Those Square Craters On The Moon. . . Are They Really "Craters"?

By
William E. Haynes

Preface

What is "Square Craters" all about?

In August, 1966, NASA launched the first of five Lunar Orbiter spacecraft. Their mission: Map the Moon photographically, with particular emphasis on the Lunar equatorial belt where the Apollo landings were about to occur.

All five spacecraft performed flawlessly, returning data which resulted in over three thousand 20 by 24 inch photos depicting all of the Moon's near side and 99% of the far side. In fact, the first three did so well that NASA re-programmed the last two to scan areas other than the equatorial belt that was of interest for the Apollo landings.

In 1970 a selected compilation of these photographs was published by NASA in a book entitled: "The Moon as Viewed by Lunar Orbiter" by L.J. Kosofsky and Farouk El-Baz. Among the photos taken was one of an area near the Lunar North Pole. It appears on Pg. 14 and is captioned (in part): "The very low solar elevation brings out the apparent squareness of the shallow depressions at E13, G12, and J14" (The references are to coordinates on the photo).

"Square craters?" I was intrigued! In fact, so intrigued that I ordered a full size copy of that photograph. What I found is reported in the paper that follows.

Those Square Craters on the Moon. . .
Natural or Ancient Artifacts?

LUNAR ORBITER

In August, 1966, NASA launched the first of five Lunar Orbiter spacecraft. Their mission: Map the Moon photographically, with particular emphasis on the Lunar equatorial belt where the Apollo landings were about to occur. All five spacecraft performed flawlessly, returning data which resulted in over three thousand 20 by 24 inch photos depicting all of the Moon's near side and 99% of the far side. The Earth's Moon always shows us the same face, with only slight deviations called *librations*, giving Earth-based astronomers glimpses around the Moon's 'corners'.

The first three Orbiter spacecraft were injected into equatorial orbits compatible with the search for suitable Apollo landing sites. They were so successful that the last two, Lunar Orbiters IV and V, were inserted into Lunar polar orbits. This allowed them to pass over the entire Moon as it slowly rotated inside their orbits. The Orbiters were equipped with two cameras: a high resolution camera with focal length of 610 mm and a lower resolution camera using an 80 mm lens.

On one of its northward passes over the near side of the Moon the camera on Orbiter IV caught sight of the Lunar North Pole. The resulting picture is designated IV-190 H3, meaning Lunar Orbiter IV, picture number 190, high resolution, section three (See Fig. 1.). That picture is reproduced on page 14 of The Moon As Viewed From Lunar Orbiter (op cit).

The caption under the picture begins:

"A close-up of the north pole area. . ."

and ends:

"The very low Solar elevation brings out the apparent **squareness** (emphasis is mine) of the shallow depressions at E13, G12 and J14 (picture coordinates)."

The Square Craters

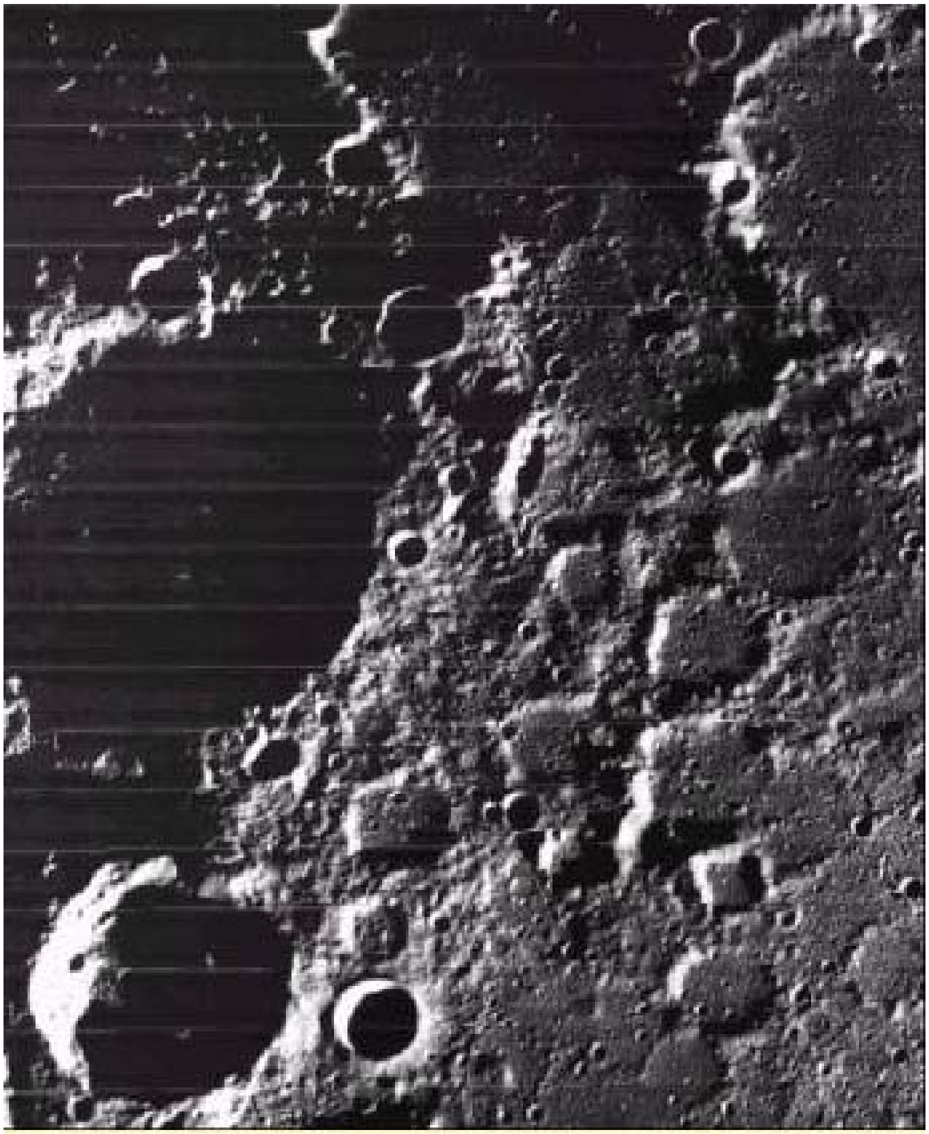

Fig.1. Image as shown on NASA print from
Lunar Orbiter data. Designated IV-190H3.

My first reaction to the photo was amazement.

How could someone discover an "apparently" square crater on the Moon and not get excited about it? But <u>three</u> square craters? My curiosity aroused, I wrote to the National Space Science Data Center, Greenbelt MD and obtained a higher quality print. The new print was made directly from a negative that had been constructed from the electronic signals sent out by Lunar Orbiter IV.

A glance at the picture confirms the NASA caption writer's comment: those three depressions do look square. Further examination brought out some additional oddities. If the two larger depressions are compared, it becomes apparent that if they are square, they are also parallel and aligned with each other. Surely, chance can not account for that?

I began to wonder how large the squares were.

NASA provides information in their publication that permits calculation of the scale. In this case the framelet width is 14.2 km (8. 8 mi). Framelets are the narrow strips running left and right across the picture. They result from the method of converting the image electronically for transmission to Earth, and provide a handy distance scale. Using that and other data in the publication, I constructed the overlay shown in Fig. 2.

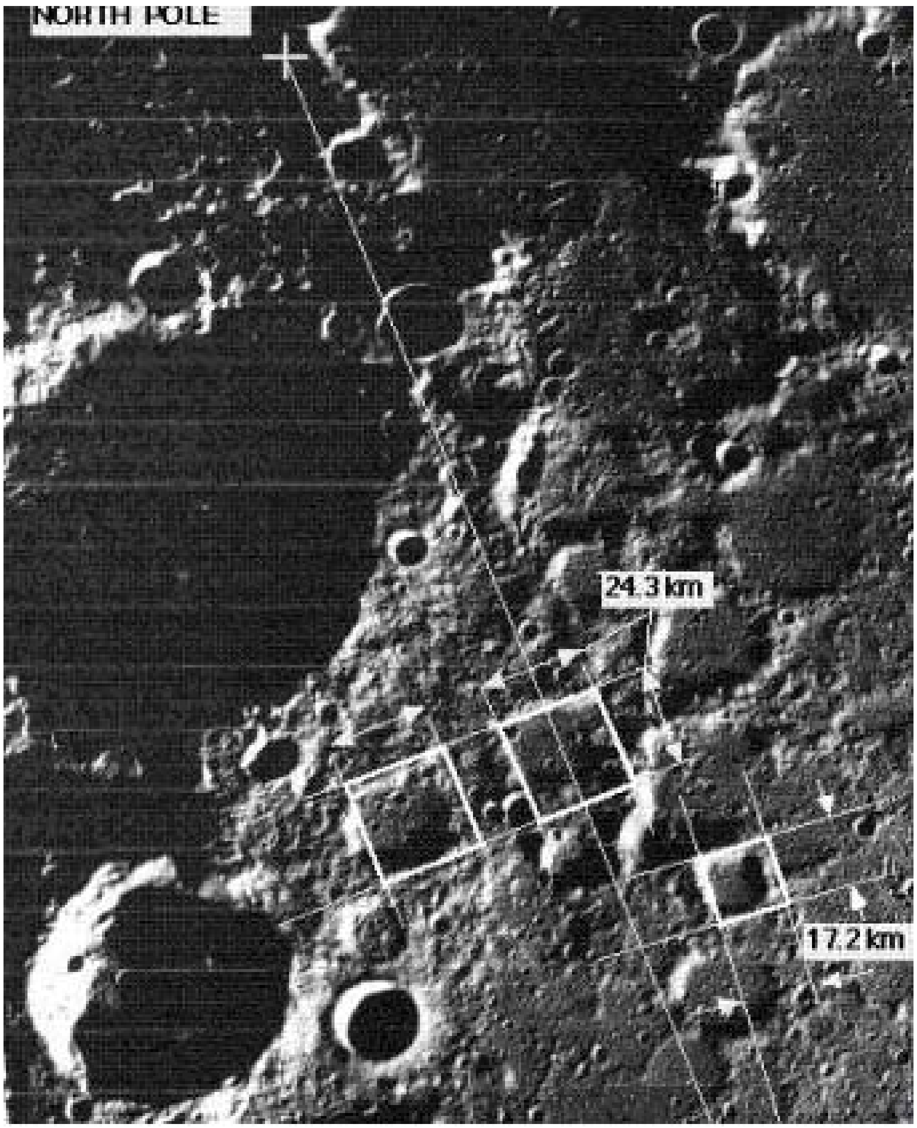

Fig. 2. The same image with overlay showing geometric relationships, scale and alignments.

The reasoning used was as follows:

If I construct squares matching the marks on the lunar surface, how well will they fit? Will they match so poorly as to strain logic? Or will they reveal additional information? The results are fascinating!

I believe that it is essential to an appreciation of the results that the reader understand how I arrived at the final geometry. I did NOT just draw squares that fit the apparent boundaries of the "depressions."

Starting at the indicated position of the Lunar North Pole, I drew a straight line downward. Any straight line drawn away from the pole points due south, but this line was selected to pass through the apparent center of the eastern large depression.

This immediately revealed a startling fact: The line from the pole that passed through the center of the eastern square, bisected it perfectly. That this is not to be taken lightly is shown if one visualizes a similar line drawn through the western square: it would be at an arbitrary angle to that square.

Furthermore, the line through the eastern square determined a size for the sides of the two large squares. If they are indeed squares, the length of their sides has to equal the distance between the north and south boundaries along that north-south line. Using the data provided on the spacing of the framelets, I determined that this is 24.3 km.

Then I drew two lines perpendicular to the north-south line and passing through the north and south intersections with the eastern square. As you can see, they lie comfortably along the north and south boundaries of both squares. Now, perhaps one would expect that these lines would fit the north and south boundaries of the first square. But note that they also lie comfortably along the north and south boundaries of the second square.

Next I laid out four lines to delineate the eastern and western boundaries of the two large depressions, starting equidistant from and parallel to the original north-south line, 24.3 km apart and leaving a space equal to half that distance between them. The result can be seen in Fig.2. The match between the depressions and the square overlays is quite good.

Note that I did not simply draw squares that appear to match. The method I used drove me to arrive at the square shape by the inherent geometry (selenometry?) of the structures themselves. For example, the distance between the northerly and southerly boundaries of the right hand square might have been a poor match for the east to west width. Instead, it matches very well. Similarly, the extension of the right hand square northerly and southerly boundaries could have been a poor fit to the corresponding sides of the left hand square. Instead, they lie right on its north and south boundaries. Furthermore, there is no "natural' reason why the space between the two squares need be just half their width, but it is. And finally, there is surely no natural reason why the two squares need to match overlays that show them to be parallel to and aligned with each other.

By the time I had gotten this far I was getting pretty excited. But the best was yet to come!

I began to seek a possible relationship between the two large squares and the smaller but better defined depression south east of them. Clearly, it was not aligned with them, but perhaps there was a size relationship?

The area of the two large squares, 24.3 km on a side, is 590 square km. Half of that is 295 sq. km and would yield a square with sides 17.2 km long. I tried this on the third square with the results you can see in Fig. 2.

The depressions match rather well with an overlay which orients the two larger squares along a north-south line and with each other and which shows them to be the same size and spaced just half their width apart, within the accuracy allowed by the damaged crater walls. Furthermore, the smaller square is shown to comfortably match an overlay with exactly half the area of the larger squares.

What conclusions may be drawn from all of this? Well, there are only two possible over-all conclusions:

The first is that I have applied procrustean reasoning to an accident of nature; in short, that I am seeing things that are not there. The second is that we are confronted with an alien artifact at least 3.9 billion years old and of truly colossal proportions.

I contacted (several years ago) Mr. Donald Wilhelms, a Lunar geologist (that term is preferred to "selenologist") who worked for the United States Geological Survey in Menlo Park, CA. He pointed out that Mare Imbrium to the south and Mare Humboltianum to the east had both deposited ejecta and created numerous secondary craters, as well as many straight valleys to be seen in the area of these depressions.

I asked about the possible age of the depressions, commenting that judging from their worn condition they appeared to be among the older markings. He agreed, and estimated that they would be older than 3.9 billion years, the age of Mare Imbrium. He showed no enthusiasm for the possibility of artificial origin of the square depressions.

If we examine the implications of these results, we must come to one of the conclusions I have cited above. If these are artificial and over three billion years old, they can not by any stretch of our imagination be of human origin. So they would be mute but powerful proof that whether there are "others" out there now or not, they or their Lunar regolith moving equipment were here on Earth's Moon back then.

There’s one more intriguing idea I want to share with you.

The age of the Earth is about 4.5 billion years. The earliest evidence of life on Earth is in the form of primitive fossils discovered by my friend, UCLA Prof. Bill Schopf, in Australia. They have been dated as about 3.9 billion years old.

Over 3.9 billion years have passed since those square "depressions" were created and they show the effects of the meteoritic bombardment which was then still actively shaping the surface of our Moon. Nevertheless, those square craters are still there, easily discernible near the Lunar north pole, challenging us to notice them, explore them and solve their mysteries.

How could such a massive alien artifact be known and not be publicized? But the craters and their squareness have been known and publicized ever since the Lunar Orbiters' pictures were included in a NASA book published in 1970. No one seems to have paid any attention to them, until now.

If our Moon had visitors four billion years ago, who left the imprint of engineering projects of the scale shown by these square craters, what other artifacts may lie buried in the Lunar polar sands? They would hardly have been concerned about concealing their work from a possible sentient race that would not arise on the planet below for over three thousand millennia!

We probably won't find out for some time. The Lunar pole is not a likely spot for a landing by a manned space vehicle. That would require a polar orbit, one which calls for killing all of the momentum about the Moon's equator and adding equivalent momentum at right angles, about the Moon's poles. This can be done for a small probe (Lunar Orbiter weighed about 390kg, or about 850 lbs.). But for a large, manned vehicle the energy required would be much higher.

There is the possibility of astronauts using a trajectory that would produce a Lunar Polar orbit. It has the drawback of not being a “free return” trajectory, so that if a problem developed that required return to Earth, the energy required would be greater, reducing the “fail safe” capability of the mission, as demonstrated by Apollo 13.

Probably we will not visit the lunar North Pole until we have established a permanent lunar outpost and have reliable surface transportation capable of making the 5400 km round trip from the lunar equator and back. But we could certainly put remotely controlled teleoperators in the craters and explore them for signs of intelligent activities!

There is one widely discussed reason for that trip; one which is being used to justify new Lunar explorations. That is the recent widely publicized possibility of water ice near the lunar South Pole. There is also direct, sensor evidence of water ice mixed into the regolith near the North Pole of the Moon. The conditions (very low sun angle and possible permanently shaded craters) that permit it at the South Pole also exist to a lesser extent in the North.

Water ice, which breaks down readily into hydrogen and oxygen using photo voltaic power, would provide lunar residents with two of the elements most essential to life and useful as rocket propellants. Finding adequate amounts of water ice on the Moon could enable a lunar outpost to evolve into a lunar nation in a much shorter time than if that vital resource had to be hauled from Earth, or from somewhere else in the Solar System, such as Europa or a cometary nucleus.

So there is a complementary reason for going to the Moon's pole.

Perhaps those first visitors from Earth will discover more than they bargained for; perhaps even a monolith?

Summary of Data and Computations

Summary of Data

Page	Mission	Frame	Spacecraft Altitude	Camera Tilt	Latitude	Longitude	Sun Elevation	Framelet Bearing
14	IV	H190	3373 Km	1° 50'	70° 20' N	63° 30' W	13° 30'	N 82° 20' W

Photo data from Photo Reference Table, pg. 150 (Op Cit)

Computing Framelet Scale:

(Op Cit Ch. 1, Pg. 5, Fig. 6)
High resolution (H) picture shown as 4.2 Km wide framelet for 46 Km spacecraft altitude (reference parenthetical statement, pg. 4 of referenced text). Using the spacecraft altitude of 3373 Km given in the Photo Reference Table, the proportions are:

3373 Km / 46 Km = W / 4.2 Km

W = 308 Km

The measured width of the print provided by NASA is 15 9/16 in. Therefore, 15 9/16 in. = 308 Km and the scale of the print is:

1 in. = 19.8 Km = 2.54 cm; Therefore, 1 cm = 7.8 Km

This was found to be in good agreement with the width of the crater Hermite, given as 109 Km in the NASA caption on Pg. 14 (OP CIT). It should be noted that the validity of the conclusions is not dependent upon the accuracy of the scale.

All data were obtained from, The Moon As Viewed From Lunar Orbiter L J Kosofsky, Farouk El-Baz; NASA SP-200, dated 1970; Library of Congress Catalog Card Number 75-60148.

The Small Crater

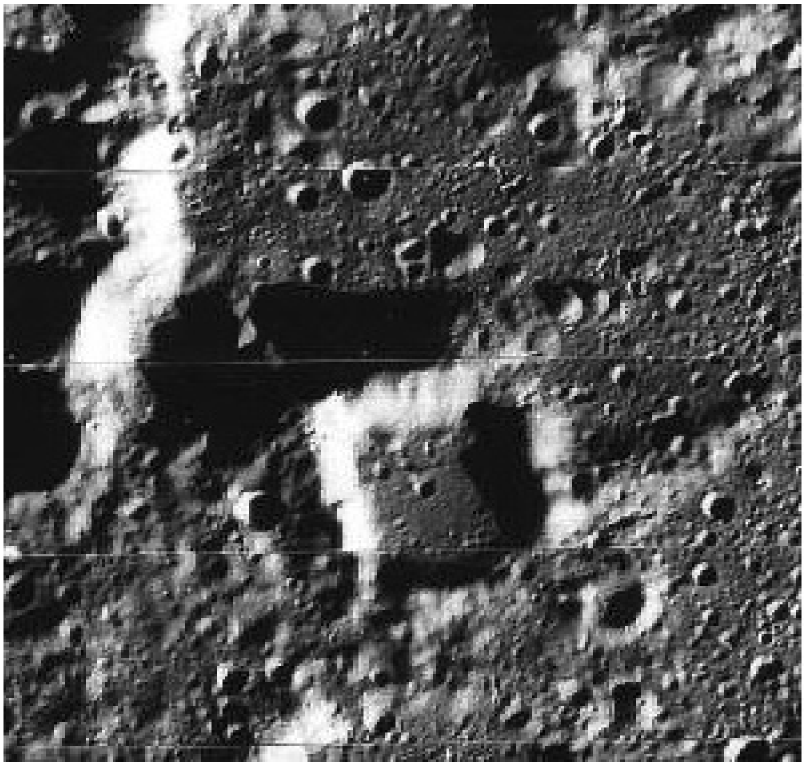

Fig. 3 The smaller crater close-up.

Closer examination of the smaller crater allows estimating the height of the crater wall. The sun angle was given as 13.5 degrees, and framelet width as 14.2 Km. Using the framelet width as it appears in this larger scale image results in 14.2 km equaling 37 mm, for a ratio of 2.6 mm per Km. The shadow of the escarpment on the east side of the square crater as seen here is about 16 mm or 6.2 Km long.

The relationship is:

X (height of the escarpment) = 6.2 sin 13.5 deg.
X = 6.2 * 0.233
X = 1.4 Km, or 4,600 ft.
It is also apparent that some of the smallest craters seen in this image are only about a few hundred meters across.

In 2000, I contacted Prof. Farouk El-Baz, co-author of the NASA book, The Moon as Viewed from Lunar Orbiter, that originally caught my attention about square craters, to further discuss the square craters and how they may have been formed. My coorespondence with him is found in *Appendix 1*.

Epilog: Clementine

Sometime after I wrote this paper in 1990, I heard about the Clementine mission, a Naval Research Laboratory space probe deigned to test advanced imaging hardware. It took many more high-resolution images of the Moon than Lunar Orbiter. When they announced that the images were available on the Net, I tried to find the "square craters" region, but had no success.

After persistent requests of the Clementine project, I receive an e-mail response on September 26, 1999, from Eric Douglass, (V.P. of the American Lunar Society) who responded on their behalf. It contained the image shown in Fig. 4 in which the west wall of the small square-crater is clearly obscured by what appears to be a pasted image that masks the squarness of the crater.

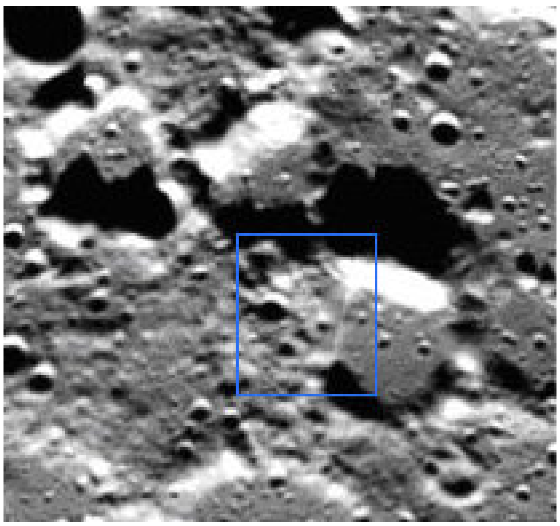

Fig. 4. Received Clementine Image

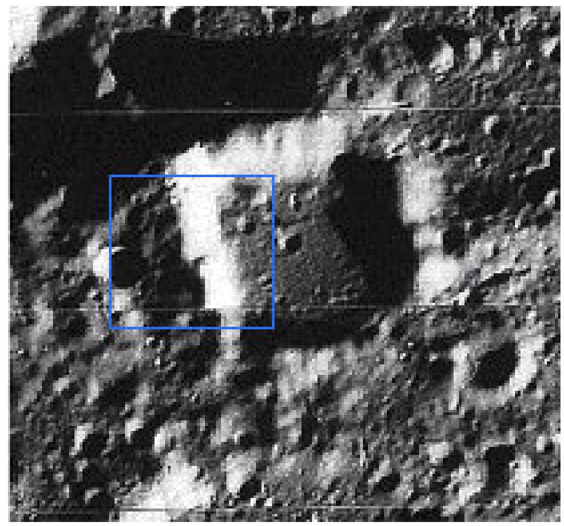

Fig. 5. Lunar Orbiter Image (from Fig. 3)

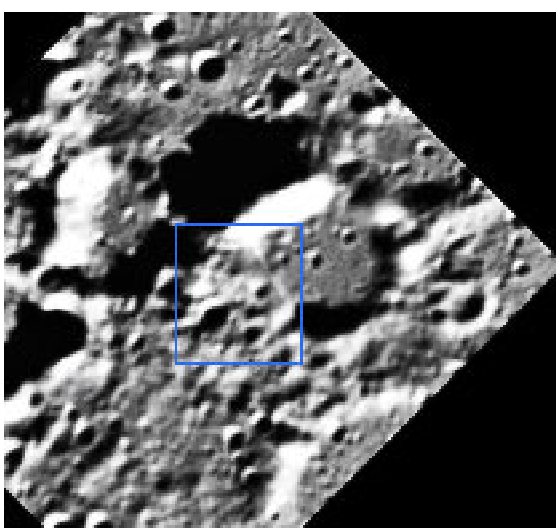

Fig. 6. Rotated Clementine image of Fig. 4

The blue boxes indicate the areas of interest. Notice that the left-wall of the crater in Lunar Orbiter image (Fig. 5) appears to be obliterated in the furnished Clementine image (Fig. 4)

Upon closer examination it appears that this was a poor attempt to paint out this part of the picture with a clone tool.

Figure 6 is the image of Figure 4 rotated to match the angle of Figure 5.

Figure 7 is a close-up of the artifact in image of figure 4 that is overlaying the left wall of the crater in the image of figure 5.

Note the bright highlight created by the straight edge of the artifact (on the right side of the image).

Fig. 7. Close up of the edge of the artifact obliterating the left-wall.

The text of the e-mail I received from Eric Douglass on September 26, 1999, that contained the image (Fig 4) as an attachment is found in *Appendix 2*.

Observation and Conclusion

There can be only one conclusion. Someone tried to deflect my interest in "square craters" by sending me this crudely altered image.

To accept otherwise would require the viewer to believe that either the west wall of the smaller crater had collapsed in the interval between Lunar Orbiter and Clementine, or that the original photo showed a wall that was not really there.

I leave it to the readers to draw your own conclusions. My conclusion is that someone actually set out to deflect me from examining the subject. The obvious crudity of the effort speaks poorly for the competence of whoever did it. But it raises the more important question:

Who or what was so intent on deflecting me from investigating this issue? And Why?

Appendix 1

In 2000, I contacted Prof. Farouk El-Baz, co-author of the NASA book, The Moon as Viewed from Lunar Orbiter, that originally caught my attention about square craters, to further discuss the square craters and how they may have been formed. Following is my coorespondence with him:

> Dear Professor El-Baz:
>
> I have had a copy of your book: "The Moon As Viewed From Lunar Orbiter"since shortly after its publication. There is a particular image that has fascinated me for almost twenty years. It appears on page 14, and the commentary begins "A close-up of the north pole area."
>
> Rather than going in to detail here, permit me to suggest that you access my website at: http://members.home.net/bill2space/ *(NOTE: that was my previous website and it is no longer active.)*
>
> Please select my paper: "Square Craters on the Moon" the hypertext for which appears at the bottom of my home page.
>
> I await your comments with some excitement but a degree of trepidation!
>
> Sincerely,
> Bill Haynes
> =====================

On March, 16, 2000 Prof. Farouk responded via email:

> Subject: Re: Square Depressions
> Date: Thu, 16 Mar 2000 11:03:56 -0500
> From: Farouk El-Baz <farouk@crsa.bu.edu>
> To: bill2space@home.com
> References: 1
>
> Dear Bill,
>
> When an impact occurs at a highly fractured terrain the fault trends (straight lines) partley control the shape of rim. This can easily produce the "square" shape.
>
> Fraouk El-Baz

My response to Prof. Farouk:

> Dear Farouk:
>
> Apparently you are saying:
>
> 1. Such "square depressions" should be common. (If so, where else are they, and why did these gain the special attention of the caption writer for the picture in your book?)
>
> 2. Such square depressions also "easily" line up with each other and with such key features as due north/south lines.
>
> 3. Such features also occur "easily" with areas that are identical or exact multiples of each other.
>
> 4. It is common for fault lines to be exactly perpendicular to each other and for such crossing fault line pairs to be equidistant from each other so as to form squares.
>
> 5. It is also common for the fault line-induced crater walls to stop just as they intersect the other pair so that there are no extensions beyond the crater boundaries, SO THAT EVEN ADJACENT, ALIGNED SQUARE CRATERS SHOW NO SUCH EXTENSIONS BETWEEN THEM!
>
> I really expected you to deal with the primary aspects of my paper. In it I postulate two possible explanations for the conditions I describe:
>
> They are purely a result of "procrustean reasoning" on my part, or they are the residue of truly massive non-human artifacts.
>
> I am disappointed that you disposed of that issue in such an off-hand manner.
>
> Bill Haynes

Prof. El Baz never commented on my reply.

Appendix 2

The text of the e-mail I received from Eric Douglass on September 26, 1999, that contained the image (Fig 4) as an attachment follows:

Subject: Re: Square Craters
Date: Sun, 26 Sep 1999 23:40:33 -0700
From: "William E. Haynes" <bill2space@home.com>
Organization: @Home Network
To: ejdftd@interpath.com
References: 1 , 2 , 3 , 4
eric douglass wrote:

Bill:

On your LO photo there were three craters. Between the two upper ones is a small double crater. This is the double crater in the upper left of the Clementine image I sent you. Thus, it doesn't show the upper two square craters (this was in the seam and would require some time for me to produce), but does show the third lower one (toward the bottom right; flat floor, multiple small craters in the floor).

Happy hunting,

Eric Douglass

- End -