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Small White Ball of Light Flies Near Airliner: Investigation of High Resolution, Digital, Color Photographs of July 3, 2005 at 2031 Hrs., Palo Alto, California

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Event Details

Mr. and Mrs. Lance Boehm[1] were at the Montebello Open Space Preserve[2] (located just east of the crest of the foothills running up and down the San Francisco Peninsula) just before sundown (at 2032 L) on Sunday, July 3, 2005. The altitude at this site is about 2,600 feet MSL with excellent horizontal visibility in all directions except to the E and SE where trees blocked the local horizon. Both are amateur astronomers and were waiting for sundown to begin watching for interesting astronomical sights. At about 8:31 pm local time (i.e., 2031 L) Mr. Boehm was in the process of taking a "scenic picture." He looked at the completed image on the liquid crystal display (LCD) of his digital camera and noticed an airplane in it (Figure 1). His lens zoom was full wide angle (28 mm). Before, or while, taking this photograph he did not hear the jet nor see any of its lights or reflected luminous flashes from it. It was approaching from the northwest in an otherwise clear sky. He estimated that the airplane was at an altitude of about 3,500 to 4,000 feet MSL and flying on a north/northwest to east/southeast heading; he didn't notice whether it changed its direction of flight during the sighting. He also estimated its air speed at between 180 and 200 mph. There was no wind and the air temperature was about 55 - 60 deg F.[3] It is important to note that the airplane is not centered but offset to the upper-right quadrant which supports his account.

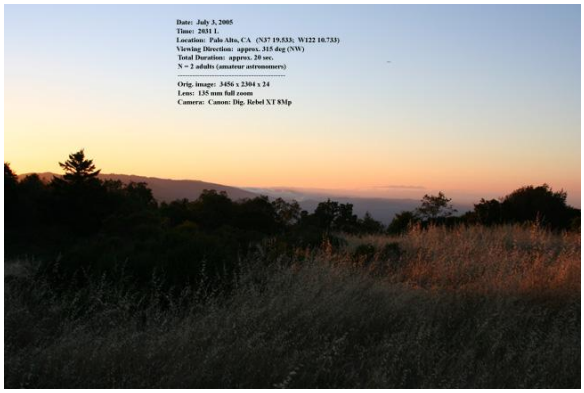

Figure 1. Photograph 1 in a Series Taken Looking Approximately N.W. from Crest of Foothills Just West of Palo Alto, Calif.

[1] The author has permission to release all names in this report.
[2] Lat N37 19.533; Long W122 10.733
[3] These weather details were confirmed by the Daily Climatological Report from the National Weather Service.

He used his camera's through-the-lens view finder at all times to center and roll-orient the various scene details; he hand-held his camera at all times, i.e., no tripod was used, however, the camera possessed an image stabilization capability which helped him obtain particularly sharp images.

Boehm wrote that several seconds later, "While looking through the camera's viewfinder I saw something just behind the airliner, which appeared to be following it briefly, visible only faintly in Figure 2 directly beneath the tail of the airplane and more prominently in an enlargement. (Figure 3) The UAP was "…just behind the airliner, matching its speed." Then it started moving away fairly quickly. (Figure 4) It didn't appear to be dropping (down) from the airliner, since it was moving away in an almost horizontal line. (see Figure 8, an enlargement of Figure 4). The unknown object was white or silver in color, and appeared to be round. After a few seconds the object just vanished," Mr. Boehm wrote to NUFORC on 4 July 2005. (Figure 7)

The commercial jet airplane was identified by the photographer (and later, independently by the author) as an American Airlines B-757 inbound for San Jose Airport located some fourteen miles ESE of the witness's location.

Fig. 2 Photograph 2 in a Series. Airliner with White Object Flying Very Near its Tail

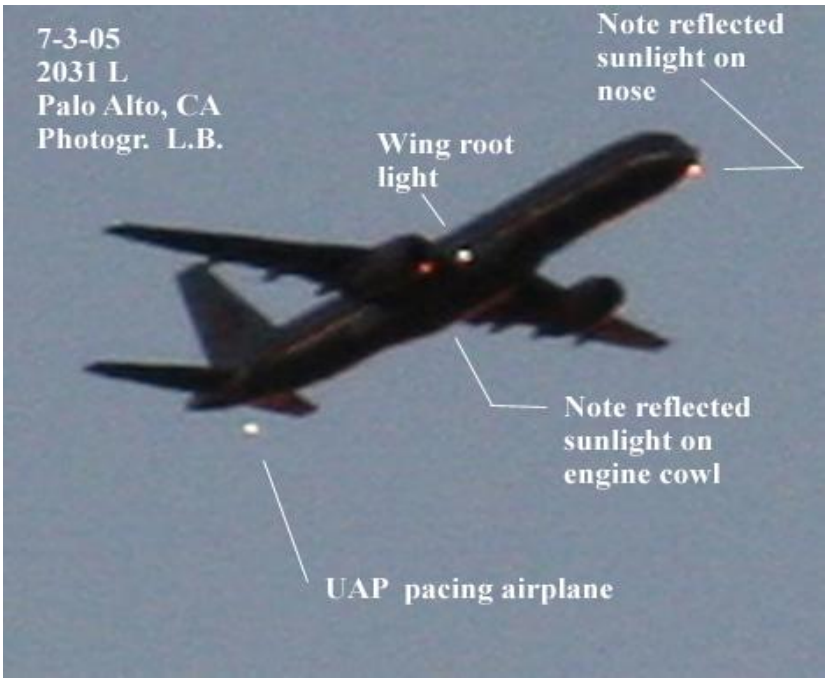

Fig. 3 Photograph 2 in a Series. Greatly Enlarged View of Figure 2 with White Object Flying Very Near its Tail

Fig. 4 Photograph 3 in a Series. Airliner with White Object Moving Away to Left

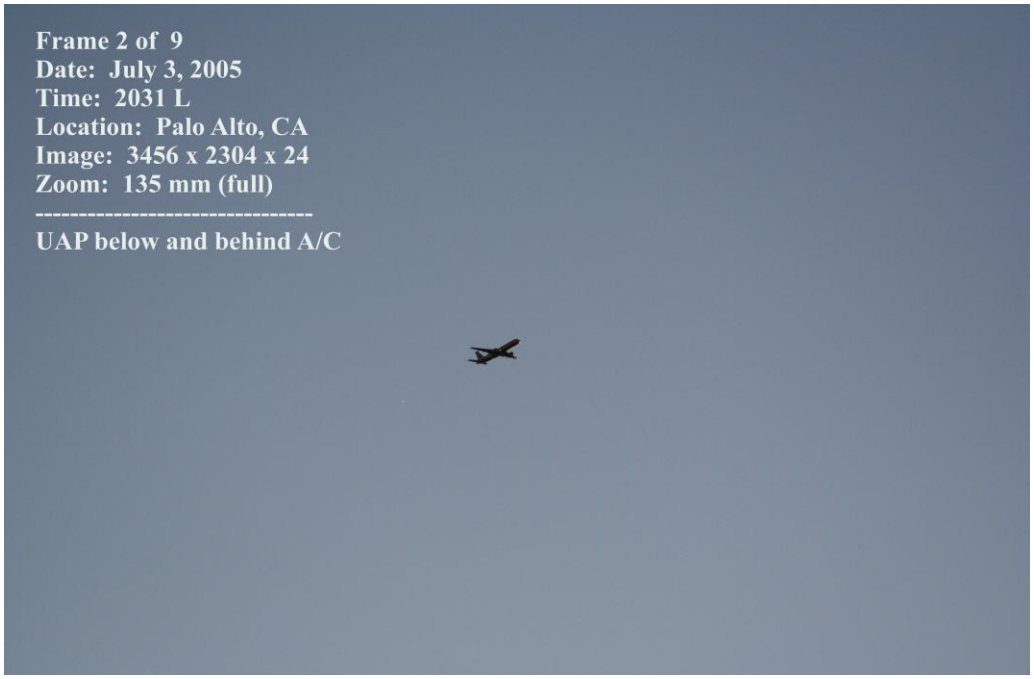

Fig. 5 Photograph 4 in a Series. Airliner with White Object Departing to the West (left)

Selected Photographic Details

Camera: Canon Digital Revel XT, 8 Mp SLR.[4] (Manufacturer Part No. 0209B003; model also referred to as a 350D. The fact that this was a single lens reflex model means that the image received was not displayed on a liquid crystal (or other) screen but was seen directly through the lens system similar to analog (film) cameras.

Lens: Canon EF 28-135 zoom

Image Processing: All five frames were taken at a resolution of: 3456 x 2304 pixels and 24 bits of color (depth). After JPEG compression each frame comprised 2.1 MB each (approx. 91:1 compression).

[4] He purchased this camera in May 2005 and already had taken "a few thousand photos" with it! On July 13th he wrote, "…at this point I feel right at home with it."

Data Analysis Findings

Incident Timeline: An attempt was made to reconstruct this series of events so as to determine their timing. These events were confirmed by Mr. Boehm through a careful second-by-second reconstruction of the relative positions of the airplane and UAP and their magnetic bearings. Table 1 presents these estimates.

Table 1

Time Reconstruction of Events(1)

Est. Elapsed Time (sec.)	Event	Est. Azimuth angle of A/C
0	First scenic photo #1 taken (zoom pre-set to 28 m) Airplane at about forty degrees above horizon.	315 deg.
4	Photographer examines LCD screen display and sees airplane	
6	Looks up for airplane	
8	Sees airplane and luminous UAP. He notes their close proximity "for several seconds." He realizes that its motion precludes it from being a star or planet.	
11	Looks at camera, adjusts zoom lens (135 mm) while looking through camera lenses	
13	Locates airplane and UAP and takes shot #2 UAP almost immediately stops and "began moving in the opposite direction." (to west)	350 deg
14	Takes shot #3	005 deg
15	Takes shot #4[5] UAP continues to accelerate to the west and about thirty-five degrees above horizon.	015 deg
18	Photographer tries to "follow the object with the camera (pans away from airliner) but is unable to take another photograph due to its small size.	
19	UAP suddenly blinks out. "Before I could take another shot, it was gone." (at altitude of about 18 deg. and azimuth of about 300 deg.)	
22	Photographer pans camera back to airplane and takes shot #5	030 deg.

(1) The azimuth angles are only approximations based upon inspection of the photographs, a graphic solution, and Mr. Boehm's drawings.

[5] Photos 2, 3, and 4 were taken with the camera set to sports/burst mode or about 1 per second.

UAP Details

The small, intense, white object is seen on three consecutive digital frames. Each has been greatly enlarged by the same amount and printed side by side in Figure 6 for comparison. They should be basically the same in various characteristics since distance has not changed significantly and it did not appear to blink or change intensity (see question 11C below).

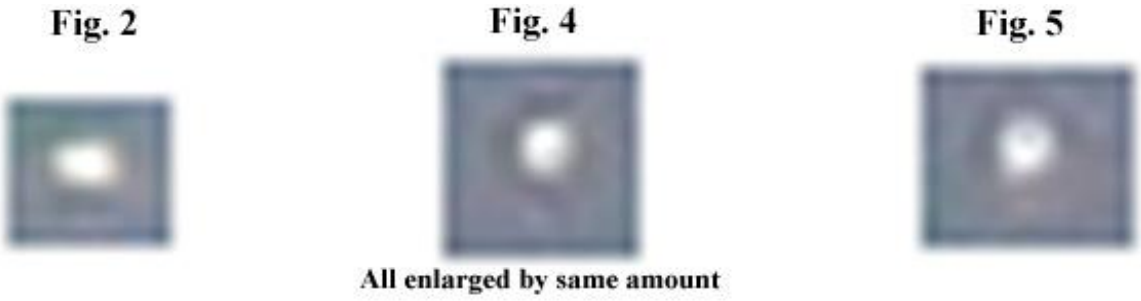

Fig. 6. UAP Image of Figures 2, 4, and 5 Enlarged by Same Amount

Based on a careful comparison of these three jpeg enlargements[6] I discovered that: (1) The intensity of the white UAP was so high that it saturated the pixel sensing capability of the camera's charge coupled device (CCD) sensor (i.e., over 255 units) making it impossible to determine its actual photometric luminance. (2) The height to width ratio of the left (Fig. 2), center (Fig. 4), and right (Fig. 5) UAP disc was: 1.34, 0.39, and 1.30, respectively. Thus, the shape of each UAP image varies only slightly as can be seen. Each UAP image is composed of only about three pixels by four (square) pixels, more about this later.

UAP Relative Intensity: The pixel percentage gray scale intensity values of the uncompressed pixels making up the UAP image and surrounding area in Figures 2 and 3 are given in Table 2. These values are relative. They extend from the darkest pixel given a value of 100% to the brightest given a value of 1%. These numbers permit comparisons to be made between the three digitized frames. Intensity values for the sky on all four sides of the UAP in Table 2 were 43 and 44%.

Table 2

Relative Percentage Gray Scale Intensity Values of
Pixels at and Near the UAP of Figure 2 and 3

Pixel Column (left-to-right)

Pixel Row	1	2	3	4	5	6
1	49	42	36	33	40	45
2	39	**12**	**1**	**1**	27	44

[6] The characteristic smoothing (lossy compression effects of JPEG) of these three images is seen here.

3	42	**19**	**4**	**2**	23	41
4	45	44	39	36	38	42
5	47	51	49	49	46	44

The pixel gray scale relative intensity values of the uncompressed pixels making up the UAP image in Figure 4 are given in Table 3. Intensity values for the sky on all four sides of the UAP in Table 3 ranged from 47 and 49%.

Table 3

Relative Percentage Gray Scale Intensity Values of
Pixels at and Near the UAP of Figure 4

Pixel Column (left-to-right)

Pixel Row	1	2	3	4	5	6
1	45	49	54	53	53	47
2	48	50	46	41	42	45
3	52	47	**13**	**1**	25	46
4	52	44	**8**	7	26	46
5	49	**48**	**28**	23	38	49
6	48	50	50	47	46	49

The pixel gray scale intensity values of the uncompressed pixels making up the UAP image in Figure 4 are given in Table 4. Intensity values for the sky on all four sides of the UAP in Table 4 ranged from 47 to 48%.

Table 4

Relative Percentage Gray Scale Intensity Values of
Pixels at and Near the UAP of Figure 5 and 6

Pixel Column (left-to-right)

Pixel Row	1	2	3	4	5
1	51	31	24	33	49
2	44	**12**	**14**	**15**	45
3	45	**12**	**1**	**20**	42
4	45	29	29	39	45
5	47	44	44	45	46

It may be noted that: (1) If a 20% intensity value is arbitrarily assigned to represent the UAP then the UAP occupies a 2 by 3 pixel area for the data of Tables 2 and 3 and Table 4 and by a 2 x 2 pixel area for the data of Table 3. (2) Normal light scattering of the relatively collimated luminous rays from the UAP may be expected both from the atmosphere between the UAP and the camera and (to a lesser degree) within the lens elements. This scattering is clearly demonstrated by the progressive decrease in intensity with distance from the center of each UAP, i.e., the percentage values increase *in all directions* from the center of the UAP.

The relative clarity of the atmosphere makes any calculation (or estimate) of distance (due to aerial perspective effects) unwarranted here. Indeed, the distance to the UAP cannot be known without radar or other precise technical means.

Selected pixel luminance values are given in Figure 7 which is an enlargement of Figure 4. It should be noted that the luminance of the sky (at each horizontal tick mark) shown on the right-hand vertical scale remains relatively constant in the red, green, and blue spectrum, and the UAP's luminance is approximately the same as the airplane's wing root light source (viewed well off its optical axis).

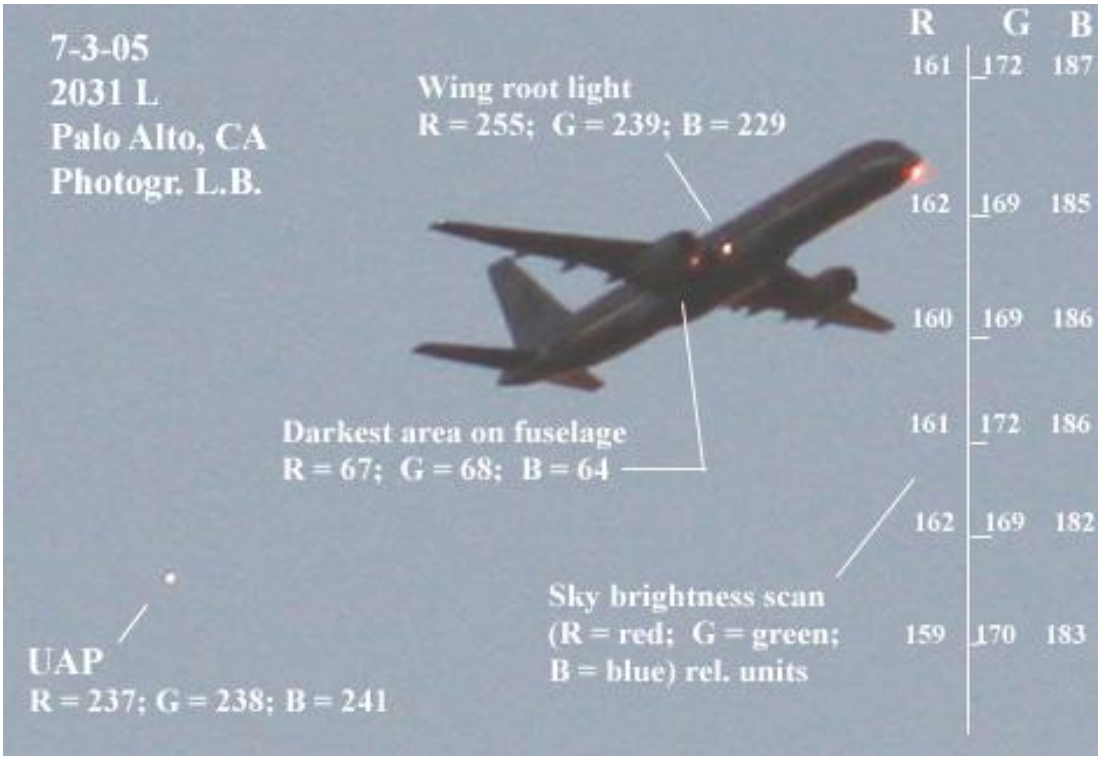

Fig. 7. Pixel luminance values of Selected Details of Figure 4.

UAP Approximate Size: Knowing that the vertical stabilizer of the B-757 is about 26 feet high[7] a calculation of the size of the UAP can be made *by assuming that it was at the same distance as the airplane*. Thus, in Figure 3 the UAP measures 2 mm high and the tail measures 20 mm:

2/20 = x/26 x = 2' 7" = approximate height of UAP

In Figure 8, the UAP measures 1.6 mm and the tail measures 14.6 mm:

1.6/14.6 = x/26 x = 2' 10" = approximate height of UAP

If the UAP was nearer or farther from the camera than the airplane then these calculations will be too small or large, respectively.

Airplane Landing and Taxi Light Characteristics: The Boeing 757-200 uses high intensity Xenon discharge lamps mounted in the wing root on each side of the fuselage. The landing light lamp is manufactured by Goodrich Hella Aerospace Lighting Systems GmbH in Lippstadt, Germany.[8] The model 1X2 455 049-00 sealed beam has a peak intensity of 345,000 cd and a very narrow beam spread of eight degrees arc. Intensity fall-off with lateral viewing angles is rapid. The diameter of its covered transparent lens is only 4.7." Located

[7] This tail height is measured from its highest point to its insertion point in the fuselage.

[8] < www.goodrich-hella.com/catalog/Chapter07_Landing,_Taxi_&_Emergency_Lights/07_0010_HID_Landing_Taxi_Lights.pdf>

adjacent[9] to the landing light is the taxi light, also made by the same firm (model 1X2 455 050-00). Its peak light intensity is 56,500 cd with a much broader beam spread of about 26 degrees (or more) on each side of the optical axis. Its cover lens diameter is also 4.7." The luminous output from both of these lamps could be expected to appear to merge together when viewed off axis and at a large distance for a total luminance of 401,500 cd on optical axis. It is interesting to note that the UAP in both Figures 3 and 6 possesses an intensity that is about equivalent to these two airplane lights.[10]

Various scene details are shown in Figures 3 and 6 which are enlargements from Figures 2 and 5, respectively. In Figure 6, pixel intensity values[11] for R, G, and B (red, green, blue) hues making up the composite color image indicate that: (1) sky brightness is fairly constant at the six locations shown along the vertical, white scan line, (2) the UAP is approximately as intense as the wing root light source shown, (3) The solar reflection on the nose of the airplane possesses R = 250, G = 255, B = 249 units, (4) the right engine nacelle intensity was R = 193, G = 155, B = 150 (only 66% of the nose reflection intensity).

Reconstructed Airplane Location and Flight Path: A graphic solution to the likely positions of the commercial airplane was carried out with the following assumptions: (a) Witness altitude = 2,600 ft MSL, (b) Airplane altitude = 4,000 ft MSL, (c) Airplane heading = 105 deg, in straight flight, (d) Airplane elevation angle (above local horizontal) = 40 deg., (e) Total incident duration = 22 seconds, (f) Airplane ground speed = 200 mph (0.055 mi/sec. or 1.22 miles over 22 seconds), (g) azimuth angle at center of scene in Figure 1 = 315 deg, and (h) azimuth at airplane in last photograph (Figure 6) = 358 deg.

Based on these assumptions, the airplane's horizontal distance from the camera would be approximately one mile (slant range of about 8,211 feet).

Figure 8 is the relevant portion of the San Francisco 1:500000 section aviation chart showing the photographer's location and likely airplane flight path (solid black line and arrow head) during these photos. As discussed above, the distance to the UAP cannot be determined with precision.

[9] The center to center separation distance of these two lamps is about seven inches.

[10] FAA regulations require that commercial airplanes have their landing lights on while flying below 10,000 feet altitude to aid in their being seen by other pilots. It is not known whether the taxi lights also were on during the present photographs. It is presumed they were on because of the extreme wide angle luminance effects seen in these photos.

[11] Pixel intensity is in absolute units ranging from 0 to 255 where lower values are darker and higher values are more intense. The darkest region in Figure 7 is found on the underbelly of the fuselage.

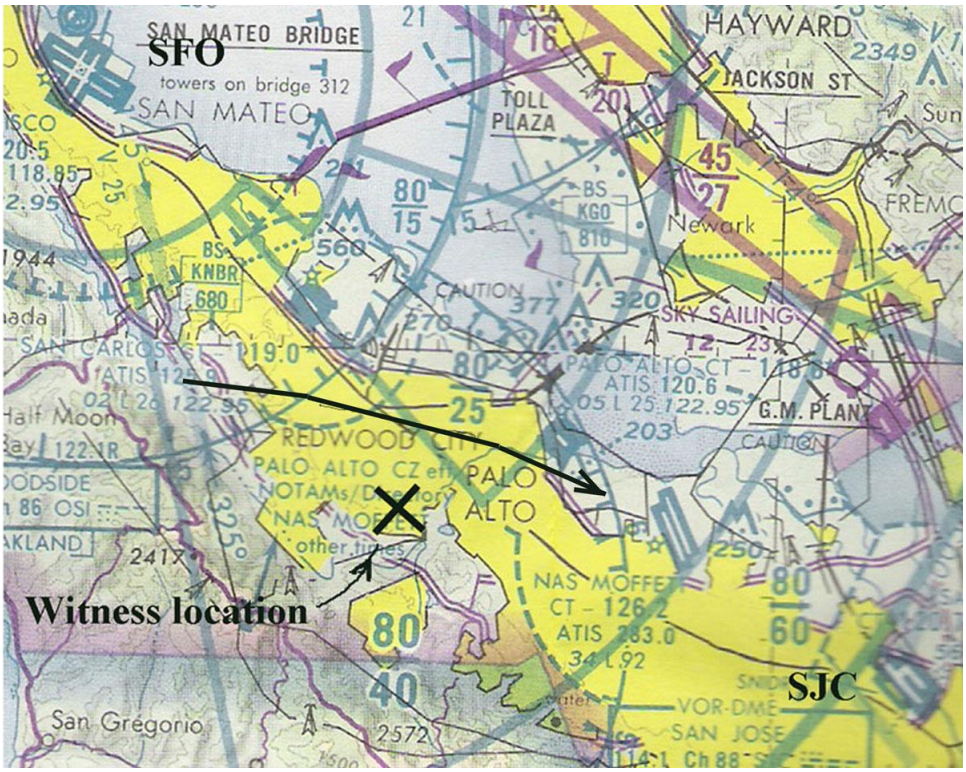

Fig. 8. San Francisco Sectional Chart Showing Location of Incident Relative to San Francisco International Airport and San Jose International Airport.

Additional Details: The following e-mail communication of July 13-14, 2005 provides some further useful data between Mr. Boehm and the author. It is reproduced without editing except to italicize Mr. Boehm's answers and comments.

The author wrote: (July 13th)
> Dear Lance,
> I appreciate your prompt and complete reply to my second set of questions (series B, dtd. 7-12-05) and other useful information.

You're welcome (mailed July 14th)

> I've driven up Page Mill Drive so many times that this spot is very familiar to me. I believe it also serves as a trail-head heading down-hill ton the north side of Page Mill ending at the Palo Alto park at its bottom.

Your memory serves you well. I've hiked along this trail many times. It's a nice getaway after work!

> Also, your sketches will greatly help us understand better the compass azimuth directions for each photograph. Please try to estimate or measure (with a compass) the direction of your camera's line of sight for each sketch. I believe that you already have my home address:

Will do.

> Regarding my question 7B, this is a routine question. Some witnesses do not want to be publically identified with their sighting details. I'm glad that you don't care. I may or may not write up a formal technical report, it's too early to tell right now.

I can understand people's concerns. Being an IT geek by profession and an amateur astronomer people have always thought I was a little weird anyway. Adding this to it isn't going to matter much! Hehe

> Your photos are most interesting and potentially important from a scientific standpoint. Therefore I am hoping you may be willing to answer some further questions (with my promise that this will not go on indefinitely). Here they are:

You know...the only reason I even thought to photograph what I was seeing was hearing Mr. Davenport on Coast to Coast AM for years now!

> 1C. Did you see the intense, white light with your naked eyes?

Yes. I saw it behind the airliner with my eyes before I pointed my camera in that direction to photograph it.

> 2C. Did you see the intense, white light (also) on the camera's display screen?

You can't use the LCD screen on my camera to aim and shoot photos. It's there only to display photos after they are taken, and to allow access to the camera's settings.

When I pointed the camera towards the airliner and zoomed in, I could easily see the object through the camera's optical viewfinder (which displays exactly what the lens system sees and takes pictures of).

> 3C. Did the intense, white light appear the same to you comparing each
> viewing situation?

The object's brightness appeared to be the same. Naked eye the edges of the object appeared mostly defined. When I zoomed in while looking through the camera, the edges of the object were less defined. I'm trying to think of how to describe this...

If you started at the center of the object and starting looking towards the edge, it didn't go from constant illumination to sky with a defined line. Does that make sense? If not let me know and I'll try to come up with a better description. I'm guessing this is because the object was round or rounded at the edges which means reflected light scattered in different directions at the edges.

> 4C. Can you estimate the approximate vertical angle between the jet airplane
> and the local horizon for frames 2, 3 and 4? Even a rough estimate will
> help.

The aircraft was about 40 degrees up from the horizon.

> 5C. What was the local wind condition at the time?

Very little or no wind at all.

> 6C. What was the local air temperature at the time?

I'm guessing around 60 degrees. My wife didn't have a jacket on at the time, so it couldn't have been much colder than that. She's always cold. The temp was dropping though, since the sun was going down.

> 7C Did you watch the unidentified light disappear from view? If "yes"
> describe whether it just became increasingly small until it disappeared
> or whether it blinked out of view while still relatively angularly large (like a star or planet)... or some combination or something else. In your answer to 6 was that "Before I could take another shot, it was
> gone." My question has to do with how did it disappear?

Yes I did watch it. It blinked out. It didn't appear change in size or brightness. One moment it was there, and the next it wasn't.

> 8C. You mentioned that your camera has an auto-stabilization system on it.
> Can you briefly describe how large a camera roll, pitch, or yaw can
> take place (or how fast) before image blur occurs? I assume the camera was hand-held.

The camera was hand held. It's actually the lens which has the image stabilization, not the camera itself.

Canon doesn't publish (at least not that I can find) details on how tolerant their lenses with image stabilization are against shake, movement, etc. I can tell you that when I first purchased the lens I purposely shook the camera while depressing the shutter button to see if I could put blur into the picture, and I was very surprised at how good

a job it did.

If you've ever looked through a set of image stabilizing binoculars you'll see what I mean. The ability to reduce/eliminate shake seems to be pretty comparable between Canon IS binoculars and my Canon lens.

> 9C. Your photos are outstanding in all respects. I can tell that you smoothly and rapidly re-zoomed your lens after the first shot to 135 mm and it stayed there for all the rest (as shown by the axial length change of the jet in the three frames).

Thanks. I'm surprised they came out as well as they did. Glad to know I can wield the technology when the pressure's on ;-)

> 10C. When the unidentified light accelerated away what direction would you
> estimate it was heading (compass direction in degrees if possible)?

It appeared to be headed West, so 270 degrees. After it disappeared I scanned the sky for a minute or two in the direction I last saw it and recall seeing Venus and Mercury in that area of the sky.

> 11C. Did the unidentified light ever blink or waver in intensity at any time? If "yes" when and in what way?

Not that I recall.

> 12C. Did the unidentified light as it was departing appear to travel in a curved arc, a straight line, a zig zag, other?

It appeared to be a straight line. As it moved further away from the airliner it stopped getting closer to the horizon, so I'm thinking it had to turn or arc in some fashion. But I didn't detect any obvious change in direction (like it was maneuvering). Is this making sense?

Looking at the pictures, you can see the object moving towards the lower left of the frame. If it kept going in that same direction with no change, it would have appeared to get closer and closer to the horizon the further on it went. At one point along it's track it paralleled the horizon before blinking out. I hope you're getting what I'm trying to say here...please let me know if I'm not making sense.

> 13C. Did you look back at the jet airplane after the unidentified light had finally disappeared? If "yes" where did it seem to be going? (You indicated SJC however, some bay area approaches to OAK and SFO could appear as a circling approach to SJC via the east side of the valley (Milpitas)?

Yes I did. The last frame I sent you was taken after I had seen the object disappear, after repointing my camera at the airliner. You can tell the angle of view, sky background, etc., is different than the 3 frames I sent with the object in it.

The airliner was headed East/Southeast at about 140 degrees. Looking North from where I was, San Jose was pretty much directly to my right at 90 degrees. The airliner appeared to be headed to the South of San Jose (maybe circumnavigating it to land from the other direction?). Passengers on the left side of the airliner would have been able to see San Jose out the window.

> 14C. How many seconds went by from the instant you first saw the jet and small, white, intense light and the moment it was last seen?

About 20 seconds.

End of e-mail

Climatological Details: Weather data obtained from the National Weather Service[12] for this date, time, and locale indicated that the average wind speed was 12.6 mph with gusts as high as 30 mph out of the west (290 deg.). This fact precludes the UAP being a weather balloon since it accelerated toward the west at high speed. Relative humidity ranged from 86 to 58 percent (mean = 72 percent); the sky was otherwise clear of cloud.

Astronomical Details: Table 5 lists selected information for prominent celestial bodies visible in the western sky during this sighting. The motion of the UAP precludes it being any of these celestial bodies. Mr. Boehm included Mercury and Venus in one of his sketches in their correct positions. They were clearly not related to the UAP in any way.

Table 5

Planetary and Other Sky Objects in SW and W Sky on the Evening of July 3, 2005

Planet/Body	Rise Time	Transit Time	Set Time	Compass	Magnitude	Phase (%)
Sun	0552 hrs	1312	2032	299 deg.	n/a	n/a
Moon					99% dark	
Mercury	0757	1501	2204	WNW	0.27	50.2
Venus	0751	1459	2207	WNW	-3.9	90.1
Saturn	0714	1422	2131	WNW	-0.13	99.9
Jupiter	1305	1859	0052	SSW	-2.05	
Capella	0348	1320	2252	315 deg.	0.08	
Regulus				WSW	1.36	

* All at 18 deg above horizon at 2031 hrs L., Palo Alto time and location in tight grouping between West and WNW at Azimuth of about 293 deg.

[12] Obtained by Ted Roe.

Conclusions

These three high resolution, color, digital images of a small, white, intense light pacing and then departing from a commercial airplane cannot be identified as a weather balloon, an astronomical body, a man-made aerodynamic body, or other such remotely piloted vehicle. It remains unidentified at this time and also remains a potential threat to flight safety.

Acknowledgements

It is a pleasure to acknowledge the able assistance of numerous people who have contributed in many different ways to this analysis. First and foremost is Mr. Lance Boehm the photographer and amateur astronomer. In addition, I want to thank Peter Davenport, director of the *National UFO Reporting Center* in Seattle who alerted me to this case and put me in contact with the photographer. Also, Jim McClenahen, Ted Roe, Ruben Uriarte, and Brian Smith all of NARCAP provided valuable data and advice. Any errors or basic omissions, however, are mine alone.