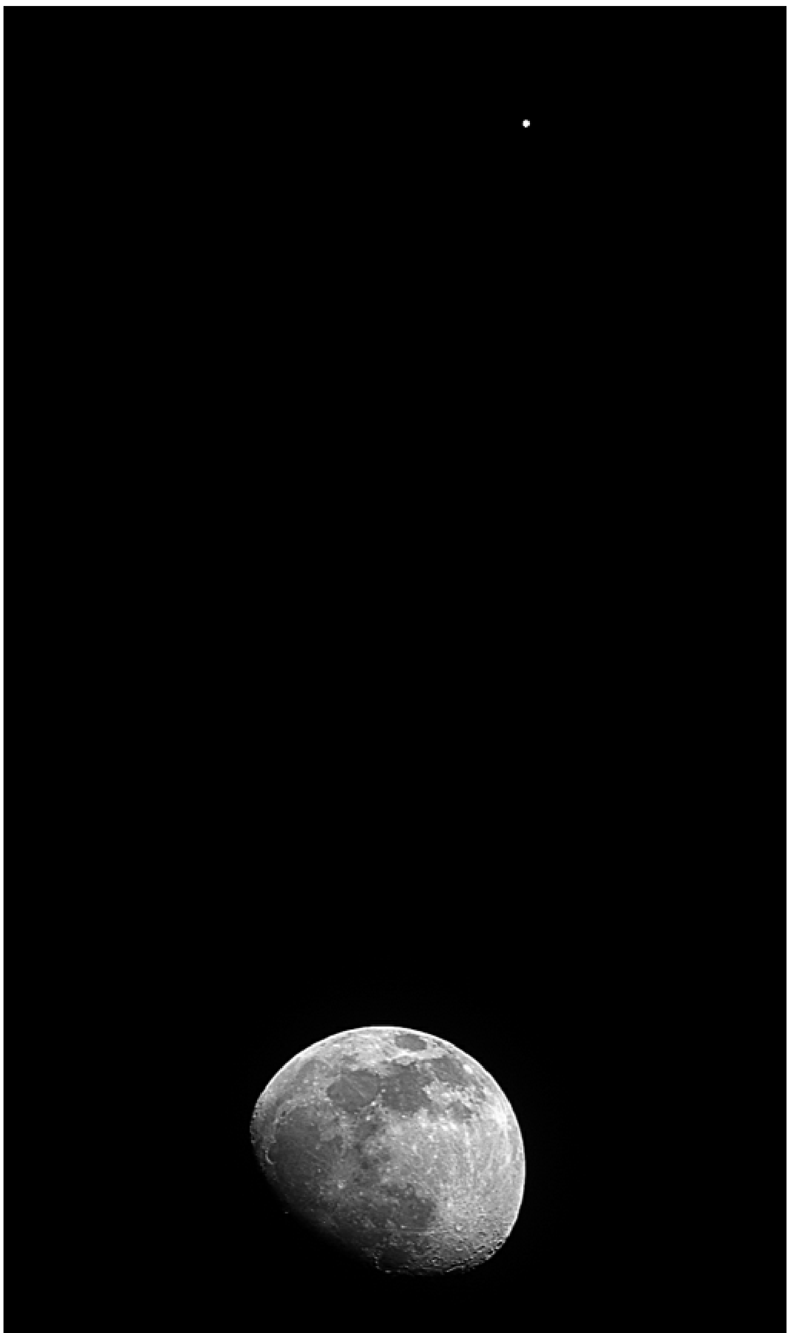
DEVOTED TO THE STUDY OF EARTH'S MOON
VOL. 24 NO. 3 AUTUMN 2005

SELENOLOGY

The Journal of
The American Lunar Society



Selenology

Vol. 24 No. 3 - Autumn 2005

The official journal of the American Lunar Society, an organization devoted to the observation and discover of the earth's moon

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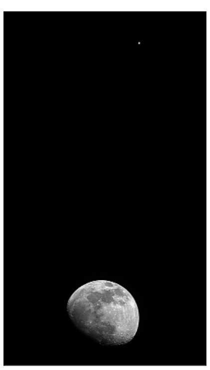

COVER:

The moon and Jupiter, 20:27 19 May 2005. by Captain Stephen Miller. Taken with a Nikon D70 w/ 300 mm f/4 Nikon lens, ISO 200, shutter speed 1/320 sec.
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Selenology, Vol. 24 No. 3, Autumn 2005. Publication of the American Lunar Society.
President: Eric Douglass; Vice President: Steve Boint; Editor: Francis G. Graham.

See our website at www.otterdad.dynip.com/als/

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OBSERVING THE MOON: THE GEOLOGIC LUNAR RESEARCHES GROUP

The GLR is an organization of friends all interested in observing and studying the Moon. We disregard individual glory and work together for the GLR because "We work in a combined effort, for our pleasure".

www.glrgroup.org

By Jim Phillips, Charles Kapral, and Raffaello Lena

The Geologic Lunar Researches Group (GLR) is a unique amateur astronomy organization dedicated to the study of the Moon. Two friends interested in the study of the Moon, Raffaello Lena and Piergiovanni Salimbeni, founded the GLR in 1997. The GLR is an international organization, based in Italy. Currently, 60 members, representing Australia, China, England, France, Germany, Italy, Spain, the United States, and Uruguay belong to this Internet-based organization.

The GLR "meets" on the Internet sharing information, images, thoughts, and articles. We are interested in many different areas of lunar study including, but not limited to, the search for new lunar domes (both lunar nearside and farside), lunar cones, recording accurate positions of lunar features, making 3-dimensional models of lunar features, and studying lunar impacts and sites of transient lunar phenomena (TLP). We now have on our website (www.glrgroup.org) the most up-to-date catalogue of lunar domes available—thanks to extensive work by many GLR members including; Robert A. Garfinkle (FRAS), Charles Kapral (AL Member-at-Large), and Brendan Shaw who plotted the domes in the catalogue onto the Lunar Aeronautical Charts (LAC). The LAC charts are also available via the website. New data are recorded and added to the catalogue and charts on a regular basis. Any observations that readers can make about these domes will be gratefully received for our GLR survey (Send your reports to: lena@glrgroup.org.).

The GLR is unique in that it is an informal

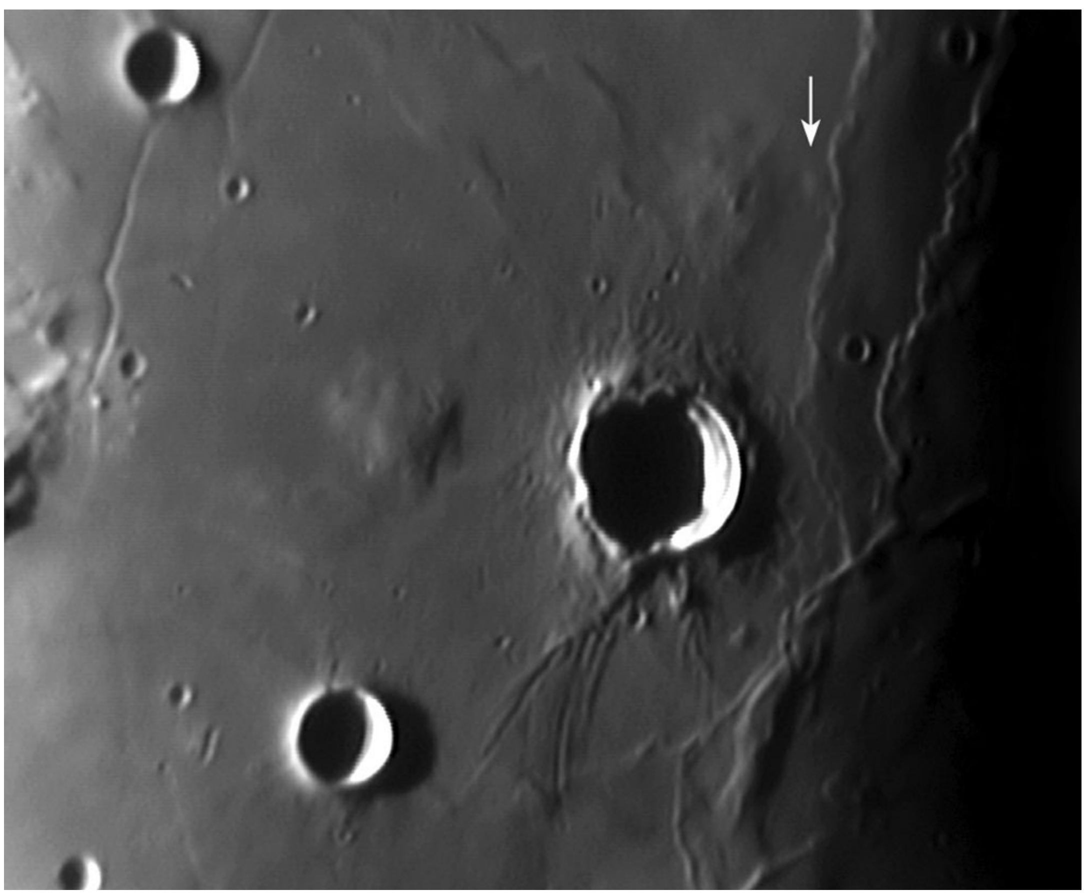

FIGURE 1: a dome near Arago Alpha. Zac Pujic on May 28, 2005, at 18:10 UT, using a 310 mm Newtonian f/28, a Wratten 25A filter, and a Philips ToUCam

FIGURE 2 : a dome near T. Mayer B. Jim Phillips on December 22, 2004 at 02:37 UT using a TMB 8" f/9 Apochromatic refractor, Atik B&W camera

organization without elected or appointed officers and there are no dues associated with membership. Everyone is free to contribute and comment on an equal basis. We consider our Internet Forum to be the equivalent of our clubhouse meetings. Naturally, we have gravitated into small groups based on our personal interests. Some of us like to image lunar features, some are interested in researching spacecraft imagery, some are mapmakers, some are mathematicians, and others are authors producing articles in which we all participate. All debating of issues is done via our Internet forum and typically only lasts a short period of time. Without having to assemble ourselves into committees, and without having those "in-charge", we are able to accomplish a large array of varied work regarding lunar study in a rapid, efficient manner. In 2004, the GLR published 12 scientific articles in a number of different journals including: the "Journal of the Association of Lunar and Planetary Observers: The Strolling Astronomer", the "Journal of the British Astronomical Association", the publication of the Lunar Section of the Association of Lunar and Planetary Observers "The Lunar Observer", and "Selenology" the journal of the American Lunar Society.

The GLR group has an ongoing project to discover and study lunar domes, a study which has shown both the elusive nature of these lunar structures and the utility of CCD-image analysis in the elucidation of their character. In the last decade, digital imaging enhanced amateur capabilities highlighting that the dome catalog needed to be verified, corrected, and expanded. In 1997, the GLR formed an active team of observers (from several countries) that focused on lunar domes. It continues to add new domes to the existing lists, providing geological information, dome measurements and dome classification by slope and height. Dome coordinates have been updated, with consistent measurements.

An example of how the GLR works: in June 2005, Zac Pujic in Australia, using his telescope

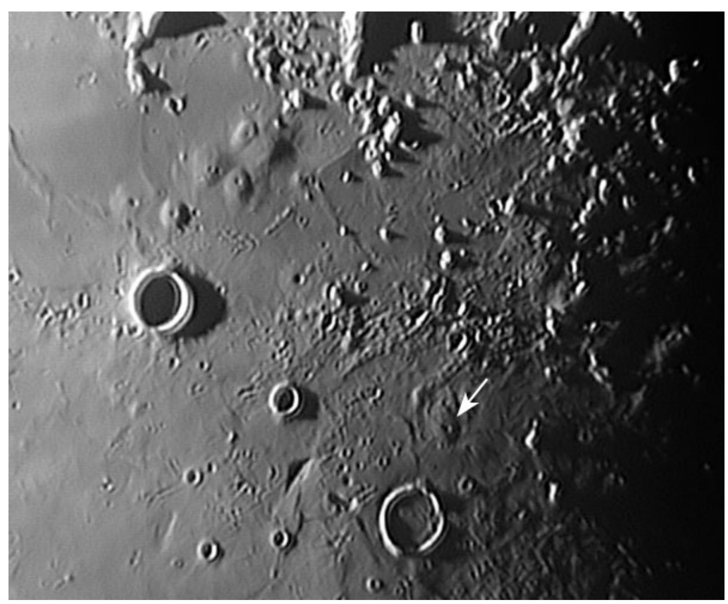

FIGURE 3 : a dome near Hortensius. E Zac Pujic on April , 3, 2005 at 19:25 UT using a 31 cm Newtonian telescope, Wratten 23 filter and a Phillips ToUcam

and camera, imaged and noted an unlisted dome near Arago. He reported this new dome to the GLR via the Internet Forum. He was unable to find the dome on any existing catalogue or list of lunar domes. Jim Phillips was able to look back and see that he too had imaged the dome at a different time. Raffaello Lena in Italy used the images provided along with the time the images were taken. By measuring the shadows cast, he was able to calculate the height of the dome. Maria T. Bregante, also in Italy, researched *Orbiter* and *Clementine* imagery. Charles Kapral and Brendan Shaw added the dome to our catalogue and maps. Meanwhile, Christian Whöler in Germany began producing a 3-dimensional model of the dome. We are now in the process of reporting these observations of a "new" lunar dome with data regarding size, 3-dimensional structure, and exact coordinates.

FIGURE 4 : a dome near Valentine. KC Pau on October 16, 2004 at 21:02 UT using a 250 mm f/6 Newtonian

Good quality data is regularly obtained by several active GLR observers and many works have been written in combined efforts by Jim Phillips, KC Pau, Zac Pujic, Cristian Fattinnanzi, Rodrigo Viegas, Piergiovanni Salimbeni, Christian Wohler, Maria Teresa Bregante, to name a few. Examples of recent works are shown in Figures 1-4. The figures show domes recently characterized and reported in our revised dome list (data have been published).

Recently we have been working on and have reproduced the conditions surrounding light streaks on the floor of Plato. Historical observations of similar events are also of great interest to us. Johann Schröter drew the identical phenomenon and reproduced it in his lunar classic *Selenotopographische Fragmente* in 1791.

The activities and data of the GLR group are shared on the forum at: http://it.groups.yahoo.com/group/domilunari

STUDY OF A LUNAR CONE NEAR FLAMSTEED P

By Raffaello Lena, Maria Teresa Bregante and Charles Kapral
GLR GROUP

1) Introduction

On the Moon there are different cone morphologies due to differences in eruption style which, in turn, is determined by magma volume, extrusion rate, eruption energy and other factors [1]. Because of this, lunar cones come in many shapes and sizes [2]. The most common are: circular (Osiris in Mare Serenitatis) , breached cones with a short sinuous rille disappearing into the mare (Isis in Mare Serenitatis), or cones that are elongated and aligned along a rille (two cones near Milichius— as described in a previous paper, there are no signs of dark pyroclastic deposits (LPD) near these two Milichius cones, suggesting that they were formed from the surface eruptions of a lateral dike [2]).

The International Lunar Cone Survey (LCS) started on April 2004 is a joint effort of the American Lunar Society (ALS), the Geologic

Table 1

Long (°)	Lat (°)	Location (near)	Dimension (km)	LAC	Remarks
-42.6	-4.8	Flamsteed P	2.8 ± 0.3	75	Identified on LO-IV-143

Lunar Research group (GLR), and independent observers [3]. Since the ALS/GLR project is a long-term study, this and any report of specific lunar cones should not be viewed as a final work. Observations and notes of lunar cones will continue to be accepted and included in our catalogue. As part of the LCS project, a small cone was identified close to Flamsteed P utilizing the Lunar Orbiter frame LO-IV-143-H3 (Figures 1 and 2). The position was determined using the LAC #75 (Table 1). For earth-based observers, this is a difficult feature. However, in the Consolidated Lunar Atlas frames E 24, 25, and 26 the cone appears as a mound.

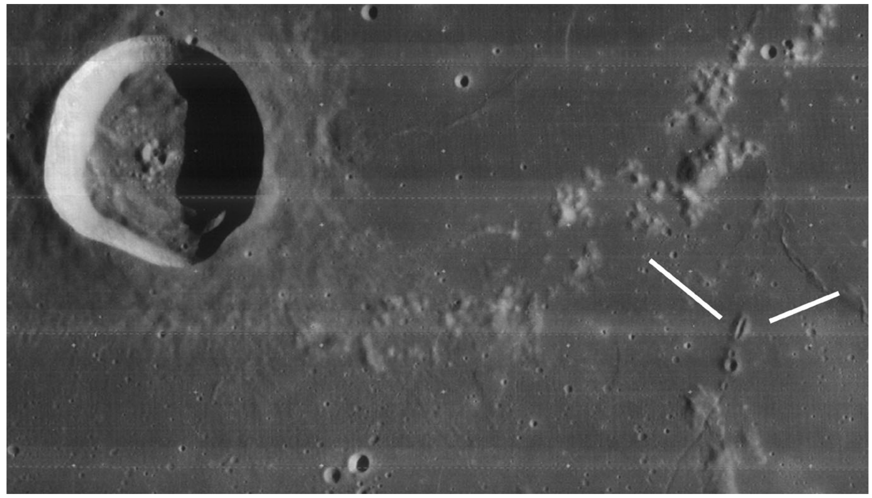

Figure 1

Here we report the description of this lunar cone with elongated shape located at 42.60º W, 4.80º S (Xi – 0.675, Eta -0.084) near Flamsteed P.

Figure 2

2) Digital images

The cone near Flamsteed P is not described in the file report of the US Geological Survey [4] (In this file report the authors reported measurements for 18 lunar volcanoes, including five lunar cones. The measurements of these lunar volcanoes (diameters, height, depth of the summit crater) were computed from Lunar Topographic Orthophotomosaics, Lunar Orbiter imagery and Apollo images). Schultz, in his book "Moon Morphology", states that "the volcanic cones have a relief comparable to that of the domes forming the Flamsteed ring" [5]. However, a close analysis of figures 1 and 2 does not show any domes in the Flamsteed ring.

3) Geological considerations and discussion

The dome is located in Oceanus Procellarum, the largest expanse of Mare on the moon not controlled by a single circular multi-ringed basin [6, 7]. Procellarum contains ghost craters such as the Flamsteed ring, suggesting that the mare is relatively shallow. As can be seen on the Lunar Orbiter frame, there are different basalts in the Flamsteed P structure. The regional mare units with highest 415/750 nm values are found within the eastern

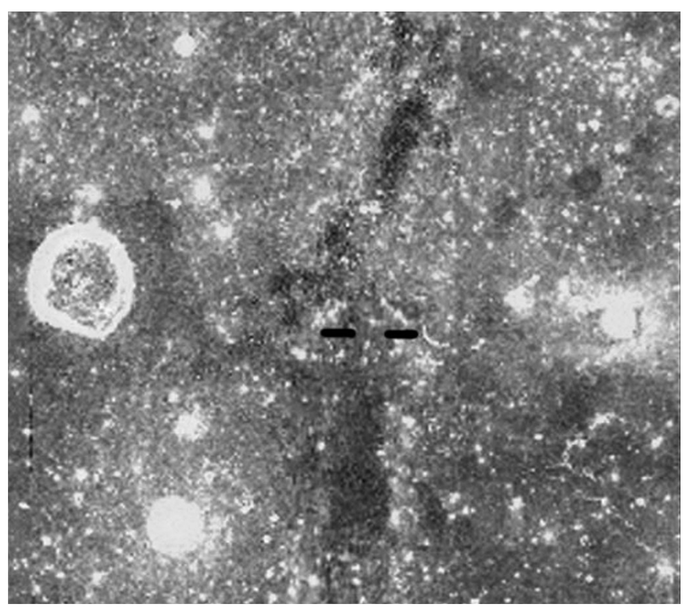

Figure 3

portion of the Flamsteed P ring. These basalts, blue in the Clementine color ratio image, represent some of the latest stages of mare volcanism [8, 9]. They have been mapped as being Eratosthenian in age, while the surrounding units are likely Imbrian [6]. The northern half of the ejecta blanket of crater Flamsteed (Eratosthenian in age) has been partially buried by lava flows encroaching from the north.

The present structure appears to be a lunar cone, in that it is elongated with a high-sloped rim (Figure 2). The cone is located in an Imbrian mare unit (Im) [5] reddish in Clementine color ratio data (Figure 3). There are no signs of dark pyroclastic deposits. Even Gaddis, using the multispectral Clementine imagery, did not identify lunar pyroclastic deposits in this region [10, 11]. Therefore, the cone was probably not built by explosive eruptions, but by overflows of lava that either erupted slowly or were quite viscous.

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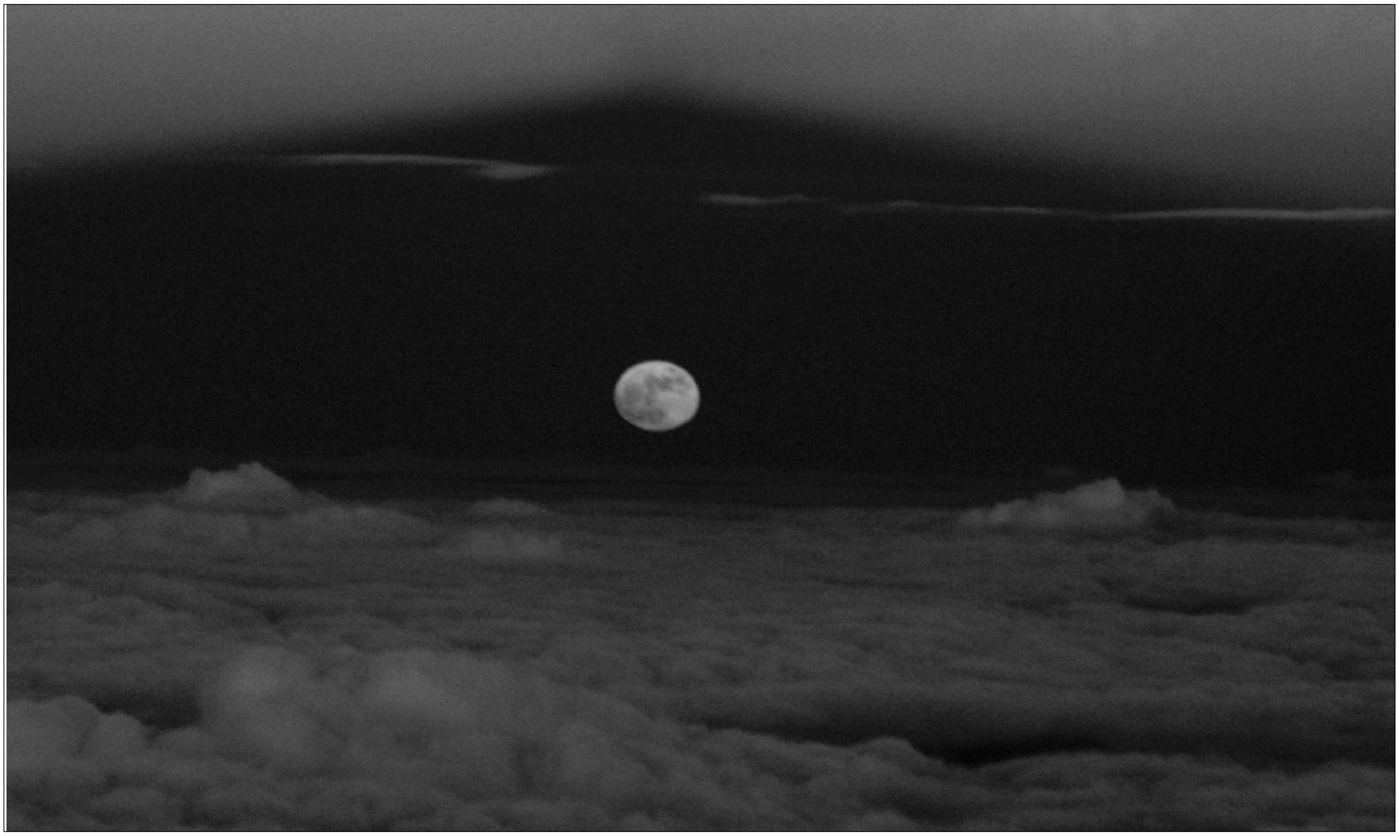
[10] L. Gaddis; "Lunar Pyroclastic Volcanism Database." July, 2002 http://wwwflag.wr.usgs.gov/USGSFlag/Space/LunPyro/lunpyroWebDb.html

[11] L. Gaddis *et al*.; "Compositional Analysis of lunar pyroclastic deposits", Icarus, Vol 161, 2003.

FULL MOON OVER MAUNA KEA

Marianne Dyson

I have been interested in the moon ever since I was a child. I was inspired by the Apollo program to get a degree in physics (with the intention of becoming an astronomer), but got lured away from graduate school at Rice by an opportunity to work for NASA as a flight controller on the space shuttle program. After working the first five shuttle flights, I left NASA to raise my children and began writing about space. Now I get to share my love of space with thousands of children each year through my books and via author visits to schools. Selenology was kind enough to run a review of my children's book, *Home on the Moon,* that was published by National Geographic and won the American Institute of Physics science writing award last year.(Anyone who wants an autographed copy for a holiday present, just send me an e-mail.) During my presentations about this book, I review the major features of the moon and teach the students an easy way to remember where the Apollo missions landed: connect the dots to draw an "N" for a nose on the moon. (Available on my animated moon map:



Taken with an Olympus 8 mega pixel digital camera on TIF mode set for 400 ASA with some optical zoom (I didn't write down how much, but I didn't use full optical or any digital zoom).

http://www.mariannedyson.com/moon.htm)

I always read Selenology cover to cover and especially enjoy learning new details about the places where the scientists expect to land the next round of missions starting in 2018 - such as Aristarchus. Thank you all for sharing your observations. I look forward to the next lunar orbiter that will provide information about my planned retirement site: Dyson crater on the far side! I do not own a telescope (yet, anyway), but I thought perhaps some of our members might enjoy this photo of the full moon taken from atop Mauna Kea, Hawaii this past September 17. I'd been told that the summit of Mauna Kea offers the best astronomical seeing in the world and found this to be no exaggeration. Because of the high altitude (13,800 feet), and hence the low level of oxygen, the ranger said that unaided viewing is actually better at the visitors' center near 10,000 feet. However, the low level of oxygen at the summit does make one a bit euphoric, especially a lunar enthusiast like me who has managed to get herself to the summit on a full moon near the equinox! All the other tourists were busy lining up on the other side of the telescope domes to watch the sunset, while I awaited the much more spectacular moonrise. Being so close to the autumnal equinox, the harvest moon rose right into the point of the shadow of the sacred mountain as the sun set in the opposite direction. The sun did put on a bit of a show: creating a double rainbow on the clouds above the moon as a sort of "warm-up" act for the main performer!

If you go to Hawaii, do not miss the opportunity to visit the observatories and photograph the moon from the summit of Mauna Kea. I highly recommend timing your visit to include the magical harvest moonrise. (You have to rent a 4-wheel drive vehicle. It cost $120/day, but that is cheaper than paying$150/person for one of the tour groups to take you.)

Editor's note: see a beautiful, full-color version of the b/w photo at http://www.mariannedyson.com/photos.htm

AT NIGHT, I'M DRAWN TO THE MOON

By Craig D. Wandke

My lunar passion began during the afternoon of July 20, 1969, when, as a Peace Corps volunteer, I looked up at the crescent moon in the sultry Honduran sky, heard Neil Armstrong's voice crackle over my shortwave radio, and was completely riveted by his small step onto the Sea of Tranquillity.

Upon my return to the States, I rushed out to purchase a dime-store telescope on a rickety tripod and began a love affair with the moon that continues to excite and inspire me. Since those early years, I have made nearly 2,000 drawings of Earth's nearest neighbor, meticulously rendered at the eyepieces of the various telescopes I have owned and cherished over my ensuing decades of lunar exploration.

Shunning the cameras, computers, CCDs, and other high-tech automated gizmos of many of my fellow amateur astronomers, I continue to draw (in the tradition of Galileo and other early moon-watchers) black-and-white pencil and India ink images of the moon. Drawings, which require the concentrated interplay of hand and eye, provide me an intimate relationship with the moon that would be lost with more advanced technologies.

My sole concession to modernity is the motor drive on my five-inch refracting telescope. The motor counteracts the Earth's rotation and keeps the moon centered in my eyepiece. Because it is not necessary to have dark-adapted vision when looking at the moon, I am able to make my telescope drawings on a clipboard with the comfort of a standard white-light lamp by my side.

During my public lectures about the moon to civic groups and schools, my audience frequently asks, "But isn't the moon a changeless world? What's there to draw?" Clearly, I am not drawing real, intrinsic changes. Rather, I record the endless dance of light across the moon's geological formations. This dance occurs each night, as it has for billions of years. Light's inexorable movement over deep valleys, imposing mountain chains, somber craters, and venerable lava flows presents a never-ending visual feast to observers.

The discerning eye at the telescope can detect the small changes that take place as the terminator, the line visible from Earth that defines lunar day and night, inches westward across the moon's surface at the rate of 12.5 degrees each day. The changes are detectable on the lunar surface in as little as 15 minutes. They parallel the larger monthly changes with which we are all familiar, as the moon cycles from new, to first quarter, to full, to last quarter—and back again to new.

It is this movement of light that results in both subtle and dazzling changes on the lunar surface, and these changes are a source of such fascination for me: an 18,000-foot high peak begins to appear at lunar dawn; a crater 80 miles in diameter disappears into the two-week

Continued on page 10

ALS MEMBERSHIP

Joining the American Lunar Society is simple. Our only requirement is that you are interested in lunar observation or studies. Once a member, you will receive this quarterly journal, *Selenology*. To become a member, mail a letter to the address below, with a check for current dues (USA members: 15$; other country members: 15$.) Note: please make the check out to Eric Douglass, President ALS, and be sure to include both your e-mail address and snail mail address.

Eric Douglass
10326 Tarleton Dr.
Mechanicsville, VA 23116

148x ___ 208x ✓

273x ___ 416x ___

Bino 207x ___

Referenced to: ___

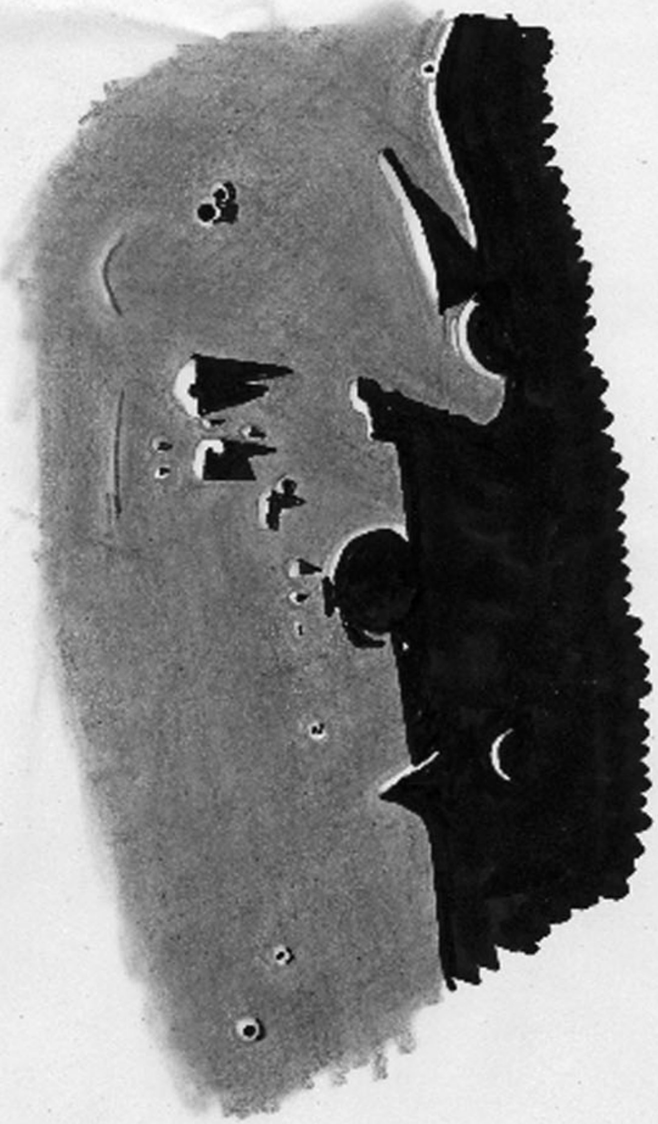
Rating: 1

10/14/05

GMT 0430

Age: 11

Terminator at: -45.09



The drawing was done at the eyepiece of my Takahashi 5" refractor with a Pentax 5mm SMC XW5 eyepiece, from Monterey, CA.

Object: Regio Prinz at Dawn

Seeing 1 - 2 - 3 - 4 - 5

A quiet and somber presence in this, one of my favorite areas of the moon, with steeple shadows feeling the lunar terrain stretching westward. Further west a crescent Aristarchus greets the rising sun. To the north Krieger is lit by the sun's early rays... a grand scene, indeed

Continued from page 8

void of lunar night; a mountain range 450 miles long casts compelling shadows at lunar sunrise on the barren plain far below; an odd, unidentified feature becomes prominent at full moon, sending me to my lunar atlases before I identify it as a familiar peak cleverly disguised by the sun's harsh light falling on it from directly overhead.

As I draw what I see at the eyepiece, it is an additional thrill to think about the fact that, during the previous eight minutes, the photons of light I perceive traveled all the way from the sun to the moon, then were reflected by the moon into my telescope. The light that carries the moon's image to me was quite literally on the moon's surface just seconds ago. While at the eyepiece I often reflect on the science, art, and metaphysics of the observing experience.

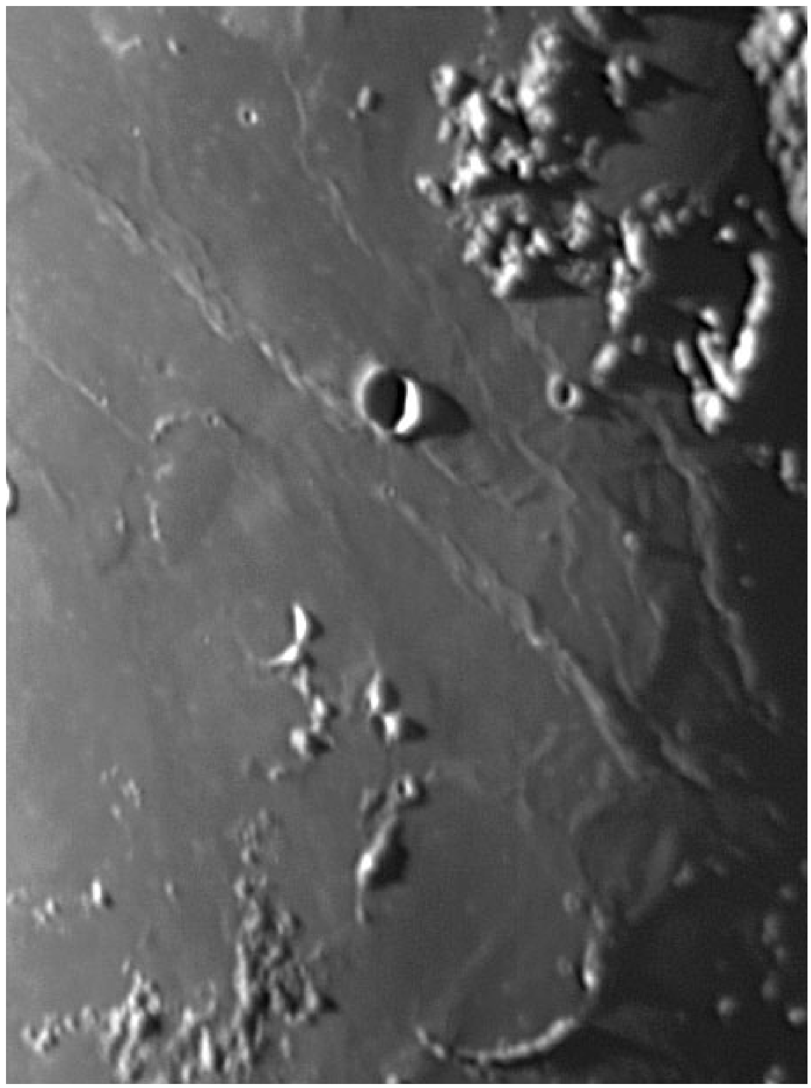
During my solitary nightly visits with the moon, I have had ample time to ponder the mighty forces that created the grand formations on the lunar surface, the constancy of its phases as an example of the order and predictability of the universe, the nature of time as reflected in the vast expanse of the moon's 4 billion-year-old existence, humanity's astounding skill at having been able to land on our satellite, and even the human ability to wonder and be inspired through mind and eye.

Tonight (weather permitting) I will return to my telescope with clipboard and drawing instruments, as I have done for more than three decades, confident that new delights await me and that I will again be captivated by the mystery and beauty of my old friend in the sky.

Published last February in the Christian Science Monitors's *Home Forum. Used with author's permission..*

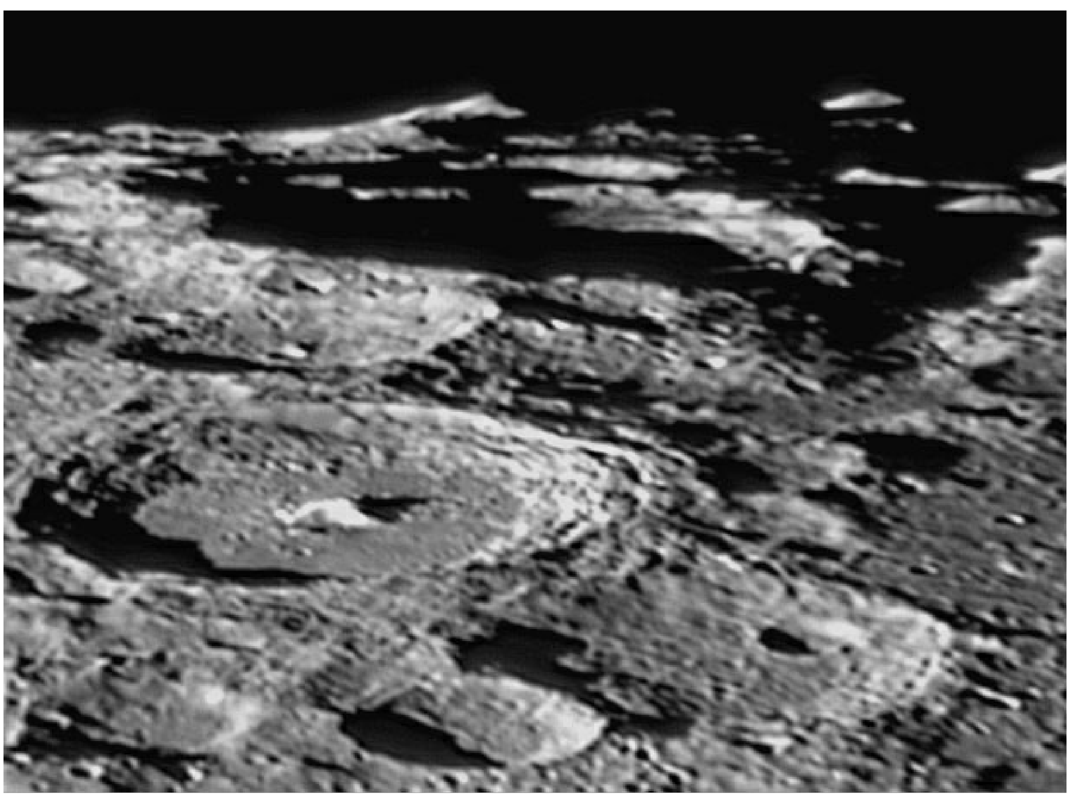
PHOTOGRAPHS FROM OUR MEMBERS:

The Imagery of KC Pau

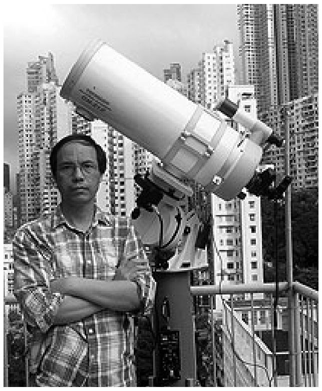


*Above: **Herigonius***
20051013 13h44m (UT) Colong: 38
250mm f/6 Newtonian + 20mm eyepiece
+ Philips Toucam Pro
Seeing: 4~5/10 Transparency: 3/10 216 frames stacked
Taken by: KC Pau, Hong Kong

At right:
Copernicus
20050418
14h28-31m (UT)
Colong: 24
250mm f/6 Newtonian
+ 20mm eyepiece
+ Philips Toucam Pro
Seeing: 5~6/10
Transparency: 4/10
Mosaic of 2 images
Taken by:
KC Pau, Hong Kong



At left:
Moretus
20051111
12h36m (UT)
Colong: 30
250 mm f/6
Newtonian
+20mm eyepiece
+Philips Toucam Pro
Seeing: 4~5/10
Transparency: 5/10
450 frames stacked
Taken by:
KC Pau
Hong Kong

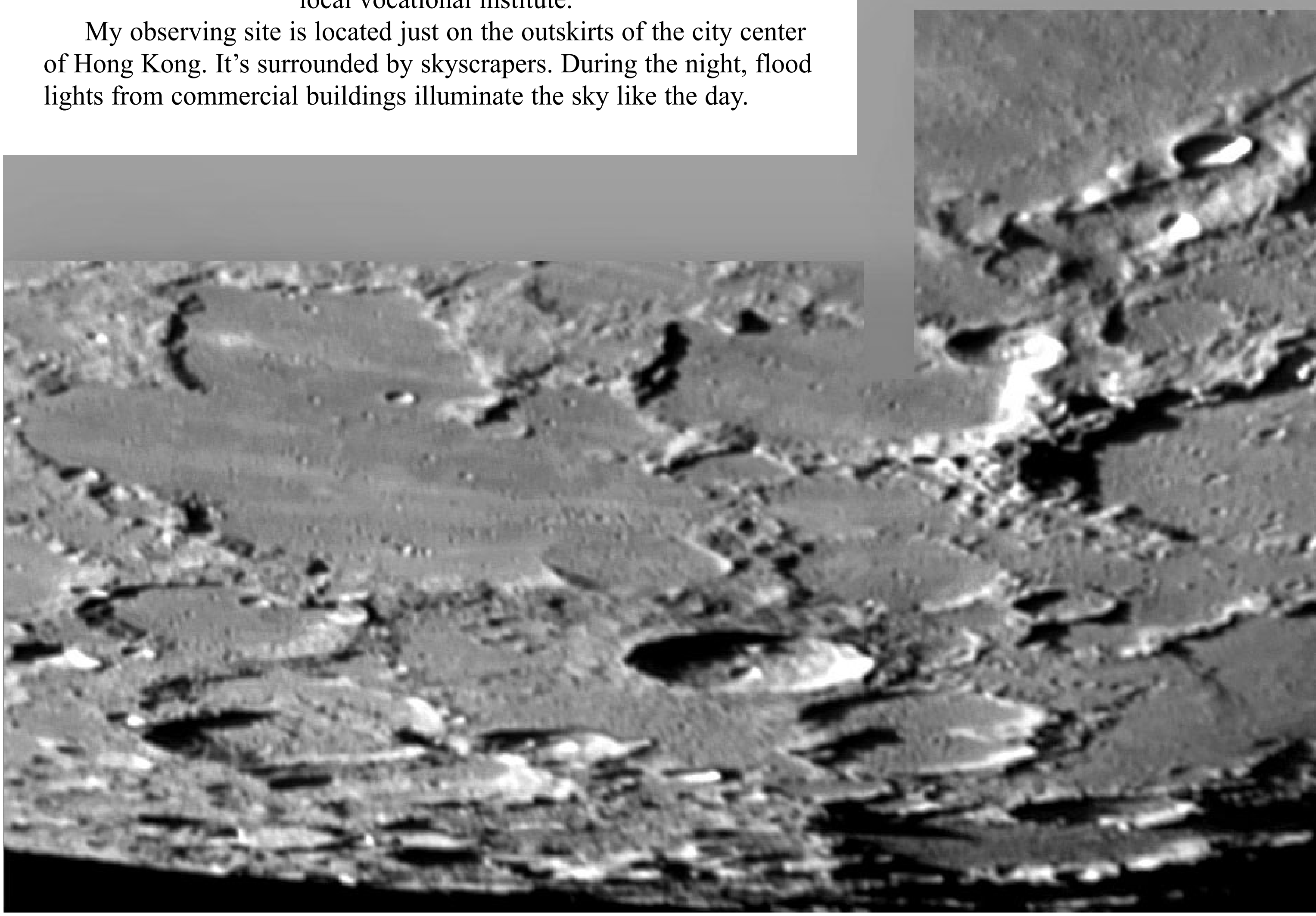


KC Pau

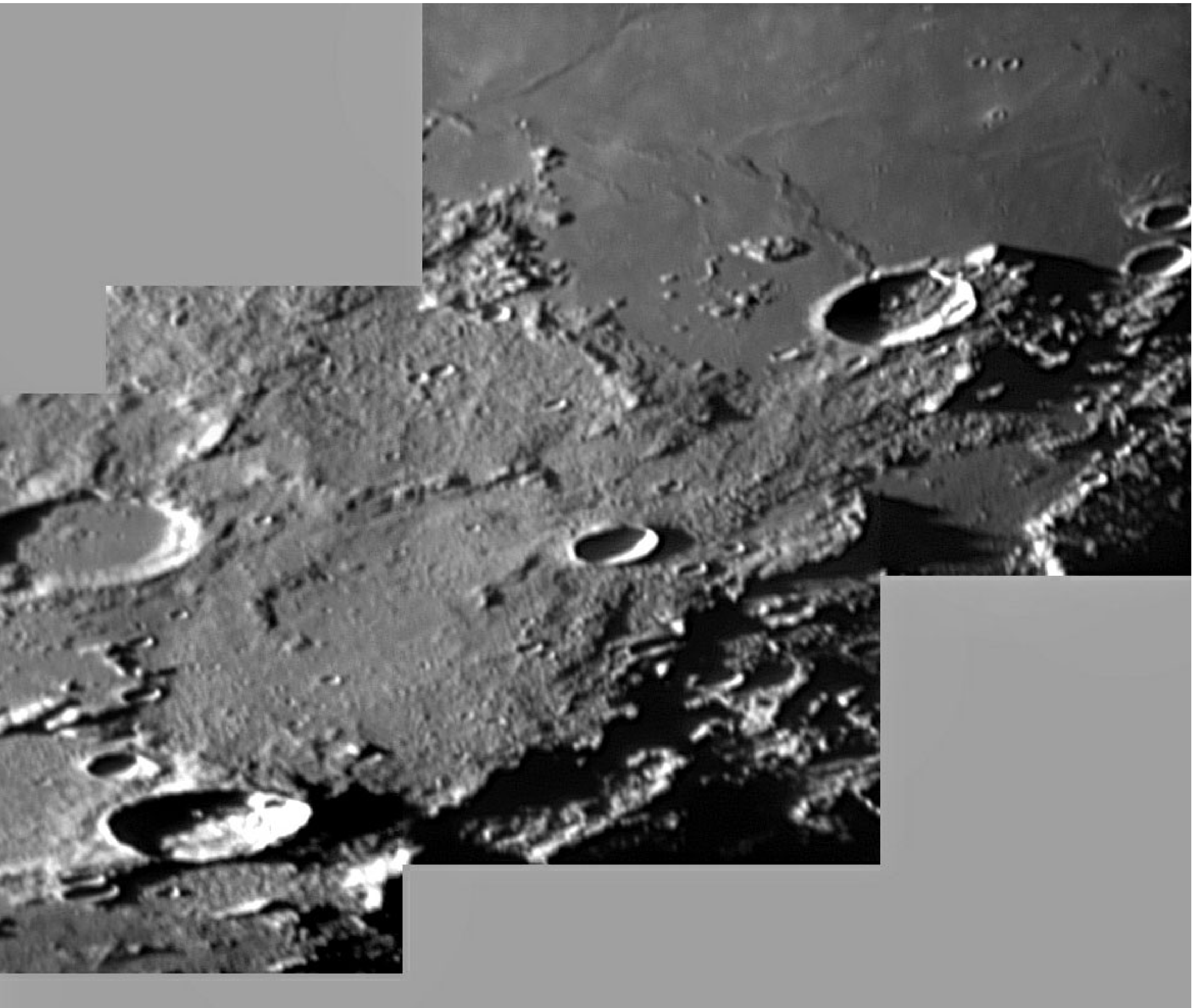
Photographer's Notes:

Currently, I mainly use a 10" f/6 Newtonian reflector for my visual observation and imaging of the Moon and Planets. For high resolution imaging, I use a 5x barlow and a Philips Toucam Pro webcam. The advantage of using a webcam is that it can catch the best seeing moment during the image capture process. Then the AVI file is processed and stacked with Registax and the resulting image is further processed with Photoshop. However, my CN212 is also a fine telescope for visual observation and imaging too. I used it to take many fine lunar images before I acquire the 10" reflector. I am a workshop instructor in a local vocational institute.

My observing site is located just on the outskirts of the city center of Hong Kong. It's surrounded by skyscrapers. During the night, flood lights from commercial buildings illuminate the sky like the day.



Above:
Fontenelle
20051111 13h03m-14m (UT) Colong: 31 250mm f/6 Newtonian + 20mm eyepiece + Philips Toucam Pro
Seeing: 4~5/10 Transparency: 5/10 Mosaic of 5 images Taken by: KC Pau, Hong Kong



Under this sky condition, I limit myself to observing bright heavenly objects such as the Moon and the Planets. However, the hot air currents dissipated from neighbourhood air-conditioners affect the seeing condition very much. The seeing condition at my site is always around 4~5/10 and seldom reaches 7/10 or higher. The only thing I can do is to wait for the short but best moment to press down the CAPTURE button. The waiting time may be an hour or more. I am lucky that my apartment has 2 balconies facing at E-S and W-S direction respectively. Usually, I observe at the W-S location because I can easily get access to my computer and other facilities. Anyway, I have to wait for the objects to come out from the neighbouring skycrapers.

Excerpted from KC Pau's web page: http://observingthesky.org/index.php?p=174

THE CAPTAIN'S MOON

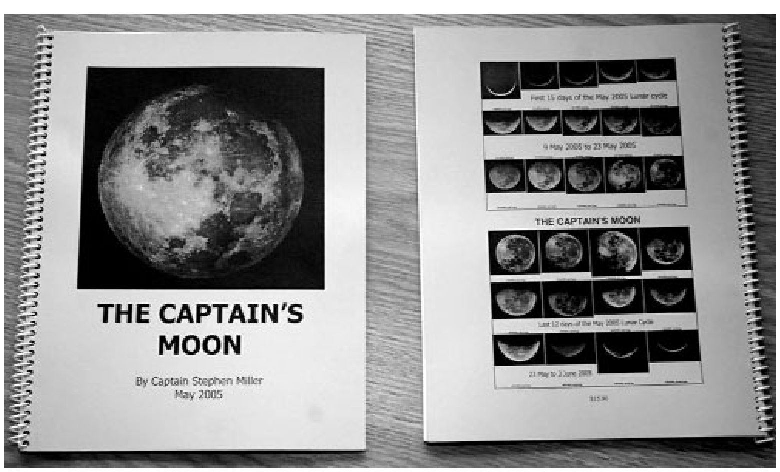
by Captain Stephen Miller

Since starting to observe and image the moon in 2002, I pondered doing something on its phases. In 2004, I started studying under the tutelage of a working astronomer and greatly increased my skills and equipment. By May 2005, I felt I was ready to finally begin 'the project'.

'The project' was to capture an image each day of an entire lunar cycle – the same cycle if possible. This included capturing ALL the images with my own equipment – not relying on other people's equipment or images to illustrate the eventual book. The chosen Lunar cycle started with the New Moon on 8 May 2005 and continued every day to the next New Moon on 6 June 2005. I almost made it, but was clouded out on the last two days.

The book is laid out to show an image of the Moon on each lunar day, along with some very basic data concerning each image. I included my thoughts and actions on that day, as well as noting some of the major objects (craters, etc) that were visible.

Above: Photo taken with Nikon D70, 300mm f/4 Nikor lens, ISO 200, 1/1000 sec. shutter
Below: The book The Captain's Moon



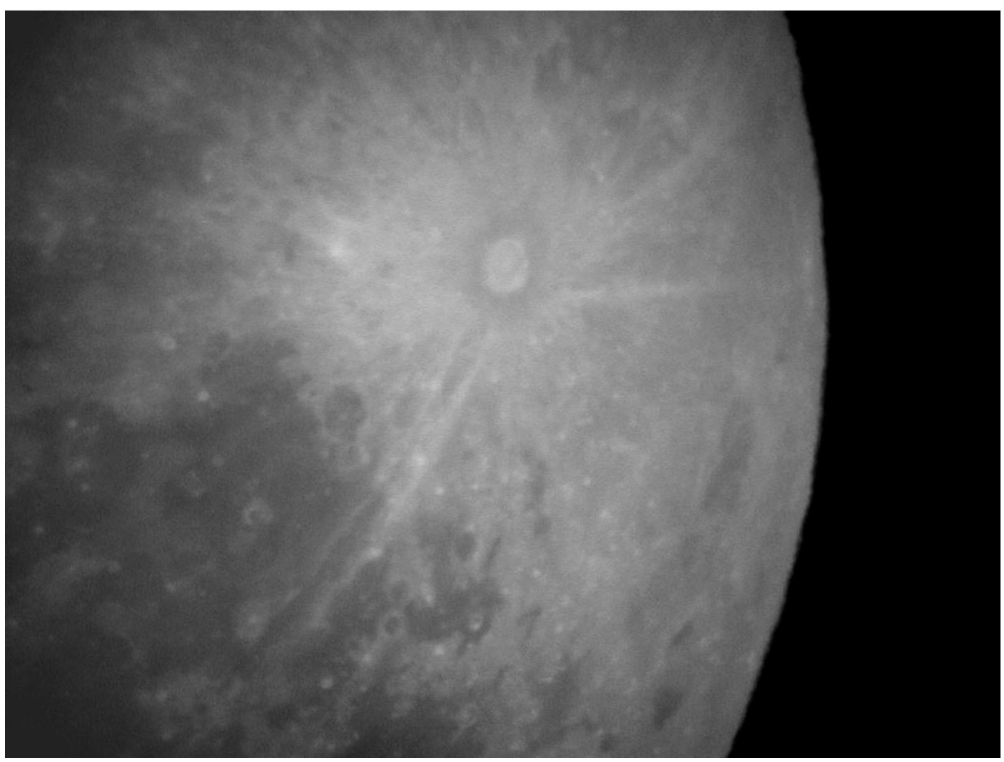
Also included were images that I had taken on that lunar day in past months or years. Many of these images were details of craters, etc. I wanted to show what was involved in imaging every day and to give beginners an idea of what they might find when observing the Moon on a given day in the lunar cycle. A glossary and summary of objects along the terminator on each day is also included. The Appendix carries pictures of the telescopes and cameras that were used.

The Captain's Moon is a direct result of my desire to share with others the objects I have observed in the heavens. The book is available for $15.00 plus $7.00 postage and handling from Captain Steve at: Captain Stephen Miller, 175 SE St Lucie Blvd, Unit C52, Stuart, FL 34996.

Currently, I am rather partial to Lunar observations although I do spend time observing the sun and planets. Primarily, I do astroimaging; again as a direct result of my desire to share with others what I have seen.

MORE PHOTOS FROM OUR MEMBERS

Above:
Sunset on Petavius
by Richard Hill,
Jim Loudon Obs.
2005 10 20 0520 UT
Celestron 14, Toucam w/
W25 filter



At right:
Tycho's lunar ray
by Michael Amato
10/10/05 2350 UT
West Haven, Connecticut
1200mm focal length
6" Newtonian
Digital Camera

ON THE HISTORY OF VIDEO IMAGING

by Eric Douglass

Lunar enthusiasts have a long history of photographing the moon. While "still camera" photography was the gold standard for decades, many have now switched to video imaging. However, when I began working in this field, nearly 15 years ago, the technology was primitive and the techniques were poorly developed. This article recounts my journey in video-imaging, and the changes in technology that took place.

I began to envision the possibilities of video-based systems for astronomy when I saw an advertisement for low-light security cameras that could be attached to a telescope (figure 1: my original video camera). At that time, few companies offered such a device so there was little room for comparison shopping. I immediately went to the library to learn about this field. Unfortunately, there were no books on the topic and only a few brief—and not very informative—magazine articles. Next I went to the television production section and there found a variety of books that addressed video technology. Unfortunately, the language was foreign, containing terms such as signal-to-noise ratio, lines of horizontal resolution, video processors, and the like. At this point I nearly gave up.

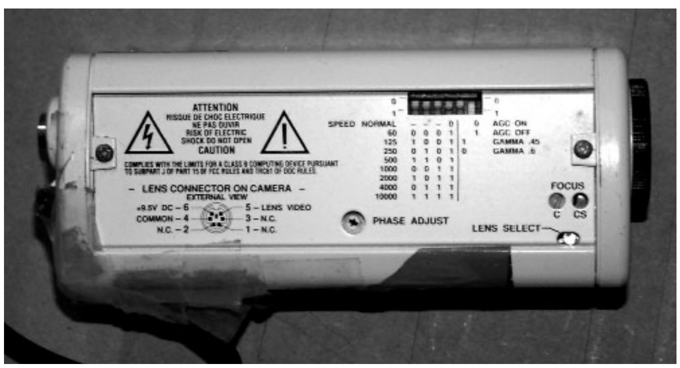


Figure 1

Figure 2

Nevertheless, I felt that this technology offered possibilities that were previously unavailable, such as real time photography and the ability to record those rare moments when the seeing was absolutely perfect; so I took a chance and bought the camera. When it arrived, I opened the box to find a rather cumbersome and heavy camera, with a variety of switches and confusing instructions. The manual was technical, clearly having been written for someone who worked in the security field. After reading the directions several times, pondering over the terms, and reading them a few more times, I attached the camera to the telescope and decided to give it a test run. The sky that night was clear with the moon at half phase. As I needed a monitor, I placed our family television in a wheelbarrow and carted it out to the telescope (my neighbors never quite know what they'll see in my driveway at night!). After making the appropriate connections, I turned this unlikely system on. The television blazed out the image of a white blur. No detail. It was fuzzy, like a cloud. I moved the focus knob of the telescope in and out, and found that the white spot decreased in size, but never resolved into details. I needed more distance between the telescope and the video camera…more than the telescope allowed. I removed the camera and held it an inch beyond the eyepiece, and then, for a moment here and there, the distance was perfect. The moon blazed out in all of its glory on a 17 inch television screen. I saw craters and mountains as I had never seen them before. I was hooked.

From this humble beginning, I knew that video photography of the moon was possible but fraught with technical problems and the difficulties brought by my own general ignorance. I needed more information and better equipment. Getting the correct distance between the camera and telescope was easily solved: I bought an extension tube. Now I could hook the camera to the telescope and see the image of the moon steadily on my television. This was my beginning system (telescope—video camera—television monitor). Next I hooked a VHS recorder in line, and was able to record the images in real time. I found myself less focused on viewing the moon and more on keeping lunar objects in the center of the field. After all, the next day I could watch the tape for as long as I wanted.

Correcting the problem of “ignorance” was more difficult to solve. I went to a college bookstore and bought a book on television production. This book, intended for a beginning college class, explained all the terminology. Here I learned that the terms “signal-to-noise ratio” indicated how much noise existed within the electronics of a system. I also learned that the term “lines of horizontal resolution” indicated the resolution of the recording system. These two terms came together in defining the different types of video systems: a VHS system (the more common video recorder) had more noise and lower resolution, but an SVHS system had less noise and higher resolution. So, predictably, I bought an SVHS recorder. Now my system had the following components: telescope—video camera—SVHS recorder—television monitor.

As I continued reading the book on television production, I learned about another magical piece of equipment: the video processor (figure 2). This “box” could increase the contrast in the image as well as enhance it. I wrote video companies for their catalogues, but most video processors were thousands of dollars—too rich for my budget! But then, as I was wandering through Radio Shack, a sign caught my eye: “Video Processor: Make Your Own Home Movies.” Here, at last, was a processor that only cost a hundred dollars (I don’t have an image of this processor; figure 2 shows my later “digital” processor). It was an analogue system with only four controls, but it had the most important ones: contrast and enhancement. That night, I placed the video processor in-line and focused the telescope on the moon. Craters that before were hidden in the gray murk popped out. Central peaks that before were soft and blurry now had hard edges. Now my system had the following components: telescope—video camera—video processor—SVHS recorder—television monitor (figure 3). However, there was a price to pay for these improvements—each increased the noise in the signal (image). In video, noise is seen as

Figure 3

Figure 4

small black “dots” that give the image a “grainy” look. But solving that problem would have to wait.

These components have remained the core of my video-imagining system. The changes have mainly been for items of higher quality. For example, the analogue video processor was retired when I found a moderately priced digital processor. This higher quality piece created less noise and had more functions. The video camera (figure 4) was also changed for one with greater light sensitivity (called the “lux rating”) and lower noise (a higher “signal to noise ratio”). The connecting wires between each component were exchanged for shielded wires, meaning that they contracted less RF (radio frequency) noise. Finally, the videotape itself was changed from regular VHS tape to highest quality SVHS tape (thicker magnetic coating, greater retentivity, etc.).

The final component change in my system was

Figure 5

the printer (figure 5). Early on, there were no simple converters that allowed one to take the video signal into the computer (called a “frame capture device”). Consequently, I bought a “video printer.” This device converted the analogue signal into a digital one and then printed the image using a thermal head (note that several different types of heads are used). This permitted the printing of a single frame from the video stream (figure 6). One simply watched the video on the monitor and pushed the “print” button at the right moment. As the moments of steady seeing were relatively brief, and completely unpredictable, this usually required going back over the tape multiple times.

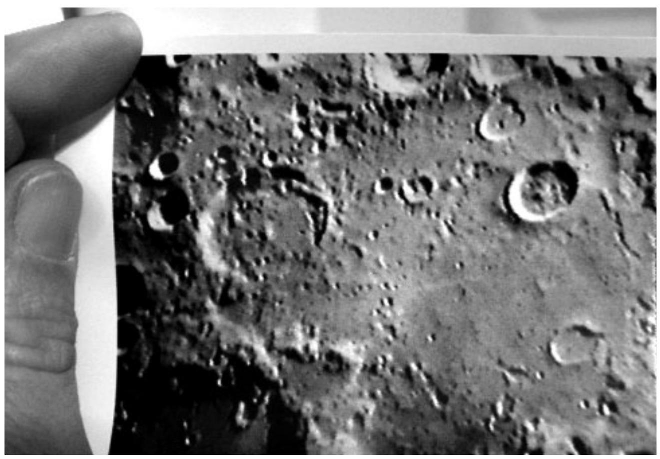


Figure 6

At a later time, devices that converted the video (analogue) signal to a digital signal for computers became available and affordable (I don’t have an image of my original converter, called a “Snappy”). At that time, I began taking images from the videotape into the computer. This had the advantage of far greater processing capabilities. While the video processor and printer had some processing options, the computer allowed far more control. However, there was still the problem of noise—those little black dots that became increasingly noticeable with processing. At one point, it occurred to me that this noise was random in nature, and could be averaged out by digitally adding images together. I began by capturing two images from the same section of the tape. I changed the transparency of the top image to 50% so that I could see the lines of both images simultaneously. After carefully lining each image up—which took considerable time—I merged the two. The results were startling. Indeed, they were so startling that I began capturing four images at a time and merging them together. The process took 20 minutes for each stack (figure 7: here are the results of one such stacking). At a later time, computer programs for “stacking” became available—they would automatically merge dozens or even hundreds of images in a fraction of the time.

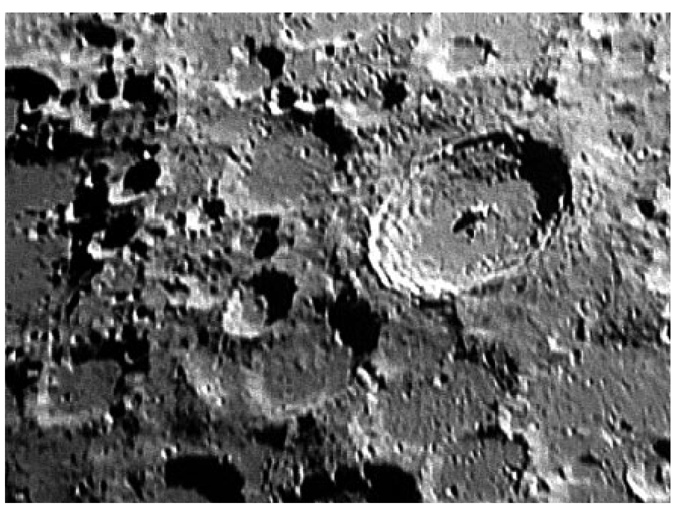
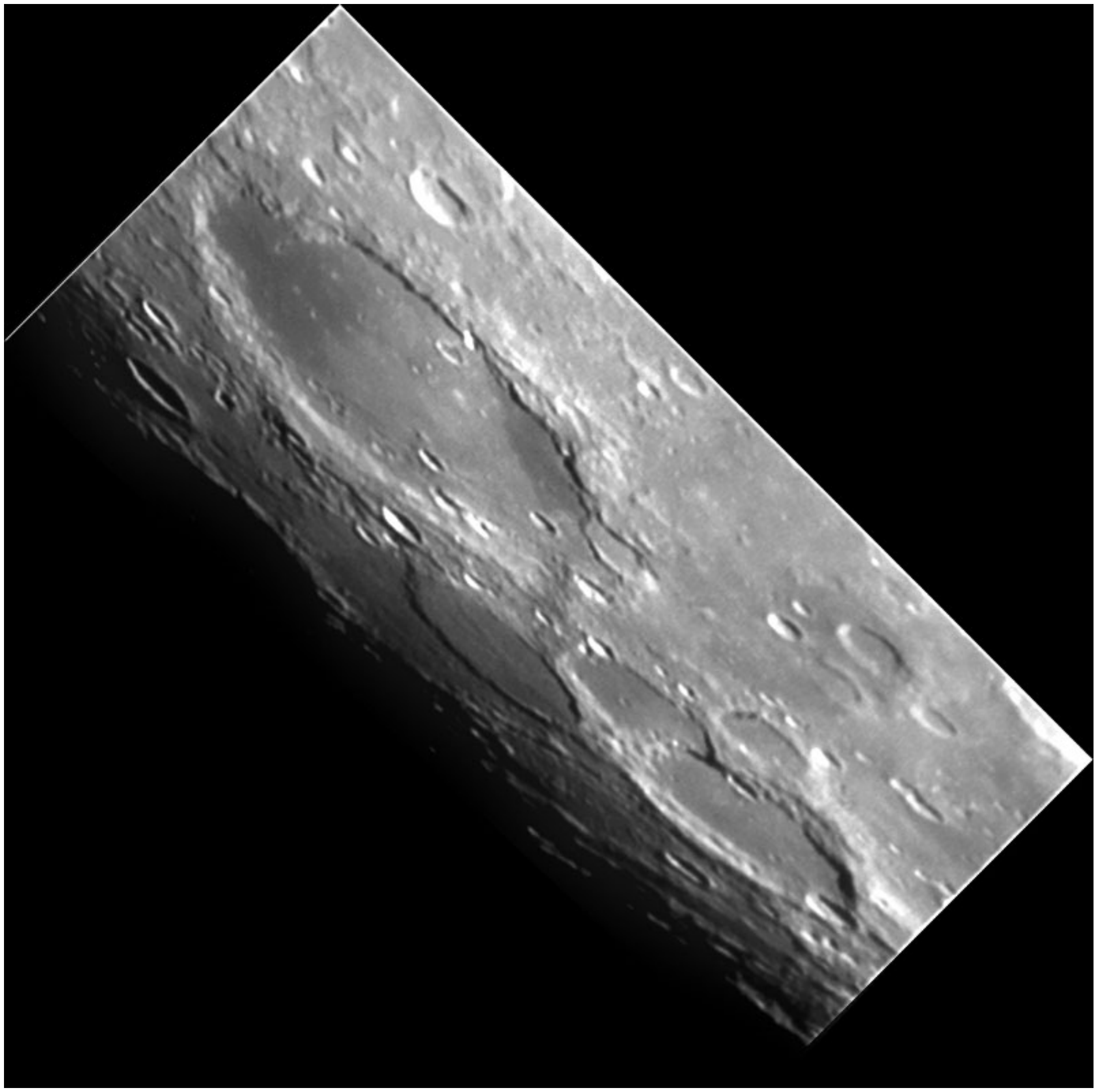


Figure 7

Today, most people in video imaging don’t use the video equipment that I describe above. Most are unaware of the transformations that have occurred in the field and the difficulties that had to be overcome. Present day systems are much easier and better. The main change, of course, has been the advent of the portable computer with large hard drives and fast processing chips. Now many video photographers simply stream the input into the computer itself. This is better, for it removes the many wires, pieces of equipment, and video tape—each of which imprints its own noise on the signal. Still, I kind of miss the old days when knobs, dials, sliders, tapes, connections, and troubleshooting were required to put a decent image together.

NOTES ON SCHICKARD, WARGENTIN, NASMYTH AND PHOCYLIDES IN ORDER OF DECREASING AGE

by Howard Eskildsen



Schickard

Size: 233 x 233 km, **Period:** Pre-Nectarian (4.55-3.92 billion years ago), **Features:** Few high walls with summits up to 2700 meters, rim is crater-riddled, immense flat floor with lava fill, dark and light albedo regions and numerous craterlets. The lighter colored fill is believed to be the same age as the Orientale Basin and covers earlier lava flows. A dark halo crater visible in the photo just north of the center of Schickard exposes older mare material that underlies light colored ejecta from Orientale. Dark regions on opposite corners of Schickard have been interpreted as younger lava flows that partially cover the lighter ejecta. Secondary craters from Mare Orientale scar the southwestern portion of the crater.

Nasmyth

Size: 80 x 80 km, **Period:** Not listed, but to me it appears Pre-Nectarian; it is certainly older than Phocylides and Wargtentin, **Features:** Battered wall intruded by Phocylides and Wargentin, flat floor with craterlets. Crater floor lies at nearly the same elevation as the floor of Wargentin.

Phocylides

Size: 117 x 117 km, **Period:** Nectarian (3.92-3.85 billion years ago), **Features:** Battered walls, flat lava floor with numerous craterlets. Crater floor lies at nearly the same elevation as the floor of Schickard

Wargentin

Size: 87 x 87 km, **Period:** Nectarian (3.92-3.85 billion years ago), **Features:** Flat floor with lava or possibly ejecta fill to the level of the crater wall, forming a plateau. Crests resembling wrinkle ridges cross center of crater. No craterlets visible in photo, suggesting that the fill material may be younger that the fill of the other three major craters in the photo.

Resources:

Legrand, Christian, and Chevalley, Patrick (2004) Virtual Moon Atlas, Expert Version 2.1

Wood, C., (2003) *The Modern Moon,* Cambridge: Sky Publishing

Moore, P., (1976) *New Guide to the Moon,* New York: W.W. Norton & Company

Wilhelms, D., (1987) The Geologic History of the Moon, USGS Prof. Paper 1348, Washington: GPO

Sheet 2 Topographic Lunar Map (1963), Army Map Service, Corps of Engineers, U.S. Army, Washington, D.C. (Viewed at Lunar Planetary Institute Website: http://www.lpi.usra.edu/resources/mapcatalog/LTM/sheet_2_grad/72dpi.jpg<http://www.lpi.usra.edu/resources/mapcatalog/LTM/sheet_2_grad/72dpi.jpg>).

BRANDON VALLEY HIGH SCHOOL ASTRONOMY

by Steve Boint

Introduction

The students in my astronomy class at Brandon Valley High School in Brandon, SD, go one step beyond reading textbooks and occasionally looking through telescopes; working from digital photos, they measure the vertical displacement of lunar features. At first, I feared it would be an exercise in exasperation for all of us, but student results have been remarkably strong.

This region of the U.S. has the benefit for gardeners of being along the fringe of a warmer growing zone. Unfortunately for astronomers, this means that the sky is usually turbulent, fronts often meeting directly overhead, except for January and February nights that plunge to -10 degrees F or worse—much too cold for people or computers. Consequently, the focal length of the camera/telescope is limited. This is the single biggest source of controllable error in our measurements. High school astronomy classes with access to clearer skies should produce even better results.

Checking our work against the LTO maps and the LAC maps (the latter of which provide only a ballpark figure), shows an error in our measurements ranging from 0% to 40%. The average error rate is 16%. If the most suspect work is removed, a confidence value of plus or minus 30% seems reasonable.

Method

I take and process the photographs using an f 4.5, 10” dob, 2x Barlow, and digital camera (currently an SBIG 237a). From one of the photos, students are assigned a feature with a long, clean shadow. Then, using the shadow method, they calculate the vertical displacement of the feature.

Using digital images requires a few unique twists to the usual methodology. In order to get the the x,y coordinates of the peak, the students must find a grayscale value halfway between the brightest pixels at the top of the feature and the shadow at the foot of the peak. They then locate, near the desired measurement site, the pixel closest to this value. The same is done for the shadow’s end, working from the values of the darkest point in the shadow and the grayscale value just beyond the shadow’s tip. These steps are necessary in order to take account of the vagaries of penumbras.
Because the peak and shadow often have more than one pixel close to the desired value, students record up to five different sets of coordinates for each, attempting to adequately represent the clarity, or lack thereof, found in the image. The different values for the vertical displacement these provide are then averaged with an accompanying plus or minus value representing the precision. This precision value also allows for weeding out work by students who were manipulating the data or being sloppy.

Feature	Xi	Eta	Height (m)	Date	Time (UT)	Average Shadow Length (arc sec)	Optical Chain Length (mm)
Aristoteles	.211	.764	2100	8/7/2000	1:33	2.192	3098
Hainzel	-.423	-.643	2000	10/9/2000	2:10	8.437	4409
Hainzel	-.420	-.637	2100	10/9/2000	2:10	8.211	4409
Hainzel	-.416	-.643	2100	10/9/2000	2:10	8.313	4409
Hainzel	-.413	-.646	1900	10/9/2000	2:10	7.268	4409
Mons Deville	.010	.682	1300	6/10/2000	2:23	12.673	3098
Mons Pico Beta	-.026	.621	1900	12/13/2002	1:27	22.091	2100
Plato (depth at east rim)	-.071	.786	2100	8/9/2000	1:34	8.831	3098
Prom. Laplace	-.302	.409	2600	10/9/2000	1:40	5.116	3098
Walter Crater central peak	.015	-.546	2300	7/7/2003	2:24	5.4	2100

Table 1. Observation site: 96.73133 degrees longitude, 43.52933 degrees latitude, elevation of 434.64 m. Mons Pico Beta and Walter were imaged with an SBIG 237a, all others with a Meade 216XT. All shadows measured fell to the lunar west of the feature.

Conclusions

Although the electronic publication of the LAC and LTO maps by the Lunar and Planetary Institute (http://www.lpi.usra.edu/resources/mapcatalog/) allowed us to calculate the error in our work, it also made many of our measurements obsolete. Table 1 shows most of our results which remain interesting. A couple of students continue to work on a larger project and I expect their results in the next year.

Astronomy teachers who would like to have their students get a taste of real research through this type of project may contact me (steveboint@earthlink.net) and I will gladly share the Microsoft Excel templates we use to increase the ease and speed of calculations. A great debt is owed to Harry Jamieson by all of us who pursue calculating the vertical displacement of lunar features through the shadow method. His *The Lunar Observer's Toolkit* software handles the excruciating math.

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