienced by only a very few people. Does collecting images sufficiently justify undertaking such difficult journeys? Questions historians ask about these previous explorations of Earth and now of space easily apply to the general narrative told in this study, and to specific case studies mentioned throughout.

CHAPTER ONE: THE CULTURAL ORIGINS OF ASTRONAUT PHOTOGRAPHY

> *"I know of no reason why photography should not find favor with the pioneer whose object is to map out a new route and to picture to the scientific world at home, in a trustworthy manner, what he himself has observed during his travels."*
> -John Thomson, Photography Instructor, Royal Geographical Society, 1891[34]

The second program of the American human spaceflight effort, Project Gemini, offered engineers, managers, and astronauts at NASA the opportunity to develop and practice procedures deemed critical to lunar landing missions of Project Apollo, the fulfillment of President Kennedy's Moon race vision. After the first piloted flight of the series, the successful Gemini 3 mission of veteran Mercury astronaut Gus Grissom and rookie John Young, NASA was already playing catch-up to the Soviet Union.[35] Five days previously, on March 18, 1965, cosmonaut Aleksei Leonov had walked in space. A potential "stand-up EVA" planned for Gemini IV was soon upgraded to a full spacewalk. If all went according to plan, mission commander James McDivitt would stay in the spacecraft while pilot Edward White ventured outside to test a small gas-jet-powered maneuvering unit. On June 3, 1965, White became the second human to venture outside a spacecraft and into the vacuum of space. (Figure 2)

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[34] Thomson, John. "Photography and Exploration," *Proceedings of the Royal Geographical Society and Monthly Record of Geography*. Vol. 13, No. 11 (November 1891), p. 669-670.

[35] For clarification, NASA switched to using Roman numerals for mission numbering after the first piloted mission of Gemini, so only Gemini 3 uses the Arabic numeral.

This moment, captured by McDivitt with a Hasselblad still camera from the relative safety of the spacecraft's cabin, did more than just provide a moment of pride for NASA and a nation that invested so much in the success of what seemed to some almost science fiction.[36] From this moment, NASA became keenly aware of an opportunity to promote their entire effort with stunning visuals of an American against the backdrop of Earth passing far below. While hand-held astronaut photography was a small part of the four orbital Mercury flights, it was not until Gemini IV that the motivations, rhetoric, and physical demands put on the astronaut as a photographer all came to resemble historical examples of exploration photography. Before examining the heritage of such exploration photography, the question remains: when did NASA come to understand the power of photography to represent the human spaceflight program to interested audiences?

In his NASA oral history, Richard Underwood, the NASA photographer charged with training astronauts in the composition of images, recounted the processing of the Gemini IV film negatives in Building 8 at the Manned Spacecraft Center (MSC) in Houston.[37] As Underwood tells the story, Robert Gilruth (then MSC director), George Low (then deputy MSC director), Maxime Faget (spacecraft designer), and others were present for a viewing of the negatives during the post-flight review. Upon viewing White's thirty-nine photographs from the maneuvering unit-mounted Zeiss Contarex camera and magazines from the Hasselblad McDivitt used, Gilruth and Underwood

[36] The film of White's EVA was shot from a 16mm camera he positioned next to his closed hatch. He retrieved the camera and film when he returned to the cabin.

[37] To honor his dedication to the space program after his death, NASA renamed the Manned Spacecraft Center in Houston the Lyndon B. Johnson Space Center; "Houston Space Center is Named for Johnson," *New York Times* February 20, 1973, p. 19.

debated the value of the images. According to Underwood, Gilruth's review focused first on images of the spacecraft and astronauts, but Underwood intentionally refocused his attention on images of Earth. Underwood attempted to convince Gilruth of the scientific and public relations value of the images, stating, "Yeah, but we're looking at things that no human being has ever seen before, parts of Africa and other places."[38]

As a result of this exchange, Gilruth charged Underwood with instructing astronauts not only in the technical aspects of photography, but also in photography as a way of thinking about audiences so that the astronauts would bring back spectacular images for some and information for others. Seeing a human against the backdrop of space gave viewers a sense of scale and excited scientists about the potential for human exploration. Gilruth, in his prominent role as head of the facility responsible for building human spacecraft, training astronauts, and operating the missions, was most certainly aware of what those photographs could do for NASA.

But NASA's astronaut photography represents only one part of a larger story of heroic exploration and expedition photography. Despite their otherworldly nature and creation by amateurs, astronaut photographs fall into photographic categories that include aesthetics, theme, and subject matter. Common visual themes of exploration photography transcend all of the exploration projects examined, including landscapes, images taken for strictly scientific or engineering documentation, and portraiture, although the last makes up only a small fraction of exploration images. Humans appear in these images largely as points of reference for the viewer and not as formal studies of the person

[38] Underwood, Interview Transcript, p. 5.

themselves. Apollo 12 and Skylab 3 astronaut Alan Bean, an artist in his own right, bemoaned the lack of images containing astronauts in a book about astronaut photography, where he states, “We didn't emphasize the human aspect enough, and I tell you it was a mistake.”[39] The absence of personal, familiar, or identifiable images for the public audience might have contributed to the failure to build long-term support for NASA activities. With some 20,000 still frames captured during the Apollo program alone, the substantial majority of these are landscapes, or space-scapes. Those that become true icons of the program all have a human element featured. As W.J.T. Mitchell explains in his introduction to *Landscape and Power*, the term landscape implies the presence of humankind, and the act of photographing the land then creates an idea of the land encountered by people. In this light then, astronaut photography is a significant part of the larger genre of landscape photography. Making the leap between exploration photography of Earth-bound subjects and visual representations of space voyages by humans requires an examination of the cultural origins of astronaut exploration photography in the periods of the Great Surveys of the American west and British exploration of the Antarctic.

The importance of images

Those sent on expeditions to capture images play the role of surrogate. In place of interested audiences participating in the journey, professional or amateur photographers went to provide a visual sense of places nearly impossible to visit on their own. Whether

[39] Schick, Ron and Julia Van Haaften. *The View from Space: American Astronaut Photography, 1962-1972*. New York: C.N. Potter, 1988, p. 100.

by training or happenstance, some images captured take on meanings other than the expedition sponsors, intended audiences, or photographers could predict. Thousands of images exist from the exploration projects to the American West, Antarctic, and space, but the content and composition of some makes them easily representative of the visual rhetoric of each project. These images illustrate the most crucial elements of each exploration program. They are exemplars of the rhetoric used to promote the projects: they place these new locations in a human context, represent the means by which the explorers travelled to these remote locations, allude to the grandeur of such spaces and the human versus nature challenge of such expeditions, and incorporate some nod to the scientific goals of each project. With each photograph comes a certain level of popularity as well with repeated use by news media, artists, and duplication for other forms of public consumption.

Some concepts, conveyed through words and images, were more effective in corralling wide support for heroic exploration. When examining the rhetoric used in each period, common ideas emerge and make connections between these projects evident. Common goals of each expedition included the scientific discovery of geological and other natural resources, increasing support for territorial expansion, and opening new areas to commercial and economic expansion. Those concepts gained support from a set of rhetorical visual characteristics found in photography and noted earlier. Textual support for the common themes abounds in prior scholarship on the rhetoric of exploration of the American West, Antarctic, and space, but the visual requires an additional layer of examination with the interpretation of representative images.

Timothy O’Sullivan, trained during the Civil War by noted photographers Mathew Brady and Alexander Gardner, served as photographer on multiple official U.S. government expeditions, including two to the American West. While working for geologist Clarence King on the Geological Exploration of the Fortieth Parallel from 1867 to 1869, O’Sullivan created photographs that encapsulated his ideas about the landscape while also conforming to the narrative King wanted to present about the geology of the territory. His iconic image of the Carson Desert of Nevada, which shows an ambulance carriage pulled by a team of horses, may well be the most reproduced photographs of this period. (Figure 6) This image sets the tone for what exemplifies the primary photographic themes throughout the years since along with others the three other significant examples here. While numerous examples of come from other expeditions and photographers, the three selected best express the visual continuity found in exploration images.

O’Sullivan’s photograph of a horse-drawn covered wagon traversing a desolate and sandy landscape expresses just some of the hardships encountered by early explorers of the American West. The wind-contoured foreground sand, dotted with footprints and wagon tracks draws attention to the sparse mid-ground vegetation and four-horse team pulling a recently turned wagon. Behind the wagon, sandy dunes and perhaps rockier hills beyond shape the horizon against an empty sky. Within the image, subtle clues indicate the staged nature of the scene, making this image less about capturing a journey in process and more of a reflection on the hardships of exploration. The sweep of the wagon tracks shows how the wagon moved from the lower right and circled back to its final position for the photograph. The one or possibly two sets of human tracks in the sand indicate at least one trip of the photographer or an assistant to and from the wagon. These elements indicate a consideration for the arrangement and framing of the scene by O'Sullivan, and express his vision of a scene that in some way represents the journey of the expedition team.

As the first of the representative images of exploration selected, O'Sullivan's depiction of known objects such as the horse team and wagon physically situates humans in the context of the space without showing actual people. While not explicitly about the expedition itself, O'Sullivan's image does show the means of transportation of people to and through the location explored, yet another key visual element in representative images of exploration. This photograph also reflects on the grandeur of the landscape and the magnitude of human interaction with the landscape by putting familiar and scalable objects in the frame to give viewers a point of reference for the size of the hills and their extremely stark nature. Indications of the scientific nature of the expeditions are more difficult to decipher from this particular image, but the wagon itself and the passage of humans through unfamiliar territory allude to discovery and the collection of information in an abstract sense. The ultimate meaning of O'Sullivan's photograph is essentially that the scene's untouched landscape is available to the kind of exploration expressed by the fresh footprints and wagon tracks seen in the foreground.

As a second example, photographer Frank Hurley had countless days to photograph the *Endurance* trapped in an ice floe during Shackleton's Weddell Sea expedition. While images such as the *Endurance* seen at night (Figure 7) have often been seen as iconic and representative of the challenges of Antarctic exploration, those images do not necessarily bring together all of the major themes important to shaping visual understandings of exploration in still photography. Hurley, a self-made professional photographer from Australia, joined Shackleton as not only expedition photographer, but also as a full-fledged crewmember with duties commensurate with his availability and skills. Still, Hurley captured hundreds over 500 glass plate negatives, many of which were lost with the abandonment of *Endurance*, which the ice crushed in late 1915. Of those salvaged, a daylight image of *Endurance* far in the distance with different ice formations between photographer and ship brings together the themes of exploration photography in a single frame. (Figure 8) Thanks to Hurley's photographic skills, this single image represents an ongoing fascination with human exploration of often-extreme landscapes.

Black-and-white views of an essentially colorless landscape give few insights into the subtleties of the features seen, though textures and contrast are quite apparent. The foreground of Hurley's image depicts a blanket of almost cotton-like ice formations. This veritable ice carpeting gives way quickly to a mid-ground of razor sharp ice chunks, presumably navigable by people but treacherous-looking nonetheless. At the rear of this wide and dangerous field of ice is the sailing vessel itself appearing far more fragile than in images taken closer to the ship. Little about this image expresses any desirability for a human presence as the ice field of the mid-field and background nearly squeezed out *Endurance* entirely, which eventually became reality. Overall, Hurley's scene creates a bleak outlook for the ship and the expedition team at a time when they least needed to reflect upon their dire straits.

Like Timothy O'Sullivan's photograph of the ambulance wagon traversing the Carson Desert, Hurley captures a sense of human scale in this frame by placing the expedition's sailing vessel in the distance. This gives the viewer a sense of how ships travelled to this frigid and dangerous land and what were the varied dangers posed by the immense, ever-changing, icy landscape. Hurley contextualizes ice as not only different from what most of the audience would find familiar, but also as the most significant feature of the Antarctic. Placing the ship in the scene, though at the rear, gives a long view of the single human element and its battle against the ice in a truly human versus nature scenario. And like O'Sullivan's subtle cues in his image of the ambulance wagon, Hurley's inclusion of the ultimate collecting tool on a scientific voyage (the ship) and the space between it and the photographer alludes to the sense of a great swath of ice to explore, study, and document. The contrast between the foreground and what Hurley referred to in his caption as ice flowers, and the background of pressure ridges formed by the ice floe also contributes to a sense of difference that would presumably intrigue those who studied ice formations. Hurley's still photograph brings together the key components seen across exploration photography that exemplify the visual goals expedition leaders had for using cameras to create a visual rhetoric of the project.

Later in the twentieth century when much of the Earth's most notable features had already been explored with cameras, the next step in human exploration, that of space, most certainly needed photographs as a source of evidence and visual rhetoric that would benefit audiences and explorers alike. Astronaut explorers, trained to operate cameras and frame images for a variety of uses, were entrusted with encapsulating their experiences and their mission's rhetorical goals in a visual medium. While one astronaut of the three on Apollo missions typically had primary responsibility for photography, the equipment often circulated amongst them or traded between the moonwalkers during EVA work according to scripted mission plans. For Apollo 11 lunar surface work, mission commander Neil Armstrong, as the first to step on the Moon, took charge of the majority of the early photographic work. He captured a full panoramic series of photographs soon after his first steps, and then a long series afterwards including setting up the American flag. His image of Lunar Module Pilot (LMP) Buzz Aldrin standing next to the flag with the lunar module nearby represents the third of my selected images to contain prescribed elements found across the history of exploration with cameras. (Figure 4)

In his first moments on the lunar surface, astronaut Buzz Aldrin glanced around and described the scene as "magnificent desolation," a phrase often repeated by many at NASA and Aldrin himself afterward. The gray and brown lunar soil, dotted with small rocks and littered with boot prints, carries from foreground to a distinct horizon line that sharply defines the blackness of space from the emptiness of the lunar landscape. Standing against this starkness are the vibrant white astronaut extra-vehicular mobility unit (EMU) suit, the raised U.S. flag, a television cable laying along the ground, and the shadowed legs of the lunar module off to the left in the mid-ground. The background is empty other than a slight rise on the right behind the astronaut, begging questions of what draws these suited Earthmen to such a dreary place.

In an almost indistinguishable salute to the flag, Aldrin draws attention to the focal point of the photograph, one rarely seen so explicitly in images of exploration other than as a signifier of the team's ultimate triumph over nature. The presence of the astronaut and the flag in particular set very familiar human elements into an unknown alien environment, with those characteristic boot prints giving true human scale to the setting. While only vaguely understood by general viewers, the inclusion of the LM to the left does help frame the voyage and the transportation of astronauts to this place. Unlike many prior exploration photographs that represent the imposing natural features of a landscape or those to come in later lunar missions to more mountainous regions, this image from Apollo 11 gives a sense of grandeur in just the way Aldrin described in his initial assessment: the desolation is what makes the scene so sublime. And while a human-related object in an image conveys the struggle against such alien landscapes, it is the piece of equipment protecting the human element that most clearly defines the gravity of the situation on the Moon. Survival in this harsh environment fully depends on that white space suit and a personal life support system. None of the scientific instruments deployed on the mission are visible in this photograph, nor are any of the soil and rock sampling tools used by the astronauts. Those elements would readily explain the scientific nature of the project, but other clues do exist to give the image viewers an idea about exploration and discovery. Lunar photographs in particular feature small crosshairs (fiduciary lines) on the frames created by a Reseau plate, which are used in photogrammetry to help precisely measure distance and size when other tools are unavailable. The landscape itself also presents a great unknown, inviting inquiry and exploration made possible by human traffic through the space, as indicated by the tracks of the astronaut boots. In short, this single image includes a wealth of symbols that make it an excellent representation of a class exploration photograph in the tradition of those captured by Timothy O’Sullivan and Frank Hurley.

Representative images of exploration encapsulate the rhetoric, narrative, and meaning of the projects in ways impossible with words alone. Photographs as fixed images can imprint their messages on viewers through symbolic and literal codes, according to Roland Barthes, and their lasting impressions last more readily than those of moving images through the ease of their reproduction, reuse, and transfiguration into new forms. These still photographs became a means for permanently remembering, celebrating, and representing exploration. They are images fundamental to understanding exploration, superseding even iconic images, as they convey a wide range of themes when iconic images focus on more specific ideas and receive their status as iconic not from within but without their source. The content of representative images forms the basis for the visual narrative of each exploration project, with hundreds or thousands of other images to support that narrative.

Introduction to Western Photography

Before moving into an explicit analysis of the historical links that exist between the visual culture of exploring the American West, Antarctica, and space, it is crucial to describe first the conditions under which photography became part of period of heroic exploration before NASA’s human spaceflight program. Going back to early exploration of the New World, Africa, and the Far East by Western Europeans, often-imaginative artwork accompanied stories of the expedition parties and their harrowing stories of bad weather, treacherous seas, and confrontational native peoples. If their ships returned at all, with or without a bounty of goods acquired from the new lands, both the textual and visual played a role in spurring governments and companies to invest in further discoveries. Mapmakers, scientists, and painters created visual representations for their audiences, while heroic and charismatic explorers planned new expeditions bound in the promise of more support from the financial backers.

In decades following the Lewis and Clark expedition to explore the Louisiana Purchase territory, other intrepid explorers ventured west to survey the land and inventory the region's natural resources. Amongst other necessities, what made the expeditions possible was financial support, support gained by making the benefits of investment evident through first, promotion and, second, proof of the promised benefits on return from the wilds. [40] Throughout the early period of western exploration, including the Lewis and Clark expedition, visual representation played a key role in bringing the experiences of the expedition party back to the investors, who were usually the federal government or railroad companies. The explorers littered their notebooks with small sketches of animals, plants, and other features and discoveries made during their journey (Figure 9). These somewhat rudimentary sketches, made by the explorers themselves, revealed to Thomas Jefferson, Congress, and bureaucrats how significant visual representations of otherwise unknown natural elements were for their own understanding and explaining the value of exploration to their constituents. Later expeditions rarely

[40] The problematic nature of this phrase, and especially its use in exploration generally, became a common topic in historical circles after Frederick Jackson Turner's "frontier thesis" address to the American Historical Association in 1893. Patricia Limerick engages with the term frontier in the case of space exploration in an exhibit essay: Limerick, Patricia Nelson. "The Adventures of the Frontier in the Twentieth Century," in *The Frontier in American Culture: An Exhibition at the Newberry Library, August 26, 1994 - January 7, 1995*. James R. Grossman, ed. Berkeley: University of California Press, 1994.

departed for the trans-Mississippi west without at least one moderately skilled artist on hand to document the party's discoveries visually.

Advancements in photographic technology, and a public fascinated with the seeming truth of photographs, encouraged another way of visually capturing the promise of westward expansion.[41] That did not mean photographers and explorers found it easy to make photography of the west possible. Expedition leaders, particularly those of the four Great Surveys of the West – Clarence King, Lt. George Wheeler, Ferdinand V. Hayden, and John Wesley Powell – made the case with their financial sponsors that visual representations were critical to successful expeditions as promotional tools in support of further scientific and economic development. To provide the greatest range of visual information, expeditions required photographers, artists, and topographic drafters. Photographic support of these expeditions by professionals such as John Hillers, William Henry Jackson, and O'Sullivan, and the continuing mission of the United States Geological Survey (USGS) to document the lands of the United States, ascribed a certain purpose onto the photographs. These images served primarily as evidence and documents of a place, and were not necessarily aesthetic in their creation. Photographs offered expedition sponsors an expanded physical view of the nation itself, making them crucial for developing government and public support for additional exploration. As Martha Sandweiss points out, photographs are excellent descriptive tools, but do little to explain

[41] William Mitchell explains that finding truth in photographs in the pre-digital period of photography linked the ideas of the technology and the scientific method as both required an understanding of evidence. See: Mitchell, W. J. T. *The Reconfigured Eye: Visual Truth in the Post-Photographic Era*. Cambridge: MIT Press, 1994.

an event.[42] Survey leaders, politicians, and scientists therefore used the images to generate accompanying text. Text and images worked together as rhetorical devices for creating an idea of the American West that invited additional exploration and commercial development.

Science, commerce, and the military utility of pushing native peoples farther west made for circumstances that favored increased textual and visual documentation during expeditions. Lengthy descriptions and hand-drawn illustrations in the Lewis and Clark journals provided the source of inspiration for further scientific investigation.[43] Later expeditions continued to expand the catalogue of plants and animals of the region and began to examine the geological resources that would spur the U.S. government and mining companies began sending their own groups to document the land itself. Notable at this time were the mapping of the Oregon Trail area and parts of California and Oregon by John C. Fremont and the U.S. Army Corps of Topographical Engineers in the 1840s, and the commercial efforts to find a reasonable passage for a transcontinental train route through the 1850s.[44]

As the country charged through expansionist debates and compromises over the political and racial character of added territories, the government expanded the funding for expeditions in the 1840s. While early expeditions were mainly military in funding and

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[42] Sandweiss, p. 327.

[43] The original documents, maps, and journals of the Lewis and Clark expedition are in collections at the American Philosophical Society, Philadelphia, PA, Missouri Historical Society, St. Louis, MO, and Beinecke Library at Yale University.

[44] White, Richard. *"It's Your Misfortune and None of My Own": A History of the American West*. Norman: University of Oklahoma Press, 1991, p. 121-122.

character, support waned with the onset of the Civil War in the early 1860s. The delay of the Civil War gave prospective expedition leaders a chance to rationalize the need for additional expenditures, this time to include scientific investigation as not a secondary but primary purpose. Martha Sandweiss argues in *Print the Legend* that the interlude of the war gave surveyors renewed cause for additional work. Attention then turned to the desire for expansion west supported by a public highly receptive to photographs other than those of war.[45] That is what exploration images came to symbolize for the public audience, a future full of peaceful expansion on multiple fronts. In her article on science and John Wesley Powell's excursions west, Elizabeth Childs states, "Questions raised by the West's unique landscape, as it was revealed in the art of the survey artists, forced the scientific mind into new depths of geological time and inspired a new respect for natural process."[46] So, not only were surveys and their accompanying documentary images (both impressionistic and literal) important for enlarging the concept and mythology of the West, but they also provided commercial and intellectual rationales for additional government support.

Introduction to Antarctic Photography

The physical and intellectual requirements for taking photographs in the Antarctic were no less complicated for two of the most celebrated and remembered expeditions to the Southern Ocean than those to the American West. Frigid temperatures, ice floes, and charismatic expedition leaders challenged photographers like Herbert Ponting, the

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[45] Sandweiss, p. 194.

[46] Childs, Elizabeth C. "Time's Profile: John Wesley Powell, Art, and Geology at the Grand Canyon." *American Art*. Vol. 10, no. 1. Spring 1996, p. 7.

scientific photographer on Robert Scott's disastrous last expedition on the *Terra Nova* (1910-1913), and Frank Hurley, who accompanied Ernest Shackleton on his ill-fated journey on the *Endurance* (1914-1917). As a member of the scientific team, Ponting never traveled far from the coast or nearby depot points set up to support the polar team. Ponting, therefore, needed to train Scott and other expedition members in photography, whose photographs and camera were found not far away from their frozen bodies. Ponting's photographs document the crew's experiences, wildlife, and the weather, but had little to do with anything other than science and documentation. Following the expedition's tragic end, Ponting took it upon himself to turn his photographs into a means of honoring those who died by giving public and private lectures and printing albums for the families of the expedition members, supporters, and the government. His own account of the expedition, however, took ten years to compile and relied heavily on Scott's journals and not his own photographs to document Scott's expedition.

Shackleton hired the Australian Hurley for the journey aboard the *Endurance* to capture photographs during extreme conditions and to chronicle everything: the treacherous nature of the pack ice, life aboard ship, and especially the expedition's unexpected struggle to escape a sinking ship and survive on a desolate continent. During the voyage, the crew experienced temperatures as low as -34° C in the depths of winter, rode out numerous blizzards, and faced a life of diminishing supplies.

Thanks to the importance placed on image making by Shackleton and his patrons, the ship was spacious enough to accommodate a dark room and image storage area for Hurley. He secretly salvaged the plates he created from the flooded ice-locked ship, despite Shackleton's opinion that the plates were worthless. The two eventually agreed to a deal whereby Hurley could keep 120 developed plates, a small Kodak camera, and three untouched rolls of film to document the rest of the trip. And while the voyagers went cold and hungry for weeks on end, eventually sacrificing their sled dogs to avoid having to feed them precious rations, they knew that their lives and legacy were documented on Hurley's glass plates.

By the time of Antarctic expeditions of the early twentieth century, photographs were not only commonplace in news reporting but also expected as a part of these heroic journeys to remote lands. These experiences connect visually and culturally to exploration of the American West, sharing what Janis Edwards describes as the power of images residing in their perceived ability to frame an event and suggest universal values attached to that event in public imagination.[47] Despite their successes or failures, explorers provided heroic visual narratives, both mythological in nature and culturally important in forming a public perception of a place. The American West, on one hand, became conquerable and a place to populate and cultivate. Antarctica, on the other hand, with its treacherous landscape, offered a far better analogy for the experience of astronauts. Michael Robinson discusses the importance of Arctic exploration to American culture, but asserts that, "…the widespread belief that exploration is an impulsive and instinctive activity, deeply rooted within the human psyche" developed as a result of Artic exploration. Robinson continues by folding this into a larger "pandemic of

[47] Edwards, Janis L. "Echoes of Camelot: How Images Construct Cultural Memory Through Rhetorical Framing." In *Defining Visual Rhetorics*. Charles Hill and Marguerite Helmers, ed. Mahwah, NJ: Lawrence Erlbaum, 2004, p. 179.

exploration" at the time, to include exploration of the Antarctic.[48] As both Scott and Shackleton spent considerable time on ensuring a visual record of their projects, it seems fair to state that they provided a more substantive and reliable visual narrative by which Britain and world could understand the rigors of polar exploration.

Common themes of exploration photography

NASA's early astronaut photography shares a number of common traits with other exploration efforts over the previous century. Viewing these historical experiences with a wide-angle lens, the importance of expedition photography to the formation and perpetuation of public memory becomes clear. While the photographic examples I gave earlier show a tendency for common visual characteristics, the overall success of the missions was just dependent on the return of the explorers or the collection of data. Photographs became a means of making a positive impression on contemporary Americans about value of those the places and experiences, imprinting them in our collective cultural memory. Astronaut photography made an incredibly strong visual contribution to how we continue to see the 1960s, the Space Race, and the Cold War, not only because the images were spectacular, but because of tremendous supporting components that also supported those previous expeditions. A closer examination of how astronaut photography contributed to American visual culture requires a three-part examination.

Running through these three expeditions are common components that require a comparative analysis using methods from visual culture studies. First, components of

[48] Robinson, p. 163.

producing images require examination. In what ways did producers conceive of and promote images, what criteria existed for selecting still camera technology, and how did the surrogate photographers train for producing images? In the case of exploration photography, issues of environment became an increasingly important issue in preparations as the conditions became more complicated but technologies became more manageable. The next step is when images return from expeditions, as they require handling, processing, and distribution. Much of this part of the story relies on the rhetoric developed for photography's purpose in exploration projects. The final stage of the process examines the interaction between audiences and the images. No matter the goals set by photographers or expedition leaders, audiences respond to the images in sometimes-unpredictable ways. Analyzing audience reception becomes the means of discovering the ability of photographers to make a lasting impression on public memory.

Contributing to these common threads throughout the history of exploration photography are practical considerations, including but not limited to financial support, finding qualified individuals to take photographs (or training the explorers to take them), and the difficulty of taking delicate photographic equipment into extreme environments. To historicize astronaut photography, I examine their efforts within the context of exploration photography and its historiography. While the most significant scholarly debate about photography revolves around consideration of it as an art form, subthemes in the literature provide useful ways of discussing exploration photography as a significant part of visual culture scholarship.[49] More specifically, the visual, historical, and technological traditions established in previous exploration programs—in this case, the American West and the Antarctic—lead to a better appreciation of how audiences understood astronaut photography. This section examines those common historiographical threads as both continuities and discontinuities between early expeditions and as cultural originators of the experiences of astronauts capturing images.

Production – rhetoric

No expedition or project moves very far without a mission statement or list of goals the participants wish to accomplish. And while the people and their words change over the course of my three exploration examples, the intent of the rhetoric remains much the same, steeped heavily in terminology associated with competition, commercial opportunity, and scientific discovery. Whether it is the project leader, the lead scientist, or the entire team, someone must establish the basic rhetoric that defines the work, its aims, and the benefit to an audience the project provides. By definition, rhetoric is the use of words to please, influence, and persuade. In the case of exploration, a number of charismatic and politically motivated individuals and groups developed sets of rhetorical devices in order to encourage potential donors, excite audiences, and proclaim some measure of success despite the failure to accomplish goals. Those who create the rhetoric,

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[49] Batchen, Geoffrey. *Burning with Desire: The Conception of Photography*. Cambridge: MIT Press, 1997; Bourdieu, Pierre. "The Social Definition of Photography." In *Visual Culture: The Reader*. Jessica Evans and Stuart Hall, eds. London: Sage, 1999; Kember, Sarah. "The Shadow of the Object: Photography and Realism." In *The Photography Reader*. Liz Wells, ed. London: Routledge, 2003; Tagg, John. *The Burden of Representation: Essays on Photographies and Histories*. Minneapolis: University of Minnesota Press, 1993; Trachtenberg, Alan. *Reading American Photographs: Images as History, Mathew Brady to Walker Evans*. New York: Hill and Wang, 1989.

leaders of the project in one way or the other, use it to define what follows. From the justification of the Lewis and Clark expedition as an effort to locate a practical transcontinental route to the possible mining of Helium-3 on the Moon as suggested by Apollo 17 geologist-astronaut Harrison Schmitt, rhetoric has always played a significant though largely symbolic role in exploration. By presenting this rhetoric widely, in scholarly publications, letters to potential funders, lectures, and the media, exploration leaders sold their ideas. The possibility of photographing the lands to be explored brought the fruits of those promises back to the audiences more quickly, creating a visual rhetoric or evidence of successes, failures, and the struggle undertaken all around. A well-formulated, thought out rationale for exploration can mean the difference between an explorer making history or watching it from a distance.

The rhetoric of frontier promises, opportunities, and natural wonder allowed expedition leaders and organizers to accumulate the necessary financial support for their exploration. Concurrent with these mid-century expeditions was the development of a process for reproducing scenes and permanently printing them on a surface, most famously perfected by Louis Daguerre of France. His development, and those of others working on the photographic reproduction process such as Englishman Fox Talbot, began a process of what Walter Benjamin calls the democratization of the image during the age of mechanical reproduction.[50] No longer were an artist's impressions required to represent a real scene: a machine could bring those images to anyone able to pay for it. Historian Martha Sandweiss discusses how during the early period of photography,

[50] Benjamin, Walter. "The Work of Art in the Age of Mechanical Reproduction." In *Visual Culture: The Reader*. Jessica Evans and Stuart Hall, eds. London: Sage, 1999, p. 72.

primarily the 1840s, the technology of producing photographs was simply too complicated to document events in the field and too fragile to transport from place to place.[51] Once the technology caught up to the needs of those wishing to represent the outdoors, representing the discoveries of western expeditions became possible, at least in theory.

Literature on visual rhetoric, the persuasiveness of images, helps define the ways in which these rationales become particularly relevant during projects that visually document unknown places. While traditional artists accompanied many early expeditions to the American West, photography made visual representations even more useful to project leaders as a means of reinforcing the utility of the expeditions. While not necessarily garnering the same public notoriety as an elegantly painted vista, photographs became a means of quickly gauging an audience's almost reflexive reactions to images. The technology allowed expedition leaders to turn positive feedback for their support of their next project. Unlike text-based arguments, visuals tend to prompt a comprehensive, quick, and visceral response by viewers.[52]. Exploration photography, therefore, became an efficient way to spread a visual rhetoric that reinforced textual rationales circulated prior to each expedition season. With this in mind, scholar Charles Hill's insight that, "Rhetorical images are ubiquitous, powerful, and important," contributes to a clear

[51] Sandweiss, p. 91.

[52] Hill, Charles A. "The Psychology of Rhetorical Images," in *Defining Visual Rhetorics*. Charles Hill and Marguerite Helmers, ed. Mahwah, NJ: Lawrence Erlbaum, 2004, p. 33.

connection between the cultural significance of exploration photographs and public memory.[53]

Exploration of the trans-Mississippi west came on the heels of the formation of the United States itself. As William Goetzmann points out in his landmark book *Exploration and Empire*, the increased desire to explore territories at this time indicates a transition in the relationship between the regional and national culture.[54] As the nation began to expand its territory in the post-Revolution period, largely through the Louisiana Purchase completed by Thomas Jefferson, the formerly regionally focused population needed to adjust to a more nationalized perspective. Rhetorically, the idea of this natural expansion of the nation to encompass the land mass from Atlantic to Pacific Ocean was consolidated in the Jacksonian era under the term Manifest Destiny. Therefore, many viewed territorial expansion and the exploration of those lands as a natural process, despite one obvious issue: the inhabitants already living there. In fact, historian Eva Respini calls William Henry Jackson's photographs as definitive expressions of Manifest Destiny, the ultimate method for creating a mythological image of a place.[55] If the images were to encourage westward commercial development and habitation, an apparent lack of residents supported the idea of it as a blank canvas of sorts.

In terms of gaining support through claims of advancing scientific knowledge and the possibility of economic expansion, survey leaders appealed to other respected

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[53] Ibid, p. 38.

[54] Goetzmann, William H. *Exploration and Empire: the Explorer and the Scientist in the Winning of the American West*. New York: Knopf, 1966, p. xiii.

[55] Respini, Eva. *Into the Sunset: Photography's Image of the American West*. New York: The Museum of Modern Art, 2009, p. 12, 30.

members of the academic community to write to Congress on their behalf. In an 1870 letter to Representative James A. Garfield, Smithsonian Institution Secretary Joseph Henry requested passage of funding of Powell's second Colorado River expedition because: "The region through which the river and its branches flow is one of the most remarkable on our continent…. This region is, therefore, highly interesting in a scientific point of view and also in that of the economical application of a portion of it to agricultural purposes."[56] Henry, who was familiar with Powell's earlier expedition as well as photography from the region, saw the Smithsonian and Powell's research goals as convergent, evidenced in Powell's later role as director of the Smithsonian's Bureau of Ethnography until his death in 1902.

During the infancy of photography, however, traditional artists still played a significant role in formulating a vision of the American West. Their use of color, scale, and the ability to convey the grandeur of the landscape touched viewers on an emotional level, as photographs, at this point in only black-and-white, could not (Figure 10). This art, as Elizabeth Kessler shows, continues to effect perceptions of space in our world today. Kessler argues that in the process of interpreting data from the Hubble Space Telescope, scientists looked for inspiration in the work of nineteenth century painters such as Thomas Moran, who was a painter on the Ferdinand Hayden's 1871 survey of the Yellowstone region, and Alfred Bierstadt, in assigning color in a familiar and artistic

[56] Henry, Joseph. *The Papers of Joseph Henry, Vol. 11*. Washington: Smithsonian Institution Press, 2007. Doc. 142, p. 291-292.

way.[57] Keying in on the familiar, what they knew to be appealing and comfortable to the public, scientists assigned color in Hubble images to replicate known visual references, making those images more immediately understood (Figure 11).

Kessler's work touches on issues of the connections between art and science relevant to this study of exploration photography. Those distant and abstract places in the universe seen by Hubble scientists using the telescope allowed for creating visual links to paintings touched on the emotional nature of paintings. Artists like Moran and his compatriots used their impressions of the landscape, not a literal interpretation, to play on the feelings of the viewers and inspire additional interest. Whether viewed in a gallery or through a lithographic print in a publication, artists engaged with their audiences through ideas, not science, using vivid colors to strike at the emotions of the viewers. On the other hand, photography's expected depiction of reality connected it more strongly with expectations for scientific evidence. Audiences believed that seeing a photograph connected them in an unmanipulated way with the location. In the cases of exploration, familiar elements within the photographs assisted in creating an understanding and public memory of those expeditions. But nineteenth century photography only involved color when added later with colorization techniques. By the time of Antarctic exploration, the autochrome process was just coming into use. In such a generally colorless place though, even Henry Ponting's earliest experimentation with color imaging had little impact on the public audience. (Figure 12) NASA would find out, decades later, that planning for color photography on the Moon presented similar issues, putting scientific and public needs

[57] Kessler, Elizabeth A. *Picturing the Cosmos: Hubble Space Telescope Images and the Astronomical Sublime*. Minneapolis: University of Minnesota Press, 2012, p. 5, 33.

against each other when providing astronauts with film magazines for their photographic assignments in a relatively monotone environment.[58]

The sweeping landscape paintings by survey painters that Kessler describes, while rarely reproduced or seen by a large public audience when created, gave those responsible for creating the rhetoric of support for westward expansion – politicians, writers, historians, and philosophers – idyllic images from which their words could suggest a new and idealistic path westward. Similarly, Angela Miller observes in relation to justification for creating visuals of the west that, “The rhetoric that linked nationalism to the geographical unity, breadth, and scale of the New World must be weighed against the evidence of landscape paintings themselves project to modern eyes a view of nature both bounded and contained.”[59] The dissemination of photographs of these locations, similar to the artwork in its use as a means of transmitting messages, allowed a positive message of westward expansion to circulate quickly amongst the public thanks to the ease of reproduction.

Drawing on the work of historians such as Patricia Nelson Limerick, Kessler identifies a relationship between images of outer space and a desire to conquer in the same sense as many Americans saw the western landscape in the middle to late nineteenth century. This art depicts the “frontier” of America, a word historian David

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[58] The importance and role of color, both in painting and photography, deserves a more extensive treatment and may serve as a spin-off from this dissertation. The links between these three expeditions are strong, and are bolstered by research such as that of David DeVorkin on scientific balloon photography during the period between the major periods of Antarctic and space exploration. As both a technological and a visual story, the characteristics of these projects provide sufficient grounds for primary and secondary research, but it lies on the periphery of my focus here. See: DeVorkin, David H. *Race to the Stratosphere: Manned Scientific Ballooning in America*. New York: Springer-Verlag, 1989.

[59] Miller, Angela. *The Empire of the Eye*. Ithaca: Cornell University Press, 1993, p. 10.

Wrobel states, "…has become a metaphor for promise, progress, and ingenuity."[60] The term frontier flows freely in the rhetoric of exploration without clearly defining the scope of westward expansion in the U.S. during the nineteenth century. Visual and textual products of western exploration such artwork, photographs, diaries, and other representations of the landscape contribute directly to reinforcing the rhetoric Wrobel describes as fundamental to understanding the term frontier.

American frontier rhetoric, with its explicit links between the visual and textual, continued through exploration during the late nineteenth and twentieth centuries. Patricia Nelson Limerick identified the fault of using frontier rhetoric too freely to describe nearly any new and different path forward. She states that, "The term 'frontier' blurs the fact of conquest and throws a veil over the similarities between the story of American westward expansion and the planetary story of the expansion of European empires."[61] While the term itself wields significant power, and promotes a set of American ideas about progress, it cannot be underestimated in its usefulness in various contexts, such as those Limerick describes. In particular, she examines its use in the space exploration context, linking both types of exploration in the same way Kessler links the visual representations of both activities. These visual and rhetorical connections demonstrate how NASA used both words and images to garner public and political support throughout its existence.

In examining how frontier rhetoric carried into modern uses, Limerick states that, "The story of the American nation, as imagined by the Paine commissioners [in their

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[60] Wrobel, David. *The End of American Exceptionalism: Frontier Anxiety from the Old West to the New Deal*. Tucson: University of Arizona Press, 1993, p. 145.

[61] Limerick, p. 75.

1986 report on the future of NASA], was a triumphant and glorious story of success, with the complex stories of Indian conquest and African American slavery simply ignored and eliminated."[62] As NASA certainly identified in their use of the frontier term, "The notion of a heroic journey accomplished was one that could be appreciated, even shared, by the potential audiences of the survey photographs."[63] In her argument, Limerick stresses that, "…the promoters of space exploration and development may well qualify as the nation's most committed and persistent users of the frontier analogy." A skilled NASA public affairs and political effort could exploit nostalgic feelings for an idealist American public by harkening back to the "benefits" of western expansion by using the same rhetoric in talking about expansion into space.[64]

Rhetoric other than that of the frontier also links heroic exploration. Exploring the Antarctic continent required perhaps even more rhetorical and financial backing than movement westward across the American landscape. Subsidies needed to cover not only basic travel expenses and supplies but also an entire ship. In this case, the relative barrenness of the land meant that goals were rhetorically more scientific, but at their core were rooted in competitive efforts to strengthen national pride. Efforts to become the first to trek to and from the South Pole, or across the entire continent in the case of the *Endurance* expedition, corresponded in scope to exploration efforts undertaken

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[62] Limerick, p. 88.

[63] Childs, p. 15.

[64] Launius, Roger D. "Perceptions of Apollo: Myth, Nostalgia, Memory or All of the Above?" *Space Policy*. Vol. 21, no. 2. May 2005, p. 129–39.

throughout what historians call the Heroic Age of Exploration.[65] This period, marked by penetration into the interior of underexplored continents like North and South American, the Antarctic and Africa by mainly by Europeans, closed with the beginning of World War I and a new period of technological development in transportation. The mood of exploration in the post-war world was characterized by themes of accomplishment, overcoming difficult environments, and nationalism. In the case of Antarctic trips made by Robert Falcon Scott in 1910 and Ernest Shackleton's cross-continent expedition in 1914, those themes are evident in both the attempts and the repercussions of their failures.

Following in the long tradition of military expedition leaders, Scott, in pursuit of a promotion and prestige, sought out work exploring Antarctica under the auspices of the Royal Geographical Society (RGS) beginning in 1899. At first glance, descriptions of Scott as moderately charismatic and popular may not lead one to consider him the sort to venture after the lofty goal of reaching the South Pole first.[66] Scott, however, nearly perfectly fit the mythological bill for what an explorer needed to be in order to please the public vision of a heroic explorer: brave, daring, honorable, literary, honest, and,

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[65] For scholarship on the origins of and the so-called heroic nature of polar exploration in the early twentieth century, see: Quartermain, L. B. *South to the Pole: The Early History of the Ross Sea Sector, Antarctica*. London: Oxford University Press, 1967; Baughman, T. H. *Before the Heroes Came: Antarctica in The 1890s*. Lincoln: University of Nebraska Press, 1999; Larson, Edward J. *An Empire of Ice: Scott, Shackleton, and the Heroic Age of Antarctic Science*. New Haven: Yale University Press, 2011; Wilkinson, Alec. *The Ice Balloon: S. A. Andree and the Heroic Age of Arctic Exploration*. New York: Knopf Doubleday Publishing Group, 2013; Clifford, Nicholas et al., *Key Concepts in Geography*. London: SAGE Publications Ltd, 2008.

[66] Solomon, Susan . *The Coldest March: Scott's Fatal Antarctic Expedition*. New Haven: Yale University Press, 2001, p. 10.

ultimately, tragic.[67] And while his first mission aboard the HMS *Discovery* in 1901 failed to make it closer than 530 miles from the Pole, Scott had a far easier time wielding rhetoric to sway his constituents, the British Navy and RGS, to provide funds for a second trip in 1910.

Like those who came before and since, Scott's rhetoric for Antarctic exploration focused on potential scientific discoveries, economic benefits, and a need to succeed on a global level.[68] Coming near the end of Victorian England's most grand period of colonial successes, the potential of a British expedition reaching the South Pole before the Japanese, Americans, Germans, or Norwegians most certainly counted a great deal towards gaining government and academic support. Scott's expeditions had explicit nationalistic and imperialistic overtones at a time considered the height of the British Empire's power; the impetus for the *Discovery* voyage arose from the government itself, but *Terra Nova* sailed based on public confidence in Scott as a national hero. Susan Solomon explains that a sort of "Antarctic fever" developed as part of the repercussions of the 1909 controversy between Peary and Cook about who reached the North Pole first. That excitement inspired fundraising efforts around the entire empire; and 8,000 volunteers applied to participate in the expedition. [69] As the "official" British expedition

[67] Preston, Diana. *A First Rate Tragedy: Robert Falcon Scott and the Race to the South Pole*. Boston: Houghton Mifflin, 1998, p. 5.

[68] Interestingly, in Herbert Ponting's recollection of the *Terra Nova* expedition, his view was that Scott only focused on reaching the pole, and put all other pursuits such as research, science, and photography far behind as priorities; Scott, Robert Falcon. *Scott's Last Journey*. Peter King, ed. New York: HarperCollins, 2000, p. 185.

[69] Solomon, p. 54.

to the South Pole, Robert Scott's status as a national hero was secure, no matter the result.

Ernest Shackleton was, as author Caroline Alexander suggests, "…a man of romantic ambitions," and made a firm commitment to finding a place of honor for himself amongst the greatest explorers of his time.[70] Raised in middle class Irish home, he had no means of self-supporting his ambitions but married well. By cobbling together enough financial support from wealthy investors, Shackleton attempted his first polar trek in 1907, coming within 100 miles of the South Pole in 1908 before poor weather, a lack of supplies, and loss of their final pack pony forced the team to return to their ship, the *Nimrod*. Despite the failure, the British heralded his accomplishment, calling him a national hero, and Shackleton received a knighthood from King Edward VII in 1909.

During this heroic age of polar exploration, Shackleton proved to have an innate ability to appeal on nationalistic grounds for the funding of his expeditions. The journey's official name itself, the Imperial Trans-Antarctic Expedition, indicated its grand conception.[71] Shackleton's success in convincing not only his own government but also wealthy investors and finding other creative means of raising money is a testament to his skill in using rhetoric for self-promotion. He appealed on nationalistic grounds and encouraged investment from royal societies, wealthy individuals, and even public schools. What aided him most, as Shackleton biographer Roland Huntford explains, was

[70] Alexander, Caroline. *The Endurance: Shackleton's Legendary Antarctic Expedition*. New York: Knopf, 1998, p. 4.

[71] Barczewski, Stephanie. *Antarctic Destinies: Scott, Shackleton and the Changing Face of Heroism*. London: Hambledon Continuum, 2007, p. 87.

the willingness of the press to sing his praises.[72] To make up the balance of his funding needs, Shackleton also sold his services as a lecturer and national hero. By offering the story's rights, in both written and visual formats, Shackleton finally earned the funding necessary to make his dreams come true in 1914.

Perhaps even more than explorers of the American West, Ernest Shackleton found heroic, nationalistic, and visual rhetoric necessary to interest a wide range of investors in his venture to cross Antarctica. In a letter to Winston Churchill, then head of the Royal Navy, Shackleton attempted to enlist the support of the government by putting his own risks for science and country side by side with the risks taken daily by Churchill and the British Navy. He explained, in his letter, the relative ease of and benefits to exploring the Antarctic compared to endeavors such as military aviation or even crossing a busy city street.[73] Shackleton did not stop at soliciting the Navy for funding. For its part, the Royal Geographical Society begrudgingly granted Shackleton £1000, hoping to get some scientific data in return from this voyage, as they were less than pleased with the returns from his earlier attempt to reach the South Pole. Shackleton, by his nature a private explorer and not officially directed by his country's government, needed to sell his exploration plans to potential supporters. In the climate of a world on the brink of a world war, he had difficulty convincing those wary of his family's past financial problems and his own government to supply any money towards his ambitious plan.[74]

[72] Huntford, Roland. *Shackleton*. New York: Carroll & Graf, Inc., 1998, p. 365.

[73] Huntford, p. 372.

[74] MacKenna, John. *Shackleton: An Irishman in Antarctica*. Madison: University of Wisconsin Press, 2002, p. 128.

As Caroline Alexander points out, continental discovery via camera first occurred during these expeditions to Antarctica.[75] Having seen the success of the visual products of the Scott expedition (1910-1913), Shackleton expected the telling of his story in similar visual terms, hoping, of course, for a less deadly outcome. Prior to the last few decades, however, the iconic images captured by Frank Hurley of the *Endurance* experience hardly compared with those of the Scott expedition taken by Herbert Ponting. Perhaps visuals of a heroic and dead explorer meant more to the public than a heroic, living one. It was actually Scott, as historian Stephanie Barczewski explains, that first identified the necessity of photography after the expedition to pay off financial debts.[76] After hearing of Scott's death, Ponting continued for years to capitalize on his photographs just as photographers on the great surveys of the American west. Shackleton was able to take advantage of the wisdom of Scott and marketing of Ponting to prepare his own photographic plan for his expedition in 1914.[77]

Production – funding

The intention of rhetoric is to sway the opinions of an audience, but with the reasoning that some practical outcome may be achieved. Explorers for centuries employed rhetoric to sway possible sources of funding in their direction in order to accomplish their goals. The issue of funding sources proves to be one of the more variable factors across these three instances of exploration. The result of gathering

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[75] Alexander, p. 10.

[76] Barczewski, p. 213-214.

[77] For more on the continuing story of the photographs, see *The Endurance*, website http://www.kodak.com/US/en/corp/features/*Endurance*/, accessed September 29, 2010.

support via rhetoric, both textual and visual, is the accumulation of financial backing to pay for exploratory projects. In terms of finances, however, sources demand different returns on their investments based on their interests and not necessarily those of the explorer. In the cases of the American West, Antarctic, and space exploration cover income and outcome-based funding models, whereby finances or profits accumulate either prior to or after the project's life. The magnitude, potential danger, and physical scale of exploration does require, even today, non-financial contributions or the involvement of a single or collective group of governments. As exploration moved across and under seas, beyond national boundaries, and outside the atmosphere, so did the need for broad cooperation amongst countries, or tacit acknowledgement of the efforts. In the competitive environment of international politics, nothing has driven the competitive spirit quite like exploration continues to do today.

Front-end support comes most readily from those with available funds, such as governments, companies, and other private sources of wealth. Sole sponsorship by a government negated the need for any return on the investment. In those cases, an elevated sense of pride or prestige would have its own benefit that most certainly could outlast the financial boon exploration offered. If securing additional resources were required, the promise of what profits would come on the back-end of the project become more important. With photographic evidence in hand, explorers made the promise to pay expedition staff, return money on loans or pay off debts, and otherwise profit from the project upon completion. In some instances, such as that of Sir Ernest Shackleton's *Endurance* trip to the Antarctic, he and his supporters were willing to wager that the financial return on any trip to the South Pole, successful or not, would outweigh the costs of the journey. Even the specter of failure or death was not enough to dissuade; failures great or small would still make for a profitable story.

As official government expeditions, funded by appropriations from Congress, expedition leaders Powell, King, Hayden, and Wheeler focused their efforts on pleasing politicians. In essence, the government purchased the images, and required special arrangements when photographers and survey leaders desired commercial sales of the images for monetary benefit beyond the survey fee. While the distribution of payments to photographers came in their agreement to join the survey, not everyone was pleased with their fee or with the use of the photographs afterwards. E.O. Beaman, the initial photographer on John Wesley Powell's second expedition to the southwest, felt slighted by not having a say in the distribution of his photographs, so Powell paid him $800 for his interest and hired a new photographer mid-survey.[78] Historian James Cassidy explains that in the aftermath of the Hayden Survey, both Hayden and expedition photographer William Henry Jackson exploited the potential of Jackson's photography by exhibitions.[79] None of the expedition leaders seemed shy about using what resources their adventures yielded to leverage additional financial support from the public and Congress.

Exploring a territory such as the American West with a camera, a process hindered by weather and terrain and with no sense of urgency other than seasonal

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[78] Worster, Donald. *A River Running West: The Life of John Wesley Powell*. Oxford: Oxford University Press, 2001, p. 237.

[79] Cassidy, James G. *Ferdinand V. Hayden: Entrepreneur of Science*. Lincoln: University of Nebraska Press, 2000, p. 225-227.

changes, made selling the expeditions far easier than those attempting to accomplish a first. For Antarctic explorers including Scott, Amundsen, and Shackleton, photographs served as proof of accomplishment. Being the first, the implications of winning something with an impact on national prestige, certainly motivated investment in what seemed like a sure thing. Scott relied heavily on his military and heroic reputation to gain financial support. While the *Discovery* mission was entirely government funded and supported, the *Terra Nova* trip was entirely private, requiring Scott to seek investors and other contributions. Public fundraisers and government grants covered the bulk of Scott's needs, but he eventually asked members of the expedition team to forego their paychecks due to what he confided in photographer Herbert Ponting was the severe financial mismanagement of the voyage.[80] This, and a number of other errors on Scott's part, served to undermine his heroic status decades after his death when historians uncovered the reality of the financial, managerial, and tactical mistakes he openly admitted in his journals and privately to some members of the expedition.

Shackleton, known as self-confident and charismatic, could sell the idea easily based on merely the perception of his knowledge, skills, and experience. And he was anything but shy when approaching wealthy supporters for loans and gifts. In his biography of the famous explorer, Roland Huntford notes that Shackleton was, "…the only one who openly promoted his expedition as a commercial venture. His aim was to be first at the South Pole. Money would flow from telling the story in books, lectures, newspapers and the exciting innovation of the cinematograph. For Steuart [a friend

[80] Preston, p. 158.

through his brother], Shackleton held out as well the enticement of mineral rights."[81] Without the direct link to government funding Scott enjoyed, Shackleton played on family connections to secure government support and funding. Through his brother and his own direct requests to Winston Churchill, then First Lord of the Admiralty, Shackleton appealed for financial and verbal support, which he received in the form of a £10,000 grant. While wary, Churchill's support swung on the possibility of increased national prestige gained by a successful cross-continental voyage.[82] The mere promise of wealth based on such an expedition, however, hinged on success in both reaching the goal and discovering promised resources: the *Endurance* trip provided neither, but the safe return of the crew meant images, stories, and notoriety that essentially paid off the expedition debts.

Funding for space exploration, however, stemmed from more varied rhetorical sources than earlier projects. In the midst of the Cold War, inspired by decades of science fiction and the rise of more advanced rocket technologies, countries like the United States sought to add the environment to space as a competitive element in the one-upmanship of the mid-twentieth century. Largely funded as a whole agency and not in pieces for each individual project, if Congress agreed to budgetary requests, NASA's position as a government bureaucracy allowed it to parse out funding to the agency's needs in preparing to reach the ultimate goal set forth by President Kennedy in 1961. While that lofty goal suggested a focus on proof-of-concept engineering work such as launching

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[81] Huntford, p. 156-157.

[82] Ibid. p. 362.

vehicles capable of taking humans safely into space and back, photography gradually became a very small subset of projects that received funding. Alongside scientific experimentation, hygiene equipment, and leisure time, photography transitioned from an *ad hoc* astronaut activity to a fully developed program with training and mission time specifically set aside for the process. While documentation of specific contract obligations for photographic work during the space program is slim, a more extensive analysis is required of the relationship between the financial and operational commitments NASA made to a visual medium so quickly and readily funded on most every exploration project that came before.

Production – training

Another of the key themes identified across these exploration case studies is the degree of professional training of the photographers themselves. A major expense of any expedition is the payment of staff trained in specific tasks crucial to the rhetorical goals of the project and those brought on board to support physically the mission's completion. Formal training or professional background of those employed as expedition photographers plays some role in the stories of expedition photography. As a burgeoning imaging technology and potential art form in the late nineteenth and early twentieth centuries, those claiming professional experience as photographers more often learned the craft through practicing in commercial settings, studying under studio owners, or teaching themselves through practice and published instruction guides.[83] Rare was the

[83] Excellent examples of guides from the period of exploring the American West and Antarctic with cameras are: Abney, Sir William de Wiveleslie. *Instruction in Photography*. London: Piper & Carter, 1882; Paltridge, George H. *Photographic Instruction Text: A Systematic Course and Working Guide in All*

instance when a formally schooled artist took up the camera with the intention of creating artistic images. In the cases cited here, the lack of academic training on the part of the expedition photographers held true, but they varied widely in the informal training. While astronauts were mostly engineers and test pilots by education and training, with some scientists trained as pilots joining the corps late in the 1960s, photographic training and practice was largely a sideline that some took more seriously than others. The mission of astronauts simply did not give them the luxury of spending more than a brief moment considering the capture of images artistically, keeping in mind issues of composition, lighting, or anything beyond the technical requirements of camera operation.

What really separates the efforts of professional photographers and their surrogates (the astronauts on space missions) is the *intent* of the photographs they produce. For a professional photographer, the process of creating a photograph ranges from selecting the technology to affix the image to a plate or film to the display of the print. This is the creative process of an artist: manufacturing an image and presenting it to viewers in an intentional way. Astronauts had no such creative intent or control. Their role in the photographic process was to collect images. They needed to understand how to manipulate the equipment, follow written guidelines and settings, a form of script, recorded in the mission plan in order to collect an image, and return safely to the Earth with the visual representations of their experiences. They made a collection of images, but that is where their part in the process began and ended. NASA staff including photography technicians, managers, and public affairs officials brought the process to its

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the Processes Which Ordinarily Take Up the Attention of Camera Workers. New York: Photo-Text Press, 1900.

completion by developing films, handing them off to either scientists or another intermediary for distribution. One may consider astronauts as a set of collectors, akin to census data collectors or pollsters. This required moderate instruction in performing the photographic task, but their involvement ended at framing images and returning the equipment to photographic technicians at NASA. Astronauts played no known part in developing films or selecting images for public release, thus removing them one step from consideration as professional photographers. This should not diminish the importance of their role but serve to place them along a spectrum of experience and motivation.

During exploration of the American West, project leaders hired photographers with a wide range of training and experience. From the on-the-job training of John Hillers during Powell's second Colorado trip to the photographer William Henry Jackson, the primary photographers of these expeditions never brought much formal education with them. Initially, Hillers was hired by Powell as a boatman and occasionally assisted the expedition photographers E.O. Beaman and, later, James Fennemore. Later, he replaced both of them. Donald Worster suggests, rightly so, that even though his skills were learned along the road, Hillers became not only a talented photographer but also a fine artist.[84] Following the definition of an artist-photographer, this then means that the photographer determined, with a specific point of view, the scene to be captured, what camera to use, the settings required, how to process the film, and then played some role in the use of that image as part of a narrative of the expedition.

[84] Worster, p. 241.

Timothy O'Sullivan and William Henry Jackson entered their survey work from a different direction than John Hillers. Both men spent many years of the Civil War either photographing or sketching scenes of battle, O'Sullivan as an employee of famed Washington, D.C., photographer Alexander Gardner, and Jackson as an artist-observer. O'Sullivan left little textual evidence of his point of view or thought process in framing a scene, as he did not keep journals. As Toby Jurovics explains in his essay on O'Sullivan's survey work, the photographs included by Gardner in his 1866 book credited to O'Sullivan are indicators of the style he carried through his survey work. Through examining the journals of survey scientists during his work with Clarence King, Jurovics found that O'Sullivan's work was often collaborative, showing he clearly understood the audience for his images was other geologists, surveyors, and those in need of details about the western environment.[85] The conjunction between artist, photographer, explorer, and scientist became a crucial element in these expeditions, and later ones as well.

Similarly, Ferdinand Hayden and William Henry Jackson developed a working relationship that provided each with assurance of professionalism. Hayden's ego as a surveyor and Jackson's vision of portraying not only the dramatic landscape but also the heroic surveyors melded easily.[86] From historian Peter Hales' perspective, Jackson's background working for the Union Pacific Railroad and as a photographer in Omaha prepared him for survey work as an artist, Jackson had already bought into a somewhat

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[85] Jurovics, Toby, ed. *Framing the West: The Survey Photographs of Timothy H. O'Sullivan*. Washington, D.C.: Library of Congress, 2010, p. 19, 25.

[86] Hales, Peter B. *William Henry Jackson and the Transformation of the American Landscape*. Philadelphia: Temple University Press, 1988, p. 78.

fanciful concept of the West; his visualization of the land through photographs would continue to support an idealized place.[87] His images could in essence sell the concept, and Hayden saw the great potential in using Jackson to further his own desire to perpetuate his expeditionary work.

Exploring the frigid, icy Antarctic with a camera threw up obstacles up for photographers like Herbert Ponting and Frank Hurley. Their prior experiences of travel and exploration photography, however, prepared them for the environment and demanding leaders. Ponting joined the *Terra Nova* expedition based solely on Scott's reputation and despite a prior work commitment.[88] He developed considerable experience over the prior ten years doing freelance photojournalism for nature periodicals, and his 1910 publication on Japan earned him an RGS fellowship.[89] With the RGS connection in hand and a reputation for producing elegant narratives through visuals, Ponting became a significant addition to Scott's voyage despite not making the final trek to the Pole. For the final leg of the trip, Scott requested that Ponting train team members to handle a small camera themselves. (Figure 13) Scott, keenly aware of the ongoing controversy between Robert Peary and Frederick Cook over reaching the North Pole, understood that having

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[87] Ibid, p. 27.

[88] Jones, Max. *The Last Great Quest: Captain Scott's Antarctic Sacrifice*. Oxford: Oxford University Press, 2003, p. 182.

[89] Arnold, Harry John Philip. *Photographer of the World: The Biography of Herbert Ponting*. Teaneck, NJ: Fairleigh Dickinson University Press, 1971, p. 33.

photographic proof and accurate navigational evidence of the accomplishment meant the difference between instant recognition and battling naysayers or competing claimants.[90]

Perhaps more than any of the photographers, Frank Hurley acquired actual photographic and technical training through schooling. He attended a Sydney technical school and purchased his first camera at age seventeen. Alasdair McGregor, Hurley's biographer, depicts the photographer as motivated (he opened his own postcard business as a young professional), adventurous, and willing to take risks to get the best image.[91] Hurley was also an innovator, using the popular and recently developed Paget color process during his work in Antarctica. This technique had the advantage of making the glass plates very sensitive and, therefore, advantageous in the polar environment. Such was Hurley's dedication to his craft that Shackleton smashed the glass plates deemed more than the team could salvage and transport, so Hurley would not be tempted to save them and overburden the team.

While bearing some resemblance to expedition photographers of the heroic age of terrestrial exploration, astronauts bore few of the same philosophical or artistic burdens of those men. Trained as test pilots, engineers, and the occasional scientist, their background could hardly be more different from their predecessors. The clearest connection between the stories of training for photographers during exploration of the American West and the Antarctic is the total lack of formalized art education. As members of the scientific teams charged with creating visual representations, survey

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[90] Cook claimed he reached the North Pole in April 1908 with only two witnesses and a photograph as proof. Peary followed a year later with his own claim, but with no photographic or navigational evidence but five expedition members to verify the team got within five miles of the Pole.

[91] McGregor, Alasdair. *Frank Hurley: A Photographer's Life*. New York: Viking, 2004, p. 19-20.

photographers created narratives with framed images that needed to represent the most important aspects of the expedition. Their constituents, the expedition leaders, financial supporters, and general audience, needed satisfaction with their products and confirmation of the established rhetorical goals of the expeditions. While astronauts were dedicated to performing photographic tasks to the best of their abilities and accomplishing virtually the same visual goals as previous expedition photographers, they completed those without the luxuries of time and space. In the area of environments and challenges is where a true division exists between the experience of photographic exploration of Earth and space with cameras.

Production – environments and challenges

While rocky trails and rapid-filled rivers faced explorer-photographers of the American west, even greater dangers loomed for those who took exploration to far more treacherous and other-worldly environments. Only the depths of the oceans might compare to the hostile nature of space, but those who trekked into the American west and the icy Antarctic carved new routes and visual routes through spaces that earned them the label of "heroic explorers." As the destinations of explorers became increasingly extreme, so too was the effort to manage the technologies needed to record visuals of these places. Horses and mules carried loads of photographic equipment and supplies before, during, and after the Great Survey work of the late nineteenth century. Perhaps the most disappointing were losses of photographic plates on the return journey, experiences had by both Timothy O'Sullivan and Frank Hurley. Both lost precious cargo when their transportation failed: a mule accident on a rocky trail for O'Sullivan and the stranding of the *Endurance* for Hurley. These environments are far from the extremes of space, but all include elements of danger and physical movement that make transporting fragile glass plates quite difficult. Conversely, the harsh climates decreased the ability of the photographer to spend the time photographers prefer to plan, compose, and capture a photograph.

Not only were photographers battling new environments, but they were also forced to prioritize their supplies and equipment needs. Funding only allowed a photographer so many mules or horses to transport his cameras, a portable darkroom, chemicals, and glass plates. Likewise, in an even more limited space, photographers who headed south with the Antarctic explorers found their workspace even more limited. Luckily for Hurley and Ponting, their needs were respected by the expedition leaders and each was given defined spaces onboard the ships and in camps to store and process their work.[92] Space-bound astronaut photographers were even more limited by size and weight in what they could carry. Engineers made every effort to minimize the physical requirements of space camera equipment. Manufacturers made lighter cameras, removed unnecessary parts (especially bulky viewfinders), and developed thinner films to keep weight and volume to an absolute minimum. As is true with exploration and technology over time, the space for photographic equipment became more limited as the technologies for human survival increased. Likewise, camera technologies became more compact, portable, and reliable.

[92] Steven Pyne describes the difficulties Ponting and Hurley had with doing traditional landscape photography in the Antarctic, but also how they went beyond expectations to portray the experiences of the expedition teams. Pyne, Stephen J. *The Ice: A Journey to Antarctica*. Iowa City: Iowa University Press, 1986, p. 176-177.

For each of the Great Surveys, the survey leader selected a professional photographer for the job of documenting the group's discoveries on glass plates and with the available camera technology of the time. Exploration of other extreme environments over the course of the early twentieth century such as the jungles of Africa, the depths of the oceans, and the great mountain peaks included photographic documentation as a key feature of the project, using the most advanced cameras available at the time. They were, for their time, dangerous, life or death experiences as well. However, those expeditions, like Jacques Cousteau's work in the deep oceans or Edmund Hillary's ascent of Mt. Everest, lack many of the major components of projects examined. While they produced representative images with many components of typical exploration photographs, the photographic efforts and resulting catalogs of images do not contribute a greater understanding of the cultural trajectory of exploration photography for this analysis

Not until humans left Earth itself were choices about camera technology and photography divided between the hands of professional photographers and engineers and a group of non-professionals, men who were trained engineers and pilots. Putting the responsibility for capturing the first human perspective images of Earth, outer space, and the Moon puts those images in a separate category considered amateur in nature. NASA, however, directed its photography staff to train astronauts thoroughly in the use of cameras, but their non-professional status plays a significant role in the dissemination and reception of space photography.

Packing anything for expeditions required thoughtful, logistical planning, and the needs of photographers underwent scrutiny for what some viewed as its non-critical status as part of the mission. The state of the art in photography for the late nineteenth century could hardly fit inside a modern photography dark room today. Not only were the cameras bulky and incredibly fragile, but the equipment required to support their transportation and film processing also required the use of numerous carts and pack animals to make it across the rough ground of western terrain. Professional photographers at the time of the Great Surveys required glass plates for their images, ranging from small five-inch by eight-inch plates up to twenty inches by twenty-four inches for large scenic shots that allowed photographers to reproduce the scenes in large format, a process far easier than attempting to enlarge them. The fragility of the plates meant careful packing for bumpy overland trips on the backs of pack animals or wagons. William Henry Jackson famously lost a portion of his photographic plates when one of his carts overturned on a steep hillside, sending him scrambling to salvage what he could of the equipment and negatives.[93]

Cameras carried by photographers for the Great Surveys needed to suit the types of photography they intended to do, including stereographic, panoramic, and large-format glass plate work. Rather than the elegant and easily handled metal bodies most are familiar with today, cameras of the 1860s and 1870s resembled large wooden boxes with lenses extending from one side and black bellows on the opposite side used to focus the camera. The complexity of camera technology and image development at this time is of particular interest because the dry plate process (negating the need for a wet surface to expose the glass plate) existed, but until the gelatin dry plate was perfected by Richard

[93] Cassidy, p. 172.

Maddox in 1871, wet plates still offered photographers better quality and faster image capture and development time. In their journeys across the American West, survey photographers O'Sullivan, Hillers, and Jackson were constrained by the bulk of the equipment they required.

Skill and experience also guided the choices made my Antarctic photographers Ponting and Hurley, though by their time, technological advances minimized the size of their cameras and equipment and left room for additional cameras, experimentation, and processing equipment. Ever concerned with the hierarchy of the team, Robert Scott's organization of his *Terra Nova* team's McMurdo Sound base camp hut included demarcated zones for different roles and rank, with Ponting's area serving as sleeping quarters and a makeshift darkroom.[94] Despite his cramped quarters, Ponting processed some 2,000 negatives and prepared over 25,000 feet of movie footage. Ponting's concern for continuing the expedition's visual narrative extended into teaching both Scott and expedition member Henry Bowers to operate a small camera for snapping the victory image when they finally reached their goal. Numerous accounts of Ponting's experience cite his adventurous spirit when it came to photographs. He attempted to use the newly developed autochrome process, made use of a movie camera, and his expert employment of lenses like telescopes allowed him to search the horizon for the *Terra Nova* months after its encasement in ice.[95] Ponting carried out his duties as what Scott called "camera-artist" of the expedition, skillfully employing the available technology to his advantage.

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[94] Preston, p. 149.

[95] Savours, Ann, ed., *Scott's Last Voyage, Through the Antarctic Camera of Herbert Ponting*. New York: Praeger Publishers, 1975, p. 41; Solomon, p. 248.

Much the same is said of Frank Hurley's inventiveness and skill during his experience as part of the Weddell Sea party of Ernest Shackleton's pre-World War I polar expedition. As the *Endurance* itself was intended as a base for the team throughout the mission, Hurley managed to commandeer a space aboard ship for a darkroom and equipment storage. Stocked with glass plates, film, cameras, and processing equipment, Hurley had his own space in which to work and store lantern slides for his monthly presentations to the crew.[96] References to the specific equipment he carried are scant, but one photo caption in a biography of Shackleton states that Hurley brought along eight cameras, including two movie cameras.[97] In his case, however, the abandonment of the ship left little evidence of his body of work behind since Shackleton permitted him only one tin of negatives and a single film camera for the duration of their escape and rescue.

The involvement of astronauts in either the preparation, planning, and technological choices for photography during early spaceflight is minimal at best. Anecdotal stories, likely rooted in some facts, suggest that John Glenn and Walter M. Schirra, Jr. were the originators of photographic efforts by astronauts, Glenn having requested to take the first hand-held camera on a flight and Schirra for suggesting the Hasselblad 500C as the camera of choice for the program. Even descriptions of astronaut responsibilities, whereby responsibilities for learning the entirety of the spaceflight process were divided between astronauts to create specialists who could better inform and teach their colleagues, most certainly included at least one person who familiarized

[96] Lansing, Alfred. *Endurance*. New York: Carroll & Graf, 2000, p. 43.

[97] MacKenna, p. 145.

themselves with small equipment like cameras. Certainly, stowage of equipment and organization came down to astronaut preference, so their input was critical to defining the type of equipment they were comfortable using as well as how they accessed it. What is clear, however, is that documentation of science and engineering efforts drove the choices made about camera technology, and astronauts, for the most part, played willing students and executors of the plans for photography during early spaceflight.

Distribution - visual characteristics

Similar to the way people identify tropes in horror movies or television sit-coms, the visual commonalities of photography are striking when examining images from across human exploration projects over the last century and a half. Such trends are common in photography, often seen in tourist photographs. Each journey needs an "establishing" shot documenting arrival at the destination. With such a photograph, the idealized notions of a scene, established through textual rhetoric, become visual for the audience. The photographer lays the grandeur of the landscape before the eyes of the audience, allowing for varied interpretations but encouraging awe and wonder at the spectacle of nature, or what historian Miles Orvell calls the "view" type of landscape photograph.[98] In these view landscape photographs, audiences experience what David Nye discusses in his book *American Technological Sublime*, which is the growing linkage in the United States since the early nineteenth century between the concepts of sublimity and technology.[99] While the grand paintings of the American west by Thomas

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[98] Orvell, Miles. *American Photography*. Oxford: Oxford University Press, 2003, p. 41.

[99] Nye, p. xix.

Moran may have inspired and caused a sense of awe amongst those who saw them, technology made reproducing photographic representations of the natural sublime easy and available to a wider audience.

Other than the “view” type of landscape photograph, numerous other visual trends carry through exploration photographs. Such ventures, laden with frontier or pioneer rhetoric, typically draw on the sense of the far off horizon to bracket the landscape within the bounds of the camera and the sky, expressing a vastness of the place but also the ability to ponder what lies beyond that line in the distance. The vanishing point plays a role here as a visual cue to direct the gaze to a distant point. As the ground converges with the sky at the horizon line, drawing the eye and mind towards the distance, and what lies beyond that line. (Figure 14, Figure 15, Figure 16) The land between the viewer and the horizon beg for understanding, inquiry into their contents. What is seen is just as important as how it is seen, giving those who control the creation and distribution of the images a way to link them to the rhetoric used to support the project from the start.

Other minor themes linger in images created during exploration projects. A look back at the progress of the expedition, for either artistic or engineering purposes, crops up in images regularly. These images depict the means of transportation to the remote location to show what brought the explorers to this point. Getting to that point is only half the battle, so seeing the boats, sleds, or spacecraft used in travelling supply viewers with some sense of the struggle. (Figure 4, Figure 6, and Figure 8) As projects of national importance, often well publicized prior to launching, moments when the explorer celebrate or openly take pride in their efforts return a sense of accomplishment and pleasure to the viewers. Whether the image is of planting a flag or exulting in a successful effort, expedition participants speak to the audience in these moments, sharing the excitement of that moment. And while arriving at a location and celebrating the moment may convey one part of the story, actions inside the environment are the heart of the story. If the viewers are to imagine themselves at a certain place, then they need to see its scale. Mountains, ice floes, and the dusty lunar surface offer few natural points of visual reference for contemporaries of the explorers. What mill worker of the late nineteenth century could mentally recall an image of a deep canyon, let alone see themselves in it? Photographers, as part of expeditions to *terra incognita*, needed to show themselves there, for the rest of us to begin to grasp the size of such landscapes.

Images became the means by which explorers justified their research, just as NASA used *Earthrise* to promote the accomplishments of the space program. As Elizabeth Childs says of the Powell survey photography by John K. Hillers, "The artistry of these pictures supported their social and political functions: these views could at once persuade, instruct, impress, and delight."[100] Comparing nearly any landscape photograph from the West or Antarctica with *Earthrise* makes the connections even more obvious (Figure 8, Figure 17, and Figure 18). These stark and uninhabited scenes compare easily to the stark, rocky, uninhabited landscape of the lunar surface (Figure 19). In all three cases, the horizon towards which the photograph aims is the true subject of the image. Horizons give an indication of more, a future, and a clear path between viewer and the potential that lies beyond that line. As the most studied of the periods, however,

[100] Childs, p. 12.

scholarship on photography of the American West may offer further insight into how scholars can examine later exploration photography as well.

A number of specific questions Martha Sandweiss attempts to answer about photography of the West help shape my analysis of the meaning of astronaut photography. By analyzing images and their context, she sought to understand the linkages between exploring a new region, ideas that develop about that place, and changing pictorial representations of it connected to photography and its uses, meaning, and ability to shape ideas of that place.[101] Sandweiss's observations transition quite easily to the context of the exploration projects of the Antarctic and space, though no scholars have employed such analysis. Not unlike travel by wagon and horse to the American West or by ship to the Antarctic, space presented serious challenges to transporting camera equipment. Americans came to understand exploration through information found in newspapers, books, magazines, and on television, all media heavily reliant on visuals. Production and dissemination in both of these instances, therefore, had similar origins and needs, and the creation of meaning is the interpretive step taken in part by the remainder of this section.

While thousands of photographs exist from the early space programs, a number of case studies will serve here as useful points of comparison for the rich set of visual examples from other arduous and image-rich missions of discovery. A key visual counterpoint to photographs taken during the Great Surveys and *Terra Nova* and *Endurance* trips to Antarctica is the iconic image called *Earthrise*, the photograph of

[101] Sandweiss, p. 4.

Earth rising from behind the Moon taken during Apollo 8.[102] As discussed previously, the concept of the frontier, represented through alluring images of a distant horizon beyond a barren or treacherous landscape, plays a significant rhetorical role in many of the expeditions. Visually, a comparison of images from the other expeditions to *Earthrise* shows the persistence of this theme throughout the history of photography.

Part of what makes *Earthrise* so interesting is its status as the product of a government-funded program, but a program that apparently spent little time considering documenting the view of Earth from lunar orbit.[103] This spontaneous "crew selected" target hardly received mention in the post-mission analysis documents produced by NASA including the official mission report and a special document produced regarding photography on Apollo 8.[104] If NASA, like the corporations in Brown's analysis, cared little for the aesthetic qualities of the images, how do such images become such an important part of an American visual legacy beyond the space program? It bears noting here that the quality of images from the Great Surveys, while unable to rival the picturesque qualities of the paintings produced by Moran, Bierstadt, and others, were taken by professional photographers, who carefully composed their images. The ability of professional photographers to conceive of a scene, a factor in the three earliest

[102] The orientation of the image is subject to the perspective of the astronaut inside the spacecraft, and there are differences between the color and black-and-white versions of this photograph, which will be discussed in a later chapter.

[103] The only note about taking the rising Earth photo contained in mission documentation or the recollections of the crew members comes from the first volume of the flight plan, which includes a page for "lunar photo flyby procedures" in the reference materials at the back. It contains a line item for photographing "earth set and earthrise" with the 16mm Maurer moving film camera, not the Hasselblad still photography camera.

[104] Allenby, Richard. *Analysis of Apollo 8 Photography and Visual Observations*, NASA SP-201. Washington, D.C.: NASA, 1969.

expeditions mentioned here, was likely not a factor in considering the aesthetics of photography during the Apollo program – there was no room in a tiny capsule for an additional person to take photographs. Astronaut photographers were there to primarily prove the technology of spaceflight worked, and secondarily, or even farther down the list of priorities, document the experience.

The strongest ideological connection linking *Earthrise* to the other landscapes is that of the frontier, already identified here as common to many exploration experiences. Similarly, the nationalistic overtones present in the rhetoric of the American Great Surveys and the British Antarctic trips carry over into their visuals, though more subtly than one may perceive in images of astronauts on the Moon. An image from Apollo 15 of Commander David Scott saluting the U.S. flag firmly planted in the lunar surface (Figure 22) echoes of jubilant images from western exploration (Figure 20) and the Antarctic (Figure 21). While not as explicit as the Apollo 15 image with the prominence of the U.S. flag, the other figures express satisfaction with the accomplishment. Despite possible problems or failures in their mission, these images offer a sense of human scale in relation to landscape features otherwise indiscernible to the audience.

Experiences of triumphing over unknown lands (and sometimes people), such as that of empire-making of the British examined by James Ryan in his monograph *Picturing Empire*, provides a substantial point of comparison with the American victory in the space race as seen in *Earthrise*. He argues that, "…photographs – composed, reproduced, circulated and arranged for consumption within particular social circles in Britain – reveal as much about the imaginative landscapes of imperial culture as they do about the physical spaces [pictured]."[105] According to Ryan then, images of success in expanding an empire speak to the nature of the culture doing the conquering. Anne Lindbergh astutely recognized the space/African exploration connection as well in the preface to her Earth Shine essays. In compiling a book of essays about space and travelling in Africa, she notes that the two places are joined by their extremes at least, reminding the reader that, "We cannot live in the wilderness and forget civilization. Nor can we live in the heat of civilization without realizing its increasing problems…."[106] By photographing *Earthrise*, William Anders unknowingly reinforced the long-held idea that the space race was a type of final attempt to expand outward the Manifest Destiny principles of decades past.[107] As a signal of victory, *Earthrise* fits into the imperialist genre of photography discussed by Ryan, as well as maintaining an association with the concept of the frontier so prevalent in American visual culture.

A third common theme throughout exploration photography is what might be deemed the rearview mirror images, those that appear to consciously take a look behind the photographer to give the viewers an understanding just how the photographer and expeditions members reached these far-off locations. This strategy reinforces the concept in photography of the best image may often be behind the photographer. In cases of exploration, the mode of transportation becomes the subject of the photograph, and the photographers play with concepts of distance between the camera and the vehicle and the vehicle and the horizon. (Figure 23, Figure 24, Figure 25) The breadth of these types of

[105] Ryan, p. 19-20.

[106] Lindbergh, vii.

[107] Maher, Neil. "Shooting the Moon." *Environmental History.* Vol. 9, No. 3. July 2004, p. 528.

images include those focusing simply on perspective through those strictly for documentation, drawing as much attention to the camera's point of view as it does the subject of the image. Across the expeditions examined here, the importance of these images lies less in their public appeal as part of a mythical journey to the unknown and more on their place in creating a realistic visual narrative, capturing the experience for posterity.

Transportation technologies in the context of the landscape served a number of purposes for exploration photographers. Putting them in the physical context of unknown landscapes gave tool of exploration needed some context. Reaching remote canyons via rocky landscapes and rough rivers required lugging equipment and supplies for hundreds of miles, so Hillers' depiction of transportation methods used during Powell's second trip to the Colorado River made the scale and danger of the voyage evident (Figure 23). Similarly, while large sailing vessels were familiar to people of the early twentieth century, their appearance in photographs by Ponting and Hurley clarified their use in transporting people and equipment to the hostile icy landscape of the Antarctic. As part of the narrative of the Weddell Sea party Shackleton lead to reach the South Pole, Hurley's photographs situated the team's struggle to save their ship and supplies from the treacherous ice (Figure 24). Later, as they left the ship behind and crossed the ice floe, only this image and a handful of other surviving frames remained to tell the story of the party's battle in the Antarctic.

The unfamiliar appearance and function of the lunar landers generally, but especially resting on the dusty lunar surface did not present spontaneous understanding of lunar transportation for viewers as canoes and sailing ships offered audiences of the American West and Antarctic exploration photography. The sight of these fragile human-built devices within the harsh and alien landscape offered just some visual clarification of the lunar landscape's danger. Astronauts in spacesuits confirmed the challenges of the Moon. In the case of Apollo 12 astronauts Pete Conrad and Alan Bean, their second extra-vehicular activity (EVA) brought them to a lunar resident of Earth origin: the aptly named Surveyor 3 lunar lander, sent in 1967 to perform preparatory research for human landings. The view from Surveyor 3 back towards the lunar module Intrepid contextualizes the mission as one of long voyages for both the human and the robotic, displacing the viewer from traditional exploration photography only in setting, but not in perspective (Figure 25). The audience for space photographs, like those viewing scenes of American West and Antarctic exploration, saw a constructed scene meant to convey distance travelled, the requirement of technology to achieve that voyage, and the harshness of the landscape in which they see the voyagers. Perhaps even more indicative of this view of distance travelled is the iconic image of Harrison Schmitt during Apollo 17, which frames ideas of nationalism, humanity, and technology in a single image (Figure 26). At no other time in the history of exploration did a photographer capture the mission's rhetoric, origins, destination, and participants as expertly as Cernan did in this photograph.

Setting a human in the context of harsh environments, rather unknown to the audiences, may provide a sense of understanding that environment, but belie a number of realities about the situations depicted. While the waterfall-like setting of William Henry

Jackson's images of a survey companion standing on Mammoth Hot Springs in Yellowstone Park looks elegant and conveys the natural beauty of the spot, the danger of scaling the terraces and avoiding the scalding water (averaging about 80°C) put the photographer and survey member in considerable danger (Figure 27). Danger abounded in the Antarctic as well. Robert Scott grew concerned about Henry Ponting's risk-taking for photographs after attacks by penguins and a near fatal encounter with orcas he attempted to photograph from an ice floe.[108] The ice presented obstacles at every turn for expeditions, but were ready-made photographic subjects for giving a sense of scale as well (Figure 28). Geological features of the lunar surface confronted Apollo astronauts as well. Known for its wide-ranging examination of the Taurus-Littrow lunar highlands, the Apollo 17 mission plan took astronauts Eugene Cernan and Harrison Schmitt through what might have been the grounds of more recent volcanic activity (Figure 29). They found numerous large boulders, unusual soils, and returned more samples to Earth than any other mission. Considering the low-gravity, airless environment in which they operated, astronauts faced challenges greater and far more of a deterrent to further human exploration of the Moon than those of the past, and the photographs of humans in that place served to confirm those dangers.

What is worthy of note at this point is that the primary audience, in varying orders of priority, remains the same throughout the history of exploration photography: scientists, patrons, and the public. To review the series of photographs collected during any of these three expedition periods, it is evident that the overwhelming majority of

[108] Preston, p. 138.

photographs collected are landscapes and nature views. Rarely are people depicted, save in the cases of special studies of Native Americans during the Great Surveys or of expedition crewmembers for the purposes of giving human scale to natural features. Even astronauts make few appearances in still photographs compared to the bulk of images captured for geological or other scientific purposes. Simply stated, people were not the most important subject of exploration photography. Considering the limited resources available to the photographers on these voyages, allocating more than a handful to showing fellow travelers ignored the primary driver of spending expedition funds on photography: the needs of the primary audience for those images. In each instance, patrons wanted the use of scientific or technical information available in those photographs to their benefit. Getting the plentiful images to the audiences became the next step in the narrative of exploration photography.

Distribution – audiences and strategies

The state of printmaking and reproduction technologies played a significant role in the ability of image-makers to distribute their products to their audiences. While printing multiple prints from glass plate negatives posed no problem for late nineteenth century photographers, there was no means to reproduce them for mass-market publications like newspapers until the halftone process came into use during the 1880s. Audiences were limited then to those able to purchase prints (often stereographs), view them in an exhibition, or access them in a bound photographic catalog such as those distributed to Congress by geological survey leaders. While the government-sponsored efforts of the Great Surveys meant that copies of the prints ended up in government repositories, copies made for other patrons and sale to the public by the photographers, using their original glass plates meant a limited circulation of prints but one that created a hunger for these visions of the West. Providing exact visual representations to a public accustomed to lithography and paintings was of little importance. Those, like Congress, who required precise scientific documentation to plan future development of the added territories, received the necessary reports with plenty of sepia-toned printed photos included.

Make no mistake, however, about the intentions of these and later exploration photographers: they did not join expeditions for selfless purposes of supporting science or exploration. From William Henry Jackson's agreement to supply any needed prints to the government while retaining the right to sell the images he captured on the Hayden surveys to the extensive, for profit lecture tours of Herbert Ponting and Frank Hurley after their Antarctic adventures, photographers on expeditions sought to benefit from their work. With more advanced means of reprinting images in newspapers, magazines, and books, the Antarctic photographers reached a broader segment of the public. The images not only became part and parcel of funding plans for the missions themselves but also supported the long-term individual finances of Ponting and Hurley. Their status as full-fledged members of their respective expeditions meant that their experiences and images contributed to a close public identification between them and their disastrous polar trips. In the cases of photographers of the American West and the Antarctic, the professional nature of the work and shrewd financial arrangements kept ownership of the photographs largely in the hands of the photographers. And as the age of heroic exploration came to an end with the start of World War I, both men, however, found fame and fortune far less beneficial than they expected.[109]

The case of astronaut photographers had no such commercial aspect or even any involvement in distribution by those who captured the images. As an exclusively government endeavor, the space program's public nature meant the images, save in the instance of being withheld for national security reasons, became part of the public domain and usable by anyone.[110] The explosion of mass media and a hunger for more immediate visual representations accompanying the rise of television gave NASA a reason to circulate still images quickly and broadly. Television broadcasts were fleeting in this period that lacked home recording technologies. Newspapers and magazines, however, became family keepsakes, leafed through multiple times and tucked away in a cedar chest as a memento of the experience. NASA found a willing consumer for the photographs in a culture adapted to absorbing visual images with few questions. Historian Michael L. Smith states in his work that NASA sold itself to the public not through spectacular feats with hardware alone, but the ideas the iconography of space exploration could convey, "…an image of national purpose that equated technological preeminence with military, ideological, and cultural supremacy."[111] Astronaut

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[109] Ponting's images, while heralded for their depiction of a tragic experience, were viewed as anticlimactic as they did not show the most famous portions of the journey: Scott and his team's demise. Hurley found the climate for his significantly chilled by the war and for a culture of heroes developing from the continental battles – not those of the far reaches of the globe. For more, see: Barczewski, p. 219-224.

[110] David, James. "Astronaut Photography and the Intelligence Community: Who Saw What?" *Space Policy*. Vol. 22, no. 3. August 2006, p. 185–193.

[111] Smith, Michael L. "Selling the Moon: The U.S. Manned Space Program and the Triumph of Commodity Scientism." In *The Culture of Consumption: Critical Essays in American History, 1880-1980*. Richard Wightman Fox and T. J. Jackson Lears, eds. New York: Pantheon Books, 1983, p. 177–209.

photographs, in short, were the primary vehicle for the literal and rhetorical image of the space program, but to some, the ideas they conveyed held more long-term value than the instant gratification offered by amazing views of human-made technologies sent outside Earth's atmosphere.

Reception and Public Memory

Measuring the success of rhetorical images to accomplish their mission requires analyzing the resultant actions by viewers. Depending on the mission goals, audience use of images may include seeking additional funding for additional exploration, speaking to others about the images, or coming to believe in the ideology conveyed but the narrative of the images. In the instances examined in this chapter, explorers meant for their project photography to reinforce ideas established from the expedition's outset: finding natural resources (for public and private purposes), scientific documentation, increasing national prestige, or just the "inevitable need" for humankind to explore and conquer. Responses to images collection by audiences such as scientists, bureaucrats, industrial leaders, other nations, and the public, increased ideological and physical attention paid towards those geographic regions.

Images alone did not drive migration to the American West, but it certainly contributed to the appeal of the "myth of the West" and the United States as a "land of opportunity." With the completion of the transcontinental railroad line in 1869, travelling to any point within the continent relatively quickly became reality. Companies looking to exploit the land could move supplies and employees there with grand hopes of exploiting the land for profit. Individuals moved there on the promise of rich soil for farming and grazing. These visions, aided by the photographs, textual descriptions, and artwork generated by the Great Surveys drove the idea of the frontier as open and inviting, usually excluding the harsh realities of the climate, landscape, and previous occupants.[112] Here is where the traditional mythology about the West breaks down and not even careful editing of photos in a narrative series accompanied by descriptions from the survey leader or members can remove the reality of native peoples from the situation in the West.

Trips to Antarctica and the Moon had no preexisting populations to threaten the establishment of rhetoric relating to national prestige and scientific discovery, as presented by the mission leaders. And while accomplishing notable firsts such as reaching the South Pole or the Moon may appeal to those interested in the global stature of their country or learning about the geological and scientific character of these remote, desolate places, both experiences proved to provide only short term gains for the nations involved in the projects. Not only did Roald Amundsen, a Norwegian, reach the South Pole before Scott or Shackleton and secured photographic proof, but also any prestige to be gained in the western world by those valiant failures dissipated with the start of World War I. In a strangely similar way, enthusiasm for space exploration in the United States, built on the popularity of space science fiction over the prior decades, waned when Americans saw the devastation of the Vietnam War on their television screens every night. Once won, the races held little lasting interest for the broad public audience. Scientists and engineers, however, continue to study both regions to this day, learning

[112] Respini, p. 12.

information that encourages further exploration. By whom or what is the question that still lingers.

The role of images in satisfying the immediate needs of the public seems well satisfied in these expedition projects. Photographs of the new places showed a boundless landscape, but one conquered by heroic patriots seeking knowledge and resources. For the true audience of the photographs, the scientists, geologists, engineers, and industrialists hoping to find further reason to support exploration and development, this evidence and the testimony of those who took the photos became crucial documents for study. In the age of digital scanning and file sharing via the Internet, those photos are more readily available than ever. The ability to view images of exploration meant that audiences had material to interpret as accurate representations of unimaginable places then made real by exploration rhetoric, supported by governments and investors, and employing capable technicians and photographic technologies. These means of production allowed photography to occur in challenging environments, using a specific strategy for informing the audience visually, and guided by a visual theme developed by expedition leaders. While not all memorable, these images serve their ultimate and simple purpose as documentation of exploration, showing the human hand in creating new landscapes on this world and others.

Like the masterful paintings that preceded it, photography contributed to a sense of national identity formulated by those venturing to the American West from large eastern cities. As Angela Miller explains, the usefulness of the landscape image lies in, "…its multivalence of meaning – was well adapted to serve a diffuse nationalism without provoking more direct allegiances to place or section, to social class, or to urban polity."[113] An inherent element of visual culture, what Miller refers to as a multivalence of meaning, makes assigning meaning problematic for those that try. As she explains, attempts to link the landscape of the West to a sense of American-ness was fraught with challenges as the landscape itself was a contested space.[114] A similar problem exists when analyzing other exploration photographs, but one can tease out a few distinct types of photographs and their likely meaning for photographers, expedition leaders, and a general audience based on image content and context.

Beyond issues of process and distribution to audiences, the looming issue for analysis of exploration photography is determining what meaning they hold for audiences. The key to their enduring cultural significance lies in the life of the images in public memory and use. As photographs, prints from either glass or acetate negatives or reprints in publications gave photographs a more lasting physical presence than paintings as those were typically viewed in more private settings. The availability of photographs gives the audience repeated opportunities to interpret and find their own meanings in the photographs, however much the photographs are guided by captioning or other textual references. Artists, scientists, engineers, government administrators, and casual viewers have the opportunity to find within those photographs, often seen as part of a larger series of photographs covering the same topic, what they want to find based on their own needs.

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[113] Miller, p. 15.

[114] Miller, p. 18.

Determining the meaning of astronaut photography to individuals or groups, however, begins with understanding how and why those images were created.

CHAPTER TWO: WHY AN AMATEUR NEEDS A BETTER CAMERA THAN A PROFESSIONAL

> *"A pro can do professional work because he is familiar with the principles of light and optics. Few amateurs have the time to master this science so thoroughly. There is a camera, however, the single lens reflex Hasselblad, that will put a more professional quality into any amateur's work, even a beginner's. It does through precision, quality lenses and automatic aids."*
> -Hasselblad 500C print ad, July 1961[115]

For work in the microgravity environment, support equipment and training provided astronauts with the means to manage experiments, maneuver efficiently, and secure loose items in the cabin. The ever-present Velcro strips employed by NASA already did some of the work, but during extra-vehicular activities (EVA), particularly during the Gemini program, when one astronaut left the cabin and one remained inside, the potential for unsecured items to float into space was constant. Beginning back on John Glenn's *Friendship 7* flight in 1962, NASA provided a system of lanyards for tethering small objects to a single point inside the vehicle.

That strategy continued through Gemini, including the Gemini X mission commanded by a veteran of one flight, John Young, and piloted by rookie Michael Collins. Difficulties on previous Gemini flights put pressure on the last few missions to accomplish tasks left incomplete, making the three-day flight quite busy. In addition to successfully docking with their Agena target vehicle and rendezvousing with the Agena

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[115] Hasselblad camera advertisement, "Why an amateur needs a better camera than a professional," *Popular Photography*. Vol. 49, No. 1. July 1961. Inside back cover, p. 145.

abandoned by Gemini VIII mission due to its emergency return to Earth, Young and Collins performed nearly a dozen other experiments involving radiation, navigation, and scientific photography. To record these tasks, the mission included five cameras: two Maurer 16mm sequence cameras to cover EVA work, two Maurer 70mm still cameras for the scientific and general photography, and a single Super Wide Angle (SWA) Hasselblad 70mm camera for EVA still photography and interior photographs. (Figure 30) The Gemini X mission report records that the astronauts felt the Hasselblad's size made it easy to use, but the bulk of the Maurer still camera prevented the astronauts from capturing the full view out the spacecraft windows.[116] Unfortunately, none the lanyards and training provided them would prevent that Hasselblad from escaping the spacecraft for its own orbital voyage.

Just past 49 hours into the flight, as Collins finished his attempt at a second EVA to test a gas-powered maneuvering unit, the lanyard attachment screw in the SWA worked its way free and the camera escaped into the vacuum of space. The lanyard was not even their first method of securing the camera during the EVA, merely the backup. The primary method was a bracket attached to the Extravehicular Life Support System (ELSS) affixed to the astronaut's chest, which provided information on oxygen and electricity during the spacewalk. The bracket stubbornly refused to stay in its slot on the ELSS, so as it swung free in the weightless environment, the screw worked its way out of the camera. The most useful piece of camera equipment on the mission, and the contents of its last magazine, never returned to Earth. By this time, Hasselblad was a well-

[116] *Gemini Program Mission Report, Gemini X,* Report #MSC-G-R-66-7. Houston: NASA, August 1966, p. 7-42 to 7-43.

established manufacturer of astronaut photographic equipment. The loss of the precious EVA camera, one of just two on the flight, meant the remaining camera would need to do double duty and continue to function to complete mission photography. Having a good camera, in the environment of space, was essential to giving non-professional photographers the opportunity to return photographs of professional quality of extraordinary subject matter.

In the early history of hand-held cameras in space, four topics come to the fore. Each requires exploration in this chapter on photographic production during the early U.S. human spaceflight program. First, as in all other expeditions, the project's rationale not only justifies it but also promises a return on the investment. Photography, as the first chapter demonstrated, provided proof and reinforcement for the rhetoric explorers and their supporters used. This element of image production naturally leads to the second topic of the present chapter, funding. In the cases of national projects, funding sources may appear more secure, but still depend on providing results. And those results depend specifically on the two remaining elements of producing: the technologies used and training of astronaut non-professionals in the art and practice of photography.

The unique story of photography performed by astronauts boils down to the crucial difference between its origins and those of other exploration projects. The Gemini IV story related at the start of Chapter 1 shows this well: viewing the photographs captured by White and McDivitt prompted NASA managers to consider dramatically increasing the profile of photographic responsibilities for astronauts. While imaging spaceflight for the purposes of engineering documentation never came into question, allowing still photography or hand-held camera operation of any kind took far longer to integrate into the minds of NASA managers. As with set-aside funds for photography during the Great Surveys of the west, or the hiring of professional photographers for Antarctic voyages, photography was, for most exploration projects after the mid-nineteenth century, a given. What administrators, politicians, and the managerial engineers considered as the most significant goal of human spaceflight distinguishes this experience from those of the past. Historian Roger Launius points out that the intention of putting U.S. astronauts in space had little to do with understanding the environment, doing scientific experiments, or anything other than surpassing Soviet achievements and winning the space race component of the Cold War.[117] Similarly, historian Matthew Hersch illustrates the tension between the first groups of astronauts and the scientific and technical community at NASA, and shows how as a group, the astronauts could enact or resist changes to mission planning based on their positions as the faces of the program.[118] Still photography, something not specifically supported by engineers or managers, seems an appropriate outgrowth of interactions between astronauts, the press that followed them constantly, and a public hungry for any images of their lives and experiences as the country's first space voyagers.

With eight successful flights under their belts, it took NASA something spectacular to instigate serious action in terms of getting the right equipment and training for the astronauts. According to the story as told by Robert Underwood, photography

[117] Launius, Roger D. "Why Go to the Moon? The Many Faces of Lunar Policy." *Acta Astronautica*. Vol. 70. January 2012, p. 165–75.

[118] Hersch, Matthew H. *Inventing the American Astronaut*. New York: Palgrave Macmillan, 2012, p. 44-45.

expert and astronaut trainer, the exposure of NASA managers to the freshly processed photographs of Earth captured by Gemini IV astronauts James McDivitt and Ed White convinced them that photography was a worthwhile investment. Underwood's characterization of the photography hints at the ways in which images could support the NASA mission, giving substance to the rhetoric and bolstering financial support from the government: "…we're looking at things that no human being had ever seen before, parts of Africa and other places. You can see what's really going on."[119] Keenly aware of the time constraints on their time, even astronauts resisted video and photography work at times, most infamously on Apollo 7 when mission commander Walter Schirra strongly resisted adding additional television broadcasts while in orbit. What repercussions, if any, did NASA experience because of its slow adoption of photography as part of astronaut activities in space? This chapter suggests a direct connection between the overemphasis of NASA managers on the technical and engineering elements of missions and how that necessarily disconnected them from effectively communicating the accomplishments of spacefarers to the public.

Rhetoric and Funding

In his characterization of General George Custer's last stand at Little Big Horn, historian Richard Slotkin cites Walt Whitman's poem "Death," written for the Centennial celebration in 1876, as evidence of the mythic frontier's hold on American minds. Slotkin writes that, "The Frontier in whose real geography Custer moved and acted was already

[119] While people had certainly seen these places before, the clear view of them from space offered by astronaut photography was unique and new. Underwood interview, NASA, p. 5.

in his own time a space defined less by maps and surveys than by myths and illusions, projective fantasies, wild anticipations, extravagant expectations."[120] He continues by citing the time as one of transition in the frontier myth from one of expanse and resources to one more industrial and imperial, equating this to a more current perception of American culture as exceptional and strongly linked with ideas of progress. Between that time and the space age, exploration of the Polar Regions only increased the sense of Western culture as one more advanced, technologically savvy, and scientific in its approach to learning about the planet and universe we inhabit.

By the time of the space race, photography no longer had the new and exciting appeal it brought when selling western exploration in the 1870s, or the sharpness for print media and freshness of moving images offered by the work done in Antarctica. The world of television brought the story of the space age immediately into the homes of millions around the world, so that photographs from space, while still able to amaze and capture the imagination even today, were not necessary to sell the concept of human spaceflight. Proposing such a dangerous task (in truth far less costly in terms of lives lost than any other exploration project before) during a complicated political climate required substantial verbal and textual rhetoric to garner public and political support.[121] In this case, however, the flexibility and resolution of photography, its scientific and technical

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[120] Slotkin, Richard. *The Fatal Environment: The Myth of the Frontier in the Age of Industrialization, 1800-1890*. New York: HarperPerennial, 1994, p. 11.

[121] McDougall, Walter A. …*The Heavens and the Earth: A Political History of the Space Age*. Baltimore: Johns Hopkins University Press, 1985.; Logsdon, John M. *John F. Kennedy and the Race to the Moon*. New York: Palgrave Macmillan, 2010.

potential and long-term ease of use for virtually any purpose made still photography a requirement during NASA's race to the Moon.[122]

A significant source of the rhetoric of spaceflight continues to come from the long history in literature and public culture of dreams of spacefarers and other worlds. Films, television programs, magazines, and comic books of the early to mid-twentieth century provided a richly illustrated set of examples to inspire wild and imaginative journeys beyond the surface of the Earth, a topic covered thoroughly in the highly regarded book *Space and the American Imagination* by political scientist Howard McCurdy. He argues that creating actual public policies to undertake spaceflight required bringing together imagination, popular culture, and reality.[123] And while the public was excited by early robotic flights, the inclusion of a human in the process, an astronaut, brought spaceflight into their lives more intimately than ever before. Here, as McCurdy and others point out, is where viewers at home, thanks to articles in newspapers and magazines and extensive television coverage, could connect with spaceflight on a personal level. They gained the ability to envision space for themselves, even though they could not imagine working the highly technical (and microgravity) world of these test pilots cum star voyagers.

Space policy makers of the late 1950s and early 1960s seized upon the opportunity to bring rhetoric and reality together. They reacted to Soviet accomplishments and threats, in the form of ballistic missile and satellite launches, using

[122] Because both the Great Surveys and NASA's programs are government-sponsored and run, any images from them are part of the public domain and are free to reproduce, manipulate, or reuse without licensing or permission.

[123] McCurdy, Howard E. *Space and the American Imagination*. Washington, D.C: Smithsonian Institution Press, 1997.

centuries of rhetoric involving fantastical spaceflight adventures and frontier ideology. But while President Dwight Eisenhower struggled in his second term to keep a balanced budget while attempting to restrain the space and missile race and concurrently working to maintain a public appearance of U.S. superiority in robotic, scientific, and military spaceflight.[124] The same goals were not true of his successor.

President Kennedy and his advisers took every opportunity to capitalize on frontier ideology, and the option of strong civilian and military space programs provided an opportunity to fulfill an aspect of his "new frontier" with a very bold statement. In a report presented by MIT professor Jerome Wiesner's select committee to then president-elect Kennedy just days before his inauguration, the panelists reported that in regards to spaceflight: "…man will be compelled…by the same motives that have compelled him to go to the poles and to climb the highest mountains of the [E]arth." [125] This rhetorical support came despite the panel's strong statements that spaceflight would most certainly be dangerous and embarrassing for the new President. NASA officials took advantage of Kennedy's affinity for this language as well. When presenting a prepared statement to the President at a budget meeting on March 22, 1961, NASA Administrator James Webb concluded by saying that, "pioneering on a new frontier [creates] more viable political, social, and economic systems for nations willing to work with us in the years ahead."[126]

[124] McDougall, p. 112.

[125] "Report to the President-Elect of the Ad Hoc Committee on Space," January 10, 1961. Pre-Presidential Papers, Box 1072, John F. Kennedy Library, quoted in Logsdon, *John F. Kennedy and the Race to the Moon*.

[126] Webb, James E. "Administrator's Presentation to the President," March 22, 1961. NSF, Box 282, John F. Kennedy Library, quoted in Ibid.

When examining Kennedy's presidency, it becomes clear that the history of exploration and particularly exploration of frontiers played a major role in the public and private rhetoric spaceflight supporters used when encouraging the President and American public to stand behind their programs.

To fulfill these ideals of exploration and the pioneering nature of American spaceflight activities, NASA took an active role in providing rhetorical support for these ideals. Even in forms such as the naming of programs and launch vehicles, NASA and the military used those most indicative of success and exploration in mythological terms. Name choices included Pioneer (named by the Advanced Research Projects Agency) and Mariner, as well as those that elicited ideas of power, like Apollo, Saturn, and Atlas (named by the U.S. Air Force). Complex contributions to spaceflight rhetoric of the time include the portrayal of astronauts as heroes, reinforcement throughout of American exceptionalism, and wide distribution of images to proclaim the openness and success of NASA's human spaceflight program.

The most effective rhetoric affecting image production would be expected from inside NASA at the division chief and management level, but most documentation veers towards practical issues and not broad-based concerns expressed by politicians. Memos regarding photography passed regularly between the upper tiers of managers for the Apollo program, only vaguely referencing the goals and audiences for photography. In the spring of 1966, a sequence of memos at the Manned Spacecraft Center (MSC, now Johnson Space Center) exchanged by the Public Affairs Office (PAO), Flight Crew Operations division manager Deke Slayton (effectively chief astronaut), and Apollo

Spacecraft Program Office chief Joseph Shea shows internal conflict over photography. Though never resolved with a response from Shea, the memo trail indicates a significant conflict between the public affairs needs and the reality of scheduling astronaut work. PAO and Slayton made their cases to Shea about the degree to which astronauts could or should provide photographic coverage during Apollo missions. Paul Haney, MSC's chief public affairs officer, wrote an extensive list of requirements for the duration of missions, which amounted to constant movie and television coverage framed in ways filmmakers might plan to shoot a movie.[127] Slayton's response indicated his unwillingness to sacrifice mission time to any drastic increase in photographic activity that would conflict with the accomplishment of basic mission requirements.[128] A review of the organizational structure at MSC during this period shows how detailed discussions of photographic requirements occurred at a high level during the major development period for the Apollo program. Haney, Slayton, and Shea were all direct reports to the center director, Robert Gilruth, who occasionally appears as a signatory to memos regarding photography as well.

A greater purpose for photography of and by astronauts appears lost on those at the top of the managerial chain, whose focus was, not surprisingly, achieving the primary mission goals and bringing the astronauts home safely. A draft summary of discussions of the Astronaut Lunar Photography Subpanel of the President's Science Advisory

[127] Haney, Paul. Memorandum to Joseph M. Shea. April 4, 1966. Johnson Space Center History Collection, Record #27055. Location 075-15. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[128] Slayton, Donald K. Memorandum to Joseph M. Shea. April 27, 1966. Johnson Space Center History Collection, Record #27055. Location 075-15. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

Committee (PSAC) stated as much in their observations of how NASA inconsistently managed photography as an element of scientific exploration and public relations.[129] Slayton, in his response to the extreme request by the PAO for photographic coverage on Apollo, stated that, "…there is a legitimate desire for some reasonable photo coverage. Whether it be based on PAO, documentation, engineering, or purely curiosity considerations is relatively immaterial."[130] Leading up to the Mercury and Gemini missions, practical engineers like flight operations director Walter Williams and development director Maxime Faget, held firmly to the belief that the essential mission requirements of spacecraft performance, astronaut safety, and achieving technical goals were all that mattered in mission planning. Williams was critical of not only the weight and size of the cameras, but clearly, the intent of the photography was lost on all managers until the turning point Richard Underwood described in his oral history regarding the return and review of Gemini IV photography.[131] At that point, the content of the photographs and not just the practicalities of fitting cameras into a spacecraft with weight limits based on rocket-lift capabilities became an unstated goal. Management would provide astronauts with high-quality equipment, training, and mission time to capture not only useful documentary photographs of operations, but also scenes, objects, and events of public and scientific interest.

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[129] Drew, R.C., "Informal Summary of the Astronaut Lunar Photography Subpanel Meeting, September 12, 1967, Cambridge, Massachusetts." NASA Historical Research Collection, NASA Headquarters, Folder #012443.

[130] Slayton Memorandum to Joseph M. Shea. April 27, 1966.

[131] Underwood interview, NASA, p. 4-7.

Requesting the funds to make spaceflight possible, and by proxy the still photography of those missions, was based in a skilled use of imaginative and established frontier rhetoric by politically minded managers at NASA. Like other government agencies, NASA regularly sent representatives at the highest levels of the organization to Congress for appropriations hearings. Requests leading up to construction of the bulk of Apollo hardware reached a peak between FY1965 and FY1967 near the $5 billion mark, nearly 60% of which went towards human spaceflight.[132] The value of frontier rhetoric stressed by NASA and going back to the approval of the Moon effort by President Kennedy in 1961 began to run out with Congress leading up to this period when NASA asked for higher appropriations. The President was adamant about the psychological significance of the goal even if it meant a commitment to more funds for NASA as long as they went towards Apollo.[133] Senators acceded to the plan, but support quickly diminished after Kennedy's assassination and transition to funding the war in Vietnam. Though rhetorically more supportive than Kennedy, Johnson proved to be less effective in sustaining Congressional support for an extensive Apollo program, particularly with his focus on civil rights and the Great Society projects. What this meant for photography specifically was a push to make technological choices efficiently, looking for cost-effective but reliable equipment that would withstand the rigors of space use, and

[132] As a percentage of the U.S. GDP, the peak achieved in this period was about 5%, so while dollar amounts dipped and then increased throughout space shuttle operations, there was a consistent decline in that as a part of the federal budget and in the percent spent at NASA on human spaceflight. See charts included in the Review of U.S. Human Spaceflight Plans Committee, "Seeking a Human Spaceflight Program Worthy of a Great Nation," Washington, D.C.: NASA, 2009, http://www.nasa.gov/pdf/396093main_HSF_Cmte_FinalReport.pdf, accessed October 28, 2014.

[133] Harland, David M. *NASA's Moon Program: Paving the Way for Apollo 11*. Berlin: Springer-Praxis, 2010, p. 106.

ensuring that astronauts had proper training to use the equipment. With the primary goal of providing visual evidence (for science and engineering), fulfilling rhetorical goals with photography came as a bonus for NASA, one they found it difficult to manage given their dual status as a government agency and provider of the vast majority of space images seen by humans.

Selecting Technologies and Training Astronauts

Mercury

The oft-repeated stories of the technological origins of professional camera procurement for astronauts at NASA are that it began with the astronauts themselves, but reflect a willingness to experiment and slowly determine the best technology for the task. The recollections of John Glenn and Wally Schirra are strikingly similar in this respect, both relating how they walked into a local shop looking for something to take on their mission (Glenn bought his Ansco Autoset camera in Cocoa Beach, Florida; Schirra bought his Hasselblad in Houston, Texas) (Figure 31). Glenn's point-and-shoot daytime photography with the Ansco inspired the trend of astronaut hand-held photography. His mission also included a NASA-selected 35mm Leica 1G camera (Figure 32), which engineers modified with a spectrographic lens and reticle for ultraviolet photography of Orion – making this the first human-operated astronomical experiment in space. To make operating the Ansco easier, RCA contractor Roland "Red" Williams added a pistol grip handle and trigger to the Ansco so Glenn's spacesuit gloves did not hinder his work, permitting one-handed operation. Placement of the handle to align with the Ansco's exposure button required Williams to flip the camera upside down, and move a replacement Polaroid eyepiece to what became the top of the camera so Glenn could properly sight the Earth's horizon for the photographic study. NASA engineers also added a large reticle with bumper to the Leica, as the model selected had no built-in viewfinder and Glenn's spacesuit helmet prevented accurate aiming for such precise photography. He could simply rest the reticle against his closed visor to steady it for pointing at Orion.

In Senator Glenn's retelling of this story in an interview in June 2011, the issues camera choice and modification were apparently at his discretion since most at NASA found photography to be a dangerous diversion from the important engineering work Glenn was to perform on Friendship 7:

> Glenn: And the decision had been made that they didn't want to distract the astronaut.
> Levasseur: So it was about distraction then?
> Glenn: Yeah, that was the first thing. And there so wasn't going to be a camera onboard. And I talked to Bob Gilruth about it, talked to him a couple of times. He thought they'd gone a little far about that one also. So, he finally decided…to have one.[134]

Glenn's story about how he purchased the Ansco camera does not differ today from how it was told decades ago. The selection of two cameras, however, begins to indicate several technological problems that arose when selecting camera equipment for spaceflight. Glenn explained in our interview about the Ansco that, "… the one I was to use for regular shooting and just targets of opportunity, this was it." With significant weight restrictions and close confines inside the capsule, carrying one camera for standard Earth orbital images and a second for astronomical observations show the

[134] Glenn, John and M. Scott Carpenter. Interview with the Author, June 26, 2011. Transcript p. 3.

competing interests even at this early stage of human spaceflight. Together, with all of their modifications, the two cameras were evidence of the need to find an all-purpose camera for spaceflight with a single body with interchangeable lenses and magazines to streamline training and mission time spent preparing the equipment.

NASA's camera technology experimentation continued with Carpenter's mission. For Aurora 7, NASA selected a Robot Recorder 36 camera, a model known mainly for its industrial and documentary application. (Figure 33) Flight transcripts and the testimony of Christopher Kraft, NASA flight director at the time, indicated that Carpenter frequently operated the camera during his three orbits, and Kraft attributed the 250-mile off target landing in part to the distraction of taking photographs. John Boynton and E.M. Fields, authors of the official mission report section on spacecraft and launch vehicle performance, explained the concern a bit more tactfully than Kraft's derision of Carpenter: "Astronaut Carpenter exposed an extensive series of general interest color photographs of subjects ranging from terrestrial features and cloud formations to the launch vehicle tankage and the tethered balloon." The modifications to the camera to make a long series of exposures are clear: engineers permanently attached a large film magazine to the camera, making a roll of around 200 frames available during the mission. Carpenter, so dedicated to photography, valiantly saved the Robot camera from being waterlogged during his spacecraft egress – though his 16mm observer camera films were not as lucky and were nearly useless in post-mission analysis. (Figure 34) The Robot camera technology, however, made no particular impact at NASA amongst the astronauts or engineering team, and this particular model never saw use again in space.

Scott Carpenter's part in the story of astronaut photography appears minimal at first, particularly since he only flew in space once. The somewhat notorious nature of his off-course landing, however, and the probability of photography's role in the miscalculation influenced later astronauts and their attention to flight plans. No other landing in the space program was off by such a great distance, and no other astronaut carried his hand-held camera off the spacecraft and onto the recovery ship. Carpenter, still quite proud of his photographic work, fondly recalled the Robot Recorder in our interview: "And I remember that it was spring wound and that it had a five frames a second capability and 250 frames…[B]ig, big roll of film." He created opportunities to depict what Glenn had little time to capture on his flight. Glenn managed to bring back about 70 exposed frames on separate rolls of film, compared to the over 200 photos Carpenter took on one roll. The massive film roll relieved Carpenter of the hassle Glenn found with separate rolls floating in the spacecraft, and perhaps opened up the opportunity for more photography than was practical in a period of spacecraft research and development.

While John Glenn took it upon himself to procure a camera in a Cocoa Beach drug store for his flight, Wally Schirra looked to take a high quality professional camera on his *Sigma 7* mission in October 1962. Schirra's familiarity with cameras and photography was extensive prior to his mission, having purchased a number of them for personal use over the years. Schirra added to that collection when he purchased a

Hasselblad 500C from a Houston camera shop during his early days as an astronaut.[135] The Swedish-made camera model, introduced to the commercial market in the late 1950s, quickly gained the respect of photographers, both professional and amateur for its quality, reliability, and flexibility. At that early stage, however, astronaut photographic work came under the classification of "experiments," for the purposes of understanding the Earth's airglow layer, making weather observations, and beginning the process of ground surveillance. The official flight report for MA-8 states:

> A series of terrestrial color photographs were taken by Astronaut Schirra for two purposes: (1) to aid in building up a catalog of space photographs of various physiographic features of the earth, such as folded mountains, fault zones, and volcanic fields; and (2) to obtain photographs of cloud patterns for comparison with those of other satellite programs.[136]

The use of images for public relations or for anything other than scientific experiments was never mentioned in such reports, but these images became, nonetheless, the way in which most people in the U.S. and around the world connected to the space program.

As astronauts, the Hasselblad Company, and other books and articles tell this "origins" story, the relationship between NASA and Hasselblad was the brainchild of Schirra. In his autobiography and official NASA oral history, he explains his consultation with famous photographers at major pictorial magazines such as *Life* (Ralph Morse and Carl Mydans) and *National Geographic* (Dean Conger and Luis Marden) to find out what

[135] Hasselblad USA, "Hasselblad in Space," on http://www.hasselbladusa.com/about-hasselblad/hasselblad-in-space/in-the-beginning.aspx, accessed 4/14/2010; Schirra, Walter M. Jr. and Richard N. Billings, *Schirra's Space*. Boston: Quinlan Press, 1988, p. 80; Schirra, Walter M. Jr. Interviewed by Roy Neal, December 1, 1998. Interview Transcript, NASA Johnson Space Center Oral History Project, Houston, TX, p. 18.

[136] Boynton, John H. and Lewis R. Fisher. "Spacecraft and Launch-Vehicle Performance." In *Results of the Third United States Manned Orbital Space Flight, October 3, 1962*, NASA SP-12. Washington, D.C.: NASA, 1962, p. 9.

the most appropriate camera would be to achieve sharp and unparalleled photographs. Taking their unanimous advice, Schirra, "…decided that a Hasselblad, with its larger film frame, was more suitable than a 35 millimeter camera. I had a Hasselblad adapted."[137] (Figure 35) The image depicts Schirra and Slayton examining two Hasselblads with engineer Roland "Red" Williams, who did the modifications on Schirra's camera as well as countless others.[138] The Hasselblad lying on the table may be Schirra's own unmodified camera (the silver edging is a classic feature of these cameras), and handling what the caption states is the Hasselblad modified for his flight, which appears darker and without a focusing hood. Schirra continued to credit himself and experienced photographer friends with determining what modifications would make the camera flight ready, explaining in his NASA oral history at least that those changes were made by a Pan Am laboratory near Cape Canaveral.[139] Schirra, in these interviews at least, leaves little doubt of his perception of the role he played in moving Hasselblad from its well-regarded role in the professional photography world to being the high-profile supplier to the glamorous visual world of spaceflight.[140]

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[137] Schirra, p. 80.

[138] Bartman, Lora. "Photographer Built Camera for Glenn's Flight." *Spaceport News*. John F. Kennedy Space Center, February 27, 1998. Vol. 37, No. 4, p. 7.

[139] Pan American World Services was under contract to the Air Force at Patrick AFB to run some operations on the base, and apparently did maintain some kind of photographic lab operations as well. Schirra, Oral History Transcript, p. 19.

[140] Coincident to the completion of this dissertation, RR Auctions of Boston, Massachusetts, consigned a camera previously owned by Gordon Cooper for their November 2014 space auction. A visual inspection revealed this camera's lens was used on both missions, but the camera body appears to be that of the MA-8 flight. At the time of this writing, it appears that Cooper and Schirra may have used different camera bodies. Schirra sold what he believed to be his Mercury Hasselblad at auction in 1994.

It comes as little surprise, perhaps, that during this period of technological experimentation, particularly in the realm of small equipment for astronaut use in flight, there was a willingness to test out what engineers and pilots felt was the best camera to document his first spaceflight. And, despite the need for some necessary modifications due to the special environment of the spacecraft, engineers and astronauts alike came to agree with Schirra, from that point of making Hasselblads the cameras of choice on all successive U.S. space missions through the end of the space shuttle program in the middle of 2011. This relationship, perhaps the longest lasting between manufacturer and consumer in the space program, came to play a significant role in shaping the cultural legacy of both institutions.

Researching these unique cameras, used nearly fifty years ago, presents a serious challenge to scholars today. Not only have many of the astronaut-photographers passed away (including Walter Schirra, and all but Glenn of the original Mercury Seven at the time of this writing), but so have many of the engineers and technicians employed by NASA and the camera manufacturers. Looking beyond stories of the people involved, the paper trail of their work appears lost for the most part. The official location for NASA's Johnson Space Center archival records, the National Archives center in Ft. Worth, Texas, does not have any materials from the Photographic Technology Laboratory, where films returned from flight were processed. Whether those records fell under federal record regulations remains unclear. The difficulty of finding sources becomes perhaps the greatest challenge to interpreting the story of astronaut photography overall. By balancing information gleaned from oral histories against the moderate amount of primary sources such as mission reports, correspondence and technical information maintained by NASA's Flight Crew Operations Division, one could form a reasonable picture of the way in which NASA selected cameras for spaceflight.

Adding another layer are the cameras themselves, most often in the collections of the Smithsonian National Air and Space Museum, the Kansas Cosmosphere and Space Center in Hutchinson, Kansas, the NASA visitor center at the Kennedy Space Center in Florida, and the Johnson Space Center and the Space Center Houston in Texas. While the first two museums maintain formal accession documentation and transfer paperwork from NASA, the provenance of items in the hands of the NASA centers and their associated for-profit counterparts is less clear. Through the years, many names and descriptions omitted their status as space-flown artifacts. (Figure 36) Locating evidence of their identity is problematic at best, and usually impossible. A long-term goal in my capacity as the responsible curator for astronaut cameras in the National Collection of the National Air and Space Museum is to understand the disposition of these cameras in order to preserve the material legacy of technological choices made for the space program, which supplied a rich visual record of these dramatic moments in human history. Together, the material culture, oral histories, and primary sources enrich our understanding of the importance of astronaut photography to the visual culture of this period of the Cold War and within the history of exploration photography.

Walter Schirra's Hasselblad was hardly the first camera in space, or first hand-held camera for that matter, so it is important to reveal some of the background to photography at NASA leading up to that decision to use Hasselblads exclusively. NASA engineers, going back to the days of the agency in its prior incarnation the National Advisory Committee for Aeronautics (NACA), required the work of photographers to document experimentation with aircraft designs, rocket launches, and other testing centers around the country. Work at the Ames Research Center in Mountain View, California, the Lewis (now Glenn) Research Center in Cleveland, Ohio, the Langley Research Center in Hampton, Virginia, and the Wallops Flight Facility on Wallops Island, Virginia, necessitated thorough visual recording for later analysis. NACA sought out photographers, many with aerial reconnaissance photography experience in World War II, to photograph this work from the ground, and the air. John R. Brinkmann, the lead photographer during this period, described how a group of engineers and photographers would take boats out to Wallops or nearby islands to watch launches directed by Dr. Robert Gilruth, one of NACA's most senior engineers.[141] Other tests photographed included wind tunnel work that employed elaborate photographic systems to show flow rates over objects and burn processes on ablative materials, usually done with fast-motion photography to allow engineers to slow down the frames and see what was occurring (Figure 37).

This cadre of photographers working to document NACA's early experimentation with rockets and spacecraft design transitioned to the new space agency created by President Eisenhower in 1958. Owing to their aeronautical and early spaceflight work at Langley, Brinkmann's Photographic Division was absorbed into the Space Task Group (STG) chaired by Gilruth, and tasked with documenting the effort to make human

[141] Brinkmann, John R. Interviewed by Summer Chick Bergen, March 16, 2001. Interview Transcript, NASA Johnson Space Center Oral History Project, Houston, TX, p. 4.

spaceflight possible. The photographers had just as many new experiences to grapple with in this period of experimentation as the engineers. Eugene Edmonds, an early hire by Brinkmann, recalled new challenges presented to the photographers in his official oral history:

> Well, they'd want everything photographed, so I started out in a helicopter, following these planes up about a thousand feet…. Eventually they got to the point where they developed it to where it was getting nearer the real thing, and then they wanted to start testing it at higher altitude…. And it reached the point where they were going to start firing it off of a rocket up at [NASA Wallops Flight Facility,] Wallops Island, Virginia, and they were going to fire it, say, about ten thousand feet, and they wanted that covered."[142]

The STG's sole purpose became putting Americans in space in the hopes of besting the Soviet Union in the ongoing Cold War space race.[143] After President Kennedy expanded its goals in May 1961 to include a human lunar landing, experienced photographers like Brinkmann, Edmonds, and John Holland picked up shop and moved in 1961/62 with the rest of the STG to their new and permanent home: the Manned Spacecraft Center, then under construction in Houston, Texas.[144]

Examining the stories of these NASA photographers prior to the arrival of the astronauts opens a view into the larger structure of the space program at the time that complicates the Schirra story to some degree. With the move to Houston and increased activities at the Cape Canaveral launch facilities, photographers under Brinkmann's

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[142] Edmonds, Eugene. Interviewed by Sandra Johnson, November 25, 2003. Interview Transcript, NASA Johnson Space Center Oral History Project, Houston, TX, p. 6.

[143] For more on the overall history of the space race, see: Collins, Martin J. *Space Race: The U.S.-U.S.S.R. Competition to Reach the Moon*. San Francisco: Pomegranate, 1999.

[144] The Manned Spacecraft Center was renamed the Lyndon B. Johnson Space Center in 1973 for the former president and champion of the spaceflight cause in Texas, "'Johnson Space Center' Name Now Official." *Los Angeles Times.* February 20, 1973, Part I, p. A14.

charge rarely wanted for work. Between establishing an operational processing laboratory in old airplane hangars at Ellington Air Force Base (near the future site of MSC) and photographing the testing of astronauts at training facilities around the country, the Photographic Division also played a role in suggesting cameras for onboard the spacecraft. Brinkmann describes the managerial and equipment set-up process as the easy part, but putting cameras on the spacecraft as a bit of an unknown to him.[145] He implies that not only was the process of making the spacecraft itself complicated, but also that integrating photography a part of spaceflight would result in a new set of rules, restrictions, and demands. As a professional photographer, he also saw the possibility of disharmony between the needs of NASA engineers (concerned with safety, weight, and tests) and the potentially great influence visual media could have in making spaceflight real for people back on Earth.

Documentation from this period is sadly lacking, as small equipment came about on a more ad hoc basis than the large engineering projects like building the infrastructure to test rocket engines and launch spacecraft. Whether selected by the spacecraft manufacturer (McDonnell Aircraft Corporation of St. Louis, Missouri, in the case of the Mercury and Gemini capsules) or engineers at NASA, small 16mm movie cameras made their way into the design of the first U.S. human spacecraft. The Pilot Observer and Instrument Observer cameras, manufactured by the D.B. Milliken Company of Arcadia, California, recorded just what their names indicate. (Figure 38) For viewing after recovery of the spacecraft, these films showed the pilot’s activities directly and in relation

[145] Brinkmann, Interview transcript, p. 15.

to the instrument panel. As a backup starting with Gus Grissom's *Liberty Bell 7* flight, astronauts wore a circular mirror on their chests so that the Pilot Observer Camera would also record the reflection of the pilot's use of the instrument panel, just in case the Instrument Observer Camera malfunctioned. (Figure 39) Another small camera recorded Alan Shepard's MR-3 flight using a mirror adapter for pointing out a small porthole window of the capsule. The J.A. Maurer-manufactured Earth/Sky Observer captured a series of images at the rate of one frame per six seconds, giving an almost movie-like quality to the entire set of images when viewed in sequence for the entire fifteen-minute flight. (Figure 40) While these sequence cameras operated throughout the Project Mercury flights and the testing for Gemini two-astronaut missions, smaller hand-held 16mm cameras took their place into Projects Gemini and Apollo in order to make the documentation tool more mobile.

In spite of a few random selections for hand-held cameras during the first two orbital flights, Hasselblad was the camera of choice on the final two Mercury flights. Schirra and Gordon Cooper were of one mind in taking a professional camera into orbit – not an "instamatic" as Cooper characterized those used by Glenn and Carpenter.[146] Echoing Schirra's oral history and biography comments, Cooper tells of his life-long interest in photography and dedication to taking professional-quality photographs during his spaceflight in his autobiography, *Leap of Faith*. Characteristic of his notoriously sly nature, he explains, "As I kept shooting pictures, I didn't say anything and stayed quiet in

[146] Cooper, L. Gordon. *Leap of Faith: An Astronaut's Journey Into the Unknown*. New York: HarperCollins, 2002, p. 49.

the cabin, hoping the guys at Mercury Control would think I was asleep."[147] Cooper's attitude here indicates he noticed the reaction to Carpenter's overuse of the camera and planned ahead of time to keep his own photographic work concealed from his superiors.

Other than a modified Hasselblad 500C, Cooper also carried a Robot camera on his Mercury mission. (Figure 41) Like Carpenter's Robot Recorder 36, Cooper's Robot camera (probably the Royal 36 model shown in a mission report pamphlet) was modified, but this time, it was nearly indistinguishable from its commercial form.[148] (Figure 42) Also worth noting here are the measures taken to strip most of these cameras of their brand identities. Other than the Leica carried by Glenn and the Hasselblad carried by Schirra, the cameras have blank exterior surfaces. So as not to appear to favor any particular brand, NASA did its due diligence as a government agency by de-commercializing these technologies. Another notable modification to Cooper's Robot camera, described in the official mission report, are the three red "feet" attached to the right side of the camera. When used in space, Cooper placed the feet against the window over his head to get a steady shot.[149] While the exact need to relocate the film winding mechanism to the bottom of the camera is unclear (the camera is upside down in this view), the camera was operated otherwise as it would be on Earth. A view of the camera's actual top shows the exposure button, exposure counter, a bracket for a flash or

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[147] Ibid.

[148] National Aeronautics and Space Administration. *The Triumph of Astronaut L. Gordon Cooper, Jr. and the Faith 7*. Report #NASA-TM-85532. Houston: NASA, 1963, p. 19.

[149] Up until 2008, this camera was not identified as the Robot camera Cooper used on Faith 7. Documentation from the Museum's registrar's files, consisting largely of transfer documents from NASA, does not note it as such. Following additional research into the camera in mission documents, the added feet, stripped exterior, loss of the original viewfinder, and addition of the larger advance dial make this camera, in all probability, one of two still cameras Cooper used on his Mercury mission.

viewfinder, and a filled-in hole for the original location of the winding mechanism. The addition of a larger dial likely made advancing the film easier for Cooper while wearing his spacesuit gloves.

These early instances of selecting technologies for spaceflight seem more like chance and are evidenced only through anecdote, not through a government contract, purchase orders, or receipts. John Glenn in fact recalls that NASA never even reimbursed him for the Ansco camera.[150] Numerous popular articles, websites, oral histories, and books repeat the stories of the Glenn and Schirra camera purchases with no question as to the reality of the claims.[151] The heroic treatment of the original Mercury astronauts and all astronauts of the pre-Shuttle era leaves no doubt in the minds of most that the originators of photography at NASA were these high-profile personalities. This storyline seems all too easily manufactured. Like the tales of George Washington chopping down a cherry tree or the swaths of other notorious stories of the nation's first president, historians are trained to question such simplistic stories of origination.

Without documentary or artifact proof, however, anecdotes of astronaut camera selection are hard to disprove. Even NASA's own photographic technology staff, particularly Richard Underwood, commonly repeated these stories, reinforcing the legends rather than contradicting them with a counter-narrative giving credit to existing NASA staff photographers, save those two instances. The astronauts themselves do

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[150] Glenn/Carpenter, Interview Transcript, p. 3.

[151] See examples of this in: Van Riper, Frank. "Space Cameras: From Ansco to Hassy to Digital." Washington Post. October 23, 2003; Hasselblad website: http://www.hasselbladusa.com/about-hasselblad/hasselblad-in-space/space-cameras.aspx (accessed November 3, 2014); Pearlman, Robert. "Sigma 7 at 50: Retro Space Images Recall 5th U.S. Spaceflight." *Space.com*. October 3, 2012.

frequently credit two individuals from outside the astronaut corps with influencing their understanding of photography and cameras. Ralph Morse, *Life* magazine's photographer for the early days of the space program, not only photographed the astronauts but also consulted with them about photography and cameras, earning the nickname of the "eighth astronaut" for his close relationship with them. The other was Bill Taub.

Head photographer at NASA for many decades, Taub participated in documenting early astronaut activities so closely that he was affectionately called "Two More Taub" for his constant requests to the astronauts for more photos.[152] Taub, an amateur photographer who began his career with NACA at 17 years old in the early 1940s, was widely known across NACA, and later NASA, for his artistic shots of the wind tunnels at Langley. First employed as a model maker and draftsman, his artistic background, and apparent inability to mesh well with the Photographic Lab staff, put him in a position to work nearly independently on photographing the Mercury astronauts, shooting with little to no direction from his superiors.[153] Taub's lasting impact on the memories of the surviving astronauts from this program imparts a sense of closeness and trust between the photographer and astronaut. Taub, along with respected photographer friends from *National Geographic* (probably Dean Conger and Luis Marden, who Wally Schirra also cited as photographer friends), formed bonds with the astronauts as they all continued to photograph some of the more intimate and personal moments the first seven astronauts experienced in their preparations for spaceflight. While it can only be inferred from these

[152] Glenn/Carpenter, Interview Transcript, p. 6.

[153] Taub, William P. Interviewed by Sandra Johnson, November 8, 2006. Interview Transcript, NASA Johnson Space Center Oral History Project, Houston, TX, p. 12.

references, these professional photographers must have played some role in preparing astronauts Glenn, Carpenter, Schirra, and Cooper for their camera work in space.

While Mercury astronauts did communicate with familiar photographers and NASA staff photographers during their training, it appears to have amounted to no more than camera operation tips and general thoughts on photography at the earliest stages of hand-held cameras for still photography in space. Time allotted to photography in mission planning was minimal, so the public and scientific audiences for images happily accepted any images offered as evidence of the spaceflight experience. The lasting impact of experienced professional photographers on the space program comes in motivating the astronauts to take photography as more than just a science experiment. And despite the objections of NASA managers at the time, photography became a crucial task during missions, providing the rich visual record of human space exploration that people rely on for their memories of the early U.S. space program.

Focus on Hasselblad: Professional Cameras for Professional Astronauts

For a program that touted its "all-American" character from the beginning, using an international source of technology seems puzzling, and a noteworthy exception to the standard procedures for U.S. government procurement. Common American-made camera brands available on the commercial market at the time included Ansco, Argus, Graflex, and Kodak, amongst an even wider range of internationally-produced brands, but something about Hasselblad made it the mainstay of the U.S. space program from Project Mercury though the entirety of the space shuttle program. It is important to explore not only the history of the Hasselblad brand and its decades-long connection to NASA, but also the impact such a choice made on the images returned from space. How did the experiences of astronauts Schirra and Cooper make it so easy for NASA to overlook other (American) camera manufacturers in favor of the Swedish Hasselblad? What did each entity gain by making concessions on the production of the cameras that resulted in such a lasting association? This relationship, ongoing through the present day, represents the most enduring and perhaps most culturally influential technological choice NASA made in the early days of the space program.

No serious scholarship is devoted to exploring the relationship between the aerospace industry and contractors for photographic technology, and relatively few scholars even mention it as a technological element of the space program.[154] In the case of NASA and its selection of Hasselblad and other manufacturers for space-worthy products, even less exists to substantiate the popular works that chronicle this Swedish-American partnership or the cultural significance of using non-American technologies to depict space exploration by humans. Interestingly, the book *Dark Moon* aimed to refute the truth of the lunar landings with image analysis in the first chapter, “Photo Call.” The authors spend nearly all of the first one hundred pages detailing the supposed lies perpetrated by NASA, the astronauts, and engineers from Hasselblad and other corporations involved in making camera equipment for the space program, both in terms

[154] The most detailed work, which is more about technology than serious historical examination, is Dwight Steven-Boniecki, *Live TV From the Moon* (Burlington, ON: Apogee Books, 2010). Major works on space technology such as McDougall, …*The Heavens and the Earth: A Political History of the Space Age*. do not mention cameras other than in a passing fashion. Robert Poole’s *Earthrise* is one of the first to engage with the images on a scholarly level.

of inadequate technology and purposeful handiwork with processing.[155] The supposed scientific nature of their examinations of the photography is laughable, and barely worthy of a mention here as it lacks all markers of serious scholarship. On its own website, the Hasselblad Company spends a number of pages and images on explaining its own history and the formation of its most fruitful partnership.[156]

While known throughout the late nineteenth century as the largest photographic supply company in Sweden, the Hasselblad family only began manufacturing cameras at the beginning of World War II. The Gothenburg-based family's connection to photography started with the importing of photographic equipment and supplies in the 1840s, not long after Daguerre's announcement of his process in Paris in 1839. The family business, F.W. Hasselblad & Co., built mostly as an import-export operation in the port city, found a niche market opportunity with photographic equipment and early operations ensured they became the top photographic supply chain in Sweden for nearly a century. It was not until a few decades later, after establishing itself as a supply chain for photographic materials imported from around Europe, that the Hasselblad family formed a corporate relationship to take their business across an ocean and distinguish itself from other camera shops in Sweden.

According to the company's own historical narrative, Arvid Viktor Hasselblad, son of the founder of the family business and an amateur photographer, happened to meet George Eastman while Hasselblad was touring London on his honeymoon. The fortuitous

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[155] Bennett, Mary and David Percy. *Dark Moon: Apollo and the Whistle-Blowers*. Kempton, IL: Adventures Unlimited Press, 2001, p. 7-76.

[156] Hasselblad website, http://www.hasselbladusa.com/, accessed August 12, 2011.

meeting for the Hasselblad family evolved into a business arrangement that allowed the Hasselblad's photographic supply chain to become the sole distributor for Kodak products in Sweden for over 80 years. This relationship was advantageous for both sides in that it allowed Kodak a simple access point to supply the growing numbers of Swedish amateur and professional photographers as technology got easier to use and more affordable in the late nineteenth century, appealing to a wider consumer market in the twentieth century. For the Hasselblads, the opportunity allowed their business to expand exponentially with access to the U.S. market, prompting the company to split off its photographic division, Hasselblad's Fotografiska AB, from the remainder of the import/export business in 1908. Based on a simple handshake between Eastman and Hasselblad in 1888, the companies linked their business efforts, allowing Hasselblad easy access to the American camera market when their commercial manufacturing division began work after the close of World War II.

As the company continued in its photographic supply capacity through the early twentieth century, Arvid's grandson Victor Hasselblad, born in 1906, had an unconventional upbringing, even by European standards. In his teen years, his father removed him from school in order to travel the world and learn about photography. Through their corporate connections, the Hasselblads sent Victor first to his grandfather's American friend, George Eastman. Eastman mentored Victor in film processing and other specialties, and sent Victor on a worldwide expedition to meet with other companies and learn their time-tested manufacturing techniques. Victor then decided to make his own way in the world – apart from his family's distribution business – by opening up a camera shop in Sweden, continuing his education and that of others by publishing technical articles on photography.

The connection between Hasselblads and aerial observation, and therefore the company's later dedication to providing high quality equipment for the space program, stems from Victor's first entry into camera manufacturing. His knowledge of photographic techniques became known around Sweden and caught the attention of the Swedish air force during World War II. When it recovered a downed German reconnaissance aircraft, the air force enlisted Victor to help them understand the camera found onboard.[157] In hopes of beginning their own photographic reconnaissance work, the air force paid Hasselblad to develop a camera for them, eventually known as the HK 7, the very first Hasselblad-built camera. Quickly, Victor's company grew to twenty employees, many of whom were auto mechanics and local watchmakers. Their knowledge of metals and precision work instantly gave the cameras a level of respectability for the intricate mechanisms, which also had its drawbacks. The hand-held HK 7, a 7 x 9cm format camera that used interchangeable lenses and 80mm film, was quite fragile due to the delicate work that also made them so unique. The Swedish air force, however, purchased 342 of Hasselblad's cameras from a product line that included the small HK 7 and the SKa4, a model specifically for mounting inside a reconnaissance airplane.

The death of Victor's father Karl Erik early in the war permitted him to claim a majority stake in the family's main distribution business. At such a perilous time for new

[157] This event is noteworthy historically since Sweden remained neutral during the war.

businesses, Victor found stability with the F.W. Hasselblad Company. The newfound sense of stability allowed him to take a risk by entering the commercial camera market. Before the end of the war, Victor had plans for continuing camera production while supporting it with the retail operations as well as the production of clocks and watches by the men hired to produce the military cameras. Just three short years after the end of the war in Europe, Hasselblad had an operational, commercially-viable camera, and quite naturally to Victor, it was announced where he knew it would gain the most attention: at a New York City press conference. That old connection with the Eastman family and the Kodak Company left the door to the American market wide open, and the first commercial model, the 1600F, made a splash amongst professional photographers (Figure 43).

Introduced in 1948, this single lens, mirror reflex, 6 x 6cm medium format camera was of incredibly high-quality and precision, but quite delicate and it malfunctioned easily. Hasselblad did ensure, however, flexibility of use by designing a camera with the options of changing lenses, viewfinders, and film magazines very easily. To overcome the delicate nature of the 1600F, a revised version, the 1000F, entered the market in 1953, improving on many of the flaws of the 1600F (Figure 44). Leading up to its release to the public, the magazine *Modern Photography* undertook extensive field tests of the camera, which proved the cameras durability and reliability.[158] They ran nearly 500 rolls of film through a single camera, and dropped it twice, without finding a single problem. With this success, Hasselblad began an intensive media campaign through popular professional

[158] "The Two New Hasselblads." *Modern Photography*. December 1954, p. 72-77, 124-125.

photography magazines to extol the virtues of the 1000F, and soon to follow Supreme Wide Angle (SWA), 500C, and Super Wide Camera (SWC) models of the 1950s.

This is where the stories of camera manufacturer and fledgling space program meet. Not long after the SWA (1954), 500C (1957), and SWC (1959) models entered the market, some in the new exploration program in the United States took notice of the highly respected Swedish-made camera. Regardless of who brought the camera to the attention of NASA managers and equipment specialists, the Hasselblad Company's operating philosophy of creating cameras with "modularity, versatility, and reliability," would be quite attractive to anyone seeking equipment that needed to function flawlessly in a relatively untested and unknown environment. Their advertising campaigns highlighted this mantra, and spun it in a way that makes the appeal of the brand to NASA quite clear. (Figure 45) Later, Hasselblad played up the success and cohesiveness with NASA's needs to advertise themselves as the most flexible camera manufacturers. (Figure 46) The second ad leaves the options open to the buyer, a role rarely given to personal technology consumer before the age of personal computers and software options.[159]

Both NASA and Hasselblad had reason for caution as development of the cameras proceeded since the microgravity, low oxygen, and varied temperature environs of space and technical requirements for spacecraft launches meant that the cameras required significant modifications. These known problems included mitigating issues of off-

[159] Paul Ceruzzi explains the expansion of options in personal computing that opened up in the 1980s, and in software for them not until 1990. Ceruzzi, Paul E. *A History of Modern Computing*. Cambridge: MIT Press, 2003, p. 9, 96.

gassing, heat, weight, lubricants, and operations. Realizing the value of developing a relationship through such a project, Victor Hasselblad and other company representatives apparently took all necessary measures to modify their cameras for safe operation inside and outside a space vehicle. As the professional relationship (and personal as it turns out – Victor and his wife became good friends with a number of astronauts) developed, so did the manner in which the modifications occurred.

From the start, one of the more fashionable features of cameras – at least in the late 1950s – raised concerns at NASA. For Schirra's mission, technicians stripped the camera of its leatherette coverings to avoid any off gassing inside the small Mercury capsule, apparently by a Pan American laboratory near Cape Canaveral. This rather ad hoc solution, while understandable during Project Mercury, a period of developing hundreds of new technologies, became an easier fix for when NASA worked directly with Hasselblad on cameras for Gemini and Apollo.[160] Engineers at Hasselblad by that time would later manufacture all NASA cameras without such coverings.

While removing the camera's coverings minimized the concerns of adhesives and other materials off gassing into the spacecraft environment was easily tackled, minimizing the weight of the cameras required more creativity at Hasselblad and their engineering counterparts at NASA. In assessing the cameras, engineers at NASA and Hasselblad determined that some normally critical elements of the camera's structure needed removal or alteration in order to make them as light as possible. In spaceflight, every gram of weight is counted because a proportional amount of fuel is required to lift

[160] Bartman, "Photographer Built Camera for Glenn's Flight."

that item into orbit and beyond. By agreeing to construct the camera case using lighter metals, Hasselblad opened up their design and manufacturing process to significant change. Engineers also determined that removing typical parts such as the mirror, focusing screen, hood, and case linings meant less weight and they were not required for space operation. (Figure 47) As there would be no way for the helmeted astronaut to look through a small area to view the possible image, the mirror used to bounce the image from the lens to the viewfinder was unnecessary, as was the viewfinder itself. To make up for the loss of the viewfinder, part of the astronaut training program included how to aim the camera without such help.

Operation of a camera in space turned out to be a different process than on Earth, and that unique environment forced engineers to find a new way to lubricate the camera's internal mechanisms. NASA discovered that Hasselblad's recommended lubricants used for consumer cameras on Earth, Isoflex Topas L 32 (grease) and Isoflex PDP 48 (oil), would evaporate or solidify in the vast temperature swings of space. The use of an alternative, a synthetic material requested by NASA, meant that the astronauts did not need to maintain the cameras during the mission, and minimized the risk that cameras would jam during operation. It was not a perfect process, but vacuum chamber testing meant that the cameras were prepared as close to the right configuration for space operation as possible.

To minimize the influence of the sometimes-high temperature environment of space of the lunar surface, Hasselblad switched the black metal camera box to silver to reflect more of the sun's heat. Temperature swings on the Moon were vast, going from

120° C during the day to -150° C at night. By using aluminum-covered or silver painted surfaces on equipment intended for use on the lunar surface, NASA avoided potential heating issues with cameras and scientific experiments.

Finally, the dials, switches, and buttons on the camera underwent modification. Enlarging them made operation by astronauts easier when wearing bulky spacesuit gloves. This rather extensive set of modifications to such well-respected equipment proved the responsiveness of Hasselblad to what they quickly acknowledged to be not only an outstanding means for promoting their products, but also a means of establishing their brand as part of a historic American program.

The prominent role Hasselblad played in NASA's astronaut photography program cannot be overlooked for its trans-Atlantic nature as well. Long touted as an American program based on American ingenuity and technology, NASA's human spaceflight efforts notably passed over American camera manufacturers as well as those from Japan and other parts of Europe in favor of this relatively recent addition to the camera market. What can be understood from this unusual diversion from the very pro-American spirit of the early three space programs is the willingness of NASA to acknowledge just where to find the best quality equipment regardless of country of origin. For decades, lenses from Germany and France were known to employ the best optical engineering methods to create products respected around the world. Restrictions did (and still do) exist, however, for the purchase of products by the U.S. government from international companies.[161] Conveniently, NASA worked around this issue in two ways: by proving through testing

[161] Buy American Act of 1933, 41 U.S.C. § 8302, signed by President Herbert Hoover and kept current through Public Law 112-283.

that the Hasselblad was a superior product to accomplish the tasks required (an exception allowable through the law), and by working with a purchasing agent in the United States, Paillard, Inc. of Linden, New Jersey, so that it became an indirect purchase that still supported American businesses.[162] But for scientific, engineering, and promotional purposes, NASA could not afford to miss any opportunity to record each unique mission. They simply selected the best available technology to produce (thanks also to additional work by the Kodak Company to create space-friendly film) some of the most iconic images of the twentieth century. Involvement in the second NASA human spaceflight program gave Hasselblad the opportunity to develop their products specifically for a space environment.

Gemini

Gemini program decision-making in preparation for Apollo followed a more rigorous path than that taken for the Mercury program at NASA. By the time of the last four Gemini missions in 1966, departments across the Manned Spacecraft Center in Houston were researching the next generation of cameras astronauts would employ to capture the stunning images of Project Apollo. With extended mission length during Gemini, an additional crewmember, and more space for storage, the types of cameras examined for different types of photography, both commercial and developed specifically for spaceflight, also increased substantially. Managing the research and responsibilities amongst a larger set of interested offices at NASA meant increased organization and

[162] For a contemporary perspective on the benefits of involvement in the space program, see: Perez, Renato. "Prestige is High in Space Photos." *New York Times*, September 25, 1966: 162.

management so as not to duplicate efforts or expend funding needlessly, as well as identify appropriate lines of communication and responsibility across the center.

Camera equipment documentation reflects the efforts of managers and engineers to develop versatile equipment to function for multiple experiments. Within that desire did lay, however, a measure of reason. When putting the possibilities on the table, as scientists and engineers did when selecting cameras for Gemini missions, they recognized the need to balance between flexibility and the constraints of the spacecraft, finding that, "use of an all-purpose camera to satisfy several needs on one flight necessitate building a larger, heavier system than any one experiment by itself would require."[163] And making anything for space larger or heavier was normally not an option. Getting experiments to conform to fewer available pieces of equipment, modifying those to satisfy more realistic experiment goals, may have resulted in some experiments being cancelled or changed, but it largely allowed interested audiences to gather the needed photographic data.

Planning for increased photographic experiments developed long before missions took place, but documents are lacking in establishing the initial decisions about which cameras to employ for Gemini. According to a November 1964 memorandum, some five months before the launch of Gemini 3 (March 23, 1965), meetings held in October and November between interested scientists, NASA engineers, and Department of Defense (DoD) parties took place to locate any common needs in order to minimize the amount of photographic equipment needed on each mission. Other than aligning experiments with

[163] Gill, Jocelyn R. Memorandum to Science Mission Director. November 10, 1964. Johnson Space Center History Collection, Record #22741. Location 075-13. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

the available cameras, the 70mm Hasselblad (Figure 49) and what NASA termed the "MSC 70mm camera" (a J.A. Maurer-developed camera, Figure 50) they also found instances when experiment results would align with PAO requirements: "It was concluded that the requirements for synoptic terrain and weather photography fitted well with the Public Information Office requirements for still photography…."[164] While not ready for use until the complex missions of Gemini IX-A in June 1966, the Maurer camera became one of only two non-Hasselblad still cameras used during the Apollo lead-in program (the other being a Zeiss Contarex model used on the Gemini IV, V, and VII). (Figure 48) Unlike the time of technological experimentation during Project Mercury, the selection of cameras at NASA for the somewhat enlarged capsule and extended missions of Gemini required additional consideration for efficient packing and timeline planning.

Following Robert Gilruth's support in the wake of the Gemini IV images, photographic efforts during Gemini missions did increase, and quickly. Press kit information for the next mission, Gemini V, with Gordon Cooper commanding and Charles "Pete" Conrad as pilot, shows the number of photographic experiments for scientific, technological, and military purposes doubled with nearly twice as much time on-orbit than Gemini IV.[165] And while the press kits for Gemini IV and V reflect a repetition of experiments using nearly identical language, the mission time allotted to photographic work the astronauts undertook increased significantly, as did the secretive

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[164] Gill Memorandum. November 10, 1964. Record #22741. Location 075-13.

[165] *Gemini Program Mission Report: Gemini V*, Report #MSC-G-R-65-4. Houston: NASA, October 1, 1965, p. 8-1 to 8-48.

nature of their work. Some of the added photographic work for Gemini V came at the request of the DoD. According to mission commander Gordon Cooper, veteran of the final Mercury mission, the increase in work resulted in an increase in the types and number of cameras available in the spacecraft. In his autobiography, *Leap of Faith*, and his official NASA oral history, Cooper recounts feeling as though their small cabin felt filled to the brim with nearly twenty different cameras, handing the astronauts responsibility for a tremendous amount and variety of photographic experiments.[166] While perhaps feeling overwhelmed by camera equipment, Cooper illuminates, through this statement, the shift in focus stressed by Gilruth in his statement to Richard Underwood about the astronauts bringing home spectacular photographs, presumably for public consumption. What the press kits and mission documents do not specifically support, however, is just that: how NASA planned to use the photographs collected. The assignment of photography experiment code numbers according to the type of project indicates that particular audiences existed for the images, but not what intermediary steps NASA took to review, select, and disseminate photographs for publicity purposes.

Training astronauts for mission work unrelated to spacecraft operation consumed far more time than one might expect from the lack of direct documentation on training available. Gemini mission reports reflect a number of broad categories summarizing the preparations and experiences of each mission. Included in this post-flight documentation are descriptions of the briefings and training given for mission experiments including the

[166] Mission records reflect fewer cameras onboard Gemini V than Cooper recalls, around three or four with a number of special lenses: Cooper, p. 129-130; Cooper, L. Gordon Jr. Interviewed by Roy Neal, May 21, 1998. Interview Transcript, NASA Johnson Space Center Oral History Project, Houston, TX, p. 24.

biomedical, optical, photographic, and scientific experiments. The breadth of these sections shows the degree to which crew time, as a portion of overall training, was spent preparing for experiments. (Table 1)

From this table, we see quite clearly that experiment training decreased over the course of the Gemini program, while the number of experiments remained relatively steady but dependent on the expected mission duration. The proportion of photographic experiments to experiments overall remained relatively constant, going from no portion of the experiment work on Gemini 3 to a high point of 66% of the work on Gemini VI-A. Nothing, however, indicates that photographic training for any of the experiments was proportional to the time spent in training since there are no records that reveal enough detail about training time to make any kind of judgment as to the relative priorities given to one type of experiment over another.

For Project Gemini at least, the management's perspective was that photography was an integrated part of mission time reserved for experiments. These projects, steered by technical staff at MSC, scientists, and DoD offices, offered up designations for the experiments based on their origin; "MSC" for those originating at NASA, "S" followed by a number if from the scientific community, and "D" followed by a number if requested by the DoD. In a report summarizing the DoD experiments, of the sixteen the department requested and had flown, only three were photographic in nature and all of those were only attempted on Gemini V.[167] While the DoD continued with other experiment types on later missions, perhaps this lack of interest in continued

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[167] Ballentine, Wilbur A. "DoD/NASA Gemini Experiments Summary." In *Gemini Summary Conference* Proceedings. February 1-2, 1967, SP-138. Washington, D.C.: NASA, 1967, p. 309.

photographic work is linked to the realization that their photoreconnaissance satellites remained the preferred method for observations. The insertion of other people between image collection and processing certainly complicated matters.[168]

As the first true foray into integrating photographic training and planning into the larger mission of astronauts, Project Gemini focused considerable attention on preparation. Training always consumed copious hours prior to flights, and although the experiment portion of that somewhat naturally declined over the course of the short Gemini program, that reflects a ramping up of the complexity of preparations for Apollo mission requirements. Handling cameras and small equipment became more natural as astronauts trained more and made repeat trips to space, but they needed to divert attention to activities such as extra-vehicular work, rendezvous and docking, and intricate spacecraft maneuvers. What did not decrease was the amount of photography completed during the program. That, in fact, increased in its proportion of total experiments with the total number of frames captured coming close to 500 during the Gemini XII mission in late 1966. [169] By that time, photographic information no longer came from experiments alone. Astronauts had more freedom to capture images termed targets of opportunity, those of general interest, or moments found by astronauts to contain some particular information or experience they wished to capture on film. This freedom to move beyond the bounds of experimentation and into a place where astronauts took some small

[168] David, p. 185–193.

[169] By the time of the final mission report, for Gemini XII, tables for photographic data results show a breakdown between experiment photography and other types of photography, with the vast majority of images being general interest and not related to experiment work. *Gemini XII Mission Report*, Report #MSC-G-R-67-1. Houston: NASA, 1967, p. 12-26.

measure of time to consider their photographic work shows a transition in their role from simply recorders to astronaut-photographers.

Apollo

With a goal as monumental as reaching the Moon in less than a decade, preparations for every aspect of the lunar program required attention even before Project Gemini ever began. Mercury astronauts and supportive engineers brought hand-held photography into an accepted position as part of astronaut performance and mission reporting, making it a formalized part of Gemini mission planning. Preparing for the unique character of the Moon, however, required special consideration for nearly every item astronauts needed. In early 1964, engineers from MSC's Advanced Spacecraft Technology Division (ASTD) and the Instrumentation and Electronic Systems Division (IESD) were already hard at work with photographers from John Brinkmann's Photographic Technology Division (PTD, later PTL) to discuss development of a lunar hand-held camera. The seventeen-page statement of work and design document not only details precise requirements for a camera for use on the lunar surface, but also takes the somewhat surprising position of recommending a single stereographic camera for the entirety of astronaut lunar photography.[170]

Terminology used in discussing the goals of photographic work, again, tend towards pragmatic issues of cost, reliability, suitability, modifications needed, and weight

[170] Melliff, Vernon C. Memorandum for the Record. February 28, 1964. Johnson Space Center History Collection, Record #27201. Location 075-15. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

and volume considerations.[171] Such discussion, while originating at lower levels of the organization, even when about seemingly mundane details such as what manufacturers to choose and the extent to which cameras needed modification for flight use were details considered important at the highest level of management at the primary center for human spaceflight. Suggested in Slayton's memo to Gilruth was the formation of a committee to make decisions about camera selection and priorities, the Camera Review Board, formally created by order of George Low, MSC deputy director, on July 15, 1966.[172] The board's initial membership included Robert Gilruth's special assistant, Paul Purser, as chairperson, plus representatives from the Photographic Technology Laboratory (PTL, John Brinkmann), Instrumentation and Electronic Systems (IESD, Myron Curtner), the Experiments Program (EPO, Fred Pearce), Flight Crew Support (FCSD, Helmut Kuehnel), Space Sciences (SSD, George Bonner), and Public Affairs (PAO, Andrew Sea). While Slayton's initial suggestion of the board did not include a public affairs staff member, Low's revision to include such a representative indicates his and upper management's awareness of the need for a member of this board to act on behalf of the agency's image and public needs.

Still, the primary responsibility for camera selection ended up in the hands of the Instrumentation and Electronic Systems Division (IESD), despite Slayton's explicit objection that, "operational requirements, human factors, crew training, and management,

[171] Slayton, Donald K. Memorandum to Robert Gilruth. May 17, 1966. Johnson Space Center History Collection, Record #27201. Location 075-15. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[172] Purser, Paul. Memorandum through George Low to Robert Gilruth. January 24, 1968. Johnson Space Center History Collection, Record #32389. Location 075-24. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

development, and procurement of crew operational photographic equipment," remain a responsibility of the Flight Crew Systems Division.[173] As the only dissenter to the late 1967 revision of the Camera Development Review Board's charter, Slayton made a claim on these tasks for his division. This could indicate an ongoing difficulty in communications between Flight Crew Support and Instrumentation and Electronics, a conflict made clear going back to the initial meeting of an Ad Hoc version of the board prior to its formal establishment. Paul Purser's notes from that initial meeting on June 9, 1966, included comments about IESD being, "handicapped in their camera development work," because of insufficient communications on camera requirements. More specifically, Purser suggested that, "IESD and FCSD should develop closer working relations and interchange of information on flight crew camera requirements."[174] Whether this shortfall in communications early on resolved itself, it appears the firm decision of most at MSC that IESD manage, "the development and provisioning of all photographic instrumentation," per the final version of the Camera Review Board's charter from September 8, 1967. Despite any actual control of the research, development, and procurement held by IESD, documents from well into 1968 from Warren North, chief of FCSD, to the Systems Engineering branch of IESD responsible for camera work indicate the strong influence of preferences within FCSD. North lists specific pieces of equipment and technical specifications for parts of the Hasselblad system needed for

[173] Slayton, Donald K. Document Review Memorandum to Jim Marsh. October 31, 1967. Johnson Space Center History Collection, Record #32389. Location 075-24. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[174] Purser, Paul. Memorandum for the Record. June 13, 1966. Johnson Space Center History Collection, Record #27389. Location 075-15. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

lunar photography from the Command Module (CM), strongly recommending their purchase for greater cost effectiveness and weight savings.[175]

Hasselblads were far from the only piece of camera equipment on board Apollo spacecraft, so photographic training and mission time included the competing interests of still and television imaging during Apollo. The ability of television camera manufacturers like RCA and Westinghouse to miniaturize studio camera technology for use inside and outside space vehicles prioritized this expanding medium's immediacy for the public relations.[176] And while working with television cameras added a layer of complexity to mission timelines, [177] still photography proceeded with relatively little difficulty. Kodak provided a thin base film to maximize the number of frames available in each film magazine, reducing the number of magazines needed during flight. Flight Crew Support staff such as Jeff Bremer recall this as one of the most advantageous elements of Apollo still photography. It maximized the exposures per roll, but it did make for quite tricky processing by the photo lab.[178] In fact, PTL chief John Brinkmann pushed for a number of technical elements that would maximize the amount of photographic information, for the scientific, technical, and public audiences, requiring prioritization of selecting

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[175] North, Warren J. Memorandum to Systems Engineering Chief (Peckham). May 15, 1968. Johnson Space Center History Collection, Record #33470. Location 069-63. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[176] Steven-Boniecki, p. 18.

[177] The conflict between astronauts and television work was most infamously experienced during the Apollo 7 mission when the crew refused to complete a live television broadcast because of their packed schedule. Commander Walter Schirra led what some at NASA termed a mutiny by insisting his crew rest and not perform unscheduled broadcasts. Schirra, p. 202.

[178] Jeff Bremer, Email response to interview questions from the author, August 14, 2012, p. 2.

specialized cameras and films.[179] He stated that: "the PTL recommends that the Apollo Spacecraft Program place a high priority on securing a maximum volume of photography. Film is light in weight per unit (about 1 gram) and has a great scientific impact per unit."[180] From the professional, image processing side of the house at NASA, there was strong support for having high quality equipment and adequate time dedicated to the work in order to make a significant impact with images.

According to Mr. Bremer, the technician responsible for procurement, flight-testing, and qualification for each Hasselblad, the relationship between NASA and Hasselblad was mutually beneficial. After some issues with contractors during Gemini for the film magazines, Paillard and Hasselblad stepped in during Apollo to provide NASA with technical support throughout. Mr. Bremer recalls that:

> We had a wonderful relationship. At that time, NASA was writing fixed price contracts, no incentives, no extra profits. We never had any cost overruns. We learned that Victor Hasselblad, the founder and owner of the company, had a great interest in the U.S. space program and he committed any and all of his resources to make our equipment. He set up separate assembly lines and parts bins and inspectors for our equipment.[181]

At least in preparing cameras for missions, the design, manufacture, and preparation appears to have been quite smooth. Once in space, however, it came down to the training of astronauts and their ability to overcome difficulties and capture desired images that

[179] Brinkmann, John. Memorandum to Chief, Systems Engineering Division, Through the Director of Administration. May 13, 1968. Johnson Space Center History Collection, Record #33430. Location 069-62. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[180] Brinkmann Memo, May 13, 1968. Record #33430. Location 069-62, p. 3. Underlining from original document.

[181] Bremer interview, p. 4.

determined the ultimate success or failure of selecting a single manufacturer's cameras for all still photography.

With the Hasselblad reconfirmed as the camera of choice for the Apollo program generally and on the lunar surface in a slightly modified form, astronauts could begin, or, in the case of astronauts who flew during Gemini, continue to train for photographic work during their space flights. As expected, with another crewmember, additional technical elements to the mission, and more flight time, the need for photographic documentation also increased. In August 1967, for the first time in the U.S. space program, FCO Director Deke Slayton made a formal request for astronaut training in photography. A memo from Slayton to an administrator in charge of contracts and procurements requested that a formal Request for Proposal, "…be issued for the development and presentation of an astronaut general photography training course," outlined in an attached document.[182] The request continued to outline primary and secondary purposes for the course. These span from the priorities of learning photographic basics and making in-flight decisions about photographic situations to the less important needs of learning the effects of radiation on films, preparation of a self-guide on photography, and giving the flight crew support staff the appropriate information on how to continue preparing astronauts for photography.

Though Slayton's request appears somewhat generated out of thin air because it referenced no preceding events, requests, or studies, the timing makes more sense if a

[182] Slayton, Deke. Memorandum to Procurement and Contracts Division, Attn: L.G. Damewood. August 22, 1967. Johnson Space Center History Collection, Record #30818. Location 075-22. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

study completed just a few weeks prior prompted his action. At a conference regarding lunar science and exploration directed by Wilmot N. Hess, the Apollo Program Director for Science and Applications, one element of the study, as summarized in Appendix B of the report, addresses the importance of adequate photographic training for astronauts. A subset of scientists and photographic experts, including future Moonwalker Harrison Schmitt, Polaroid camera inventor Edwin Land, geologist Eugene Shoemaker, and astrophysicist Thomas Gold recommended techniques, technology, and training for lunar photography. Specifically, the panel suggested that:

> …potential astronauts for the Apollo lunar landing missions be especially trained in photography, generally, and in particular, in the use of the Hasselblad camera for early Apollo missions. The astronauts should be given Hasselblad cameras with viewfinders similar to those to be used on the Moon. They should be encouraged to take many pictures of their everyday activities and surroundings. These pictures should be extensively criticized by an expert who would give each participant constructive advice. Such a program will help instill an instinct for good documentary pictures on the lunar surface."[183]

Follow-up meetings through the fall of 1967 and early 1968 by the subpanel reflect an ongoing discussion and encouragement of increased photographic work by astronauts to complement the needs of scientists and the general public.

Based on the timeline established in Slayton's request, the possible three-day course consisting of approximately twenty lecture hours, would educate astronauts by the fall of 1967, and provide self-study materials for those brought into the program later. The statement of work identifies Helmet Kuehnel as the project manager with Jeff

[183] Hess, Wilmot N., *1967 Summer Study of Lunar Science and Exploration*, NASA SP-157. Washington, D.C.: NASA, 1967, p. 398. NASA Historical Research Collection, NASA Headquarters, Folder #012443.

Bremer and R. Thompson of the FCSD as the technical monitors for the contract.[184] In an interview with Mr. Bremer in 2012, he confirmed the utility of the course as it was given, stating that, "The crew response to my setup of classes was terrific. They really like[d] the way we presented the way to adjust the exposure settings for each type of picture i.e. desert, ocean, cities, farmland, etc."[185] By all accounts, primarily from the astronauts themselves, handling photographic equipment posed no great difficulty to them, and they felt well trained for that element of mission work. Apollo 15 Command Module Pilot (CMP) Al Worden, selected for the astronaut corps in April 1966, described his transformation from complete beginner to proficient photographer with this statement:

> I first became interested in photography when I was the backup Command Module Pilot (CMP) for Apollo 12…. As [Dick Gordon's] backup I needed to become familiar with his flight plan and the experiments he was to perform. That meant that I should become familiar with the camera and the photography called for in the flight plan. I discovered that as I became comfortable with the camera and the photos I took, I started to enjoy the process of taking photos and improving my technique with time…, but because it was so enjoyable and satisfying, I worked very hard on my own to become proficient.[186]

Though Worden did not recall the training course designed by Jeff Bremer and the FCSD staff, he expressed no concern over the support from NASA in his effort to prepare for mission photography for Apollo 15. In fact, by the time of his flight, and entirely new photographic project was added to his list of work: detailed lunar observations via his hand-held camera in conjunction with a large format metric camera and panoramic

[184] Slayton Memo. August 22, 1967. Record #30818. Location 075-22, p. 7.

[185] Bremer, Jeff. Email response to interview questions. August 14, 2012, p. 5.

[186] Worden, Alfred. Email response to interview questions. August 10, 2012, p. 1.

camera installed inside the Service Module (SM) of the spacecraft.[187] Worden became the first CM pilot to make a trans-lunar extra-vehicular spacewalk to retrieve those rolls of film, later studied by geographers and scientists to create detailed maps of the lunar surface.

As with virtually every process and procedure planned for space missions, the steps not only required hours of training and time in simulators for pre-flight practice, but also a set printed documents for in-flight use. Procedure manuals offered astronauts a written set of checklists and reminders on each step of the mission, making spaceflight more like scripted acting than an engineering accomplishment. Operating cameras and other equipment became part of the same scripts, or in some cases, required entirely separate documents due to the sheer volume of work. For each Apollo mission, a photographic plan complete with predetermined camera settings, expected mission elapsed times, and target listings prepared astronauts prior to flights. For the flight documentation carried in the spacecraft, those plans and technical details were distilled down into small notations in the official flight timelines embedded in portable flight plans and checklists. (Figure 51)

Astronauts, however, with their independent and motivated personalities, learned enough from their photographic training to avoid sticking strictly to these mission scripts when they found a strategic opportunity to change elements of the mission plan to accommodate photography or felt some visual inspiration. Within moments of putting his

[187] El-Baz, Farouk. "Training Apollo Astronauts in Lunar Orbital Observations and Photography." In *Analogs for Planetary Exploration*, W. Brent Garry and Jacob E. Bleacher, eds. Geological Society of America, 2011, p. 49–66.

boot prints onto the lunar surface, Neil Armstrong, known for his deliberate and cautious work as an astronaut, snapped numerous photographs with his Hasselblad Electronic Data Camera before collecting the single contingency sample required in the mission plan as his first lunar activity.[188] Pressured by Mission Control and Lunar Module Pilot Aldrin for not proceeding first to the sample, Armstrong wrapped up his photography, saying later, "It was going to take somewhat more effort to get that sample–to get the equipment and the container for that sample–than it was to get a few pictures."[189] In the moment, not only was there a logical reason for changing the order of activities because the scoop equipment took more effort to assemble and the camera was already in hand, Armstrong, as historian James Hansen puts it, "…was so intent on taking a few pictures…," because capturing those sights was important too.[190]

More often repeated is the story of veering off the flight plan for photographic opportunities on Apollo 8, when, on the fourth lunar orbit, the three astronauts saw the Earth emerge from behind the Moon for the first time. Numerous sources cite this as an unscripted, unplanned moment of photographic activity, with Frank Borman, Jim Lovell, and Bill Anders scrambling to find cameras and magazines. While the exact moment may have caught them off guard, as they had only just rotated the Command-Service Module to face the windows towards home, scientists and mission planners long expected the

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[188]Hansen, James R. *First Man: The Life of Neil A. Armstrong*. New York: Simon & Schuster, 2006, p. 498. In case of an urgent need to leave the lunar surface, plans for astronaut work on all missions included collecting a contingency soil and rock sample small enough for the astronaut to carry back to the lunar module by hand.

[189]Hansen, p. 498.

[190] Ibid.

infamous *Earthrise* moment to be captured during Apollo 8. The notation for the image even appears in the final mission photographic plan. But, at that exact moment in their mission (Figure 51), the page from their flight plan shows that none of them were scheduled to be taking photographs or even looking for this now iconic moment.

Similarly, astronauts took sometimes-extraordinary measures to capture images they themselves planned. During Apollo 12, astronauts Pete Conrad and Alan Bean contrived to take a photo of themselves, together, during their time at Surveyor III. Bean asked flight crew equipment managers to make a timer for the Hasselblad he and Conrad carried so that they could set up the camera temporarily on a solid surface and then walk some distance away to get themselves both in the frame. This unplanned photo, which the astronauts were certain would not receive approval as part of their schedule, meant Bean had to hide the timer inside a tool carrier bag and fish it out later while on the Moon. Unfortunately for Bean, Conrad, and audiences back on Earth, the timer was hidden too well, and he never located it in time to keep the mission on schedule. Bean later reproduced how he thought that photograph and the experience would have looked in some of his own paintings.[191]

On Apollo 16, astronauts John Young and Charlie Duke executed a series of photographs, captured on television and Duke's Hasselblad over five frames, to show Young leaping off the lunar surface and saluting the U.S. flag planted nearby. (Figure 5) Without a viewfinder on the camera, the astronauts repeated the leap photograph to

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[191] Bean, Alan. *Painting Apollo: First Artist on Another World*. Washington, DC: Smithsonian Books, 2009, p. 214-215. Paintings referenced include *The Fabulous Photo We Never Took*, 1999, and *Our Little Secret*, 2003. The scene was also reproduced in "That's All There Is," *From the Earth to the Moon*. Dir. by Jon Turteltaub. HBO, 1998; HBO Home Video, 2009 DVD.

ensure they captured it, having recorded it as moving footage as well on the remotely controlled television camera on the lunar rover. Duke described the moment, which he actually captured perfectly on the first leap attempt, during the mission, “Hey, John, this is perfect, with the LM and the Rover and you and Stone Mountain. And the old flag. Come on out here and give me a salute. Big Navy salute.”[192] What was so difficult for Young about the leap salute was getting his body weight plus that of the space suit and his Personal Life Support System (65 lbs in 1/6 gravity, just under 400 lbs on Earth) off the ground and maintaining his balance. Commentary by Duke and Apollo Lunar Surface Journal author Eric Jones attributes the success of it to Young’s comfort level with the environment so soon into the mission (just an hour into the first EVA) and his incredible balance and coordination.[193]

Apollo photographic work was not free of its problems, though, and malfunctions, the use of incorrect setting, or the wrong film magazine became fodder for technical debriefings held after every mission. From the memorandum generated from the Apollo 10 photographic debriefing, it is clear that astronauts were, “not quite happy with the photographic equipment.”[194] Not only did they experience what they called persistent jamming of the film, but the cameras also malfunctioned, the large 250mm lenses took up too much space and were unwieldy, and they needed to swap one viewfinder between

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[192] Jones, Eric and Ken Glover, eds. *Apollo Lunar Surface Journal*, Apollo 16. Mission transcript, Mission Elapsed Time (MET) 120:25:23. http://www.hq.nasa.gov/alsj/a16/a16.html. ALSEP Off-load section. Accessed April 24, 2013.

[193] Ibid. Young stepped onto the lunar surface at approximately MET 119:03:54.

[194] El-Baz, Farouk. Memorandum for File, “Apollo 10 Photo Debriefing, Case 340.” June 12, 1969, p. 4. NASA-CR-106888. National Aeronautics and Space Database, accessed January 18, 2013.

cameras too often. Despite the problems with equipment, and recommendations made on remedying that problem for future missions, the crew commented that they felt well prepared for photographic work, especially with the photographic plan in place and available during the mission.[195] Upon return of flight hardware, NASA technicians and engineers such as Jeff Bremer and James Ragan took steps to repair the cameras, modify future flight hardware according to recommendations by prior crew experiences like that of Apollo 10, and update photographic plans to account for operational recommendations or additional desirable scientific and technical work. Bremer recalls that, "After we received the flight hardware we had to run a Post Flight acceptance test to prove that the camera equipment still functioned properly after the flight. It was basically shoot film with each lens, magazine, and camera, and evaluate it. Once the equipment passed the test, it was put back in bonded storage for use on later flights."[196] Nowhere in these experiences is the source of any problems with photographic equipment really identified: equipment flaw or user error. Some instances such as using the wrong film magazine with the wrong settings or using the wrong developing technique in the photo lab did occur.[197]

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[195] El-Baz, "Apollo 10 Photo Debriefing, Case 340," p. 5.

[196] Bremer interview, p. 2.

[197] Bill Anders admitted to using ASA 2000, a high speed film for the Earth-facing side of the Moon, while on the night side of the Moon, an error corrected by special processing by the PTL: Anders, William. Interviewed by Paul Rollins. October 8, 1997. Interview Transcript, NASA Johnson Space Center Oral History Project, Houston, TX, p. 12-14 to 12-15. Jeff Bremer recalled one error made by the photo lab, but not the specific mission: Bremer interview, p. 2. Anecdotal stories circulate about cameras jamming, but nothing substantive appears in mission reports.

Conclusions

To carry out the duties of scientists, explorers, artists, poets, historians, and photographers back on Earth, astronauts required the tools to perform tasks as surrogates. For photography, NASA sought out the most effective system that would go beyond the expectations of professional photographers and function flawlessly in the harsh environment of space. Most of the astronauts, trained as engineers and pilots, took on photography as another part of their duties, with well-defined procedures neatly laid out in training sessions, pre-mission documentation, manuals, and notations integrated into the official flight plans. This level of careful planning for all aspects of spaceflight work, the intense training, preparation, and integration that went into on-hand documents during missions, gave astronauts a plan for carrying out a mission.[198]

Astronaut photography inadvertently supported part of the Cold War race to the Moon often pointed out by scientists: the physical presence of humans was not necessarily required for space exploration missions. The argument continued over the decades, notably during the Space Shuttle era when humans on space missions launched satellites and telescopes such as Hubble with the capability of servicing. The inherent risk of putting humans in space added costs and burdens to spaceflight. Any supposed value added by the human presence in space for scientific endeavors continues to run counter to the arguments made by scientists for more robotic space programs, both commercial and

[198] While contingency plans existed and improvisation was possible during missions, in those instances, photography became part of documentation only. While my work does not delve into such planning to any degree, future work may focus more on the training and planning for contingency photography. How NASA went about training and communicating with astronauts for moments, such as that on Apollo 13, would make for an interesting component of a study of contingency planning for spaceflight generally.

government-run civilian programs, raising anew the debate over the real need for humans to venture off the planet.

In terms of photography, images from robotic probes predate nearly every type of observation made later during human missions. The missing piece during the 1960s, however, was the significance of putting a human eye behind the lens of those cameras. Remotely controlled cameras or those pre-programmed to create and transmit images from space such as the ones on the Lunar Orbiter launched just prior to Apollo, gave us our first views of an Earth rising from behind the Moon and a whole Earth floating in the blackness of space. Those images, however, are not high resolution or in color, because the technology did not yet exist to transmit pictures of that quality back to Earth electronically, and they do not carry with them the same gravitas as those created by the hands of astronauts and their trusty Anscos, Robots, Hasselblads, Maurers, and Nikons. The knowledge that a person aimed those cameras and documented a moment, and an experience, of being in an environment so hostile and unforgiving, imparts an entirely different meaning. As surrogates for multiple audiences, astronauts needed to satisfy a wide range of interests with still photography, a task most often seen by the engineers at NASA as a sideline or distraction from the technical duties of proving the feasibility of humans space travel. What the astronauts produced in the first eleven years of the human spaceflight era, a rich archive of tens of thousands of images of Earth, space, and the Moon, serves as the source of our visual understanding of this period of awe-inspiring and sublime scientific and technical achievements. The cultural response to astronaut photography through different media publication requires analysis for understanding the true impact of such images on public memory and understanding of spaceflight.

These images collected by astronauts also provide visual inspiration for others, those focused on images as art. Astronauts were not artists. They did not participate fully in the production, processing, and dissemination of photographs, so had almost no role in shaping how audiences understood the images. Other than providing a contextual caption to publically released image, NASA also missed the opportunity to define interpretations of astronaut-collected photographs. Neither the astronauts nor NASA actively sought to create a narrative of the spaceflight experience like those created by photographers who journeyed to the American West or Antarctica. The story of astronaut photography cannot be seen as an artistic experience, but one of refined archival documentation using high quality equipment to capture the human perspective of moving outside Earth's atmosphere.

CHAPTER THREE: PHOTOGRAPHS FOR EVERY AUDIENCE

> *"But, the most impressive aspect of the flight was [when] we were in lunar orbit. We'd been going backwards and upside down, didn't really see Earth or the Sun, and when we rolled around and came around and saw the first Earth rise. [T]hat certainly was, by far, the most impressive thing. To see this very delicate, colorful orb which to me looked like a Christmas tree ornament coming up over this very stark, ugly lunar landscape really contrasted."*
> -William A. Anders, Lunar Module Pilot, Apollo 8[199]

In the wake of the Apollo 1 fire on January 27, 1967, NASA engineers and contractors worked to build a safer and operational Block II command module in order to resume the human spaceflight program. The first crewed Earth-orbital Apollo test mission, Apollo 7, flew in October 1968. For the first time since the brief and crude television broadcasts by Gordon Cooper during his Mercury *Faith 7* flight, a series of live television broadcasts by the astronauts brought the realities of spaceflight to televisions around the world. The mission's success provided the necessary information on operation of the spacecraft to permit planning for a lunar orbital mission using the massive Saturn V two short months later.

While still sorting through revised mission plans in the summer of 1968, George Low, Apollo Project Manager, suggested a significant shift in the plan for Apollo 8. Motivating the change was word from Grumman Aerospace that a complete lunar module would not arrive at NASA until early 1969 for Earth-orbit testing. That meant flying it on

[199] Anders, Interview Transcript, p. 12-13 – 12-14.

Apollo 8 as scheduled was impossible in late 1968 and forced further adjustments to the planned mission schedule. Low began considering a plan that would send the Apollo 8 CSM around the Moon, motivated largely by the lack of a lunar module, plus signs of Soviet progress towards a human mission around the Moon. With the end of the decade and President Kennedy's challenge of landing on the Moon looming, NASA put the entire Apollo program to the test by using a Saturn V to put the Apollo 8 spacecraft in orbit around Earth's only natural satellite. While the new plans necessitated some crew changes for missions, astronauts and ground support crew agreed to the change, and sped up work to facilitate the December launch. In their excitement during a flight back to Houston from a contractor, the astronaut crew quickly designed a mission patch depicting their symbolic figure-eight pattern around the Moon. (Figure 53)

Apollo 8 was a trailblazing mission from the start. It was the first launch of the Saturn V rocket with passengers in the command module, and only the third full test launch carried out, giving it an official designation of AS-503 (the third flight of the Apollo/Saturn V launch vehicle). In addition to seasoned astronauts and former crewmates Commander Frank Borman and Command Module Pilot James Lovell, NASA added a rookie astronaut, Lunar Module Pilot (a misnomer in this case since there was no lunar module) Williams Anders. After accepting assignment to this unique mission, the three men trained furiously from the time NASA officials decided on the new mission profile in August 1968 until the December flight. With over thirty days of combined spaceflight time, the participation of Borman and Lovell certainly figured in NASA's willingness to go ahead with the mission along with the extensive preparations underway by the Apollo 9 crew to test extensively the lunar module in Earth orbit.[200] At the same time the three men trained in simulators, the ground crew at the Kennedy Space Center prepared the Saturn V launch vehicle and Launch Pad 39 for the December 21 launch. As work progressed on this extraordinary undertaking, many came to realize that for the first time, human eyes would see the Earth from over 200,000 miles away, and lose sight of it – along with all communications – as they traveled around the far side of the Moon.[201]

The launch and two and a half day trip to the Moon proceeded as planned, and on Christmas Eve 1968, Frank Borman, James Lovell, and William Anders fired their SPS engine to place themselves in an elliptical orbit of the Moon. Almost as soon as they began their second circuit, Anders and Lovell pulled out camera equipment and plunged into their busy photographic plan. The work focused on mapping the lunar surface, especially the far side, detailed images of landmarks, and most importantly for planning, extensive photography of features in the targeted first landing location of Mare Tranquillitatis. The flight plan, as written by NASA, had all technical camera specifications laid out to include f-stops and other settings to make camera use simple and almost "point and shoot," despite the crew not having automatic cameras. This permitted more time to focus on targets and less on finding settings for specific conditions. Even preparing for situations such as dim light photography, best done with special film, received attention ahead of time and film magazines for such photographs

[200] As the primary decision-maker on crew selection, Deke Slayton went through multiple iterations for flight and back-up crews. He discusses the rationale for putting Borman in charge of the first trip to the Moon in his autobiography: Slayton, Donald K. with Michael Cassutt. *Deke!: U.S. Manned Space : From Mercury to the Shuttle*. New York: St. Martin's Press, 1995, p. 183-192.

[201] Poole, p. 2.

had special labels and notations in the flight plan. Mission planners worked in advance with technicians, the crew, and equipment contractors to ensure that no guesswork remained when astronauts used camera equipment as they circled the Moon. Other than smudges on the windows due to the off gassing of sealant used between the window and the frames, the crew had few hurdles to completing the task of capturing scheduled targets of opportunity as well as some spontaneous “crew selected” images during their flight.

As the Apollo 8 crew entered their fourth of ten lunar orbits, Borman continued rotating the CSM with the three main spacecraft windows rotating around towards the Earth. During the first three orbits, the spacecraft followed an elliptical path in order to slowly and carefully approach on this first attempt at a lunar encounter. Borman then rotated the vehicle from the engine pointing forward (to slow it for orbit) to a more circular orbit with the nose pointed at the Moon, slowly spinning like a toy top. Entering their fourth orbit, the astronauts glimpsed a spectacular view as they rounded the far side of Moon and saw Earth in the distance. As his right hand window rotated into view of the Earth, Anders exclaimed, “Oh, my God! Look at that picture over there! Here's the Earth coming up. Wow, is that pretty!”[202] The crew scrambled to find the right film magazines for their Hasselblad cameras to capture on film the photograph now known as *Earthrise*.

Anders snapped the first photograph (Figure 54), though it was in black-and-white and closely resembled an image taken by the first Lunar Orbiter spacecraft two and a half

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[202] Anders, William. *Apollo 8 Flight Journal*, Mission elapsed time 075:47:30. Corrected Transcript and Commentary. W. David Woods and Frank O'Brien, eds, 2009, Apollo Flight Journal, http://history.nasa.gov/afj/, accessed October 11, 2014.

years earlier (Figure 55). Less than a minute later, he swapped out the black-and-white film magazine for one with color film and captured the iconic *Earthrise* color image (Figure 1) as part of a sequence of nearly twenty photographs with different lenses and from different angles. Since photographs cannot speak for themselves, it took the eyes of NASA's corps of professional photographers, public affairs officers, and other amazed viewers on Earth to catapult this single frame from Apollo 8's Magazine B to the pages of publications around the world. Without any inherent scientific or technical value, the recognition of its uniqueness and the legacy of its use and reuse by magazines, newspapers, books, and the environmentalist movement cemented its place as one of the most well-known images of the twentieth century.

Through the landing of Apollo 11 in July 1969, NASA activities garnered intense and near-constant media attention. While that interest waned somewhat after the first successful landing, the provision of still photographs increased exponentially, allowing even greater focus on the needs of those most stymied by the lack of opportunity to explore a new place: the scientific community. Between Project Mercury days when still photography was an afterthought of NASA managers and the last three Apollo missions when astronauts mapped the Moon using special high-resolution cameras, the influence of audiences altered significantly the trajectory of photographic work.

Beyond acquiring greater technological capabilities, three additional components were required for NASA to produce a visual rhetoric through still photography. First, interested communities who required spaceflight visuals captured by photographer surrogates needed the ability to shape mission photographic plans. Who were these audiences, how did they submit their requests, and what were their expectations in regards to visual representations of spaceflight? Beyond who requested the photographs are issues of the prioritization of photography within mission plans. How did NASA manage requests for images and integrate those into the textual guidance given to astronauts before and during flights? Finally, when film magazines returned from missions, astronauts exited the traditional photographer's role and left their photographs in the hands of technicians and other NASA personnel who made those films available to audiences. Who physically managed the processing of flight films and how did they convey these images to scientists, engineers, and public affairs officials for final disposition? Answering these questions contributes to the cultural analysis of how still photography reinforced NASA's space exploration rhetoric of the 1960s and 1970s.[203] Ultimately, though, without the actual astronaut-photographers more than minimally involved in processing films and determining how audiences would interact with their images, putting additional hands on the photographs altered how audiences interpreted and understood the experience of early human spaceflight.

Audiences

The process of selecting images for publication by managers and public affairs officials may appear as somewhat self-evident: if the amazing photographs seen in newspapers and magazines were all that returned from space, the job would be simple. Astronaut photography instead provided an extreme opportunity of choice through the

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[203] While the immediately accessible and cataloged NASA documentation is incomplete in respect to the entire process of still photography planning and processing, additional research in the papers of upper tier NASA managers may yet reveal more detail on this subject.

hundreds of images collected during the Mercury and Gemini programs and over 18,000 from the Apollo program alone. As with previous exploration projects, images returned from astronaut space exploration needed to fit into a preconceived notion of the project's meaning in order to both promote and perpetuate support of the project. As documentary, scientific, and technical data, images provided information while also supporting to the sometimes-fanciful conceptions of exploration held by the audiences they served. The government and public audiences needed visuals to sustain political support and provide understanding of spaceflight, while scientists and engineers needed evidence to support continued research and technical work. Images, however, rarely serve a single purpose, and the ultimate legacy of NASA photography is the unforeseen ways in which the publication of certain photographs evolved into their popularization and use in unexpected places. Identifying the audiences themselves and the means by which they received the images will give some definition to the types of images returned by astronauts.

With its status as part of the U.S. government and research as a component of its mission, NASA became the primary audience for space photography provided by their satellites and astronauts during orbital and lunar missions. From top to bottom, the NASA audience required a visual means by which it could complete its own missions in terms of administration, engineering assessment, scientific research, mission planning, and the communication of accomplishments to audiences outside the agency. While positioned far behind the mission critical requirements such as vehicle operation and safety, still photography, movies, and television broadcasts became crucial in connecting the reality of 1960s spaceflight to those mostly familiar with the fictional space travel of television and movies.

Early planning and management of astronaut schedules put emphasis, quite understandably, on operating and assessing the operation of spacecraft. Only gradually was additional work integrated as time in orbit lengthened. After the two Mercury suborbital flights, NASA began planning for that extra time for the work John Glenn would perform as the first American to orbit Earth. In a preliminary flight planning document circulated by engineer Helmut Kuehnel – head of what was then called the Flight Activities Section – to the associate director level of the center, the suggested focus was simulation leading to a formal plan for three elements: mission control, systems evaluation, and observation.[204] Kuehnel emphasized the first two elements as critical and though he included the reference to observations, made no specific mention of photography. He instead suggested the recording of observations in, "…voice recording and written notes and sketches."[205] His omission of photography seems unintentional, but does lend weight to my earlier anecdotal story of Glenn's rather late addition of a camera to his flight equipment. Examination of Mercury flight plans and those through the end of Apollo confirm the secondary nature of observational work by astronauts who, for their own survival naturally, treated spacecraft operation and crew

[204] Kuehnel, Helmut. Memorandum for Associate Director, September 19, 1961. Record Group 255, Entry E. 20, Subject File SS-6, Box 2. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

[205] Ibid, p. 2-3.

safety as their primary responsibilities.[206] Not until Gordon Cooper's MA-9 flight did a final flight plan call out astronaut activities not related to spacecraft operation or safety in a prioritized order, which placed photographic experiments at the third, fourth, and seventh positions.[207] While astronaut photography never superseded critical mission elements like operations and safety, the importance of visual representations increased quickly through Project Mercury and into Project Gemini, when the addition of another astronaut to the flight made more mission time available for such work.

In a very visible way, Gemini NASA mission plans call out the audiences for photographic experiments carried out during flights. Designations included "D" prefixes for Department of Defense (DoD)-initiated work, "MSC" for projects originating at that center, and "S" for those experiments proposed by the scientific community both inside and outside of NASA. While experiment designations continued in the Apollo mission documents, photography no longer appeared in documents described as a series of experiments but as part of the regular procedures carried out by crewmembers.[208] Mission preparations included a thorough photographic plan that broke photography down into either operational or scientific work. Mission planners then included photographic plan elements within the official flight plan timeline and concluded the

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[206] For examples, see final flight plans such as: NASA Manned Spacecraft Center, *Flight Plan for MA-7/18*, Langley Station, Hampton, VA, May 1, 1962. Record Group 255, Entry 155, Box 1. National Archives and Records Administration, Southwest Center, Ft. Worth, TX. For Apollo objectives and plans, see: Orloff, Richard. *Apollo by the Numbers: A Statistical Reference*. Washington, D.C.: NASA, 2000.

[207] NASA Manned Spacecraft Center, *Flight Plan for MA-9/20*, prepared by Spacecraft Operations Branch, Flight Crew Operations Division, Houston, TX, March 4, 1963. Record Group 255, Entry 155, Box 2. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

[208] For an extensive list of Apollo designations, see: Mueller, George. Memorandum to Distribution, May 2, 1968. Attachment to Record #33720. Location 075-25. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

process with formal photographic debriefing sessions following the flight. The philosophy on Apollo photography was summarized in the *Apollo 8 Photographic Plan*: "The objectives in this plan that aid the assessment of this and future missions and the planning of future missions are given first priority and are listed as operational objectives." While other photography was desirable, the plan states, targets of opportunity did not displace other critical mission operations.[209] While NASA rhetoric called for visuals of spaceflight to enlighten a broad audience, internal communications and documentation support the idea that insiders worked to put the agency's spaceflight goals, engineering needs, and scientific investigations above other concerns.

By sheer numbers, one might surmise that science was the sole driving force behind the images taken by Apollo astronauts. Nearly 18,000 individual usable frames of film resulted from Apollo astronaut photographic work, building upon the over 2,600 frames taken during Project Gemini, and the paltry 332 frames from Mercury missions. And while documentation and operations show science was only a background benefit to spaceflight in the eyes of NASA managers, the yield of photographic material offered NASA a storehouse of images for ongoing scientific research. With a voice in photographic planning and resource allocation, giving them ability to steer the amount of mission time allocated to photography, the scientific community of planetary geologists and astronomers shaped the targets of those images. Image content in this case largely excluded the human explorers themselves in the context of space or the Moon in favor of

[209] Experiments Section, Mission Operations Branch, Flight Crew Support Division. *Final Photographic and TV Operations Plan, Apollo 8*. November 18, 1968. Johnson Space Center History Collection, Record #209525. Location 077-66. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

scientific and engineering interests. As percentages of total images, those with an implied or obvious scientific purpose vastly outweigh those featuring people by nearly 20 to 1. (Table 2) In terms of volume, what these figure indicate is a clear distinction between who the audience was and was not. The public needed familiar human forms to interpret images, but scientists looked for diverse content types supplied in plenty through astronaut photography.

An interpretation of the statistical figures for image content for the purposes of understanding the audience influence on astronaut photography suggests that representing people made little difference to NASA and their public relations and rhetorical goals. Alternately, it is possible that human representations were not considered in planning for photography. Only a handful of the images with human figures in them appear staged or posed, with most being clearly accidental or of boot prints or shadows. While NASA staff photographers like Richard Underwood offered guidance on image composition, only a few photographs appear planned other than if the intent was to depict a certain feature of the environment or technology. Closer examination of missions with the highest percentages of human forms – Gemini IV, Gemini XII, and Apollo 17, with eight, ten, and eight percent of photographs with humans in the frame respectively – show that they are also some of the most high profile missions in regards to goals. Gemini IV included the first U.S. spacewalk in mid-1965. Gemini XII was the last of its program and provided a final opportunity to perfect some procedures necessary for Apollo, especially EVA and docking. Apollo 17 in December 1972 was the last mission of its program as well with the longest expected stay on the Moon, the most scientific work (with the only scientist-astronaut, a geologist) planned, and the highest yield of rocks, images, and data, including the ubiquitous *Whole Earth* image (Figure 66). The significance of the human in accomplishing goals on these three missions perhaps encouraged an increased attention to taking photographs of themselves, though few were more than incidental in nature. Of course, there is also the possibility that the crews of these missions were just predisposed to photographing each other more because of mission requirements. While these observations do not suggest an intentional neglect in scheduling photographs that included people, but there was no obvious effort to help the Earth-bound understand spaceflight through the appearance of familiar shapes such as human figures, footprints, or shadows. The engineering, scientific, and bureaucratic audiences, then, benefitted most from the catalog of photographs produced in the early space program.

Administrators

For the highest levels of NASA management, images meant a great deal in the legislative game of securing funding. In this context, the idea of NASA's work was as important as its actual work, so photography captured by astronauts could and did provide materials for increasing the visibility of the agency amongst elected officials and the public. Available documentation from upper level managers at NASA indicates a relatively high degree of involvement regarding photographic planning. As early as December 1962, Robert Gilruth became a regular recipient of memos regarding astronaut-captured photographs and their value to those inside NASA.[210] In this regard, the head of MSC was at least aware of how much NASA scientists valued astronaut photographs as such evidence came from few other sources at that time. Another memorandum sent from public affairs officer Brian Duff to NASA Administrator James Webb in late 1963 summarized photographic work of astronauts and the press pool through Project Mercury. Duff's outline includes how those products were useful for outreach and internal engineering needs.[211] Worthy of note on this document is its origins in the PAO, revealing the pathway of visual communications expected in this early stage of human spaceflight. Everything was seen as potentially useful for increasing the profile of NASA programs and even the public face of administering the agency required to know what was available.

Additional discussion between departments at NASA that included upper level managers continued into the months prior to the first Gemini launch in early 1965. In December 1964, the Office of Space Science and Applications (OSSA) at NASA Headquarters approved an astronomical photography experiment and transferred funds for the grant to MSC.[212] The memorandum regarding the project went through the office of MSC director Gilruth, but approval and direction to carry out the experiment from the Headquarters level indicates the awareness and involvement of administrators in shaping

[210] Goett, Henry. Forwarded letter from Dr. Jocelyn Gill to Dr. John O'Keefe, Goddard Spaceflight Center, dated December 13, 1962. Received by Gilruth January 21, 1963. Record Group 255, Subject File SS-1.1, File 0627. National Archives and Records Administration, Southwest Center, Ft. Worth, TX

[211] Duff, Brian. Memorandum to James Webb. November 18, 1963. Office of Public Affairs, 1958-1968, Correspondence, NASA Historical Research Collection, NASA Headquarters. Folder #18171, Box 1.

[212] Foster, Willis. Memorandum to MSC Director Robert Gilruth. December 3, 1964. Johnson Space Center History Collection, Record #22903. Location 075-13. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

photographic work during Project Gemini. This is not an indicator, however, that NASA managers believed astronaut photography could provide any support to the agency's mission. That shift came with new views that placed relatable subjects, the astronauts, in the photographic frame and context of space.

By the time of Gemini IV, astronaut photography again appeared on the radar of the most important NASA managers working on human spaceflight, including George Low and Robert Gilruth. While they released astronaut-captured photographs from all of the Mercury missions, none until the Gemini IV mission depicted the reality of human life in Earth orbit. During a review of the photographs captured by James McDivitt and Edward White, Low and Gilruth expressed delight at the decision to photograph the spacecraft and astronauts themselves, as photography trainer Richard Underwood related the story.[213] To these managers, the value of images emanated from the ability to see humans and their technological creations in the context of space. Underwood on the other hand, as a professional photographer, directed their attention to what was perhaps the most valuable aspect of astronaut photography in the long term: Earth imaging. This shifted the way managers and engineers at NASA approached planning photography for missions, broadening motivations for photographic experiments.

Leading up to the Apollo program, administrators at NASA called for a number of planning groups and processes for ensuring that photography by astronauts covered all of the needs of NASA and its constituents. In an exchange of memos in early 1966 between Associate Administrator for Manned Space Flight, George Mueller, and the Associate

[213] Underwood, Interview transcript, p. 5.

Administrator for Space Science and Applications, Homer Newell, the two agreed to form a committee to analyze lunar photographic data.[214] Their intention was to organize the appropriate staff to deal with current and future analysis concerns in order to manage a valuable asset expected from lunar missions. Formal confirmation of the need for such a committee came, however, from an even higher level. In late 1967, the President's Science Advisory Committee (PSAC) Space Panel appointed a sub-panel to study and guide lunar photography.[215] Their initial meeting in the fall of 1967 involved discussions of developing a stereographic close-up camera later manufactured by Kodak and flown on a number of Apollo flights. (Figure 56) Later meetings of the committee included executive sessions in which Mueller himself reviewed plans for early missions, with details on the agenda such as electrical fuses used in the Hasselblad cameras, batteries for a spot meter, and the possibility of using color film in geological photographs.[216] The Advisory Committee on Lunar Surface Photography included notable faces concerned with photography from inside and outside NASA, including Dr. Edwin Land, Dr. Eugene Shoemaker, and Nobel Prize winner Dr. Edward Purcell. Along with the other participants, the inclusion of such distinguished professionals on a lunar photography

[214] Mueller, George. Memorandum to the Associate Administrator for OSSA, Homer Newell, March 3, 1966. Johnson Space Center History Collection, Record #26650. Location 066-55. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[215] Rosen, Milton. Memorandum for the Record, November 1, 1967. Johnson Space Center History Collection, Record #31485. Location 068-65. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[216] West, Julian. Memorandum for the Record, December 17, 1968. Johnson Space Center History Collection, Record #36066. Location 075-31. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

committee is a testament to the seriousness with which NASA treated imaging on the Moon.

Other advocates for photography, in this case lunar photography from the CSM during orbit, also came from the upper tiers of NASA management. Apollo lunar program director General Samuel Phillips wrote to Robert Gilruth in March 1968 to request a review of orbital photography for scientific, operational, and contingency purposes.[217] His memo in this case refers to a cancelled plan for a Lunar Mapping and Survey System, a version of which flew as a three part mapping system during the last three Apollo missions. Responding to the concerns of those in the scientific, engineering, and planning communities at NASA, Phillips advocated for thoughtful consideration of logistical needs for such photography, and potential for missed opportunities with a vehicle and astronaut in lunar orbit. Astronauts in fact became crucial to early lunar mapping with their "bootstrap photography" until the mapping camera system consisting of a mapping camera, altimeter device, and panoramic camera flew in the experiments bays of the Apollo 15, 16, and 17 service modules.

Images could concurrently contain elements of utility and meaningfulness to viewers within NASA. Other than a brief moment following Gemini IV when NASA managers identified a unique value of astronaut photography upon seeing Ed White on his EVA, the vast majority of their later planning, discussions, and photographic work did not include discussions of any significance to including people in the photographs. In a

[217] Phillips, General Samuel C. Memorandum to Robert Gilruth, March 29, 1968. Johnson Space Center History Collection, Record #32984. Location 069-51. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

practical sense, mission planners identified overlapping interests of groups inside NASA early enough to make it possible to capture images for more than one purpose with the fewest number of cameras and equipment.[218] Perhaps in this single way, NASA failed to identify the visually unique nature of their activities: the ability to put people into space and return images of that for public consumption. The ability of Earth-bound people to identify with an image and find meaning in it changed when relatable elements such as people appeared in the photographs. In this way, the underwhelming number of images released of astronauts in space up through the end of the Apollo program contributed to a general misunderstanding of spaceflight's dangers, and perhaps distortion of the utility of putting humans into space. The human spaceflight program then was ill served by its own visual products: without a human in the picture, photography by robotic surrogates was seen as something accomplished just as easily. Ultimately, administrators bore responsibility for not considering adequately how image content familiarized non-scientists and engineers with spaceflight.

Engineers

While documenting crew performance through telemetry and debriefings served to provide details about missions, photography as a tool for documenting spacecraft and component performance became invaluable as NASA gathered more spaceflight experience. Early expectations by NASA managers were that the data acquisition cameras, small 16mm movie cameras, were adequate to capture photographic evidence of

[218] Gill Memorandum, November 10, 1964.

slower procedures such as spacecraft rendezvous, docking, and lunar landings.[219] (Figure 57) That would leave still photography for documenting single noteworthy moments within the mission relevant to the evaluation of mission operations. Early Gemini flight plans included still photography as part of experiments with more or less scientific intentions, but those documents make no mention of potential uses of images by engineers. In an interesting commentary on preparation for flight and using images for operational purposes, Gordon Cooper and Pete Conrad detailed their concerns about visual orientation during their Gemini V mission debriefing.[220] The mission, already loaded with photographic work, apparently did not include any visual references for Cooper and Conrad to orient the spacecraft in relation to the Earth's horizon, with Cooper complaining characteristically that, "Never once did we have any darn thing to show us what out the window should look like."[221] Cooper went on to suggest that hand-drawn sketches placed in simulator windows would have helped, and encouraged planners to include fuel on the long-duration flight of Gemini VII so that Frank Borman and Jim Lovell could capture photographs to aid later crews in training for what they would see.

As activity increased in preparation for the Apollo lunar landings, so did the concern over documenting necessary stages of those missions with photography. In early 1968, Apollo program manager George Low identified for MSC director Gilruth's

[219] Slayton, Deke. Memorandum to Apollo Spacecraft Program Office Manager (George Low), October 26, 1964. Johnson Space Center History Collection, Record #22623. Location 075-13. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[220] Spacecraft Operations Branch, Flight Crew Support Division, *Preliminary GT-5 Flight Crew Debriefing Transcript Part I*, September 1, 1965. Record Group 255, Entry 155, Box 10. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

[221] Ibid, p. 43.

assistant Paul Purser the photography planned at the time. They included, first, documentation of the lunar module at the landing site, followed by images of crew performance and local geography.[222] Still, as the Apollo program went on, suggested documentation of most engineering-related issues referenced the 16mm data acquisition camera, with passing references to useful shots possible with the Hasselblad cameras such as the tire marks left in the lunar soil by the lunar rover.[223] Generally, however, documentation available regarding engineering photography tended to steer such imaging towards moving images and not still, perhaps indicating the value to engineers of understanding issues that changed over time and not just single moments captured in photographs.

Examples from two particular events illuminate the additional value offered engineers in still photographs. During the Gemini IX-A mission, the target vehicle did not properly shed its payload fairing, prompting the term “angry alligator” for its appearance. (Figure 58) Engineers analyzed this and other photographs captured by astronauts Thomas Stafford and Gene Cernan to determine the cause of the malfunction. Visual evidence complemented the voice descriptions recorded on board the spacecraft and in transmissions to the ground, so this combination provided engineers at NASA the material they needed to prevent such mishaps in the future. Documentary photography also provided a level of accountability within NASA, never seen more clearly than in the

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[222] Low, George. Memorandum to Paul Purser, Special Assistant to the Director, February 21, 1968. Johnson Space Center History Collection, Record #32675. Location 075-25. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[223] Smith, Richard. Memorandum to James McDivitt, March 25, 1971. Johnson Space Center History Collection, Record #43521. Location 073-31. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

frames captured by Apollo 13 astronauts of their damaged SM after jettison and prior to reentry into Earth's atmosphere. Unable to inspect the damage physically, the crew photographed the module as it tumbled away, giving NASA engineers their first and only visual clues as to what caused the near-catastrophic damage and cancelled the lunar landing. (Figure 59)

Broadly speaking, engineers required still and moving images in order to document the ways in which their equipment and written procedures were successful or not in the space environment. To complete the visual record for a mission and get the most benefit for the effort, photographic priorities were established to include documentation of operational factors, evidence for future mission planning, the possible replacement of some work with photography, and recording scientific or other data.[224] Though dealing with human characters in the greatest mission ever undertaken by humans, NASA engineers never acknowledged the centrality of people to the story of spaceflight documentation.

Scientists

Observational activities such as photography took a backseat to spacecraft operations in mission plans, and preparing astronauts for that work required input from interested audiences who needed visual materials. Either directly, by sitting in on meetings to formulate flight plans, or indirectly, by having representation in such

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[224] Memo refers specifically to the first lunar landing, but engineering priorities changed little in follow-up missions; Klabosh, Charles (Operations Branch, FCSD). Memorandum to Chief, Mission Operations Branch (Helmet Kuehnel), February 23, 1967. Record Group 255, Entry 154W, Box 7, Document #CF325-7M-88. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

meetings, audiences for images inside NASA contributed ideas that shaped both planned photographs and the possible targets of opportunity. By the time of Wally Schirra's Mercury flight, the list of requested photographs shifted to specific descriptions in final flight plans, as opposed to random images captured out the window. Of the three astronaut-involved experiments listed in the MA-8 flight plan, three involved photography and none rated higher than work associated with spacecraft control, medical observations, radio checks, and other scheduled operations.[225] Schirra later commented that his time in orbit was quite constrained, and he managed to capture only a few relevant photos to satisfy a request by NASA scientists for terrestrial features that could inform Earth resources work and possible mission planning for Mars exploration.[226] In closing out Project Mercury, Gordon Cooper experienced an extensive science debriefing after his flight that included very specific questions regarding exactly how he captured photographs for each of the science photography experiments.[227] The questions regarding equipment procedures, the process of sightings based on stars, and terminology used in discussing weather and Earth features reflected extensive preparation for these experiments, and indicate the future track for astronaut photography for scientific purposes.

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[225] NASA Manned Spaceflight Center, *Flight Plan for MA-8/16*, August 7, 1962, Houston, TX. Record Group 255, Entry 155, Box 1. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

[226] NASA Public Affairs Office, *MA-8 Press Conference Transcript*, Houston, TX, October 7, 1962, p. 10. Record Group 255, Entry 60, Box 2. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

[227] Manned Spacecraft Center, *MA-9 Science Debriefing*, June 26, 1963. Record Group 255, Entry 155, Box 2. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

Formalization of scientific photography during Project Gemini lead to greater description of the objectives, scope, and procedures in each mission's flight plan, hinting at extensive preparation by scientists to get it included on a flight. On Gemini IV, for example, the flight plan and an associated working paper provides details regarding a number of planned DoD, MSC, and scientific experiments involving cameras.[228] While two DoD experiments on basic object and surface photography were cancelled prior to the mission, one MSC experiment to capture two-color Earth limb photographs and two science experiments for synoptic terrain and weather photography did occur. The working paper provided top-down information on the experiments and the process for carrying them out. The final flight plan distilled the working paper information into systematic instructions along mission elapsed time marks and other procedural notations. Inclusion of scientific work in a mission plan at any stage of its development did not mean a guaranteed place on the mission though. On Gemini XII, the mission plan for photography had a late modification by the Flight Crew Support Division's (FCSD) Warren North, who sent a memo to the Gemini Program Office to exclude particular Earth photography work because the spacecraft and crew lacked preparation.[229] The plans for photography and any experiments remained in flux even during the mission, with real time events playing a role in final products.

[228] Flight Crew Support Division, Spacecraft Operations Branch. *GT-4 Flight Plan*, May 19, 1965. Record Group 255, Entry 155, Box 7. National Archives and Records Administration, Southwest Center, Ft. Worth, TX; Hrabal, Gordon. *Experiments for GT-4 Mission, NASA Program Gemini Working Paper No. 5023*, May 14, 1965. Record Group 255, Entry 155, Box 7. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

[229] North, Warren. Memorandum to Manager of the Gemini Program Office, November 4, 1966. Record Group 255, Entry 154W, Box 5. NASA Document #CF323-6M-504, National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

The scale and scope of reporting of scientific photography expanded with Gemini IV, the first long duration mission, developing into an extensive list of symposia, experiment reports, and other post-flight documentation that required the input of both the principle investigators and astronauts as co-authors. While the astronaut-photographer for individual frames cannot often be determined, their co-authorship of reports suggests either a respectful nod to their role in capturing the photographs or an actual involvement of both in analyzing the results. As engineers and test pilots, the former seems unlikely, as few claimed serious interest in observational scientific work of any kind.[230] In NASA Technical Note D-3982 entitled "Terrain Photography on the Gemini IV Mission: Preliminary Report," Paul Lowman of the Goddard Space Flight Center (GSFC) and the two mission astronauts are shown as authors of the report based on photography in the S-5 Synoptic Terrain Photography Experiment. The last page of the report, however, acknowledges the input of others at NASA who helped interpret the photographs captured by McDivitt and White. This may indicate that the geographical and scientific information in the report did not require the astronauts' contribution.[231] That does not negate astronaut input entirely, as experiential information and direct observational recollections were undoubtedly valuable in writing a narrative of the mission's

[230] Only some of the original seven Mercury astronauts and many of those who followed noted in some way their photographic work. The best examples are the memoirs: Schirra and Billings, *Schirra's Space*; Stafford, Thomas and Michael Cassutt. *We Have Capture: Tom Stafford and the Space Race*. Washington, D.C.: Smithsonian Institution Press, 2002, p. 129; Carpenter, Scott and Kris Stoever. *For Spacious Skies: The Uncommon Journey of a Mercury Astronaut*. Orlando: Harcourt, 2002, p. 211, 263, 295; Glenn, John and Nick Taylor. *John Glenn: A Memoir*. New York: Bantam Books, 1999, p. 250-251; Aldrin, Buzz and Ken Abraham. *Magnificent Desolation: The Long Journey Home from the Moon*. New York: Harmony Books, 2009, p. 39-40.

[231] Lowman, Paul, James McDivitt, and Edward White, "Terrain Photography on the Gemini IV mission: Preliminary Report." NASA Technical Note D-3982, p. 13, June 1967, Goddard Space Flight Center.

photographic work, but their direct influence on the use and perception of photography from Gemini missions seems highly unlikely. Successive experiment reports compared results from the same experiments across missions, making only a casual nod towards the astronaut contribution.[232]

For the Apollo program, the input of scientists into photographic plans is apparent across the documents from mission preparations, as well as in the sheer number of photographs collected that lack a human or technological subject. Science informed Apollo photographic planning from the top, as seen with the heavy representation by scientists on the President's Science Advisory Committee (PSAC) sub-panel on lunar photography: astrophysicist Thomas Gold from Cornell University, physicist Edward Purcell from Harvard, and astronomer James Baker of Harvard, who co-created the Baker-Nunn camera.[233] Much of their pre-Apollo discussion revolved around the development of a stereoscopic camera to capture close-up images of lunar soil and rocks, conversations going back to at least 1965 amongst NASA scientists on functional requirements for the camera.[234] The experiments program involved numerous principal investigators from outside research institutions. The goal became one of minimizing equipment and maximizing scientific output with the possible overlap in interests

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[232] For early and late program mention of experiment results for photography experiments such as S005, S006, S011, S029, and objects of opportunity, see "Manned Space Flight Experiments: Gemini V Mission," January 6, 1966, and "Interim Report, Manned Space Flight Experiments, Gemini XII Mission," Report #MSC-TA-R-67-3, August 1967.

[233] Rosen Memo, November 11, 1967, p. 1.

[234] Pearce, Fred. Memorandum to Distribution List, October 28, 1965. Johnson Space Center History Collection, Record #25820. Location 075-14. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX; on science priority of ALSCC, see Hess, Wilmot. Memorandum to Deke Slayton and George Low, April 21, 1969. Johnson Space Center History Collection, Record #37545. Location 075-33. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

between agency scientists and the principal investigators. The cases of the stereo camera work and a special four-Hasselblad camera system for multispectral photography show that NASA knew that although it might compromise the rights of the outside scientists by reusing the equipment for operational purposes, the urgency of program made the move necessary at times.[235] Satisfying the scientific community inside and outside NASA had its own set of bureaucratic requirements.

Calls for additional scientific photography carried through the entire Apollo program, presumably based on the idea that when the program finally ended such high resolution and close range photography of lunar features may not be possible for a long time. Still photography planned through the end of the program came to include an extensive set of Earth resources work done during the orbital missions, detailed imaging of scientific experiments set up on the lunar surface (ALSEPs), and geographical mapping done on the last three lunar missions.[236] Of special importance were singular opportunities to photograph phenomena from the perspective of astronauts travelling through translunar space. Preparations for the Apollo 13 mission included astronomical training to aid in photographing and describing Comet Bennett from the crew's unique

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[235] Hess, Wilmot. Memorandum to George Low, June 10, 1968. Johnson Space Center History Collection, Record #33718. Location 070-11. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[236] Hess, Wilmot. Memorandum to George Low, July 17, 1968. Johnson Space Center History Collection, Record #34170. Location 070-21. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX; Hess, Wilmot. Memorandum to Deke Slayton and George Low, August 21, 1968. Record Group 255, Entry 20, Subject File SS-25, Box 3. National Archives and Records Administration, Southwest Center, Ft. Worth, TX; Gilruth, Robert. Memorandum to Sam Phillips, July 23, 1968. Johnson Space Center History Collection, Record #34262. Location 075-26. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

point of view.[237] Photography of Lagrangian points such as L5 and Gegenshein were also planned during lunar orbital activities. Apollo 15 astronaut Al Worden commented in an interview that he was most proud of capturing these due to their high scientific value.[238] As seen in Table 2, the overwhelming majority of astronaut photography had a scientific intent. That gave the motivated, goal-oriented astronauts a connection with scientific staff and ability to satisfy specific needs, not just the abstract wishes of people like Richard Underwood with his objective for them to capture something meaningful. Though the handful of truly iconic images astronauts captured sustains their memory now, the real substance of their work also continues to satisfy the needs of the largest community of users of astronaut photography.

Government Agencies

NASA was hardly the only government agency in the 1960s looking at the value of human observations from space. The Weather Bureau, which later became part of NOAA, was a common customer when it came to requesting photographic work by astronauts, particularly during Project Mercury. To confirm camera lens filter needs for generations of Tyros and Nimbus weather satellites, the bureau requested a photographic experiment on Schirra's MA-8 flight to record different filter effects on a single film

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[237] Calio, Anthony. Memorandum to James McDivitt, March 30, 1970. Johnson Space Center History Collection, Record #41381. Location 072-36. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[238] Lagrangian points are five distinct locations in the Earth-Sun system (or other two body systems) where a smaller third body could, based on the gravitational equilibrium at these points, maintain its position relative to the Earth and Sun. Gegenshein is a the reflection of sunlight off body of dust concentrated at the L2 point, directly opposite Earth from the Sun. Al Worden, email to author, p. 2.

frame.[239] A letter regarding Schirra's photographic results and plans for more weather photography on MA-9 written by Robert Gilruth (director of MSC) to Fred Singer (director of the National Weather Satellite Center at the U.S. Weather Bureau) confirms the desirability of photographic work from hand-held cameras at senior levels of NASA and other government organizations.[240] Despite Schirra's trouble taking any photographs on MA-8, Gordon Cooper reused the equipment on MA-9 for the same experiment with some additional filters for infrared photographs.[241]

Beyond weather photography of Earth and the mapping photography done of the Moon for the Weather Bureau and USGS respectively, the biggest non-NASA government "customer" for photography was the DoD. Capturing photographs for national security required that the processing and distribution of those photos did not unintentionally reveal more information than was acceptable. Historians James David and Dwayne Day have written extensively on national security needs at the time as they relate to NASA. David explored the topic of astronaut photography and national security in his 2006 article in which he describes the reaction of those in the defense world to images taken of Israel and Egypt during Gemini missions, a particularly hot region at the time. Over the course of Project Gemini, 11 of 15 experiments were successfully carried out with the "D" designation, meaning for the DoD, but only three included photography and were all completed on Gemini V. As part of the Gemini Summary Conference, USAF

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[239] "MA-8 Press Conference Transcript," p. 10.

[240] Gilruth, Robert. Memorandum to Fred Singer, February 13, 1963. Record Group 255, Subject File SP-20.1, National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

[241] Eggleston, John. Memorandum to James Bost, Mercury Project Office. Record Group 255, Subject File SP-20.6, National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

representative Wilbur Ballentine presented on the results of the experiments, and how they bettered the DoD's understanding of how human work in space might benefit his department.[242] Concern about the ability of astronauts to capture sensitive locations on Earth in high resolution continued during the Apollo program, mostly influencing the size of lenses carried for Hasselblad cameras and the procedures for processing films. As most photography during Apollo focused on the lunar surface, however, it was not until Skylab that national security issues arose as a major issue for NASA. In fact, recent declassification of Area 51 information included verification of the DoD and CIA role in attempting to suppress astronaut photographs of the desert location taken during Skylab missions.[243]

David and Day's research, some of the only scholarly material on the subject of overlap between the intelligence community and NASA's human spaceflight program, reveals astronaut photography was closely scrutinized by the DoD and intelligence community for possible use.[244] The work of those agencies also influenced the technology used during the space program, even into the space shuttle era. The issue of camera lenses and image resolution created problems for scientists wanting clear views of both the Earth and Moon. A concern existed that the mapping and panoramic cameras proposed for the final three Apollo missions could reveal the capabilities of the sensors and lenses of spy satellites in use by NRO, which were manufactured by the same

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[242] Ballentine, Wilbur. "DoD/NASA Gemini Experiments Summary," p. 307.

[243] Day, Dwayne. "Astronauts and Area 51: the Skylab Incident." *The Space Review*. January 9, 2006; David, Leonard. "Area 51 Declassified: Documents Reveal Cold War 'Hide-and-Seek'." *Space.com*. November 6, 2013.

[244] David, "Astronaut Photography and the Intelligence Community," p. 185.

companies.[245] As a result, the Apollo SIM Bay cameras had somewhat lessened capabilities with a resolution of about three feet from seventy miles altitude. The film returned from the three missions, however, became the basis for the first high resolution topographic maps of the Moon, an invaluable resource for geographers and scientists involved in lunar research.

Mapping and Planning

During Project Mercury, the possible uses of photography were broad and not entirely defined. Later, photographic work during Gemini and Apollo not only provided information for managers, engineers, and scientists, but also for mission planners. Images from completed missions could influence flight patterns or procedures on successive missions. That usually meant better, more efficient equipment and procedures or capturing different geographical features and landmarks along the spacecraft's trajectory. For Apollo in particular, imagery played a crucial role in informing scientists and engineers about the terrain of the Moon and possible landing sites. Such "bootstrap" photography became one of the most discussed topics in planning for missions.

As part of their post-mission process, crew debriefings included questions about photographic work as part of the lengthy sessions done over days and weeks. Based on their flight experiences, astronauts often recommended modifications to various pieces of equipment, both large and small, to aim for improved mission results. In the case of cameras and photography, changes to the spacecraft windows and lenses included for

[245] Ibid.

interior and exterior imaging were common. A notable change was required after Apollo 8 circled the Moon in late 1968. When three of the five spacecraft windows fogged up making observations difficult, investigations revealed that a material used to seal the windows off-gassed. Over the next few missions, engineers experimented with different sealants to correct the problem.[246] With clear windows for hand-held photography, mission planners used each mission as an opportunity to gather photographic data using the standard Hasselblad camera equipment and other specialized cameras as the Apollo program matured.

While NASA engineers preferred developing or modifying future practices based on moving images, for the most part, capturing still images was still part of mission plans during critical phases. For example, in preparation for the first tests of the lunar module, one contingency plan included sending astronauts on a spacewalk to move from the CM to the LM if they were unable to dock the two vehicles properly. Plans also included adequate photographic coverage of such a process, including still images, to show how the spacewalking astronaut moved from one craft to the other.[247] To alleviate any fear that such photography might get in the way during "Plan B" scenario, Slayton, the memo's author, stated explicitly that camera use was on a non-interference basis. In other words, documentation of any kind, rightfully so, was secondary to astronaut safety and mission success. For example, the maneuvering done by Neil Armstrong on Apollo 11 to

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[246] Mission Evaluation Team, "Apollo 8 Mission Report," February 1969, NASA Report #NASA-TM-X-66369. Houston: NASA, 1969. Accessed at the NASA Technical Reports Server, http://ntrs.nasa.gov, January 2, 2014.

[247] Slayton, Deke. Memorandum to George Low, May 13, 1968. Johnson Space Center History Collection, Record #33446. Location 075-25. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

avoid numerous boulders and craters encouraged FCSD planners for Apollo 12 to request simulated oblique photography to prepare astronauts Conrad and Bean for locating the correct crater containing Surveyor III based on their expected approach angle.[248] Other procedural changes included adjustments and notations for special photographs such as those of Earth and the Moon during the transit phases of the mission. As spacecraft window orientation during those flight phases often obscured views of the two spheres, altered flight plans included procedures to reorient the vehicle in order to capture the appropriate frames.[249] Timing was critical for photography, so the desire to capture a full Earth image meant that only the Apollo 17 mission's outbound path to the Moon provided an opportunity to view such a sight. (Figure 66)

One of the highest post-mission Apollo priorities was for NASA planners to acquire, analyze, and use photographs taken in order to adjust designated mission equipment, procedures, and maps made for the next scheduled mission.[250] To build on available lunar images from other robotic explorers like the Lunar Orbiters and Surveyors, orbiting piloted vehicles became bases for surface geographical photography. Such photography served to narrow down potential targets for landing and provided photographic information for geologists at the USGS who created maps of the lunar

[248] North, Warren. Memorandum to James Sasser, September 2, 1969. Record Group 255, Entry 154W5, Box 3, Document #CF342-9M-170. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

[249] North, Warren. Memorandum to Chief, Mission Planning and Analysis, January 22, 1970. Record Group 255, Entry 154W5, Box 4, Document #CF22-70M-001. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

[250] Slayton, Deke. Memorandum to Homer Newell, May 16, 1969. Record Group 255, Entry 154W5, Box 2, Document #CF342-9M-85. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

surface. During the orbital portions of early Apollo missions, astronauts used bracketed cameras with timers attached to capture strips of images. For Apollo 14, a hand-held topographic camera based on those already in use in reconnaissance satellites at the time provided additional images for developing accurate maps by lunar geologists. [251] (Figure 60) On the final J-type missions, a complex equipment suite located in the SIM Bay of the SM provided data and images for research. (Figure 61) The data retrieved from that system allowed the USGS to create the first three-dimensional images and maps of the lunar surface.[252] Planning for such photography was, in terms of both the technology and the work, added seamlessly to the training and mission performance of the astronauts, with little creativity or response required from them to carry out requirements. According to Al Worden, Apollo 15 command module pilot, "These cameras were added to our flight plan to enhance our understanding of the lunar surface in a much more detailed way than ever before…. These cameras were mostly technical and I followed the instructions in the flight plan to operate them. Every operation of these cameras was prescribed before flight."[253]

Adjustments made to flight plans based on photography of the Moon's surface for the purpose of later Apollo landing site targets were referred to as bootstrap

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[251] A Hycon lunar topographic camera flew on Apollo 13 but was not used until the Apollo 14 mission. McDivitt, James. Memorandum to Rocco Petrone, November 22, 1969. Johnson Space Center History Collection, Record #40170. Location 075-41. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[252] Desire for and documentation of lunar mapping cameras is voluminous, and deserves full scholarly treatment in an entirely separate study. As those photographs stemmed from a remotely operated camera, they fall outside the purview of this dissertation as its focus is hand-held cameras.

[253] Worden, email to the author, August 10, 2012.

photography.[254] For Apollo 12, a planned trajectory was altered in the months prior to flight based on the need to photograph the projected landing sites for Apollo 13 (Fra Mauro) and Apollo 14 (Descartes), which also required an adjustment to onboard printed maps.[255] Such changes to flight maps and plans continued though the program, with significant input coming from scientists at Bellcomm, the contract managers for mapping photography and home to noted geologist Farouk El-Baz. As a geology instructor to the astronauts, particularly the command module pilots on the last three missions, El-Baz trained the astronauts to verbally describe and pinpoint with cameras the necessary landmarks on the Moon.[256] However, such work was limited and received no more time on the flight plan than those managing crew time felt was appropriate. Pushback on the work came in the form of rejections for additional photographs from FCOD when a flight crew's schedule appeared too full and passed a threshold for daily activity.[257] With the photographic data analyzed by scientists and managers, site selection committees made the final decision regarding landing sites, but available documentation shows the high value placed on the photographic work of astronauts for planning and mapping purposes.

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[254] Morrey, Alfred (Mission Planning and Analysis). Memorandum to informal distribution list, February 9, 1970. Johnson Space Center History Collection, Record #41078. Location 072-26. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[255] El-Baz, Farouk. Memorandum to Lee Scherer, Lunar Exploration Office, September 2, 1969. Johnson Space Center History Collection, Record #39296. Location 075-35. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX; Slayton, Deke. Memorandum to George Low, September 15, 1969. Johnson Space Center History Collection, Record #480843. Location 079-15B. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[256] El-Baz, "Training Apollo Astronauts…," p. 3.

[257] North, Warren. Memorandum to James Sasser, April 30, 1970. Record Group 255, Entry 154W5, Box4, Document #CF62-70M-130. National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

Public Affairs and the Media

The conduit for communicating NASA’s work to the public was the Public Affairs Office, with a division at headquarters in Washington, D.C., and each of the centers around the country. This office not only represented NASA to the public, but also brought NASA engineers some sense of what visual materials would interest the public and best convey the agency’s message about human spaceflight. While scientists and engineers involved in the program could directly influence photography from within the agency, or through principal investigators, the media and the public had only the PAO by which to gain visual information about the dangerous and costly missions. The PAO, under tremendous pressure to plan for any possible scenario, considered nearly every point of the mission as a possible instance for conveying the NASA narrative.

From the outset, the relationship between the public visual representations of spaceflight was on the minds of NASA managers. Those on the inside of the process, the people responsible for procuring films, cameras, and other equipment, spoke up and at length about the value of photography as part of the public service angle of exploration. John Brinkmann, chief of the PTL, voiced his opinion about photographic work in a memo to the chief of the Systems Engineering Division upon the occasion of the cancellation of a lunar mapping camera project. Responding to a mid-1968 change in his department’s role in developing films, Brinkmann explicated the need for a variety of still image types, concluding that, “Film is light in weight per unit (about 1 gram) and has a great scientific impact per unit. There is a possibility that it could be the only item of importance evolving from the mission, and it is the only tangible contact that the general public has to the program."[258] The awareness and concern shown here by a professional photographer for public need reveals an understanding of photography's power perhaps not yet fully understood by public affairs officials.

In the early stages of planning for astronaut photography during the Apollo lunar landings, the JSC PAO wrote a lengthy list of required photographic coverage elements to Joseph Shea, then head of the Apollo Spacecraft Program.[259] The four-page memo included general criteria for motion picture shooting, to occur in parallel to 70mm photography. The all-encompassing list of documentary photography, deemed unreasonable and extreme by Deke Slayton's FCOD, included nearly 100 different mission elements that the PAO intended to make available to anyone that might request images through their office. Hardly a moment of the mission went unconsidered in creating the list, including storing empty food pouches, climbing down the LM ladder, and the moment when the main parachutes opened to slow the CM for a water landing. While there were three crewmembers to capture some of these moments, one might imagine that while climbing down a ladder or reentering the atmosphere and speeding towards the Pacific Ocean at a speed of nearly 11,000 meters per second (over 36,000 feet per second) could be a difficult time to pull out a heavy camera to take a snapshot.

Advocates existed outside of the PAO for historical and documentary images as part of connecting the public to the experiences of Apollo astronauts. In a particularly

[258] Brinkmann, John. Memorandum to Chief, System Engineering Division, May 13, 1968. Johnson Space Center History Collection, Record #33430. Location 069-62. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[259] Haney, Paul. Memorandum to Joseph Shea, April 4, 1966. Johnson Space Center History Collection, Included in Record #27055. Location 075-15. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

stinging memorandum to the chief of the Mission Operations Branch, Max Faget, father of the blunt ended capsule design, criticized an early draft of the Apollo 11 lunar landing photographic plan for its near complete disregard for, "…the visual appreciation of the astronaut's activity on the moon during this singularly historical event."[260] Faget continued with his dismal appraisal of the plan by pointing out a lack of a plan to photograph both crewmembers with the Hasselblad camera, using the terms "stingy" and "low quality" in reference to the overall content of the plan. As the chief of the engineering and design division, certainly interested in photographs for his own department's use, Faget was also keenly aware of the need to satisfy the short and long-term impressions possible with still photographs. In perhaps a more telling memo from later in the program, scientists in the planetary and Earth resources division made a suggestion one might assume to be an obvious one to have made at the start of the program. Paul Gast, the division chief, wrote to the JSC PAO to say that the two should work together to ensure that film fames were used efficiently for both their purposes, then processed in a manner to support both their needs with the public and those of the geologists studying samples taken.[261] Another motivation for this recommendation was the possible input of the scientists into the release of photographs, with Gast stating their value in, "…making available to the news media photographs that are more meaningful

[260] Faget, Maxime. Memorandum to Chief, Mission Operations Branch, February 27, 1969. Johnson Space Center History Collection, Included in Record #36956. Location 071-16. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[261] Gast, Paul. Memorandum to Acting Public Affairs Officer, JSC, June 17, 1971. Johnson Space Center History Collection, Included in Record #43848. Location 075-46. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

than randomly selected individual shots."[262] In the cases of engineers and scientists, seemingly common sense approaches to planning photography in conjunction with the PAO fell at rather late stages in the program, perhaps revealing a poorly thought-out plan for visual communication with the public.

Corporations

Not excluded from the vast audience for space images taken by astronauts were corporations who could benefit from information contained in still photographs, a possibility they themselves recognized at the end of the Mercury missions. Within months of Gordon Cooper's *Faith 7* mission in May 1963, at least two companies, Mobil Oil and ITEK, contacted NASA regarding ways to integrate input from astronaut photography experiences into their own work. In the case of Mobil Oil, researchers at one of their laboratories contacted NASA to see how they could analyze Mercury photographs for what was presumably any determinable information in the photographs on oil deposits.[263] While photogrammetric analysis was already underway at the GSFC on the data, sharing the results with a corporation for their potential gain posed no concerns for NASA managers as the photos and any data gleaned from them was a matter of public record and scientific interest.

In a very different way, a photographic technology company wished to use information from NASA to inform the way it manufactured and tested its products. From

[262] Ibid.

[263] Grant, Charles. Memorandum to Jerome Rosenberg, NASA HQ, July 15, 1963. Record Group 255, Folder SP-20.1, National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

the experiences of Mercury astronauts, ITEK, a large format camera maker from Palo Alto, California, hoped to learn how it could improve its own company-funded research into the production of a lunar reconnaissance camera.[264] While the camera they proposed evolved into the remotely-operated camera flown on the last three Apollo missions, they clearly felt at this early stage of development that the astronaut point of view captured via hand-held cameras could inform their investigation. ITEK sought information well in advance of its eventual contract to create the mapping camera, but its interest in the human need for such images only built upon its existing work on remotely operated spy satellites for the U.S. intelligence community.

The commercial implications of astronaut photography may appear hazy at first glance, but companies who dealt with Earth resources issues such as oil, gas, and other mining operations benefitted from the earliest color images taken by people. Those operations turned to the cheaper and safer method of satellite imaging in the later 1960s and 1970s with the rise of programs like the Nimbus, LANDSAT, and GOES satellite systems. [265] Mercury astronaut photography, however, contributed some of the first clear color Earth images to scientific work done to steer corporate operations. By the end of the Apollo program, LANDSAT's emergence as a potentially commercial image program ended the specific need for astronaut photography for mapping. In the end, the attempt to

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[264] Stalder, Jack, Director of Programs, ITEK. Memorandum to Walter Williams, NASA Associate Director, June 28, 1963. Record Group 255, Folder SS-3, National Archives and Records Administration, Southwest Center, Ft. Worth, TX.

[265] Mack, Pamela. *Viewing the Earth: The Social Construction of the Landsat Satellite System*. Cambridge: MIT Press, 1990, p. 20.

commercialize the resource failed and it remained freely available to anyone interested in Earth-directed photography.

The most obvious commercial use of astronaut photography during this period was the retail market for ephemera related to human spaceflight. As identified by John Brinkmann, head of NASA's PTL and ultimately responsible for processing visual materials from flight, a demand for images would arise following the lunar flights in particular. He expressed deep concerns over process for distributing films to commercial entities in a memorandum sent immediately before the Apollo 11 mission.[266] While there was no argument against the legality of companies producing films and other products for profit using NASA visuals, Brinkmann expressed serious concern over the workload such requests would create and the lack of a defined procedure for handling requests. Above all, he sought resolution to the issue of ensuring that none of the other uses would make it appear as though those companies had any exclusive rights to use or distribute the images, as they were all public domain. NASA had–and still has–no ability to stop companies from creating retail products based on images taken by astronauts, but they could control the official agency descriptions and the perception as originator of, and authority on, astronaut photography.

The Public

As a public, government-funded entity, the ultimate audience for any photographs captured by NASA astronauts was the American taxpayer. What those images mean to

[266] Brinkmann, John. Memorandum to Wesley Hjornevik, Director of Administration, June 24, 1969. Johnson Space Center History Collection, Included in Record #38393. Location 071-44. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

the public requires a different form of analysis, but NASA presumed to know the needs of the public audience during its early human spaceflight programs. I would contend that the most direct means for the public to understand the physical reality of spaceflight, and to continue supporting the project, was to represent humans in the context of space via still images. Statistics show that millions around the United States and the globe watched live and recorded coverage of NASA missions on televisions, but still images, for their ease of reproduction and distribution beyond the reach of television, became the primary means by which most people viewed NASA's activities. This required a procedure for those images to go from film magazine to publicly available resources like newspapers and magazines.

One public audience, far larger than the immediate beneficiaries of any of NASA's research and photography, was the international community, including those in positions of authority and anyone with access to printed news media. International requests for photography were recognized as opportunities for good will from the leadership levels down through to those who fulfilled the requests for the images. Lyndon Johnson used the *Earthrise* image as a reminder to world leaders what good the U.S. government brought to the world.[267] As a matter of daily work concerns, the Photographic Technology Lab (PTL), run by John Brinkmann, bore responsibility for fulfilling requests from inside and outside the United States for reproductions of astronaut still and moving images. Following the Apollo 8 mission, Underwood expressed concern about a lack of clear procedures for working with NASA's Office of International Affairs

[267] CBS, "A Conversation about the U.S. Space Program with Former President Lyndon B. Johnson," p.3.

(OIA) and PAO to satisfy the needs of international requests for images. In resolving such deficiencies and streamlining the connection between the PTL and OIA, he identified the benefit to NASA as one in which, "…photographic programs have a great potential of establishing good will with our international neighbors."[268] As a means of communicating a positive message about human space exploration at NASA, and thus the U.S. government, the photographs by astronaut-photographers–our surrogates in space–became critical tools for encouraging positive foreign relations.[269]

The public had few mechanisms for engaging with the NASA's process for prioritizing photographic needs, and without any collective awareness for what would satisfy their curiosity about spaceflight, people naturally identified most with familiar representations in photographs. Many astronaut still photographs featured some element of the spacecraft or other spaceflight technologies, although that did not mean viewers outside the engineering or scientific community would understand the photograph's content. As an audience for astronaut photography, the public needed guidance from NASA and the astronauts. That assistance came through the voice of public affairs officials and news media interviews with astronauts, who played the role of interpreter of images to a public desperate to comprehend image content. Understanding NASA's process of gradual narrowing down to the most appropriate images for publication and

[268] Underwood, Richard. Memorandum to Wesley Hjornevik, Director of Administration, through John Brinkmann, January 29, 1968. Johnson Space Center History Collection, Included in Record #36525. Location 070-64. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[269] NASA sent nearly all returned crews, and some spacecraft, on goodwill tours around the country and world. Most noteworthy are those examined by Teasel Muir-Harmony in her recent dissertation, which examines the global diplomatic implications of tours, exhibits, and other outreach performed by NASA: Muir-Harmony, Teasel. *Project Apollo, Cold War Diplomacy and the American Framing of Global Interdependence*. Dissertation. MIT, 2014.

consumption requires expanded analysis as part of examining how non-astronauts interceded in the after-mission life of the images, shaping the legacy of astronauts and their photographs.

Photographic Operations

Audiences for astronaut photography had varying degrees of success receiving images because of their direct or indirect expressions of need for still photographs. The process by which those images made it from film roll to viewer shaped their use and consumption. NASA, not known for a lack of bureaucratic hurdles, developed a procedure for moving all flight films along this trajectory, primarily though work of those in the PTL. Unfortunately, any records generated by that office appear lost or destroyed, but certain memorandum retained by other NASA offices regarding the PTL's process and relationship to the PAO, most clearly documented during the Apollo program, illuminate the ways in which still photographs became a usable commodity for intended and unintended audiences.[270]

Upon return of spacecraft to Earth, recovery operations brought the vehicle and its occupants from their ocean landing location to an aircraft carrier. During Project Gemini, astronauts often remained within their spacecraft while a crane lifted the spacecraft onto the carrier deck. The process during Apollo had astronauts lifted one-by-one up to a rescue helicopter and the capsule was lifted separately by crane. As spacecraft were unloaded after non-lunar landing flights, a representative of the PTL picked up film

[270] Kathy Keltner-Previs' excellent dissertation on the television presentation of Apollo provides details on the earliest goals of the PAO being one of service to journalists because of their considerable ability to get messages to Congress and the public.

magazines used during flight and returned them to the Lab for processing within 36 hours of a mission's end.[271] In an outline of procedures for film retrieval for the Apollo 8 mission, the Chief of the Test Division wrote that, "Any onboard photography containing earth-looking views shall be prepared for distribution at once, but shall not be released until so authorized by the Director, MSC."[272] This indicates a pause in process of getting still photography released that allows for the national security review. James David discusses this issue in his 2006 *Space Policy* article. Written for the Apollo 8 mission, the enclosed outline with the memo details the distribution of still images throughout NASA and the timeframe in which that was to occur. Listed first for each type of image to distribute is David Goldenbaum, a member of the Apollo Spacecraft Office's Test Division. His position at the top of each category was explained with a note that his copies were for the MSC Mission Evaluation Team.[273] Implied within this prioritization (which ignores the initial national security review period) is the need to analyze visually every aspect of Apollo missions, both to supply information to those who would speak about the mission publicly and to inform future missions.

Magazines from lunar landing missions were processed somewhat differently. Once the spacecraft, its contents, and the astronauts arrived in Houston, everything went into the Lunar Receiving Laboratory so that any potential lunar debris was contained in an

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[271] Arabian, Donald. Memorandum to John Brinkmann, December 11, 1968. Johnson Space Center History Collection, Record #36006. Location 075-31. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[272] Ibid, p. 1.

[273] Ibid, p. 5.

environmentally controlled space.[274] Post-mission processing for Apollo missions 11, 12, and 14 included concerns about the possible transmission of “moon germs.” Quarantine was established in the LRL, which covered staff involved in processing the spacecraft and its contents, those who cared for the astronauts, and the astronauts themselves during the week prior to landing and up to twenty-one days post-flight. One staff member involved in processing films for Apollo 11 (and other missions) was PTL technician Terry Slezak, whose oral history offers valuable insight into the methods used to decontaminate film magazines and transfer them outside quarantine for distribution. In addition to his task to photograph astronauts inside quarantine, Slezak also had the assignment of decontaminating the film magazines with ethylene oxide gas without exposing the film.[275]After completing that process, Slezak explained that armed guards arrived with a PTL courier to rush the magazines to the lab for processing and distribution. The exact procedure was simulated more than a dozen times just like any other NASA process during the year leading up to flight films returning.[276] Slezak gained notoriety for having touched lunar dust by accident during his processing of Apollo 11 film magazines when he picked up one that Armstrong accidentally dropped on the Moon. (Figure 62)

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[274] Forrester, William. Memorandum to the Biomedical Branch, October 12, 1966. Johnson Space Center History Collection, Record #28191. Location 076-13. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[275] Terry Slezak, interviewed by Rebecca Wright. July 29, 2009. Interview Transcript, NASA Johnson Space Center Oral History Project, Houston, TX, p. 23-24.

[276] Ibid, p. 23.

Processing flight films at the PTL underwent its first test after the Apollo 7 mission. According to lab chief John Brinkmann, staff went on twelve hour shifts for the first six days after the mission to process moving and still films for those who required the first set of duplicates from the original film rolls. Processing film on this round the clock schedule apparently set them back on preparing for Apollo 8 as the lab was also responsible for loading magazines prior to flight as well.[277] With a small staff, the PTL contracted out some of this work, and the experience of Apollo 7 prompted Brinkmann to write his superiors to alert them to a potentially disastrous situation with increased films returning from future missions. As seen in Table 2, still frame returns went up significantly with each successive mission, which gave the lab increasing work and a requirement for new equipment and more technicians. Unfortunately, I have not found additional documentation to reveal how the lab dealt with the incredible yields of the late Apollo program.

The route taken by scientific films, those taken with special film or using filters that made them useful to only scientists, however, is far murkier for the historian to discern. Numerous scientific proposals undoubtedly arrived at NASA for experiments to attempt during spaceflight. Flights to low Earth orbit and beyond remove the interference of the atmosphere from observations made through cameras and telescopes, for example, making spacecraft an ideal platform for astronomical and other scientific studies. As the data acquired for these experiments was visual, astronauts used special film magazines,

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[277] Brinkmann, John. Memorandum to Wesley Hjornevik, November 27, 1968. Johnson Space Center History Collection, Record #35851. Location 070-52. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

designated for specific experiments, to capture the appropriate shots. Special processing for these films frequently occurred at contracted labs with specific capabilities for ultraviolet film development, for example. Numerous resources exist on the experiments by way of mission reports, post-program scientific conferences, and results reports required of the principal investigators.[278] The visual results, however, are often either unavailable in a digitized format from NASA, no longer in NASA hands, or were deleted from NASA archives. In a recent attempt to acquire images found in the Gemini V mission report, taken during an experiment to photograph the zodiacal light phenomena. I discovered that those images were deleted from the JSC image library. How or why this occurred is unclear, but it may be possible to track the images down via the records of each principal investigator. As scientific and astronomical images are not the focus here, locating them and researching the reasons they no longer exist in an official NASA repository remains a topic for future research.

Worth mentioning here is the long-term accessibility of Hasselblad orbital photography for lunar research purposes. Because scientists remained the leading audience for astronaut still photography, entire sets of photographic reproductions just a generation or two removed from the flight films found homes with those most in need of the images for their ongoing research. Through the end of the Apollo program, NASA remained the only repository and contact for images needed by lunar scientists through its relationship with Bellcomm, Inc., a subsidiary of AT&T organized to support NASA with technical advising. The company maintained a library of images and technical

[278] The NASA Technical Reports Server (http://ntrs.nasa.gov), available to researchers in public and private (password protected, secure access) modes, acts as the clearinghouse for such materials.

information for use by their staff and NASA. When Bellcomm ended operations with the end of Apollo, the entirety of the image and reference collections as well as some staff transferred to the Smithsonian National Air and Space Museum, becoming the nucleus of what is now the Center for Earth and Planetary Studies. Farouk El-Baz, Bellcomm's trainer to the astronauts in lunar mapping and orbital photography, became the first CEPS director and helped steer CEPS towards involvement in astronaut photography of Earth during the Apollo Soyuz Test Project in 1975. A few years later, scientists and other researchers acquired the ability to access the same high quality photographic reproductions of astronaut still photography through a larger set of facilities established as part of NASA's Regional Planetary Image Facility network, the first of which was CEPS. While the digitization of images renders onsite research at these facilities somewhat antiquated today, the principle of wide distribution and accessibility to the community of interested scientists originated at NASA at a time when the existence of the photographs themselves required hard copy libraries to exist at nationally and internationally recognized lunar and planetary research facilities.

The final step in taking film magazines from flight to the eyes of audiences other than scientists, at least in the case of photographs deemed relevant for immediate public release, was the addition of captions. These content messages attempted to frame conceptions of the images, though little of the text came to linger in the memories of viewers. My research into historical PAO files did not uncover documentation of how this occurred, but the oral histories of Terry Slezak and Richard Underwood explained the involvement of other staff in generating the text that accompanied images. As a means of communicating the details and context of the image, the caption provided by NASA was the most common way the media and public viewers received additional information about the image. For Gemini missions in particular, which all remained in Earth orbit, Underwood developed his own process for comparing mission transcripts, magazine numbers, and maps to determine exactly when in the mission timeline a certain image was taken in order to identify the content and write up descriptions, for either geoscientists or public affairs officers.[279] Underwood did not state it explicitly but presumably the same process, perhaps with assistance from lunar scientists, continued through the Apollo program. Terry Slezak commented in his oral history that, "…we interfaced with the astronauts a lot. They would pick out certain pictures from their missions that they thought were the most salient features of the mission."[280] With explanations from the astronauts, Underwood's research, and input from geophysical or lunar scientists, descriptions of image content were developed to inform those otherwise lacking knowledge of spacecraft, Earth, space, and lunar features.

Who then decided which images of the hundreds or thousands available from each mission would become available to the average viewer? Slezak's comment above indicates the astronauts did play a role in guiding PAO officials in which images best highlighted the significant moments of their missions. Richard Underwood said, on the other hand, that, "Public affairs would get the ones they liked, and I'd give them a nice big write-up on those pictures so they could release them," which positions him as a

[279] Underwood Interview Transcript, p. 24.

[280] Slezak Interview Transcript, p. 20.

crucial voice in conveying information about image contents. Almost certainly, it was some combination of these two, bringing together the knowledge, ideas, and information held by the astronauts, scientists, public affairs staff, and that of photography specialists. In reality then, NASA employees involved in photography do bear some degree of responsibility, both positive and negative, for the ideas informed by visual evidence collected by astronauts as the images are cited even today as proof both for and against NASA rhetoric regarding human spaceflight.

Expectations Fulfilled

While the types of images astronauts captured were somewhat predictable, rarely if at all did those at NASA consider openly how publicly released images might shape perceptions of this heroic period of exploration. The creation of a persistent public understanding of NASA's mission in human spaceflight required the involvement of administrators, public affairs officials, and the astronauts themselves, using images that also fit an existing visual rhetoric of triumph, technological achievement, struggle, humans as part of the landscape. Moving and still images gave audiences the evidence needed to complete processing of the personal testimony of their surrogates in space exploration. Each audience then had the opportunity to consume astronaut photography for what information they needed to produce a response.

Intentionally or not, NASA astronauts provided new images that fit a series of visual tropes for exploration that existed prior to humans venturing off the Earth's surface in the twentieth century. They were well trained in photographic plans and had some of the best quality camera equipment available to produce high quality images for multiple uses. Mission plans acted as scripts so astronauts could easily infer the desires of interested audiences, especially this at NASA and in the scientific community whose instructions for images were very specific. Still, astronauts acted as photographers and used their own sense of composition and subject when veering off schedule for composed shots that conformed to the existing visual tropes and remain the most common in the visual lexicon of the space age. Through the guidance of the written plans and using their own instincts for what made for a good photograph, the results of astronaut photography showed that crew-selected images often fulfilled public needs and expectations. The thousands of still images captured for engineers, scientists, other government agencies, and corporations satisfied those requirements, but as evidence, were not a significant means by which the public constructed a collective memory of the experience of human spaceflight.

As part of our collective understanding of the experiences of exploration, certain images, perhaps best described as icons of the space program, endure as symbols that undeniably recall a sense of accomplishment, success, and pride. Classic landscape views (Figure 16), horizon or “frontier” studies (Figure 19), astronauts demonstrating pride in their achievements (Figure 22) , technologies of travel set in the alien environments of space (Figure 25), and the enormity of terrain features of the Moon (Figure 29) situated astronaut photographs comfortably within a visual history of exploration. Along with perhaps a half dozen other images cited here, most featuring the astronauts in the setting of space, make up the small set of familiar images used consistently to represent the prespace shuttle era of human spaceflight. So while the images captured ultimately fulfilled the rhetorical needs of NASA, they were far from representative of the entire visual record of human spaceflight. To appease the most relevant audience for their long-term successes, however, NASA minimized the scientific achievements of astronauts in favor of the instant gratification of giving the public exactly what it thought it needed.

CHAPTER FOUR: THE AFTERLIFE OF ASTRONAUT PHOTOGRAPHY

> *"We took cameras specifically to document all of the geology we were trying to explain. Because we would explain it…tell them what it would look like. We could take a picture and bring it back. It made all the difference in the world. Well let's face it, look at the picture we took of the full Earth. They tell me that's the most sought after picture that NASA's ever had a request for. You think I'm gonna come home and not have a picture of me saluting the American flag on the Moon? Give me a break!"*
> - Eugene Cernan, Commander, Apollo 17[281]

The earliest images of Earth from space came from V-2 rocket test flights in the U.S. desert southwest after World War II. Confiscated German rockets, more powerful than those developed by the U.S. military during the war, underwent a series of tests by Army and other researchers at the White Sands Missile Range outside of Las Cruses, New Mexico.[282] Within a few years, the same German engineers who developed the rockets in the first place would leverage, thanks to the Project Paperclip effort, their knowledge to create the next generation of rockets capable of reaching orbit, and later, the Moon.[283] It was the U.S. military, however, who put a small 35mm movie camera on

[281] Mark Stewart Productions. "The Last Man on the Moon." Mark Craig, Dir. From filming outtakes, February 28, 2013.

[282] These included engineers from General Electric, Bell Laboratories, the Jet Propulsion Laboratory, the Naval Research Laboratory, and the Applied Physics Laboratory. See: DeVorkin, David H. *Science With A Vengeance: How the Military Created the US Space Sciences After World War II*. New York: Springer, 1993, p. 109-128.

[283] Neufeld, Michael J. *Von Braun: Dreamer of Space, Engineer of War*. New York: Alfred A. Knopf, 2007.

board one of those post-war V-2 rockets and recorded what camera engineer Clyde Holliday called the view of Earth, "…to visitors from another planet coming in on a space ship."[284] The grainy black-and-white still frame taken from the film reel showed little detail, but hinted at the contrast to come when seeing the Earth against the black background of space. (Figure 63)

Imaging of Earth, in parts, continued over the next two decades through robotic cameras and then those used by astronauts when they began carrying hand-held cameras along on missions. For decades leading up to the final mission of the Apollo program in late 1972, moviemakers, artists, and writers speculated on how such voyages to space might shift human perspective. Would we establish Moon colonies for later trips to Mars and beyond? How would this intimate knowledge and experience with space travel affect our conception of our place in the universe and inspire travel to other planets? Or, as some speculated, would humankind turn its attention back towards the Earth itself with the ability of humans and satellites to image the planet in parts or as a whole orb? One outspoken writer of the counterculture movement of the 1960s, Stewart Brand, drew the attention of many around the world towards the latter perspective with his environmentally minded campaign to encourage the publication of a whole Earth image. Brand's work, in addition to that of the growing environmentalist agenda spurred on by works such as Rachel Carson's *Silent Spring*, brought about a dramatic shift in the public perception of astronaut photography during the Apollo program.

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[284] Holliday, Clyde. "Seeing the Earth from 80 Miles Up." *National Geographic*. October 1950. Vol. 98, No. 4, p.511-528.

Coincident to the rise of military-industrial complex of the 1950s came a growing concern for the welfare of the planet. Engineers and scientists manipulated materials into new chemicals for industrial, commercial, and military uses, causing many to question the potential danger such things posed to Earth and its inhabitants. Early concern came from Rachel Carson, the marine biologist and author of the 1962 landmark work *Silent Spring*. The conservationist cause found sympathetic minds in the counterculture movement, people concerned with what was seen as overly aggressive commercialization that threatened their ideas of a peaceful and environmentally friendly society.[285] Writer Stewart Brand was one of those who took up the flag of Carson's concerns, inspiring budding environmentalists to think about how NASA could play a role in shaping the future of their movement.

Illinois native and Stanford University graduate Stewart Brand immersed himself in the countercultural movement in San Francisco in the mid-1960s following a short stint in the U.S. Army. Through his ongoing education in different San Francisco colleges and participating in medical LSD studies, Brand became associated with Ken Kesey and his group of Merry Pranksters, eventually starting an early music festival that inspired some of the legendary musical events of the decade. As Brand himself tells the story, he was in the middle of an LSD hallucination when the San Francisco skyline inspired a thought about the curvature of the Earth: why was there no published photograph of a

[285] For an excellent historical look at the complexity and origins of the counterculture movement, see: Braunstein, Peter and Michael William Doyle. "Historicizing the American Counterculture of the 1960s and '70s." In *Imagine Nation: The American Counterculture of the 1960's and 70's*. Braunstein and Doyle, eds. New York: Routledge, 2002.

whole Earth?[286] Satellites and other spacecraft had yet to be equipped with a camera and the necessary technology to capture a photograph of more than partial Earth at the time of Brand's contemplation in 1966. What he saw then, and used to energize his campaign, was the potential power of an image depicting the entire Earth against the black backdrop of space. For the surging environmentalist movement and a counterculture concerned with peace around the world, a depiction of the globe as a fragile place needing protection served as a rallying cry.

Brand's cause became one of invoking what he called the "great American resource of paranoia" by turning the demand for the photograph into the question, "Why haven't we seen a photograph of the whole Earth yet." Plastered on the ubiquitous buttons and posters of counterculture life, Brand literally sold his message to the American public of his own initiative. (Figure 64) He sold them on college campuses, first at the University of California at Berkeley, and then others around California and the country. He and his friends sent them to scientists and anyone he felt had influence with NASA or the Soviets to turn cameras back towards Earth during robotic or human missions.[287] Having heard his plea for a whole Earth image, NASA used its geostationary weather and communications satellite ATS-3 to give the world the most complete photograph yet of the Earth in late 1967. Once released, Brand had the perfect image for the cover of the very first issue of the *The Whole Earth Catalog*. (Figure 65) Building off the successful community response to the buttons, Brand and his cohort first published

[286] Brand, Stewart. "Photography Changes Our Relationship to Our Planet." *Click!* Smithsonian Photography Initiative, http://click.si.edu/Story.aspx?story=31, accessed on March 28, 2014.

[287] Ibid.

their first issue in the fall of 1968, a guide and retail publication for products deemed useful within the do-it-yourself climate common within the counterculture. The catalog's success proved Brand's campaign had real influence within the counterculture movement and made government officials take notice. Later catalogs featured new photographs of Earth from space as astronauts took them during the Apollo program, though the publication never featured the most famous of those, the *Whole Earth* image from Apollo 17. (Figure 66) Brand's point about the value of seeing Earth from space was made clear from countless reuses of astronaut-captured Earth images for decades after.

From the start, Brand and his cohort were critical of there being no images of a whole Earth, but the *Whole Earth Catalog* contents reveal strong support for NASA and particularly photography by astronauts. In the Spring 1969 edition, one page features a small write-up on the Apollo 8 mission as well as a list and purchase information for recent NASA publications featuring astronaut photography.[288] Placed within a section about whole systems, and in the context of a publication intended to offer tools to individualize understanding of and working with the environment, a feature about NASA publications and projects brought photographic accomplishments to an audience already highly receptive to the view of Earth presented by the astronaut images. By speaking to the community historian Fred Turner calls the New Communalists, the *Catalog*'s editors made NASA astronaut photographs of Earth far more accessible to an interested community.[289] Stewart Brand and those associated with the *Catalog* found that

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[288] Brand, Stewart, ed. *Whole Earth Catalog*. Spring 1969, p. 7.

[289] Turner, Fred. *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*. Chicago: University of Chicago Press, 2008, p. 4.

technology in the form of NASA human spaceflight and astronaut photography offered a means to promote their dream of a more inclusive, united globe.

Personal impressions of seeing Earth from space, often related in debriefings and interviews by Apollo astronauts who took part in the nine missions to the Moon, set the stage for the ongoing usage of photography from those missions. For these other worldly experiences, as Eugene Cernan stated in response to my recent questions asked regarding Apollo photography, the images were crucial to creating an understanding back on Earth about the experience and value of spaceflight. While characterized accurately as documents of scientific and technical work, what set certain images apart was the discovery of the unexpected in single frames of film, things that evoked emotion in the familiar.[290] Repeated stories from the time of the missions and in popular works of history in the decades that followed added a mystique to the still images, giving them a tinge of the immortal quality photographer Underwood said astronauts needed to aim for when taking pictures. How NASA and the astronauts approached discussing photographs played an important role in how audiences interpreted the wealth of still images captured during the early human spaceflight program.

Surrounding anniversaries of particular missions, commentary flows from NASA, journalists, and historians regarding the heroic nature of lunar exploration. For example, to mark the mission's 45th anniversary in 2013, NASA released a computer simulation that recreated of the lunar orbits of Apollo 8 using spacecraft data, Lunar Reconnaissance

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[290] While the authors define the term iconic immediately, their only references to NASA images with iconic status are the series of images recalled thanks to video coverage of the space shuttle *Challenger* disaster of 1986. Hariman and Lucaites, p. 3. Discussion of the term and meaning of iconic appear regularly in visual culture journals and scholarly books. Important to note is: Moxey, Keith. "Visual Studies and the Iconic Turn." *Journal of Visual Culture*. Vol. 7, No. 2 (2008): 131-146; and Mitchell, *Picture Theory*.

Orbiter images, and astronaut photography from the mission. News outlets and social media quickly disseminated the video, putting the flight and *Earthrise* back on the front page.[291] Narrated by space writer Andrew Chaikin, the computer generated images and subsequent interviews perpetuated the myth of *Earthrise* as a serendipitous moment. What the flight plan and mission documents show are the notations and expectations not for the exact moment *Earthrise* was photographed, but just the availability of such a scene. As with nearly everything astronauts did, the moment was identified during astronaut preparations and plans, leaving astronauts well prepared for the concept, perhaps just not at that exact moment in the mission. (Figure 51) Targets of opportunity and all required images appeared in neatly organized tables or memorandum for every mission. Two instances, however, clearly contradict the understanding of *Earthrise* as totally spontaneous. A bullet point on one of the last pages of the flight plan shows a need to capture "Earth Set and Earthrise." The page, a listing of lunar flyby photography procedures, gave a short list of photographic activities at both less and greater than 180 nautical miles from the Moon. The astronauts also famously used an RCA television camera during their broadcasts throughout the mission.[292] These broadcasts, at least a week before public release the photograph itself, gave television viewers their very first human perspective on Earth from the vicinity of the moon. The pictures made Earth look

[291] NASA Goddard Scientific Visualization Studio, "NASA: Earthrise – The 45th Anniversary," viewed on September 5, 2014: http://www.nasa.gov/content/goddard/nasa-releases-new-earthrise-simulation-video/#.VAoJVPldWSo.

[292] The most famous broadcast from Apollo 8, the Christmas Eve reading from the Book of Genesis, only featured the constant image of the lunar surface passing by a Command Module window.

like not much more than a big ball of light.[293] (Figure 52) While prepared technically for the site of Earth emerging from behind the Moon, few associated with NASA or otherwise could foresee the deep significance the image connoted for decades following Apollo 8.

So how do these two elements influence the dissemination and public understanding of the color *Earthrise* photograph – how the Moon and Earth truly appeared to astronauts? One possibility is that NASA focused so much on the television broadcasts as tools for public relations that it failed to come to terms with the potential influence and emotional value of still photography from Apollo 8 or any human-crewed mission. Having access to a new technical capability such as live television, NASA certainly wanted to latch onto the public popularity of instantaneous moving images of newsworthy events. More and more families at the time were getting their news about things like the war in Vietnam through television news broadcasts instead of printed media. Putting Apollo missions on display, especially this first one around the Moon, in the homes of millions around the world appealed to NASA as a means of garnering political and public support.

Examining the agency's public affairs and Administrator's office records in detail, a task for future research, may reveal a different perspective on prioritizing different image types, perhaps illuminating a reason why the color *Earthrise* received less immediate attention. The story of dissemination, the last moments NASA controlled the

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[293] Compared to television images of today, Apollo era broadcasts appear fuzzy or grainy, as noted by Kathy Keltner's dissertation, "From Myth to Metaphor to Memory," though at the time were considered very clear: Dubrow, Dick. "Well, you've seen it: Buck Rogers is real." *The Evening Star*. Washington, D.C., July 21, 1969, p. D-5.

images, is critical to analyzing their transition from only documents of a mission to visuals implanted permanently in public memory. Some sources, however, do lead to understanding how NASA's photographic program and public affairs office disseminated still photographs. As described in formal reports and oral histories, the Photographic Division in Building 8 at MSC took great care in processing negatives, preferring hours of careful development over using advanced machines to speed up the creation of masters for release to the press. Richard Underwood described the process of releasing images as rather informal, with senior managers and public affairs officers examining photographs as they came off the machines, often being caught up in their sheer beauty. Framing these photographs with textual descriptions also shaped public understanding. Historian Robert Poole recognized in his recent publication that, "The captions supplied by the photographic service were, however, informative rather than poetic."[294] While the caption underwent revisions, this initial text released to the world avoided any judgment or expressing emotion.

In the days, weeks, and months following NASA missions, images spread across the pages of newspapers, magazines, and other media, sometimes alone but usually set visually within the wider context of contemporary events. As news stories and magazine features about early spaceflight missions faded, the rhetoric about spaceflight continued, amplified using photographs. Those moments became touchstones for a time of tumult, as shining moments of brilliance and success. The vibrant communities of space historians, scientists, and enthusiasts continue to use astronaut photography even today. An equally

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[294] Poole, p. 28.

fervent community of Moon hoax supporters uses the photography to support their own cause.[295] The apparent value of such images continues to inspire new generations of astronauts, environmentalists, and politicians, who seek to revive the emotions evoked by what some see as humankind's greatest technological triumph. While lunar geologists continue to use Apollo images for research purposes, the life of these publicly available images continued far beyond NASA's expectations.

Immediate Reactions

As exciting and dangerous as human spaceflight appeared to those watching around the world, the U.S. and Soviet programs were far from the only thing attracting attention at the time. By the time of the final landing on the Moon in late 1972, animosity over the war in Vietnam had grown to a fever pitch with protests at university campuses and in cities around the country. Rioting around the country throughout the 1960s over the inequality of the races only slowly subsided after the deaths of the heroic figures who worked to forever change the landscape of race relations. Ongoing troubles in the Middle East, a vibrant counterculture movement, and economic crises spent weeks and months on the front pages of major newspapers. The reality of the day-to-day for Americans rarely if ever included pondering the benefits of spaceflight, though momentary excitement over major astronaut achievements never escaped notice.[296]

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[295] Bennett and Percy, *Dark Moon*.

[296] Polling number in support of moon landings spiked around the Apollo 11 landing, but just barely reached over 50 percent. For useful charts on this, see: Launius, "Public Opinion Polls and Perceptions of U.S. Human Spaceflight," p. 167-168.

Astronaut photography mattered most in the daily lives of the audiences who expected to benefit from it: scientists, engineers, and management at NASA responsible for boosting the visibility of the agency's accomplishments and with an eye towards future budget allocations for prospective programs. Principal investigators for photographic experiments during Gemini and Apollo examined copies of returned films and published results in professional and popular venues. Frequently, analysis of astronaut photography appeared in official NASA publications, the same publications later advertised in the first issues of the *Whole Earth Catalog*. Engineers examined photographs in the immediate aftermath of missions for adjustments to equipment and procedures for future missions. Administrators presented them as proof of NASA's triumphs and mission successes. These professional audiences, the ones responsible for predetermining the results of astronaut photography by contributing to photographic plans, used the images as evidence and influenced others within their respective fields. None of them had the ability to project or shape responses of the non-professional audience, those who used astronaut photographs in a multitude of media and as visual representations of their own messages about what astronauts saw.

If astronaut photography made a difference in the lives of professionals in the sense of providing evidence for study and work, then giving the images meaning came in the process of their dissemination to a public audience. Not only did those in the U.S. see film and video from missions on national and local news broadcasts, newspapers and magazines regularly ran stories about NASA featuring astronaut photography. Thanks to the ease of spreading images via print and television reproduction, people could virtually step into the shoes of astronaut photographers no matter their location in the world. From the early days of Project Mercury, NASA worked with the USIA to ensure distribution of images through outreach efforts, direct connections with the foreign press, movie and radio program production, and then tours of spacecraft and astronauts.[297] Evidence of the influence of astronaut photography, their appearance in materials that contributed to the legacy of the astronauts as our surrogates in space, exists in areas ranging from artistic interpretations to reuse in presentations by environmental activists. The continued use of astronaut photography through the present day illustrates the veracity of Richard Underwood's reminder to astronauts as they trained in photography: a sort of immortality existed for them through photographs of their experiences.

Gauging immediate reactions to astronaut photography by audiences requires merging information gleaned from NASA archival documents, scientific and technical reports that used the images as evidence, and some of the most widely circulated contemporary newspapers and magazines. For audiences with access to those sources in the period following missions – from days to months after their conclusion when visual information became available –photographs played a transformative role in terms of research, technology, and personal viewpoints. For many, astronaut photography seen in those moments solidified a public view of astronauts, NASA's human spaceflight program, and their accomplishments. Positive public memories of those achievements took shape thanks to the visual and textual rhetoric of NASA, journalists, and other

[297] Kendall, Harry. Memorandum to Paul Haney, November 8, 1961. Record Group 255, Folder SS-6, National Archives and Records Administration, Southwest Center, Ft. Worth, TX; on the Apollo 11 post-mission tour, see: Muir-Harmony, Dissertation p. 191-205.

writing for public audiences. Those memories are reinforced and endure even today thanks in large part to the impressions made upon seeing the still images – and not all people did see the images – brought back from space by astronauts.

Professionals

After processing, some of the first people to review astronaut photography were the professional community of scientists and engineers working on the next steps in human spaceflight mission planning. Information contained in those images could alter the operations, safety, or experiments planned so photographs required analysis. Such examinations had the potential to alter plans in major or minor ways, so capturing high quality photographs received serious attention as a part of astronaut training in data gathering. Outside those related to mission operations, the intelligence community also sought out astronaut photography in order to maintain some level of control over any high-resolution images that could pose a national security threat or provide them with useful intelligence about other countries. Inside and outside government agencies, professionals sought to use images captured by astronauts to enhance their understanding of Earth, the Moon, and the impact of human activity on both bodies. Despite the importance of such images to the broad interests of researchers and subsequent publication of images with their findings, little of this work made a significant impact on the general population. Interpreting the data compiled in Table 2, the bulk of photographic work supported the interests of professional scientists, engineers, intelligence analysts, and others around the government using in the images as evidence.

For scientists at research universities, laboratories, and government facilities, astronaut images were an invaluable source of information for their geological, meteorological, and astronomical studies of Earth and the Moon. Those photographs became illustrations for countless articles, presentations, and books published for decades afterwards, providing inspiration for additional research and investigation with more powerful research tools in later years such as satellites and telescopes. In the forward accompanying the publication "Manned Spaceflight Experiment Symposium, Gemini Missions III and IV," the editor states that this was the first symposium in a series intended to cover the results of mission experiments.[298] The immediate audience and participants were to be the scientific community, but as George Mueller stated in his opening remarks, NASA hoped this series would also fulfill the requirement in the National Aeronautics and Space Act of 1958 for them to disseminate information about space research to as wide an audience as possible. Presentations on photographic experiments used multiple images as visual evidence, including indicating which of those photographs could serve as starting points for further research. Dr. Paul Lowman cited a photograph from Gemini IV in his report and how features seen in the North African country of Chad were proof of the utility of space photography of remote locations, as well as how images could reveal previously unknown geological features.[299] Kenneth Nagler and Stanley Soules made similar forward-looking statements in their report at the conference on experiment S-6 regarding Synoptic Weather Photography. For

[298] "Manned Space Flight Experiments Symposium, Gemini Missions III and IV," p.iii.

[299] Ibid, p. 22.

meteorologists, the photographs may not have provided any dramatic evidence of unknown phenomena, but provided material that encouraged additional research and connected existing work to the images provided by Gemini astronauts.[300]

A subsequent conference at the end of the Gemini program also brought together the research of scientists and DoD staff most interested in photographic results, but included contributions and conclusions from those who worked on issues of spacecraft engineering and astronaut experiences. Photography dominates the experiments section, with an illustrated portion written by Richard Underwood that proclaimed the benefits of astronaut photography. He demonstrated the utility and beauty of the photographs acquired for the terrain and weather experiments with numerous examples and continued with those acquired from near-object experiments but having mostly spacecraft and astronaut subjects.[301] Descriptive narratives on the scientific results fell to a presentation and paper by Jocelyn Gill from OSSA and Willis Foster, Director of Manned Flight Experiments. They explain how specific photographs taken by Gemini astronauts showed geological features ripe for future terrestrial and orbital research along the Baja peninsula and Red Sea.[302] The successful performance of such experiments, they concluded, was possible because of rigorous training and procedure development akin to that used in preparing for spacecraft operation. While training for photographic work was unlikely to rival that carried out for spacecraft operations, the community of scientists and engineers

[300] Ibid, p. 32.

[301] Underwood, Richard. "Space Photography." In *Gemini Summary Conference, February 1-2, 1967.* Houston: NASA, 1967, p. 231-290.

[302] Gill, Jocelyn and Willis Foster. "Science Experiments Summary." In *Gemini Summary Conference, February 1-2, 1967.* Houston: NASA, 1967, p. 292-293.

responsible for formulating experiments, preparing equipment, and developing procedures and training for astronauts made their satisfaction with astronaut work known through presentations at conferences like this and publications in journals and NASA books.

In addition to engagement with photography at professional scientific and engineering conferences and in publications, NASA also used a strategy of assembling large volumes of selected images from Gemini missions through the Government Printing Office. Compiled by the Scientific and Technical Information office at NASA Headquarters, the volume for Gemini missions III to V served as a conduit between NASA and the scientific community. The first sentence of its introduction reads, "The purpose of this volume is to provide examples of the photographs obtained from the first three manned Gemini flights, and to make them available to scientific users in various disciplines."[303] For seven dollars, anyone could purchase the book to view 242 printed color photographs (three from Gemini 3, 95 from Gemini IV, and 144 from Gemini V) selected by a panel of photographic experts primarily from inside NASA. Editorial responsibility for the volume fell to Jocelyn Gill from OSSA. Most captions are straightforward geographical information, indicating the utility of Richard Underwood's identification work, with some minor meteorological and geological explanations. That publication style left images wide open to scientific interpretation, and only guided casual viewers by identifying noteworthy landmarks. With the involvement of scientists in selecting the images from mission indices, lists of which were printed at the end of the

[303] National Aeronautics and Space Administration. *Earth Photographs from Gemini III, IV, and V*. NASA SP-129. Washington, D.C.: NASA, 1967.

volume, the book has a scientific intent but left open the possibility that non-professionals could find enjoyment and value in owning the book. With this accessible format for visual presentation and captions, NASA paved the way for commercially viable editions published for later missions.

Scientists interested in Gemini photography for astronomical, geographical, geological, and other scientific analysis could access the images through involvement in the photographic experiments, direct request from NASA, or review in publications. The utility of the images in their work and later publication of them in academic and professional publications illustrates the importance, at the time, of human observations of Earth, the Moon, and other celestial phenomena. Notable in such articles is the inclusion of photographic reproductions. As tools of science, showing the evidence upon which analysis was made is crucial in attempting to convince readers of the veracity of the argument. By including the photographs discussed, crediting the photographers (either generally with NASA or the astronaut by name), and noting processing of the frames for specific areas of interest, researchers acknowledged the necessity of visual evidence in proving their point. Based on the expectation that scientists would use such images, government scientists prepared some preliminary analysis of their own regarding the possible uses of Gemini photographs. The U.S. Geological Survey issued an early summary of images in a March 1967 report done at the request of NASA, assessing the cartographic potential of orbital photography using just four illustrative images and one map based on the fourth of the images to demonstrate their point.[304] This technical report predicted the addition of the Reseau plate to Apollo Hasselblad cameras, noting that photogrammetric data such as fiduciary marks for making measurements were required to make accurate maps.

Just one month after that report, Paul Lowman, a scientist at the Goddard Space Flight Center in Maryland, followed that initial report with his own and included seventeen photographic plates as examples.[305] This more thorough examination of Gemini photographs as material for geological research presented a preliminary overview of image use in research, but also some of the NASA technical information on cameras used and cross-references to existing works. While inclusive of NASA scientists' own research, these government publications became a platform for image analysis by other scientists, laying out all of the technical information otherwise required in scientific work for creating baseline metadata. When not directly involved in shaping photographic results, researchers needed NASA to provide such data after the fact to make use of images taken by astronauts.

Later in 1967, academic journals began featuring articles that included analysis of photographs taken by astronauts. In the *Astrophysical Journal*, scientists from the Yerkes Observatory and Northwestern University published an article on a nebula as seen in a

[304] Nugent, Robert and Lowell Starr, "Gemini Photography Evaluation," NASA Technical Letter – 69, Washington, D.C.: NASA, March 1967.

[305] Lowman, Paul. "Geologic Applications of Orbital Photography." NASA Technical Note D-4155. Washington, D.C.: NASA, April 1967.

single Gemini XI photograph reproduced in the article.[306] They included detailed descriptions of the camera system used (the Maurer 70mm camera), wavelengths of light analyzed, and film processing for their research. While they made frequent references to the astronaut photographers, it is clear that the authors understood the benefits and drawbacks of having human operators at the controls for such work. There was a presumption and expectation in these reports of acquiring better photographic data in the future through remotely operated telescopes and satellites. Proportionally, however, terrestrial and lunar surface image experiments received more attention than astronomical phenomena, and therefore saw wider distribution and publication in scholarly work.

For years following the end of the Gemini program, even into the orbital and lunar missions of Apollo, geologists used astronaut-captured photographs from Gemini for their research into terrestrial structures over wide areas. As explained by Lowman in a June 1969 article, one of the key benefits of Gemini orbital photography was the amount of land seen in each frame, the availability of color and multispectral coverage, and the unlimited ability to disseminate the photographs.[307] Like his earlier summary report on Gemini photography, Lowman noted here the many advantages and disadvantages of orbital photography for scientific work, many of which existed regardless of human or robotic involvement in image capture. While technology and uncontrollable environmental conditions limited the quality of returned images, Lowman, a NASA scientist, encouraged further use of astronauts photography for mapping, tectonic and

[306] O'Dell, C.R., Donald York, and Karl Henize. "Structure of the Barnard Loop Nebula as Determined from Gemini 11 Photographs." *The Astrophysical Journal*. Vol. 150, December 1967.

[307] Lowman, Paul. "Geologic Orbital Photography: Experience from the Gemini Program." *Photogrammetria*. Vol. 24, Issues 3-4, June 1969, pp. 77-108.

sedimentation studies, and the planning of fieldwork and regional surveys. Lowman even dedicated a short section to the "unlimited dissemination" possible because of the Space Act requirements, making the work a real boon to scientists around the world.[308] In the same issue of *Photogrammetria*, H.E.C. van der Meer Mohr similarly assessed the value of Gemini photography, though his positive commentary looks at the potential of imaging for geological mapping.[309] These resources received promotion by NASA scientists and principle investigators in professional research journal publications, encouraging additional and nuanced research plans for later missions.

Photographic targets for specific geological areas, discussed in other articles, stemmed seemingly from Lowman and the NASA team's knowledge of current interests while planning for work by astronauts. Candidate locations for photographic work required prior identification to make the work by astronauts during missions straightforward and essentially scripted by way of mission timelines and plans. A brief survey of articles resulting from Gemini photographic experiments shows a confluence of research for scientific knowledge and for commercial interests.[310] Geologist Frank Wobber, working for IBM and later EarthSat, published articles following both Gemini and Apollo missions that, at their core, indicated the Earth resources knowledge gained from astronaut and other orbital photography. His heavily illustrated work frequently included notations inscribed on the images to illustrate features of interest for locating

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[308] Ibid, p. 93.

[309] van der Meer Mohr, H.E.C. "Geological Interpretation of Hyperaltitude Photographs from Gemini Spacecraft." *Photogrammetria*. Vol. 24, Issues 3-4, June 1969, pp. 167-174.

[310] Wobber, Frank J. "Space Photography: A New Analytical Tool for the Sedimentologist." *Sedimentology*. Vol. 9, 1967, p. 265-317.

natural resources. For example, structures in and around the Red Sea were studied commonly because of the relationship between visible geological patterns and possible oil and other natural resource deposits.[311] The long-term study of this region relied heavily on astronaut photography for visual investigations until the network of Earth resources satellites went into orbit to provide automated imagery collection in the early 1970s.

More important than the articles themselves to understanding the impact of astronaut-captured photographs is their use within the publications. In most cases, the articles included at least a single visual reference, and often used multiple photographs, some heavily modified with cropping and pre-Photoshop hand editing. (Figure 67) Embedded within often-lengthy textual explanations of their findings, the photographs, in their original, edited, and retouched formats, revealed plentiful support for theories about geological, meteorological, and astronomical features and phenomena. When used as evidence, astronaut photographs not only fulfilled the original goals of scientists whose photographic experiments became part of human missions, but also the needs of scientists globally, whose research interests dovetailed with the results. The photographs, as indicated by Wobber's article on planning for future satellite missions, also indicated what more frequent robotic vehicle imaging would offer to researchers. Just as engineers and scientists found in adjusting mission plans during the active phases of the Gemini and

[311] Abdel-Gawad, Monem. "Geological Structures of the Red Sea Area Inferred from Satellite Pictures." In, *Hot Brines and Recent Heavy Metal Deposits in the Red Sea*. Degens and Ross, eds. Berlin: Springer-Verlag, 1969, p. 25-37.

Apollo program, photographs captured by astronauts did far more than expected originally as a means of informing future scientific work.

Editing photographs, tweaking them with overlaid interpretive elements or cropping them to focus on distinct features, requires examination as part of the process of disseminating astronaut photographs because it fundamentally shaped and altered the experience of the viewers. For the audience of these articles – other scientists – only the segment of the photograph relevant to the research mattered as long at the edited material did not negate the use of the photograph as evidence. In the example from the van der Meer Mohr article, the cropped image he used as his first example is a nearly indistinguishable part of the actual photograph taken by astronauts White and McDivitt. (Figure 68) By cropping out the vast majority of the image, the author eliminated nearly all context unless the viewer was intimately aware of the geography featured, any aesthetic value wiped out in favor of establishing the image as one of science. What this demonstrated and did repeatedly throughout the space program was that in using publically available images generated by a government source, audiences had the ability to imagine and reimagine astronaut photographs in thousands of ways. NASA managers only pinpointed a handful of those images as useful from their first release.

The exponentially higher number of images from Apollo meant that more scientists wrote even more articles on features seen in photographs. In the case of missions targeting the Moon, however, geological and geographical investigations surpassed all others types of research regarding the interpretation of photographs. In these specialties, physical evidence in the form of rocks and soil returned by astronauts added new dimensions to the character of research, allowing scientists to enhance findings gained from each.[312] Principal investigators for imaging experiments naturally published their findings, typically through reports prepared for or through NASA. The most significant source of research in the immediate aftermath of the Apollo program came from the Apollo Lunar Geological Team. This research component of NASA was home to geologists and other scientists intimately familiar with the expectations for image and sample returns from the lunar landings – their work shaped those results in a direct way through representatives at mission planning meetings. Their research interests were the basis on which specific images were taken and samples collected. As the direct audience for the vast majority of images collected by astronauts, scientists found plentiful visual material on which to base their research in the nearly 20,000 film frames featuring the lunar surface and hundreds of pounds of samples returned.

Special reports prepared by NASA scientists often served as the basis for additional work by those in the next tier of researchers, were cited repeatedly throughout the following decades, and became an impetus for those same researchers to build upon the work later. With a plethora of evidence at hand in the form of images and samples, thousands of articles, conference proceedings, special journal editions, and edited volumes were produced in the four decades that followed. Even today, scientists from the handful of Regional Planetary Image Facilities work with the first generations of masters

[312] Briefly, some examples of scientific articles using the geological samples are: Apollo Lunar Geology Investigation Team. "Geologic Setting of the Apollo 15 Samples." *Science*. Vol. 125, No. 4020 (January 28, 1972): 407-415; Pieters, C. and T.B. McCord. "Characterization of Lunar Mare Basalt Types. A Remote Sensing Study Using Reflection Spectroscopy of Surface Soils." In: *Lunar Science Conference, 7th, Houston, Tex., March 15-19, 1976, Proceedings*. Volume 3. New York: Pergamon Press, 1976, p. 2677-2690; Donohue, Patrick Howard. "Origin and Evolution of High-Titanium Mare Basalts." Dissertation. University of Notre Dame, 2013.

made from the original flight films created from Apollo photographs in their continuing work on lunar geology. Samples collected and later stored at the Lunar Receiving Lab (LRL) in Houston are still accessible to scientists, though through strict protocols and security restrictions.[313]

Photographs from the Mercury, Gemini, and Apollo programs fulfilled a particular role for those who established the need for images and targets slated for astronaut work. A professional community of scientists and engineers played a role in shaping the scripts astronauts followed, so the content and context of the images mirrors the programs themselves. Mercury, a test period for people, vehicles, and procedures, was also one of experimentation and newness for photography, nearly always Earth-focused and lacking relatable content for viewers relegated to life on the ground. Gemini, an oft ignored program used to perfect the techniques necessary to landing successfully on the Moon – rendezvous, docking, and EVA – was also one about perfecting the technologies and procedures for photography. For the ultimate show of power, ingenuity, and experience, Apollo demonstrated how the managed and measured process developed at NASA could provide some of the most visually memorable moments in human history. This refinement of photographic practices over the course of three programs and just under a decade provided a plethora of photographs for scientific research, engineering studies, and public relations. They would continue to support the missions of each audience for decades following the last lunar landing of Apollo 17 in December 1972.

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[313] All lunar material remains the property of the U.S. Government except for pieces lost/stolen or gifted to those deemed NASA heroes (plaques with their embedded lunar samples are required to be publicly viewable). For the story of one team's quest to locate missing and stolen samples, see: Kloc, Joe. "The Case of the Missing Moon Rocks." *Atavist*, No. 12, February 2012.

Responses to Apollo photographs particularly, immediately following and long after missions became, despite the satisfaction of and continued use by scientists, the visible contribution of astronauts to the space program and evidence of their experiences.

Outside of the scientific and technical communities of users, exploration photographs by astronauts appealed to the managers and political entities responsible for making human spaceflight possible. These important and useful evidentiary tools took center stage next to witness testimony at the regular and special hearings in front of Congress. As with any government agency, upper level managers worked through PAO offices to take their message to supporters, but were also required to report regularly on their progress and explain any problems experienced. The most notable and publicized hearings were in the instances of the two major disasters NASA experienced during this period, the Apollo 204 capsule fire and the Apollo 13 mission failure. NASA's use of images and their appearance in printed hearing records varied by the setting, in this case the house of Congress in which the hearing took place, and presumably the nature of record keeping for the hearings. The hearings following the Apollo 13 mission's technical failure make for an excellent case in point. The Senate hearing record includes a handful of drawings, but no photographs of parts or other engineering information specific to the accident.[314] On the other hand, the House hearings were extensive and included a copy of the accident review board's report. Within the House hearings proper, NASA representatives showed slides of the equipment in question as photographed prior to the flight. Speakers presented astronaut photographs only within the context of the

[314] "Apollo 13 Mission: Hearing Before the Committee on Aeronautical and Space Sciences." United States Senate. Ninety-First Congress, Second Session, April 24, 1970. Washington, D.C.: GPO, 1970.

review board supplemental material, showing the Service Module damage caused by the oxygen tank explosion, printed as an appendix in the final record of the hearings.[315]

As part of the normal operations of NASA and Congress, authorization hearings were held and biannual reports were submitted to keep members of the assigned committees informed as to the use of allocated funds and program progress. Throughout its history, NASA submitted bi-annual reports to Congress to report on activities over the previous half year. While not a comprehensive review of the work done by astronauts, the report that encompassed the first two Apollo flights included a number of crew photographs and other illustrations, as well as material on the non-human spaceflight activities of NASA work as well.[316] Annual authorization hearings to renew NASA's mission as an agency and establish funding needs became another venue to present visual evidence from astronaut experiences, typically at the beginning of the slides to grab attention. For example, during the FY1971 hearing, NASA management presented a few astronaut photographs, but stepped up the presentation in their FY1972 hearing in early 1971 with a video of Apollo 14 mission highlights narrated in person by the crew. They continued in the hearing by speaking about their experiences while showing slides of the photographs taken on the Moon.[317] Both Apollo 15 and 16 crews presented testimony and

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[315] "The Apollo 13 Accident: Hearings Before the Committee on Science and Astronautics." United States House of Representatives. Ninety-First Congress, Second Session, No. 19, June 16, 1970. Washington, D.C.: GPO, 1970.

[316] "Twentieth Semi-Annual Report to Congress, July 1 – December 31, 1968." House Document 91-153, October 3, 1969. Washington, D.C.: NASA, 1969. It should be noted that the vast majority of the report detailed activities other than human spaceflight, reflecting NASA's actual work and not just what garnered the most public attention.

[317] "1972 NASA Authorization: Hearings Before the Committee on Science and Astronautics." First Session on H.R. 3981 (superseded by H.R. 7109), March 2, 1971. Washington, D.C.: GPO, 1971.

photographs during informational hearings on just their missions, while the Apollo 17 experience was integrated into the FY1974 authorization hearing that featured only geologist Harrison Schmitt.[318] While this is only a summary of the late Apollo program Congressional hearings and the use of photographs, a more comprehensive examination of NASA preparations for such hearings may tell a more complex story. Additional research may also illuminate what responses NASA expected to the inclusion of images or how persuasive visual evidence may have ultimately been in accomplishing the funding goals of these hearings.

For the professional science and political communities, astronaut photography more than fulfilled the expected needs foreseen during mission preparations. Scientists and legislative affairs staff at NASA had thousands of images from which to work when looking to understand lunar features and prepare material for different hearings on Capitol Hill. What differs between the uses of images as evidence in these two scenarios was not just the audience using the images but also those meant to be persuaded by the presentation and interpretation of the photographs. The scientific community's objective standards for evidence made the use of astronaut photographs far more persuasive and significant than how NASA used images in the highly subjective setting of Congressional hearings, which depended on a far more diverse and intricate set of evidence than photographs or research alone. Within the public context of publication, photographs taken by astronauts found an undoubtedly more murky and complex response.

[318] Committee on Science and Astronautics, House. "Apollo 15 Mission Report." HRG-1971-SAH-0005, September 9, 1971; "Apollo 16 Mission Report." HRG-1972-SAH-0003, May 16, 1972; "1974 NASA Authorization." HRG-1973-SAH-0023, March 14, 1973, p. 501-533.

Non-Professionals

People outside the primary audience for astronaut photographs, those who had no connection to the scientific content of images, had fewer technical and more thoughtful and emotional reactions to the images. An interesting comparison evolves though when examining the relationship between spaceflight visuals released following Apollo missions and those that competed for the same space in news outlets and public attention. One of the most visually compelling events that competed with Apollo for the attention was the Vietnam War. Nightly news coverage regularly brought a national audience moving images of the successes and failures of the American military in Southeast Asia.[319] On a less frequent basis, usually about three times each year, newspapers and television programs also provided viewers with images of spectacular space missions that sent humans around and to the surface of the Moon.[320] It then came down to producers of printed and television news outlets to decide if and how they would allocate space and time to these events. The public's interaction with and memories of these historic events was primarily a mediated one, designed by a combination of those taking the images, those releasing the images, and those making the choices on what made it in front of the

[319] Crucial to understanding the connection between memory and images of the Vietnam War is the first chapter of Marita Sturken's *Tangled Memories: The Vietnam War, the AIDS Epidemic, and the Politics of Remembering*. Berkeley: University of California Press, 1997. She explains that one agreed upon point about the War was that it was divisive, but that nearly all photographs in the public sphere support the understanding of it as a brutal attack on the innocent people of Vietnam (p. 93).

[320] Complete mission coverage on major networks such as CBS occurred for nearly every U.S. human mission from Alan Shepard's Mercury flight through Apollo 12.

public. The politics of the printed news publication process had tremendous impact on the reception of astronaut photography by the reading public.

Before examining the ways in which the public encountered astronaut photographs in traditional print media, another form of direct public engagement by NASA needs examination. In a format first seen in the publication *Earth Photographs from Gemini III, IV, and V* from 1966, large, colorful editions of formally printed photographs became a hallmark of NASA's externally facing effort to proclaim its good deeds and contributions. This book and one compiling images from the final Gemini missions and prepared at NASA Headquarters in the Scientific and Technical Information Division, show awareness for the value of visually explaining achievements as part of NASA's federal mandate set forward in the Space Act of 1957.[321] For simple identification of geological features, necessary reference information for Earth and Moon surface shots, Richard Underwood worked on captioning the images accurately.[322] The success of the book amongst scientists and the public prompted internal NASA discussion of similar Apollo books after Apollo 8's successful return from the Moon.

In March 1969, memos circulated between NASA managers about compiling a book to highlight the photographic achievements of astronauts during Apollo. Unlike the simple layout and scientific focus of Gemini photographic volumes, Apollo publications took a different form, and sought a different audience. In planning for Apollo

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[321] NASA, *Earth Photographs from Gemini VI through XII*, NASA SP-171. Washington, D.C.: NASA, 1968; Low, George. Memorandum to Richard Johnston, Special Assistant to Robert Gilruth, March 18, 1969. Johnson Space Center History Collection, Record #37166. Location 071-23. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[322] Underwood, Interview transcript, p. 19.

photographic books, NASA expected far more photography to sift through, which necessitated consideration for how to best use the resource. Sales expectations were also an issue, and managers set sights very high. Writing to MSC director Robert Gilruth, LARC director Edgar Cortwright encouraged the compilation of a book similar to those published during Gemini, in part to appeal as a Christmas gift if the book was finished in time for the 1969 season. According to his memo, sales of the Gemini book associated with photographs from the first three missions sold nearly 30,000 copies after its 1966 release.[323] Additional encouragement came in this period with news that *Exploring Space With a Camera*, the 1968 publication edited by Cortwright which included only a small portion on astronaut photography, sold out from GPO at 54,000 copies.[324] The positive attention yielded by such volumes quickly became an increasingly apparent part of the discussions within NASA.

In a quick succession of memoranda in March and April 1969, agreement between MSC and Headquarters staff determined the desirability of a simple publication for Apollo images. With an indexical style seen as more efficient, the workload fell to the PTL staff to assemble images and develop text with support from a variety of departments and the top management at MSC.[325] Teams developed these special

[323] Cortwright, Edgar. Memorandum to Robert Gilruth, March 25, 1969. Johnson Space Center History Collection, Record #37237. Location 071-24. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[324] Day, Melvin. Memorandum to Robert Gilruth, May 26, 1969. Johnson Space Center History Collection, Record #37973. Location 071-36. University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

[325] Low, George. Memorandum to Robert Gilruth, April 3, 1969. Record #37341. Location 071-25; Johnston, Richard. Memorandum to George Low, April 9, 1969. Record #37392. Location 071-25; Johnston, Richard. Memorandum to Distribution, April 21, 1969. Record #37531. Location 071-31; all

publications to reflect the vastness of images collected, but the quantity and quality of the products are inconsistent generally when examined across the program. Surveying the list of official reports shows only Apollos 8, 10, and 12 had mission-specific photographic reports in this series. Apollos 7 and 9, though, were never even featured in a compilation volume. Following the Apollo 13 mission, it appears most all photographic reports were integrated into larger mission reports on either science or the mission itself, ending the indexical style of printing results. Even so, astronaut photography easily served a reference function in reports on other matters as well, giving NASA many opportunities to feature this unique resource.

Newspapers and news magazines were certainly the most accessible pubic resource for viewing astronaut-captured images. Stories featuring these images were usually accompanied by simple captions, and only occasionally full stories, that explained the content and context of the photograph. Because these photographs appeared set within the text of other stories selected by editors, it is important to analyze the space program as part of the larger cultural landscape of the late 1960s in which NASA's human spaceflight program occurred. Because of the frequency of human missions in this period, it becomes instructional to use case studies from the start and end of the Apollo program to understand how at both the height of popularity and end of the era, people encountered astronaut photographs in their daily lives. Looking at the use of images such as *Earthrise* from Apollo 8 and *Whole Earth* from Apollo 17, perhaps the most notable astronaut photographs ever taken, should give a sense of public interest.

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from Johnson Space Center History Collection, University of Houston, Clear Lake Archives, University of Houston, Clear Lake, TX.

Exploring the politics behind news making both inside and between publishing outlets, as well as the one between news publishers and NASA staff, offers a means to understand the importance of astronaut images to print media. These relationships were refined regularly and influenced how and where photographs appeared, particularly when placement on the front page was possible. The 1960s was a period of massive expansion of the representation of science and technology reporters in newsrooms, which scholars saw as a reaction to Sputnik and the race to the Moon.[326] How readers encountered astronaut photography became part and parcel of their engagement with the most salient current events of the day. This negotiated situation, invisible to readers, involved writing and organizing news in ways editors and publishers felt would sell more issues, garner editorial respect within the community of news outlets and critics, and uphold principles held by the publishers and editors of the papers.[327] While the actual public popularity of the space program at this time was far less than memory and legend might indicate now, brief glimpses of life in space offered to readers of the most widely published newspapers and magazines of the 1960s meant great exposure for NASA's human spaceflight program. Through astronaut photography, NASA's reach was broad and perhaps far more lasting than anyone expected.

[326] Burkett, Warren. *News Reporting: Science, Medicine, and High Technology*. Ames: Iowa State University Press, 1986, p. 30. On how this increased reporting reflected back on science education, see: Nelkin, Dorothy. *Selling Science: How the Press Covers Science and Technology*. New York: W. H. Freeman and Company, 1987, p. 21.

[327] For examples of this practice at different newspapers, see: Diamond, Edwin. *Behind the Times: Inside the New York Times*. Chicago: University of Chicago Press, 1995; Broder, David S. *Behind the Front Page: A Candid Look at How the News Is Made*. New York: Simon and Schuster, 1987.

The media played an important role in shaping public understanding of NASA's human spaceflight program from even before the 1959 announcement of the first group of seven astronauts. Enthusiasm for space topics from films to televisions to artwork and other visual forms permeated post-war American culture as Howard McCurdy explained.[328] These imaginative creations, sometimes informed by actual rocket engineering, laid the groundwork for expectations of actual spaceflight. The news media became the conduit by which readers came to understand how space really appeared and felt, with reporters and publishers translating the words and images of astronauts into digestible, understandable, and relatable stories. This put print media outlets in an interesting position over a decade known for a dramatic rise in the ownership and popularity of televisions, intense public events such as the assassination of President Kennedy, and the war in Vietnam. Former *Houston Chronicle* Science and Space Editor Warren Burkett wrote in his instructional book for up and coming science reporters that the primary criteria for reaching print are timeliness, timing, impact, significance, uniqueness, and human interest.[329] In an industry dependent on placing appealing stories on the front page to increase readers, newspaper and magazine reporters must understand their audience in order to satisfy publishers whose profits came from advertising and increasing readership.[330] The unique appeal of human spaceflight encouraged media outlets to keep spaceflight and the experiences of astronauts on the front page as often as

[328] McCurdy, *Space and the American Imagination*, p. 51.

[329] Burkett, p. 32.

[330] On the intensely competitive nature of print journalists and their insider perspective on the beats they cover, see: Broder, *Behind the Front Page*.

possible since it was their best first option for grabbing attention about the events television networks carried live. While time may have been on the side of the television stations, the lasting impressions made by printed images meant print media outlets had a more serious and permanent role in forming the visual memories for the public.[331]

Print media coverage of the path-breaking Apollo 8 flight around the Moon provides ample material for analyzing the broad coverage of a single event, and how that reflected the newsroom and public debates about the importance of spaceflight. Enthusiasm for the unique and exciting topic of human spaceflight made excellent fodder for the editors of papers and magazines, most interested in selling as many copies as possible while conveying compelling stories to encourage repeat readers. Knowing their audience meant knowing that not every copy would be snatched up based on putting astronauts on the front page, but the tremendous reach of print journalism at the time made the opportunity for impressions using astronaut photography have nearly universal penetration into the U.S. population.[332] Like any other topic, NASA missions competed for position in publications, but as a subject of the science and technology reporting, there was additional pressure on reporters to energize stories and bring their best to the

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[331] On the reliance of public and individual memories on the media, though specifically the often-abused ability to use television to reconstruct events, see: Hoskins, Andrew. "Television and the Collapse of Memory." *Time & Society*. Vol. 13. No. 1 (2004): 109-127. For an excellent discussion of the individual nature of the inscriptive format selected for memories, see: van Dijck, José. "Mediated Memories: Personal Cultural Memory as Object of Cultural Analysis." *Continuum: Journal of Media & Cultural Studies*. Vol. 18, No. 2 (2004): 261-277.

[332]As noted by Sharon Dunwoody in her commentary on essays in Bauer, Martin W. and Massimiano Bucchi, eds., *Journalism, Science and Society: Science Communication Between News and Public Relations*. Vol. 7. New York: Routledge, 2007, newspaper readership generally at the time of the Apollo flights would have averaged around one per household in the United States (from data at Editor and Publisher Yearbook Online http://www.editorandpublisher.com).

newsroom in order for their material to make the front page.[333] Trusting Amber Boydstun's assertion that the most important dynamic in creating news is momentum, the space program built up that quality in spades over the first decade it flew people into orbit and to the Moon.

The impact of publishing *Earthrise* within the complicated period of late 1968 and early 1969 publications shows the incredible popularity of the space program as reflected in major newspapers across the U.S. despite other national and international problems of the moment. For example, the *New York Times* published a horizontally oriented version of the color *Earthrise* photograph from Apollo 8 on the front page of their December 30, 1968, edition with an article by writer Homer Bigart.[334] Nearby "above the fold" stories include reports of New York state budget needs and the concerns of the Johnson administration and United Nation about Israel's raid on Beirut the previous day (Figure 69). On the same day, the *Los Angeles Times* used a similarly oriented version of Anders' color photograph on their front page, though the headline of the day regarding the attack of Beirut dominates, confusing the notion of which story the paper considered to be the most newsworthy (Figure 70). These two instances not only

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[333] Political scientist Amber Boydstun gives a statistical analysis of news coverage based on the press having an organizational process, being very competitive, and a proclivity towards what she calls the disproportionate information-processing systems. The final framework would explain the high visibility for human spaceflight in the 1960s but the relatively low public support for it: Boydstun, Amber E. *Making the News: Politics, the Media, and Agenda Setting*. Chicago: University of Chicago Press, 2013, p. 6.

[334] The issue of positioning of *Earthrise* still causes debate amongst those who frequently publish the image. Based on the recent video created for the 45th anniversary of Apollo 8, the photograph was taken from the perspective typical of horizon images familiar from the perspective of one standing on the surface with the Earth rising from beyond a horizontal line. However, comments made by Bill Anders about his position in relation to the Moon and the spacecraft indicate that what he saw looking out the window was Moon to his left and the Earth appearing from behind on the right, a 90 degree clockwise positioning from the typical view. No matter the orientation selected, every possible viewing angle was possible as astronauts floated in all directions in zero gravity.

provide a sense of the ways in which one of the most historic moments appeared in printed media, but also how that moment competed for coverage with other news events.

Other publications of *Earthrise* show the varying context of its initial printing in different newspapers. The *Washington Post* used a heavily cropped version of *Earthrise* on the last day of 1968, though it played second fiddle on the front page to a solitary Earth image from the translunar portion of the journey. Without an accompanying story, the textual surroundings for the images are articles about Lebanon's response to the Israeli attacks, District of Columbia city council-members seeking to overturn mayoral decisions on police use of guns, and Senator Edward Kennedy's challenge for the majority whip job. While the Apollo 8 images dominated front-pages of some major publications, the surrounding text focused on issues pertaining to local politics (Figure 71). While sometimes portrayed today as an all-consuming public event, the story of the first humans flying around the Moon appeared in newspapers as one brief part of the story of December 1968. Another part of the story of disseminating images involves decision-making at these publications. What appears on the front page in particular involves an entirely different set of political considerations, certainly a rich area for future research.

Like the daily newspapers, news magazines such as *Time, Life*, and *Newsweek*, spent considerable cover and interior space on publicizing the photographic and technological achievements of Apollo 8. Full-color spreads from issues of each magazine, *Time*'s edition of January 3, 1969, *Life*'s issue on January 11, 1969, and *Newsweek*'s printings of January 6 and July 7, 1969, all feature lengthy stories and reproductions of *Earthrise* in some form, but never as prominently as those first newspapers from just days after the mission. Considering their longer story development period, the appearance of astronaut photographs within such magazines is a testament to their appeal from a narrative and commercial perspective.

Another example of a contemporary publication that discussed Apollo 8 photography, an article written anonymously for the journal *Nature*, mentions what the author thought were six of the most important images from the mission. The *Earthrise* image is not among those six.[335] This may be at least one early indication that the "special correspondent" who wrote the article, like NASA, spent little time contemplating the long-term emotional potential of an image of Earth rising from around the Moon's surface in the earliest of publications after the mission and focused on the scientific and engineering benefits of astronaut photography. Newspapers at least, while prominently featuring *Earthrise*, steered public interest towards the photographs, but other stories of the day provided plenty of distraction for those uninterested in the space program.

Publication of the *Whole Earth* image (also referred to as the *Blue Marble*) from Apollo 17 likewise spread a single image quickly and broadly. Papers were again constrained by the post-mission development and dissemination process at NASA, so the image only made front pages in time for Christmas Eve 1972, five days after the command module and crew landed safely in the Pacific Ocean. Modern articles on the topic of the image's release nearly universally proclaim its instant worldwide popularity

[335] "First Look at the Apollo 8 Pictures." *Nature*. Vol. 221, January 18, 1969: 215-217.

thanks to publication on nearly every newspaper front page.[336] But while the *New York Times* featured it prominently on the front page on December 24, 1972 (Figure 72), and the *Boston Globe* used its entire front page for the image on Christmas Day (Figure 73), other major U.S. dailies did not print it so obviously, if at all. The *Chicago Tribune* placed the photograph, credited to Harrison Schmitt, on their Christmas Eve second page (Figure 74). Similarly, the *Los Angeles Times* pushed the image to the third page with no article but flanked by advertising and other news stories on Christmas Eve (Figure 75). And while the *Washington Post* regularly printed astronaut photographs through the days immediately after the landing and frequently about NASA topics, the *Whole Earth* image never appeared on their pages in late 1972.

Magazines of the day such as *Time*, *Life*, and *Newsweek* paid some attention to the Apollo 17 mission as well, but not to the extent they had for early missions. Interestingly enough, the mission coincided with publication of the very last regular issue of *Life* magazine at the end of 1972. That final cover did not include photographs of any kind, but did feature a large farewell story for Apollo as human spaceflight and astronauts particularly appeared so frequently and elegantly issues throughout the program. *Time* also included stories in their two issues immediately following the mission's end, but did not feature *Whole Earth* or Apollo 17 on a front cover. The December 11 issue that year had a caricature of Miami Dolphins head coach Don Shula on the cover, and a call out to a story about the end of Apollo in the cover's upper right corner. Issues through the end

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[336] Boyle, Alan. "40 Years Later, Apollo 17's Blue Marble Leaves a Mark on Our Memory." Cosmic Blog, http://www.nbcnews.com, December 7, 2012 (accessed November 4, 2014); Tobin, Mitch. "The Black and Blue Marble: 10 Whole Earth Views from Space." EcoWest.com, September 12, 2013 (accessed November 4, 2014).

of 1972 and into early January of 1973 focused cover stories on things ranging from skiing to Marlon Brando's latest film.[337] Similarly, the mission and photograph lost out to cover stories in *Newsweek*, which focused its mid-December through early January cover stories on the topics of crime, an Episcopal bishop, Henry Kissinger, and coping with depression. The crime issue of December 18, 1972, featured a similar story to that of *Time*'s December 11 issue, celebrating the end of Apollo, but additional issues featured still images taken from television coverage and not *Whole Earth* (December 26, 1972).[338]

The appearance of the *Whole Earth* image in deeper newspaper pages meant that stories and photographs took precedence on front pages around the country. The ongoing Vietnam War continued to take up space, though coincident with Apollo 17 was word about a temporary halt to bombing Hanoi by U.S. forces for the Christmas holiday followed by intense bombing for multiple days that brought the North Vietnamese back to the table for peace talks. Major news also included daily updates on the medical condition of former President Harry Truman, who would pass away on the 26th, discovery of plane crash victims who resorted to cannibalism in the Andes Mountains, and a 6.2 magnitude earthquake that struck Managua, Philippines. After five previously successful missions to the lunar surface and one near-disaster, perhaps NASA images and stories no longer elicited the same emotional reactions the way they did during the triumphal moments of Apollo missions 8 and 11: the "first-ness" of the spaceflight had worn off. So while research material for scientists and engineers skyrocketed following the excitement

[337] *Time*. December 25, 1972: 30, 33; January 1, 1973: 49-51.

[338] *Newsweek*. December 26, 1972: 45-46; January 2, 1973: 38.

of the early lunar missions, newspapers began treating NASA human flights as a worthy pursuit for stories only when significant landmarks were passed. Since publishers especially considered events only in the short term, looking at the context of the image provides a sense of what else meant something to people at the time. Scholarship that considers this period broadly tends to ignore space exploration as part of the social, economic, and political landscape.

Ongoing Reactions

Despite a relatively rapid drop in front page attention paid to human spaceflight between Apollo missions 8 and 17, astronaut-captured photographs made a lasting impression on public memory and represent some of most instantly recognizable and beloved images of the 20th century. While novelists, artists, and cartoonists imagined a visual future for humans leading up to and through the beginning of Space Age, astronauts brought home images for us to participate virtually and visually in their journeys. Ideas about space travel, our world, and the Moon took shape through the lenses of astronauts, and then on the pages of newspapers, magazines, and publications that reached around the world to spread positive impressions of NASA's exploration efforts. The penetration of these images into our collective memory not only serves as a testament to the beauty of our environment, but also reminds us of the turn towards an ever-increasing visual culture during the 1960s.

Rarely, if at all, have historians included the details or even general facts about the space program in survey histories of the 1960s. Most major works barely make note in accompanying timelines of the seminal moments of say John Glenn's Project Mercury flight or Neil Armstrong's steps on the lunar surface during Apollo 11.[339] Issues of technological development, political wrangling, or the larger cultural significance of spaceflight are left to specialist historians to examine, and then relate to the larger historical narrative. So despite the tremendous reach of astronaut photography through publications and reuse in other media, and its ongoing role as a touchstone for public memory of the early NASA human spaceflight program, it never received more than a passing appearance as an illustration in survey scholarship on the Cold War.

Worth consideration as part of the lasting influence of astronaut photography is how the use of color or black-and-white film altered conceptions of features seen in astronaut images. Media formats such as the magazine and indexical catalogues offered some exposure to full color photography, but the public most often saw still photographs by astronauts published in black-and-white as part of newspaper mission coverage. Magazine subscribers for *Time*, *Life*, and *Newsweek* benefitted from regular large, multi-page color spreads of selected images and narratives about the missions.[340] Special

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[339] Neglecting the human spaceflight story from works on liberal culture and politics of the 1960s is common, though Kennedy and Johnson were major advocates of exploration. See: Matusow, Allen J. *The Unraveling of America: A History of Liberalism in the 1960s*. New York: Harper & Row, 1984. Other mentions usually include a notation of program milestones in timelines or brief inclusion as "highlights" of the period. See: McWilliams, John C. *The 1960s Cultural Revolution*. Westport, CT: Greenwood Press, 2000; Greene, John Robert. *America in the Sixties*. Syracuse: Syracuse University Press, 2010. Informal but repeated references to the space program abound. See: Heale, M.J. *The Sixties in America: History, Politics and Protest*. Chicago: Fitzroy Dearborn Publishers, 2001.

[340] For example, see of those magazines associated with the three most significant missions, Apollo 8 (issues for December 1968 through January 1969), Apollo 11 (June and July 1969), and Apollo 17 (December 1972 to January 1973); other examples are a *Look* Magazine special edition in 1969, priced at $1.25, featuring *New York Times* staff writer text, a reproduction of a Norman Rockwell painting, and color photographs from Apollo 8. A similar issue, for 25 cents more, was published for Apollo 11 later the same year.

editions of these magazines featuring even more photographs were certainly popular with non-subscribers at newsstands and in grocery stores as mementos of the events. When it came to the Moon, however, the purpose of photographing in black and white had more to do with scientific needs than those expected for engineering or public uses.[341] Printing of black and white photographs and poorly color corrected stills may have unintentionally formed a misconception of the actual color of the Moon. In numerous transmissions, broadcasts, and post-mission debriefings, astronauts from lunar missions (including those that did not land on the surface such as Apollo 8, 10, and 13) described the color of the Moon as varying from tan to a very dark gray depending on their viewing angles in relation to the Sun.[342] The composition of dark lunar dust and rocks (mare), while reflective of the Sun's light, leans heavily towards glass particles containing iron, giving lunar regolith a brown or rust colored appearance, and making it magnetic.[343] Unless casual viewers read additional materials, though, the impression left of the Moon was a very bland, bleak, and colorless one indeed based on cursory readings of photographs.

How then would such an impression of the Moon, plainly seen in prints in newspapers and from the early black-and-white television cameras used during the lunar missions, negatively influence what appeared to be a very popular and exciting national

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[341] The purpose of using such film was the higher contrast available with black-and-white film and the application of the Roseau plate for photogrammetry. In the case of Apollo 12, when their color television camera broke and they only had black-and-white film magazines with them on their trek to Surveyor III, all images of that historic moment are black-and-white.

[342] For examples, see: Mission Operations Branch, Flight Crew Support Division. "Apollo 11 Technical Crew Debriefing, Vol. 1." Houston: NASA, July 31, 1969: 10-9 to 10-10; "Apollo 12 Technical Crew Debriefing." Houston: NASA, December 1, 1969: 9-14.

[343] Lindsay, John. *Lunar Stratigraphy and Sedimentology*. Amsterdam: Elsevier Scientific Publishing Group, 1976, p. 227-283.

initiative? While even the ability to use television and still cameras in such harsh and cramped places was a technological triumph, their products did little to sell space as vibrant and welcoming. In truth, the Earth came off as fragile and the Moon appeared dull and desolate. Nothing about astronaut photographs could change how the mood of American society would influence interpretations of the images, and come to understand them within the context of events of the time. These images are brief, symbolic, shining moments in time when humanity achieved something spectacular. Ultimately though, neither the journey nor the destination were attractive enough to keep public attention focused on the Moon as more than a place we once went.[344] The ultimate reality of Apollo could be then that the Earth and places that lay beyond our Moon, seen in spectacular images taken by robotic explorers and space telescopes, should be the real objects of attention for NASA.

Several instances, however, are worthy of note where astronaut photographs inspired the creation of artwork, public art displays, and other public presentations, although these impressions were not commonplace or accessible to very many at the time. Syndicated opinion pieces and books like Norman Mailer's *Of a Fire on the Moon* were widely available in addition to news broadcasts and other media products that directed attention at perceived problems with flying people to the Moon or questioned its value in comparison to terrestrial concerns.[345] While these pieces largely reflect broadly

[344] While a few scientific/robotic missions returned attention to the Moon, including the currently successful Lunar Reconnaissance Orbiter, the vast majority of space research money since has been spent on spacecraft to other planetary bodies and telescopes for observing objects well beyond it.

[345] Mailer, Norman. *Of a Fire on the Moon*. Boston: Little, Brown, 1970. Contemporary and modern critiques of the value of Project Apollo can be found in many newspaper archives, but historical criticisms

upon actions taken by NASA, there is significant evidence of contemporary recognition of how astronaut photography influenced ideas about the Earth, the Moon, and how we see ourselves. Anne Collins Goodyear reflected on NASA's adoption of an art program early in its life in her dissertation and resulting book chapter, "NASA and the Political Economy of Art, 1962-1974."[346] Artists frequently drew inspiration from Apollo photographs, especially as seen in works by Angela Manno (*Home* - Figure 76 - and *Spaceship Earth* - Figure 77), Robert Shore (*Lunar Confrontation* - Figure 78), and Derman Uzunoglu (*Earth Rise* - Figure 79), which all now reside in the collection of the National Air and Space Museum. Even before Apollo's end, scholars and artists recognized this connection and the expectation that visuals from the space program would continue to inspire artists for years to come.[347]

In addition to those stand-alone pieces, some photographs provided inspiration for larger artistic works in public spaces. In the 1970s, Drexel University in Philadelphia, PA, installed a mosaic representation of an Apollo 11 Earthrise image at the entrance to their Newman Center building, which was removed when it became the Marks Intercultural Center in 2010 (Figure 80).[348] Robert McCall, who painted conceptual art

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are well summarized in: Launius, Roger. "Interpreting the Moon Landings: Project Apollo and the Historians." *History and Technology*. Vol. 22, Issue 3 (2006): 225-255.

[346] Goodyear, Anne Collins. "The Relationship of Art to Science and Technology in the United States, 1957--1971: Five Case Studies." Dissertation, The University of Texas at Austin, 2002; Goodyear, Anne Collins. "NASA and the Political Economy of Art, 1962-1974." In *The Political Economy of Art: Making the Nation of Culture*, Julie F. Codell, ed. Madison: Fairliegh Dickinson University, 2008, p. 191–206.

[347] Malina, Frank J. "On the Visual Fine Arts in the Space Age." In *Leonardo*, Vol. 3, No. 3 (July 1970), p. 323-325.

[348] The specific Catholic iconography of the mosaic likely played a role in its removal when the center transitioned to a have a broad culturally diverse goal. As only tangential to my dissertation, I only speculate

for the movie *2001*, made a career out of imagining and reimaging the known and unknown in space. While it is not a literal interpretation of an astronaut photograph, McCall's mural *The Space Mural – A Cosmic View*, painted in place by the artist for the opening of the National Air and Space Museum in July 1976, represents visual elements of the Apollo lunar experience and space sciences. (Figure 81) Such elaborate works are rare and do not typically exist outside museums and NASA facilities, so impressions made on viewers occur only in environments already attracting a self-selected audience of those interested in spaceflight. But the scarcity of large public displays such as these shows, to some degree perhaps, that while space artwork and photography have tremendous appeal to a public audience in small personalized settings, there may not be a place for human spaceflight in large public settings not directly related to spaceflight.

While some were inspired to a point of creating artwork, others saw in those photographs information and messages for motivating a movement. Members of the environmental movement appear to have rejected the frontier and imperial overtones of the images in favor of a more holistic approach to understanding the Moon-Earth relationship. What lies beyond the horizon in *Earthrise* is our home planet, and seeing this sight for the first time gave social commentators like Anne Morrow Lindbergh reason to ponder the fragility of our floating blue orb. For geographers as well, seeing the Earth from great distances gave them an avenue for reconceptualizing how we understand the Earth in physical terms. Geographer Denis Cosgrove observed that, "They [Apollo photographs] have been enormously significant however in altering the shape of

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here about the mural, but with indications of others at places such as Ben & Jerry's in Vermont, an additional survey of such displays would be appropriate in the future.

contemporary geographical imagination." Conceiving anew our view of the physical Earth coincides with the reconsideration given to the well-being of the planet.

As I contend regarding the space agency's use of photography more generally, Kim McQuaid also found that, "From NASA's formative years, it had consistently mishandled opportunities to increase its political support by providing practical and understandable Earthly services to citizens and taxpayers."[349] By missing an opportunity to satisfy environmentalists and taxpayers with Earth photography, whether from satellites or human missions, NASA consciously and publically moved away from ideas about Earth in favor of continued exploration outwards. McQuaid's evidence also suggests that top administrators in NASA, Hugh Dryden in this case, vigorously rejected the idea of including Earth photography on human spaceflight missions. Despite the obvious political implications of use of *Earthrise* as an image of a triumphant American project, this moment also signaled NASA's passivity to the opportunity to fuel Earth research during the formative years of climatological studies. While astronauts and scientists continued working on Earth-focused imaging, administrators made little attempt to make a firm statement, perhaps to avoid the politics of it, about such observations.

Understanding meaning in the case of *Earthrise* and other astronaut photographs involves acknowledging the multiplicity of meanings that could be created when NASA released images to the public with little context and supporting information. When picked up by the press, social commentators, and others, the image's popularity skyrocketed, and

[349] McQuaid, Kim. "Selling the Space Age: NASA and Earth's Environment, 1958-1990." *Environment & History.* Vol. 12, no. 2, May 2006, p. 127–163.

people found their own meanings within the codes embedded in the visual. Public reception was and continues to be very positive for images that the astronauts and officials at NASA call some of the greatest products of human spaceflight. When asked what he thought his most significant contribution to the space program was, astronaut and *Earthrise* photographer William Anders modestly admitted, “Maybe taking that picture which had a lot of ecological and philosophical impact at the time.”[350] Even the photographer himself understood the historical significance and long-term influence in our scientific and cultural perspectives on the Apollo program, perhaps better than NASA itself.

[350] Anders, Interview transcript, p. 15-16.

EPILOGUE: CONTINUING RESONANCE

> *"People who go to these frontiers want to share the experience, they want to record data to record the knowledge from the frontier, and photography is a great medium in which to do this."*
> -Dr. Donald Pettit, astronaut, photographer, and chemical engineer, Luminance Conference 2012

In the fall of 2008, I travelled to the Kennedy Space Center with colleagues on the Museum's team creating the latest exhibit project, *Moving Beyond Earth*. Our topic, making low-Earth orbit a permanent place to live and work during the era of the space shuttle, ISS, and in the future, made the space center an excellent point of reference for a variety of issues never before examined in our Museum: the spaceflight workforce, decision making in spacecraft design, and the diversifying astronaut corps. Guided tours of the processing building for the orbiter *Discovery*, a ride up the launch pad elevator to the 195th floor and the white room and open hatch of the shuttle *Atlantis*, and a walk around the floor of the ISS equipment facility gave us unforgettable first-person views of the enormous amount of hardware it takes to keep the U.S. in space.

During our tour of the ISS facility, we saw payloads being prepared for launch, and the huge container used to transport them across the center and load them into the space shuttle. One of those payloads caught my eye, something called the cupola. (Figure 82) I had heard of it not only for its Star Wars-like configuration of windows, but also because this was to be an almost entirely experiential space, meant to give astronauts unfettered views of Earth with one central and six surrounding angled windows.[351] But at the time, it was questionable if the unit would ever go into space at all. The senior curator on the exhibit project and Museum's space shuttle curator, Dr. Valerie Neal, commented on my excitement over the cupola photographs upon our return. She told our group that expectations inside NASA at the time were that in the post-*Columbia* disaster climate of caution, payloads going to the ISS were streamlined to only those necessary for science and servicing. We were all sad to hear that this tremendously cool ISS attachment might never move past the spot where we saw it in Florida.

Learning about this possible decision coincided with my sense of NASA's philosophy overall, especially about their uses of and expectations for photography, that what mattered now was scientific research and not the emotional experiences provided by photography of Earth and space. The post-Apollo era of human spaceflight has been marked by an attitude of "what have you done lately" in terms of payloads released, science results, and overall goals. Construction of the ISS fell into that same category, with only the disruption to assembly caused by the loss of *Columbia* on a non-ISS flight of note to the public. Nevertheless, despite over four years of delays following the completion of the cupola in 2005 by Italian subcontractors, NASA confirmed that the cupola would indeed fly to the ISS. Once installed during STS-130 in early 2010, the cupola quickly became a gathering place for astronauts and frequent location for crew portraits. (Figure 83) It also gave astronauts interested in photography a platform for

[351] Other than the expansive views of Earth offered by this configuration, its location on the ISS positions it for a visual line of sight for operating the remote manipulator system (Canadarm2) during the approach and docking of resupply spacecraft.

documenting Earth, natural phenomena, and their work from the unique vantage point of 350 kilometers (220 miles). The availability of such a space today brings the story of hand-held astronaut photography full circle from the flight of John Glenn in 1962 to the latest Expedition crew orbiting as I complete this dissertation.

After Apollo

From the first orbital flight through trips to the Moon and now orbiting Earth daily, astronaut photography fundamentally shaped how we see and understand space, spaceflight technology, and astronaut life. The end of the Apollo program was far from the end for astronaut photography. The volume of photographic work on Apollo 17 signified an exponential increase of frames returned. Afterward, astronaut photograph turned to exclusively near-Earth photography with orbital stays starting with the Skylab Orbital Workshop. The vantage point of orbit, be it from Skylab, ASTP, the space shuttle, or ISS, did not eliminate opportunities for astronomical or geological photography, but refocused them on the Sun and Earth specifically. The emergence of remote sensing, weather, and other satellites and telescopes removed the vast majority of mapping and scientific photography from the bailiwick of astronauts, allowing them to train their cameras on more targets of opportunity. Thanks to additional storage space on bigger spacecraft, astronauts were virtually unconstrained by the amount of film available, especially after digital cameras came into use in the late 1990s and exclusively with the operational phase of the ISS in the early 2000s.

Recalling the heroic age of human spaceflight today falls largely on the media, but others affected by the images and experiences of that period make their own connections to the visual culture through art, presentations, and verbal recollections. For his part, Alan Bean is the only astronaut of the early spaceflight program who literally makes a living off what he saw during his time in space. While he took art lessons before his Apollo 12 and Skylab 3 flights, he has since spent his time creating real and imaginative views of that period with oils on canvas (always including a trace of what he claims to be a little Moon dust from a patch he wore on his lunar spacesuit). His catalog of original paintings numbers in the hundreds, and lithographic reproductions are available widely online and in specialty space-related stores. Bean's printed catalog of an exhibition of his works, *Painting Apollo*, shows his ongoing interest in commemorating his experiences and those of his fellow astronauts, and providing the public with a first-person interpretation of the spaceflight experience. Though only sometimes based strictly on photographs taken during missions, his work plays on popular ideas of the heroic but never questions the value of the early human spaceflight program.

A more diverse and experienced set of astronauts emerged after Bean's time. Astronauts rode on spacecraft capable of carrying up to eight passengers at a time. The space shuttle, deemed by some to be a utility truck for NASA's ambitions to launch satellites and other payloads into orbit and beyond, became an orbital station for astronaut photography using far more still, video, closed circuit, and television cameras ever carried to space before. NASA even extended imaging duties to include shooting films that benefitted commercial outlets, using precious training and on-orbit time for such ventures as the multiple films produced using IMAX Corporation equipment. Not only did astronauts continue to function as still photographer surrogates, they received extensive training as proxies for cinematographers. The extremely limited amount of 70mm IMAX film carried to space in shuttle storage lockers meant that film directors and cinematographers planned virtually every second of film use. Toni Myers, writer or director of most of the NASA series of IMAX movies, commented that the astronauts were so well trained and captured such stunning footage that barely a second of what was captured over 24 flights went unused for the six movies they made with NASA cooperation.[352] Unlike the days of NASA leadership having to beg astronauts on Apollo 7 to continue with their live television broadcasts, shuttle astronauts willingly participated in creating stunning visual representations for gigantic screens that put people closer to the feeling of spaceflight than ever before.

Just like astronauts during the first decade of human spaceflight at NASA, some shuttle and space station crewmembers enjoyed and focused on photographic tasks more than others. Neurologist Roberta Bondar, the first female Canadian astronaut, flew to space in 1992 on the space shuttle and parlayed her passion for photography into a post-astronaut career in photography. She has multiple published books of her surface and orbital photography and a number of exhibitions at galleries around the U.K. and Canada,

[352] Neal, Valerie. "Bringing Spaceflight Down to Earth: Astronauts and The IMAX Experience®." In Michael J. Neufeld, ed. *Spacefarers: Images of Astronauts and Cosmonauts in the Heroic Era of Spaceflight*. Washington, D.C: Smithsonian Institution Scholarly Press, 2013, p. 149-174; Toni Myers, comments to the author, April 4, 2012.

much of in concert with her environmental activism.[353] While not an astronaut per se, spaceflight participant Richard Garriott undertook a massive photographic project during his eleven-day stay on the ISS. Garriott's father, Skylab and shuttle astronaut Owen Garriott photographed a series of locations on Earth during his 60 days of the second Skylab mission. Richard attempted to capture photographs of the exact same locations as part of the Windows on Earth project to show the dramatic change in Earth's surface during the intervening 35 years.[354] These post hoc examples show how an increased interest in photography could transition into useful information, but did not mean that astronauts treated on-orbit photography as an artistic endeavor.

Only towards the end of the space shuttle program did any intentions emerge to have astronauts spend more than a passing moment considering the same issues as professional art photographers during a mission. Professional photographers such as John Brinkmann and Richard Underwood were employed to get astronauts high quality equipment and training going back to the Gemini and Apollo programs, though technicians have always assisted astronauts with learning to use cameras like using any other piece of equipment or technology on the spacecraft. It was not until the initiation of a photography project between art photographer Michael Soluri and the crew of the last Hubble servicing mission, STS-125, that art and photography came their closest to

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[353] Roberta Bondar, as a one-time astronaut, has not generated an archive of news stories like other astronauts. Her website, http://www.robertabondar.com, compiles the greatest amount of that news and information.

[354] Richard Garriott was the first to use software developed by the Windows on Earth project while in orbit to determine the exact position to photograph the exact locations his father also photographed. For more, see http://www.windowsonearth.org.

merging.[355] Soluri presented his concept to the crew three different times in the months prior to their scheduled October 2008 launch date. He proposed photographing their training, shooting a series of portraits of the crew and training staff in the common and uncommon settings around NASA facilities. At the request of mission commander Scott Altman, he also taught them about elements to consider when composing a photograph, to see with their eyes more than just information. The results were spectacular, with a self-portrait by John Grunsfeld during one of his two EVAs to repair Hubble showing the great potential for astronauts to develop as artists with the camera. (Figure 84)

Though trained by an artist, none of the STS-125 crewmembers converted the experience as surrogate photographers to even that of amateur photographers. Soluri met up with the crew four months after their flight, as they began to go their separate ways, to debrief them about their photographic work. He noticed that Mission Specialists Michael Massimino and Michael Good did not take any still photographs during their two spacewalks. Nothing was captured by Pilot Gregory Johnson either as his flight duties included managing the IMAX 3D camera. The balance of photography came from the three Soluri suspected to be most interested in photography: Commander Altman and Mission Specialists Megan McArthur and John Grunsfeld.[356] Their training in photographic techniques provided their special mission with a perspective not typically taken to space by astronauts, but it would take an astronaut who came prepared with a

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[355] Soluri wrote about his own perspective on astronaut photography and the iconic in his contribution to a conference and proceedings related to the 50th anniversary of Sputnik. See: Soluri, Michael. "Examining the Iconic and Rediscovering the Photography of Space Exploration in Context to the History of Photography." In *Remembering the Space Age: Proceedings of the 50th Anniversary Conference*. Steven J. Dick, ed. NASA SP-2008-4703. Washington, D.C.: NASA, 2008, p. 271-339.

[356] Soluri, Michael. Email to the author, October 16, 2014.

natural artist's eye, technical expertise, and uncommon ingenuity to break down the wall between being simply a proxy to being a legitimate photographer.

Six astronauts at a time now occupy the space station, and their months on board offer extensive time to perform scientific experiments and free time to explore their own interests. Two-time ISS astronaut Donald Pettit capitalized on this time and the prime Earth viewing location of the cupola more than anyone has so far. (Figure 85) During his first mission to the space station on Expedition 6 in 2003, he designed and constructed a special "barn door tracker" using spare parts to allow for precise movements of a camera to track locations on Earth for sharper images. (Figure 86) For his second mission, Expedition 30/31 in 2012, he regularly used a mounting system inside the cupola for up to seven cameras to shoot simultaneous still photographs. The raw files gave materials for those with photo and video manipulation software the ability to create a stream of images to run like a high-resolution video of the aurora and weather patterns.[357] Dr. Pettit often lectures about his experience and photography, describing the cupola as one of the most unique and meaningful facilities on the ISS. [358] His thoughtfulness about photographic process and composition, however, makes him rare amongst astronauts throughout NASA's human spaceflight programs. Much like artist-astronaut Alan Bean, Pettit has taken an active role in making an astronaut's eyes and their camera equipment the most artistic and meaningful of his generation of space explorers.

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[357] The short film "The ISS Image Frontier – Making the Invisible Visible" by science filmmaker Christoph Malin compiled video from the ISS, Pettit's Luminance 2012 presentation, and a running time lapse of Pettit's images to make the film. The final product received a great deal of press for its production quality and artistic composition: http://vimeo.com/61083440, accessed October 14, 2014.

[358] For Pettit's eloquent description of his interest in and hopes for his imagery, see his speech from the Luminance 2012 conference, http://vimeo.com/51632896, accessed October 14, 2014.

The visual products of our proxies in space going back to John Glenn continue to resonate with the same audiences NASA wanted to reach when the images first returned from space flights. Perhaps more so in this age of rapid digital reproduction, the most iconic of astronaut photographs appear in hundreds if not thousands of online presentations. Those who take up a particular space-related cause, just like Stewart Brand and his push for a whole Earth image, regularly use astronaut photographs to illustrate their points. NASA feeds interest this with their own websites dedicated to Earth photographs captured by astronauts.[359] Al Gore's Oscar-winning environmental film, *An Inconvenient Truth*, featured a presentation of his argument about global warming, a slide show he claimed to have given a thousand times. On the screen, Gore sets his frame of reference for his set of beliefs about how people see the Earth by displaying the *Earthrise* and *Whole Earth* images from Apollo. They became touchstones in our collective memory, examples the fragile and pure Earth photographed by heroes of Gore's and so many of his generation.

Former Vice President Gore is far from the only public figure of his generation to look back fondly on early human spaceflight for inspiration and meaning. Dr. Neil deGrasse Tyson, director of the Hayden Planetarium at the American Museum of Natural History in New York City, frequently speaks about the influence of *Earthrise* on his own life, the trajectory of spacefaring, and our culture. His keynote address from the 28th

[359] Exclusively for images of Earth: http://eol.jsc.nasa.gov/; http://visibleearth.nasa.gov/. For general collections of images, NASA now only updates their main Flickr page, https://www.flickr.com/photos/nasa2explore/, though their old pages run by each center are often still available, examples being from: KSC, http://spaceflight.nasa.gov/gallery/index.html; JSC, http://images.jsc.nasa.gov/; Dryden, http://www.dfrc.nasa.gov/Gallery/Photo/; Marshall, http://mix.msfc.nasa.gov/, all accessed on October 16, 2014.

annual National Space Symposium in 2012 exemplifies the sentiments held by many who look back at the late 1960s successes in space as a national triumph in a time of social upheaval and war. About halfway through his speech, he comments on the Apollo 8 mission, its place within the story of 1968, and the image that he says changed forever the way people look at Earth. Tyson states: "There was Earth, seen not as the mapmaker would have you identify it. No, the countries were not color coded with boundaries. It was seen as nature intended it to be viewed. Oceans, land, clouds. We went to the Moon, and we discovered Earth. I claim we discovered Earth for the first time."[360] His life-long passion for spaceflight, astronomy, and science fiction resonate amongst those in the space community, but his personable style allows the essence of his words to touch the public broadly. As one of the most public figures in space science, Tyson's speeches often go viral, and this small segment about Apollo 8 of an hour-long address to the space community became the core of a campaign by NASA and space enthusiasts to reinvigorate support for spaceflight.[361] As was true in the 1960s, however, concerns over economic stability, national security, and social welfare seem to have drowned out these voices for a strong spaceflight program.

Where NASA finds the most success now with images are those released not from astronaut hand-held cameras but from those remotely operated from Earth. The popularity of the Hubble Space Telescope and a series of rovers on Mars indicate a

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[360] Tyson, Neil deGrasse. "Launch Keynote: 28th National Space Symposium." Space Foundation: https://www.youtube.com/watch?v=VLzKjxglNyE.

[361] Penny4NASA, http://www.penny4nasa.org/. seeks to increase NASA's budget to 1% of the federal budget in part based on Tyson's belief that American culture thrives most when we have strong support for exploration.

revived enthusiasm for space exploration, but perhaps not one that involves the same risks as using humans as the source of image collection. Extending our vision to other planets, solar systems, and galaxies continues a legacy of imaging that goes back to NASA's beginning, but with an abstract person (or set of people in these cases) behind the controls of the process we cannot imagine ourselves in the place of photographer. Telescopes in Earth orbit and robots crawling across Mars hardly make for relatable observers. An analysis comparing astronaut photography to the incredible popularity of Hubble and rover photographs should be developed, especially regarding the interesting cultural attachment created between the public and these proxy observers. The subject, however, requires additional research not part of the line of inquiry laid out here.

Concluding Thoughts

We remember the space race of the 1960s as a series of dramatic moments of success and failure, events seen around the world on television and the front pages of newspapers and magazines and duplicated now on websites and publications as reminders of a heroic age of spaceflight. While millions watched from afar and hundreds of thousands took part in making those moments possible, only a handful of people rode rockets into space and served as proxies for those left behind. What astronauts returned to Earth as representations of their experience, all of the textual and visual information on which we base our understanding of life off this planet, continues to serve American culture as a source of pride and wonder at those achievements.

Looking to exploration as a source of understanding our culture goes back to the earliest journeys from Atlantic to Pacific Oceans. With the availability of cameras and photographers to document the landscape, expedition leaders gave supporters evidence of development potential and the public truthful representations of places they could not travel to themselves. For each these projects, common themes bind the visual depictions of each and similar characteristics carried through a century of human movement into unknown places. Those selected for photography on earlier expeditions were trained professionals, well prepared with their own ideas about what audiences should see of these extreme environments. Astronauts came from the ranks of test pilots, and later scientists trained as pilot, rarely bringing any experience with cameras with them to NASA. As our surrogates in space, only the best training and equipment would suffice for their trips to orbit and the Moon. The images astronauts returned will more than satisfied the needs of most audiences. After passing through the filters of astronauts, public affairs specialists, and the media, the photographs provided the public and our collective memory with icons of the space age. Those photographs became part of our visual lexicon of spaceflight, appearing in the most widely circulated publications of the time, and in thousands of publications and online since then. Though largely ignored by historians of the 1960s, the instant recognition of the stories contained in these iconic images necessitated a study of this kind to contextualize astronaut photography in a wider historical narrative.

When looking at a photography taken on a Hasselblad camera by one of the first handful of humans to fly into space, some might see parts of the Earth never seen before with such clarity. Knowing that of most of those images, in their original form and not reproduced for mass consumption, rarely saw the light of day beyond more than a few hundred people's eyes means that the bulk of the work of astronauts meant relatively little as a contribution to collective memory of the early human spaceflight program. As perhaps their most significant contribution to the public understanding of what space feels and looks like, astronauts willingly took up the challenge of fulfilling the needs of virtually every person on the planet. With such pressure, laid on top of the difficulty of simply returning to Earth safely and the eyes of the world trained on your skills as pilots and engineers, the photographic returns, despite their narrow audience, can hardly be considered more than absolutely spectacular.

APPENDIX A: TABLES

Table 1 - Data compiled for Gemini mission training. Source: Project Gemini mission reports.

Mission	Mission Duration (days/hrs/min)	Avg. Training Time (hrs)	Avg. Experiment Training (hrs)	Experiments/ Total Training	Total Number of Experiments	Photographic Experiments
III	4h, 52m	411	200[362]	49%	3	0
IV[363]	4d, 1h, 56m	n/a	n/a	n/a	11	3
V	7d, 22h, 55m	457	150	33%	17	7
VII	13d, 18h, 35m	431	100	23%	18	3
VI-A	1d, 1h, 51m	332	23	7%	3	2
VIII[364]	10h, 41m	523	n/a	n/a	10	3
IX-A	3d, 0h, 21m	538	n/a[365]	n/a	7	2
X	2d, 22h, 46m	518	65.5	13%	15	5
XI	2d, 23h, 17m	541	36	7%	11	6
XII	3d, 22h, 34m	519	28.5	5%	14	7

[362] A general notation in the mission report indicates over 200 hours spent on "briefings," but gives no specific data on what portion of this covered the three experiments carried out. *Gemini III Mission Report*, MSC-G-R-65-2. Houston: NASA, 1965, p. 7-44.

[363] The mission report for Gemini IV lacks the tabulated training information found in all of the other mission reports for this program. General comments regarding training briefings indicate that two experiment briefings and a short experiments review were held at the Kennedy Space Center. *Gemini IV Mission Report*, MSC-G-R-65-3. Houston: NASA, 1965, p. 7-14.

[364] Gemini VIII was cut short due to a thruster malfunction and no experiments were carried out.

[365] No time is listed in the mission report Table 7.1.1-I. – Crew Training Summary. *Gemini IX-A Mission Report*, MSC-G-R-66-6. Houston: NASA, 1966, p. 7-11. Completion of five of the seven listed experiments would indicate some pre-flight training. With the loss of prime crew members Elliot See and Charles Bassett in an aircraft crash two and a half months before the scheduled launch meant the backup crew, Thomas Stafford and Eugene Cernan, stepped up to the prime crew positions. Stafford's previous flight on Gemini VI-A and Cernan's focus on the planned extra-vehicular activity, and previous status as the backup crew, may have contributed to poor accounting for their experiment training.

Table 2 - Tabulation of all images featuring humans in the form of figures, shadows, or footprints.

Mission	Images taken	Images featuring people[366]	Percentage of total
MA-6[367]	75	0	0
MA-7	206	0	0
MA-8	14	0	0
MA-9	37	0	0
GT-III	25	0	0
GT-IV	336	26	8%
GT-V	349	3	1%
GT-VII	426	0	0%
GT-VIA	198	0	0%
GT-VIII	18	0	0%
GT-IXA	348	13	4%
GT-X	354	7	2%
GT-XI	231	4	2%
GT-XII[368]	398	41	10%
A7	531	12	2%
A8	865	0	0%
A9	1373	65	5%
A10	1436	4	.3%
A11	1408	54	4%
A12	2119	132	6%
A13	604	16	3%
A14	1338	62	5%
A15	2640	169	6%
A16	2801	207	7%
A17[369]	3581	303	8%
TOTALS	**22,315**	**1,118**	**5%**

[366] Any results showing no images of people do not include either television or film (moving) images recorded during the flight. Still frames from the Pilot Observer Cameras were often reproduced as stills in printed publications.

[367] MA-6 flight of John Glenn was the first to have a hand-held camera for astronaut use, so the flights of Alan Shepard (MR-4) and Gus Grissom (MR-5) are not listed here.

[368] For Gemini photographic identification, see: “Gemini Photography Identification.” NASA-TM-110543, NASA Manned Spacecraft Center, p. 87.

[369] Figures available in photo index document produced for each flight.

APPENDIX B: FIGURES

Figure 1 - *Earthrise* as seen and recalled by the photographer, photographed by William Anders, December 24, 1968, AS08-14-2383 (NASA Photo).

Figure 2 - Astronaut Ed White performing the first U.S. spacewalk, photographed by James McDivitt, June 3, 1965, S65-30431 (NASA Photo).

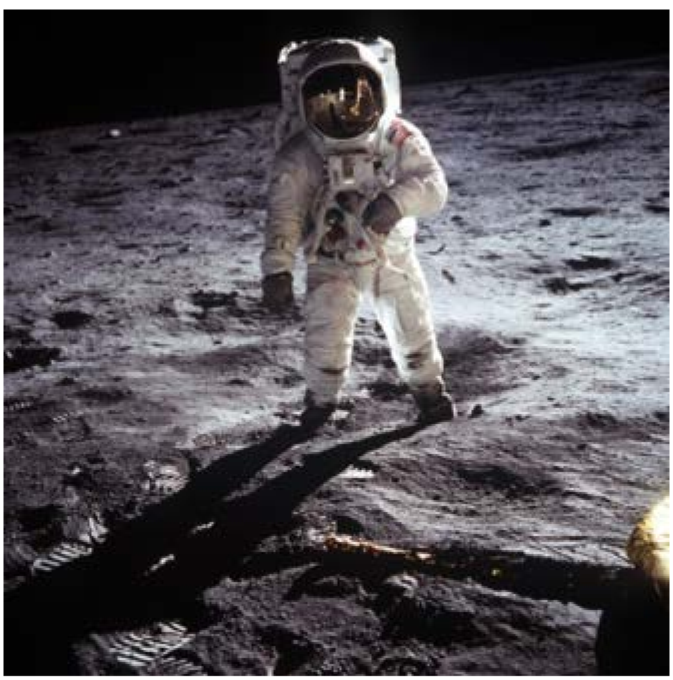

Figure 3 - Astronaut Buzz Aldrin on the Moon during the Apollo 11 mission, July 20, 1969, AS11-40-5903 (NASA Photo).

Figure 4 - Astronaut Buzz Aldrin with the U.S. flag on the Moon during the Apollo 11 mission, July 20, 1969, AS11-40-5875 (NASA Photo).

Figure 5 - Astronaut John Young leaps off the lunar surface during the Apollo 16 mission, April 21, 1972, AS-16-113-18339 (NASA Photo).

Figure 6 - Timothy O'Sullivan's ambulance wagon and portable darkroom used during the King Survey rolls across the sand dunes of Carson Desert, Nevada, 1867, Lot #77-KS-346O (NARA image).

Figure 7 - *Endurance* at midwinter, photographed by Frank Hurley, 1915 (SPRI, University of Cambridge, UK).

Figure 8 - New leads covered with ice flowers in early spring, photographed by Frank Hurley, 1914-1917 (Scott Polar Research Institute, University of Cambridge, UK).

Figure 9 - Trout, Codex J: 133, Meriwether Lewis, March 16, 1806, APSimg5141_CodexJ_133 (American Philosophical Society).

Figure 10 - ***Cliffs of the Upper Colorado River, Wyoming Territory*****, by Thomas Moran, 1882.**

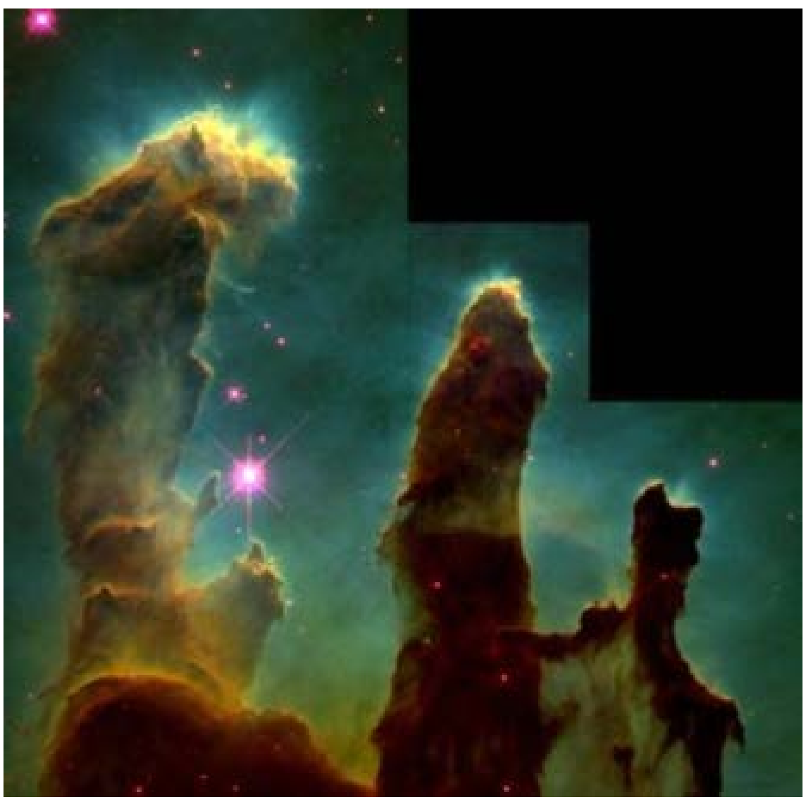

Figure 11 - ***Gas Pillars in the Eagle Nebula (M16): Pillars of Creation in a Star Forming Region*****, 1995 (ESA, STScI, J. Hester and P. Scowen, Arizona State University).**

Figure 12 - Sun over the Barne Glacier, Autochrome photograph by Herbert Ponting, 1912 (© Royal Geographical Society (with IBG)).

Figure 13 - The Polar Party at the South Pole, Scott, Oates, Evans stand, Bowers and Wilson sit in front. Union Jack flag on a pole behind, photographed by Henry Bowers, 1912 (SPRI, University of Cambridge, UK).

Figure 14 – Bear Lake, Bear Lake County, Idaho, photographed by William Henry Jackson, 1871, ARC #516732/Local #57-HS-124 (NARA image).

Figure 15 - Heavy pancake ice in which the Terra Nova was held up whilst trying to rescue the Northern Party, photographed by Herbert Ponting, 1912 (SPRI, University of Cambridge, UK).

Figure 16 - Second photograph captured by Neil Armstrong after stepping onto the lunar surface during the Apollo 11 mission, July 20, 1969, AS11-40-5851 (NASA Photo).

Figure 17 - Steamboat Springs, Nevada, photographed by Timothy H. O'Sullivan, 1867, LOT 7096, no. 98 (Library of Congress).

Figure 18 - Christmas Eve in the pack, photographed by Herbert Ponting, December 24, 1910 (SPRI, University of Cambridge, UK).

Figure 19 - *Earthrise*, rotated 90° right as typically shown in publications.

Figure 20 - Alkali Lake, Carson Dsert, Nevada, photographed by Timothy H. O'Sullivan, 1867, LOT 7096, no. 105 (Library of Congress).

Figure 21 - *Saved!*, photographed by Frank Hurley, 1917 (Scott Polar Research Institute, University of Cambridge, UK).

Figure 22 - Astronaut David Scott on the lunar surface during the Apollo 15 mission, August 1, 1971, AS15-88-11863 (NASA Photo).

Figure 23 - Boats near the mouth of the Little Colorado River, photographed by John K. Hillers, 1872, hjk00885 (U.S. Geological Survey).

Figure 24 - Conditions of the ice ahead of the ship, photographed by Frank Hurley, August 1915 (Scott Polar Research Institute, University of Cambridge, UK).

Figure 25 - Alan Bean with the Surveyor 3 spacecraft, lunar module Intrepid in the distance, photographed by Pete Conrad, November 20, 1969, AS12-48-7136 (NASA Photo).

Figure 26 - Harrison Schmitt and the U.S. flag with Earth above, photographed by Eugene Cernan, December 11, 1972, AS17-134-20384 (NASA Photo).

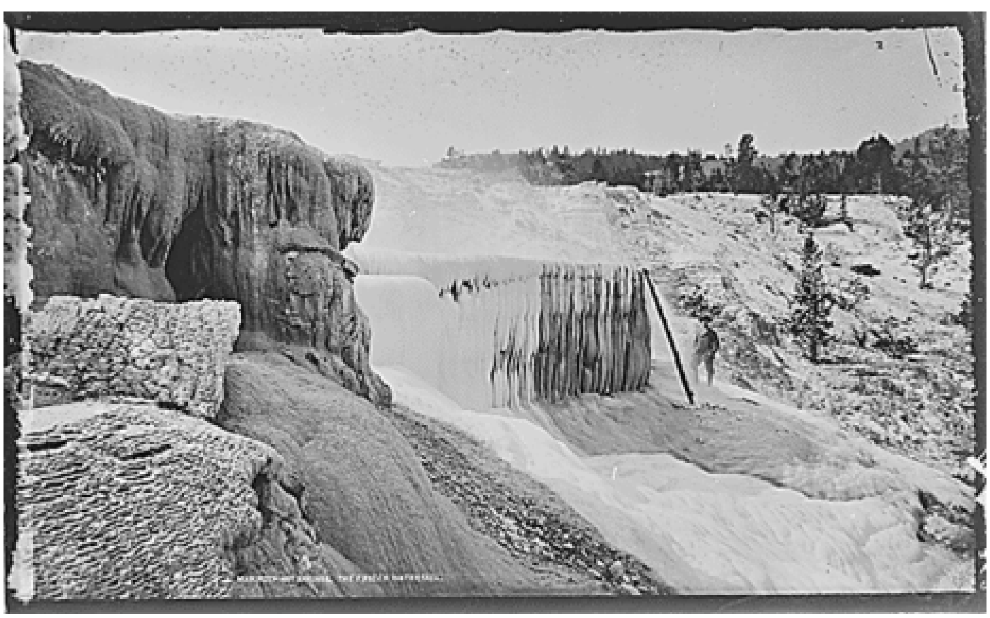

Figure 27 - Mammoth Hot Springs, the Frozen Waterfall, Yellowstone National Park, photographed by William Henry Jackson, 1878, 57-HS-362 (NARA photo).

Figure 28 - A typical pressure ridge with rafted floe, photographed by Frank Hurley, 1914-1917, P66/18-40 (Scott Polar Research Institute, University of Cambridge, UK).

Figure 29 - Astronaut Harrison Schmitt standing next to a boulder during the third EVA of the Apollo 17 mission, photographed by Eugene Cernan, December 13, 1972, AS-17-146-22294 (NASA Photo).

Figure 30 - Pilot Michael Collins inside the Gemini X spacecraft, July 18, 1966, S66-46268 (NASA Photo).

Figure 31 - Ansco Autoset camera, *Friendship 7,* MA-6, NASM Cat. #A19670198000 (NASM Photo).

Figure 32 - Leica camera, *Friendship 7*, MA-6, NASM Cat. #A19670197000 (NASM Photo).

Figure 33 - Robot Recorder 36, Gift of M. Scott Carpenter, NASA Kennedy Space Center, August 2011 (KSC Photo).

Figure 34 - Astronaut Scott Carpenter on the recovery ship *U.S.S. Intrepid* after MA-7 flight, carrying his Robot camera and spacesuit gloves, July 10, 1962, S62-04027 (NASA Photo).

Figure 35 - Astronauts Walter Schirra and Deke Slayton examine Hasselblad cameras with engineer Roland Williams, 1962, S62-06065 (NASA Photo).

Figure 36 - Hasselblad camera possibly used by Walter Schirra on Sigma 7, October 3, 1962, NASM Cat. #A19781503000 (Author's photo).

Figure 37 - Mercury capsule model in spin tunnel at the Langley Research Center, September 11, 1959, LARC Image #L-1959-06212 (NASA Photo).

Figure 38 - Mercury Pilot Observer Camera, NASM Cat. #A19790459000 (NASM Photo).

Figure 39 - Instrument Observer Camera visible over Glenn's right shoulder and the chest mirror at the bottom shows some of the instrument panel, still frame from 16mm Pilot Observer Camera, *Friendship 7*, MA-6, February 20, 1962 (NASA Photo).

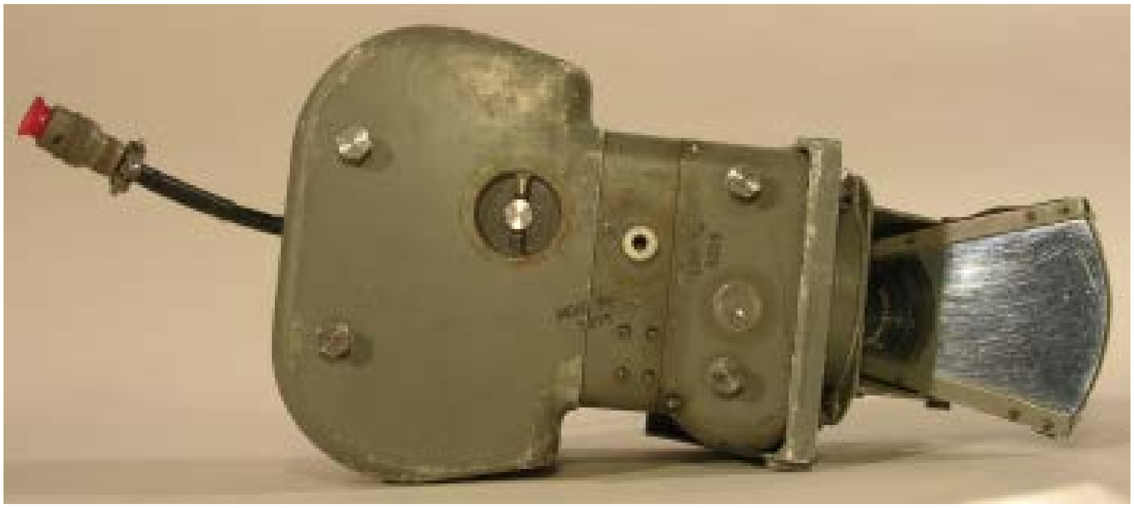

Figure 40 - Earth/Sky Observer camera manufactured by J.A. Maruer, used on unpiloted Mercury-Atlas 3A mission April 25, 1961, NASM Cat. #A19781516000 (NASM Photo).

Figure 41 - Robot camera used by L. Gordon Cooper on Faith 7, May 18-19, 1963, NASM Cat. #A19770553000 (NASM photo).

Figure 42 - Robot Royal 36 camera, as issued new, c. 1955-1969 (Camera Heritage Museum, Staunton, VA).

Figure 43 - Hasselblad 1600f model (Hasselblad USA Photo).

Figure 44 - Hasselblad 1000f model (Hasselblad USA Photo).

Figure 45 - Hasselblad advertisement, *Popular Photography*, July 1961.

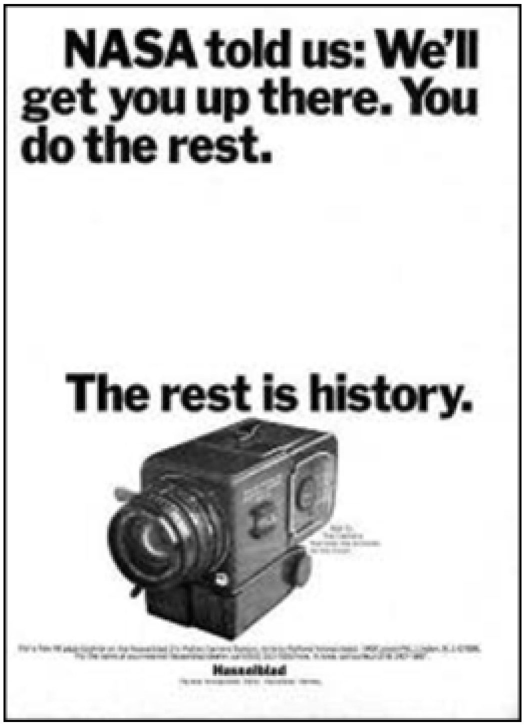

Figure 46 - Hasselblad camera advertisement, *Newsweek*, August 11, 1969.

Figure 47 - Diagram of Hasselblad 500c model and its parts (Hasselblad 500C Instruction Manual).

Figure 48 - 35mm Zeiss Contarex camera, NASM Cat. #V19890085039 (NASM photo).

Figure 49 - 70mm Hasselblad SWC from Project Gemini, NASM Cat. #A19790525000 (NASM photo).

Figure 50 - 70mm J.A. Maurer still camera from Project Gemini, NASM Cat. #A19761794000 (NASM photo).

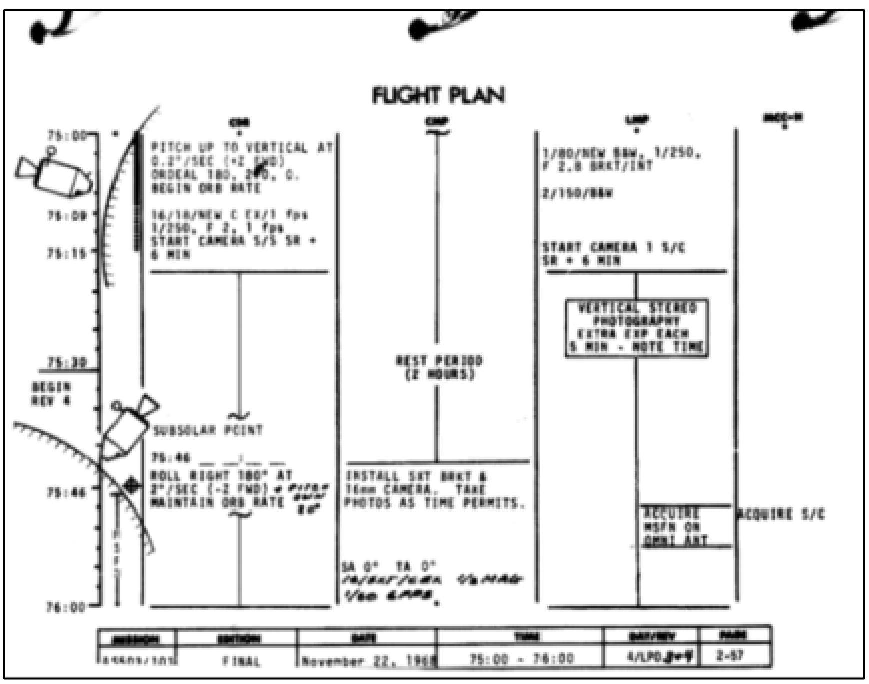

Figure 51 - Apollo 8 flight plan page for start of fourth orbit, *Earthrise* image captured at approximately MET 75:47.

Figure 52 - Television broadcast view of Earth from space, Apollo 8. Taken from *Debrief: Apollo 8* (NASA film).

Figure 53 - Apollo 8 mission patch, designed by crewmembers Borman, Lovell, and Anders.

Figure 54 - *Earthrise*, photographed by William Anders, December 24, 1968, AS08-13-2329 (NASA Photo).

Figure 55 - *Earthrise*, photographed by Lunar Orbiter 1, August 23, 1966, Frame 102-H2 (NASA Photo).

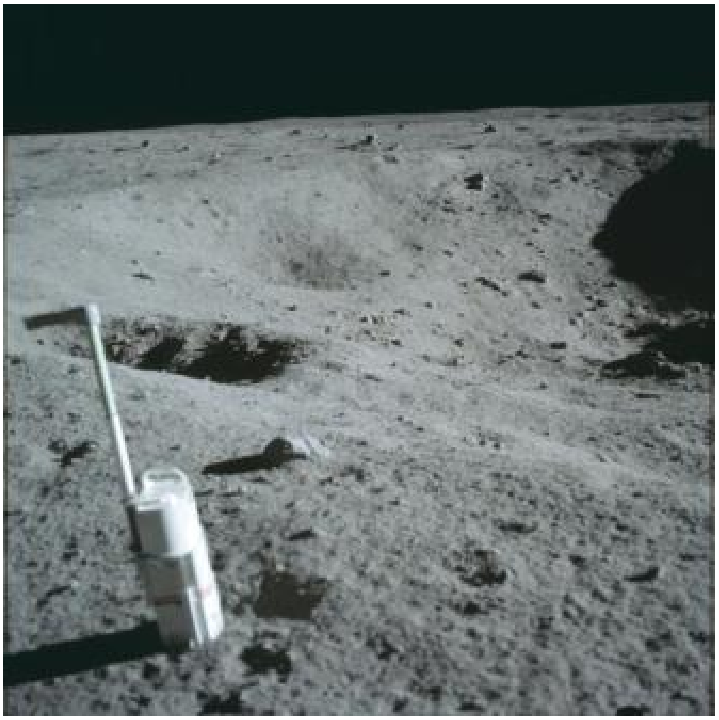

Figure 56 - Apollo Lunar Stereo Closeup Camera during Apollo 11, AS11-40-5957 (NASA Photo).

Figure 57 - Data Acquisition Camera from the Apollo 11 Lunar Module, NASM Cat. # T20140016083 (NASM Photo).

Figure 58 - The Augmented Target Docking Adapter (ATDA) as seen from the Gemini 9 spacecraft during one of their three rendezvous in space, June 3, 1966, S66-37923 (NASA Photo).

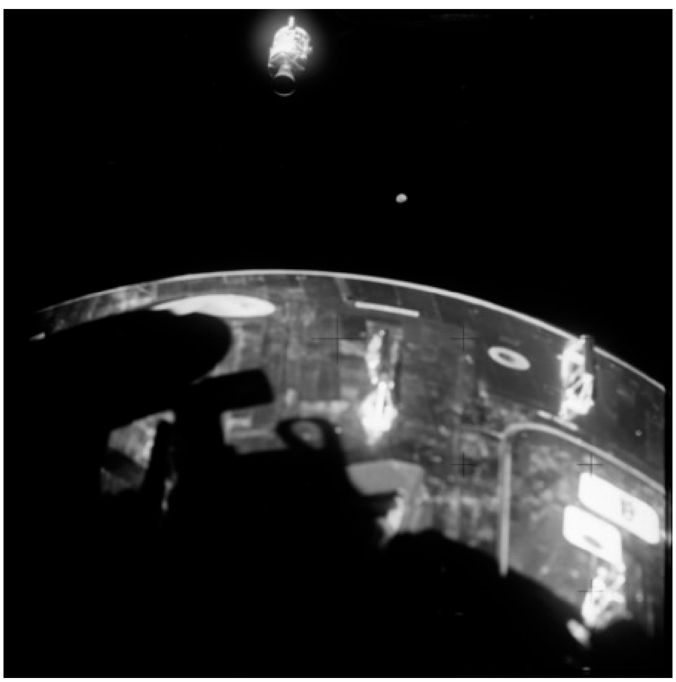

Figure 59 - Magnification of the Service Module in the upper portion of the photograph gave engineers their only look at the damage to Apollo 13, April 17, 1970, AS13-59-8500 (NASA Photo).

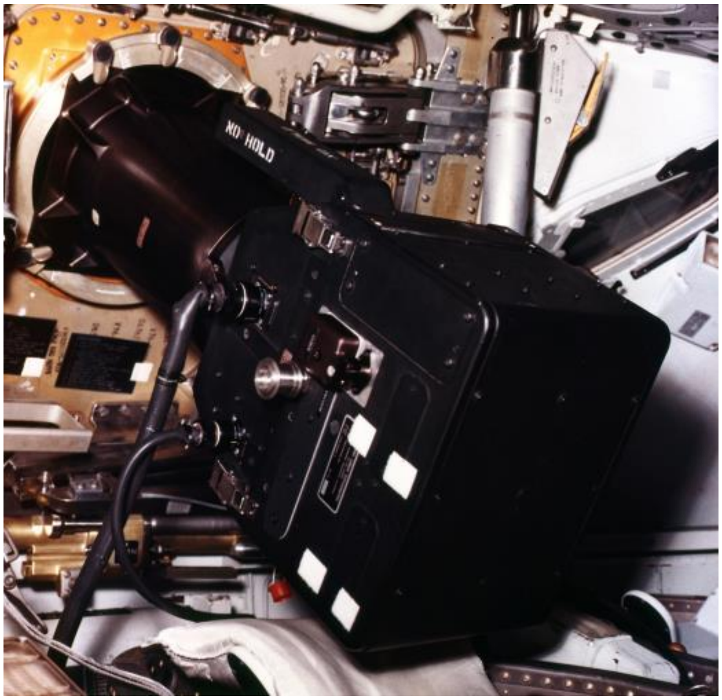

Figure 60 - The Hycon lunar topographic camera was intended for lunar mapping during Apollo 13, AS13-282A-70HC-251 (NASA Photo).

Figure 61 - Open SIM Bay of Apollo 17 service module, December 14, 1972, AS17-145-22254 (NASA Photo).

Figure 62 - Terry Slezak in the LRL with an Apollo 11 film magazine and lunar dust on his fingers, S69-40054 (NASA Photo)

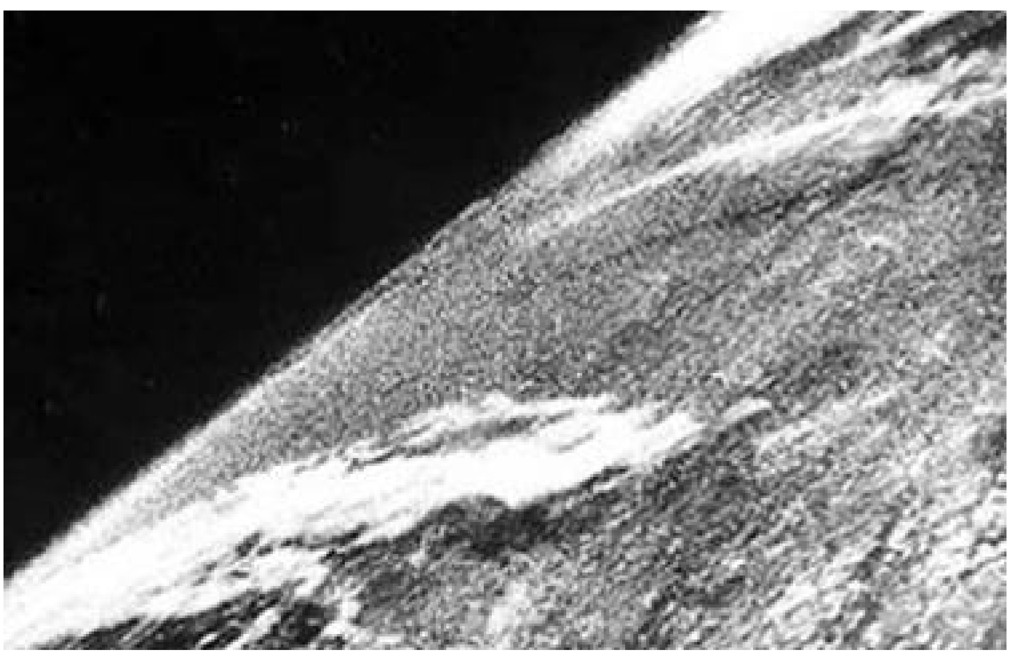

Figure 63 - View of Earth from a camera on V-2 #13, launched October 24, 1946 (White Sands Missile Range/Applied Physics Laboratory).

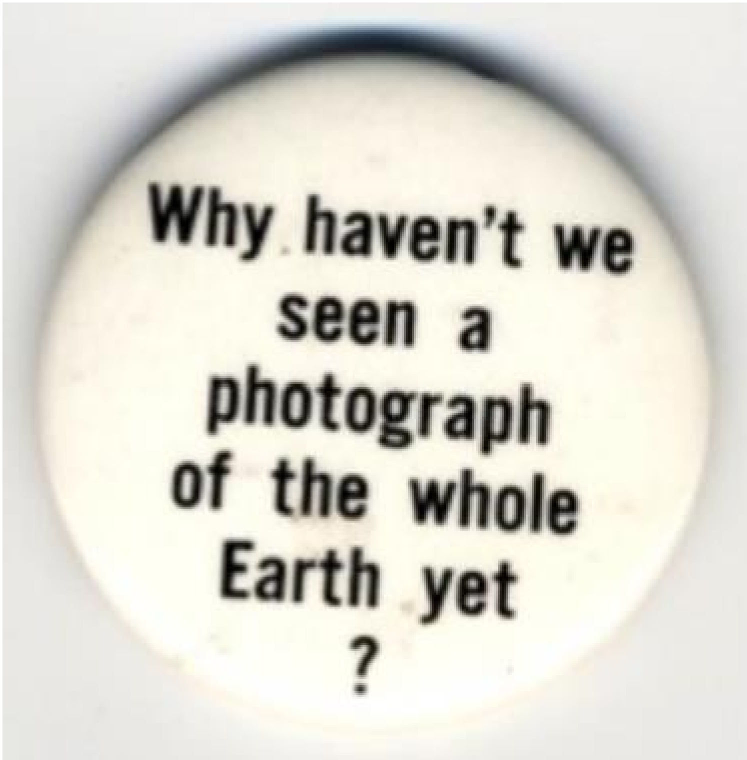

Figure 64 - Stewart Brand's slogan for the Whole Earth image campaign was featured on buttons and posters like this from the collection of the National Museum of American History.

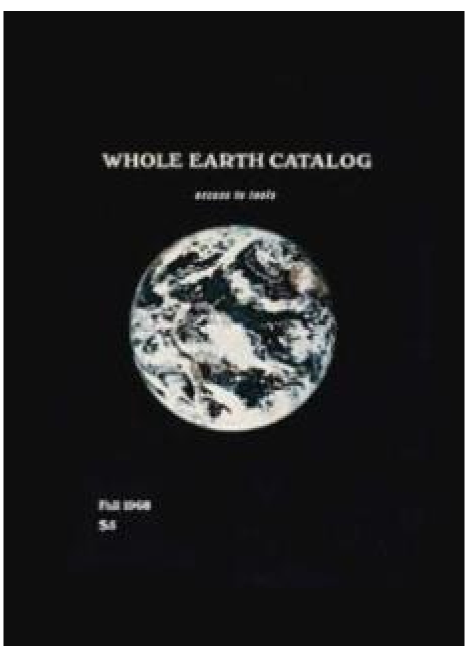

Figure 65 - ***Whole Earth Catalog*** **front cover, Fall 1968 issue.**

Figure 66 - ***Whole Earth*** **as seen during the Apollo 17 mission, likely photographed by Harrison Schmitt, AS17-148-22727 (NASA Photo).**

Figure 67 - Gemini IV photograph of part of the Sultanate of Muscat and Oman, with geological interpretation, from S65-34661 (NASA Photo).

Figure 68 - Sultanate of Muscat and Oman, Ras Al Hadd, S65-34661 (NASA Photo).

The New York Times

Johnson Aide Says Israel Disrupts Effort for Peace

New-Breed Astronauts: Scientists, Not Daredevils

Lindsay Outlines Program To Improve City in 1969

Figure 69 - ***New York Times*** **front page, December 30, 1968.**

Astronauts View Moon Photos

MONDAY

COMPLETE RACING

Los Angeles Times

FINAL

U.S. Urges Israel:

'REGRET' AIR RAID

Lebanon Asks U.N. Sanctions, Full Compensation for Damage

ISRAELI JETS BUZZ BEIRUT'S AIRPORT, STIR FRESH PANIC

New Storm May Bring More Rain on New Year's Day

OCCUPATION IS KEY

Allies Adopt Hard Attitude in Pacifying S. Vietnam Areas

Astronauts Spend Time With Families, View Moon Photos

Index to The Times

THE WEATHER

NLF 'Liberation Committees' Hold Part of Complex Strategy

Figure 70 - ***Los Angeles Times*** **front page, December 30, 1968.**

The Washington Post

Sen. Kennedy To Fight Long For Whip Job

Arab Commandos Promise Reprisals

Struck 250 Times, Pueblo Man Says

Figure 71 - ***Washington Post*** **front page, December 31, 1968.**

A CHRISTMAS APPEAL: NEW YORK'S NEEDIEST CASES, SECTION 2

The New York Times

HEAVY RAIDS GO ON FOR SEVENTH DAY IN NORTH VIETNAM

THOUSANDS DEAD AS QUAKES STRIKE NICARAGUAN CITY

Youths Rejecting Heroin, But Turn to Other Drugs

Europe Reacts to Bombing With Increasing Protests

Hog Prices Reach Record, Portending Consumer Rise

Social Ideas Change in South Africa's Ruling Group

Figure 72 - *New York Times*, front page, December 24, 1972.

The Boston Globe

A Christmas editorial:

'It's the only Earth we have'

INSIDE

Figure 73 - *Boston Globe*, front page, December 25, 1972.

Managua a City of Death— Survivors Tell of Horror

One Last View of Earth

Force of Nicaragua Earthquake at 50 Times Hiroshima A-Blast

Hughes Reported Safe

Tear Gas Disrupts Red Acrobats Here

Hanoi Hero Gen. Giap's Death Told

IRS to Scrutinize Aldermanic Expenses

Radio Hams Lend Aid in Quake Disaster

Nicaraguan Capital Shattered by Quake

Figure 74 - *Chicago Tribune*, page 2, December 24, 1972.

Jefferson 1st President to Freeze Funds

Details of Bugging Case Radio Purchase Given

9 HOUR SALE

TODAY SUNDAY ONLY

SLASHED

GAMES

FINAL COUNTDOWN ON GENUINE JEWEL GIFTS

WEEK IN WAIKIKI $259

PanAm

Figure 75 - Los Angeles Times, page 3, December 24, 1972.

Figure 76 - *Home* by Angela Manno, batik and color xerography, 1985, NASM Cat. #A20030012000 (NASM Photo).

Figure 77 - *Spaceship Earth* by Angela Manno, batik and color xerography, 1985, NASM Cat. #A20030016000 (NASM Photo).

Figure 78 - *Lunar Confrontation* by Robert Shore, oil on masonite panel, 1970, NASM Cat. #A19760332000 (NASM Photo).

Figure 79 - *Earth Rise* by Derman Uzunoglu, acrylic on canvas, 1974, NASM Cat. #A19760076000 (NASM Photo).

Figure 80 - Mosaic representation of Apollo 8 Earthrise image, Newman Center, Drexel Univeristy (removed 2010).

Figure 81 - *The Space Mural - A Cosmic View*, painted by Robert McCall, 1976, NASM Catalog Cat. #A19780181000 (Eric Long photo).

Figure 82 - Astronaut Dan Burbank, commander of the Expedition 30 crew looks out the cupola windows, April 21, 2012, ISS030-E-270467 (NASA Photo).

Figure 83 - Each STS-131 crewmember "stands" in one of the angled cupola windows, April 14, 2010, S131-E-010051 (NASA Photo).

Figure 84 - Astronaut John Grunsfeld photographed his reflection in the side of the Hubble Space Telescope, May 18, 2009, S125-E-010077 (NASA Photo).

Figure 85 - Astronaut Don Pettit positioned inside the cupola and surrounded by camera equipment, June 10, 2012, ISS031-E-112469 (NASA Photo).

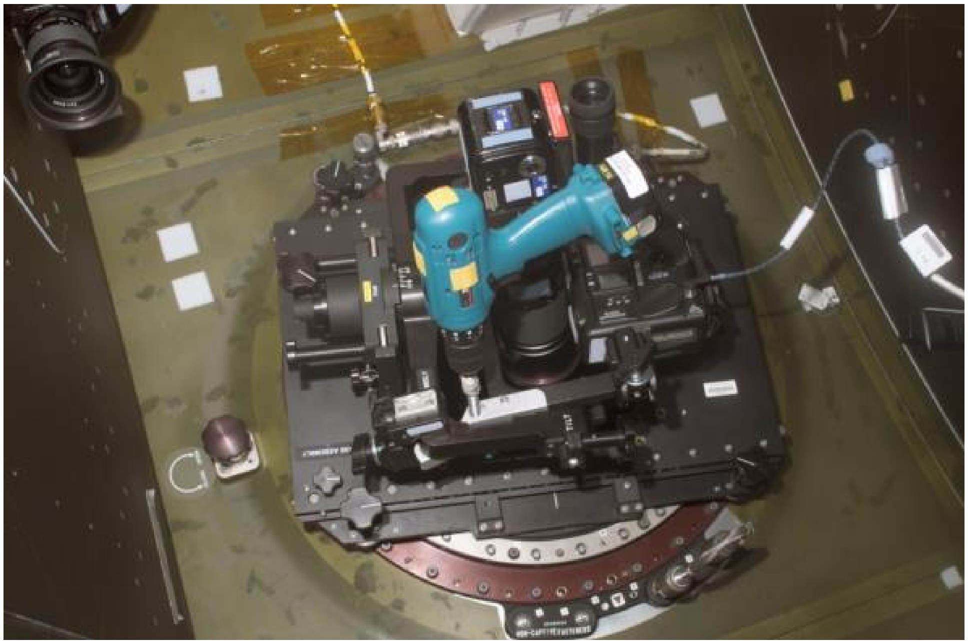

Figure 86 - "Barn door tracker" designed and built by astronaut Don Pettit on the ISS during Expedition 6, February 8, 2003, ISS006-E-25021 (NASA Photo).

BIBLIOGRAPHY

Primary Sources

Archive Collections

National Aeronautics and Space Administration Headquarters, History Office, Washington, D.C.
Office of Public Affairs
Photography

NASA Johnson Space Center Oral History Project, Houston, Texas

National Archives and Records Administration, College Park, Maryland
U.S. Information Agency (Record Group 306)

National Archives and Records Administration, Southwest Center, Ft. Worth, Texas
National Aeronautics and Space Administration (Record Group255)

University of Houston, Clear Lake Archives, University of Houston, Clear Lake, Texas
NASA Johnson Space Center History Collection

Government Publications

"1972 NASA Authorization: Hearings Before the Committee on Science and Astronautics." First Session on H.R. 3981 (superseded by H.R. 7109), March 2, 1971. Washington, D.C.: GPO, 1971.

"1974 NASA Authorization." HRG-1973-SAH-0023, March 14, 1973.

"Apollo 11 Technical Crew Debriefing, Vol. 1." Houston: NASA, July 31, 1969.

"Apollo 12 Technical Crew Debriefing." Houston: NASA, December 1, 1969.

"The Apollo 13 Accident: Hearings Before the Committee on Science and Astronautics." United States House of Representatives. Ninety-First Congress, Second Session, No. 19, June 16, 1970. Washington, D.C.: GPO, 1970.

“Apollo 13 Mission: Hearing Before the Committee on Aeronautical and Space Sciences.” United States Senate. Ninety-First Congress, Second Session, April 24, 1970. Washington, D.C.: GPO, 1970.

“Apollo 15 Mission Report.” HRG-1971-SAH-0005, September 9, 1971.

“Apollo 16 Mission Report.” HRG-1972-SAH-0003, May 16, 1972.

Ballentine, Wilbur A. “DoD/NASA Gemini Experiments Summary.” In *Gemini Summary Conference* Proceedings. February 1-2, 1967, SP-138. Washington, D.C.: NASA, 1967.

Boynton, John H. and Lewis R. Fisher. “Spacecraft and Launch-Vehicle Performance.” In *Results of the Third United States Manned Orbital Space Flight, October 3, 1962*, NASA SP-12. Washington, D.C.: NASA, 1962.

Gemini Program Mission Report: Gemini V, Report #MSC-G-R-65-4. Houston: NASA, October 1, 1965.

Gemini Program Mission Report, Gemini X, Report #MSC-G-R-66-7. Houston: NASA, August 1966.

Gemini Summary Conference, February 1-2, 1967. Houston: NASA, 1967.

Gemini XII Mission Report, Report #MSC-G-R-67-1. Houston: NASA, 1967.

Lowman, Paul. “Geologic Applications of Orbital Photography.” NASA Technical Note D-4155. Washington, D.C.: NASA, April 1967

National Aeronautics and Space Administration. *The Triumph of Astronaut L. Gordon Cooper, Jr. and the Faith 7*. Report #NASA-TM-85532. Houston: NASA, 1963.

National Aeronautics and Space Administration. *Earth Photographs from Gemini III, IV, and V*. NASA SP-129. Washington, D.C.: NASA, 1967.

Nugent, Robert and Lowell Starr, “Gemini Photography Evaluation,” NASA Technical Letter – 69, Washington, D.C.: NASA, March 1967

Review of U.S. Human Spaceflight Plans Committee, “Seeking a Human Spaceflight Program Worthy of a Great Nation,” Washington, D.C.: NASA, 2009, http://www.nasa.gov/pdf/396093main_HSF_Cmte_FinalReport.pdf.

“Twentieth Semi-Annual Report to Congress, July 1 – December 31, 1968.” House Document 91-153, October 3, 1969. Washington, D.C.: NASA, 1969.

Newspapers and Periodicals

Life Magazine
Los Angeles Times
Modern Photography
Newsweek
New York Times
Popular Photography
Spaceport News (NASA Kennedy Space Center)
The Evening Star (Washington, D.C.)
Time Magazine
Washington Post
Whole Earth Catalog

Websites

Apollo Flight Journal, http://history.nasa.gov/afj/

Apollo Lunar Surface Journal, http://history.nasa.gov/alsj/

Click! Smithsonian Photography Initiative, http://click.si.edu/

EcoWest, http://www.ecowest.com

Editor and Publisher Yearbook Online, http://www.editorandpublisher.com

Gateway to Astronaut Photography of Earth, http://eol.jsc.nasa.gov/

Hasselblad USA, http://www.hasselbladusa.com/about-hasselblad/hasselblad-in-space/in-the-beginning.aspx

NASA: 2Explore Photostream, https://www.flickr.com/photos/nasa2explore/

NASA Dryden Research Center Historical Photo Collection, http://www.dfrc.nasa.gov/Gallery/Photo/index.html

NASA Goddard Scientific Visualization Studio, http://www.nasa.gov/content/goddard/nasa-releases-new-earthrise-simulation-video/#.VAoJVPldWSo

NASA Human Spaceflight Photo Gallery, http://spaceflight.nasa.gov/gallery/index.html

NASA Johnson Spaceflight Center Digital Image Collection, http://images.jsc.nasa.gov/

NASA Marshall Spaceflight Center Image Galleries, http://mix.msfc.nasa.gov/

NASA Technical Reports Server, http://ntrs.nasa.gov

NBC News, http://www.nbcnews.com

Penny4NASA, http://www.penny4nasa.org/

Roberta Bondar, http://www.robertabondar.com

Space.com, http://www.space.com

The Endurance, http://www.kodak.com/US/en/corp/features/*Endurance*/

Tyson, Neil deGrasse. "Launch Keynote: 28th National Space Symposium." Space Foundation: https://www.youtube.com/watch?v=VLzKjxglNyE.

UStream, http://www.ustream.tv

Vimeo, http://www.vimeo.com

Visible Earth, http://visibleearth.nasa.gov/

Windows on Earth, http://www.windowsonearth.org

Secondary Sources

Abdel-Gawad, Monem. “Geological Structures of the Red Sea Area Inferred from Satellite Pictures.” In *Hot Brines and Recent Heavy Metal Deposits in the Red Sea*. Degens and Ross, eds. Berlin: Springer-Verlag, 1969: 25-37.

Abney, Sir William de Wiveleslie. *Instruction in Photography*. London: Piper & Carter, 1882.

Aldrin, Buzz and Ken Abraham. *Magnificent Desolation: The Long Journey Home from the Moon*. New York: Harmony Books, 2009.

Alexander, Caroline. *The Endurance: Shackleton’s Legendary Antarctic Expedition*. New York: Knopf, 1998.

Alexander, Thomas W. *Project Apollo: Man to the Moon*. New York: Harper & Row, 1964.

Allan, Stuart, ed. *Journalism: Critical Issues*. Maidenhead, England: Open University Press, 2005.

Allenby, Richard. *Analysis of Apollo 8 Photography and Visual Observations*, NASA SP-201. Washington, D.C.: NASA, 1969.

Anders, William, James Lovell, and Frank Borman. “Visual Observations.” In *Analysis of Apollo 8 Photography and Visual Observations, 1969*. Washington, D.C.: NASA, 1969.

Anderson, Nancy, and Michael R. Dietrich, eds. *The Educated Eye: Visual Culture and Pedagogy in the Life Sciences*. Hanover, N.H: Dartmouth College Press, 2012.

Anderson, Nancy K. “The Kiss of Enterprise: The Western Landscape as Symbol and Resource.” In *The West as America: Reinterpreting Images of the Frontier, 1820-1920*, 236–83. Washington, D.C.: Smithsonian Institution Press, 1991.

Anderson, Steve F. *Technologies of History: Visual Media and the Eccentricity of the Past*. Lebanon, NH: Dartmouth University Press, 2011.

Anderson, Terry H. *The Movement and the Sixties*. New York: Oxford University Press, 1995.

Apollo Lunar Geology Investigation Team. “Geologic Setting of the Apollo 15 Samples.” *Science*. Vol. 125, No. 4020 (January 28, 1972): 407-415

Appadurai, Arjun. *Modernity at Large: Cultural Dimensions of Globalization*. Minneapolis: University of Minnesota Press, 1996.

Arnold, Harry John Philip. *Photographer of the World: The Biography of Herbert Ponting*. Madison, NJ: Fairleigh Dickinson University Press, 1971.

Assmann, Jan, and John Czaplicka. "Collective Memory and Cultural Identity." *New German Critique*, no. 65 (April 1, 1995): 125–33.

Bal, Mieke, Jonathan Crewe, and Leo Spitzer, eds. *Acts of Memory Cultural Recall in the Present*. Hanover, NH: Dartmouth College, 1999.

Ballentine, Wilbur. "DoD/NASA Gemini Experiments Summary." In *Gemini Summary Conference*, SP-138. Washington, D.C.: NASA, 1967.

Barczewski, Stephanie L. *Antarctic Destinies: Scott, Shackleton and the Changing Face of Heroism*. London: Hambledon Continuum, 2007.

Barrett, Terry. "A Theoretical Construct for Interpreting Photographs." *Studies in Art Education* 27, no. 2 (January 1, 1986): 52–60.

Barthes, Roland. "Rhetoric of the Image," in *The Visual Culture Reader*, Nicholas Mirzoeff, ed., London: Routledge, 2002: 136.

Bartlett, Richard A. *Great Surveys of the American West*. Norman: University of Oklahoma Press, 1962.

Bartman, Lora. "Photographer Built Camera for Glenn's Flight." *Spaceport News*. February 27, 1998, Vol. 37, No. 4 edition.

Batchen, Geoffrey. *Burning with Desire: The Conception of Photography*. Cambridge: MIT Press, 1997.

Bauer, Martin W., and Massimiano Bucchi, eds. *Journalism, Science and Society: Science Communication between News and Public Relations*. New York: Routledge, 2007.

Baughman, T. H. *Before the Heroes Came: Antarctica in The 1890s*. Lincoln: University of Nebraska Press, 1999.

Bean, Alan. *Alan Bean, Painting Apollo: First Artist on Another World*. Washington, DC: Smithsonian Books, 2009.

Benjamin, Walter. *Illuminations*. Translated by Harry Zohn. New York: Schocken Books, 1968.

Bennett, Mary, and David Percy. *Dark Moon: Apollo and the Whistle-Blowers*. Kempton, IL: Adventures Unlimited Press, 2001.

Benson, Charles, and William Faherty. *Moonport: A History of Apollo Launch Facilities and Operations*. Washington, D.C.: NASA, 1978.

Bezner, Lili Corbus. *Photography and Politics in America: From the New Deal into the Cold War*. Baltimore: Johns Hopkins University Press, 1999.

Billig, Michael. "Collective Memory: Ideology and British Royal Family," in *Collective Remembering*, David Middleton and Derek Edwards, eds. London: Sage Publications, 1990

Billings, Linda. "How Shall We Live in Space? Culture, Law and Ethics in Spacefaring Society." *Space Policy* 22, no. 4 (November 2006): 249–55.

Bilstein, Roger. *Stages to Saturn: A Technological History of the Apollo/Saturn Launch Vehicles*. Washington, D.C.: NASA, 1996.

Bizony, Piers. *The Man Who Ran the Moon: James E. Webb and the Secret History of Project Apollo*. New York: Thunder's Mouth Press, 2006.

Bodnar, John E. *Remaking America: Public Memory, Commemoration, and Patriotism in the Twentieth Century*. Princeton: Princeton University Press, 1992.

Boorstin, Daniel J. *The Image: A Guide to Pseudo-Events in America*. New York: Vintage Books, 1992.

Bourdieu, Pierre. *Photography: A Middle-Brow Art*. Translated by Shaun Whiteside. Stanford: Stanford University Press, 1990.

———. "The Social Definition of Photography." In *Visual Culture: The Reader*, edited by Jessica Evans and Stuart Hall. London: Sage University, 1999.

Boydstun, Amber E. *How Policy Issues Become Front-Page News*. PhD., Penn State University, 2008.

———. *Making the News: Politics, the Media, and Agenda Setting*. Chicago: University of Chicago Press, 2013.

Boyer, Paul S. *By the Bomb's Early Light: American Thought and Culture at the Dawn of the Atomic Age*. Chapel Hill: University of North Carolina Press, 1994.

Boyle, Alan. "40 Years Later, Apollo 17's Blue Marble Leaves a Mark on Our Memory." Cosmic Blog, *NBCNews.com*, December 7, 2012 (accessed November 4, 2014).

Braunstein, Peter and Michael William Doyle. "Historicizing the American Counterculture of the 1960s and '70s." In Imagine Nation: The American Counterculture of the 1960's and 70's. Braunstein and Doyle, eds. New York: Routledge, 2002.

Brick, Howard. *Age of Contradiction: American Thought and Culture in the 1960s*. New York: Twayne Publishers, 1998.

Broder, David S. *Behind the Front Page: A Candid Look at How the News Is Made*. New York: Simon and Schuster, 1987.

Brooks, Courtney, James Grimwood, and Loyd Swenson. *Chariots for Apollo: A History of Manned Lunar Spacecraft*. Washington, D.C.: NASA, 1979.

Brooks, Peter, G.C. Frewer, and G.K.C. Pardoe. *Project Apollo: The Way to the Moon*. New York: American Elsevier Publishing, 1969.

Brown, Elspeth H. *The Corporate Eye: Photography and the Rationalization of American Commercial Culture, 1884-1929*. Baltimore: Johns Hopkins University Press, 2005.

Brown, Joshua. *Beyond the Lines: Pictorial Reporting, Everyday Life, and the Crisis of Gilded Age America*. Berkeley: University of California Press, 2002.

Bryson, Michael A. *Visions of the Land: Science, Literature, and the American Environment from the Era of Exploration to the Age of Ecology*. Charlottesville: University Press of Virginia, 2002.

Buffalo Bill Historical Center, Thomas Gilcrease Institute of American History and Art, and Yale University. *Discovered Lands, Invented Pasts: Transforming Visions of the American West*. New Haven: Yale University Press, 1992.

Burke, Peter. *Eyewitnessing: The Uses of Images as Historical Evidence*. Ithaca: Cornell University Press, 2001.

Burkett, Warren. *News Reporting: Science, Medicine, and High Technology*. Ames: Iowa State University Press, 1986.

Byrnes, Mark E. *Politics and Space: Image Making by NASA*. Westport: Praeger, 1994.

Carpenter, Scott and Kris Stoever. *For Spacious Skies: The Uncommon Journey of a Mercury Astronaut*. Orlando: Harcourt, 2002.

Carter, Edward C. *Surveying the Record: North American Scientific Exploration to 1930*. Philadelphia: American Philosophical Society, 1999.

Cassidy, James G. *Ferdinand V. Hayden: Entrepreneur of Science*. Lincoln: University of Nebraska Press, 2000.

Castleberry, May, ed. *Perpetual Mirage: Photographic Narratives of the Desert West*. New York: Whitney Museum of American Art, 1996.

Ceruzzi, Paul E. *A History of Modern Computing*. Cambridge: MIT Press, 2003.

Chaikin, Andrew. *A Man on the Moon: The Voyages of the Apollo Astronauts*. New York: Viking, 1994.

Childs, Elizabeth C. “Time’s Profile: John Wesley Powell, Art, and Geology at the Grand Canyon.” *American Art* 10, no. 1 (Spring 1996): 7–35.

Clifford, Nicholas, Sarah Holloway, Stephen P. Rice, and Gill Valentine. *Key Concepts in Geography*. London: SAGE Publications Ltd, 2008.

Cohen, Lizabeth. *A Consumer’s Republic: The Politics of Mass Consumption in Postwar America*. New York: Knopf, 2003.

Collins, Martin J. *Space Race: The U.S.-U.S.S.R. Competition to Reach the Moon*. San Francisco: Pomegranate, 1999.

Committee on Scientific Accomplishments of Earth Observations from Space. *Earth Observations from Space: The First 50 Years of Scientific Achievements*. Washington, D.C.: National Academies Press, 2007.

Confino, Alon. “Collective Memory and Cultural History: Problems of Method.” *The American Historical Review* 102, no. 5 (December 1, 1997): 1386–1403.

Cooper, L. Gordon. *Leap of Faith: An Astronaut’s Journey Into the Unknown*. New York: HarperCollins, 2002.

Cosgrove, Denis. “Contested Global Visions: One-World, Whole-Earth, and the Apollo Space Photographs.” *Annals of the Association of American Geographers* 84, no. 2 (June 1994): 270–94.

———. *Apollo's Eye: A Cartographic Genealogy of the Earth in the Western Imagination*. Baltimore: Johns Hopkins University Press, 2001.

———. *Social Formation and Symbolic Landscape*. Madison: University of Wisconsin Press, 1998.

Crary, Jonathan. *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*. Cambridge: MIT Press, 1992.

Cronon, William, George Miles, and Jay Gitlin, eds. *Under an Open Sky: Rethinking America's Western Past*. New York: W.W. Norton, 1992.

Cross, Gary S. *An All-Consuming Century: Why Commercialism Won in Modern America*. New York: Columbia University Press, 2000.

Curtis, James. *Mind's Eye, Mind's Truth: FSA Photography Reconsidered*. Philadelphia: Temple University Press, 1989.

Dallos, Robert. "Ad Men Exploit Apollo To Hilt." *Boston Globe (1960-1981)*. July 20, 1969.

David, James. "Astronaut Photography and the Intelligence Community: Who Saw What?" *Space Policy* 22, no. 3 (August 2006): 185–93.

David, Leonard. "Area 51 Declassified: Documents Reveal Cold War 'Hide-and-Seek'." *Space.com*. November 6, 2013.

David, Robert G. *The Arctic in the British Imagination, 1818-1914*. Manchester: Manchester University Press, 2000.

Day, Dwayne. "Astronauts and Area 51: the Skylab Incident." *The Space Review*. January 9, 2006

Debord, Guy. *Society of the Spectacle*. Translated by Donald Nicholson-Smith. New York: Zone Books, 1994.

DeVorkin, David H. *Hubble Imaging Space and Time*. Washington, D.C: Smithsonian National Air and Space Museum, 2008.

———. *Race to the Stratosphere: Manned Scientific Ballooning in America*. New York: Springer-Verlag, 1989.

———. *Science With A Vengeance: How the Military Created the US Space Sciences After World War II*. New York: Springer, 1993.

Diamond, Edwin. *Behind the Times: Inside the New New York Times*. Chicago: University of Chicago Press, 1995.

Dikovitskaya, Margarita. *Visual Culture: The Study of the Visual After the Cultural Turn*. Cambridge: MIT Press, 2005.

Donohue, Patrick Howard. “Origin and Evolution of High-Titanium Mare Basalts.” Dissertation. University of Notre Dame, 2013.

Doss, Erika Lee. *Looking at Life Magazine*. Washington, D.C.: Smithsonian Institution Press, 2001.

Dubrow, Dick. “Well, you’ve seen it: Buck Rogers is real.” *The Evening Star*. Washington, D.C., July 21, 1969: D-5

Dunaway, Finis. *Natural Visions: The Power of Images in American Environmental Reform*. Chicago: University of Chicago Press, 2005.

Edwards, Elizabeth. *The Camera as Historian: Amateur Photographers and Historical Imagination, 1885-1918*. Durham: Duke University Press, 2012.

Edwards, Janis L. “Echoes of Camelot: How Images Construct Cultural Memory Through Rhetorical Framing.” In *Defining Visual Rhetorics*. Charles Hill and Marguerite Helmers, ed. Mahwah, NJ: Lawrence Erlbaum, 2004, p. 179.

Eisinger, Joel. *Trace and Transformation: American Criticism of Photography in the Modernist Period*. Albuquerque: University of New Mexico Press, 1995.

El-Baz, Farouk. “Training Apollo Astronauts in Lunar Orbital Observations and Photography.” In *Analogs for Planetary Exploration*, edited by W. Brent Garry and Jacob E. Bleacher, 49–66.

Elkins, James. *Visual Studies: A Skeptical Introduction*. New York: Routledge, 2003.

Evans, Jessica, and Stuart Hall, eds. *Visual Culture: The Reader*. London: Sage, 1999.

Farrar, Fred. “Apollo Moon Team to Take 8 Cameras, Along on Mission.” *Chicago Tribune (1963-Current File)*. July 14, 1969, Sec. 1.

Fernández-Armesto, Felipe. *Pathfinders: A Global History of Exploration*. New York: W. W. Norton, 2006.

"First Look at the Apollo 8 Pictures." *Nature*. Vol. 221, January 18, 1969: 215-217.

Foucault, Michel. "Panopticism." In *Visual Culture: The Reader*, edited by Jessica Evans and Stuart Hall. London: Sage, 1999.

Franks, Suzanne. *Reporting Disasters: Famine, Aid, Politics and the Media*. London: Hurst Publishers, 2013.

Frascina, Francis. "The New York Times, Norman Rockwell, and the New Patriotism." *Journal of Visual Culture* 2, no. 1 (April 2003): 99–130.

French, Francis, and Colin Burgess. *In the Shadow of the Moon: A Challenging Journey to Tranquility, 1965-1969*. Lincoln: University of Nebraska Press, 2007.

Freud, Sigmund. *The Standard Edition of the Complete Psychological Works of Sigmund Freud*. Volume 3. London: Hogarth Press, 1953.

Freund, Gisèle. *Photography & Society*. Boston: D. R. Godine, 1980.

Freytag, Heinrich. *The Hasselblad Way; the Hasselblad Photographer's Companion*. London: Focal Press, 1973.

Friedman, Sharon M., Sharon Dunwoody, and Carol L. Rogers, eds. *Scientists and Journalists: Reporting Science as News*. New York : Free Press, 1986.

Frisch, Michael. "American Memory and the Structures of Collective Memory: A Modest Exercise in Empirical Iconography." In *Memory and American History*, edited by David Thalen, Vol. 26. Bloomington: Indiana University Press, 1990.

Gaddis, John Lewis. *We Now Know: Rethinking Cold War History*. Oxford: Clarendon Press, 1997.

Garde-Hansen, Joanne. *Media and Memory*. Edinburgh: Edinburgh University, 2011.

Gidley, Mick. *Edward S. Curtis and the North American Indian, Incorporated*. Cambridge: Cambridge University Press, 1998.

Gill, Jocelyn and Willis Foster. "Science Experiments Summary." In *Gemini Summary Conference, February 1-2, 1967*. Houston: NASA, 1967, p. 292-293

Gillis, John R, ed. *Commemorations: The Politics of National Identity*. Princeton: Princeton University Press, 1994.

Glassberg, David. “Public History and the Study of Memory.” *The Public Historian* 18, no. 2 (Spring 1996): 7–23.

Glenn, John and Nick Taylor. *John Glenn: A Memoir*. New York: Bantam Books, 1999.

Goetzmann, William H. “Desolation, Thy Name Is the Great Basin: Clarence King’s 40th Parallel Geological Explorations.” In *Perpetual Mirage: Photographic Narratives of the Desert West*, 57–67. New York: Whitney Museum of American Art, 1996.

Goetzmann, William H. *Exploration and Empire; the Explorer and the Scientist in the Winning of the American West*. New York: Knopf, 1966.

Goldberg, Vicki. *The Power of Photography: How Photographs Changed Our Lives*. New York: Abbeville Press, 1991.

Goodyear, Anne Collins. “NASA and the Political Economy of Art, 1962-1974.” In *The Political Economy of Art: Making the Nation of Culture*, Julie F. Codell, ed. Madison: Fairliegh Dickinson University, 2008.

———. “The Relationship of Art to Science and Technology in the United States, 1957-1971: Five Case Studies.” Dissertation. University of Texas at Austin, 2002.

Green, Jonathan. *American Photography: A Critical History 1945 to the Present*. New York: H.N. Abrams, 1984.

Greene, John Robert. *America in the Sixties*. Syracuse: Syracuse University Press, 2010.

Griffin, Michael. “The Great War Photographs: Constructing Myths of History and Photojournalism.” In *Picturing the Past*, Bonnie Brennen and Hanno Hardt, eds. Urbana: University of Illinois Press, 1999.

Grossman, James R, ed. *The Frontier in American Culture: An Exhibition at the Newberry Library, August 26, 1994 - January 7, 1995*. Berkeley: University of California Press, 1994.

Hacker, Barton C. *On the Shoulders of Titans: A History of Project Gemini*. Washington, D.C.: National Aeronautics and Space Administration, 1977.

Halbwachs, Maurice. *On Collective Memory*. Chicago: University of Chicago Press, 1992.

Hales, Peter B. *William Henry Jackson and the Transformation of the American Landscape*. Philadelphia: Temple University Press, 1988.

———. “Imagining the Atomic Age.” In *Looking at Life Magazine*, edited by Erika Lee Doss. Washington, D.C.: Smithsonian Institution Press, 2001.

Hall, Eldon C. *Journey to the Moon: The History of the Apollo Guidance Computer*. Reston: American Institute of Aeronautics and Astronautics, 1996.

Hammond, William M. *Reporting Vietnam: Media & Military at War*. Lawrence: University Press of Kansas, 1998.

Hansen, James R. *First Man: The Life of Neil A. Armstrong*. New York: Simon & Schuster, 2006.

Hariman, Robert, and John Louis Lucaites. *No Caption Needed: Iconic Photographs, Public Culture, and Liberal Democracy*. Chicago: University of Chicago Press, 2007.

Harland, David M. *NASA’s Moon Program: Paving the Way for Apollo 11*. Berlin: Springer-Praxis, 2010.

Harper, Joe, and Thom Yantek. *Media, Profit, and Politics: Competing Priorities in an Open Society*. Kent: Kent State University Press, 2003.

“Hasselblad Enlists Buzz Aldrin to Launch Its Lunar Camera.” *PCMAG*. Accessed June 4, 2013. http://www.pcmag.com/article2/0,2817,2419849,00.asp.

Hawkins, Stephanie L. *American Iconographic: National Geographic, Global Culture, and the Visual Imagination*. Charlottesville: University of Virginia Press, 2010.

Heale, M.J. *The Sixties in America: History, Politics and Protest*. Chicago: Fitzroy Dearborn Publishers, 2001.

Henny, Leonard. “Trend Report: Theory and Practice of Visual Sociology,” in *SAGE Visual Methods*. Jason Hughes, ed. London: SAGE, 2012: 20-21.

Henry, Joseph. *The Papers of Joseph Henry*. Washington, D.C.: Smithsonian Institution Press, 1972.

Hersch, Matthew H. *Inventing the American Astronaut*. New York: Palgrave Macmillan, 2012.

Hill, Charles A. “The Psychology of Rhetorical Images,” in *Defining Visual Rhetorics*. Charles Hill and Marguerite Helmers, eds. Mahwah, NJ: Lawrence Erlbaum, 2004.

Hill, Charles A. and Marguerite H. Helmers, eds. *Defining Visual Rhetorics*. Mahwah, NJ: Lawrence Erlbaum, 2004.

Hillers, John K. *"Photographed All the Best Scenery": Jack Hillers's Diary of the Powell Expeditions, 1871-1875*. Don D. Fowler, ed. Salt Lake City: University of Utah Press, 1972.

Hixson, Walter, ed. *Historical Memory and Representations of the Vietnam War*. The United States and the Vietnam War Series, Vol. 6. New York: Garland Publishers, 2000.

Holliday, Clyde. "Seeing the Earth from 80 Miles Up." *National Geographic*. October 1950. Vol. 98, No. 4: 511-528.

Hoskins, Andrew. "Television and the Collapse of Memory." *Time & Society*. Vol. 13. No. 1 (2004): 109-127.

Hughes, Jason, ed. *SAGE Visual Methods*. London: SAGE, 2012.

Huntford, Roland. *Shackleton*. New York: Carroll & Graf, 1998.

Hutton, Patrick. "Recent Scholarship on Memory and History." *The History Teacher* 33, no. 4 (August 2000): 533–48.

Jasanoff, Sheila and Marybeth Martello. *Earthly Politics: Local and Global in Environmental Governance*. Cambridge: MIT Press, 2004.

"'Johnson Space Center' Name Now Official." *Los Angeles Times*. February 20, 1973, sec. Part I.

Johnston, Patricia, ed. *Seeing High & Low: Representing Social Conflict in American Visual Culture*. Berkeley: University of California Press, 2006.

Jones, Max. *The Last Great Quest: Captain Scott's Antarctic Sacrifice*. Oxford: Oxford University Press, 2003.

Jurovics, Toby, ed. *Framing the West: The Survey Photographs of Timothy H. O'Sullivan*. Washington, D.C. : Library of Congress, 2010.

Jussim, Estelle, and Elizabeth Lindquist-Cock. *Landscape as Photograph*. New Haven: Yale University Press, 1985.

Kammen, Michael G. *Mystic Chords of Memory: The Transformation of Tradition in American Culture*. New York: Knopf, 1991.

———. *Visual Shock: A History of Art Controversies in American Culture*. New York: Knopf, 2006.

Kansteiner, Wulf. “Finding Meaning in Memory: A Methodological Critique of Collective Memory Studies.” *History and Theory* 41, no. 2 (May 2002): 179–97.

Kelly, Thomas J. *Moon Lander: How We Developed the Apollo Lunar Module*. Washington, D.C.: Smithsonian Institution Press, 2001.

Kelsey, Robin Earle. *Archive Style: Photographs & Illustrations for U.S. Surveys, 1850-1890*. Berkeley: University of California Press, 2007.

Keltner, Kathy. "From Myth to Metaphor to Memory: A Rhetorical Analysis of Televised Representations of Project Apollo, 1968-2004." Dissertation. Ohio University, 2007.

Kember, Sarah. “The Shadow of the Object: Photography and Realism.” In *The Photography Reader*, edited by Liz Wells, 202–15. London: Routledge, 2003.

Kessler, Elizabeth A. *Picturing the Cosmos: Hubble Space Telescope Images and the Astronomical Sublime*. Minneapolis: University of Minnesota Press, 2012.

Klein, Kerwin Lee. “On the Emergence of Memory in Historical Discourse.” *Representations*, no. 69 (Winter 2000): 127–50.

Kloc, Joe. “The Case of the Missing Moon Rocks.” *Atavist*, No. 12, February 2012.

Kornberg, Warren. “Apollo’s Eye on Earth Could Solve Space Budget Problem.” *Los Angeles Times (1923-Current File)*. March 30, 1969, sec. F.

Kracauer, Siegfried. “Photography.” Translated by Thomas Y. Levin. *Critical Inquiry* 19, no. 3 (Spring 1993): 421–36.

Krauss, Rosalind. “Photography’s Discursive Spaces: Landscape/View.” *Art Journal* 42, no. 4 (December 1, 1982): 311–19.

Kroll, Gary. *America’s Ocean Wilderness: A Cultural History of Twentieth-Century Exploration*. Lawrence: University Press of Kansas, 2008.

Landsberg, Alison. *Prosthetic Memory: The Transformation of American Remembrance in the Age of Mass Culture*. New York: Columbia University Press, 2004.

Lansing, Alfred. *Endurance*. New York: Carroll & Graf, 2000.

Larson, Edward J. *An Empire of Ice: Scott, Shackleton, and the Heroic Age of Antarctic Science*. New Haven: Yale University Press, 2011.

Lasser, David. *The Conquest of Space*. New York: Penguin Press, 1931.

Launius, Roger D. *Apollo: A Retrospective Analysis*. Washington, D.C.: NASA, 2012.

———. *Imagining Space: Achievements, Predictions, Possibilities, 1950-2050*. San Francisco: Chronicle Books, 2001.

———. "Interpreting the Moon Landings: Project Apollo and the Historians." *History and Technology* 22, Issue 3 (2006): 225-255.

———. "Perceptions of Apollo: Myth, Nostalgia, Memory or All of the Above?" *Space Policy* 21, no. 2 (May 2005): 129–39.

———. "Public Opinion Polls and Perceptions of US Human Spaceflight." *Space Policy* 19, no. 3 (August 2003): 163–75.

———. "Why Go to the Moon? The Many Faces of Lunar Policy." *Acta Astronautica* 70 (January 2012): 165–75.

Lay Jr., Beirne. *Earthbound Astronauts: The Builders of Apollo-Saturn*. Englewood Cliffs, NJ: Prentice-Hall, 1971.

Lazier, By Benjamin. "Earthrise; Or, The Globalization of the World Picture." *The American Historical Review* 116, no. 3 (June 1, 2011): 602–30.

Lazzarini, Alain. *Hasselblad and the Moon*. Granville, France: self-published, 2011.

Ley, Willy. *Rockets, Missiles, and Man in Space*. New York: Viking Press, 1968.

Limerick, Patricia Nelson. *Something in the Soil: Legacies and Reckonings in the New West*. New York: W.W. Norton, 2000.

———. *The Legacy of Conquest: The Unbroken Past of the American West*. New York: Norton, 1988.

Lindbergh, Anne Morrow. *Earth Shine*. New York: Harcourt, Brace & World, 1969.

Lindsay, John. *Lunar Stratigraphy and Sedimentology*. Amsterdam: Elsevier Scientific Publishing Group, 1976.

Lipsitz, George. *Time Passages: Collective Memory and American Popular Culture*. Minneapolis: University of Minnesota Press, 1990.

Logsdon, John M. *John F. Kennedy and the Race to the Moon*. New York: Palgrave Macmillan, 2010.

———. *The Decision to Go to the Moon: Project Apollo and the National Interest*. Chicago: The University of Chicago Press, 1976.

Lowenthal, David. "History and Memory." *The Public Historian* 19, no. 2 (Spring 1997): 30–39.

———. "Past Time, Present Place: Landscape and Memory." *Geographical Review* 65, no. 1 (January 1975): 1–36.

———. *The Past Is a Foreign Country*. Cambridge: Cambridge University Press, 1985.

Lowman, Paul. "Geologic Applications of Orbital Photography." NASA Technical Note D-4155. Washington, D.C.: NASA, April 1967.

———. "Geologic Orbital Photography: Experience from the Gemini Program." *Photogrammetria*. Vol. 24, Issues 3-4, June 1969, pp. 77-108.

Lubin, David M. *Shooting Kennedy: JFK and the Culture of Images*. Berkeley: University of California Press, 2003.

Lule, Jack. *Daily News, Eternal Stories: The Mythological Role of Journalism*. New York: Guilford Press, 2001.

Lutz, Catherine, and Jane Lou Collins. *Reading National Geographic*. Chicago: University of Chicago Press, 1993.

MacKenna, John. *Shackleton: An Irishman in Antarctica*. Madison: University of Wisconsin Press, 2002.

Mack, Pamela Etter. *Viewing the Earth: The Social Construction of the Landsat Satellite System*. Inside Technology. Cambridge: MIT Press, 1990.

Maher, Neil. "Shooting the Moon." *Environmental History* 9, no. 3 (July 2004): 526–32.

Mailer, Norman. *Of a Fire on the Moon*. Boston: Little, Brown, 1970.

Malina, Frank J. "On the Visual Fine Arts in the Space Age." In *Leonardo*, Vol. 3, No. 3 (July 1970): 323-325.

Marien, Mary Warner. *Photography: A Cultural History*. New York: Abrams, 2002.

Marling, Karal Ann. *As Seen on TV: The Visual Culture of Everyday Life in the 1950s*. Cambridge: Harvard University Press, 1994.

Marx, Leo. *The Machine in the Garden: Technology and the Pastoral Ideal in America*. 35th anniversary ed. Oxford: Oxford University Press, 2000.

Matusow, Allen J. *The Unraveling of America: A History of Liberalism in the 1960s*. New York: Harper & Row, 1984

Maynard, Patrick. *The Engine of Visualization: Thinking Through Photography*. Ithaca: Cornell University Press, 1997.

McCurdy, Howard E. *Faster, Better, Cheaper: Low-Cost Innovation in the U.S. Space Program*. Baltimore: Johns Hopkins University Press, 2001.

———. *Inside NASA: High Technology and Organizational Change in the U.S. Space Program*. Baltimore: Johns Hopkins University Press, 1994.

———. *Space and the American Imagination*. Washington, D.C: Smithsonian Institution Press, 1997.

McDougall, Walter A. *…The Heavens and the Earth: A Political History of the Space Age*. Baltimore: Johns Hopkins University Press, 1985.

McGregor, Alasdair. *Frank Hurley: A Photographer's Life*. Camberwell, Victoria: Viking, 2004.

McQuaid, Kim. "Selling the Space Age: NASA and Earth's Environment, 1958-1990." *Environment & History (09673407)* 12, no. 2 (May 2006): 127–63.

McWilliams, John C. *The 1960s Cultural Revolution*. Westport: Greenwood Press, 2000.

Melin, William E. "Photography and the Recording Process in the Age of Mechanical Reproduction." *Leonardo* 19, no. 1 (1986): 53–60.

Middleton, David, and Derek Edwards. *Collective Remembering*. London: Sage Publications, 1990.

Miller, Angela L. *The Empire of the Eye: Landscape Representation and American Cultural Politics, 1825-1875*. Ithaca: Cornell University Press, 1993.

Mindell, David A. *Digital Apollo: Human and Machine in Spaceflight*. Cambridge: MIT Press, 2011.

Mirzoeff, Nicholas, ed. *The Visual Culture Reader*. 2nd ed. London: Routledge, 2002.

Mitchell, W.J.T., ed. *Landscape and Power*. Chicago: University of Chicago Press, 2002.

———. *Picture Theory: Essays on Verbal and Visual Representation*. Chicago: University of Chicago Press, 1994.

———. *The Reconfigured Eye: Visual Truth in the Post-Photographic Era*. Cambridge: MIT Press, 1994.

———. *What Do Pictures Want?: The Lives and Loves of Images*. Chicago: University of Chicago Press, 2005.

Monteith, Sharon. *American Culture in the 1960s*. Edinburgh: Edinburgh University Press, 2008.

Morris, John G. Special to The New York Times. “Rolls of Film Shot by Astronauts Are Handled With Strict Caution.” *New York Times*. July 27, 1969.

Moxey, Keith. “Visual Studies and the Iconic Turn.” *Journal of Visual Culture*. Vol. 7, No. 2 (2008): 131-146.

Muir-Harmony, Teasel. *Project Apollo, Cold War Diplomacy and the American Framing of Global Interdependence*. Dissertation. MIT, 2014

Naef, Weston J. and James Wood. *Era of Exploration: The Rise of Landscape Photography in the American West, 1860-1885*. Buffalo: Albright-Knox Art Gallery, 1975.

“NASA Left Cameras and Lenses on the Moon’s Surface.” *The Washington Post, Times Herald (1959-1973)*. March 8, 1973.

Neal, Arthur G. *National Trauma and Collective Memory: Major Events in the American Century*. Armonk, N.Y: M.E. Sharpe, 1998.

Neal, Valerie. "Bringing Spaceflight Down to Earth: Astronauts and The IMAX Experience®." In Michael J. Neufeld, ed. *Spacefarers: Images of Astronauts and Cosmonauts in the Heroic Era of Spaceflight*. Washington, D.C: Smithsonian Institution Scholarly Press, 2013.

Nelkin, Dorothy. *Selling Science: How the Press Covers Science and Technology*. New York: W. H. Freeman and Company, 1987.

Neufeld, Michael J. *Von Braun: Dreamer of Space, Engineer of War*. New York: Alfred A. Knopf, 2007.

Nora, Pierre. "Between Memory and History: Les Lieux de Mémoire." *Representations*, no. 26 (Spring 1989): 7–24.

Norris, Pippa, ed. *Politics and the Press: The News Media and Their Influences*. Boulder: Lynne Rienner Publishers, 1997.

Nye, David E. *American Technological Sublime*. Cambridge: MIT Press, 1994.

———. *Narratives and Spaces: Technology and the Construction of American Culture*. New York: Columbia University Press, 1997.

O'Dell, C.R., Donald York, and Karl Henize. "Structure of the Barnard Loop Nebula as Determined from Gemini 11 Photographs." *The Astrophysical Journal*. Vol. 150, December 1967.

Ordway, Frederick, Carsbie Adams, and Mitchell Sharpe. *Dividends from Space*. New York: Thomas Y. Crowell, 1972.

Orvell, Miles. *American Photography*. Oxford ; New York: Oxford University Press, 2003.

O'Sullivan, Timothy H. *Wheeler's Photographic Survey of the American West, 1871-1873*. New York: Dover Publications, 1983.

Paltridge, George H. *Photographic Instruction Text: A Systematic Course and Working Guide in All the Processes Which Ordinarily Take Up the Attention of Camera Workers*. New York: Photo-Text Press, 1900.

Pellegrino, Charles, and Joshua Stoff. *Chariots for Apollo: The Untold Story Behind the Race to the Moon*. New York: Avon Books, 1999.

Perez, Renato. "Prestige is High in Space Photos." *New York Times*, September 25, 1966: 162.

Phillips, Sandra S, ed. *Crossing the Frontier: Photographs of the Developing West, 1849 to the Present*. San Francisco: San Francisco Museum of Modern Art, 1996.

Pieters, C. and T.B. McCord. "Characterization of Lunar Mare Basalt Types. A Remote Sensing Study Using Reflection Spectroscopy of Surface Soils." In: *Lunar Science Conference, 7th, Houston, Tex., March 15-19, 1976, Proceedings*. Volume 3. New York: Pergamon Press, 1976, p. 2677-2690

Poole, Robert K. *Earthrise: How Man First Saw the Earth*. New Haven: Yale University Press, 2008.

Preston, Diana. *A First Rate Tragedy: Robert Falcon Scott and the Race to the South Pole*. Boston: Houghton Mifflin, 1998.

Pyne, Stephen J. *The Ice: A Journey to Antarctica*. Iowa City: University of Iowa Press, 1986.

Quartermain, L. B. *South to the Pole: The Early History of the Ross Sea Sector, Antarctica*. Oxford: Oxford University Press, 1967.

Rabinowitch, Eugene, and Richard S. Lewis, eds. *Man on the Moon: The Impact on Science, Technology, and International Cooperation*. New York: Basic Books, 1969.

Reidy, Michael S, Gary Kroll, and Erik M Conway. *Exploration and Science: Social Impact and Interaction*. Santa Barbara: ABC-CLIO, 2007.

Respini, Eva. *Into the Sunset: Photography's Image of the American West*. New York: The Museum of Modern Art, 2009.

Richelson, Jeffrey T., ed. "Declassified Documents Trace U.S. Policy Shifts on Use of Commercial Satellite Imagery from 1970s to Today." National Security Archive Electronic Briefing Book No. 404. (http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB404/) Accessed January 15, 2014.

Robinson, Michael F. *The Coldest Crucible: Arctic Exploration and American Culture*. Chicago: University of Chicago Press, 2006.

Rose, Gillian. *Visual Methodologies: An Introduction to Researching with Visual Materials*. London: SAGE, 2012.

Rozell, Mark J., and Jeremy D. Mayer. *Media Power, Media Politics*. Lanham: Rowman & Littlefield, 2008.

Ryan, James R. *Picturing Empire: Photography and the Visualization of the British Empire*. Chicago: University of Chicago Press, 1997.

Sandweiss, Martha A. *Print the Legend: Photography and the American West*. New Haven: Yale University Press, 2002.

———. “The Public Life of Western Art.” In *Discovered Lands, Invented Pasts: Transforming Visions of the American West*, 117–33. New Haven: Yale University Press, 1992.

Sanford, David. “Space Trips Too Commercial: Consumer Corner.” *Boston Globe (1960-1981)*. February 18, 1971.

Savours, Ann, ed. *Scott’s Last Voyage, Through the Antarctic Camera of Herbert Ponting*. New York: Praeger Publishers, 1975.

Schacter, Daniel, ed. *Memory Distortion: How Minds, Brains, and Societies Reconstruct the Past*. Cambridge: Harvard University Press, 1995.

Schick, Ron, and Julia Van Haaften. *The View from Space: American Astronaut Photography, 1962-1972*. New York: C.N. Potter, 1988.

Schirra, Walter M. Jr. and Richard M. Billings. *Schirra’s Space*. Boston: Quinlan Press, 1988.

Scott, David Meerman, and Richard Jurek. *Marketing the Moon: The Selling of the Apollo Lunar Program*. Cambridge: MIT Press, 2014.

Scott, Robert Falcon. *Scott’s Last Journey*. Peter King, ed. New York: HarperCollins, 2000,

Scranton, Philip. “Behind the Icon: NASA’s Mercury Capsules as Artefact, Process, and Practice.” In *Showcasing Space*, Collins, Martin J., and Douglas Millard, eds. Vol. 6. London: Science Museum, 2005.

Simpson-Housley, Paul. *Antarctica: Exploration, Perception, and Metaphor*. New York: Routledge, 1992.

Slayton, Donald K. and Michael Cassutt *Deke!: U.S. Manned Space: From Mercury to the Shuttle*. New York: St. Martin's Press, 1995.

Slotkin, Richard. *The Fatal Environment: The Myth of the Frontier in the Age of Industrialization, 1800-1890*. New York: HarperPerennial, 1994.

Smith, Henry Nash. *Virgin Land; the American West as Symbol and Myth*. Cambridge: Harvard University Press, 1970.

Smith, Michael L. “Selling the Moon: The U.S. Manned Space Program and the Triumph of Commodity Scientism.” In *The Culture of Consumption: Critical Essays in American History, 1880-1980.* Richard Wightman Fox and T. J. Jackson Lears, eds. New York: Pantheon Books, 1983.

Snyder, Joel. “Territorial Photography.” In *Landscape and Power*, edited by W. J. Thomas Mitchell, 175–201. Chicago: University of Chicago Press, 2002.

Solomon, Susan. *The Coldest March: Scott’s Fatal Antarctic Expedition*. New Haven: Yale University Press, 2001.

Soluri, Michael. “Examining the Iconic and Rediscovering the Photography of Space Exploration in Context to the History of Photography.” In *Remembering the Space Age: Proceedings of the 50th Anniversary Conference*. Steven J. Dick, ed. NASA SP-2008-4703. Washington, D.C.: NASA, 2008.

Sontag, Susan. *On Photography*. New York: Farrar, Straus and Giroux, 1977.

Squiers, Carol, ed. *The Critical Image: Essays on Contemporary Photography*. Seattle: Bay Press, 1990.

Stafford, Thomas and Michael Cassutt. *We Have Capture: Tom Stafford and the Space Race*. Washington, D.C.: Smithsonian Institution Press, 2002.

Stegner, Wallace Earle. *Beyond the Hundredth Meridian: John Wesley Powell and the Second Opening of the West*. New York: Penguin Books, 1992.

Steven-Boniecki, Dwight. *Live TV from the Moon*. Burlington, Ont: Apogee Books, 2010.

Sturken, Marita. *Practices of Looking: An Introduction to Visual Culture*. Oxford: Oxford University Press, 2001.

———. *Tangled Memories: The Vietnam War, the AIDS Epidemic, and the Politics of Remembering*. Berkeley: University of California Press, 1997.

Swenson, Loyd S, Charles C Alexander, and James M Grimwood. *This New Ocean: A History of Project Mercury*. NASA SP 4201. Washington, D.C.: National Aeronautics and Space Administration, 1998.

Tagg, John. “Evidence, Truth, and Order: A Means of Surveillance.” In *Visual Culture: The Reader,* edited by Jessica Evans and Stuart Hall. London: Sage, 1999.

———. *The Burden of Representation: Essays on Photographies and Histories*. Minneapolis: University of Minnesota Press, 1993.

Thelen, David, ed. *Memory and American History*. Bloomington: Indiana University Press, 1990.

Thomson, John. "Photography and Exploration." *Proceedings of the Royal Geographical Society and Monthly Record of Geography*, New Monthly Series, 13, no. 11 (November 1891): 669–75.

Tobin, Mitch. "The Black and Blue Marble: 10 Whole Earth Views from Space." *EcoWest.com*, September 12, 2013 (accessed November 4, 2014).

Tomas, David. *Beyond the Image Machine: A History of Visual Technologies*. London: Continuum, 2004.

Trachtenberg, Alan. *Reading American Photographs: Images as History, Mathew Brady to Walker Evans*. New York: Hill and Wang, 1989.

Truettner, William H. ed. *The West as America: Reinterpreting Images of the Frontier, 1820-1920*. Washington, D.C.: Smithsonian Institution Press, 1991.

Tufte, Edward R. *Visual Explanations: Images and Quantities, Evidence and Narrative*. Cheshire, CT: Graphics Press, 1997.

Turner, Fred. *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*. Chicago: University of Chicago Press, 2008.

Turner, Frederick Jackson. *Rereading Frederick Jackson Turner: The Significance of the Frontier in American History, and Other Essays*. New York: H. Holt, 1994.

Underwood, Richard. "Space Photography." In *Gemini Summary Conference, February 1-2, 1967.* Houston: NASA, 1967: 231-290.

van der Meer Mohr, H.E.C. "Geological Interpretation of Hyperaltitude Photographs from Gemini Spacecraft." *Photogrammetria*. Vol. 24, Issues 3-4, June 1969: 167-174.

van Dijck, José. "Mediated Memories: Personal Cultural Memory as Object of Cultural Analysis." *Continuum: Journal of Media & Cultural Studies*. Vol. 18, No. 2 (2004): 261-277.

Van Riper, Frank. “Space Cameras: From Ansco to Hassy to Digital.” *Washington Post*. October 23, 2003.

Watkins, Billy. *Apollo Moon Missions: The Unsung Heroes*. Westport, CT: Praeger Publishers, 2006.

Watson, Mary Ann. *The Expanding Vista: American Television in the Kennedy Years*. New York: Oxford University Press, 1990.

Wells, Liz. *Land Matters: Landscape Photography, Culture and Identity*. London: I.B. Tauris, 2011.

———, ed. *Photography: A Critical Introduction*. London: Routledge, 2000.

———, ed. *The Photography Reader*. London: Routledge, 2003.

White, Richard. *“It’s Your Misfortune and None of My Own”: A History of the American West*. Norman: University of Oklahoma Press, 1991.

Wilkinson, Alec. *The Ice Balloon: S. A. Andree and the Heroic Age of Arctic Exploration*. New York: A. A. Knopf, 2013.

Winter, Jay. “The Memory Boom in Contemporary Historical Studies.” *Raritan* 21, no. 1 (Summer 2001): 52.

Wobber, Frank J. “Space Photography: A New Analytical Tool for the Sedimentologist.” *Sedimentology*. Vol. 9, 1967: 265-317.

Worden, Alfred and Francis French. *Falling to Earth: An Apollo 15 Astronaut’s Journey*. Washington, DC: Smithsonian Books, 2011.

Worster, Donald. *A River Running West: The Life of John Wesley Powell*. Oxford: Oxford University Press, 2001.

Wrobel, David. *The End of American Exceptionalism: Frontier Anxiety from the Old West to the New Deal*. Tucson: University of Arizona Press, 1993.

Zimmerman, Robert. *Genesis: The Story of Apollo 8: The First Manned Flight to Another World*. New York: Four Walls Eight Windows, 1998.

———. “Photo Finish.” *Sciences* Vol. 38, no. 6 (November): 16.

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