Journal of Geography and Geology; Vol. 9, No. 4; 2017
ISSN 1916-9779 E-ISSN 1916-9787
Published by Canadian Center of Science and Education

Topographic Analysis of Landing Areas of Apollo Moon Missions

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Received: November 3, 2017 Accepted: November 23, 2017 Online Published: November 29, 2017

doi:10.5539/jgg.v9n4p37 URL: http://dx.doi.org/10.5539/jgg.v9n4p37

Abstract

The Apollo program was NASA's (National Aeronautics and Space Administration) human spaceflight program, accomplishing landing of the first humans on the Moon from 1969 to 1972. Ever since there have been scientific and public questions about its legitimacy and claims that the associated Moon landings were staged by NASA and/or other organizations. In this paper we examine a number of the Apollo mission images through (i) a comparison with simulated views of Google Earth (Moon) and (ii) a photographic analysis of some of their features using Photoshop®. The functionality of latitude, longitude, elevation and elevation profile of Google Earth is addressed by means of a comparison with other available programs possessing the same features like NASA's Moon Trek and Alcyone Lunar Calculator. The topographic analysis through Google Moon simulations indicate that the landscapes in Apollo mission images used were inaccurate presentations of reality and there are incorrect elevations and serious land feature omissions. Moreover, the Photoshop® analysis shows conclusively that images were staged, manipulated or altered.

Keywords: Apollo missions, Moon landings, Photoshop, Google Earth (Moon), Lunar topography

1. Introduction

The United States of America through a successful program that lasted from 1963 to 1972 (NASA Space Science Data Coordinated Archive, 2017) designed, tested and flew to the moon, manned and unmanned space missions. National Aeronautics and Space Administration (NASA) the USA agency, was responsible for the program (NASA page on Apollo Missions, 2017). From 1966 to 1968 the Saturn launch vehicles and components of the Apollo spacecraft were tested in six unmanned missions (AS-201, AS-203, AS-202, Apollo 4, 5 and 6). On January 27, 1967, during a test a fire erupted in the Apollo 1 command module on the launch pad, destroying the module and killing astronauts Grissom, White, and Chaffee. On October 11, 1968, Apollo 7 was the first 3-person American space mission. In December 1968, Apollo 8 was the first manned circumlunar flight. The crew constituted the first humans to see the far side of the Moon and the Earth-rise over the lunar horizon with their own eyes. Live television pictures were broadcast to Earth. On March 3, 1969, Apollo 9 was launched. During a 10-day flight in Earth orbit, the Lunar Module (LM) and the Portable Life Support System were tested. Apollo 10 was launched on May 18, 1969. Its manned LM was flown around the Moon and descended to a height of 15.6 km from the lunar surface without landing. On July 16, 1969, Apollo 11 started its journey. On July 20, 1969, the LM landed for the first time on the Moon in the Sea of Tranquility. Astronauts Armstrong and Aldrin exited in the direct vicinity of the LM. Apollo 12, launched on November 14, 1969, landed on the Moon in the Ocean of Storms, near the Surveyor 3 probe. In two Extra Vehicular Activities (EVAs), the astronauts recovered portions of Surveyor and returned to Earth. Launched on April 11, 1970, Apollo 13 mission was aborted. During the trip to the moon a Service Module oxygen tank exploded. After a single loop around the moon, the LM was used as a 'lifeboat' and the astronauts returned safely. Apollo 14, launched on January 31, 1971, landed at Fra Mauro, where two EVAs were performed. Apollo 15, launched on July 26, 1971, explored the Hadley–Apennine area of the Moon. It was the first mission where the Lunar Roving Vehicle was used. Apollo 16, launched on 16 April 1972, landed in the Descartes Highlands and performed 3 lunar EVAs and one deep space EVA. Apollo 17 was the final Apollo lunar mission, which landed at Taurus–Littrow in December 1972. The astronauts performed three lunar EVAs and one deep space EVA. Apollo 2, 3, 18, 19 and 20 planned missions were canceled for a variety of reasons, technical and financial included. Since then no further manned space missions to the Moon were ever realized.

All the manned flights were covered with a large number of images, video recordings and live TV broadcast. This evidence, (although largely questioned) can be found electronically in well-organized libraries, where they can be easily downloaded (Apollo Image Atlas, Lunar and Planetary Institute, 2017; Apollo Lunar Surface Journal, 2017). To commemorate the 40th anniversary of the Apollo 11 mission Google, on July 20, 2009, introduced the Google Earth version of Google Moon (Google Moon, 2017; NASA, 2009). The today's version of Google Moon can be viewed using the Google Earth client, in a similar way as when viewing the Earth. There are though drawbacks that can be recognized instantly, as for example the high resolution and the 3D features that do not work for the majority of the lunar surface but are limited to the very few areas of the Apollo mission landing sites. Also, although the sunlight across the landscape works, the length of the lunar day is not correct. The aforementioned facts along with the fact that by now a very high-resolution mapping could be made available, but is not, raises questions on whether the American space exploration Authorities really wish to share their valuable information about the Moon with Google public.

It must be noted that the elevations shown on maps of the Apollo era were constructed with respect to a sphere of radius 1738 km (centered at the lunar center of mass). The value of 1738 km was then used because it was thought to be the mean radius of the lunar limb (Roberson & Kaula, 1972, p. 25-49). Today, the digital elevation model (DEM), which is based on data from the Lunar Orbiter Laser Altimeter, shows elevations computed by subtracting the lunar reference radius of 1737.4 km from the surface radius measurements. In this way, elevation values are the distance above or below the reference sphere. The average accuracy of each point after crossover correction is better than 10 meters in horizontal position and ~1 meter in radius (U.S. Geological Survey, Astrogeology Science Center, 2017).

Lunar and Planetary Institute (Kring D. A., Lunar Surface Flyovers. Lunar and Planetary institute, 2017), developed image processing capabilities that allow stitching of photographs together and draping them over terrain models to produce 3-dimensional (3D) scenes through which one can digitally fly. This method provides spectacular views of the lunar surface and offers a new tool for scientists to study the moon. Mission planners can also select landing sites and design robotic and crew *routes*.

The very large number of space missions that has been completed successfully by now provides a detailed knowledge of the surface of the Moon. The details of robotic and human spacecraft missions that have been sent to the Moon to explore the lunar surface and determine the Moon's origin, given by the Lunar and Planetary Institute, can be found in "Details of robotic and human spacecraft missions" (Lunar and Planetary Institute, 2017).

In this paper, we compare the 3D scenes simulated in Google Moon with the actual photographs taken by the Apollo astronauts. We find a number of anomalies that cannot be explained with today's technology. We further examine specific details of some Apollo photographs, which can lead one to the conclusion that there was a staging of the Apollo missions. In section 2 we present three software tools and two charts from where topography (elevation data and graphs) can be obtained. Their accuracy is examined. In section 3 we compare some Apollo photos to simulated views created in Google-Moon observing that the photos can only show elevation details of the order of 10 m or more. Section 4 deals with the photographic analysis of other Apollo mission photos. We conclude with section 5.

2. Topographic Software Tools Comparison

In Google Moon, elevation layers were created using images and data that were aligned to the Unified Lunar Control Network 2005 (Google Moon, 2017). For the plotting, a spherical moon with a radius of 1737.4 km was assumed (Archinal et al., 2006, p.3). Since Google Moon will extensively be used in Google Earth client for the simulations and since not all features of the Google Earth client function correctly on the Moon, we examine the functionality of latitude, longitude, elevation and elevation profile of Google Moon comparing them to other programs. Programs that give this kind of information are:

(a) The online, NASA application Moon Trek (Moon Trek, 2017) that allows one to view imagery and perform analysis on data from the Moon.

(b) Alcyone Lunar Calculator, evaluation version (e.v.) (Alcyone Lunar Calculator, 2017), that provides detailed astronomical information on the Moon, including high-resolution Lunar topographic information based on images taken by NASA's Lunar Reconnaissance Orbiter Camera (LROC). In addition, it offers graphical capabilities in 2D and 3D.

We present below a comparison of the Bear Mountain. Figure 1(a) shows the mountain in Google Moon, and a section from point 1 (19.900000°N, 30.700000°E, at a (relative) elevation of –2380m, see Introduction), to point

2 (20.000000°N, 30.800000°E, at –2360m elevation). At the highest point of the section the elevation is –2204m. The difference in elevation, therefore, between the highest point of Bear Mountain and points 1 and 2 is 176m and 156m respectively. The difference between point 1 and point 2 is 20m.

Figure 1(b) shows the mountain in Moon Trek and a section from point 1 (19.90000°N, 30.70000°E), to point 2 (20.00000°N, 30.80000°E). The accuracy of the point positions is diminished by a digital place compared to that of Google Moon, but the elevation of points 1 and 2 are about –2595m and –2520m respectively.

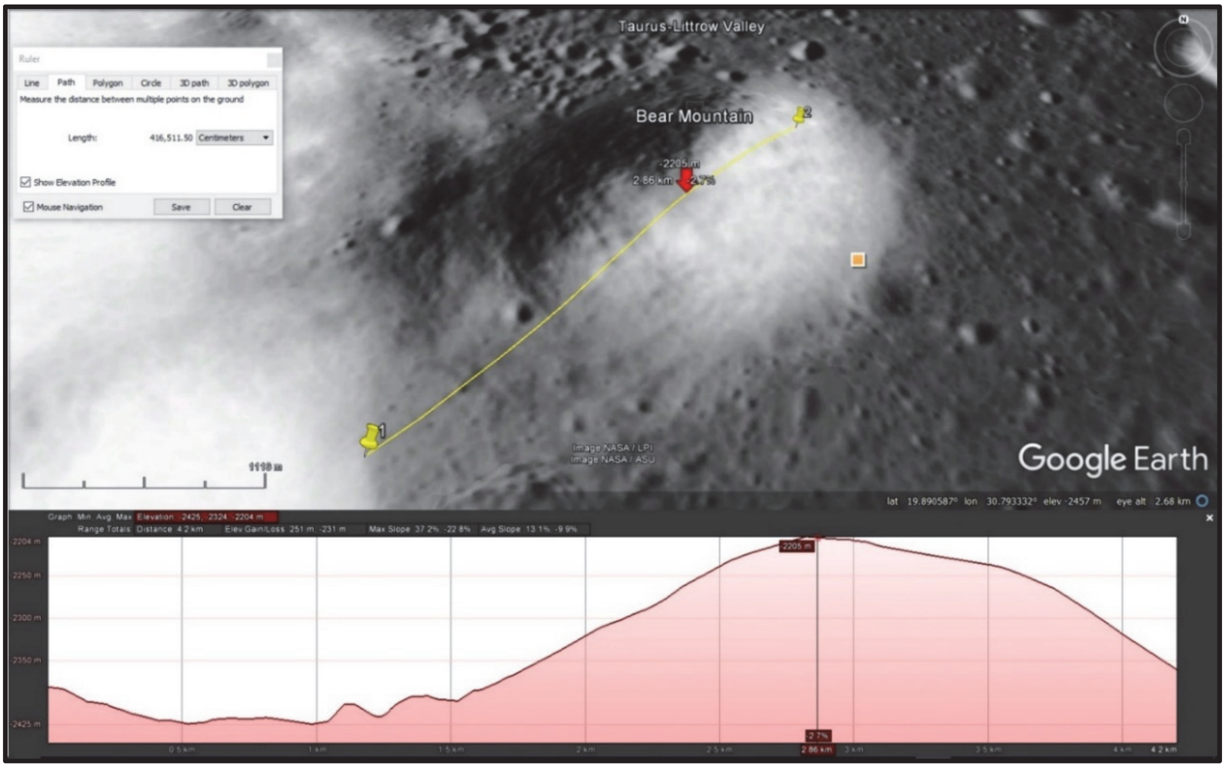


Figure 1(a). Bear Mountain in Google Moon, and a section from point 1 (19.900000°N, 30.700000°E, at –2380m) left, to point 2 (20.000000°N, 30.800000°E, at –2360m elevation) right

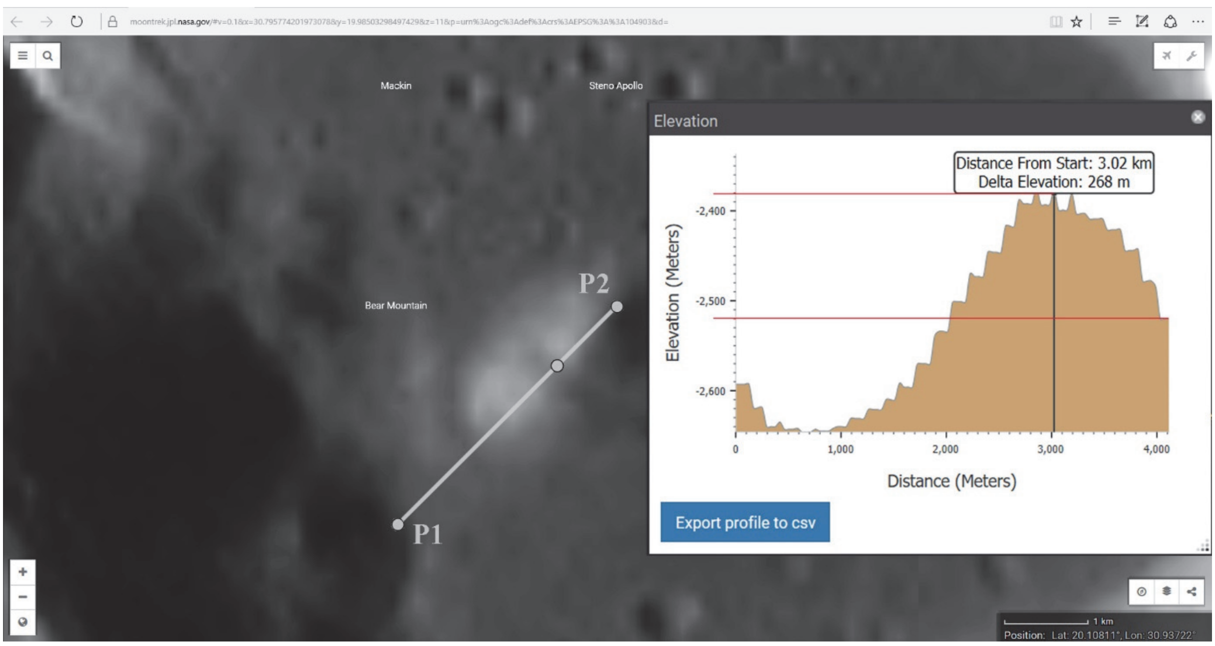


Figure 1(b). Bear Mountain in Moon Trek, and a section from point 1 (19.90000°N, 30.70000°E), to point 2 (20.00000°N, 30.80000°E). The elevation of point 1 is about –2595m and that of point 2, –2520m

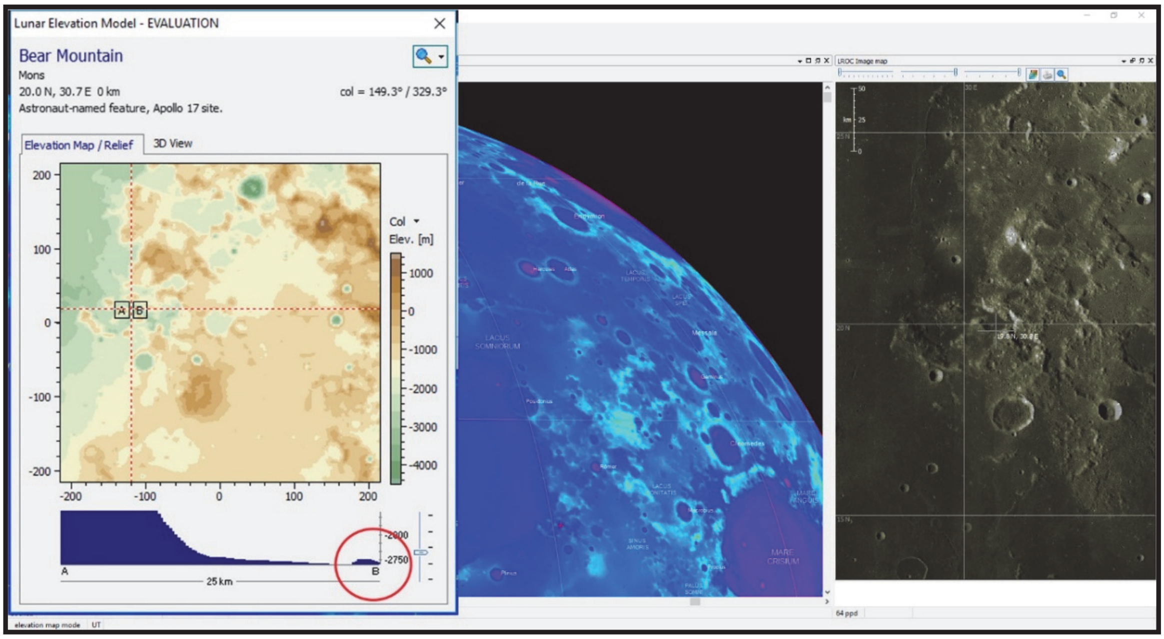


Figure 1(c). Bear Mountain in Alcyone Lunar Calculator (e.v.) and a section with the highest peak at about –2750 m (in red circle). Point 1, at 19.9°N, 30.7°E, has an elevation of –2600m and point 2, at 20.0°N, 30.8°E, an elevation of –2700m

At the highest point of the section the elevation is about –2380m. The difference in elevation, therefore, between the highest point of Bear Mountain and points 1 and 2 is 215m and 140m respectively, close values to those shown in Google Moon. The difference between point 1 and point 2 is about 75m.

Figure 1(c) shows the mountain in Alcyone Lunar Calculator (e.v.) and a section with the highest peak at about –2750m. Point 1, at 19.9°N, 30.7°E, has an elevation of –2600m and point 2, at 20.0°N, 30.8°E, an elevation of –2700m. This software has an accuracy of 0.1° and the elevation is a mean value. The section of Bear Mountain is again a rough representation.

The above comparison shows that none of the available software has better resolution accuracy than that of Google Moon (0.000001°). Moon Trek gives a logical saw cross section that has the same general shape with that of Google Moon. Alcyone Lunar Calculator (e.v.) gives elevation values compatible with Google Moon, although the cross section does not have the required accuracy.

Furthermore, Google Moon results are compared to the Chang'E-1 (an unmanned Chinese lunar-orbiting spacecraft, 2007-2008) Topographic Atlas of the Moon (Li et al., 2015). This atlas is based on the lunar global Digital Elevation Models (DEM) of Chang'E-1 (CE-1), and presents CCD stereo image data with digital photogrammetry. The spatial resolution of the DEM in this atlas is 500m, with horizontal accuracy of 192m and vertical accuracy of 120m. Color-shaded relief maps with contour lines are used to show the lunar topographical characteristics. Bear Mountain location is given as 20°00′ N and 30°42′ E (figure 2), with an elevation of about –2500m – very near the Google Moon value.

Finally, Google Moon results, are compared to the topophoto 43D1S1(50) of Apollo 17 Landing Area (Apollo 17 Landing Area, 43D1S1(50), 2017), shown in figure 3. The highest point of the mount is at 4976m and the lowest at 4700m, giving a height of 276m. In Google Moon, the corresponding points are, for the highest point –2190 m and the lowest –2510m, giving a height of 320m. It must be mentioned that the topophoto map and contour elevations are derived from radius vectors from the mass center of the moon, as referred to an arbitrary zero vertical datum of 1730000m. (For example, the map elevation of a point with a radius vector length of 1734700 is derived by subtracting 1730000m, yielding 4700m). Also observe that a lot of small features observed around the Bear Mountain are ignored by the elevation contours.

From the above discussion we can safely conclude that Google Moon is operated with the most advanced, dependable, and precise software available at present and gives a realistic presentation of the Moon surface. Longitude, latitude, elevation and elevation profiles are the most reliable at present for use by the public.

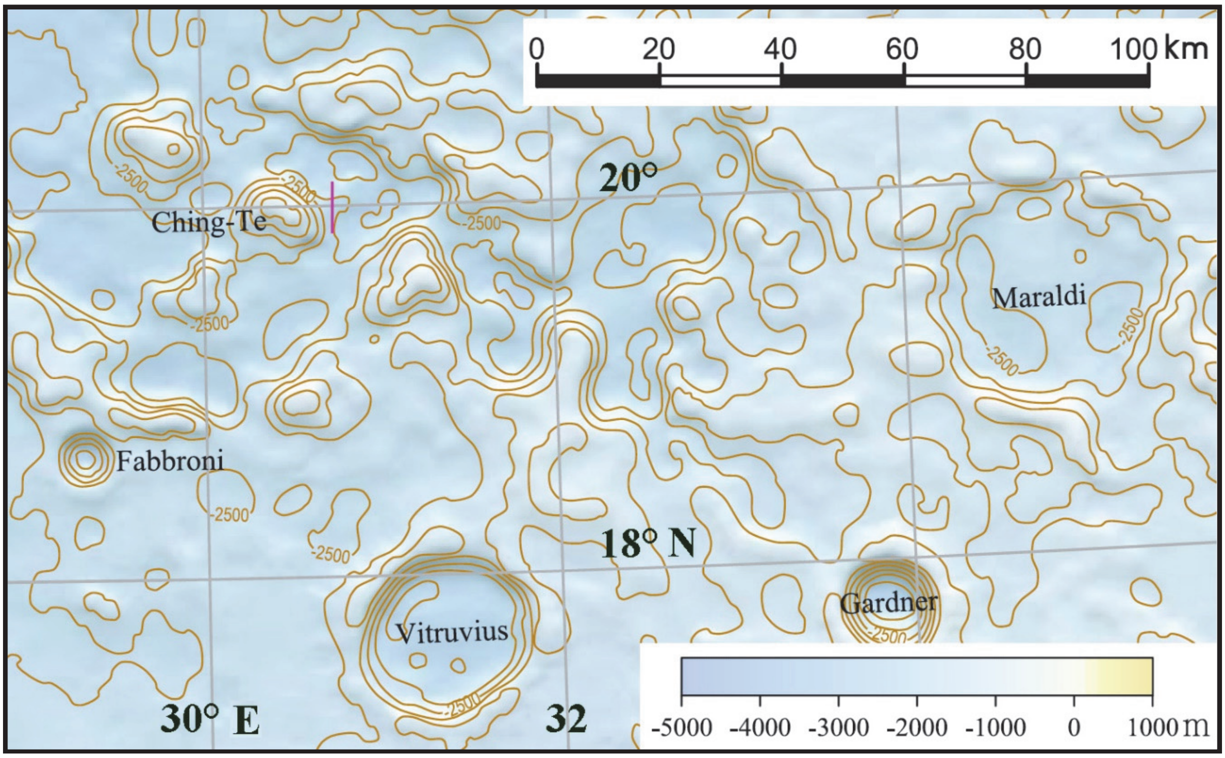


Figure 2. The Chang'E-1 Topographic Atlas of the Moon (Li et al., 2015). Bear Mountain (marked with the cross of the purple line with 20°N grid line, indicating an elevation of about –2500m

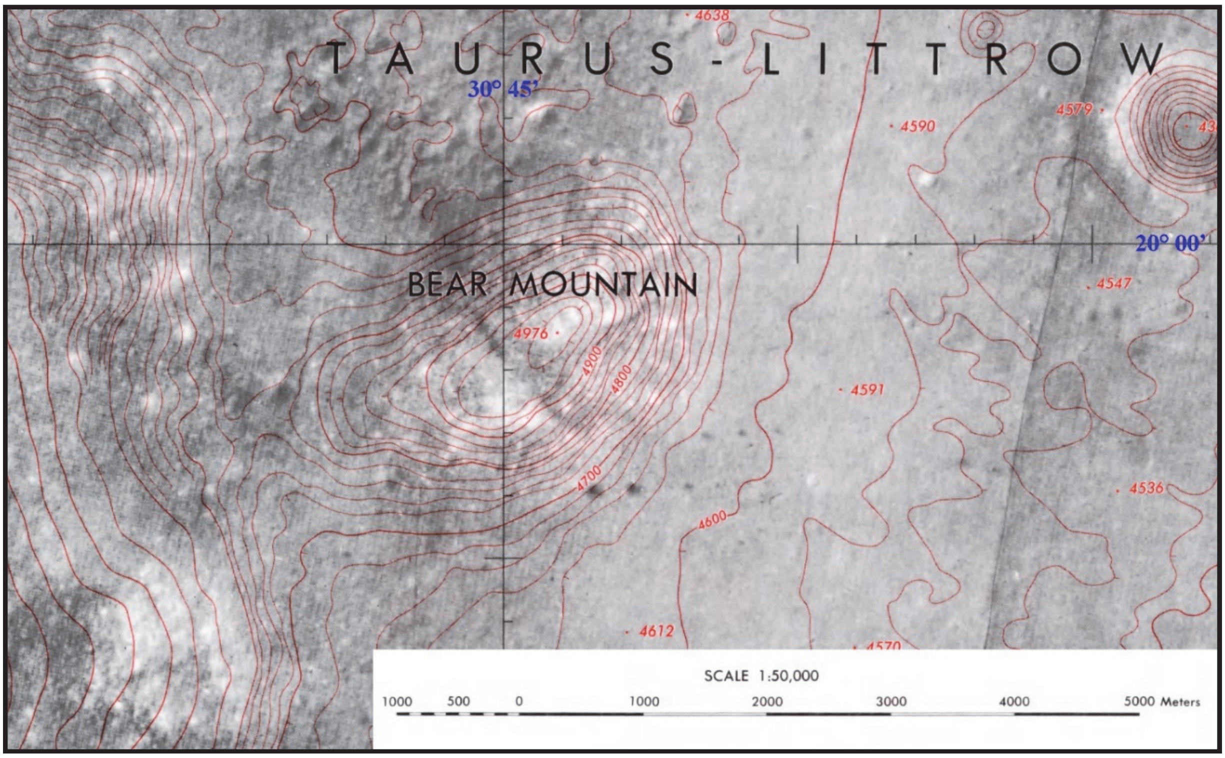
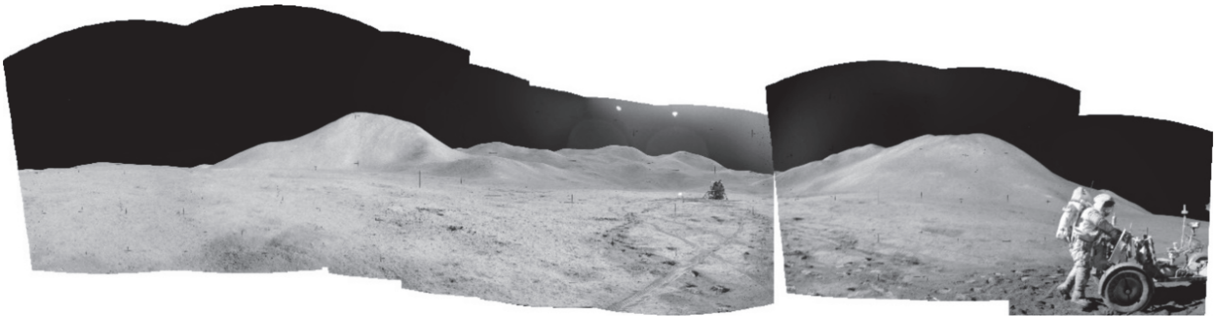


Figure 3. Topophoto 43D1S1(50) of Apollo 17 Landing Area (Apollo 17 Landing Area, 43D1S1(50), 2017). The highest point of the mount is at 4976m and the lowest at 4700m

3. Comparison of Actual Photos to Simulated Ones with Regard to Topography

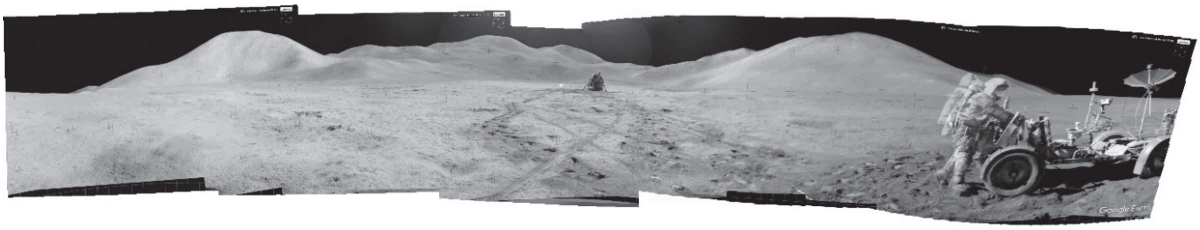
In this section, actual mission photos from Apollo 15, 16 and 17 will be compared to simulation images created in Google Moon and combined in Adobe Photoshop® (Adobe Photoshop®, 2017).

In Apollo 15 mission, Jim Irwin retook the Station 8 pan with Dave Scott's camera, starting with photo AS15-82-11047, toward the drill-stem rack. The panorama ends with photo AS15-82-11064 (Apollo 15 Map and Image Library, 2017). An assemblage of the photos was photo-merged in Adobe Photoshop®. The panorama of the View from the ALSEP site, embedded in Google Moon, was reproduced. The scene was also simulated in Google Moon. All three results are shown in figure 4.

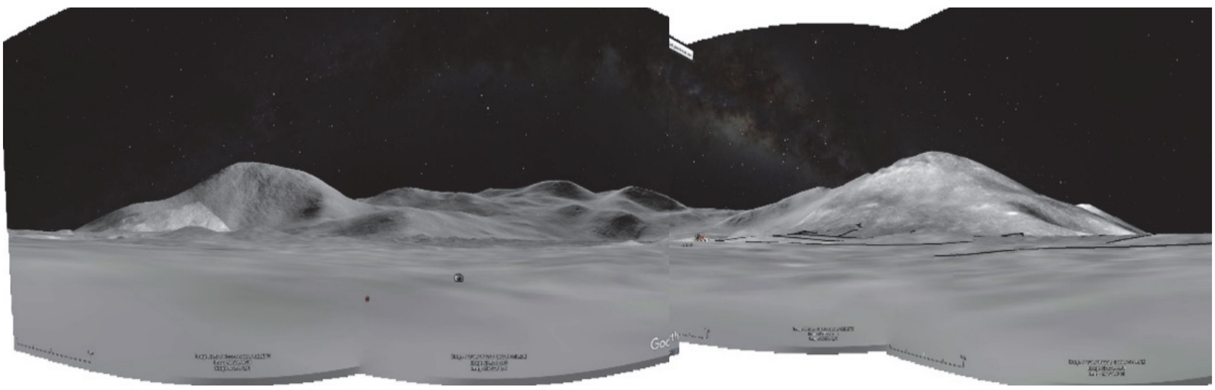


A B

(a) Panorama of photos AS15-82-11048 to 63. Photoshop® photo-merge constructs two panoramas A and B that can be placed next to each other



(b) View from the ALSEP site, constructed by photo-merging individual parts of the panorama photo shown in Google Moon



(c) View from the ALSEP site, constructed by photo-merging individual parts of the simulated view shown in Google Moon

Figure 4. Panorama of photos AS15-82-11048 to 63 compared to the panorama photo and the simulated view shown in Google Moon

One can observe that the actual photos merged in Photoshop®, were also used for producing the panorama in Google Moon. The simulated scene shows some basic differences. Enlargements (figure 5) indicate these differences.

It is difficult to explain why the irregularities shown in figure 5 are not recorded on the actual photos, unless Google Moon elevations or the indicated position of the photographer are wrong.

Figure 5. A

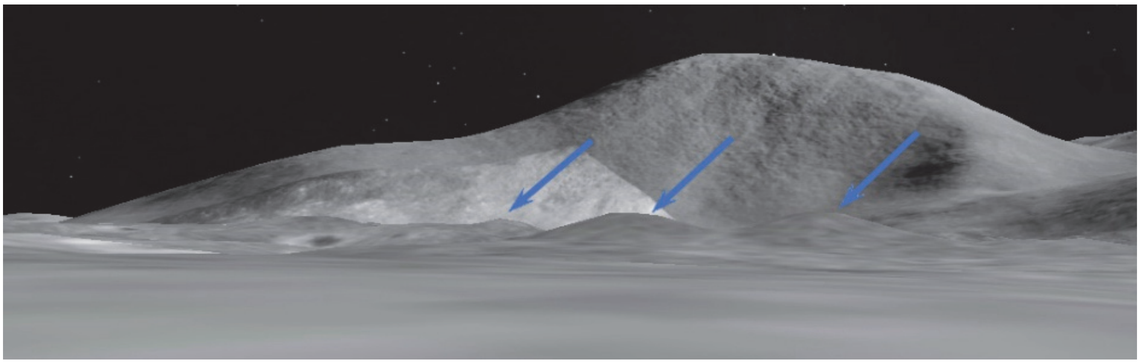


Figure 5. B

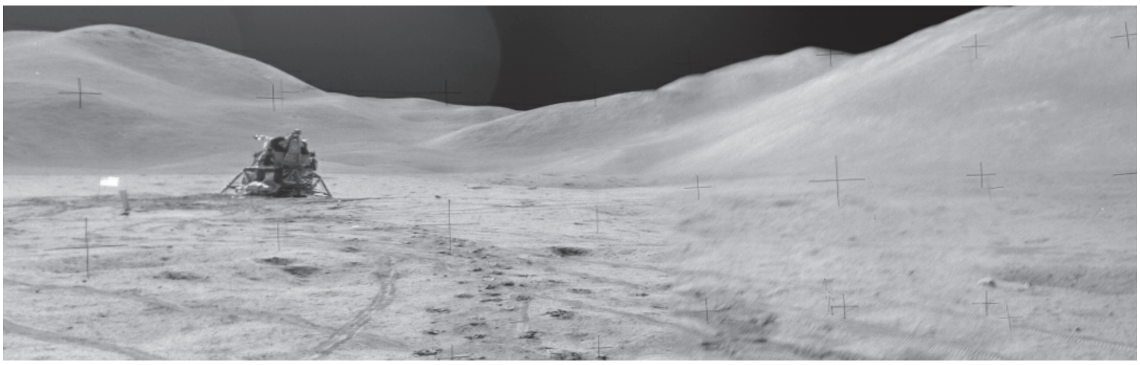


Figure 5. C

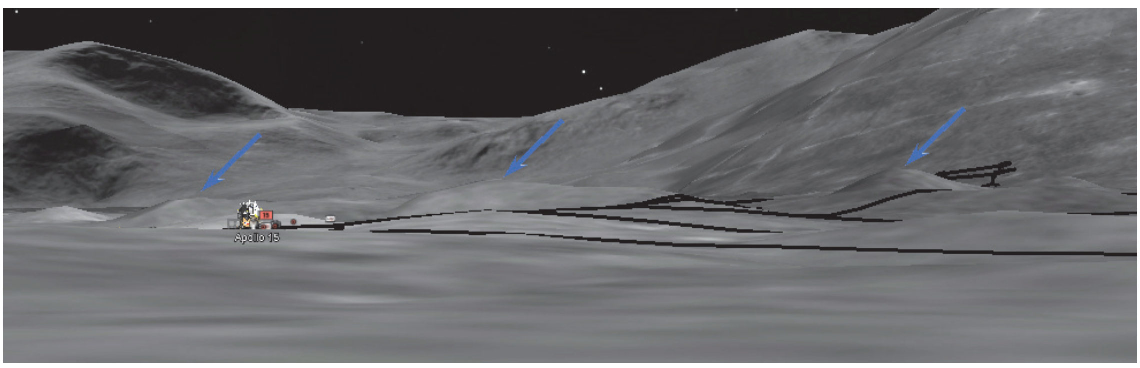


Figure 5. D

Figure 5. Comparison of the actual Apollo 15 photos embedded in Google Moon (A and C), forming the panorama of the View from the ALSEP and the simulated view created in Google Moon (B and D). The blue arrows in the simulated views show land features that should have been recorded in the photos

We proceed now with another set of photos taken from another angle to see if in this case the inconsistencies are recorded. We present in Figures 6 (a)-(c) three parts of the panorama of the Annotated landing site, by comparing the actual Apollo 15 panorama photos embedded in Google Moon and the simulated view created in Google Moon. Figure 6 indicates that the simulated view created in Google Moon shows extra features (marked in blue arrows) that are not recorded in the actual Apollo 15 panorama photos embedded in Google Moon.

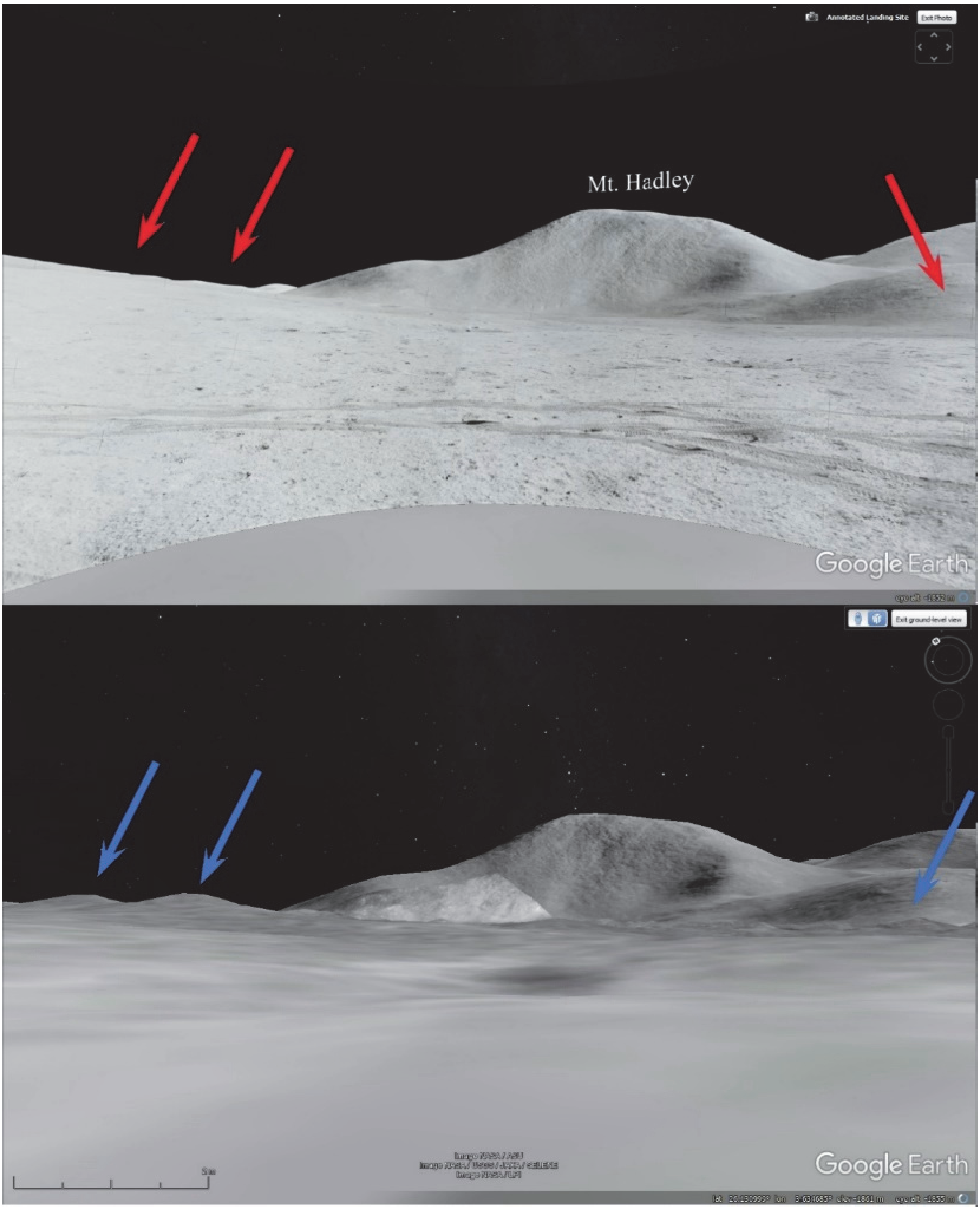


Figure 6. (a) The part of mount Hadley of the panorama of the Annotated landing site. In the actual Apollo 15 panorama photos embedded in Google Moon (top) are marked with red arrows the positions of the missing land features. The simulated view created in Google Moon shows extra features marked in blue arrows (bottom)

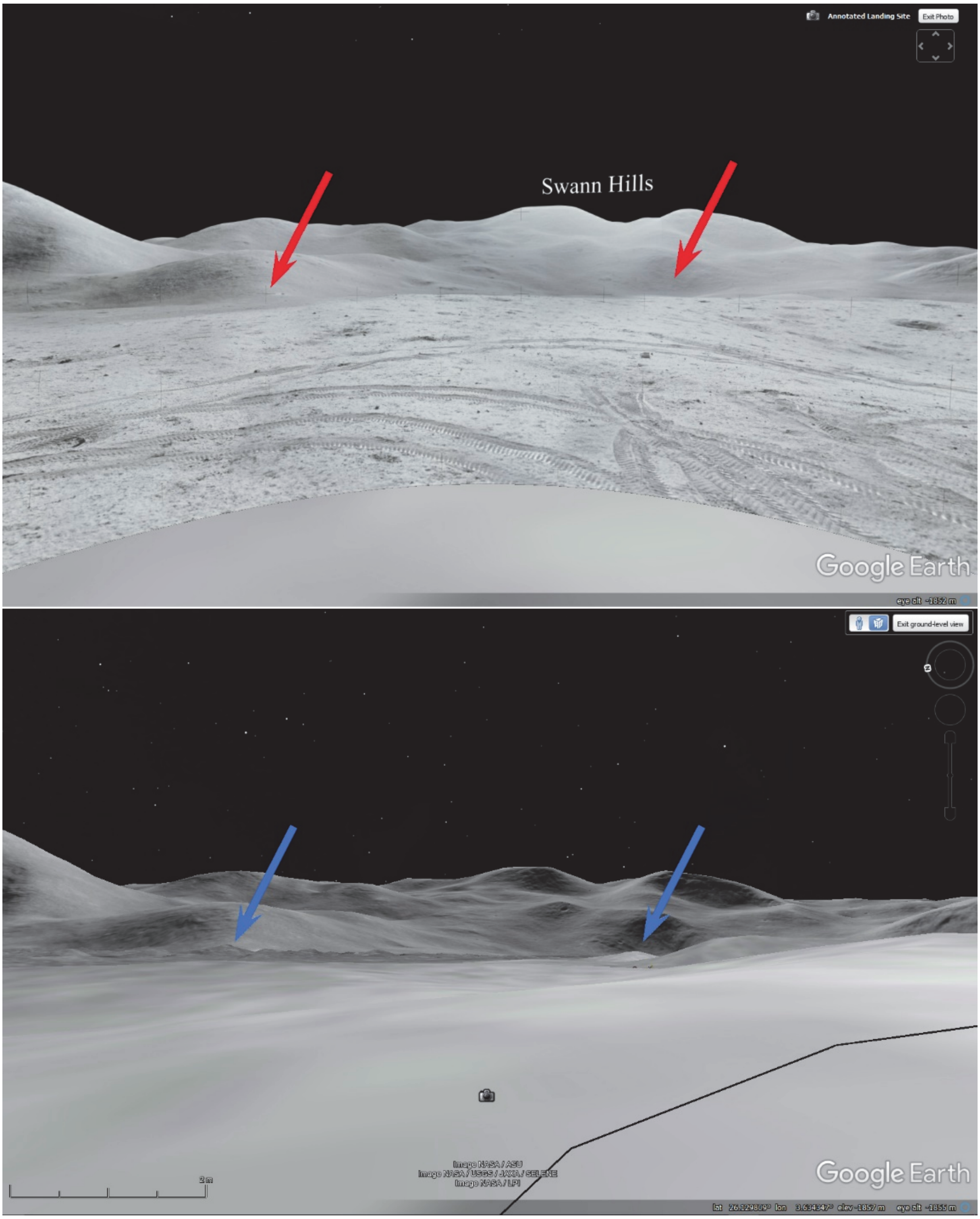


Figure 6. (b) The part of Swann Hills of the panorama of the Annotated landing site. In the actual Apollo 15 panorama photos embedded in Google Moon (top) are marked with red arrows the positions of the missing land features. The simulated view created in Google Moon shows extra features marked in blue arrows (bottom)

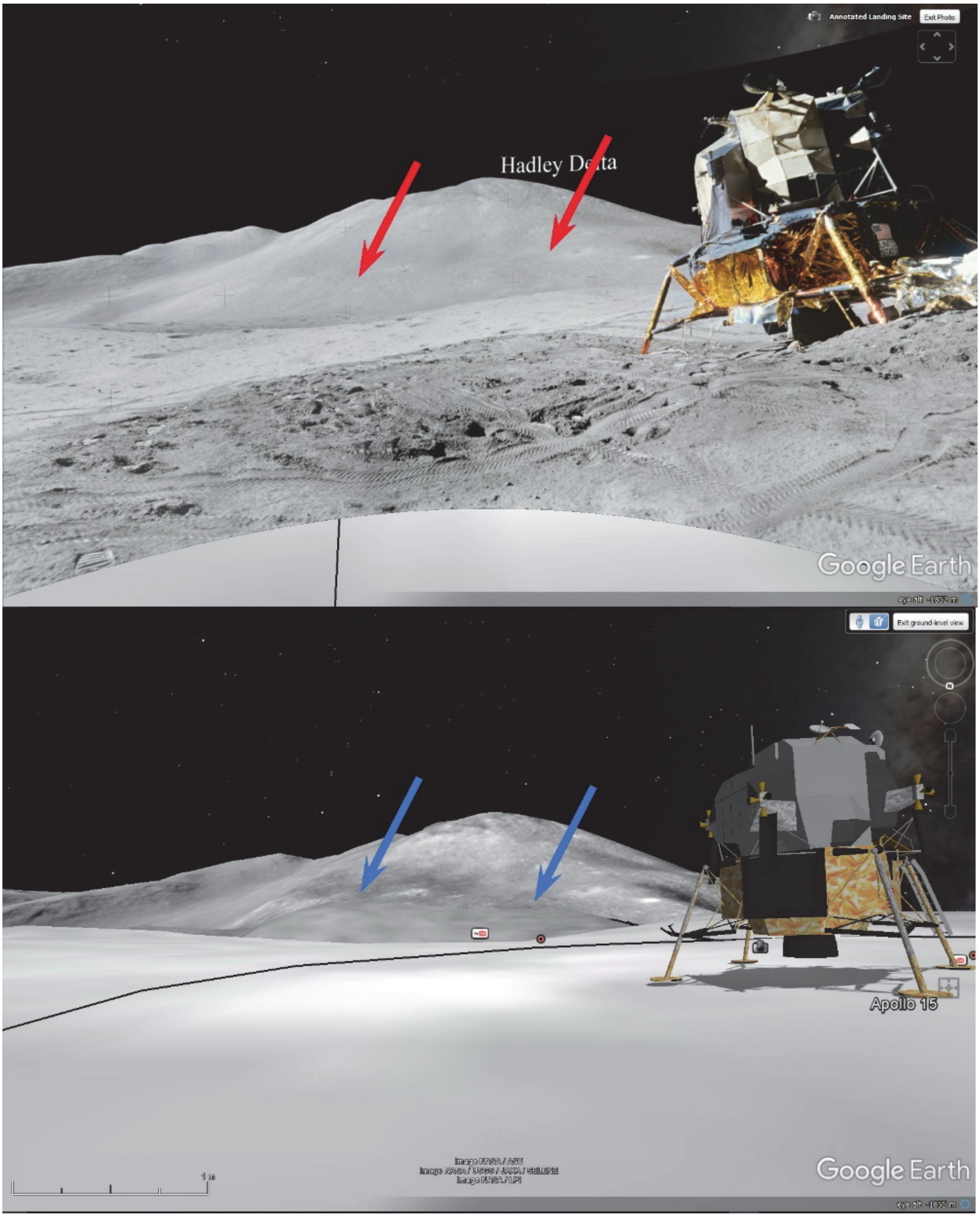
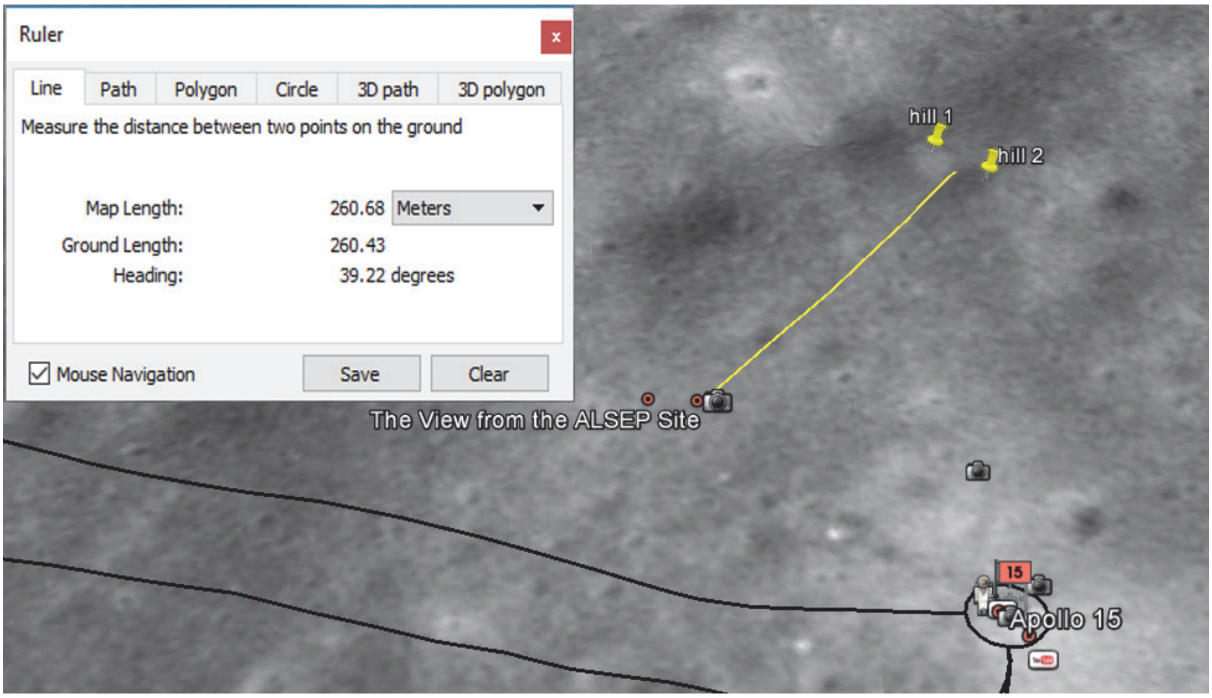
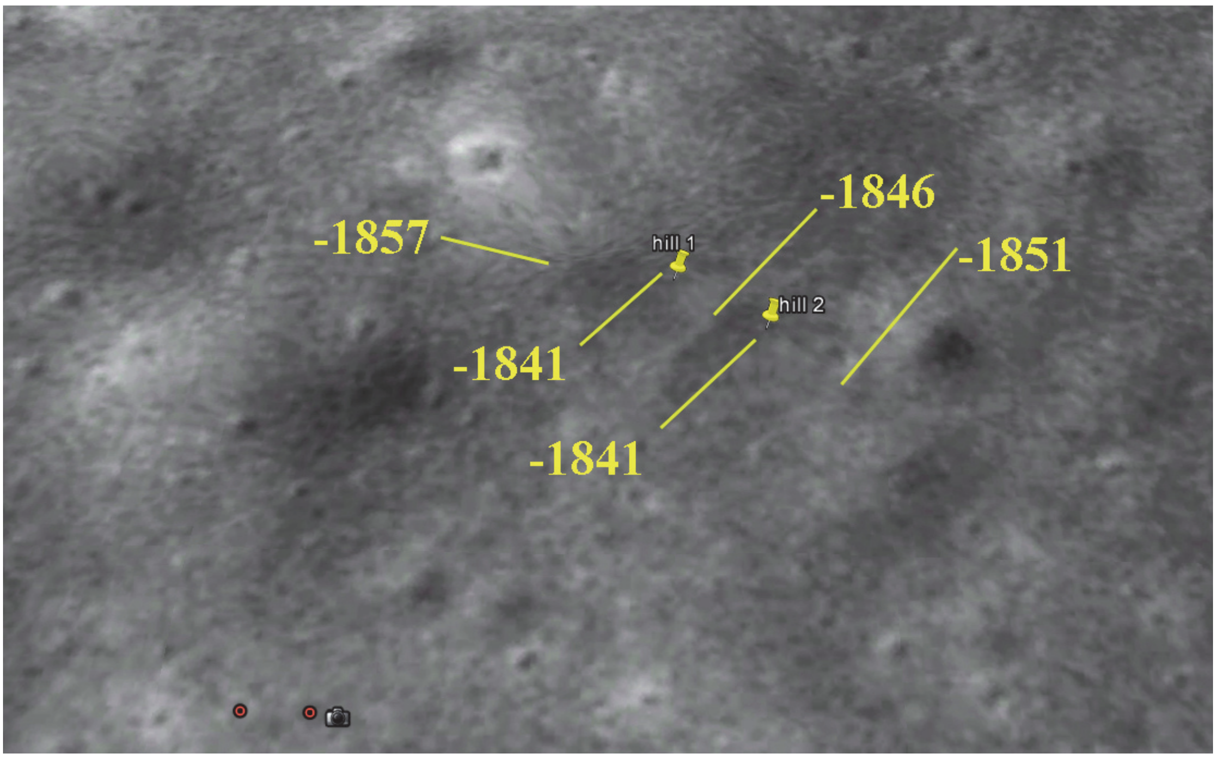


Figure 6. (c) The part of Hadley Delta of the panorama of the Annotated landing site. In the actual Apollo 15 panorama photos embedded in Google Moon (top). The simulated view created in Google Moon shows extra features marked in blue arrows (bottom)

We will now examine in detail the hills observed in figure 6(a). Figure 7(a) shows that the distance of the two hills from the camera was 261m. The hill elevations are indicated in figure 7(b) and, as shown, the topography of the area is complex with the hill tops being at about 5m higher that the fold in between them.

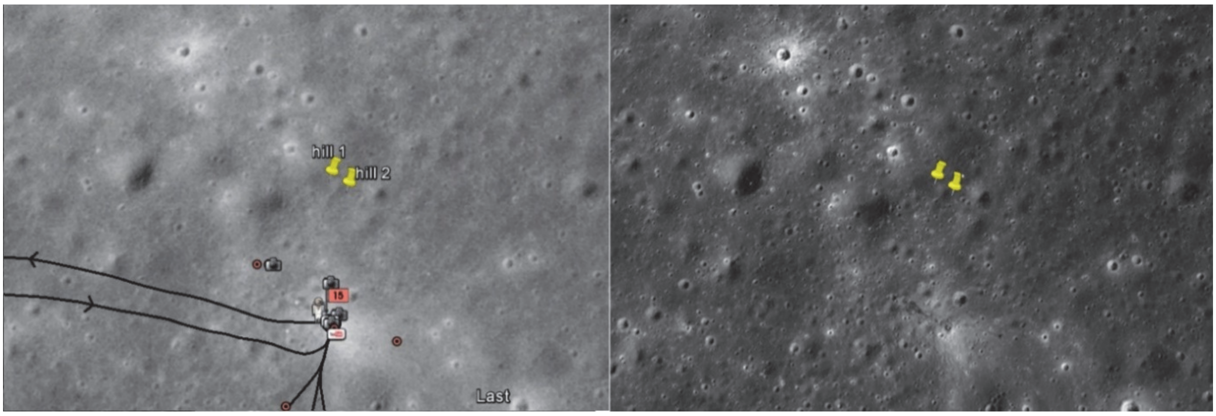


(a)

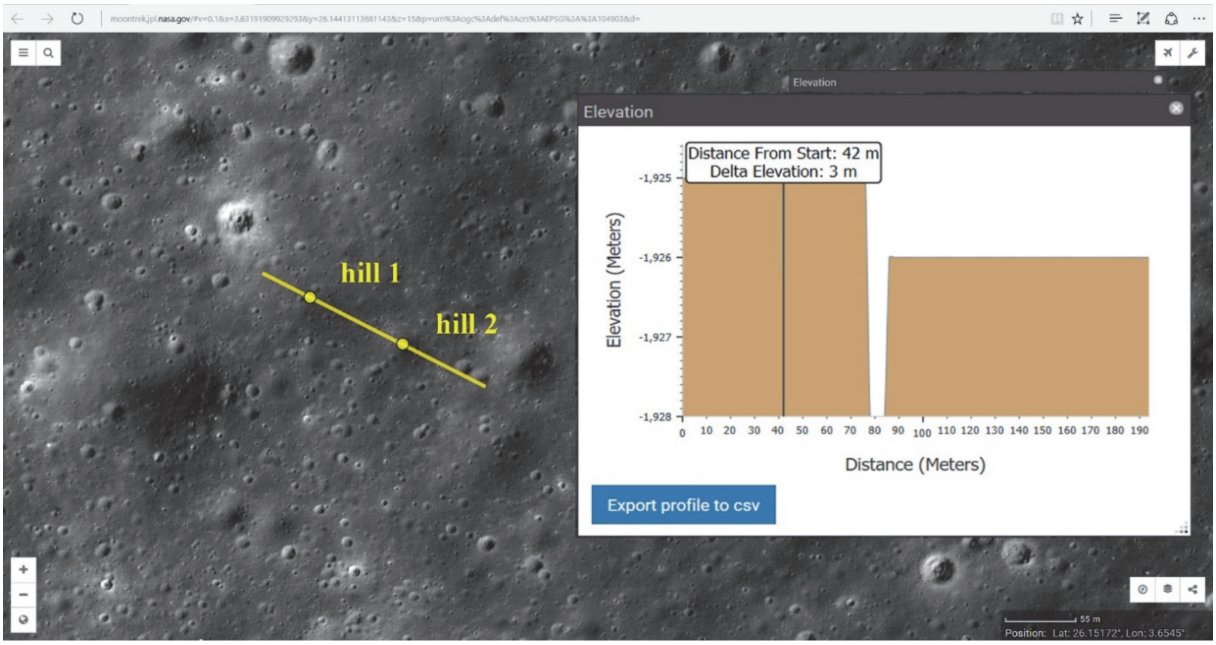


(b)

Figure 7. (a) The distance of the two hills from the camera was 261m. (b) Close-up of (a) showing a complex topography with the hill tops being at about 5m higher that the fold in between them



(a)

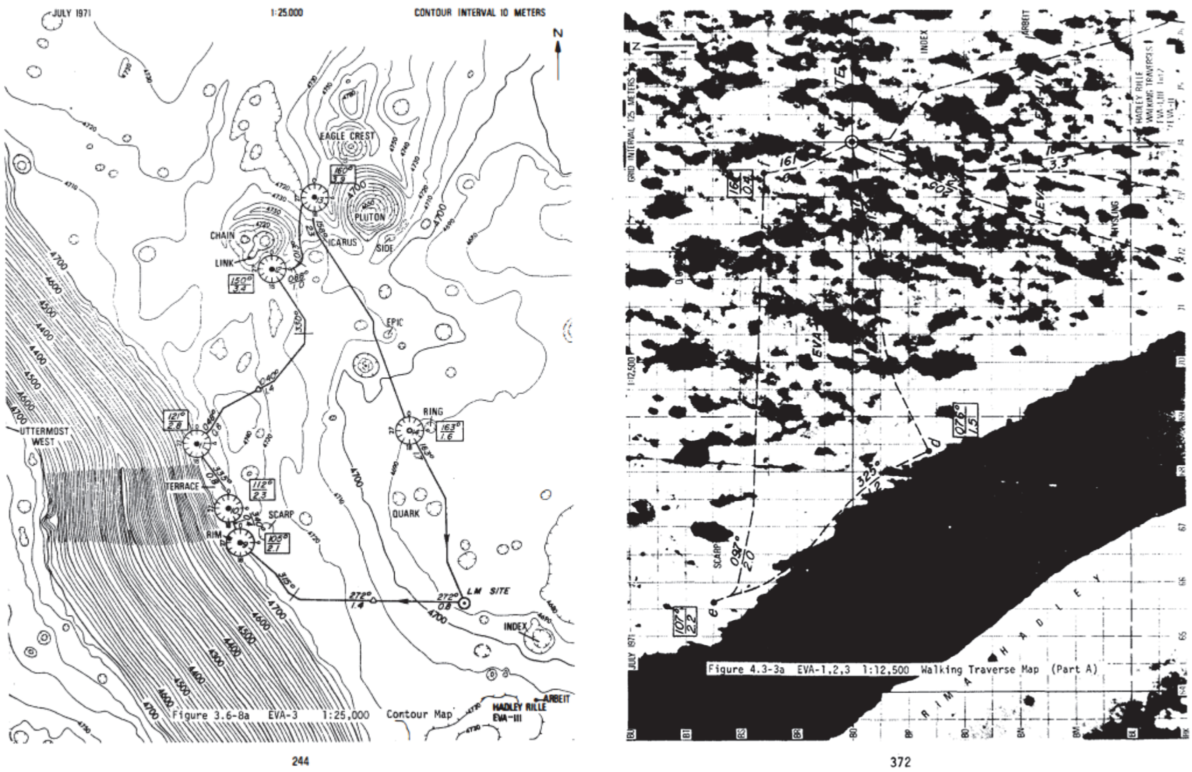


(b)

Figure 8. (a) “Area matching by superposition” of simulated hills in Google Moon (left) to the excellent magnification of the photos of Moon Trek (right) verifies the position of two slight shadows and the hills recorded in the photos. Notice that the Moon Trek photo also shows the traces of the Apollo mission left on the ground. (b) A section through the hill tops shows that the tops are at about 3m higher than the fold in between them

A representation of the above area in Moon Trek is shown in figure 8(a) where, applying “area matching by superposition” in Photoshop® of the simulated hills in Google Moon to the detailed photos of Moon Trek, verifies the position of two slight shadows and the hills recorded in the photos. Figure 8(b) shows a section through the hill tops, where the tops are at about 3m higher than the fold in between them.

One could suggest that the tools/data used to construct any simulation model in the Apollo era were not as accurate as the ones that NASA now possesses. To investigate this possibility let us examine the data available in 1971 when Apollo 15 flew. Available maps of the time are shown in the Apollo 15 Final Lunar Surface Procedures document (NASA, 1971. p. 244 & p. 372), a selection of which is reproduced in Fig 9. The best possible (elevation) difference between contours was 20m with a scale of 1:25000 and not much detail. The walking Traverse map with the greater scale (1:12500) shows only basic surface irregularities.



Walking Traverse Contour map, scale 1:25000. Contour difference of 20m

Walking Traverse map, scale 1:12500

Figure 9. The Apollo 15 Final Lunar Surface Procedures document (NASA, 1971. p. 244 & p. 372), includes the maps of the time. Not much detail could be shown and the best contour difference was at 20m. The walking Traverse map with the greater scale shows only the basic surface irregularities.

Nowadays NASA possesses very accurate measurements of the moon's complex landscape. For instance, NASA's Lunar Reconnaissance Orbiter is allowing researchers to create maps with an accuracy of 1m vertically (NASA's Lunar Reconnaissance Orbiter, 2017).

We proceed subsequently to the Apollo 16 mission. The landing site here is fairly flat, with mountains far from the landing site. The closest mountain is the Stone Mountain, with its foot at a distance of about 3 km. On the mountain slope facing the lander is the Cinco Crater (figure 10), near which a series of photos was taken to form a panorama. The panorama is embedded in the photos of Google Moon, a portion of which is presented in figure 11(a) where the South Ray Crater is clearly seen from the position the photos were taken. Figure 11(b) shows the simulated view from the same place as above, but the South Ray Crater is not visible.

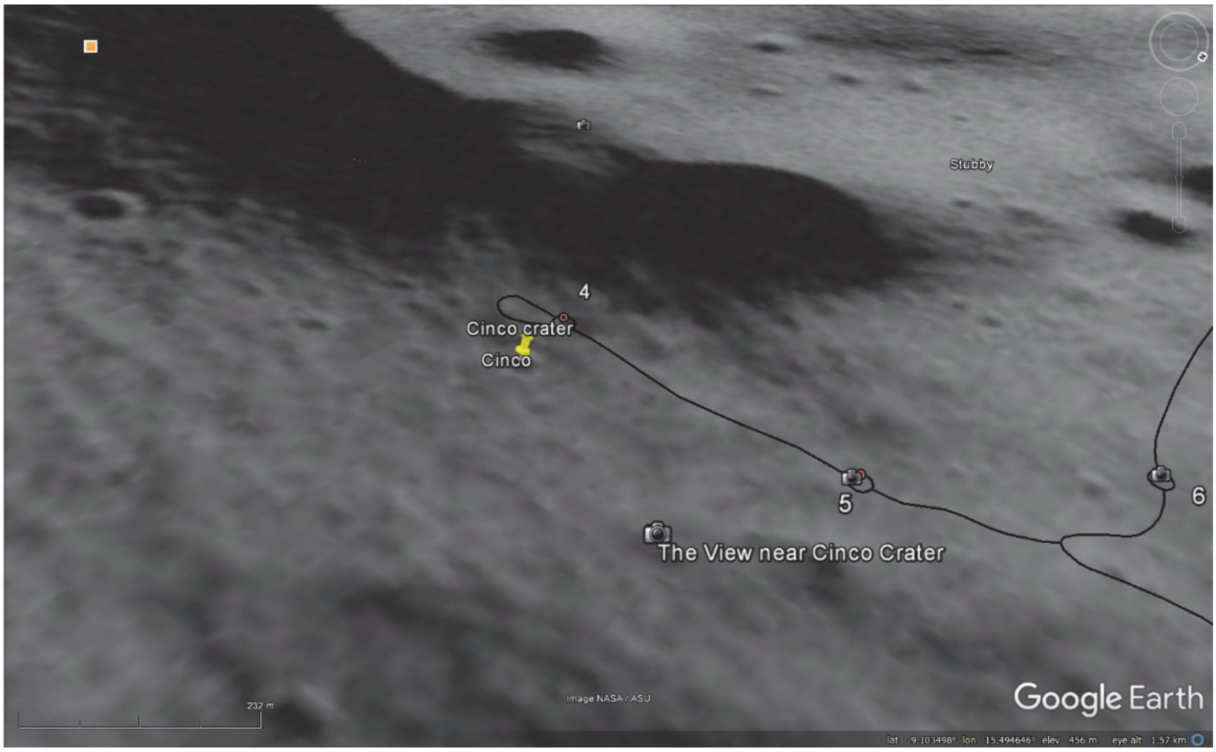


Figure 10. Google Moon simulation showing the position of Cinco Crater near Station 4 and the position of the "view near the crater," were the photo was taken

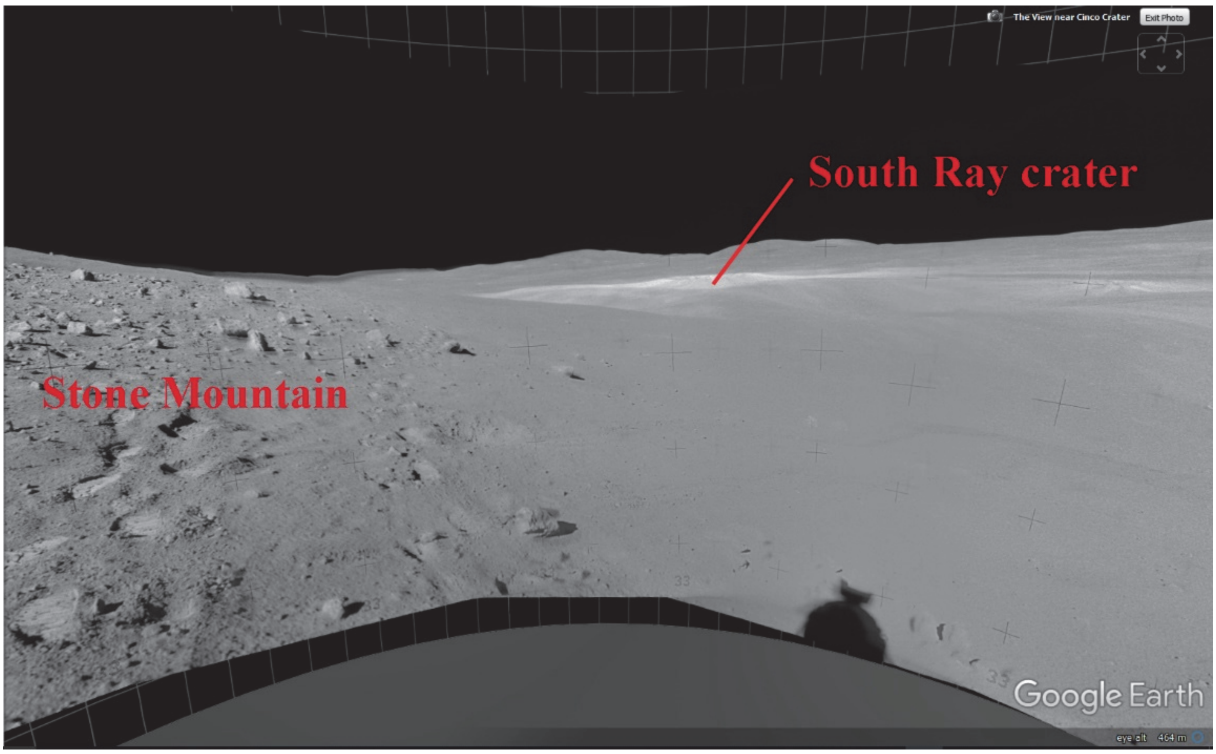


Figure 11. (a)

Figure 11. (b)

Figure 11. (a) Part of the panorama embedded in the actual photos of Google Moon showing the "view near the Cinco Crater." The South Ray crater is clearly seen from this position. (b) Simulated "view near the Cinco Crater," but the South Ray Crater is not visible from this position

A Google Moon simulation in figure 12 shows the elevation between the crater and the "view position." The elevation of the ridge of Stone Mountain at that site is 454m, whilst the elevation of the "view position," where the photos were taken is only 439m and, hence, the view of the South Ray Crater is completely obstructed.

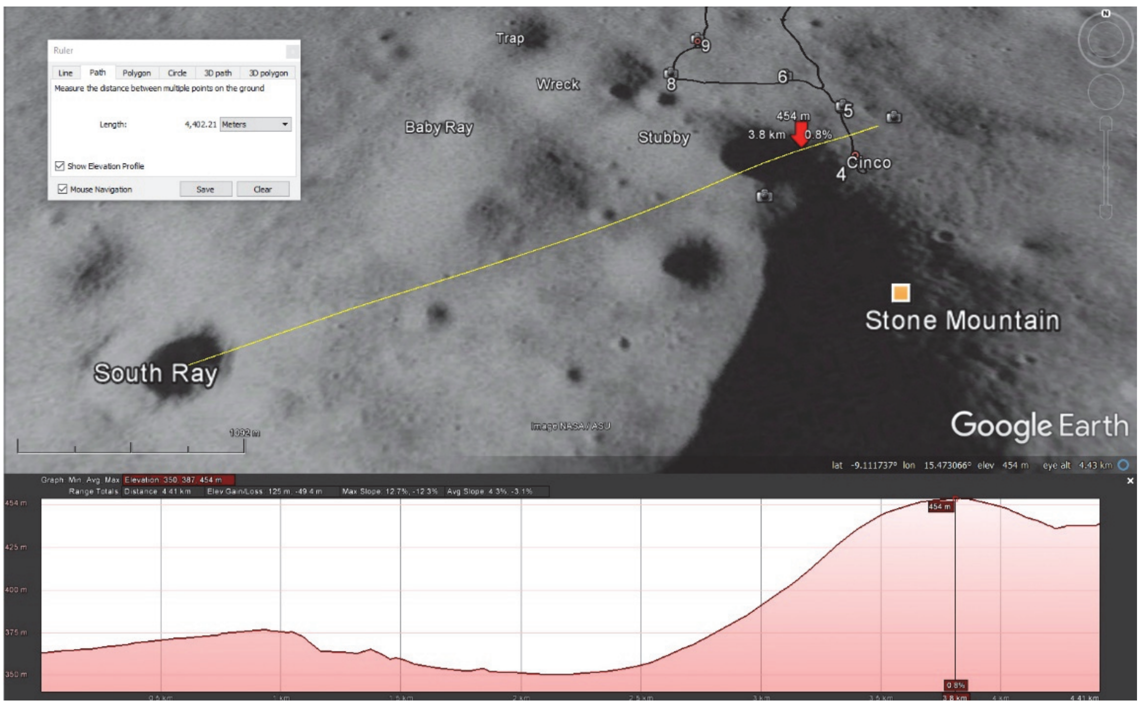


Figure 12. The contour of the surface between the South Ray Crater and the "view position" near the Cinco Crater. The ridge of Stone Mountain is higher by 15m from that of the "view position," obstructing the view of the South Ray Crater completely

In Apollo 16 Image Library (Apollo 16 Image Library, 2017) is mentioned that the photos were taken from Station 4 and were assembled in Charlie's Station 4 Pan (frame numbers AS16-110-17952 to 17974). Station 4's view is also obscured by the same ridge that prevents observation from the "view position" near the Cinco Crater. Another way of showing this is to use the excellent tools of Google Moon; in this case, the "add polygon" facility that covers the surface area like a blanket in a different color. Figure 13(a) shows the area (in green *cover*) from the two places, alleged to be the points where the photos viewing the South Ray Crater were taken from. As observed in figure 13(b), which shows the green area as seen from the top of the Stone Mountain, Station 4 is on the right side of a ridge and the South Ray Crater is on its left side. Figure 13(c) shows the view toward the Cinco Crater and Station 4 from the top of the in-between ridge.

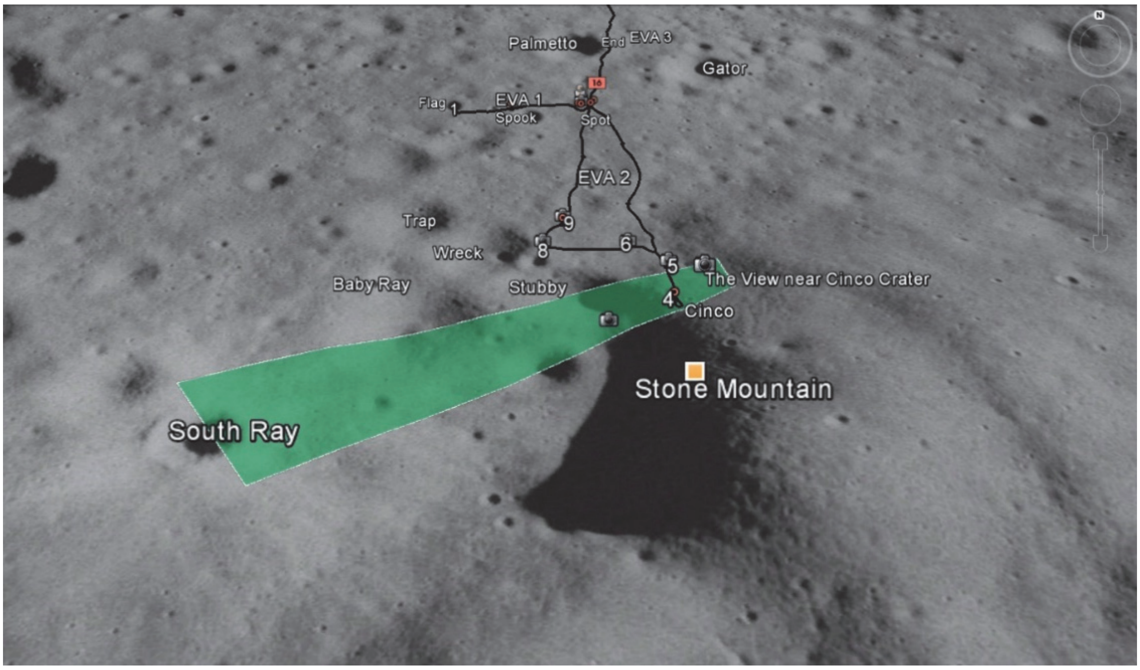


Figure 13. (a)

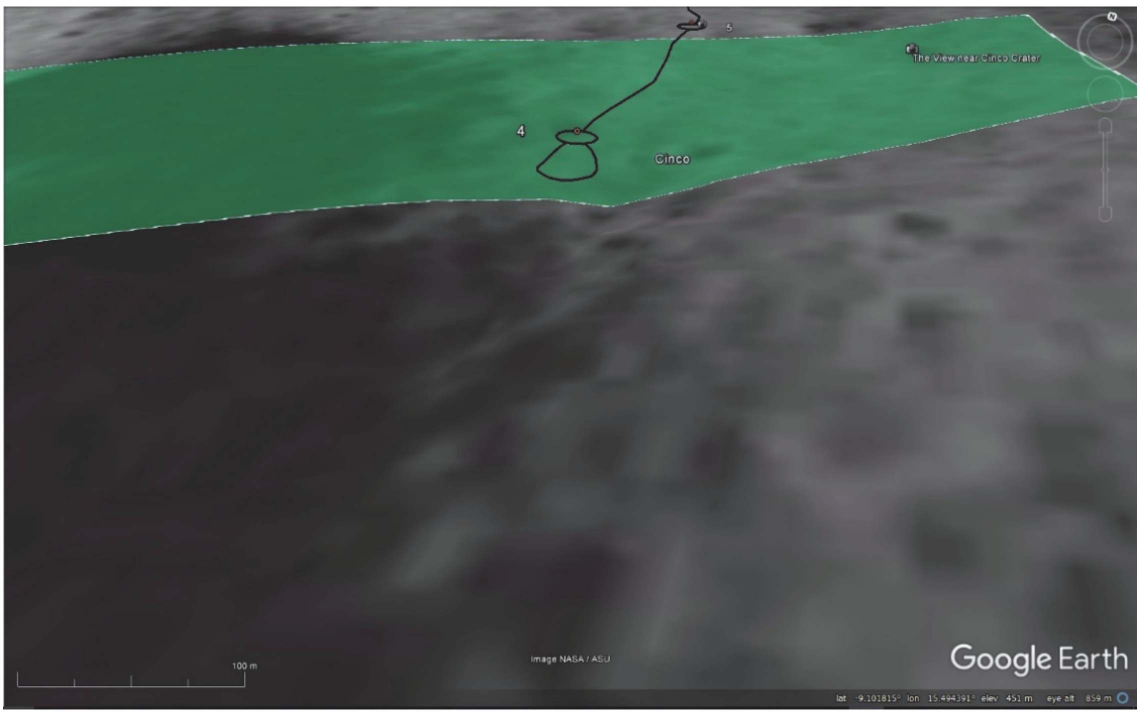


Figure 13. (b)

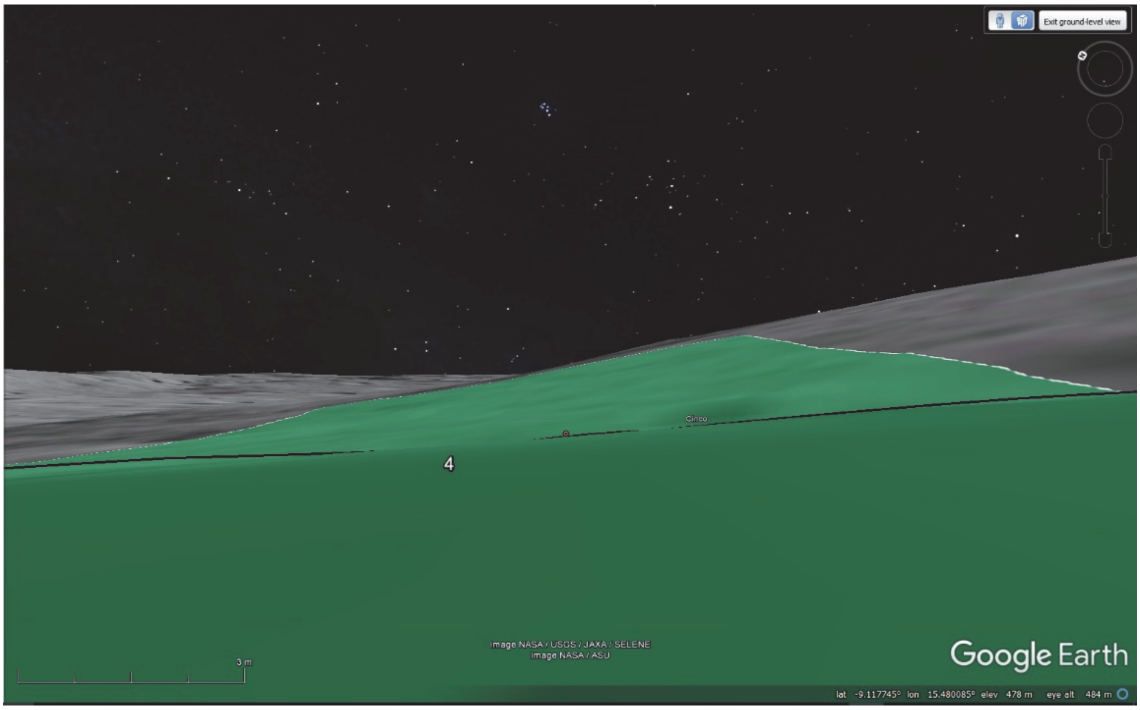
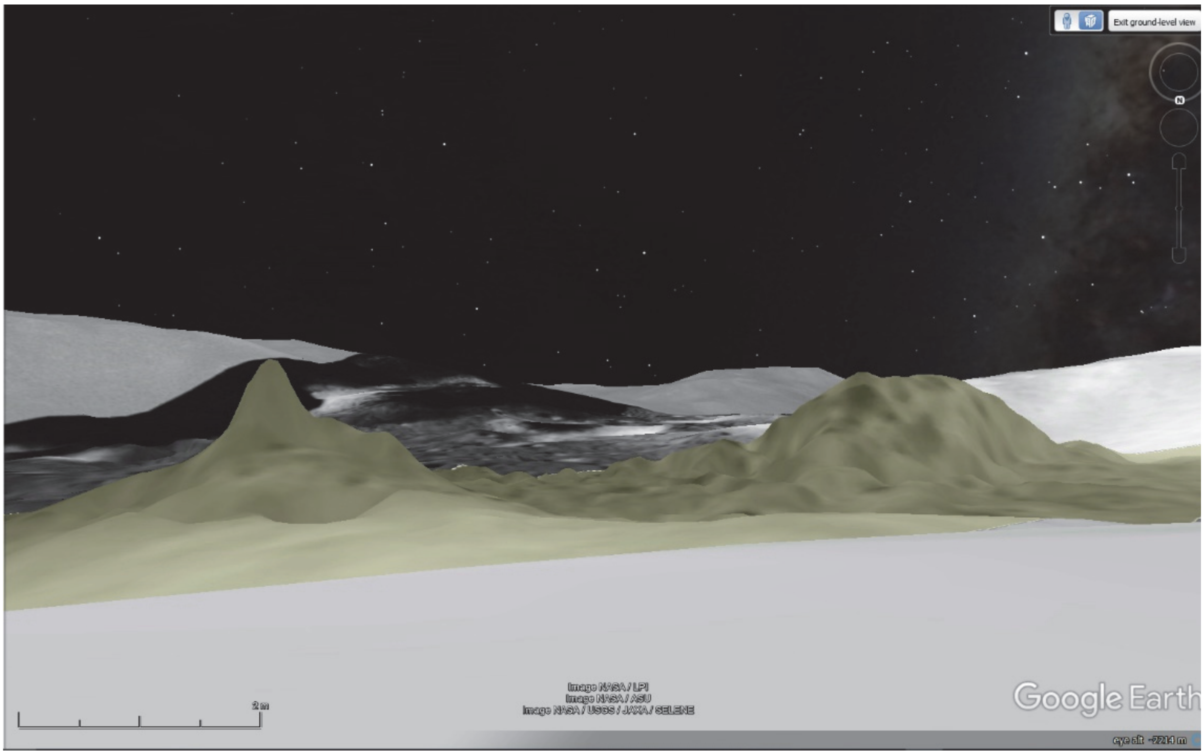


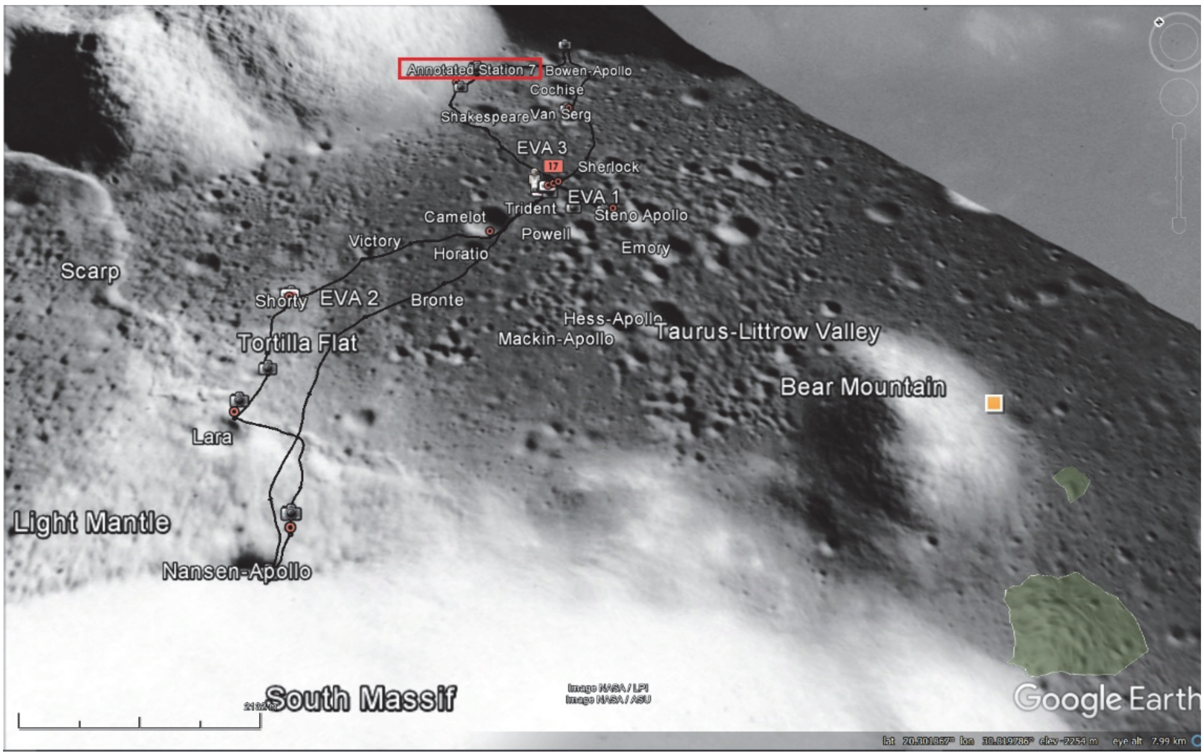
Figure 13. (c)

Figure 13. (a) View area (in green cover) from the Cinco Crater and Station 4, where the photos for Charlie's Station 4 Pan were taken from; (b) the green area as seen from the top of the Stone Mountain with Station 4 on the right side of a ridge and the South Ray Crater on its left; (c) view towards the Cinco crater and Station 4 from the top of the in-between ridge

We next turn our attention to the Apollo 17 mission. Behind Bear Mountain there is a very peculiar landscape, shown in Fig 14. It consists of a pointed hill and a larger one. Station 7 on the foot of the mountain (North Massif) could be a good observation point to see the hills above and to the side of the Bear Mountain. A simulation view in Google Moon from station 7 is indicated in figure 15(a), showing clearly the two hills. The corresponding part of the panorama from actual photos, taken from Station 7, embedded in Google Moon does not record the hills, as one can see in figure 15(b). The same, of course, can be observed in the clear enlargement of photo AS17-146-22349 (Station 7 pan. Bear Mountain, 2017), which was used to create the pan from station 7 (figure 15c).

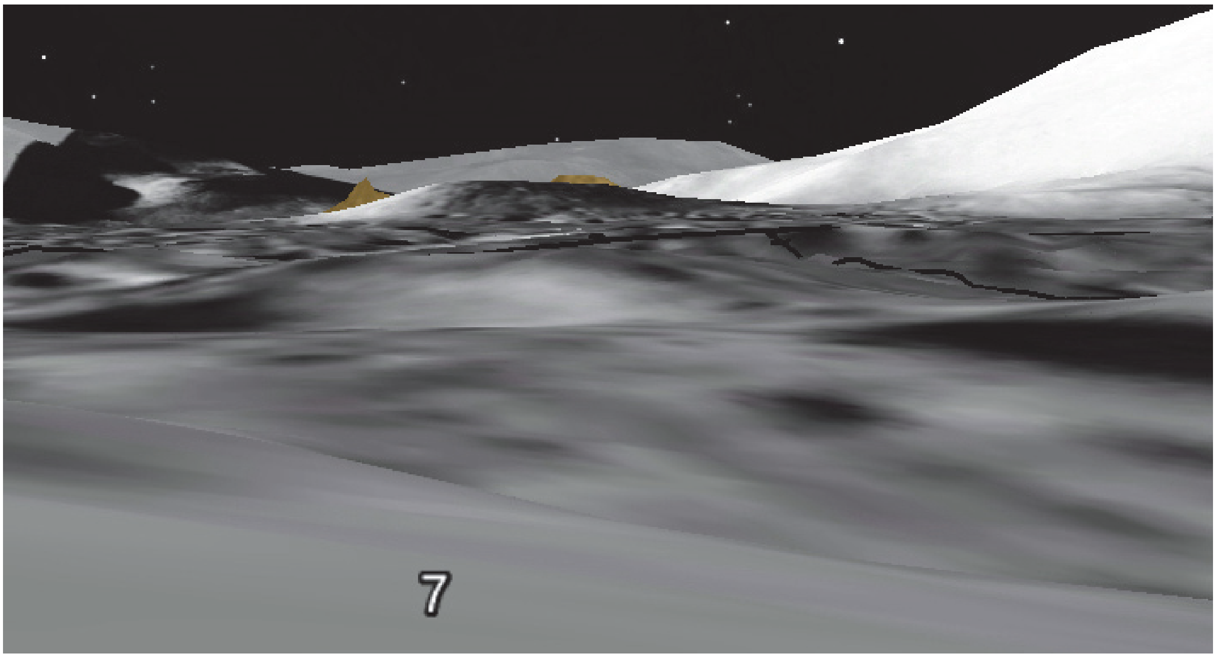


(a) View from Bear Mountain towards the landscape



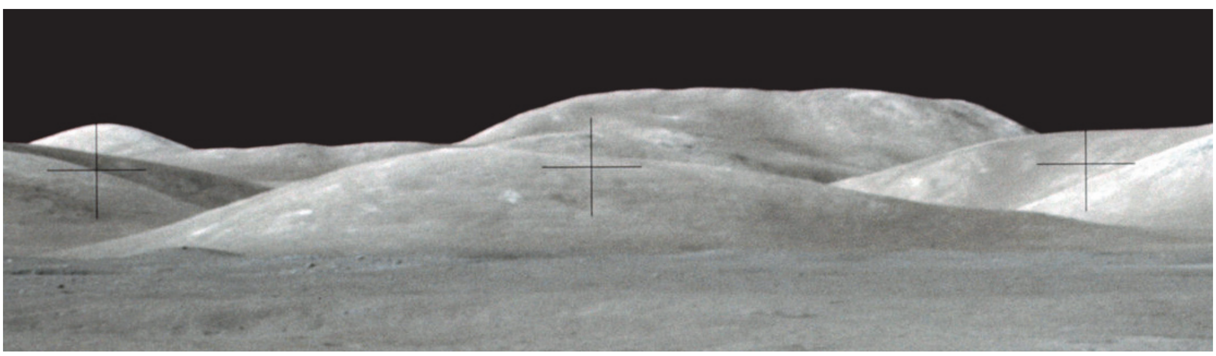
(b) Area view of Apollo 17 mission. Annotated Station 7 is indicated in red rectangle. The lunar landscape behind the Bear Mountain is indicated in green color. The small feature in green is the pointed hill and the large one is another hill.

Figure 14. Moon landscape behind Bear Mountain



(a) Simulation view in Google Moon from station 7 towards the Bear Mountain

(b) Part of the panorama from actual photos embedded in Google Moon showing the view from Station 7



(c) Part enlargement of photo AS17-146-22349 (Station 7 pan. Bear Mountain, 2017), which was used to create the pan from station 7

Figure 15. The view towards the Bear Mountain from station 7

From the above analysis, it becomes obvious that when the photos of Apollo missions, taken on the Moon, are scrutinized comprehensively, they fail to record the more-detailed simulated views. An explanation for the above is that the photos analyzed could be photos of a modeled Moon and not of the Moon itself, bearing in mind that the 70's Moon surface features knowledge as well as the then visualization tools were far inferior to their today's counterparts, where especially small land features can be very-well illustrated.

To clarify the above statement, let us at this point, give an example of an area on Earth, where the data of the Google Earth is limited. Figure 16 shows a photograph of a certain area, where low hills are present together with high hills. The "ground-level view" tool in Google Earth lacks detailed data and does not record the low hills nor the full features of the high hills. Needless to say that this is expected, as the mathematical algorithms used cannot produce features not supported by data, nor they can neglect data that reproduce existing features.

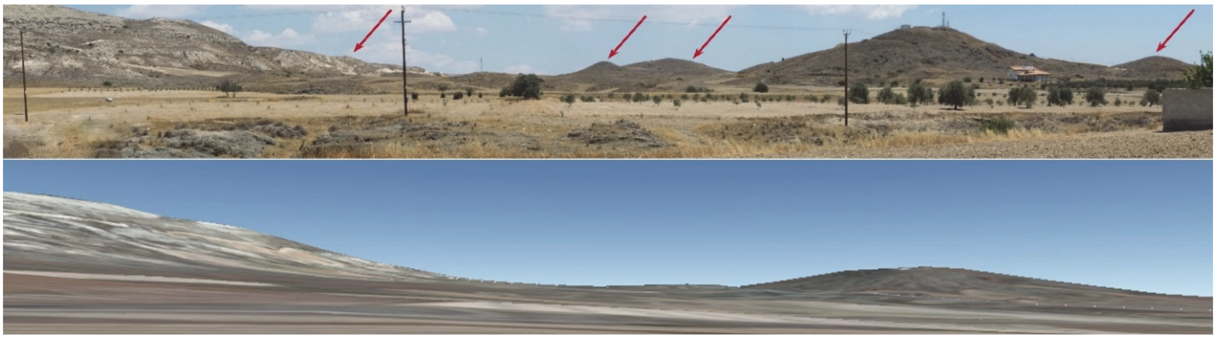


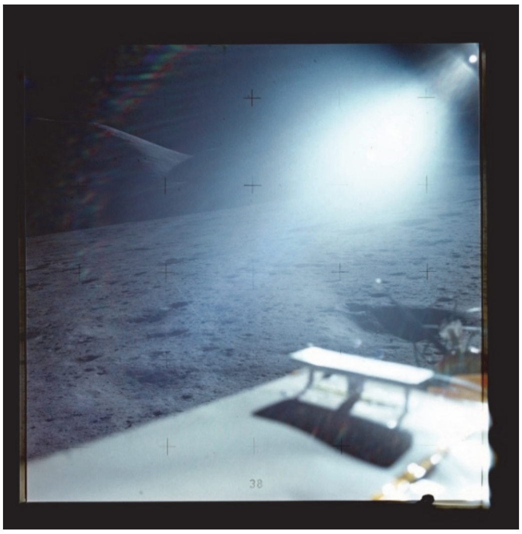
Figure 16. Top: a photograph of an area showing the low hills (see red arrows). Bottom: The "ground-level view" in Google Earth lacks detailed data and does not record the low hills nor the full features of the high hills

4. Analysis of other Apollo Mission Photos

We next check the "real" Apollo photos and try to see how the photos on the Moon were taken. Fortunately, all Apollo photos can now be found in high resolution, online, in The Project Apollo Archive (Flickr gallery, The Project Apollo Archive, 2017). The archive was created by K. Teague and this new Flickr gallery is a re-presentation of the public domain NASA-provided Apollo mission imagery at its raw, high-resolution and unprocessed form. The Archive does not show trimmed versions of photos, but the photos with the film surroundings. Also, the Apollo photos can be found, in a new-scan form, in the "March to the Moon" image library (March to the Moon, 2017).

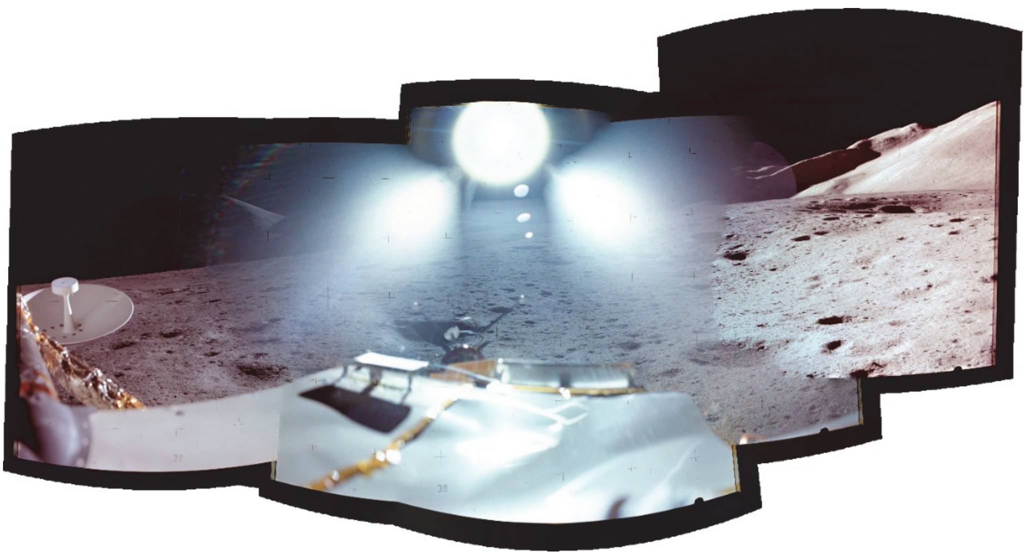
In the Apollo 15 record there are a few images that could be interpreted as having been illuminated from above or the sides. Figure 17(a) shows such a photo, photo AS15-87-11742, clearly illuminated from the top right, the side where the sun was at the time. The photo is part of a pan – recreated in part in figure 17(c) – taken by Dave Scott during the Stand-up Extravehicular Activity (SEVA), (Apollo 15 Map and Image Library, 2017). Scott stood up in the top hatch and found that, because of the one-sixth gravity, he could support himself on his elbows, without having to stand on anything, and get fairly well out of the hatch (Apollo 15 Lunar Surface Journal. Stand-Up EVA, 2017). The SEVA was useful because, as Scott explains, one of the problems at Hadley was that the resolution of the Lunar Orbiter photography was about 20m. Therefore, a detailed map could not be prepared. "*There wasn't anything to map. The maps we had were best guesses. And we had the radar people tell us before the flight that there were boulder fields - massive boulders - all over the base of Hadley Delta. Just boulders everywhere. And the photography people said "No, there aren't, but we only have 20-meter resolution, so we can't be sure*" (Apollo 15 Lunar Surface Journal. Stand-Up EVA, 2017). [This acknowledgement, in our view, explains well why small land features are not recorded on photos]. When enhancing the upper right part of AS15-87-11742, shown in figure 17(b), one can observe what appears to be a large stage light with a reflection on the casing of the light, and its rim clearly distinguished normal to the light beam. One can also observe the blackness at the left and right of the beam parallel to the rim, which in our view has no place if the sun illuminated the area. The bright area of the diagonal beam brings in mind the area where two light beams interfere with each other, as shown in figure 18(a). Finally, in figure 17(c) one can observe that the light of the round sun itself seems to be spreading very evenly, without any irregularities at is periphery, and its total appearance reminds us of a stage light (see also Amathes & Christodoulides, 2016). Furthermore, notice that the same type of diagonal lighting was used symmetrically to the sun to present the reflection at the right side. Could the reflections be generated inside the lenses of the camera and the blackness at the left and right of the beam together with the 'rim' normal to the beam be the external casing of the camera lenses? In no other photo capturing the sun, during the missions, is this kind of reflection being observed. To get two such reflections symmetrically and in a row, would be rather improbable. Only duplicating the effect with a similar camera by photographing the sun, could prove our assumption wrong.

Let us return to the sun imaged in figure 17(c). An enlargement processed in Photoshop® with the gradient mapping tool (figure 18b) reveals a bright center (a stage lamp?), a ring that has lower luminance with bright edges (the reflector?), a very thin edge, and so forth. Not only the light source itself, but also the thickness of the rings does not correspond with the sun, as seen in figure 18(c), photographed through the Earth's atmosphere in a day with high amount of sand particles in the atmosphere, which smooth the sun disc irregularities. On actual photos of the sun the disc is so bright that no graduations of brightness can be distinguished on the film or recording medium. Also, the disc is the brightest part and the brightness gradually diminishes outside the disc. No outer part of the disc is as bright as the center. Also, observe how irregular the sun disc is when viewed from space (The Sun Never Sets in This Space Station View, 2013). Why are there so many differences in the sun's characteristics between the Apollo photos to the actual sun?



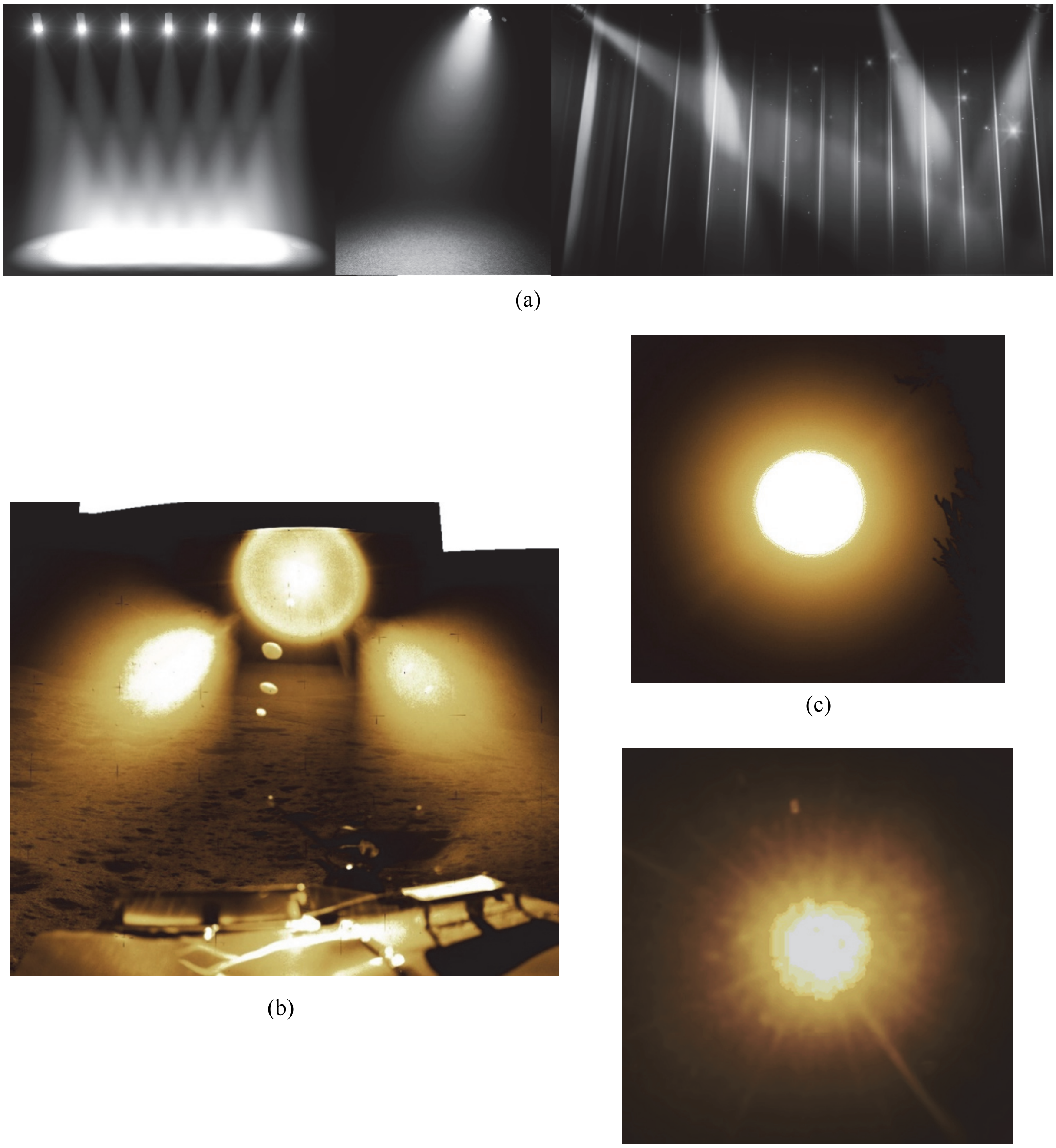
(a) Photo AS15-87-11742

(b) Enhanced upper right corner



(c) Photo-merging in Photoshop® of photos AS15-87-11740,42,43,44,45,46 and 47 (March to the Moon, 2017)

Figure 17. (a) High resolution photo AS15-87-11742 (March to the Moon, 2017) taken from above the top hatch of the lunar module (b) enhanced upper right corner showing the presence of a rim normal to the light beam (at 90°) (c) photo-merging in Photoshop® recreating part of the pan, where AS15-87-11742 is one of its photos, showing bright lights symmetrically with respect to the sun



(a)

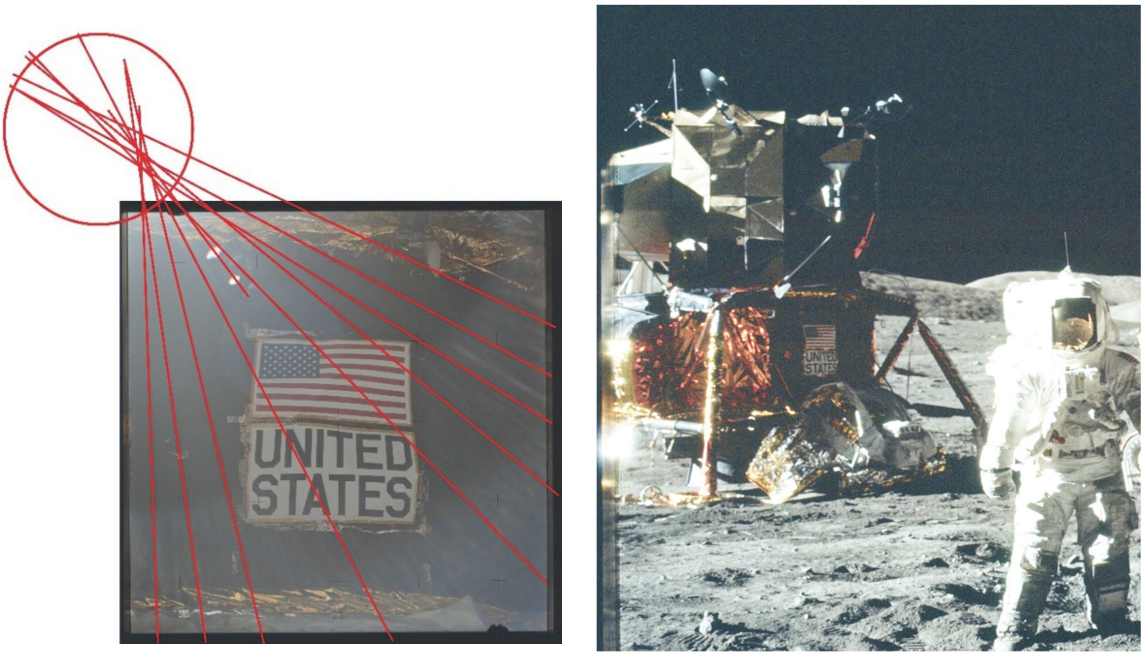
(b)

(c)

(d)

Figure 18. (a) Various stage lights. Depending on their kind, different shapes are formed. Observe the patents formed when the lights interfere with each other forming brighter areas where they merge (b) Enlargement of Figure 16(c) – photo processed with the Photoshop® "gradient mapping tool" (c) Photo of the sun taken from the ground during a day with high amount of sand particles in the atmosphere, which smooth the sun disc irregularities – photo processed with the Photoshop® "gradient mapping tool" (d) The sun viewed from space (The Sun Never Sets in This Space Station View, 2013) , processed as above – observe the irregularities of the disc

Let us finally examine one more photograph to show another peculiarity. A look at the various Apollo mission photos, immediately draws the attention to the fact that all photos taken on the moon recording the reseau-plate crosses, differ from the rest in that at the left and right ends one can observe the existence of vertical lines as well as a varying brightness. A look at the images from magazine AS17-134 shows that two images (AS17-134-20470 and 71) were presented wrongly (horizontally), as they were rotated by 90° (Flickr gallery, The Project Apollo Archive, 2017; Apollo 17 Image Library, 2017) in relation to all other photos that were vertical. This could be attested by the position of the vertical lines at the sides of the photos, a fact that shows that the original magazine could not have these two photos recorded in this way. But as the two photos were recorded vertically, as all others, the only explanation is that the camera was rotated by 90° when taking the photos (Amathes & Christodoulides, 2016). The orientation of these two photos has been "corrected" in the new scanning of the Apollo photos in the "March to the Moon" image library (March to the Moon, 2017). Therefore, it is obvious that the astronaut took the trouble to rotate the camera for just these two images and then revert the orientation back to normal. But why would anyone need to rotate the fixed on the chest camera (if that was possible anyway) with a square film format? The only probable reason, in our view, was to avoid a known reflection when taking a photo that interfered with the image. In this case, a professional photographer of those days would change the angle and position of the camera to avoid known reflections of light, and sometimes rotate it by 90° to change the direction of light coming from an on-camera flash light, fixed on one side.



(a) AS17-134-20469-Reflection source (b) Enlargement from photo AS17-134-20381

Figure 19. (a) By extending the light rays is found that the source of the light is situated above the left corner of AS17-134-203469 (b) Enlargement from photo AS17-134-20381, showing reflection of sunlight at various points on lunar module

Looking at AS17-134-20469 one can observe the "corona" patent covering the image (see for instance Bentley M., 2017). A property that such light effects have is that they generally form around the source. Therefore, the intersection of the light rays will indicate the source point. In this case it is a reflection just above the left side of the scene, situated at the gold wrappings of the lunar module (figure 19).

The astronaut then changed the angle of the camera slightly and rotated it by 90°, avoiding the reflection in the next photo, getting a clear photo. Of course, since there was no view finder and he could not know that the reflection interfered with the image, could this be only a coincidence?

Closing the section on possible photographic manipulation we cannot avoid mentioning that the earliest evidence was observed in the photo AS08-13-2344 of the Apollo 8 mission (Flickr gallery, The Project Apollo Archive, 2017). The manned spacecraft was the first of the Apollo series to successfully leave the Earth's gravity and orbit the moon. A first look on the enhancement of the large rectangle area (marked on the main photo) shows that the strike seen in this area is observed together with some vertical dotted lines and a lot of spot marks (scratches/stars?). Further enlarging the center area shows clearly that the strike is a special type of hair grip (namely a bobby pin, also known as a kirby grip) that has no justification to be there on the original film (figure

20).

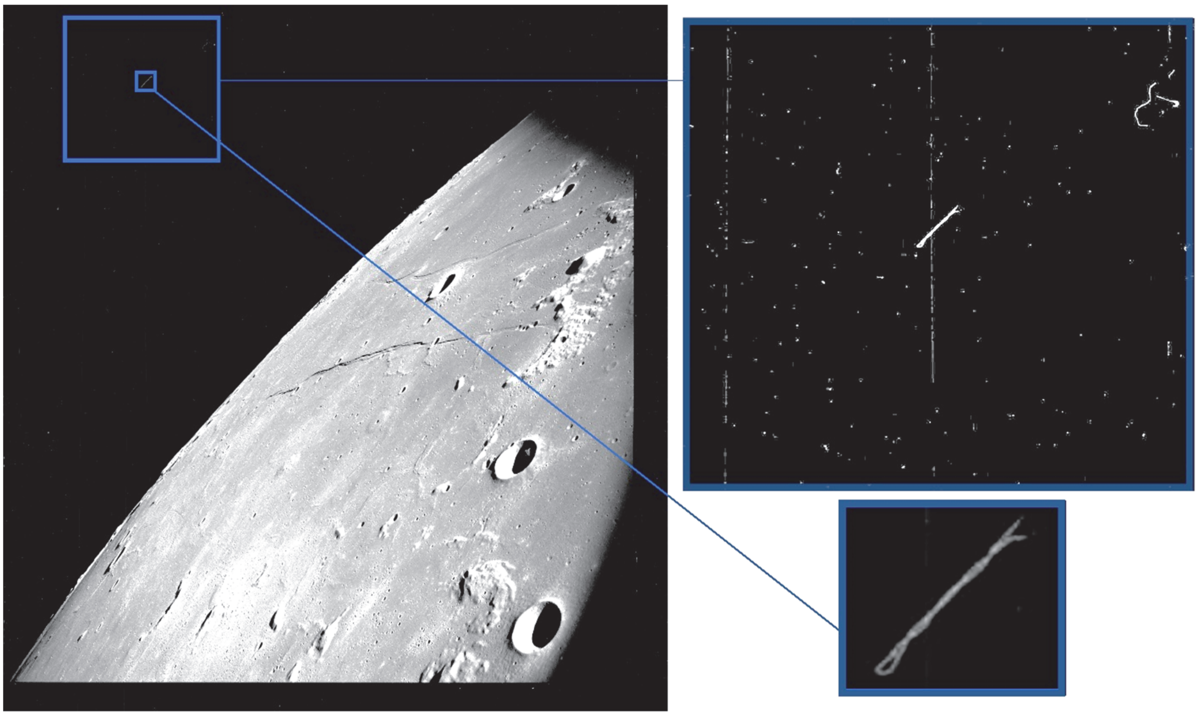


Figure 20. Enlarging the strike seen in the upper left area of photo AS08-13-2344 shows a hair grip flying above the Moon

5. Conclusions

In this paper, we have examined the validity of a number of the Apollo missions (namely 15, 16, 17) images, where one can observe a lot of inconsistencies, albeit well-hidden, that need topographic analysis as the photos are "real," even if taken in a studio.

We first set a valid framework that accepts that (i) the tools of Google Earth (Moon) give the opportunity for checking and analyzing the moon topography of certain areas, (ii) the accuracy of surface altitude known today is about 1m, as opposed to 20m during the 70's Apollo program era. Then through computer software simulations and photographic analysis, supported by basic scientific reasoning, we believe that we succeeded to provide conclusive evidence that a photo staging, as well as manipulation and/or alteration of the images has taken place.

In particular, the analyzed photos failed to record the more-detailed simulated views in Google Moon, forcing one to think that these were photos of a modeled Moon and not of the Moon itself. Common knowledge states that neither the original photo, on one hand, can miss (even in the 70's) land features nor a simulated version, on the other hand, can create non-existing land features!

A Photoshop® comprehensive analysis yields issues of existing staged light sources imitating the supposed scene's sunlight. There are issues with the alleged sunlight spreading very smoothly without any irregularities at the Sun's periphery, as well as with the evident presence of stage lighting with reflections on the casing of the light and its rim being clearly distinguished. There are moreover issues with the inexplicable change of direction of photos taken on the Moon, recording the reseau-plate crosses.

Concluding, based on the analysis presented in this paper, a statement that can very confidently be made is that the accessible NASA's photographic material constitutes a particularly weak "evidence" of man walking on the Moon.

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