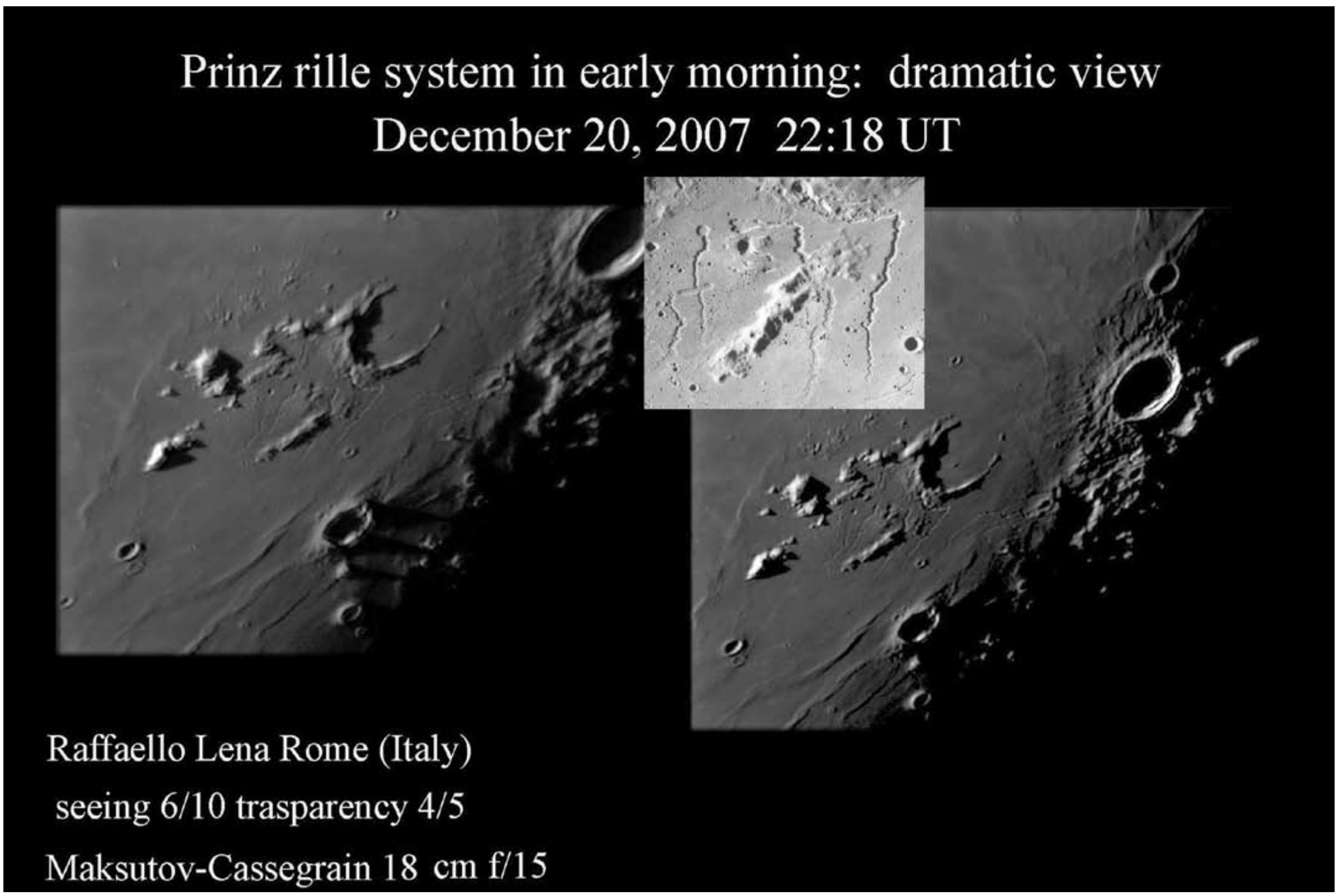
DEVOTED TO THE STUDY OF EARTH'S MOON
VOL. 27 NO. 2 SUMMER 2008

SELENOLOGY

The Journal of The American Lunar Society



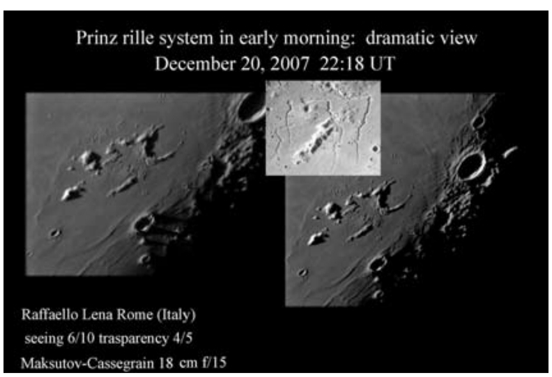
Selenology

Vol. 27 No. 2 - Summer 2008

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

Note to Readers: Raffaello Lena has come on board as editor of Selenology. Long a member of ALS, he is also the founder of the Geological Lunar Researches Group (GLR) and Selenology Today.
http://www.glrgroup.org/ http://digilander.libero.it/glrgroup/

TABLE OF CONTENTS:



COVER:

Rimae Prinz system by Raffaello Lena

Selenology, Vol. 27 No. 2, Summer 2008. A publication of the American Lunar Society.
President: Eric Douglass; Vice President: Steve Boint; Editors: Steve Boint, Raffaello Lena.
Web site: http://amlunsoc.org/

Send manuscripts, general observations, photographs, drawings and other correspondence to:
Steve Boint, VP ALS, 1807 S. Spring Ave., Sioux Falls, SD 57105
E-mail: sboint0362@msn.com
Send changes of address to Eric Douglass at edouglas10326@comcast.net
If you don't have e-mail, send them to Steve Boint
To subscribe to Selenology, send $15 US to Eric Douglass at edouglas10326@comcast.net.

Measuring The Width Of Rimae Prinz

By Raffaello Lena
GLR group

Introduction

Five rilles or rille segments lie to the north and northeast of the crater Prinz, a large Imbrian-Age crater flooded by Eratosthenian mare soils. The rilles occur mostly in a smooth, probably Eratosthenian, mare unit which exhibits relatively sharp contacts with an older, probably Imbrian, roughly-textured unit (Strain and El-Baz, 1975). The IAU's Rimae Prinz includes the four large rilles around the peak named Harbinger Mu and probably the one starting in the lower right. The thinner rilles in the west are an extension of the neighboring Rimae Aristarchus (Moon Wiki, 2008). However, in LAC 39 these prominent rilles were described as Rima Prinz I and Rima Prinz II. In LM-39 the Roman numerals had been dropped and Prinz I was renamed Rima Prinz with the remaining rilles unnamed. In LTO-39A3, Rima Prinz II had been provisionally renamed Rima Beethoven and some rilles named as Rima Handel and Rima Telemann (see Table 1). As a note of interest: the names described in LTO-39A3 were not accepted by the IAU. Strain and El- Baz (1975) describe the length of the rilles as being between 12 and 77 km and the widths as being, on average, 1.7 km. Average depth was measured at 156 m. In Apollo Over The Moon, the maximum width of Rima Prinz II is about 1.5 km. It is at least 100 m deep in the dark mare materials. In this article, I examine the sinuous rilles in Prinz. The width of the rilles was computed using an Apollo 15 image (AS15-M-2195) and, for comparison, a CCD telescopic image taken with a Maksutov Cassegrain 18 cm in diameter.

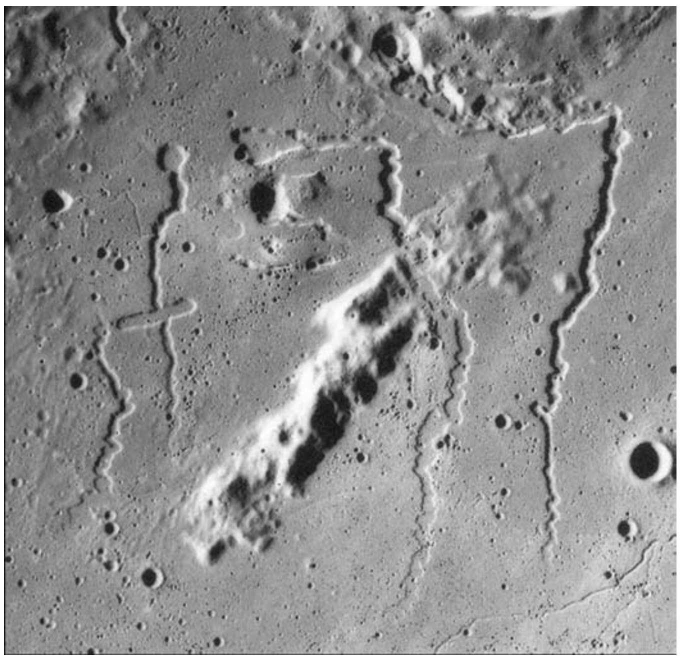


Figure 1: Apollo 15 image (AS15-M-2195) under rectified view. The corresponding rilles and rille segment are reported in Table 1.

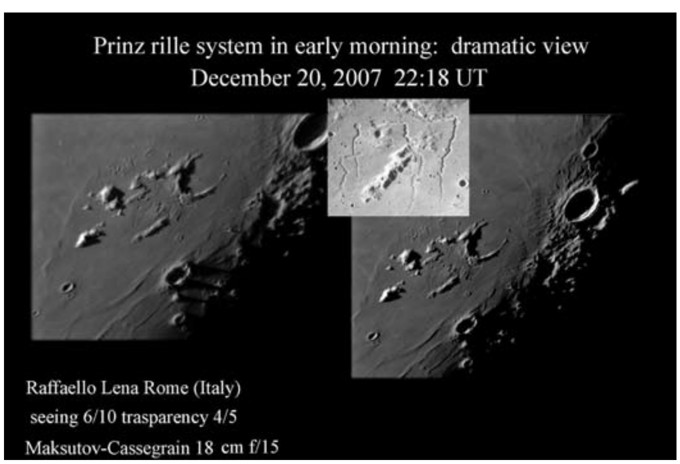


Figure 2: CCD telescopic image by the author. See also the cover image.

Digital images and measurements

Fig. 1 displays the Apollo 15 image (AS15-M-2195) under rectified view. The image shown in Fig. 2 was taken on December 20, 2007 at 22:18 UT using an 18 cm Maksutov Cassegrain and a Lumenera LU 075M. Figure 2 is composed using two different methods of processing. The label given to the rilles or rilles segments (Fig.3) is used here for practical reasons. In Table 1, the corresponding rilles are reported as they are named in the LTO-39A3. Fig. 4 is an enlarged por-

tion of the CCD image.
A calibration was obtained with the software LTVT by Mosher and Bondo using the 1994 UCLN list of benchmark locations. It's difficult to do the full measurements since the sides of the rilles are not well defined in some points.
A greater application of sharpening to the image gave over-processing with excessive width. Hence, a lightly processed image from the corresponding raw file was used (200 frames stacked of 1800). The calibration was verified by measuring the diameter of the crater Krieger C, a value of 4 km. The width of the rilles was also measured with the software Image J at the location where the rille showed fairly well-defined edges. The error was estimated as 360 m/pixel. The data are reported in Table 1. A considerable variation was measured along several locations and an average value for each feature was computed. The width of the rilles has been estimated using an Apollo 15 image along the same position (see Fig. 1 and 4) and averaging the measurements (Table 2). The scale is 100 m/pixel, computed based on the crater Krieger C . The widths obtained from the two images are shown in Fig. 5. The difference between the results obtained with a CCD telescopic image (Fig. 4) and the Apollo 15 image (Fig. 1) is shown in Fig. 6. In the diagram, the difference from the average value measured is reported so that the plus and minus values refer to the difference from the measurements of the Apollo image. Most probably, the remaining uncertainty in the measurements is related to the difficulty in distinguishing between the exact edge for some rilles.

Rille system	LTO 39A3	Width (km)	Average width (km)
D	Rima Beethoven	1.436	
		1.817	
		1.671	
		1.407	
		1.700	
		1.436	
		1.202	
		10.669	1.53±0.36
A	Rima Handel	1.114	
		1.612	
		1.700	
		1.495	
		5.921	1.48±0.36
C	Rima Telemann	1.085	
		1.201	
		1.670	
		1.377	
		5.333	1.33±0.36
F	Rimae Prinz	1.802	
		1.758	
		1.846	
		1.114	
		6.520	1.63±0.36
G	Rimae Prinz	1.055	
		1.084	
		2.139	1.07±0.36
E	Rima Beethoven	1.000	
		1.099	
		2.099	1.05±0.36
B	--	1.055	
		0.996	
		1.085	
		3.136	1.05±0.36

Table 1: Measurement using the CCD telescopic Image.

Rille system	Average width Apollo 15 image
D	1.58±0.10
A	1.41±0.10
C	1.40±0.10
F	1.53±0.10
G	1.12±0.10
E	1.10±0.10
B	1.15±0.10

Table 2: Measurement using Apollo 15 image.

As a note of interest, the measured widths in the CCD telescopic image for rilles A and F are slightly higher than the values computed from the Apollo image. The measurements, however, are consistent which each other since their error intervals overlap (Fig. 5). We get wrong values back when we measure rilles only as wide as the resolution limit of our telescope regardless of the accuracy of the measurement method: when a subject is just detected on an image but not resolved at all we get measures affected by over-sizing (Appendix 1).

The results of this study show that the examined rilles are resolved in the CCD telescopic image used in this study without any over-processing. According to Apollo over the Moon, the widest rille measured is F (named as Rimae Prinz on LTO-39A3) : the average width amounts to 1.53 ±0.10

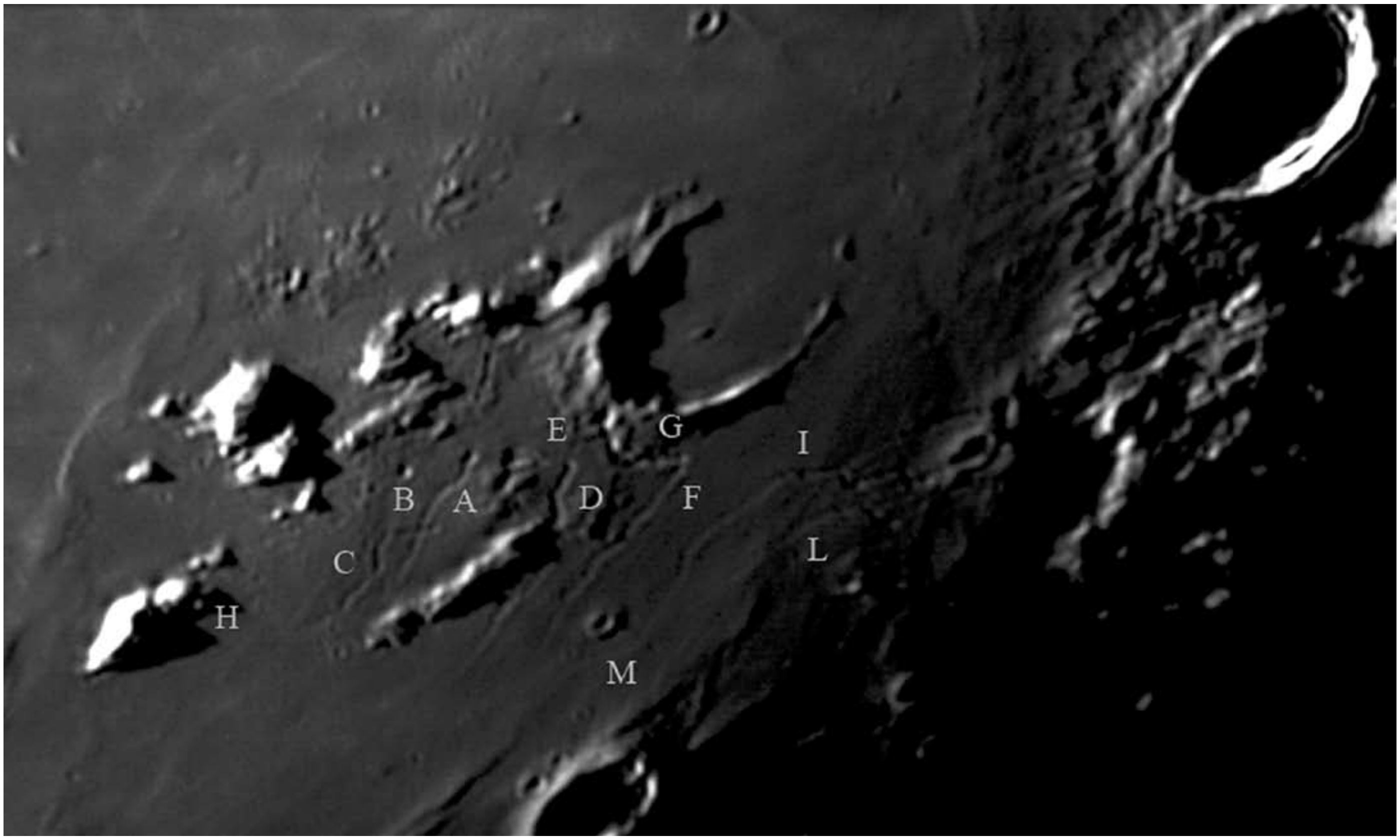


Figure 3: Rilles and their labels (The rilles M, I, L are an extension of the neighbouring Rimae Aristarchus).

km in the Apollo image and 1.63 ±0.36 km in the CCD telescopic image.

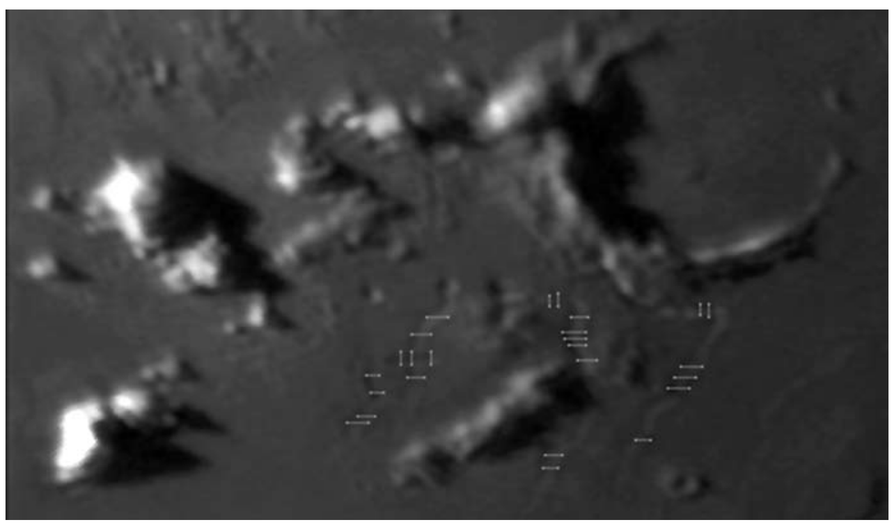


Figure 4: Rilles and locations where the measurements were computed.

References

Apollo Over The Moon; A View From Orbit, Chapter 6: Rimae (Part 1: Sinuous Rimae), Figures 192, 193, and 194 (part of Rimae Aristarchus/ Rimae Prinz near Krieger).

Astroscopic labs http://www.licha.de/astro_article_mtf_telescope_resolution.php

Lunar Aeronautical Chart (http://www.lpi.usra.edu/resources/mapcatalog/LAC/lac39)

Lunar Map series 39 (http://www.lpi.usra.edu/resources/mapcatalog/LM/lm39)

Lunar Topographic Orthophotomap (http://www.lpi.usra.edu/resources/mapcatalog/LTO/lto39a3_1)

Mosher J., Rimae Prinz (http://the-moon.wikispaces.com/Rimae+Prinz)

Mosher J. and Bondo H, 2006 (http://www.henriksucla.dk/)

Strain and El-Baz, Sinuous rilles of the Harbinger mountains region of the moon, 1975. LPSC, vol.6, pp. 786-788.

Appendix

The phenomenon of optical diffraction sets a limit to the resolution and image quality that a telescope can achieve. This limit is the effective area of the Airy disc, which limits how close two such discs can be placed. This absolute limit is called the diffraction limit (refer to the general definition in the astroscopic labs http://www,kucga,de/astro_article_mtf_telescope_resolution.php). This limit depends on the wavelength of the studied light (so that the limit for red light comes much earlier than the limit for blue light) and on the diameter of the telescope's mirror. This means that a telescope with a certain mirror diameter can theoretically resolve up to a certain limit at a certain wavelength. For conventional telescopes on Earth, the diffraction limit is not relevant for telescopes bigger than about 10 cm. Instead, the seeing or blur caused by the atmosphere sets the resolution limit.

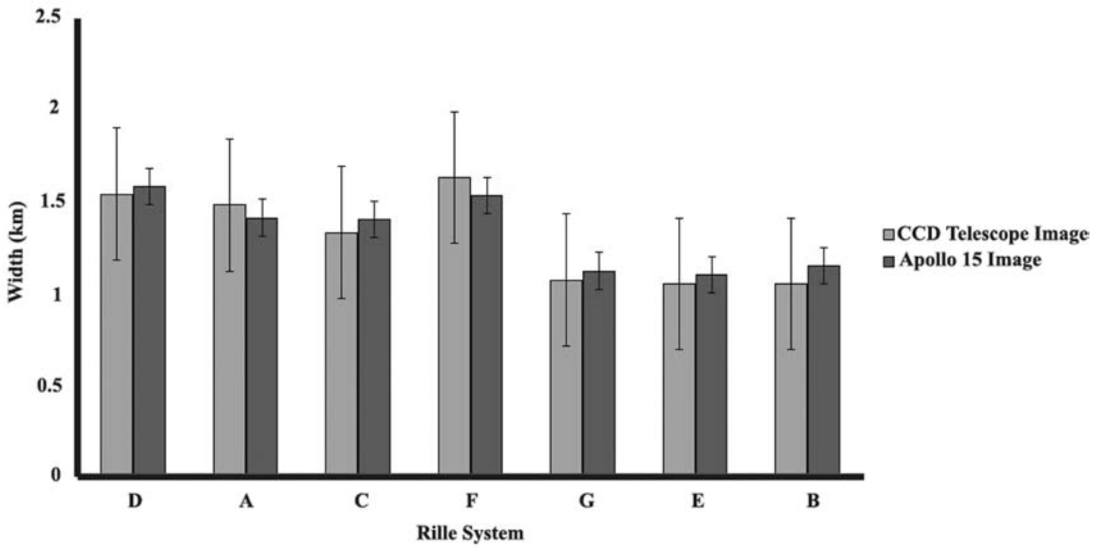


Figure 5: Width of the measured rilles.

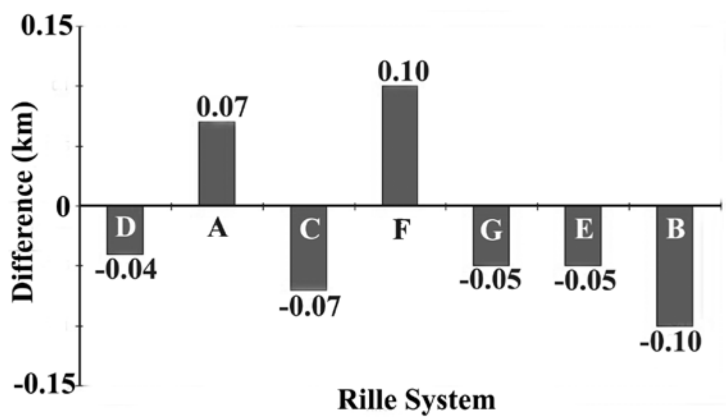


Figure 6 : difference between the average width in the CCD telescopic image and Apollo 15 image.

Dawes found out by his own observations that:

Dawes's resolution limit [arc sec] = 116 / Aperture Diameter [mm] (for green light).

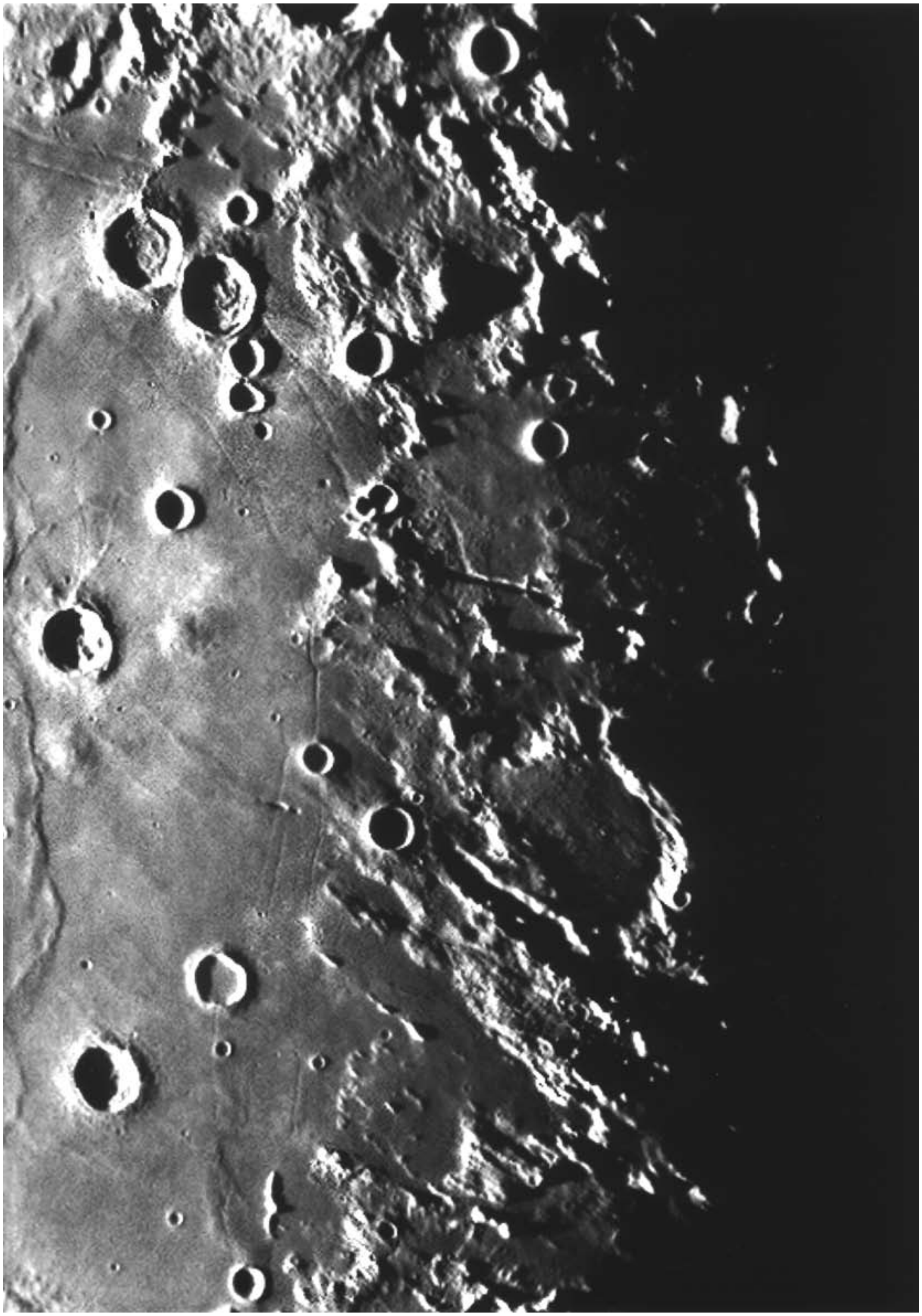
A more appropriate resolution limit has been proposed by C. Sparrow. He claimed that when the combined signal from two point spread functions (PSF) becomes a flat top the signals can still be separated. When we allow the combined signal to form not a flat top but a slightly-curved shape the distance between the two PSFs is just 1/2 of the radius of the Airy Disk.

Sparrow's resolution limit [arc sec] = 70 / Aperture Diameter [mm] (for green light).

For a telescope 178 mm in diameter (used in this study) the resolution limit is about 0.65 arc sec using the Dawes's formula and about 0.39 arc sec using Sparrow's formula.

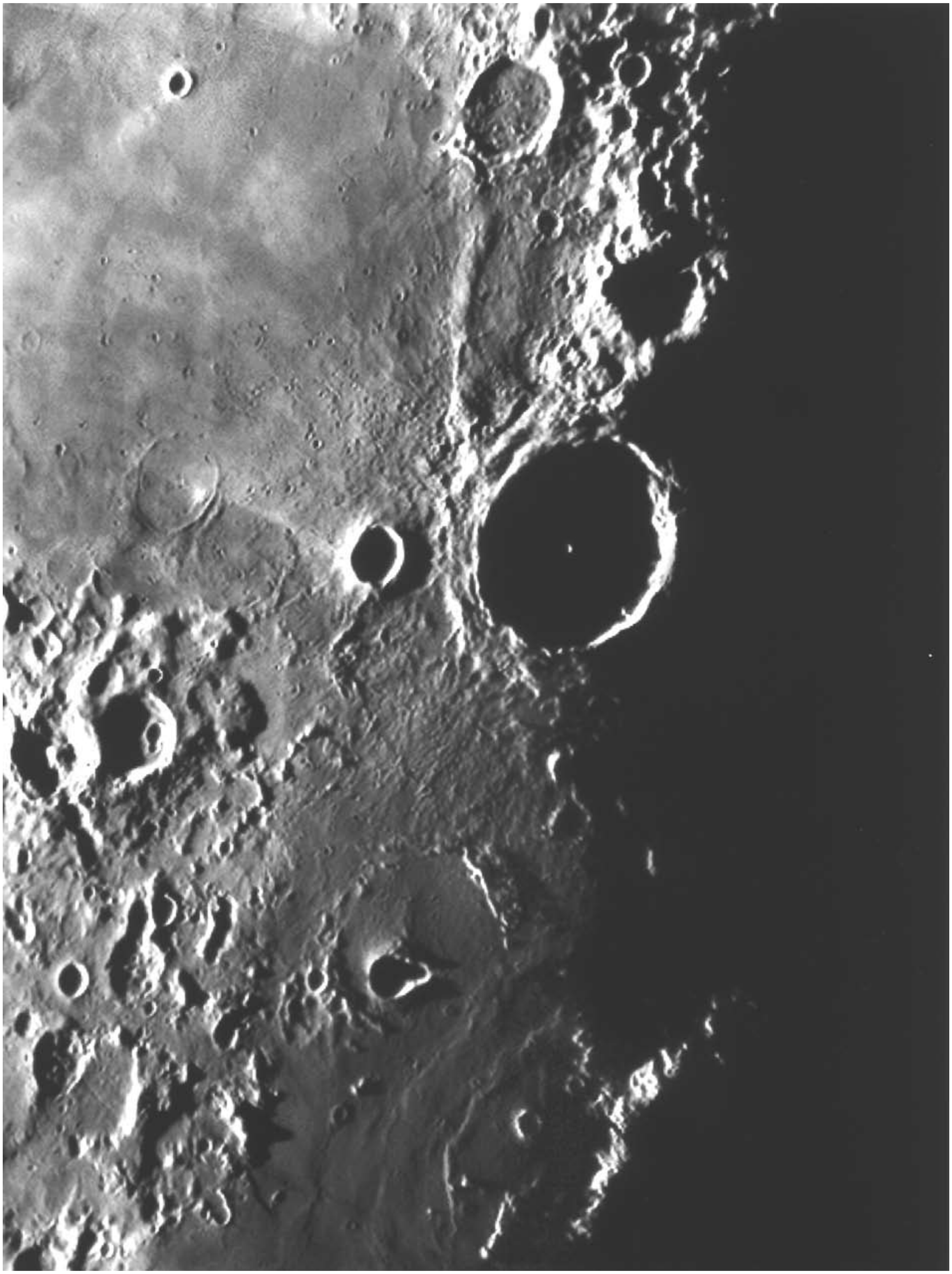
The Apollo image shows that the true average width of Rima F is about 1.5 km, which from Earth is about 0.77 arc seconds. Under near ideal conditions a 180 mm aperture would be able to detect this wide of a rille. Shallower rilles and/or an over-processed image could give over-sizing (an artefact of processing caused by enhancing a bright/dark line pair beyond the resolution limit of the optical system).

The Works Of Joseph H.C. Liu



Regions Around The West Rim Of Mare Tranquillitatis. *January 25, 2007. 01:40:46 UT. AstroPhysics 20.6cm, f/7.7 EDF refractor. 12.5mm orthoscopic eyepiece for afocal projection. Nikon Coolpix995. Non-filtered. 1/8s exposure @ ISO 200. Processed with Photoshop 7.*

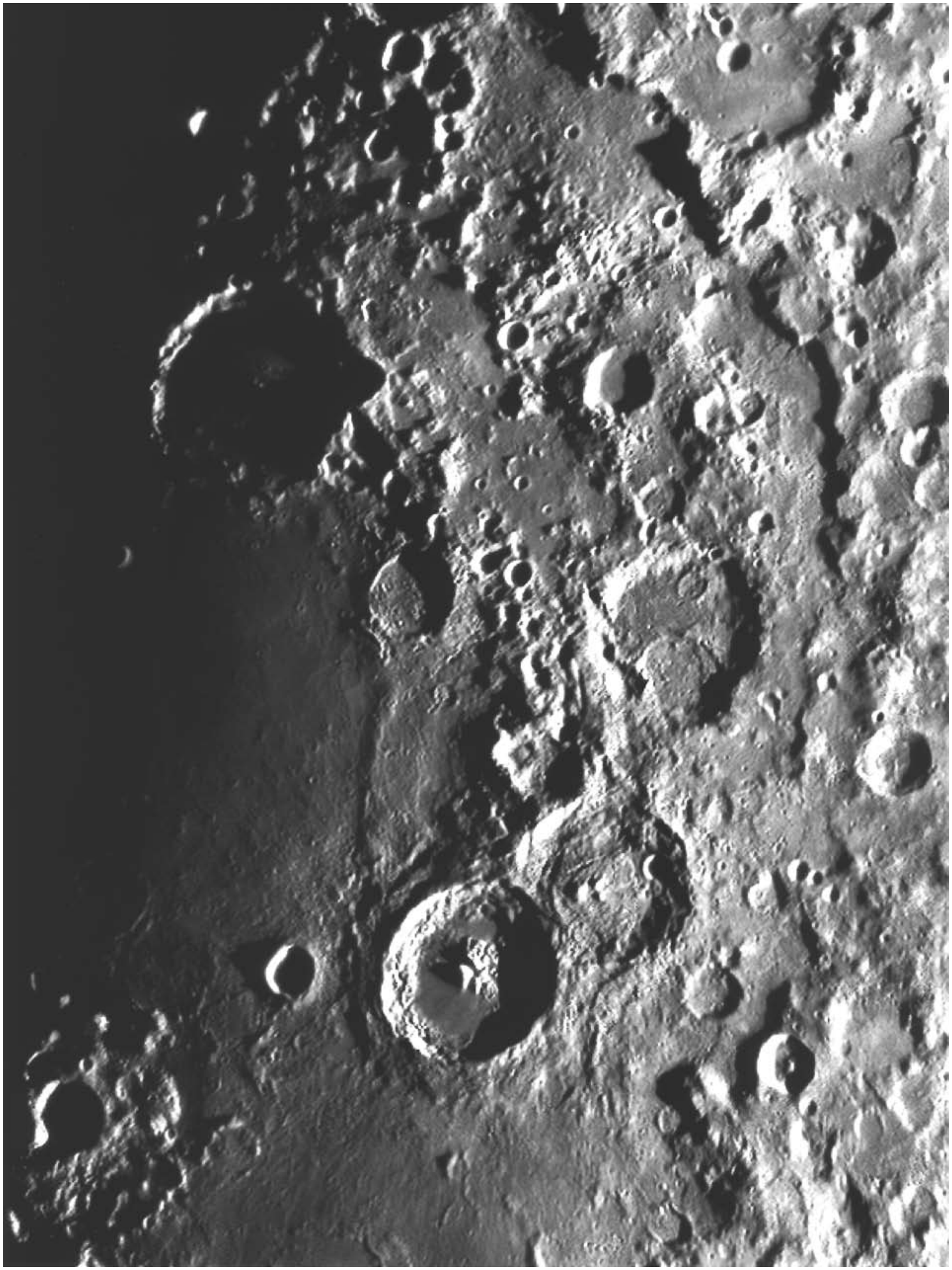
Alexander, Eudoxus & Aristoteles At Sunrise. *January 25, 2007. 01:38:56 UT. AstroPhysics 20.6cm, f/7.7 EDF refractor. 12.5mm orthoscopic eyepiece for afocal projection. Nikon Coolpix995. Non-filtered. 1/8s exposure @ ISO 200. Processed with Photoshop 7.*



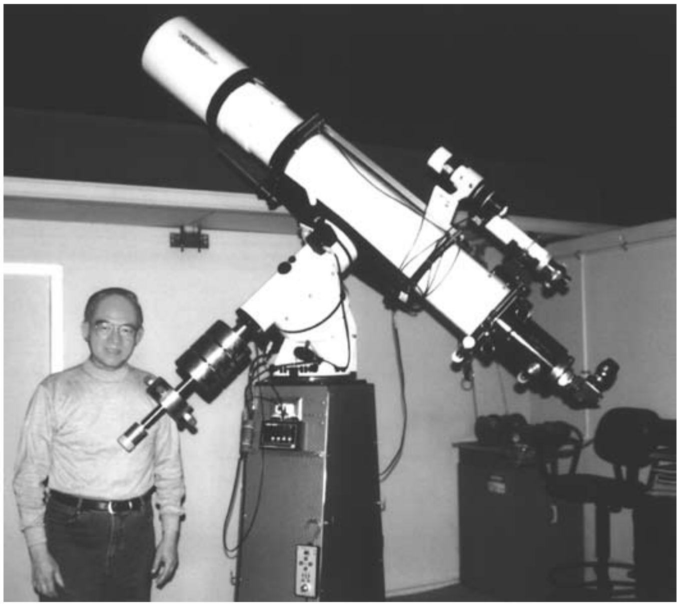
Theophilus At Sunrise. *January 24, 2007. 01:55:05 UT. AstroPhysics 20.6cm, f/7.7 EDF refractor. 12.5mm orthoscopic eyepiece for afocal projection. Nikon Coolpix995. Non-filtered. 1/8s exposure @ ISO 100. Processed with Photoshop 7.*

***Rimae Hippalus And Environs**. March 24, 2002. 02:48:52 UT. AstroPhysics 20.6cm, f/7.7 EDF refractor. 12.5mm orthoscopic eyepiece for afocal projection. Nikon Coolpix995. Non-filtered. 1/8s exposure @ ISO 100.*

Regions Around Crater And Rimae Mersenius. *May 13, 2003. 07:16:49 UT. AstroPhysics 20.6cm, f/7.7 EDF refractor. 12.5mm orthoscopic eyepiece for afocal projection. Nikon Coolpix990. Non-filtered. 1/4s exposure @ ISO 100. Processed with Photoshop 7.*



A Region Around The Western Shore Of Mare Nectaris. *November 10, 2006. 10:24:18 UT. AstroPhysics 20.6cm, f/7.7 EDF refractor. 12.5mm orthoscopic eyepiece for afocal projection. Nikon Coolpix995. Non-filtered. 1/15s exposure @ ISO 200. Processed with Photoshop 7.*



About the Photographer

Retired curator of the Hong Kong Space Museum, Joseph Liu has been featured on the cover of the April, 1974 issue of Sky and Telescope, has received Japan's Chiro Astronomical Prize (1982), has received the title "Member of the Most Excellent Order of the British Empire", and has had his work recognized by the IAU when asteroid 6743 was named "Liu" in his honor. He currently pursues astrophotography from his home in California.

The Moon Miners' Manifesto Story

by Peter Kokh
Editor: Moon Miners' Manifesto
www.MoonMinersManifesto.com kokhmmm@aol.com

By now, most members of the American Lunar Society should be familiar with MMM since the Moon Society and the American Lunar Society signed an affiliation agreement some time ago making the publications of each Society available in pdf format to members of the other.

About Moon Miners' Manifesto

MMM is a two decades old tradition that began in December, 1986, as the newsletter of (Milwaukee) Lunar Reclamation Society L5 (prior to the merger of the former L5 Society and the former National Space Institute.) MMM is published ten times a year, except January and July. MMM's December 2006 issue, #201, marked our 20th anniversary. Since issue # 90 in November 1995, MMM has served several other participating NSS chapters across the country, as well as the Moon Society (and its predecessor, Artemis Society International). I have been the editor from the beginning.

MMM: Why the focus on the Moon?

To answer this requires a bit of personal history. I was originally much more interested in Mars. By the late 1970's I had become so disappointed at America's "retreat" from the Moon in 1972 that I decided to write a novel of where we would be in space "today" (then 1980) had Nixon not canceled the Apollo program. I thought we might have reached Mars by then, but I reasoned that we would have had to "do the Moon" first. So I started to brainstorm just how we could set up permanent settlements on the Moon. Very quickly I ran into a potential show stopper. The Moon is very deficient in volatile elements such as hydrogen, nitrogen, and carbon which, so abundant on Earth, are at the very heart of our modern civilization. I started to explore how we could settle the Moon anyway—doing without this, substituting for that, etc. In the process, I became totally fascinated with the challenges posed by the Moon.

Pretty soon it dawned on me that the Moon's "predicament" is a lot like Japan's was in the nineteenth century. Japan lacked iron ore, coal, rubber and many of the things needed to develop an industrial economy. So it developed market sources for the raw materials it needed and markets for the finished products it would make with them. "Have not" Japan succeeded in developing the whole Pacific Rim: Korea, Manchuria, China, Indochina, etc. In like manner, lunar frontier settlements could only become viable if we developed other off-Earth sources for needed volatiles from which shipping costs in terms of fuel would be far less than would be the case for imports directly from Earth.

That Earth is nearby is an advantage thoroughly trumped by the disadvantage of Earth's deep gravity well. If we want self-supporting settlements on the Moon, we'll need to develop Mars, its two small moonlets, and the asteroids. Perhaps the greatest market for products and materials from the Moon will be industrial and tourist complexes in Earth orbit. It takes one twentieth the fuel to ship from the Moon to Earth orbit as it does to ship an equivalent item from Earth's surface to Earth orbit. Distance is not a factor. Of course, there are potential major export areas from Moon directly to Earth, especially: abundant, inexhaustible clean energy in the form of beamed solar power and, perhaps someday, Helium-3 fuel for ultra-clean, non-radioactive fusion plants.

In 1985, I had the chance to tour a unique Earth-sheltered house not far from my home in Milwaukee, Wisconsin, on the shore of Lake Michigan. This home named TerraLux (Latin for EarthLight), unlike most earth-sheltered homes, did not have an exposed south-facing window wall to absorb passive solar energy. It was totally under ground with eight feet of soil above (access trough the garage door). I went inside and wow! I was bathed in sunlight! Yard-wide, mirror-tiled, tubular shafts pierced the ceiling and soil above and were capped with computer-controlled reflective cowls that rotated to follow the sun across the sky. Additionally, in each wall there was a "picture window" and I could look out onto the beautiful rolling countryside as if it were straight ahead, not eight feet or more above. Behind each window was a large mirror on a 45° angle, then a vertical shaft to the surface and another mirror on an angle. These windows were giant periscopes. I had never felt so "outdoors" in any conventional surface structure. Robert A. Heinlein in his great novel, "The Moon is a Harsh Mistress", said that future Lunans would have to live underground in caves. Well maybe, but they could bring the sun and the views down below. This was an Eureka moment for me and I became convinced that no matter how alien and hostile and unforgiving the Moon seems to us, future pioneers armed with ingenuity and resourcefulness could make themselves very much "at home." This experience was the subject of the first issue's main article and set a tone for all the years since.

Read "M" is for "Mole" at http://www.lunar-reclamation.org/mmm_1.htm

MMM: Content & Themes

Most issues deal with the opening of the Lunar frontier, suggesting how pioneers can make best use of local resources and learn to make themselves at home. This will involve psychological, social, and physiological adjustment. Some of the points made will relate specifically to pioneer life in the lunar environment. But much of what will hold for the Moon will also hold true for Mars and for space in general. We have one Mars theme issue each year and occasionally other space destinations are discussed: the asteroids, Europa (Jupiter), Titan (Saturn), even the cloud tops of Venus.

The Moon Society Journal

The four page centerfold section of each issue of Moon Miners' Manifesto is reserved for the use of the Moon Society.

MMM Classics Project

During our semiannual "burnout prevention" break in July 2004, we began a new publishing venture—republishing in pdf format the classic articles from the first seventeen years, December, 1986 to November, 2003. Volumes 1-18 are now online at both of these free access locations:

www.Lunar-Reclamation.org/mmm_classics/ and
www.MoonSociety.org/publications/mmm_classics/

MMM Papers

From time to time, we have gathered multiple articles on a particular topic or theme into one paper and published it online. We will continue to do this.

www.lunar-reclamation.org/papers

MMM Projects to come

MMM GLOSSARY: Definitions of old words given special meaning in MMM and of some new words coined by MMM when no existing word would do.

MMM ONLINE SUBJECT INDEX: based on a specific list of keyword-Metatags

Looking Ahead

One of my core interests has always been astronomy, both planetary and near interstellar. (If someplace is too far away for me to fantasize about someday visiting there, my curiosity is proportionately weaker.) My first telescope was a Criterion 4" which I bought for $45 back in 1953. In 1980, I bought a Coulter 13" Dobsonian for my Wisconsin north-woods cottage. As a young teen, I dreamt of one day being stationed at a farside observatory with Earth out-of-sight, out-of-mind. But I am also passionate about my home planet. I see preservation of a green Earth and human civilization as a rallying point for those focused on the Moon, those focused on planetary defense against "Killer Asteroids", and those focused on putting human and Gaian eggs in a second basket on Mars.

Check out the following: http://www.moonsociety.org/blog/index.php?title=the_human_expansion_triway_into_space&more=1&c=1&tb=1&pb=1

I was keenly interested in the Amateur Space Telescope project of some years back and remain interested in updating that design for a placement of a pair of amateur telescopes at the L4 and L5 positions of lunar orbit where they could give us amateurs live views 60° around both lunar limbs. Considering libration, less than one sixth the Moon's surface would remain unobservable to amateurs on Earth.

P.S. I have an online bio at: http://www.lunar-reclamation.org/bio_pk.htm

TerraLux

40 Lunar Years And Counting . . .

By Ian Bennie

My first view of the moon was through a 50 x 40mm tabletop telescope when I was a 14. One of the amazing discoveries I made with that scope, was that the moon was round.

Well, I knew the moon was round …. but this was a three dimensional round, not the flat white circle it appeared in the sky. By the shadows stretching away from fantastic craters and mountains you could see the surface curving towards the lunar horizon. (Apollo 11 moonwalker Buzz Aldrin when standing on the moon, could actually see he and Neil Armstrong were standing on a sphere [1]). And with the simplest optical aid, I saw this for myself, from my own backyard.

Like many others, I looked at the moon when Apollo astronauts walked there—a special time when we knew beyond a doubt there was life beyond Earth. 40 years later, the moon still captivates me and I really enjoy sharing its grandeur with others. Like many other astronomy dads, I've been asked to present a space talk or two at a local school over the years.

I thought I'd share some of the points I've made about the moon that have been quite well-received in these talks. A number of these ideas were inspired by Carl Sagan's Cosmic Calendar[2]. The moon is a museum where we can still see some features as they were before the dawn of humanity. The Earth is around 4.5 billion years old; the moon formed at the same time. Neil McAleer points out in "The Cosmic Mind-Boggling Book [3]" that the youngest rock brought back from the moon by the Apollo 15 astronauts was 3.1 billion years old. He adds that 3.1 billion years ago was approximately when the first bacterial life began on Earth.

The massive lava flows on the moon which formed the 'maria' (seas) also occurred about 3 billion years ago[4], so these grey patches we see quite easily with our naked eyes were forming around the time of the very beginnings of life on our planet. Here's where the Cosmic Calendar comes in. To fully appreciate the age of these gray patches consider this: for the next 2 billion years or so after the

Ian Bennie with his original 1960s, 50 X 40mm Tasco '4VTE Asteroid' refractor as well as his current 102mm refractor.

maria began forming, bacterial/cellular life was the only life form on our planet, with the first vertebrates appearing just around 600 million years ago. The first dinosaurs were not to appear for around another 280 million years and when they did, they reigned supreme for 160 million years. After their extinction it would still be another 70 million years or so before we turned up……and invented telescopes with multi-coated lenses. And the lunar maria have been awaiting our inspection all that time. McAleer adds that the great lunar lava flows that formed the maria lasted for up to 800 million years. So when next your look at the lunar seas, it's interesting to reflect that you're looking at results of volcanic activity that lasted 5 times longer than the entire life span of the dinosaurs and began billions of years before they even existed.

The students I've talked to love dinosaurs, so I always introduce them to the crater Tycho. Jean Lacroux and Christian Legrand, in their excellent book "Discovering the Moon[5]", highlight that about 109 million years ago during the time dinosaurs roamed the Earth Tycho was created when a 10 km wide meteorite slammed into the moon (who knows if the dinosaurs witnessed that catastrophic event). It's fun to point out to students that dinosaurs could possibly had been walking over the very spot they're standing when the crater they're looking at was formed.

Craters make a big impression with students. I use them to show the size of the moon compared to Earth. Just take an easily observed crater, such as Copernicus, and relate the diameter of the crater to say, the distance between two towns or cities, the students are familiar with. There's plenty of craters to choose from to match up with familiar landmarks. You should see the student's reaction when I inform them the Imbrium Basin is approximately one third the size of Australia.

Ask a student to show how far the moon is from Earth and they usually stretch out their arms as wide as possible. Ernest H Cherrington Jr in his book "Exploring the moon through Binoculars and Small Telescopes[6]" offers an excellent idea. Following his directions, I carry a cardboard cutout 6 " in diameter representing the Earth and another of 1.67" representing the moon and ask two students to hold them 15'6" apart They're invariably amazed to realize the actual scale of distance between the Earth and moon.

The Museum Victoria in Australia[7] has great information about the moon. Picking from their resources, I like to tell students particularly about moonlight. For example, the moon is 33,000 times brighter than the brightest star, Sirius, though it is 14 magnitudes dimmer than the Sun, being approximately 400,000x fainter. Thankfully for us astronomers our eyes provide us with night-vision and in a dark sky the moon looks dazzlingly bright, though actually, it is just a dull grey color. Even if our sky were filled with 105,000 full moons the sky would still be only 1/4 as bright as the Sun's light. A full moon is 465,000 times fainter than a sunny day and a sheet of white paper by moonlight is 2,000 times darker than black velvet in sunlight.

On a final note, I'm always asked if the moon landings were real and if we'll ever go back to the moon. Well, among the answers I offer are that astronomers were taking scientific readings from the equipment the astronauts left on the moon for many years and that the lunar rocks brought back are the only rocks on earth with no air and water molecules, let alone the thought of going to all the trouble of faking six landings, with none of the people involved leaking that the journeys weren't real and why on earth go to all the trouble and detail to dream up a disastrous Apollo 13 mission, if none of the trips were genuine in the first place?! Besides, the landing sites are well documented, the Apollo equipment's still there, we can always go back and check — after all, the moon's only 3 days away…..

As for returning to the moon? On a visit to Sydney, Apollo 17 Lunar Module Pilot, Harrison Schmitt mentioned in a lecture that he'd been asked many times why the surface missions weren't longer, lasting only 3 days. His explanation was illuminating; after 3 days exposure to the Sun's relentless radiation, he and Commander Gene Cernan's space suits were starting to perish, to have stayed any longer would have become too dangerous. He added this would be a major challenge to overcome for future lunar missions intending to stay for extended periods. This has sometimes led to discussions concerning the Earth's protective atmosphere and how best we can preserve it, so we don't perish in the same way.

Well, the clouds have cleared and I'm off to check out a new eyepiece on my favorite Apennine Mountains . . . and so here's to the next 40 years . . . .

References

[1]Chaikin Andrew. A Man on the Moon: The Voyages of the Apollo Astronauts. Penguin Books. Page 211.

[2]Sagan Carl. Cosmos TV Series. "The Cosmic Calendar", Episodes 1 & 2. The 15 billion year age of the universe represented over 12 months; one month =1.14 billion years, one day = 40 million years, one minute = 30,000 years, 1 second = 500 years.

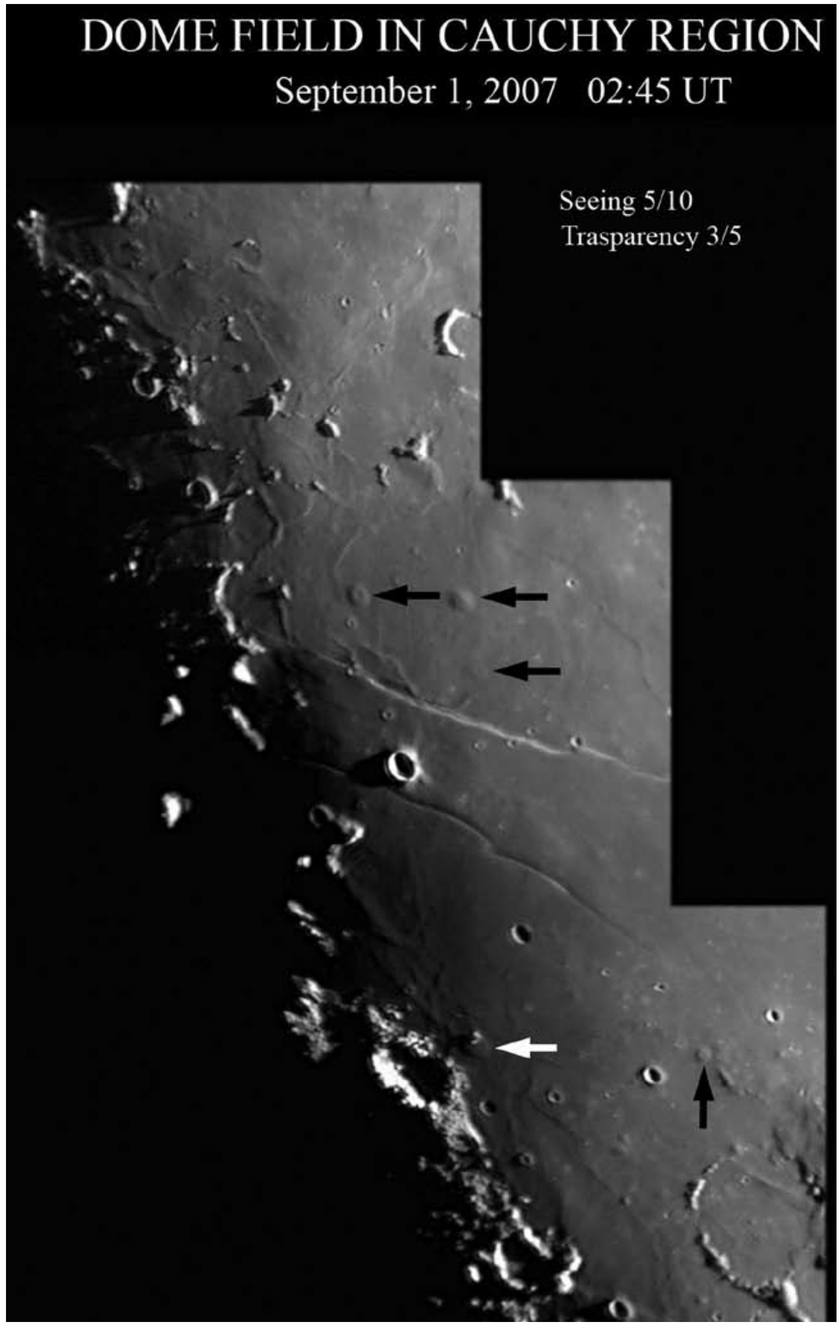
[3]McAleer Neil. The Cosmic Mind-Boggling Book. Warner Books. Chapter 3; The Moon; Full, Half and In Between.

[4]Thompson Greg D. The Australian Guide to Stargazing. New Holland Publishers Australia. Page 36.

[5]Lacroux Jean and Legrand Christian. Discover The Moon. Cambridge University Press. Page 92.

[6]Cherrington Ernest H Jr. Exploring the Moon through Binoculars and Small Telescopes. Dover Publications, Inc. New York. Page 7.
[7]Museum Victoria. Australia. http://museumvictoria.com.au/DiscoveryCentre/Infosheets/Planets/The-Moon/
Helpful reference: The Universe in One Year. Discovery Education. http://school.discoveryeducation.com/schooladventures/universe/itsawesome/cosmiccalendar/page2.html

Mystery Photo



In the last issue of Selenology, we asked our readers to identify the lunar region which had been photographed by J.H.C. Liu in our cover photo. Almost immediately, Robert Garfinkle, FRAS, responded: “The mystery lunar feature is centered on Sinus Amoris. The large crater in the lower right-hand corner of the image is Römer. The ghost craters near the center of the image (to the right of the sinus) are Maraldi D (the larger one) and Maraldi E (in the middle) and the flat-floored crater in the chain is Maraldi. The large expanse of mare at the bottom left in the image is Mare Tranquillitatis. The image is printed with south up, west to the right.” Soon after that, Andrew Martin, SFO, also correctly identified the region and added, “Also on Page 12, the ‘Mountain Range Full of Shadows on the Moon’ is Cassini Crater and Montes Caucasus.” When putting the issue together, it had gone completely unnoticed that there was no location given for that photo. Then, one month before becoming an editor at Selenology, Raffaello Lena sent this intriguing description of the area: “The region is near Cauchy, corresponds to the Lyell, Lucian, Vitruvius region. The mare near the centre of the image is Sinus Amoris. You can verify this in the Rukl Atlas charts 36 and 25. Moreover, attached is my image of the region for comparison, taken under low-medium seeing (5/10). Since lunar domes are my first activity, I marked the very-well-known domes and another dome of effusive origin (white arrow) which is the subject of a GLR study. It is named in the GLR study and preceding works as C13. The study of this and other domes was published in the LPSC 2008.”