SELENOLOGY TODAY

SPECIAL ECLIPSE ISSUE

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Geological Lunar Researches Group

The Red Moon

March 3, 2007

AstroPhysics EDT 130 f/6 and Lumenera Infinity 2-1M camera
2.4 arcsec/pixel image (binning 2x2), mosaic of 4 shots
90/100 frames stacked each shot, 200% resampled

Seeing: very poor, Transparency: fair
Mt. Rocchetta (SP) - ITALY
Paolo Lazzarotti - Nicola Guidoni

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Cover : Image taken by Paolo Lazzarotti and Nicola Guidoni.

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The lunar eclipse on March, 3-4, 2007

by Raffaello Lena, Maria Teresa Bregante and Paolo Lazzarotti

Geologic Lunar research (GLR) group

Abstract

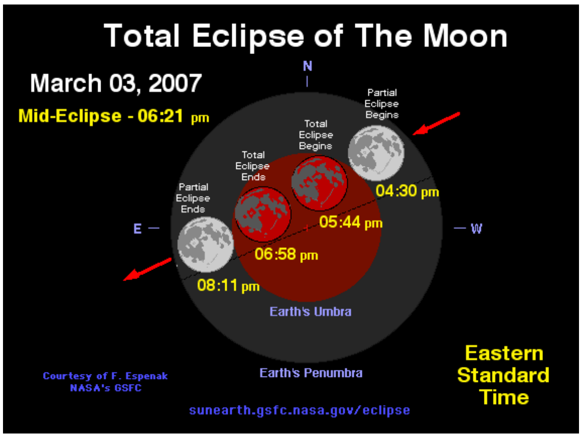
In this article we report the results about the Danjon values (L) estimated during the recent lunar eclipse (March, 3-4, 2007). The article includes data and statistical investigation of the instruments used for the Danjon estimates, such as binoculars, naked eye and telescopes and their effect on the derived value. The mean L of 2.5 +/- 0.4 obtained from 17 observations shows a good agreement with the predicted value of L = 2.6±0.3. Data indicate an eclipse of moderate brightness, at least based on the observations carried out from GLR in Italy and Spain. It indicates, if confirmed with further data based on photoelectric or visual photometry, that Earth`s atmosphere was not significantly affected by volcanic dust. The uncertainty given by the Danjon scale is caused by the subjective estimation by the observers and by the lack of a standardization to be strictly followed during the lunar eclipses. Finally a new method is suggested, with an easy approach, for an accurate enough measurements for future lunar eclipses.

1. Introduction

The first of two total lunar eclipses in 2007 is unique in that it has been partly visible from every continent around the world. The eclipse occurred at the descending node, 3.2 days before apogee and 1.9 days after the Moon occulted Saturn (northern and eastern Europe). During the eclipse, the Moon was in southern Leo, about 13° east of the 1.3-magnitude star Regulus (alpha Leo). The timings of the major phases of the eclipse are listed below:

Penumbral Eclipse Begins:	**20:18:11 UT**
Partial Eclipse Begins:	**21:30:22 UT**
Total Eclipse Begins:	**22:44:13 UT**
Maximum totality:	**23:20:56 UT**
Total Eclipse Ends:	**23:57:37 UT**
Partial Eclipse Ends:	**01:11:28 UT**
Penumbral Eclipse Ends:	**02:23:44 UT**

Figure 1



The Moon's path through Earth's shadow as well as a map illustrating worldwide visibility of the event are shown in Figures 1 and 2.

Table 1

UT of Immersion	*Crater Name*	*UT of Emersion*	*Crater Name*
21:35	*Grimaldi*	*00:06*	*Grimaldi*
21:37	*Billy*	*00:06*	*Aristarchus*
21:43	*Campanus*	*00:13*	*Kepler*
21:49	*Kepler*	*00:13*	*Billy*
21:49	*Tycho*	*00:17*	*Plato*
21:54	*Aristarchus*	*00:19*	*Pytheas*
21:57	*Copernicus*	*00:22*	*Timocharis*
22:02	*Pytheas*	*00:22*	*Copernicus*
22:08	*Timocharis*	*00:26*	*Campanus*
22:13	*Dionysius*	*00:28*	*Aristoteles*
22:13	*Manilius*	*00:30*	*Eudoxus*
22:17	*Menelaus*	*00:36*	*Tycho*
22:21	*Plinius*	*00:37*	*Manilius*
22:22	*Goclenius*	*00:41*	*Menelaus*
22:23	*Plato*	*00:45*	*Dionysius*
22:27	*Taruntius*	*00:45*	*Plinius*
22:27	*Langrenus*	*00:56*	*Proclus*
22:28	*Eudoxus*	*00:59*	*Taruntius*
22:31	*Aristoteles*	*01:01*	*Goclenius*
22:31	*Proclus*	*01:07*	*Langrenus*

At the instant of the totality (23:21 UT) the Moon was in the zenith for observers in Nigeria and Cameroon. At this time, the umbral magnitude (Umag) peaks at 1.2375 as the Moon's southern limb was passed 2.4 arc-minutes north of the shadow's central axis. In contrast, the Moon's northern limb lies 6.9 arc-minutes from the northern edge of the umbra and 32.2 arc-minutes from the shadow centre. Thus the northern sections of the Moon are appeared much brighter than the southern part, which lies deeper in the shadow. Since the Moon samples a large range of umbral depths during totality, its appearance changes dramatically with time. Note that it may also be necessary to assign different Danjon values to different portions of the Moon, i.e. north vs. south (Espenak, 2007).

The entire event was visible from Europe, Africa and western Asia. In eastern Asia, moonset has occurred during various stages of the eclipse. For example, the Moon sets while being in total eclipse from central China and southeast Asia. Western Australia catches part of the initial partial phases but the Moon sets before totality. Observers in eastern North and South America have found the Moon already partially or totality eclipsed at moonrise. From western North America, only the final penumbral phases was visible. Two central solar and two lunar eclipses occur in 2007 as follows:

2007 Mar 03: Total Lunar Eclipse

2007 Mar 19: Partial Solar Eclipse

2007 Aug 28: Total Lunar Eclipse

2007 Sep 11: Partial Solar Eclipse

Predictions for the eclipses are summarized in the links above. World maps show the regions of visibility for each eclipse. The lunar eclipse diagrams also include the path of the Moon through Earth's shadows (Fig.2). Contact times for each principle phase are tabulated along with the magnitudes and geocentric coordinates of the Sun and Moon at greatest eclipse.

A lunar eclipse also gives an opportunity to observe the Moon and learn more about the lunar geography, as various craters will be hidden and emerge from shadow at well defined times. Table 1 lists the times during which various craters entered and emerged from the Earth's shadow during this total eclipse. Times are given in UT with the data from Espenak (2007 see table 1)

2. Lunar eclipses overview

A lunar eclipse occurs whenever the Moon passes through some portion of the Earth's shadow. This can occur only when the Sun, Earth and Moon are aligned exactly, or very closely so, with the Earth in the middle. Hence, the Moon is always full during a lunar eclipse. The type and length of an eclipse depend upon the Moon's location relative to its orbital nodes.

Table 2

Time UT	Danjon binocular 6x30	Danjon nacked eye	Danjon eypiece and telescope	Seeing Antoniadi scale	Trasparency	Observer
22:45	2			II	5	Acquarone
23:20	2.5			II	5	Acquarone
23:20		2.5		V	5	Bolzoni
23:20		3		V	5	Riedo
23:20	3			II	3	Bellido
23:20		2.5		IV	3	Lazzarotti
23:20	2			II	5	Salimbeni
23:20			3	II	4	Barucco
23:20		2		II	4	Porta
23:30			3.5	II	3	Baudà
23:30		3	3	III	4	Fattinnanzi
23:30	2	2		II	3	Bregante
23:40	3			II	2	Lena
23:44	2			II	4	Acquarone
23:50			3.5	II	3	Lena

AVERAGE	2.36	2.50	3.25
standard deviation	0.475595	0.447214	0.288675
	R squared with seeing -------	R squared with seeing 0.10	R squared with seeing 0.33
	R squared with trasparence 0.38	R squared with trasparence 0.25	R squared with trasparence 1

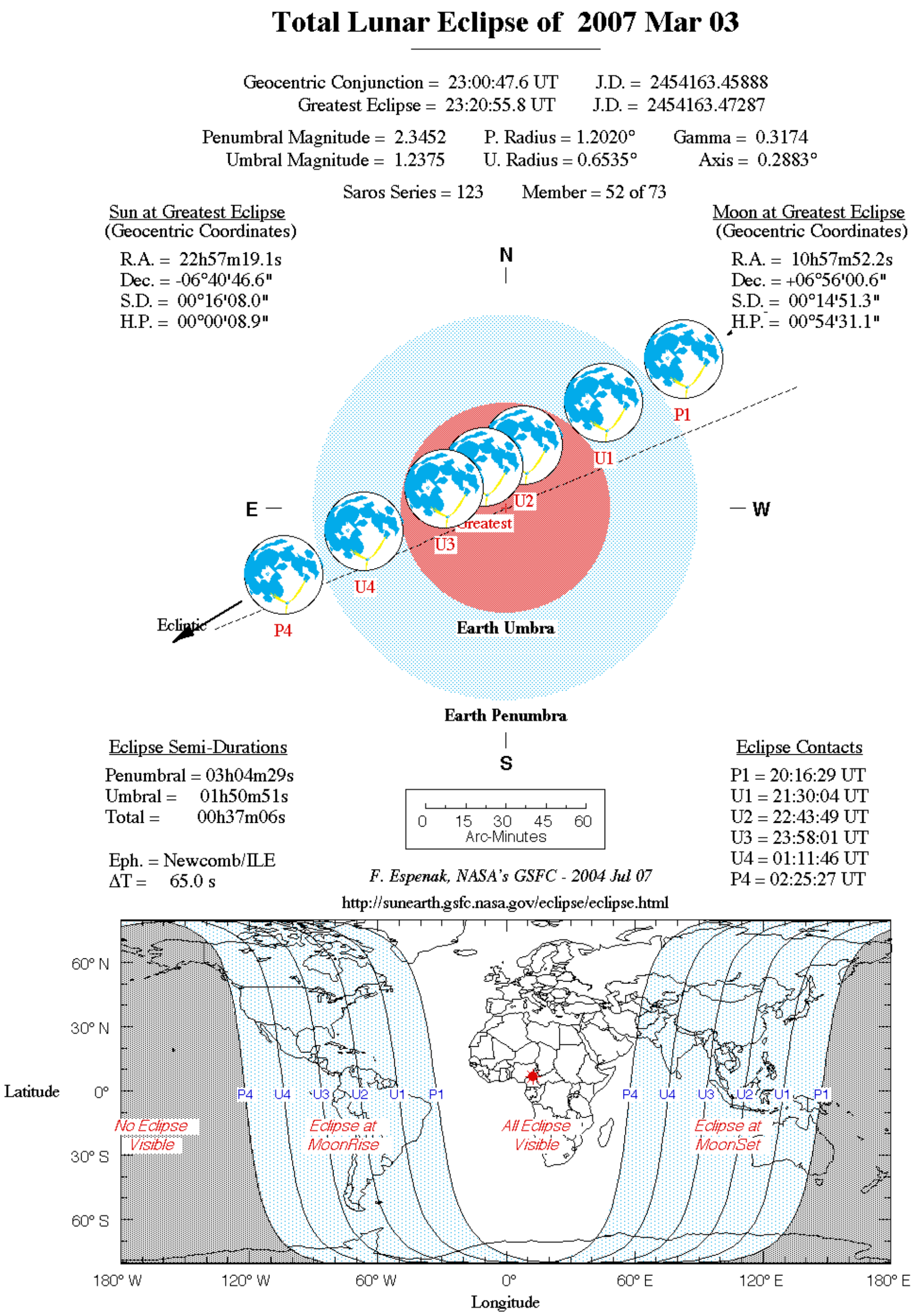


Figure 2 Espenak NASA

http://sunearth.gsfc.nasa.gov/eclipse/eclipse.html

A lunar eclipse occurs at least two times per year, whenever some portion of the Earth's shadow falls upon the Moon. However, since the orbital plane of the Moon is inclined by about 5° with respect to the orbital plane of the Earth (the ecliptic), most full moons occur when the Moon is either north or south of Earth's shadow. Thus the Moon must be near one of the two intersection points its orbit makes with the ecliptic, which are referred to the Moon's ascending and descending nodes, to be eclipsed.

The Moon does not completely disappear as it passes through the umbra because of the refraction of sunlight by the Earth's atmosphere into the shadow cone; if the Earth had no atmosphere, the Moon would be completely dark during an eclipse. The red coloring arises because of the scattering of sunlight in the Earth's atmosphere.

Sunlight reaching the Moon must pass through a long and dense layer of the Earth's atmosphere, where it is scattered by dust particles. Shorter wavelengths are more likely to be scattered by the small particles, and so by the time the light has passed through the atmosphere, the longer wavelengths dominate.

This resulting light we perceive as red. This is the same effect that causes sunsets and sunrises to turn the sky a reddish color; an alternative way of considering the problem is to realize that, as viewed from the Moon, the Sun would appear to be setting (or rising) behind the Earth.

The amount of refracted light depends on the amount of clouds or dust in the atmosphere; this also controls how much light is scattered. In general, with dust in the atmosphere more that other wavelengths of light will be removed (compared to red light), leaving the resulting light a deeper red color. This causes the resulting coppery-red hue of the Moon to vary from one eclipse to the next. Volcanoes are notable for expelling large quantities of dust into the atmosphere, and a large eruption shortly before an eclipse can have a large effect on the resulting color (as well as producing many beautiful sunsets around the world).

During a total eclipse, refraction of the blue part of the Sun light on one side of the Earth’s atmosphere left only to the red member to reach our satellite, producing a "reddish" color.

3. Danjon Scale

The Danjon Scale is a five-point scale used for measuring the appearance and luminosity of the Moon during a lunar eclipse. It was proposed by André-Louis Danjon when he was measuring the Earthshine on the Moon. An eclipse's rating on the Danjon Scale is denoted by the letter L. Danjon proposed a five point scale. L values for various luminosities are defined as follows:

L = 0 Very dark eclipse. Moon almost invisible, especially at mid-totality.

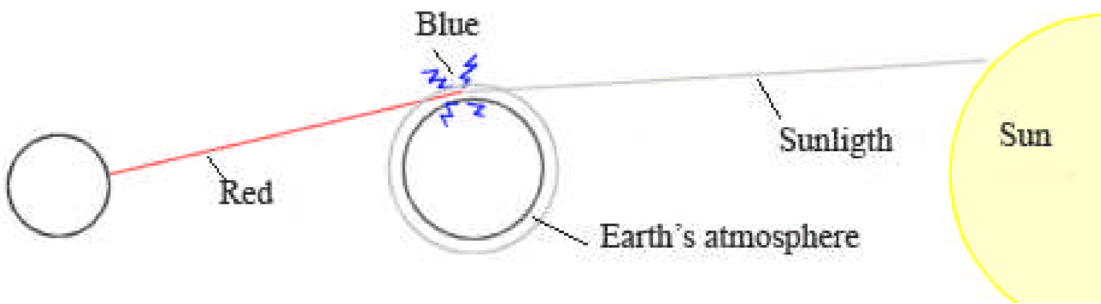


Figure 3

During a total eclipse, refraction of the blue part of the Sun light on one side of the Earth's atmosphere left only to the red member to reach our satellite, producing a "reddish" color.

L = 1 Dark Eclipse, grey or brownish in coloration. Details distinguishable only with difficulty.

L = 2 Deep red or rust-colored eclipse. Very dark central shadow, while outer edge of umbra is relatively bright.

L = 3 Brick-red eclipse. Umbral shadow usually has a bright or yellow rim.

L = 4 Very bright copper-red or orange eclipse. Umbral shadow has a bluish, very bright rim.

Espenak (2007) describes that the assignment of an 'L' value to lunar eclipses is best done with the naked eye, binoculars or a small telescope near the time of mid-totality. It's also useful to examine the Moon's appearance just after the beginning and before the end of totality. The Moon is then near the edge of the shadow and provides an opportunity to assign an 'L' value to the outer umbra.

4. Observations and statistical analysis

17 Danjon estimates from Spain (1) and Italy (16) were submitted which give an absolute range from L=2.0 to L=3.5 (i.e. dark to bright). 70.6% of the estimates fall in the range L=2-3, with 35.3% estimates of L=2.0, 17.6% of L=2.5 and 35.3% of L=3 (Fig. 4). 2% of the estimates were of L= 3.5, obtained before the end of the totality. The mean was calculated as 2.62 +/-0.55. Since the standard deviation amounts to σ = 0.55, the Danjon value is comprised at a probability of 95% between the mean value plus/minus 2σ, i. e. in the interval between 1.5 and 3.7.

Table 2 reports the estimated values from different observers along the seeing (Antoniadi scale) and transparency (scale between 1 poor to 5 excellent). An heterogeneous mode for L Danjon assignment was used, with 7 estimates carried out with binoculars, 6 with naked eye "to the sky" and 4 estimates carried out with telescopes at the eyepiece (50 magnifications), see Figure 5.

5. Results and discussion

The estimates carried out with binoculars and naked eye "to the sky" are overlapping, yielding an average L of 2.36 +/-0.47 and L 2.50 +/- 0.45 respectively. On the other hand, using telescopes with an eyepiece the average L is 3.25 +/- 0.29, which yields a brighter estimation of the eclipse. In two observing sessions, carried with an apo Refractor 13 cm f/6 and a Dobson 20 cm respectively, the value of L=3.5 was assigned based on the visibility of a bright brick-red eclipse and umbral shadow appearing with a definite bluish rim. However (see Table 2) there is not a linear relation between seeing/ transparency and corresponding estimations. The R^2 is low also for the transparency and the estimated Danjon values. The differences show that the lunar eclipse was estimated between a "dark deep red" and "a brick red", while the outer edge of umbra was described as "of moderate" or "high brightness".

The average difference between the L values estimated with binoculars/ naked eye “to the sky” and using telescopes was determined as Δ ≈0.85. This coefficient was used in order to correlate the different luminosity and to investigate for the difference revealed with the use of telescopes. As shown in Table 2, the L estimations obtained with binoculars and naked eye were corrected with the factor + Δ, while the L estimations obtained with small telescopes were corrected with the factor – Δ. Interestingly, new values yield L of 3.20 +/-0.47 and L 3.35 +/- 0.44 for binoculars and naked eye respectively, overlapping to the estimates obtained with eyepiece at the telescopes. In the same way subtracting the factor 0.85, new values for L estimated with telescopes yield L of 2.4 +/- 0.28.

It demonstrates that the differences are also attributable to the different perception given with a binocular or with an eyepiece at the telescope for low magnifications. In this scenario our results show that the scatter between several estimates is possibly due to the not standardized use of the Danjon scale and to different perception of brightness and colour between binoculars/naked eye and telescopes. As example we report two different estimates carried out by two different observers in nearby cities: Sestri Levante and Chiavari, at distance of 11 km each to other. The L values at the maximum of totality was estimated as L 2 with binocular (Bregante, Sestri Levante) and as L 3.5 with a telescope (Baudà, Chiavari using a Dobson). In order to compare these results with preceding data based on Danjon’s estimates carried out with binoculars at the mid of totality, we use the average value L of 2.5 +/- 0.4 from measurements carried out at 23:20 UT.

As shown by the R^2 coefficient, the seeing, transparency and the wheatear conditions don’t affect significantly the estimates, at least for relatively short distances (see Sestri Levante and Chiavari, 11 km each to other at the same sea level).

The uncertainties in the data are due to the subjective Danjon scale and likely represent the combined effect of many variables: instruments and their optical quality, magnification, in part atmospheric conditions but also keenness of the observer’s eye. Clearly, only some of these variables are quantifiable, and for some we have no data at all. This trend of uncertainties shows a typical value of +/- 0.5, half of each Danjon level, for colour at the umbral shadow and brightness. Moreover this trend of uncertainties increases as the eclipse progression before of the end of the totality.

Although the physical mass of Earth blocks off all direct sunlight from the umbra, the planet's atmosphere refracts some of the Sun's rays into the shadow. Earth's atmosphere contains varying amounts of water (clouds, mist, precipitation) and solid particles (dust, volcanic ash). This material filters and attenuates the sunlight before it's refracted into the umbra. For instance, large or frequent volcanic eruptions dumping huge quantities of ash into the atmosphere are often followed by very dark, red eclipses for several years.

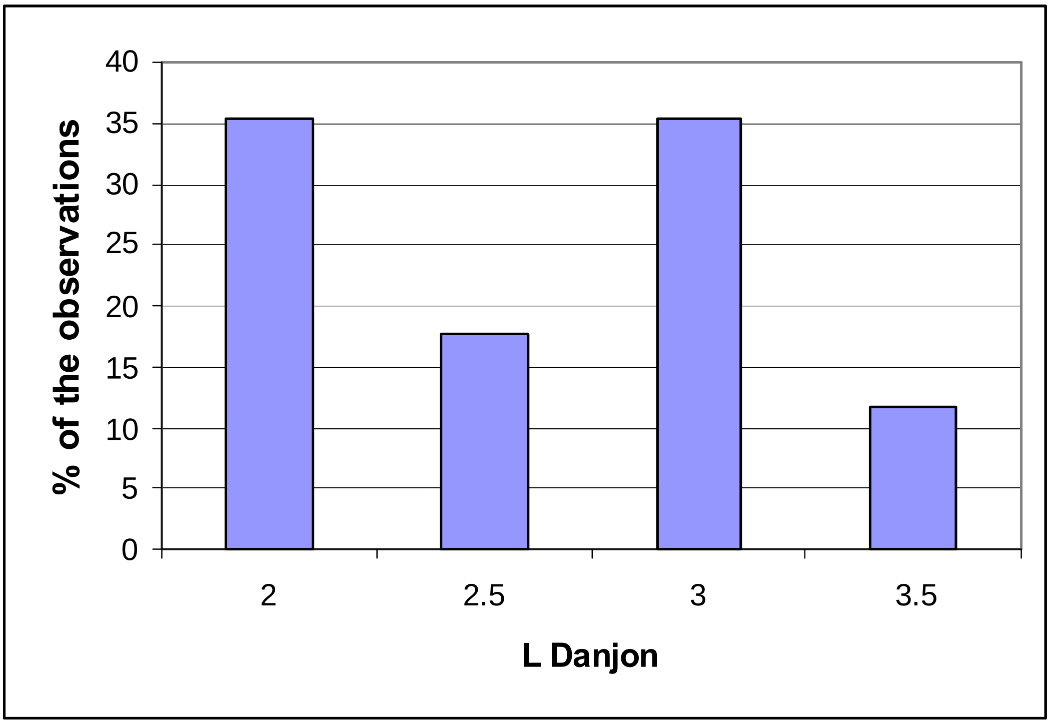


Figure 4 distribution of the estimated Danjon values

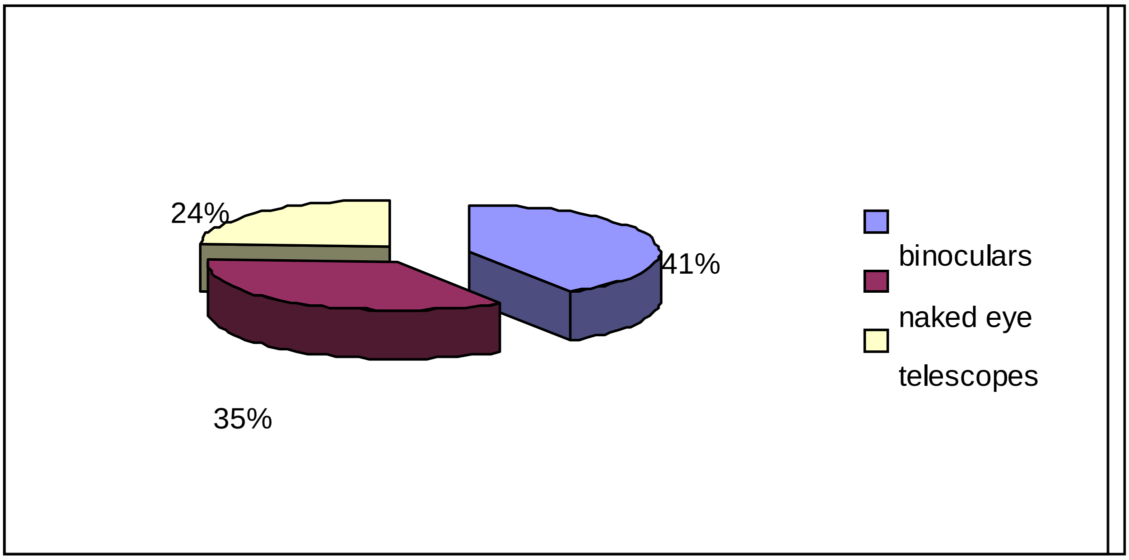


Figure 5 distribution between naked eye, binoculars or small telescopes

Extensive cloud cover along Earth's limb also tends to darken the eclipse by blocking sunlight.

The idea of using total lunar eclipses as indicators of global levels of aerosols of volcanic origin was originally proposed by Keen (2001; 1997). However the brightness of the eclipsed Moon is primarily determined by how deeply it is located inside the Earth`s umbra (umbral eclipse magnitude, Umag). In addition it also will depend on the global levels of aerosols cast in the stratosphere by strong volcanic eruptions.

Vital (2003a; 2003b) has used published data to get a correlation between umbral eclipse magnitude (Umag), the Moon`s magnitude (Mag) and apparent radius (SD, in arc minutes) at mid eclipse (the events found to be definitely affected by volcano explosions were left out of the input data).

The empirical formula described by Vital (with R^2=0.88) is:

$$\mathbf{Mag = -1.4 + 4.3\ Umag - 5\log(SD)} \qquad [1]$$

Furthermore, the Moon's magnitude and the Danjon value L are related by the empirical formula :

$$\mathbf{L = 2 - Mag_{max} / 3} \qquad [2]$$

According to Vital, it was predicted a Moon's magnitude of -2.0±0.5 at mid totality, which is related to a predicted Danjon value of L= 2.6 +/- 0.3.

Estimates reported in Table 2 and the observed mean L = 2.5 +/- 0.4 show a good agreement with the predicted value of L = 2.6 +/- 0.3.

Moreover preliminary reports show the same uncertainty of our data: estimates of the brightness of the lunar eclipse on the Danjon scale were comprised in a wide range, as L=3.5 (Bell, 2007) or L= 2 (from UK, reported at the link http://www.popastro.com/phpBB2/viewtopic.php?t=4835&postdays=0&postorder=asc&start=90). Further available data are released by Flanders (2007), described as follows: Bortle (from USA) rated the eclipse as a relatively colorless with L=3.5 on the Danjon scale, estimating it as magnitude -2.3 at mid-eclipse. Similar estimation was carried out by Rao with a magnitude -2.5, but assigning a Danjon rating L of 2.8. These estimates of magnitudes were derived by comparing the view of the Moon through reversed binoculars with Venus, Sirius, and Saturn.

Unfortunately in our investigation no data for a visual photometry (or photoelectric photometry) were carried out in order to investigate if the predicted Moon's magnitude of -2.0 +/- 0.5 is confirmed.

Table 3: transformation using the factor Δ +/- 0.85 and corresponding results obtained

Danjon binoculars	Danjon nacked eye	Danjon telescopes
2 (2.85)		
2.5(3.35)		
	2.5 (3.35)	
	3 (3.85)	
3 (3.85)		
	2.5 (3.35)	
2 (2.85)		
		3 =>(2.15)
	2 (2.85)	
		3.5=>(2.65)
	3 (3.85)	3=>(2.15)
2 (2.85)	2 (2.85)	
3 (3.85)		3.5=>(2.65)
2 (2.85)		

	Danjon binoculars	Danjon nacked eye	Danjon telescopes
OLD AVERAGE	2,36	2,5	3,25
NEW AVERAGE	3,2071	3,35	2.4
standard deviation	0.4756	0,4472	0.2887

However using the empirical formula [2], it is possible to derive a "minimum brightness" corresponding to magnitude -1.5 +/0.5, which is lower of the theoretical predicted value (-2.0 +/- 0.5) but is overlapping the standard error of a typical visual observation, surely in the range of +/- 0.5, and also in a good agreement with the above estimates (Flanders, 2007).

The Danjon value we obtained L of 2.5 +/- 0.4, also with the described scatter, indicates an eclipse of moderate brightness, at least based on the observations carried out from GLR in Italy and Spain. It indicates, if confirmed with further data based on photoelectric or visual photometry, that Earth`s atmosphere was not significantly affected by volcanic dust.

6. A new measuring scale proposal

The wide uncertainty given by the Danjon scale is probably caused by the subjective estimation by the observer and, above all, by the lack of a standardization to be strictly followed in such occasions.

The weather conditions (seeing and transparency) also play a role here, so an objective measurement is more welcome than an approximated personal evaluation.

Photometrical measurements should represent "the state of the art" for an accurate estimation of the genuine eclipse brightness but this is sometime very hard to be correctly executed by common people looking at the Red Moon.

The new method proposed here is an easy approach for an accurate enough measurement because it involves consumer hardware and very little knowledge in the imaging field.

The required hardware is:

1) A telephoto lens or a telescope featuring a low to moderate focal length.

2) A compact digicam to be used in afocal method or, better, a DSLR with removable lens.

The goal is to reproduce in the CCD field the whole Moon disc keeping much room in any corner to prevent any vignetting. At the same time, the Moon shouldn't be that small because the exposure reading by the DSLR's AE control could be hard and full of uncertainty. The desirable size with the Moon disc should be about 75% of the vertical CCD length.

To get started, an image of the Full Moon should be taken with a proper and very fast exposure; any value (diaphragm, ISO, exposure time) should be kept safe for the comparison with the eclipsed Moon to be measured when occurring.

To make measurements easier and faster, any value above should be kept safe when imaging the Red Moon but the exposure. Having grabbed the Full Moon with a fast integration time, there should be room enough to grab the eclipsed Moon with an acceptable exposure in order to prevent any blurring. When a lunar eclipse is occurring, simply image the Moon taking care of using always the same focal length and, possibly, the same ISO and diaphragm. The light fall during the maximum eclipse will get the exposure time quite longer and the difference between the two values (measured in *stop* as happens in photography) should likely represent the eclipse brightness. The bigger the value, the darker the lunar eclipse and vice versa. The *stop* is the difference occurring between an exposure value and its contiguous -stepped by a factor of 2- as shown in DSLR exposure menu. To make it shorter, 1 *stop* is the difference between 1/2000 and 1/4000 of a second or between 2 secs and 1 sec and so on. The same difference is also noticed with ISO option: 2 contiguos values (400 to 800, 1600 to 800, and so on) does represent 1 *stop* difference.

In case of diaphragms, the stepping is 1.4 which is coming from $\sqrt{2}$. That means there's a stop of difference between f/2.8 and f/4 values, or between f/11 and f/8. Hereby, 2 stops is the difference between two diaphragms values separated by a factor of 4.

In case of equipment change in the future, no afraid: simply repeat the procedure as written above!

Any eclipse measurement is relative to our own equipment and as such it doesn't matter of the way it's done. What's important is to recall the Full Moon exposure values when an eclipse is occurring. At this point it may be useful to additionally image a bright star close to the Moon in an alternating manner in order to detect slow variations of atmospheric transparency that might otherwise jeopardize an accurate measurement of the lunar disk brightness during the eclipse. Furthermore, it is favourable to perform all measurements with a bandpass filter of known spectral behaviour (or at least to report in which colour channel the brightness measurements are performed) in order to provide results that can be compared with each other even if the measurements are taken by different persons with different equipment.

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Eclipse March 2007 – Story of an amazing event

By Fabio Acquarone
Geologic Lunar Research (GLR) group

"A total Moon Eclipse a rare event, I have to look at it !", I was absorbed in thought, "Wow!! It is between Saturday and Sunday!!!".
Sometimes all pieces drive in the right way and for an Amatorial astronomer like me, that has very few moments to use for the preferred hobby, it is really pleasant.
This is the start of the story, just thinking about the event. But analysing the real scenario was not without any doubts on how to proceed.
"No experience on watching and shooting this kind of events!!, it is my first time."

Event approaching

How to classify the event ? Which of my instruments is better to use ? How to proceed in the night?
To answer at these questions I started to look at passed eclipse events looking into the WEB. And as usual a lot of information were present, a lot of experience from Amatorial guys and professional associations.

How to classify the event

I started to look at an Italian news from the magazine l'Astronomia October 2003, a Raffaello Lena's article for the 9 January 2001 Moon eclipse. Reading the article was interesting to understand how approach the event and which information write down to testify the event. First news a new kind of scale, the Danjon scale.
An article is present on the GlrGroup website http://www.glrgroup.org/papers/eclissi2003.htm, a report of the November 2003 eclipse. To retrieve some more explanation I found a NASA Eclipse home page [extract from NASA Web page http://sunearth.gsfc.nasa.gov/eclipse/OH/Danjon.html]
"The French astronomer A. Danjon proposed a useful five point scale for evaluating the visual appearance and brightness of the Moon during total lunar eclipses. 'L' values for various luminosities are defined as follows:

L = 0 Very dark eclipse. Moon almost invisible, especially at mid-totality.

L = 1 Dark Eclipse, grey or brownish in coloration. Details distinguishable only with difficulty.

L = 2 Deep red or rust-colored eclipse. Very dark central shadow, while outer edge of umbra is relatively bright.

L = 3 Brick-red eclipse. Umbral shadow usually has a bright or yellow rim.

L = 4 Very bright copper-red or orange eclipse. Umbral shadow has a bluish, very bright rim.

But other important information are needed, the time of eclipse contacts for Earth penumbra and Earth umbra. Again an article on the Italian magazine "Nuovo Orione"[March 2007] was really useful for the timing knowledge. The night before the Eclipse, I produced a simple table using all information retrieved :

Which instruments ?

I was really in doubt on which instrument was good to observe and use to take shots. Thinking about which camera to use to take shots I immediately decided for my

Lunar Eclipse 3 -4 March 2007

Fabio Acquarone

	Eclipse Phases	Italy Time Phase	Danjon	Visual Seeing/Transp	Observation Time
1.	*Full Moon*	20:30			
2.	*Start Earth Penumbra*	21:16			
3.	*Start Partial Eclipse*	22:30			
4.	*Start Total Eclipse*	23:44			
5.	*Maximum Totality*	00:21			
6.	*End Totality*	00:58			
7.	*End Partial Eclipse*	02:12			
8.	*End Earth Penumbra*	03:25			
9.	*Full Moon*	03:35			

Fig.1

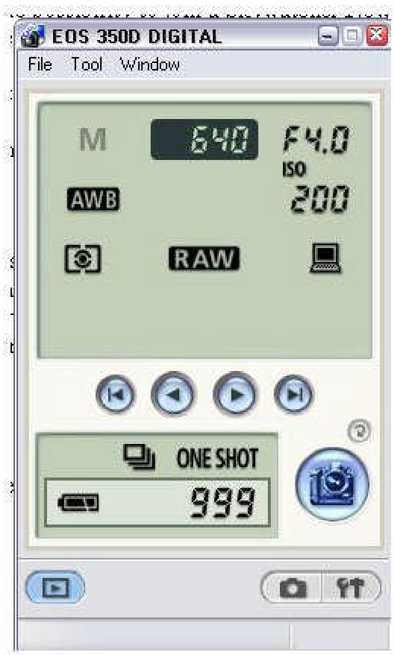
Canon 350D, no doubts on this due to the real quality and field of view. According to this decision and to the possibility to join a Skywatcher Newton 250mm f4.8 or a Televue 100m f5 or a Televue Pronto 70mm, I remembered the opportunity, using the Canon 350D to have with 1200mm of focal length a complete moon frame in afocal field of view.

So my decision on instruments went straightforward to the :

Skywatcher 250mm f4.8 1200mm focal length;
Canon rebel XT 350D Losmandy G11.

In addition to this, I remembered the opportunity to use Canon utilities like the "Remote Capture" in conjunction with the "Zoom Browser EX".
"Connecting the Canon 350D using the USB 2.0 port to my Laptop is really simple!!"

Fig.2



Shooting with the "Remote Capture" and look at the photo with "Zoom Browser" just waiting two/three seconds of download.

At the end almost in real time decide to take a new shot with different settings or remain with what configured.
Parameters like ISO and shot time are simple to change, just a click.

Zoom browser was really useful because of the possibility to look at the histogram of the photo.
Also a real look of all sequence was possible.
To understand shot after shot the state of the art.
See Fig.3 to have a simple view.

These two software at the end have confirmed a real efficiency for the special usage.

The day is come

The morning of the 3rd March was not really a good start, cloudy! I was thinking that all my preparation for the event was useless, as usual the bad luck!
But starting from afternoon clouds were transforming to clouded (veiled) sky, and at 06.00 p.m. just deep veil patches were present. I decided to mount anyway the instruments and to setup all environment waiting for good news.

At 7.49 p.m. I took my first shot to test all instruments.
Not a real good shot, veils of clouds were still present.

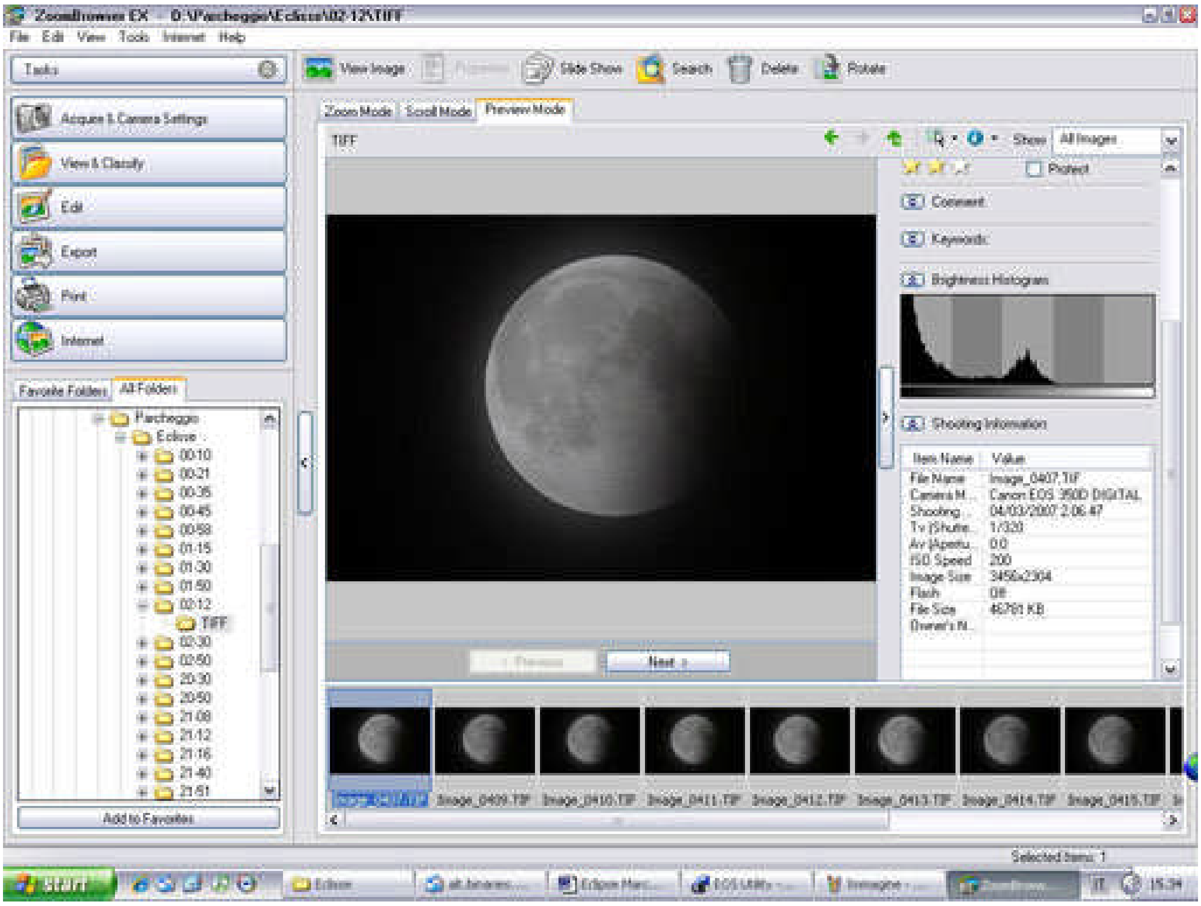

ZoomBrowser EX
File Edit View Tools Internet Help
Tasks
View Image
Slide Show
Search
Delete
Rotate
Zoom Mode
Scroll Mode
Preview Mode
Acquire & Camera Settings
View & Classify
Edit
Export
Print
Internet
Favorite Folders
All Folders
Add to Favorites
TIFF
Protect
Comment
Keywords
Brightness Histogram
Shooting Information
Item Name
Value
Next
All Images
start

Fig. 3

Fig.4

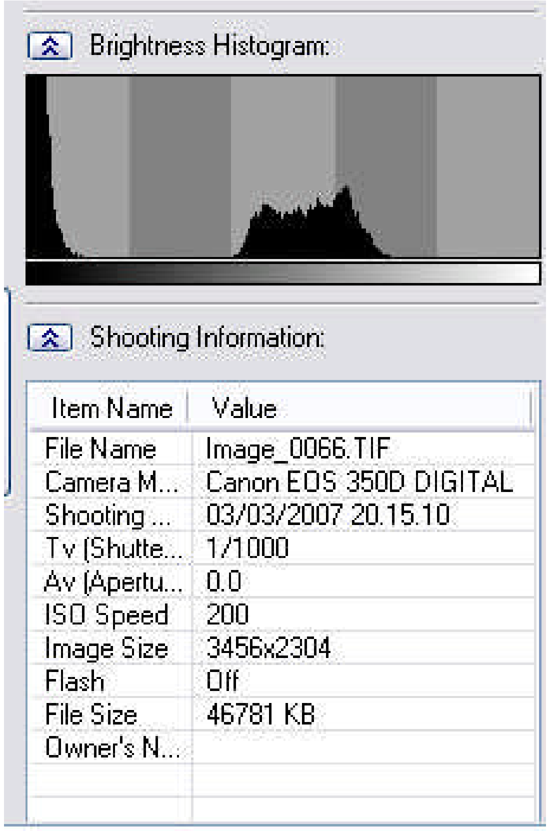
But I continued to shot to understand the right usage of all tools and also to understand the complete environment behaviour.

20.15 p.m. the weather is continuing to improve, still some humidity on the sky but I can operate well. Histogram was OK and setup for the first shots is decided.

According to my table I had to start to shot at 20:30 p.m. local time, and during the event I had to look also in visual to understand the Danjon and seeing status.

I was really excited but also scared due to my inexperience on these kind of events, so to have a solace I called a friend to share the event, he was waiting like me the time to start the real shots.

RAW setting on the Canon.



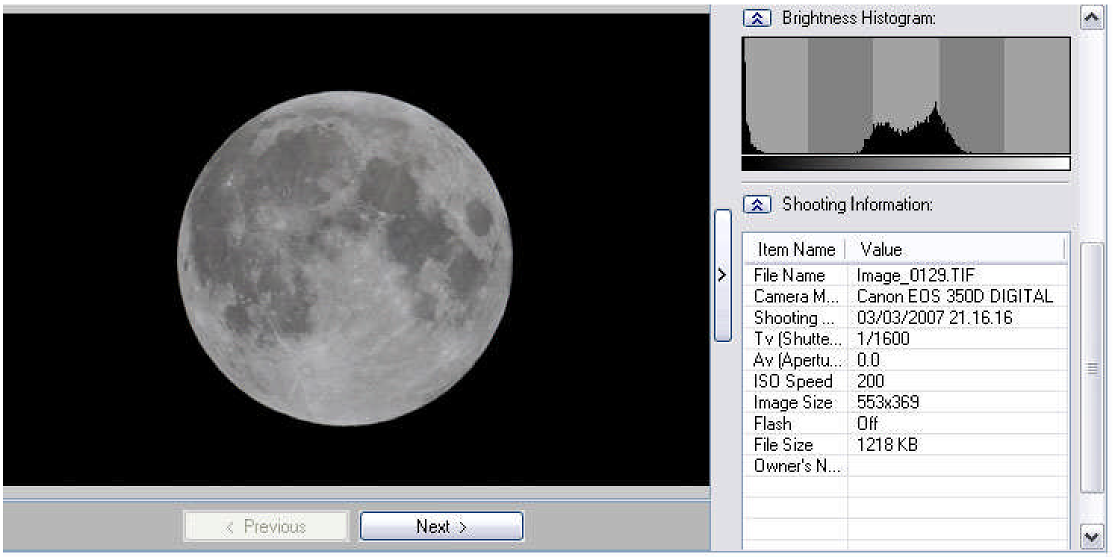
During the Eclipse

I decided to take shots continuously during the time of the entire event, at some intervals. Intervals were not scheduled with a precise gap, but just looking photo after photo to have a reasonable number of images.
Here are some examples.

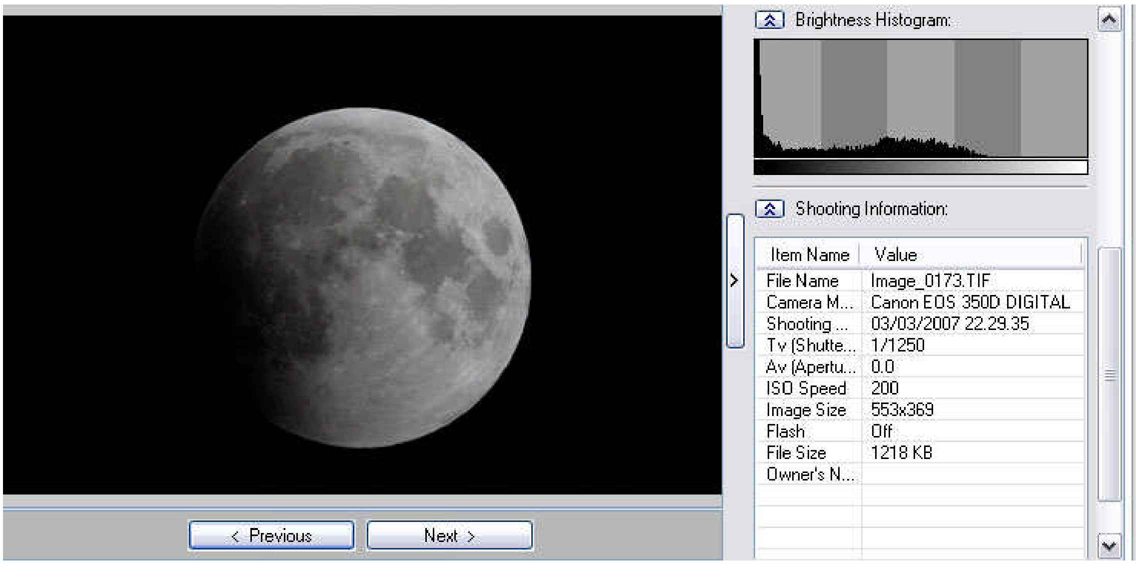
Elaboration

As specified before RAW shots were used as specific format. RAW is the preferred because of the possibility to choose every kind of changes in terms of Saturation, Brightness, Contrast and more, during the conversion to the "practical" and "manageable" format.

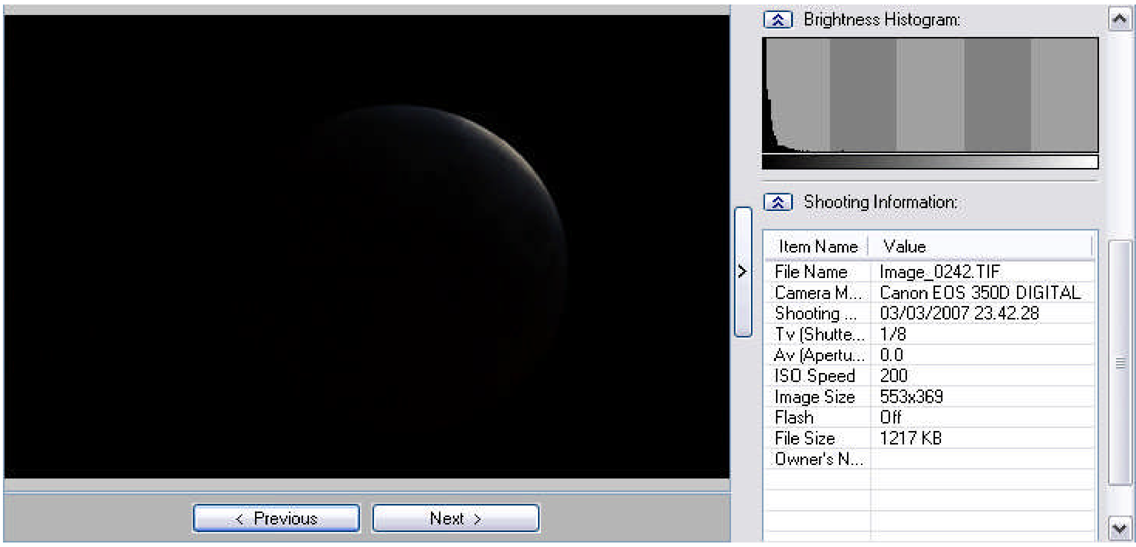
Start of Penumbra



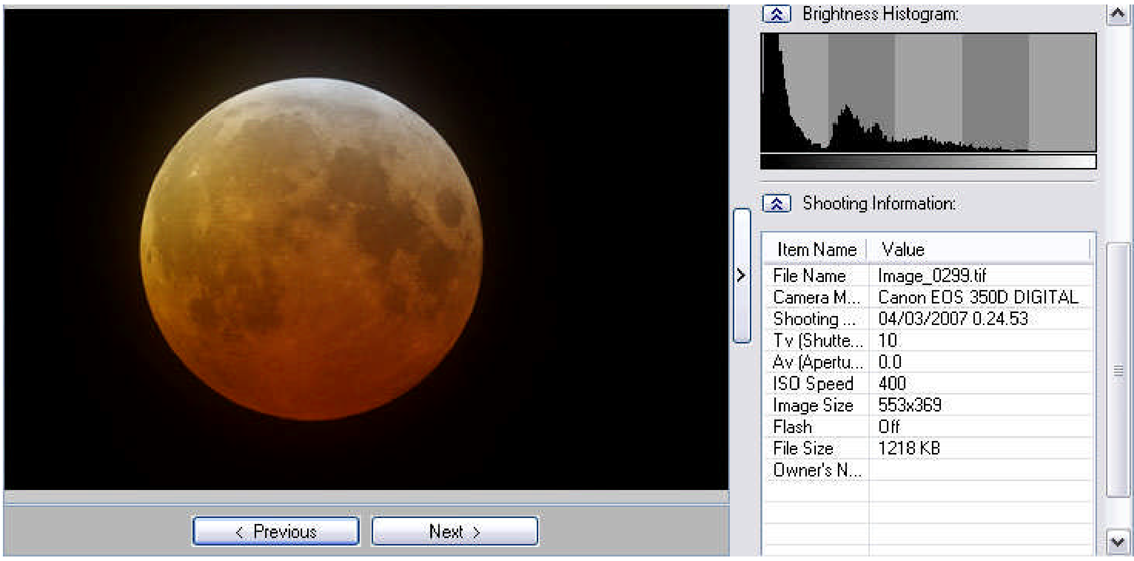
Start of Partial



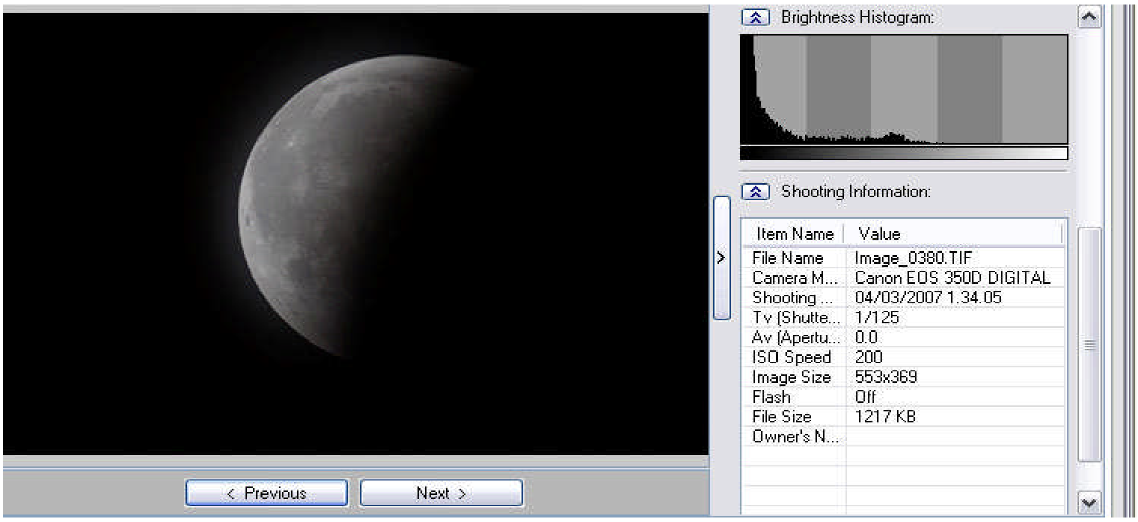
Start of Total



The Red Moon at ***Maximum Totality***

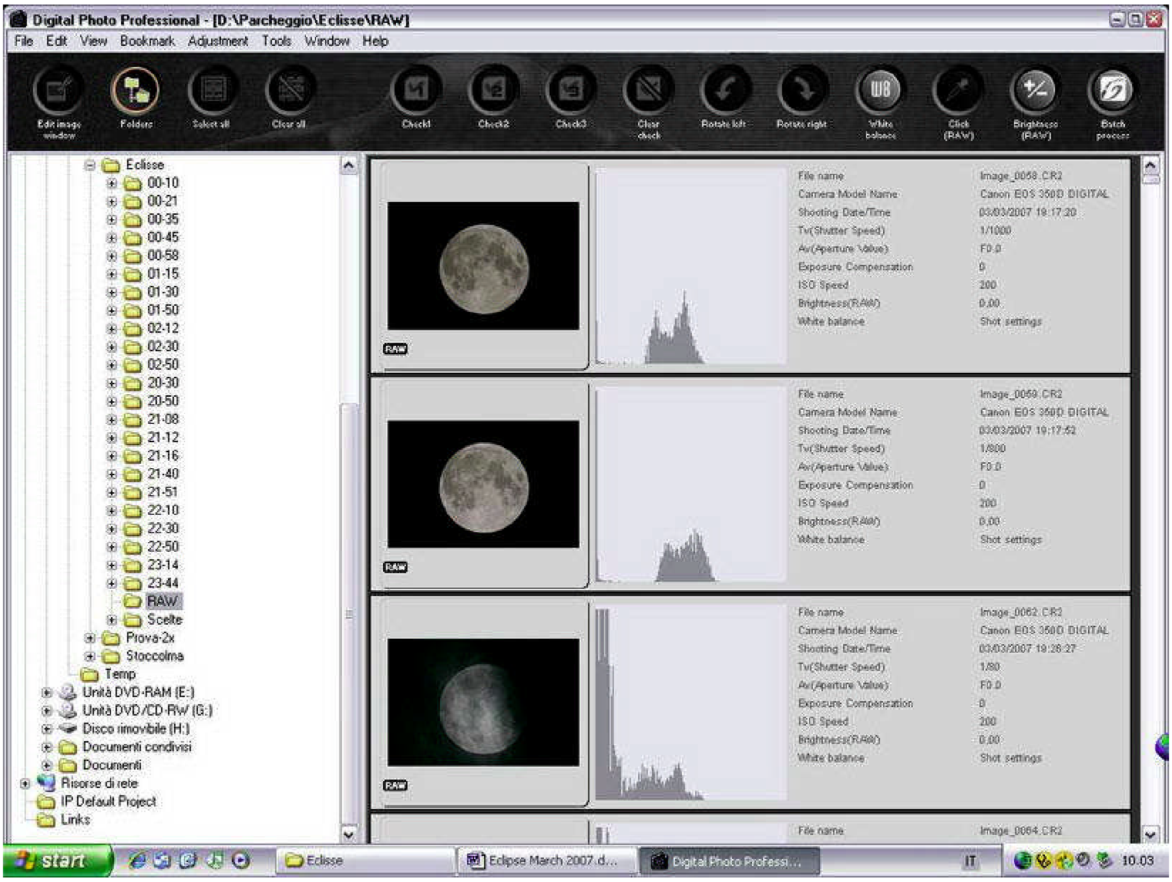


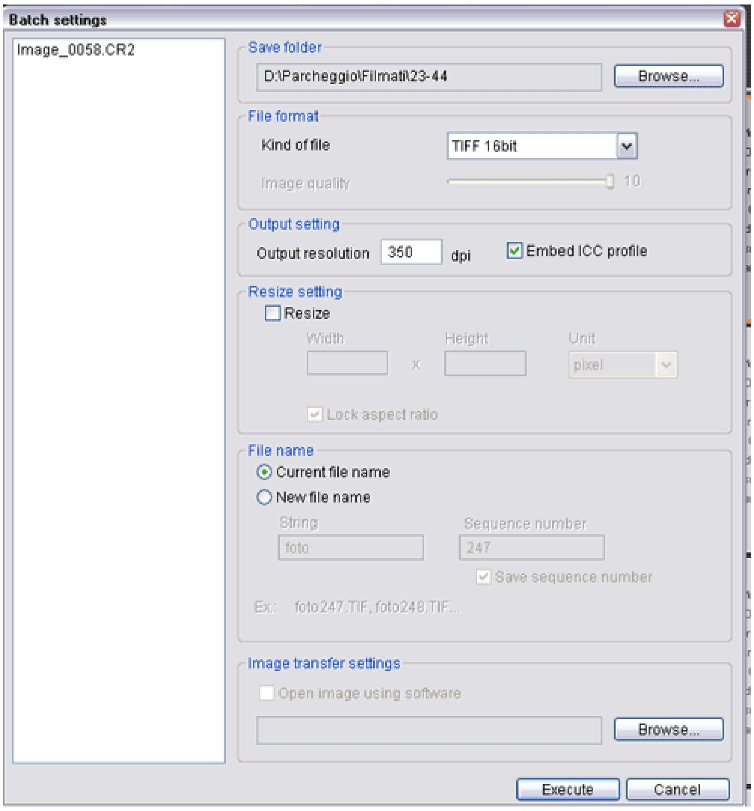
The end of totality



At the end of the event I shoot 318 photos and the table was fitted in the following way

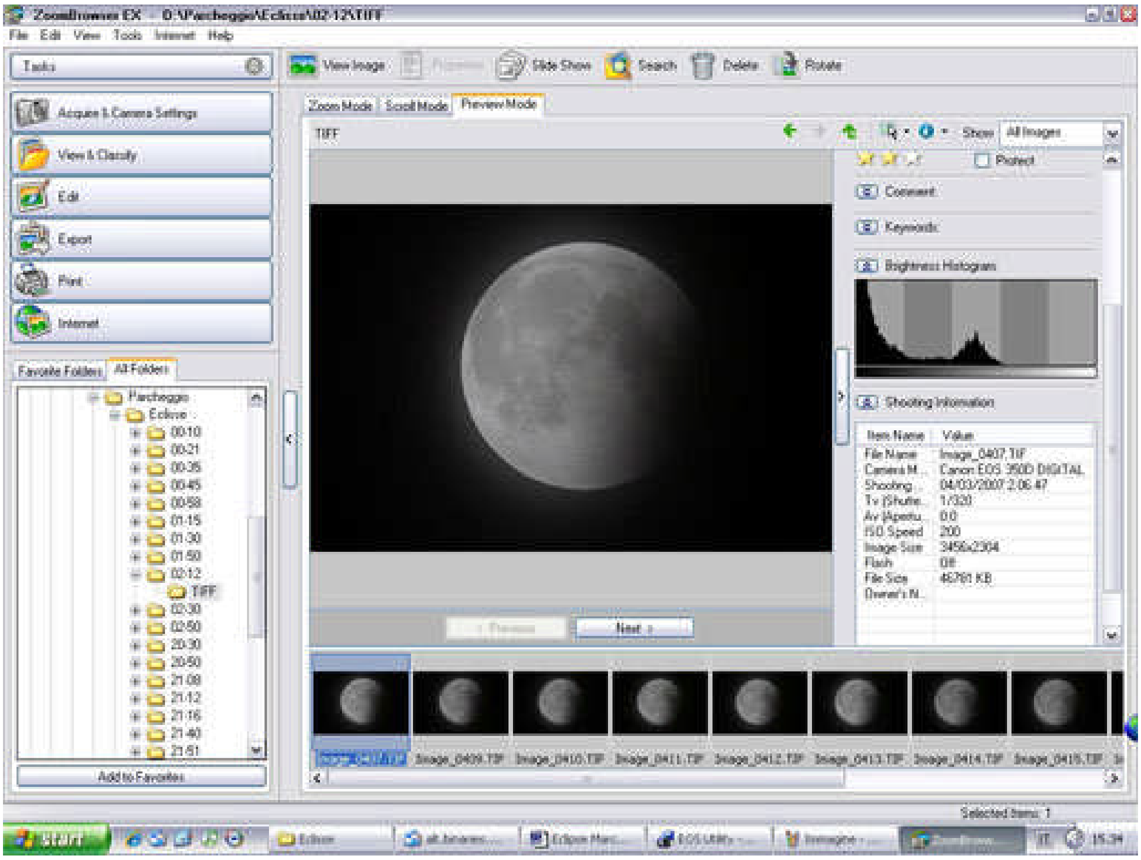
	Eclipse Phases	Italy Time Phase	Danjon	Visual 6x30 Seeing/Transp	Observation Time
1.	*Full Moon*	20:30		1/1 1/1	20:30 20:50
2.	*Start Earth Penumbra*	21:16		2/2 2/2 2/2	21:08 21:16 21:40
3.	*Start Partial Eclipse*	22:30		2/4 2/3 2/4	22:10 22:30 22:50
4.	*Start Total Eclipse*	23:44	2	2/5 2/5 2/5	23:14 23:44 23:58
5.	*Maximum Totality*	00:21	2.5	2/5 2/5 2/5	00:10 00:21 00:35
6.	*End Totality*	00:58	2	2/5-humidity 2/5-humidity 2/4-humidity	00:45 00:58 01:15
7.	*End Partial Eclipse*	02:12		2/4-humidity 2/4-humidity 2/4-humidity	01:30 01:50 02:12
8.	*End Earth Penumbra*	03:25		2/4-humidity 2/4-humidity 2/4-humidity	02:30 02:50 03:05
9.	*Full Moon*	03:35		2/4-humidity 2/4-humidity	03:25 03:35





RAW 6MBytes → TIFF 46 MBytes

318 * 46Mbytes → 14 GBytes


ZoomBrowser EX
File Edit View Tools Internet Help
Tasks
View Image
Slide Show
Search
Delete
Rotate
Acquire & Camera Settings
View & Classify
Edit
Export
Print
Internet
Zoom Mode
Scroll Mode
Preview Mode
TIFF
Show
All Images
Protect
Comment
Keywords
Brightness Histogram
Shooting Information
Item Name
Value
File Name
Image_0407.TIF
Canon EOS 350D DIGITAL
1/320
0.0
ISO Speed
200
Image Size
3456x2304
Flash
Off
File Size
46781 KB
Favorite Folders
All Folders
Parcheggio
Eclisse
TIFF
Next >
Add to Favorites
Selected Items: 1
start

It permits also the correction of achromatic aberration of the lens used to take the shot. For this session it was not the case, but maintaining all facilities is the preferred choice, just in case some issue occurs.

Image Conversion

Again Canon utilities can help to convert the RAW images into the desired format TIFF, Digital Photo Professional (see page following).

TIFF was the desired format because it maintains, as much as possible, all RAW information.
350dpi is the default for the conversion software (see preceding pages).

Image Processing

Usually to elaborate TIFF images I use Adobe Photoshop CS2, but before going into the elaboration a selection of the best shots has to be done.
Another time the Canon software "Zoom Browser EX" helps a lot. You can look the complete list of images having all information in just one window. A new directory is created on which every chosen image is copied for the later processing (see preceding pages).

At this stage Adobe Photoshop CS2 is very useful. For this event I decided to produce some card showing the red moon , all phases during the event and also a film with much frames as possible.

Card report creation

The way to proceed, after the selection, to create an observing card for this event was really simple. I haven't done any elaboration on the photos except cutting the contour of the moon to have just a slide containing the object.

Here is an example:

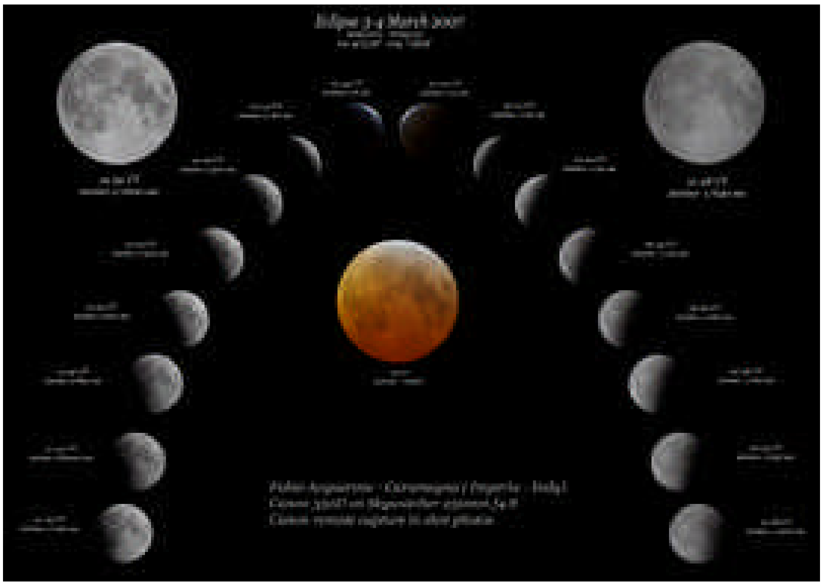
A reasonable size for the picture was used to permit a better fit on the card. Anyway the card was saved in TIFF original format (48Mbytes) and then converted to JPG (350kBytes) for the distribution.
Red moon images were cut and joined using levels on Photoshop CS2. At the end a lot of cards were created.

Film creation

For film creation it was more complicated. I used Adobe Photoshop CS2 animation facility.

"An animation is a sequence of images, or frames, that is displayed over time. Each frame varies slightly from the preceding frame, creating the illusion of movement when the frames are viewed in quick succession."
Previous chosen photos are our frames

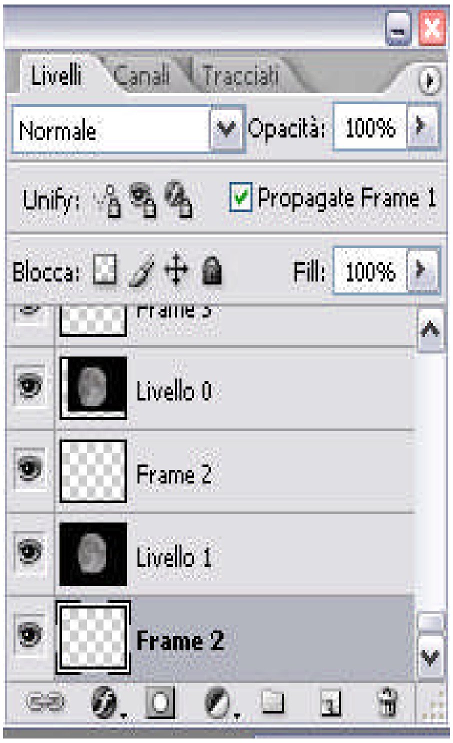

Eclipse 3-4 March 2007


Eclipse 3-4 March 2007


Eclipse 3-4 March 2007

in quick succession.

"Adding frames is the first step in creating an animation. If you have an image open, the Animation palette displays the image as the first frame in a new animation. Each frame you add starts as a duplicate of the preceding frame. You then make changes to the frame using the Layers palette."



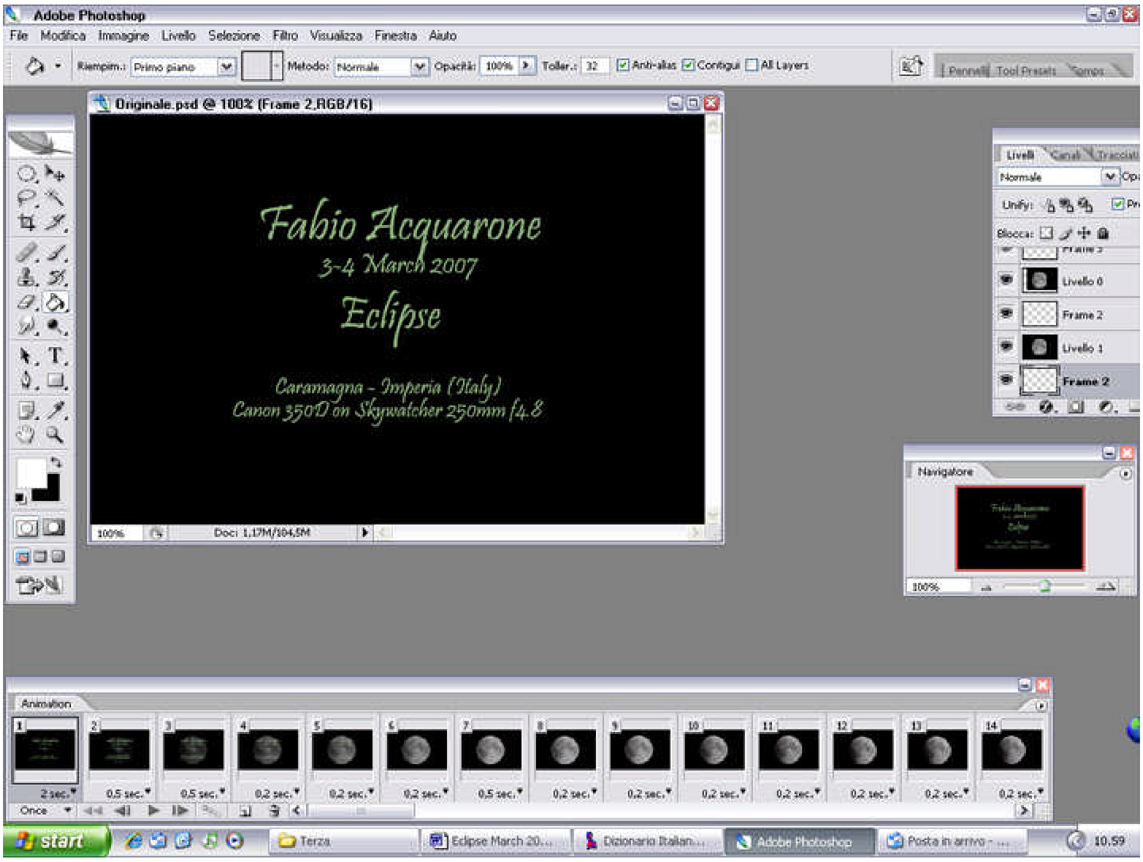
Each new layer is the image that we use as frame. The number of frames you can create is limited only by the amount of system memory available to Photoshop.

It is important to align each layer (photo) to avoid unpleasant effects. To align each layer all the potentiality of Photoshop are used, that is the possibility to reduce opacity and fill. So layer after layer alignment is required.

You can assign a delay time to each frame and specify looping so that the animation runs continuously. For my film I used a delay of 0.2 sec between each frame, excepts the initials frames with the banner.

The original film was saved in PSD format, to maintain all layers disjoined and to preserve the maximum possibility of modification and enhancement.
A gif animated was created, and using Photoshop Image Ready a QuickTime MOV was created.

ADDITIONAL MATERIAL
LINK TO THE FILM



Conclusions

I am really happy and satisfied on the results. If I think that clouds were present almost all the day before the start of the eclipse and I mounted anyway the instruments to hope for a better condition, I have to say that I was really lucky. “Fortune favours the brave!” Eclipse was on medium luminosity because the Moon was not exactly in the centre of the heart umbra, in fact in the red moon disc it was visible a very clear and white upper border.
However, the most better conditions were present on the totality period enabling to capture in a better way the red moon. My sensations during the period were really fantastic, during the totality an unreal environment were surrounding me and Canon 350D and Skywatcher 250mm were really a good couple of tools to take these wonderful moments.

References

[1] Lena, R., 2003, Fotografia, l’eclisse del 9 Gennaio 2001, L’Astronomia

[2] GLR Group website http://www.glrgroup.org

[3] NASA Eclipse Home page

[4] Nuovo Orione, Marzo 2007

Lunar Eclipse January 13, 1740

by Jim Phillips
Geologic Lunar Research (GLR) group

The attached document depicting the Total Lunar Eclipse of January 13, 1740 was published in Amsterdam in 1739 (Figures 1-5). A rough translation of the document is as follows:
“Astronomical image of a total lunar eclipse taking place on January 13, 1740, in the evening, displayed in two versions, showing the shadow of the Earth during the increasing and the decreasing darkening, passing over the Moon and the spots on it; included is an instruction especially about the time when the Moon and some of the aforementioned spots, following the corrected tables by Mr. Ph. De la Hire on the meridian of the city of Amsterdam, increasingly should begin to be darkened, etc. and reduction of this eclipse on other meridians as those of the cities not named here; computed and developed by Gerbrand Nicolaas Bak, A. M. Phil. Sc., In Ordinary Geometry of the Provincial Court of Utrecht.”

Toeneemende Verduistering -- increasing darkening

Afneemende Verduistering -- decreasing darkening

Geheel Verduisterd -- wholly darkened

Geheel Verligt -- wholly illuminated

Begint se Verligten -- is beginning to be illuminated

The Lunar Maps used to depict the Eclipse are by Johann Hevelius (Figure 2). In 1647, Hevelius published his great work on the Moon, Selenographia. It contained forty copper engravings including various lunar phases and his famous maps (Figures 6-7) which were to become the standard for nearly a century and a half. Hevelius named lunar features after geologic structures on the earth. For example, Mt Aetna (present day Copernicus) is located on the large volcanic island of Sicily (Copernicus Nimbus) within the Mediterranean Sea! (Figures 8-9). While Riccioli’s nomenclature, published in his Almagestum Novum 1651, naming lunar features after scientists and philosophers would survive (Figure 10), Hevelius’s map was, for many far superior. Dobbins and Sheehan state in their elegant book Epic Moon , page 23 “… a comparison (of Riccioli’s map) with the map of Hevelius reveals it to have nearly the identity of a tracing”.
One reason astronomers were so interested in lunar eclipse observations was for the determination of longitude on the earth. Latitude is relatively simple. In the northern hemisphere one measures the height of Polaris in degrees above the horizon. The answer is one’s latitude. Longitude is far more difficult. Pierre Gassendi and a colleague, Nicholas Claude Fabri de Peiresc used exact timings of the earth’s shadow as it passed over lunar features during the eclipse of January 1628 from their location in Aix-en-Provence, along with observations from astronomers in Paris, to work out the difference in longitude of the two locations. Afterwards they decided a more accurate lunar map was needed. Thus began a push for additional more accurate

lunar maps. To obtain more accurate results, Tobias Mayer and J.H. Lambert suggested timing the earth's shadow as it crossed individual lunar craters. The first time this method was used was the lunar eclipse of November 1, 1724 for the determination of the longitude difference between Lisbon and Paris. The present map, prepared for the Lunar Eclipse of January 13, 1740, was likely used in this same endeavour.

Acknowlegdements: the author would like to express his Special Thanks to Christian Wöhler for his translation of this document.

References

[1] Sheehan, William P. and Dobbins, Thomas A., Epic Moon, A History of Lunar Exploration in the Age of the Telescope. Willman-Bell, Inc. USA, 2001.

[2] Whitaker, Ewen A., Mapping and Naming the Moon, A History of Lunar Cartography and Nomenclature. Cambridge University Press, United Kingdom, 1999.

[3] Kopal, Z. and Carder, R.W. D, Mapping of the Moon, Past and Present Astrophyscical and Space Science Library, Volume 50. Reidel Publishing Company, Dordrecht-Holland/Boston-USA, 1974.

[4] Hevelius, Johannes, Selenographia Sive Lunae Descripto. Facsimile Reprint of the original edition of 1647, Johnson Reprint Corporation, New York and London, 1967.

[5] The Sphere of Marcus Manilius Made an English Poem with Annotations and an Astronomical Appendix. Sherburne, Edward., London, 1675.

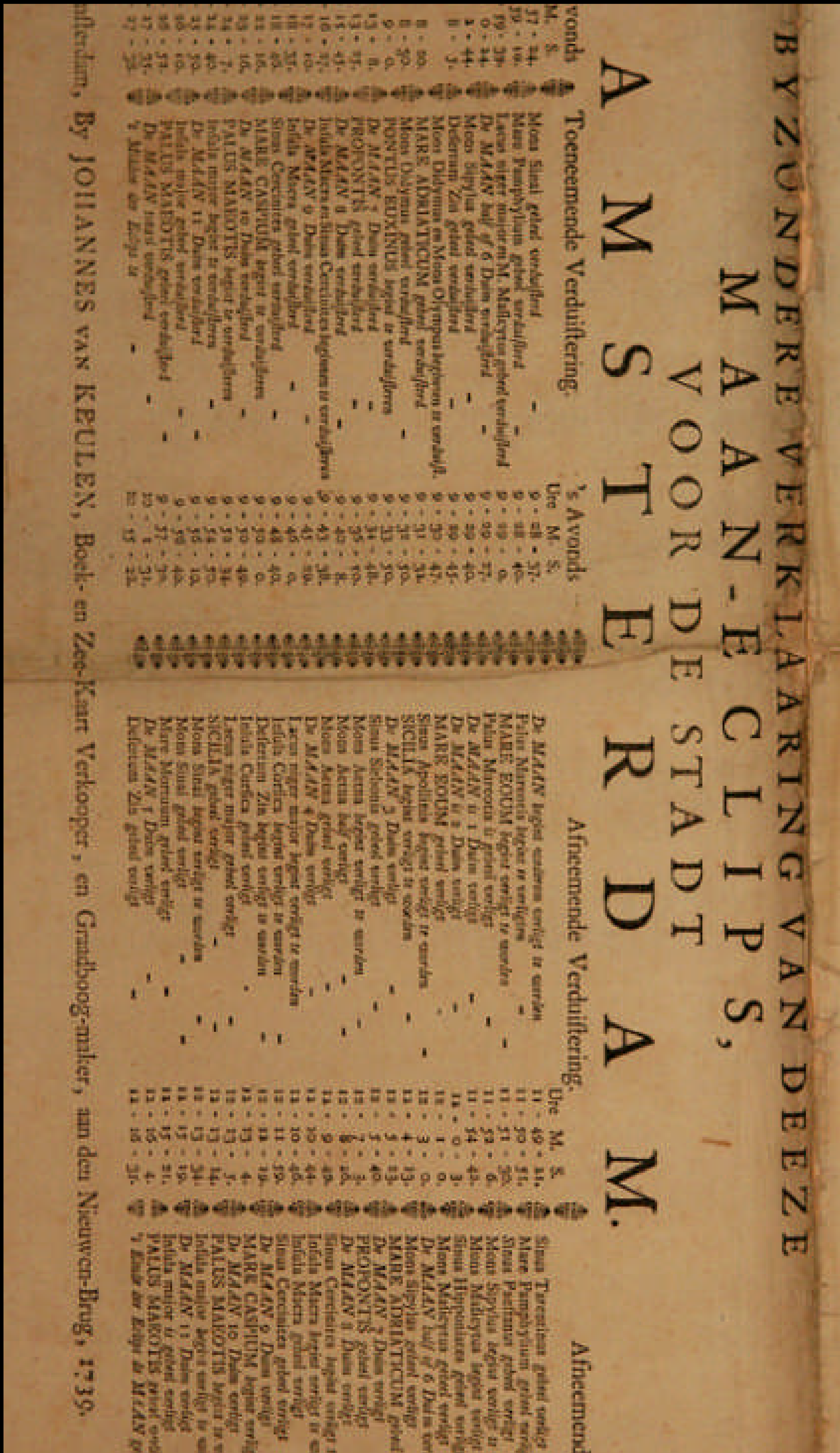
[6] Ashbrook, J., The Astronomical Scrapbook, Skywatchers, Pioneers and Seekers in Astronomy, Cambridge University Press, & Sky Publishing Corporation USA, 1984.

Figure 1


ASTRONOMISCHE AFBEELDING,
BYZONDERE VERKLAARING VAN DEZE
MAAN-ECLIPS,
VOOR DE STADT
AMSTERDAM.

Figure 2

Figure 3

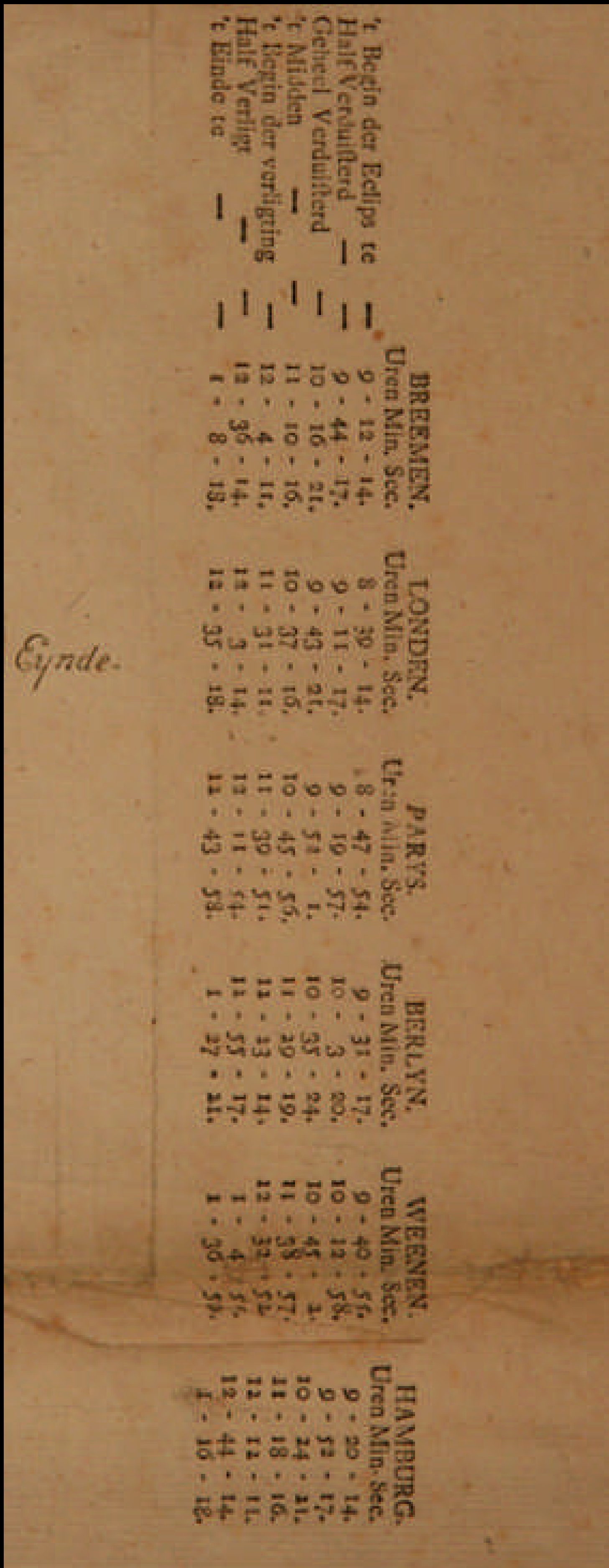

BYZONDERE VERKLAARING VAN DEEZE
MAAN-ECLIPS,
VOOR DE STADT
AMSTERDAM.

Toeneemende Verduistering. 's Avonds Ure M. S.

Afneemende Verduistering. Ure M. S.

...msterdam, By JOHANNES VAN KEULEN, Boek- en Zee-Kaart Verkooper, en Graadboog-maker, aan den Nieuwen-Brug, 1739.

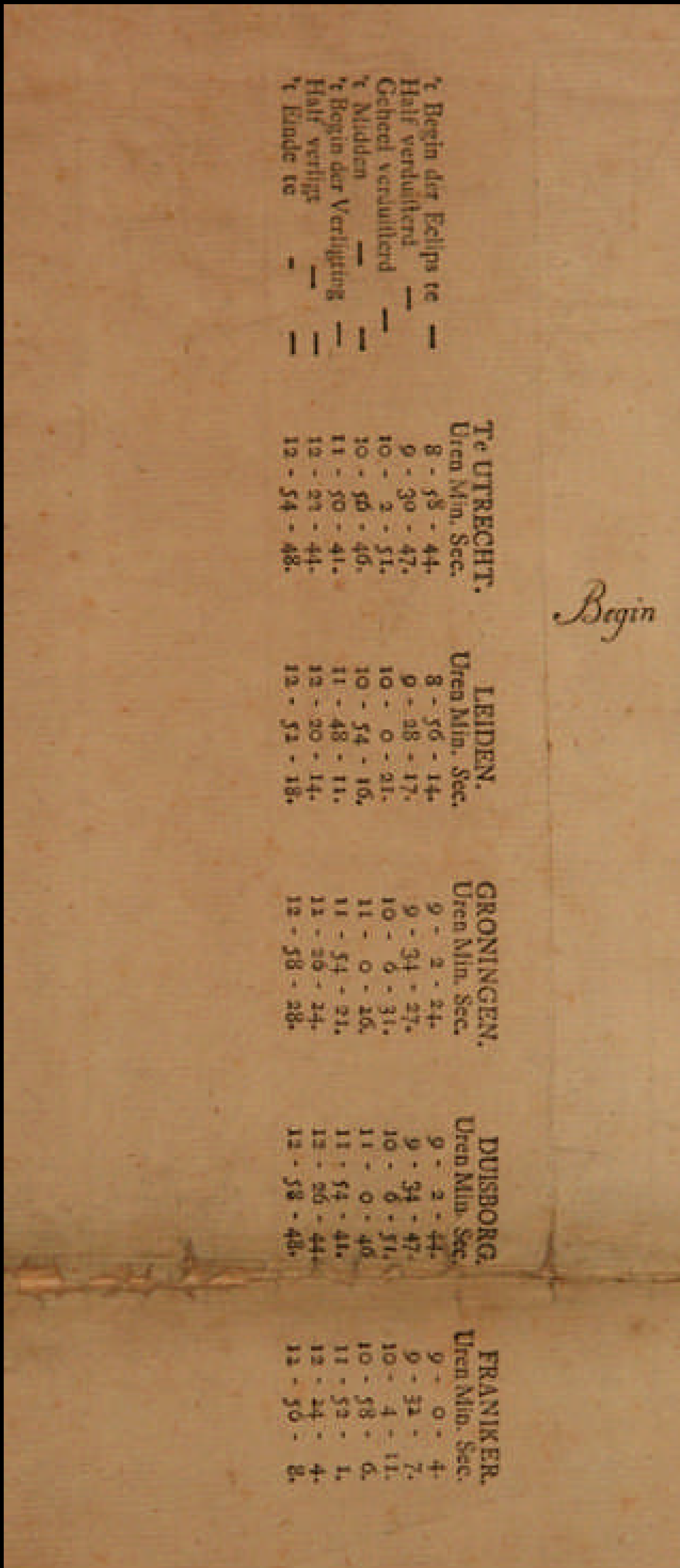
Figure 4



	BREEMEN. Uren Min. Sec.	LONDEN. Uren Min. Sec.	PARYS. Uren Min. Sec.	BERLYN. Uren Min. Sec.	WEENEN. Uren Min. Sec.	HAMBURG. Uren Min. Sec.
't Begin der Eclips te —	9 - 12 - 14.	8 - 39 - 14.	8 - 47 - 54.	9 - 31 - 17.	9 - 40 - 56.	9 - 20 - 14.
Half Verduisterd — —	9 - 44 - 17.	9 - 11 - 17.	9 - 19 - 57.	10 - 3 - 20.	10 - 12 - 58.	9 - 52 - 17.
Geheel Verduisterd —	10 - 16 - 21.	9 - 43 - 21.	9 - 51 - 1.	10 - 35 - 24.	10 - 45 - 2.	10 - 24 - 21.
't Midden — —	11 - 10 - 16.	10 - 37 - 16.	10 - 45 - 56.	11 - 29 - 19.	11 - 38 - 57.	11 - 18 - 16.
't Begin der verligting —	12 - 4 - 11.	11 - 31 - 11.	11 - 39 - 51.	12 - 23 - 14.	12 - 32 - 52.	12 - 12 - 11.
Half Verligt — —	12 - 36 - 14.	12 - 3 - 14.	12 - 11 - 54.	12 - 55 - 17.	1 - 4 - 56.	12 - 44 - 14.
't Einde te — —	1 - 8 - 18.	12 - 35 - 18.	12 - 43 - 58.	1 - 27 - 21.	1 - 36 - 59.	1 - 16 - 18.

Eynde.

Figure 5



Begin

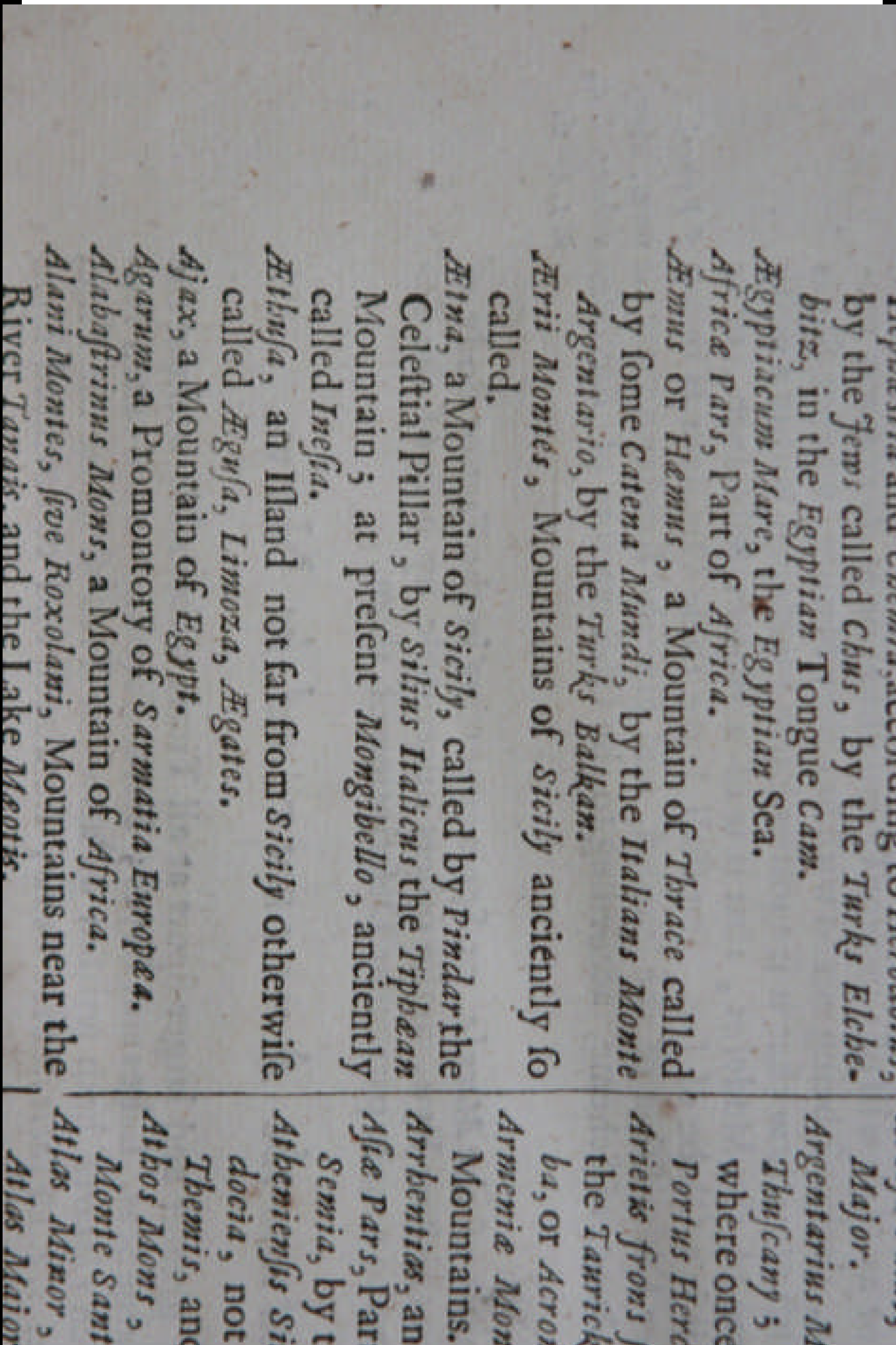
	Te UTRECHT. Uren Min. Sec.	LEIDEN. Uren Min. Sec.	GRONINGEN. Uren Min. Sec.	DUISBORG. Uren Min. Sec.	FRANIKER. Uren Min. Sec.
't Begin der Eclips te —	8 - 58 - 44.	8 - 56 - 14.	9 - 2 - 24.	9 - 2 - 44.	9 - 0 - 4.
Half verduisterd —	9 - 30 - 47.	9 - 28 - 17.	9 - 34 - 27.	9 - 34 - 47.	9 - 32 - 7.
Geheel verduisterd —	10 - 2 - 51.	10 - 0 - 21.	10 - 6 - 31.	10 - 6 - 51.	10 - 4 - 11.
't Midden — —	10 - 56 - 46.	10 - 54 - 16.	11 - 0 - 26.	11 - 0 - 46.	10 - 58 - 6.
't Begin der Verligting —	11 - 50 - 41.	11 - 48 - 11.	11 - 54 - 21.	11 - 54 - 41.	11 - 52 - 1.
Half verligt — —	12 - 22 - 44.	12 - 20 - 14.	12 - 26 - 24.	12 - 26 - 44.	12 - 24 - 4.
't Einde te - —	12 - 54 - 48.	12 - 52 - 18.	12 - 58 - 28.	12 - 58 - 48.	12 - 56 - 8.

Figure 6

Figure 7

Figure 8

Figure 9



by the *Jews* called *Chus*, by the *Turks Elchebitz*, in the *Egyptian* Tongue *Cam*.
Ægyptiacum Mare, the *Egyptian* Sea.
Africæ Pars, Part of *Africa*.
Æmus or *Hæmus*, a Mountain of *Thrace* called by ſome *Catena Mundi*, by the *Italians Monte Argentario*, by the *Turks Balkan*.
Ærii Montes, Mountains of *Sicily* anciently ſo called.
Ætna, a Mountain of *Sicily*, called by *Pindar* the Celeſtial Pillar, by *Silius Italicus* the *Tiphæan* Mountain; at preſent *Mongibello*, anciently called *Ineſia*.
Æthuſa, an Iſland not far from *Sicily* otherwiſe called *Ægusa*, *Limoza*, *Ægates*.
Ajax, a Mountain of *Egypt*.
Agarum, a Promontory of *Sarmatia Europæa*.
Alabaſtrinus Mons, a Mountain of *Africa*.
Alani Montes, *ſive Roxolani*, Mountains near the River *Tanais*, and the Lake *Meotis*.

Major.
Argentarius M
Thuſcany;
where once
Portus Herc
Arietis frons
the *Taurick*
ba, or *Acro*
Armeniæ Mon
Mountains.
Arrhentias, an
Aſiæ Pars, Par
Semia, by t
Athenienſis Si
docia, not
Themis, and
Athos Mons,
Monte Sant
Atlas Minor,
Atlas Major

Figure 10

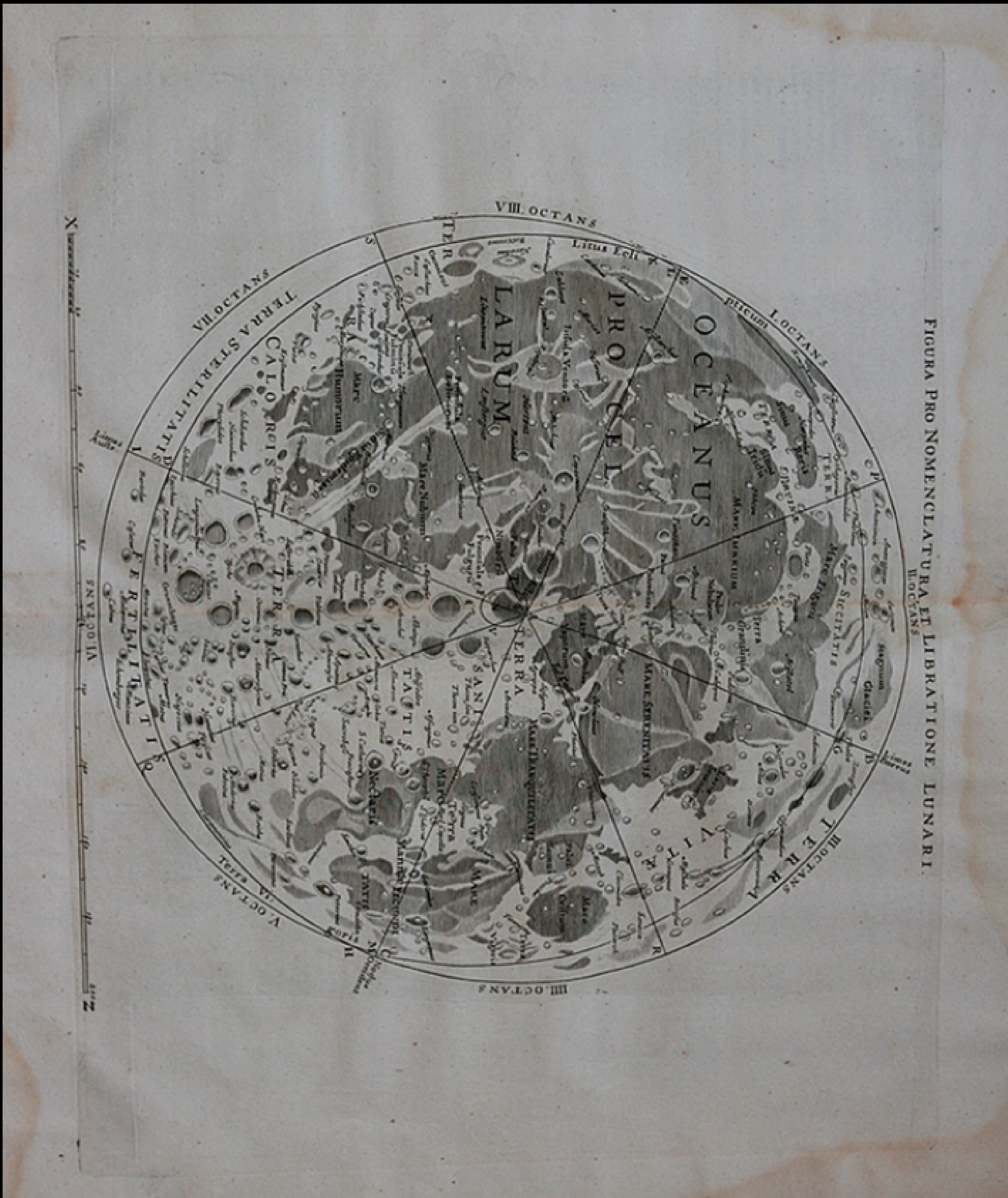


FIGURA PRO NOMENCLATURA ET LIBRATIONE LUNARI.
VIII. OCTANS
OCEANUS
PROCELLARUM
TERRA STERILITATIS

Lunar eclipse 3-4 march 2007
by Fabio Acquarone

ECLIPSE GALLERY

Eclisse totale di Luna 3-4 marzo 2007 - Cristina & Fiorenzo Mazzotti (San Romualdo - Ravenna)

Canon Eos 300D su Pentax75

Canon EOS 350D DIGITAL | 200 iso | 5.0 sec | Copyright © Diego Barucco 2007

© Piergiovanni Salimbeni

ECLIPSE GALLERY

ϕ= 37º 52' 12'' N
λ= 04º 47' 31'' W

Eclipse de Luna 3.03.2007
Canon 350D EOS + refractor SkyWatcher ED80

lunar eclipse 3-4 march 2007
by Simone Bolzoni

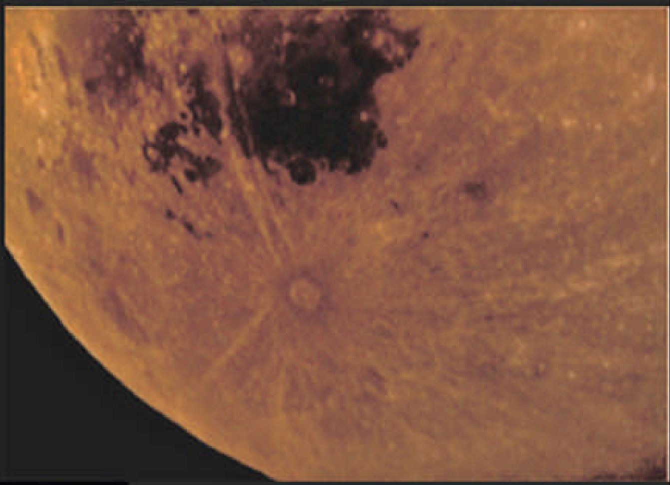
Eclissi totale di Luna, 3 marzo 2007 23:14 U.T.
Newton 25 cm F5 e Canon EOS 20DA - Esp. 2" ad ISO 800
Oss. Monte d'Aria (MC) ITALY - Cristian Fattinnanzi

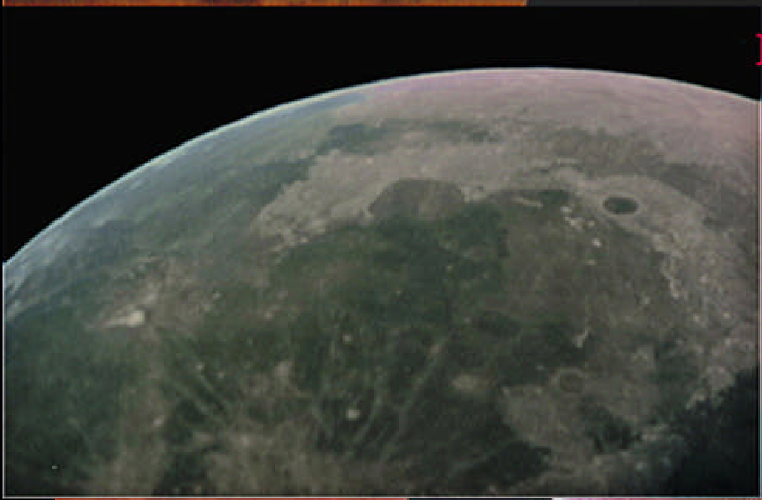
ECLIPSE GALLERY

lunar eclipse 3-4 march 2007 by Stefan Lammel


Eclipse Luna
3 Marzo 2007
21:30 UT
21:48 UT
22:06 UT
22:18 UT
22:27 UT
22:42 UT
23:05 UT
00:06 UT
00:26 UT
00:39 UT
00:53 UT
01:13 UT
C9.25 F10 + Reductor 0,5x + Mintron
Rafael Benavides
MPC J53 Posadas (Córdoba)

ECLIPSE GALLERY





Lunar eclipse 3-4 March 2007

Crisium quadrant 23:52 UT (left top)
Tycho quadrant 23:50 UT (right top)
Iridum quadrant 23:55 UT(left bottom)

Raffaello Lena from Rome (Italy)
webcam ToUcam pro
TMB 13 cm f/6 apo Refractor

Crisium quadrant 23:44 UT

Tycho quadrant 00:12 UT

Tycho quadrant 00:23 UT

Crisium quadrant 00:29 UT

Lunar eclipse 3-4 March 2007

Raffaello Lena from Rome (Italy)
webcam ToUcam pro
TMB 13 cm f/6 apo Refractor

Umbral Magnitude +1.2375
Maximum Totality 23:20:56 UT
Total Eclipse Begins 22:44:13 UT
Total Eclipse Ends 23:57:37 UT


The Red Moon
March 3, 2007
AstroPhysics EDT 130 f/6 and Lumenera Infinity 2-1M camera
2.4 arcsec/pixel image (binning 2x2), mosaic of 4 shots
90/100 frames stacked each shot, 200% resampled
Seeing: very poor, Transparency: fair
Mt. Rocchetta (SP) - ITALY
Paolo Lazzarotti - Nicola Guidoni