

Hadley: a study in fakery (version 2)

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Summary Four images from the official NASA web site for the Apollo 15 moon mission are examined. They contain incompatible data and the conclusion is that at least two of these images are faked.

In this note I want to examine four images from the NASA Apollo 15 moon mission web site, Figures 1, 2, 3 and 5.



Figure 1: Mons Hadley from LM (AS15-87-11793HR.jpg)



Figure 2: Mons Hadley from S7 (AS15-90-12208HR.jpg)



Figure 3: Mons Hadley from S9 (AS15-82-11075HR.jpg)

Figures 1, 2 and 3 are photographs of Mons Hadley taken from three different locations on the lunar surface, namely the Lunar Module, Station 7 and Station 9 respectively. These stations are shown on the traverse map of the mission given in Figure 4.

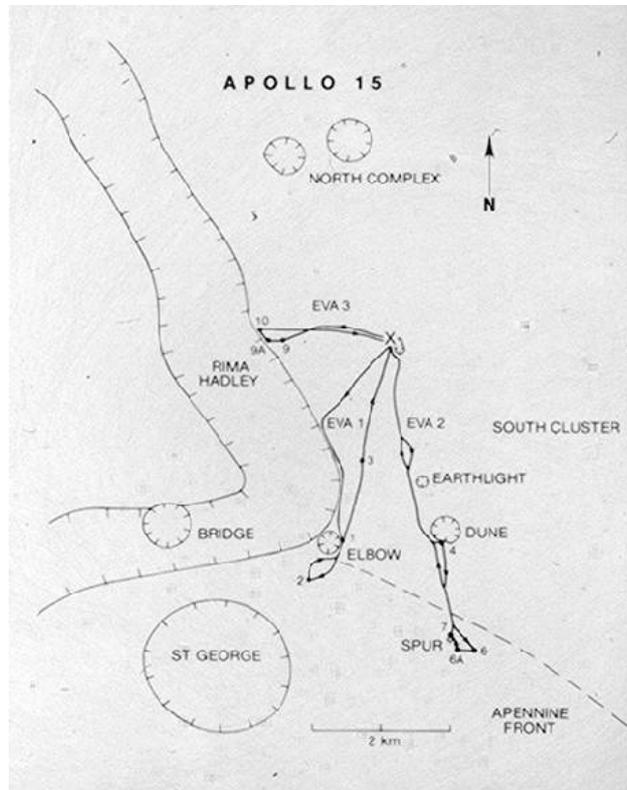
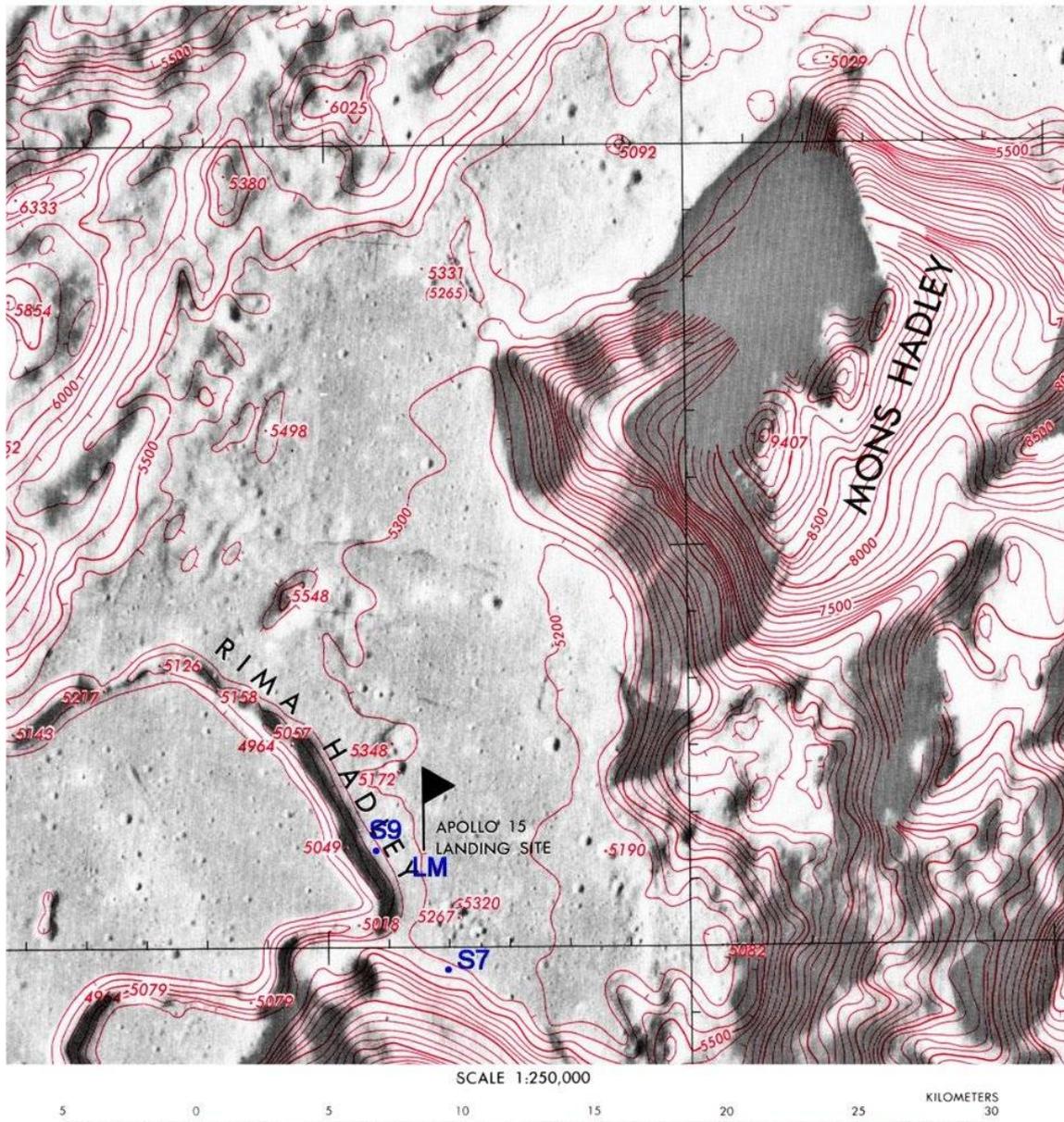


Figure 4: Traverse map from:

http://www.lpi.usra.edu/lunar/missions/apollo/apollo_15/surface_opp/



CONTOUR INTERVAL 100 METERS

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 1,730,000 METERS. FOR EXAMPLE, THE MAP ELEVATION OF A POINT WITH A RADIUS-VECTOR LENGTH OF 1,735,200 METERS IS DERIVED BY SUBTRACTING 1,730,000 METERS TO OBTAIN 5,200 METERS.

TRANSVERSE MERCATOR PROJECTION

GRID TICKS OUTSIDE THE NEATLINE INDICATE THE 10,000 METER LTM GRID, ZONE 37

THE APOLLO 15 DATUM WAS ESTABLISHED BY PHOTOGRAMMETRIC TRIANGULATION BASED ON APOLLO 15 MISSION EPHEMERIS DATED DECEMBER 1971.

Figure 5: Contour map from Apollo 15 site (excerpt)

Figure 5 is an excerpt from a contour map described thus: “Lunar Topographic Orthophotomap – Hadley (12.2 Mb) 1975 Defense Mapping Agency 1:250,000 sheet. 150 dpi scan courtesy Lunar and Planetary Institute” and like Figures 1,2 and 3, it comes from the NASA image library at: <http://history.nasa.gov/alsj/a15/images15.html>

I have marked Stations 7 and 9 on the map as S7 and S9 and the Lunar Module as LM.

The principal camera used for the surface photography was a Hasselblad camera of fixed focal length (60mm) with no viewfinder and using 70mm film. It was fitted with a registration plate marked with crosshairs on a 10mm grid. Using these details and the scale of the map (I have copied the scale bar on the bottom of the full map onto the excerpt in Figure 5) it is possible to predict precisely the view of Mons Hadley from any viewpoint and to position the registration crosshairs on the image. The only indeterminacies are (1) the position of the central crosshair and (2) the angle of the horizon (which may not be exactly the same as the bottom of the frame).

In Figure 6, I have drawn the outline of Mons Hadley viewed from S7 as predicted by Figure 5 and have marked intervals between horizontal crosshairs. For details on how this plot was constructed see Appendix 1.

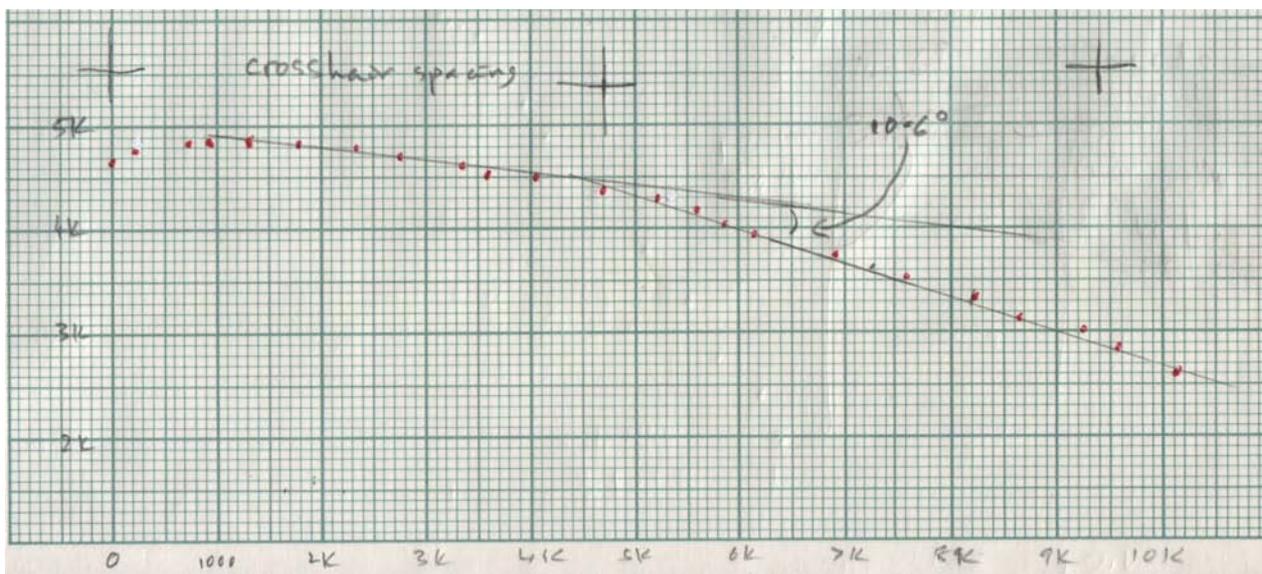


Figure 6: Hand drawn plot of the outline of Mons Hadley viewed from S7

Both scales in Figure 6 are in metres (1km per big square) as projected onto a notional screen behind the mountain.

Comparing Figures 2 and 6 we can see two important differences:

- (1) The length of the main ridge in Figure 2 is a little bit more than the interval between two crosshairs. In Figure 6 it is rather less than this interval.
- (2) The angle between the ridge and the right-hand slope is about 10° in Figure 6 but about 18° in Figure 2 (see Figure 7).

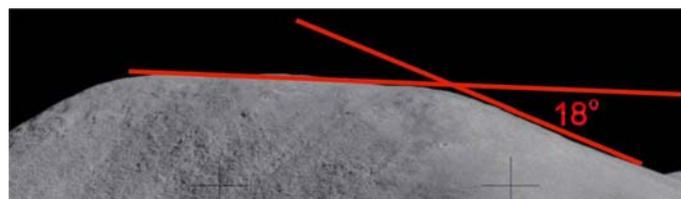
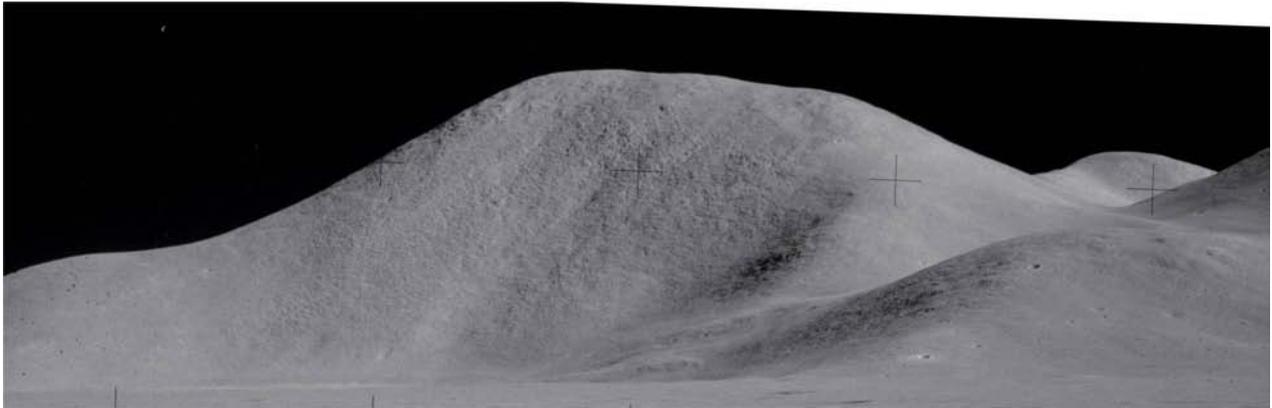


Figure 7: peak angle in Figure 2

The accuracy of the process used to construct Figure 6 is far greater than these gross differences and the conclusion is that Figures 2 and 5 cannot both be correct.

To understand what is going on, compare now Figures 1, 2 and 3. In Figure 8, I have reproduced excerpts from these three with Figure 1 scaled down by a factor .80 and Figure 3 by a factor .88. Look carefully at the skylines. **THEY MATCH EXACTLY.** You can check this by copying this figure onto a piece of paper, cutting round one outline and laying it onto the other two. More precisely, the main ridges on all three match exactly and so do the angles between the main ridge and the outlying slopes. But the lengths of these outlying slopes vary from view to view.



From S7



From LM scaled 80



From S9 scaled 88

Figure 8: Three views of the peak of Mons Hadley

Is it plausible that three views of the same mountain from different places should have exactly the same outline (differing only in scale)? No: real mountains always look different from different viewpoints. Although it is possible for a solid body to have this property, the chance of this happening for a random shape such as a mountain is vanishingly small. Moreover we can see that two of the views cannot be right by thinking a little. The top slope is caused by a ridge on the mountain, clearly visible in the earth-based photos reproduced in the postscript below, and must be regarded as an accurate feature of the mountain. Comparing LM and S7 as viewpoints, we note that the ridge points more towards S7 than LM and therefore will appear foreshortened and hence have an apparently steeper slope when viewed from S7. This is what Figure 6 shows. The same considerations apply to the view from S9. Although the change should be less than for S7, the ridge should again have slope noticeably different (less than for the view from LM). Thus at least two of Figures 1, 2 and 3 is faked.

Given that two of the ground photos are faked, it seems plausible that all three are faked and then the explanation for the similarity of the outlines is that all three pictures have been posed against the same fake backdrop. In Figures 2 and 3 we are a little further away from the backdrop and this accounts for the change of scale. The other peaks to the right are on separate sheets of the backdrop and have been moved in Figures 2 and 3 to simulate the change of viewpoint. The explanation for the differing lengths of the outlying slopes is that these are adjustable features of the backdrop. There are suspiciously straight slopes on either side of the main ridge (which is somewhat wavy). To make the mountain look different from the three places from which it was “photographed” from they slid the sides up or down which changes the apparent shape quite effectively. The give-away is the exact fit of the top profile.

Once you start to question the veracity of these photos, you start to notice other questionable features. All three photos have a clear “horizontal” line between the “flat” foreground and the backdrop. I have marked this in on Figure 9. Such a horizontal line is a feature of many of the Apollo moon photos. In terms of the findings of this note, this would be the line between the horizontal stage and the vertical backdrop.

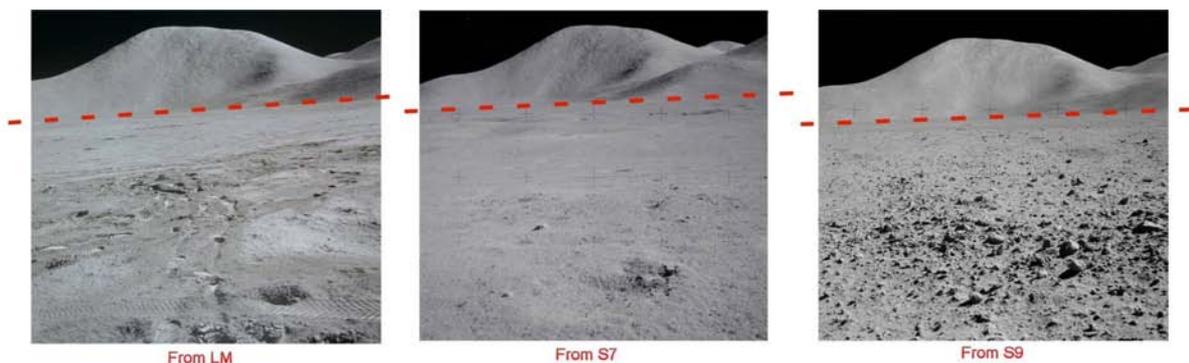


Figure 9: The edge of the stage?

There are strong markings on the face of Mons Hadley towards the camera, which vary between the views and give a good 3D effect. This is particularly clear for Figures 1 and 2. My opinion is that these have been projected onto the backdrop by something like a big OHP. Look carefully at the distortion in the markings near the left-hand slope as it moves up towards the top ridge. There is clear distortion visible between the markings in the two figures and the markings move a little closer towards the edge in Figure 2. But the distortion *does not increase dramatically* as you get to the very edge, which of course it should, because this is not an edge but a curved boundary. It

seems that the markings were projected onto the backdrop and the position and alignment carefully changed between the different views.

In conclusion, I recommend Jack White's Apollo studies featured on <http://aulis.com/>. He points to several more photographic anomalies extending across all the Apollo moon missions. You need to use your critical faculties when viewing Jack's studies as some are more anomalous than others! I have included what I consider to be three of the best anomalies in Appendix 2.

Postscript What does Mons Hadley really look like? Figure 10 shows seven photographic images of the mountain from the earth and from lunar orbit. Three are from the same NASA site as Figures 1, 2, 3 and 5. I leave you to decide for yourself, but to my eye, the real photos all show a strikingly angular mountain with a sharp peak and many interesting features quite dissimilar to the bland outline shown in the faked ground photos.

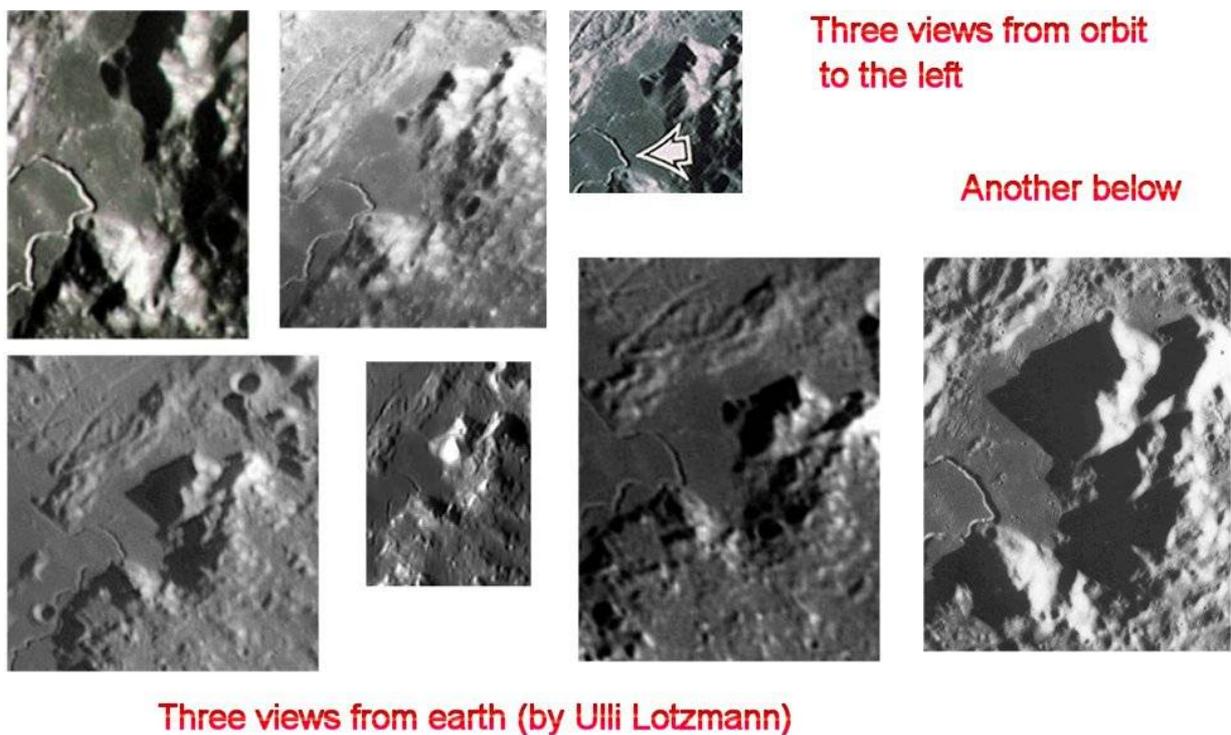


Figure 10: Seven views of Mons Hadley

The views from orbit in the top line are all from the Lunar and Planetary institute site: http://www.lpi.usra.edu/lunar/missions/apollo/apollo_15/images/

The three views from earth are taken from Ulli Lotzmann's balcony in Marburg Germany. The left two are from the NASA site and the third was sent to me directly by Ulli. The final image is from the NASA site and again taken from lunar orbit.

Acknowledgements I would like to thank Jack White for a very interesting and extensive email conversation about these photos and for tracking down some of the images in Figure 10. I would also like to thank Ulli Lotzmann for sending me the (right-hand) earth based photo, which is not on the official sites and Eric Jones (the NASA web site maintainer) for supplying me with the middle Lotzmann photo, which is supposed to be on the NASA site, but whose link was broken when I tried to download it, and for giving me some extremely interesting information about the geology (should that be lunology?) of the Hadley area.

Appendix 1: construction of Figure 6

I used ruler and hand-calculator to construct Figure 6. This elementary methodology allows you (the reader) to check the accuracy for yourself. If a line through S7 passes through adjacent contours at points P, Q in such a way that the ratio of the length w of PQ to the distance d from S7 to P (both measured on the map) is the same as 100 (contour interval) over the height difference h of P above S7, then this line is tangent to the mountain to the accuracy of the map. Refer to Figure 11 here. The horizontal lines correspond to lines on the map and the vertical lines to heights read from the contours. The condition that $w/100$ equals d/h implies the triangles are similar and hence that the sloping line labelled S7, P, Q is straight. Thus this line represents a light path from S7 passing through adjacent contours at P and Q and is tangent to the mountain and hence gives a point on the outline as viewed from S7.

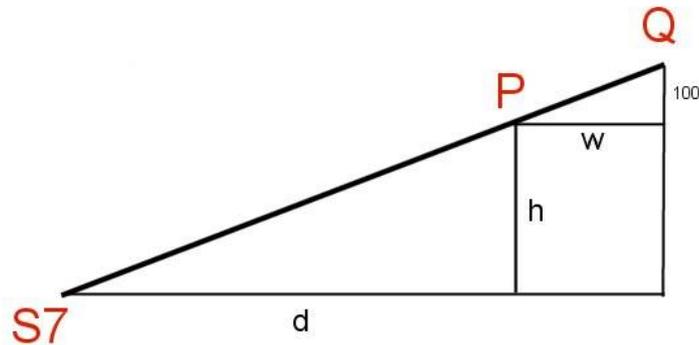


Figure 11

By guessing a point on the outline, you get a first approximation to the length to S7 and hence, by reading the heights, a first approximation to the necessary contour interval. By small adjustments you rapidly converge to a point on the outline. This process takes more time to describe than to perform.

In Figure 12 I have reproduced the radial plot that was used to draw Figure 6. Each line through S7 gives one plot point. The points P and Q where it meets adjacent contours are dotted in red. You can readily reproduce this plot for yourself and check the tangency condition described above. To draw Figure 6, I drew a notional screen line behind the mountain (the right-hand line at the back) and projected each construction point onto the screen. Since the slope was known from the construction, the height (y-coord) could be quickly found. The x-coord is just distance read from the map scale. I took the height of S7 to be 5350m for the calculation. I make no apology for reproducing hand-drawn figures, which make it clear how to check the constructions for yourself.

Appendix 2: three selected anomalies

Anomaly 1: The changeable foreground The Apollo 15 photo on the left in Figure 13 was taken before the one on the right. We are clearly approximately the same distance away because objects are about the same size (remember that the camera has a fixed focal length). The position of the camera has moved slightly to the left for the second photo. The foregrounds do not match. Even if you assume that the photos have accidentally been misordered, the foregrounds still do not match.

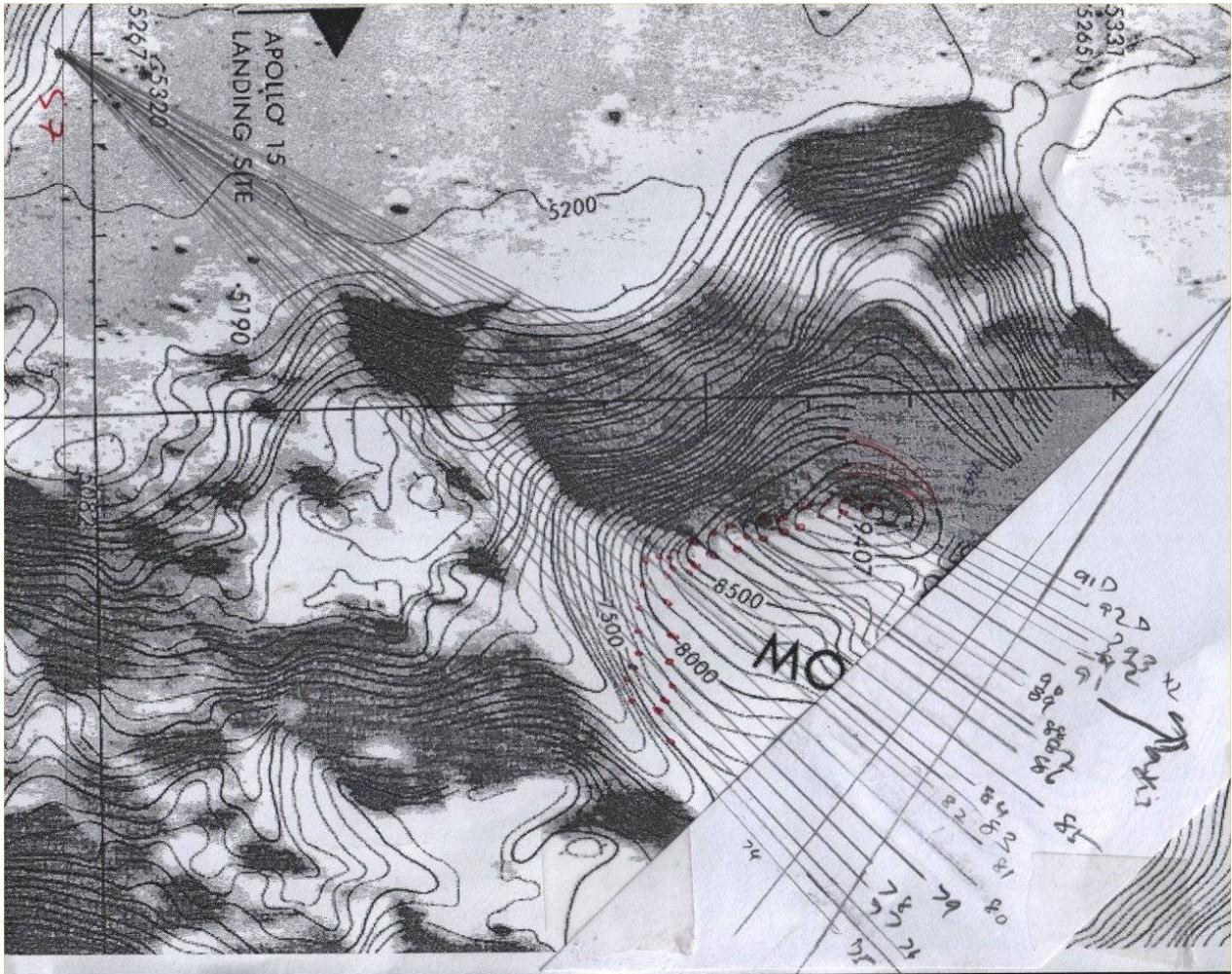


Figure 12



Figure 13

I have cropped the photos, but apart from this they are straight from the official NASA site. Some idea of what has happened is given by another photo taken between the two (Figure 14 left). The foreground tracks have been partially obscured by a swathe of clear dust. The only plausible

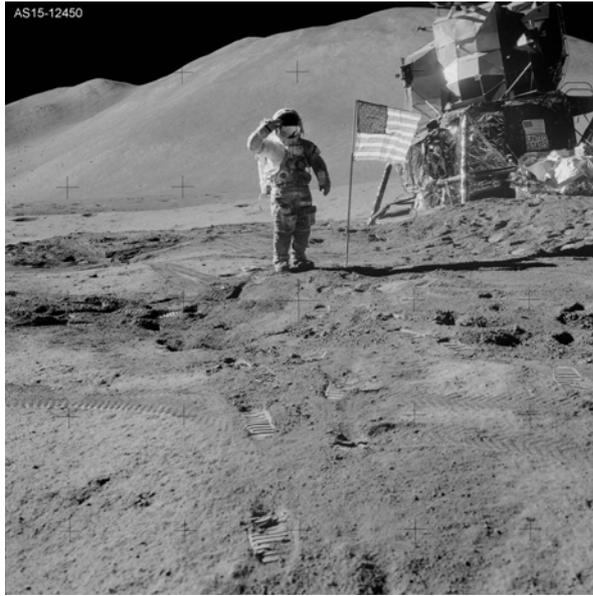


Figure 14

explanation is that this dust has been added in order to make the boot-prints clear. An implausible explanation is that the astronaut walking has disturbed the dust to the extent that it has produced this swathe of clear dust. But if one simple walk made this much dust then each footfall would obscure previous ones and the lunar rover would make so much dust that it would never leave the clear tracks that we see.

Anomaly 2: The outward shadow Look at the right-hand photo in Figure 14. The shadow is not consistent with the supposed method of photography being used. Recall that the camera used for all the lunar photographs was a fixed focal length, with no viewfinder and fastened securely to the breastplate of the astronaut taking the photo. This implies that vertical must appear vertical on the photo and the shadow of the astronaut taking the photo must point back to his feet which are at centre bottom. You can easily produce a photo with a shadow like the one in this photo, by tilting the camera. Take your digital camera out next time there is sun and experiment. No photo taken with the camera level with respect to your body (as it must be if fixed to your breastplate) can produce a shadow like this.

Anomaly 3: The halo and the crosshairs Figure 15 (left) is an iconic photo from Apollo 14. The sun has a marked halo. The source of this halo is not clear but it has had some very strange effects on the crosshairs falling within it. Look carefully at the right-hand photo, which is a detail from the left-hand one. The crosshairs are all doubled. Look very closely at the doubled crosshairs. The halo light is shining onto the main (vertical/horizontal) crosshairs, which appear light brown rather than the usual black, and the secondary (curved or slanted) appear grey. Where the two crosshairs cross you get a sharp black point as if one crosshair casts a shadow on the other. You may need to zoom in to see this clearly. Recall that the crosshairs are etched onto the glass registration plate adjacent to the film. What must be happening is that there are two light sources each casting one of the crosshair shadows onto the film. The main light source is the usual focussed image of the scene being viewed and the secondary source is responsible for both the halo and the secondary crosshairs. Where is this secondary light source? It must be quite close to the registration plate because the secondary crosshairs are significantly displaced from the main ones and this displacement must take place in the small gap between the plate and the film (you can see that the shadow is on the actual film because of the non-linear distortion typical of an image on an

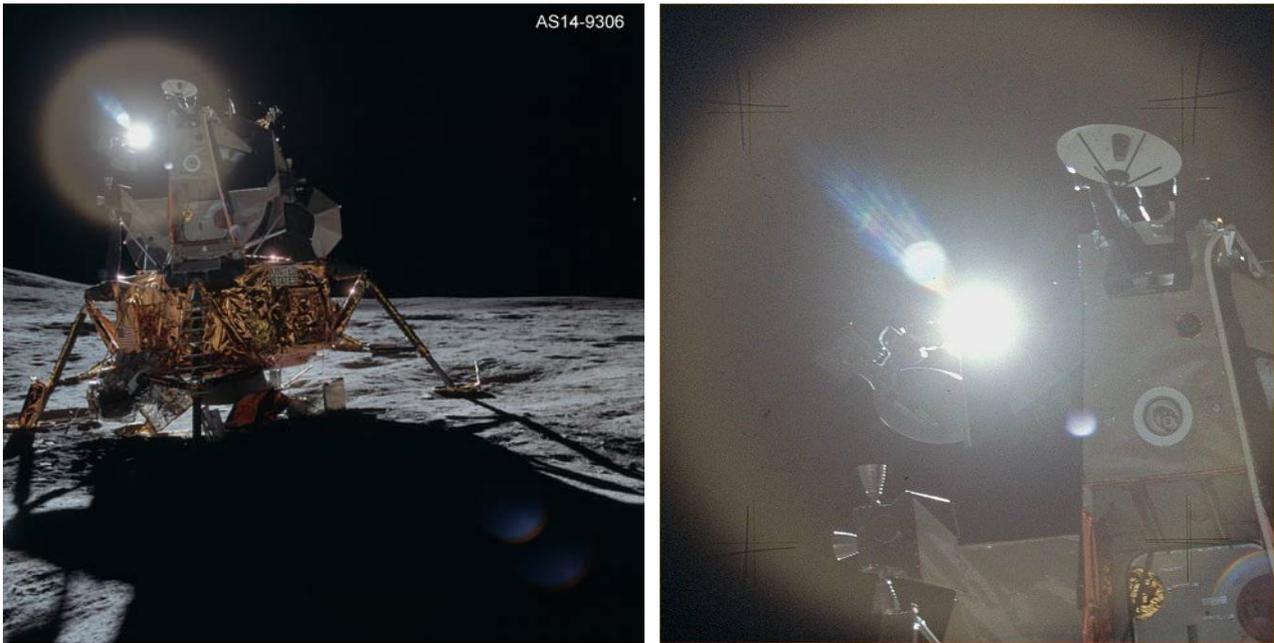
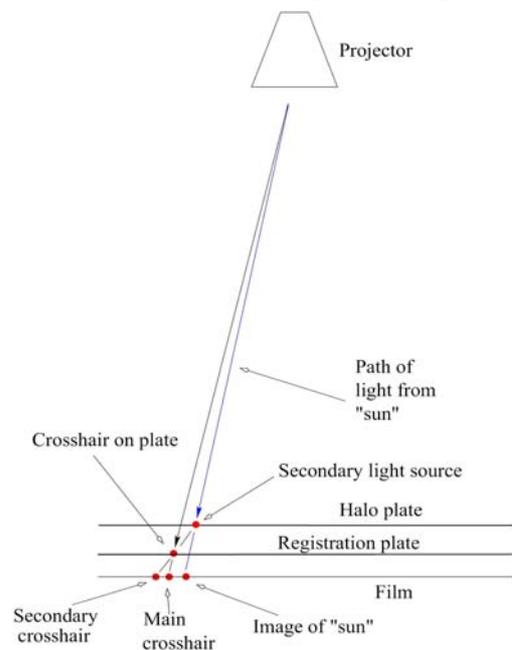


Figure 15

acetate sheet). The secondary source cannot be in or on the registration plate because light cannot travel sideways in a glass sheet for more than about the thickness of the glass because refraction causes light to be trapped by total internal reflection if travelling at an angle greater than about 45° to the inward normal. This places the secondary light source somewhere in the empty space just to the lens side of the registration plate! The only possible conclusion is that this photo like the others considered in this note was not taken by a Hasselblad camera fitted with a registration plate on the moon as it was supposed to be.

Incidentally it is quite easy to explain the doubled crosshairs if you assume that crosshairs were added during post-processing in a darkroom. Suppose that a standard darkroom enlarger was used for adding the crosshairs. If the technician decided to add a halo effect at the same time by inserting a halo filter plate above the registration plate (see sketch to the right) then the light from the "sun" passing through this plate would produce a secondary light source which would cause both the halo and the extra crosshairs.

Also incidentally, there are numerous other Apollo photos with doubled crosshairs, all of which have a corresponding halo effect. The technique described here was used frequently.



History: Version 1: 7th December 2008. Version 2: 14th January 2010. Version 1 did not contain the two appendices, which have been added to Version 2 for clarity and completeness. In version 1, I promised that the next version would use VR software to realise the view of the mountain from S7. I no longer plan to do this because the elementary construction described in Appendix 1 can readily be independently checked and this makes the main thesis of the paper stronger and more transparent.