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Analysis of Photograph of a High Speed Ball of Light

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Date of Photograph: July 16, 1988
Time of Photograph: approx. 1400 PST
Location: 33º 49' N; 116º 44' W (West of Palm Springs, CA)
Duration of Sighting: from 5 to 10 seconds
Number of UAP: one
Number of eye witnesses: one plus others (alleged)
Number of photographic frames: one

Abstract

This pilot sighting report and color photograph of an unidentified aerial phenomena (UAP) called for a number of different forensic methods including photo-analysis, aircraft window study, camera-lens-film analyses, and evaluation of reporter credibility. The single frame, Kodak color, copy negative was submitted for examination by one of the several eye-witnesses. This paper describes the results of these analyses. It is concluded that: (1) whatever the UAP was it was probably in sub-sonic flight. If the UAP was travelling at subsonic speed the estimated total sighting duration and/or its estimated distance from the witness are clearly in error by a factor of two or more, (2) no evidence of a hoax or double exposure was found nor were any bolides,

meteorites, or other unidentified aerial phenomena reported for that time and place, (3) the luminance of the main body of the object and immediately adjacent tail area were so high they fully saturated (exposed) the relatively "slow" film. This may explain why the photograph does not correspond closely to what was seen, (4) the film's optical density, as measured along the length of the white tail behind the UAP, changed in a peculiar fashion and is not characteristic of reflected sunlight off water droplet vapor, and (5) interesting micro-details were discovered that suggest the possibility of some type of energy emissions extending from the UAP but not necessarily in the direction of its flight. The nature of the UAP and constitution of its atmospheric trail remains unknown at this time.

Introduction and Flight Background Details

As many writers have said before, the credibility of a purported ufo photograph rests far more upon the credibility of the photographer than upon all of the technical characteristics and details producing the photograph. But when the credibility of the eye witness is found to be high and no evidence of fraud or hoax is found it is more reasonable to accept the photograph at least as what it purports to be, evidence of an interesting, if unknown, phenomenon of some kind.

An interesting aerial sighting (with 35mm color slide) was reported by photographer-witness, R. J. Childerhose (1966) on August 27, 1956. He was flying a Royal Canadian Air Force F-86 jet at the time. As noted by Klass (1968, pg. 146), "The photo (used on the dust cover of his book) shows an intensely bright, white, egg-shaped object that seems to be suspended below an intense thunderstorm" but visible through a hole in the clouds whose tops were at about 12,000 feet altitude or higher. He told Klass that the object seemed to have sharply defined edges and looked "like a shiny silver dollar sitting horizontal." The pilot also wrote to tell Dr. James McDonald (Maccabee, 1999, pg. 209) that "…the photo of the bright object doesn't represent quite what appeared to the naked eye. When I first saw the object it appeared as a very bright, clearly defined discoid, like a silver dollar lying on its side. The photo makes it look like a blob of light, the result of light intensity." Both Klass and Altschuler, a member of the University of Colorado's UFO study panel (Gillmor, 1968,

pg. 733), felt that the object seen and photographed by Childerhose was ball lightning. Later work by Maccabee (1999) suggests that few of the characteristics of ball lightning match those seen and photographed by this pilot witness.

Childerhose tried to explain why what he saw did not correspond to what appeared on his photograph. He stated, "The light it emitted was very much brighter than the existing sunlight at that time of day and this over-exposed the film, causing the blurred edges you see in the picture." (Klass, 1968, pg. 147) Subsequent assumptions and calculations by Maccabee (1999) suggest that the object was actually made up of two distinct bright spots/ objects very close to one another whose luminous surrounds merged together and that its power output would have been more than 10^9 watts. This classic photograph has continued to perplex investigators over the years. Interestingly, the author learned about the existence of another photograph, described in this paper, that contains a number of elements similar to the Childerhose event. As will be seen, the present case is important not only because of the apparent overlap it has with the earlier event but also because it might shed more light on why some photographs don't correspond more closely with what was reportedly seen.

The author received word via e-mail to the National Aviation Reporting Center on Anomalous Phenomena (NARCAP)[1] on January 27, 2001 that a John Williams (pseudonym) had in his possession an "original photo and negative as well as the flight log…". In this e-mail he also provided a relatively complete narrative of his flight location when the event occurred, viz., five miles NE of Mt. San Jacinto which is about eight miles NW of Palm Springs airport, California.

Basic Sighting Events

Mr. Williams, piloting a Mini-Nimbus/C sailplane[2], towed behind a standard tow plane, took off from Hemet, California's Ryan airport[3] at 1315 hrs PST on July 16, 1988 and climbed toward

[1] Since this case did not involve aviation safety the author investigated it independently from his duties as Chief Scientist for NARCAP. Nevertheless, it is included as a NARCAP Topical Report for the benefit of those who may be interested in it.

[2] The Mini-Nimbus/C sail plane has a gross weight of 480 pounds and a glide ratio of about 44:1.

the NE, eventually reaching an altitude of about 12,000 feet above ground level (AGL). The ground in this area rises from 1,600 feet above mean sea level (MSL) gradually toward the east where the San Jacinto mountain range (typically from 7,000 to 10,000 feet high) runs roughly north and south. Since the primary purpose of this flight (which lasted just over ninety minutes) was to obtain color photographs of the sailplane in flight from a chase plane, Mr. Williams had arranged for a personal friend to ride both as passenger and photographer in the Mooney 201 aircraft[4] with the pilot (Mr. D. L. S.) sitting in the left seat. Mr. R. C. sat in the right-front seat and took twenty four photographs (mainly) through his right-hand window. Mr. Williams provided him both the camera and film (discussed later) and recovered all items immediately upon landing[5].

Upon reaching 12,000 feet altitude the (commercial) tow-plane released the sailplane and immediately banked away to return to Hemet airport. The pilot of the chase plane, Mr. D.L.S., followed behind and generally to the left hand side of the sailplane which permitted the photographer to take his photos from the right hand window. All three individuals were in constant radio communication throughout the flight on 123.3 MHz. Figure 1 is a photograph of the Mooney 201 chase plane taken by Williams with his calibrated cockpit camera during the flight.

Figure 1
Mooney 201 Aircraft
(Registration: N1985Y)

insert here 8" x 10" color positive print

[3] Ryan airport, Hemet, California, is 1,512 feet MSL with a runway length of 4,300 feet and right-hand pattern. It is used extensively by soaring pilots and hosted almost a hundred such aircraft at the time.

[4] The Mooney 201 was FAA certified in September 1976 and is all metal construction. It holds four passengers and boasts a 200 hp, flat four cylinder engine. Its high maneuverability and (low wing) visibility makes it an ideal candidate as a photographic chase plane. During this flight its flaps were fully extended in order to slow to the same speed as the sail plane (approx. 120 kts.).

[5] Mr. Williams claims to possess these other frames although he could not find all of them as of September 1, 2001. He landed at between 1445 and 1500 hrs.

Figure 2 was prepared to help understand the relative instantaneous locations of the sailplane (S), chase plane (A) and the unidentified aerial phenomenon (UAP) of interest, and other geometry. The heavy black line (V - V') indicates the approximate flight path of the sailplane during the five to ten second-long visual sighting. The straight dashed line (Y - Z) is the assumed linear path of motion of the UAP. The angle (X-A-X'; not drawn to scale) represents the camera lens' angular diameter subtending an arc (Th) of approximately 57 degrees (discussed later).

Figure 2
Sketch of Relative Aircraft Locations
and UAP During the Visual Sighting

insert here 5" x 7" B&W drawing

Note in Figure 2 that during the sighting the sailplane was on a heading of about 45 degrees (magnetic); it was approximately "five miles North East of Mt. San Jacinto" at the time. In the primary witness' own words, "…a shallow descent was established to 11,000 ft. to build air speed for (the) photo run. A number of photos were taken without anything unusual (happening), then a bank and turn to the right, away from the chase plane was made (V – V'). During this turn observers in both aircraft observed, and the photographer in the chase plane photographed the UAP seen in Figure 3. Williams said that the fast-moving object looked like "…a large reflecting sphere… almost like a large ball bearing with a tail."

Initially, the UAP came from the 7:00 position relative to the sailplane (point Y) and passed in front of him at an estimated distance (d) of about 1 – 2 miles. According to Williams, "It (the UAP) exited (my) vision at the 1:00 position relative to the sailplane." (point Z). Perhaps the single most critical question is how large was distance (d)?

Mr. Williams indicated that they landed between 1445 and 1500 hrs at Hemet, Ryan Field. This amounted to a total flight duration of from 90 to 105 minutes.

Chase Plane Details. With a propeller tip-to-tip length of 6' 2" located less than ten feet ahead of the cameraman it would be unwise to photograph another aircraft looking through it directly ahead of the chase plane. A fast shutter speed could almost "stop" a blade making it become visible during its rotation or at least produce a darkened blur region that could reduce the clarity of the image. So Mr. R. C. took all photos through the right side cabin window. These photographs would likely have been taken somewhat oblique to the window plane as suggested in Figure 1.

The UAP Photograph

Figure 3 shows the Mini-Nimbus/C sailplane against a clear blue-sky background with the unidentified aerial phenomena (UAP) (white streaked region) seen just above it. The local time was about 1400 hrs. If the photograph is rotated thirty degrees CW to place the sailplane in a right-hand bank the UAP's trajectory is seen in a slight climb just as Williams recalled it. If the UAP was at a higher altitude than the witness and in straight and level flight, perceptually speaking, it would have appeared to be rising as it passed him.

Figure 3
Photograph of Sailplane and UAP

insert here 8" x 10" color positive print

Other Potential Eye Witnesses

This event allegedly involved as many as five eye witnesses in four different aircraft: (1) the sailplane in which Mr. Williams visually sighted the UAP, (2) a Mooney model 201 chase plane with a pilot (D. S. now deceased) and Mr. R. C. the photographer and friend of Mr. Williams, (3) a second sailplane in the vicinity whose pilot (Capt. Leo; first name) was the first to see the approaching UAP, and (4) the tow plane pilot.[6] It was learned that Mr. R.

[6] It isn't known if the tow plane pilot saw the UAP. No effort was made to find out at the time.

C., was an engineer who had worked previously for the Hewlett-Packard Company. He is a "very private person" according to Williams. In 1988 both he and Williams were employed in law enforcement and were very concerned that their careers would be affected by seeing and reporting this phenomenon. They maintained only infrequent contact after he (Williams) moved from southern California to the state of Washington. Williams did not know the identity of Capt. Leo other than his first name and that he was a commercial pilot. Although over thirteen years had passed since this incident took place the author attempted to locate the other alleged witnesses but without success. When asked why he waited so long to report his sighting Williams answered that he had no particular interest in ufo nor did he even place his photograph in that category. He simply forgot about the incident and the photograph until many years later (January 10, 2000) when he came across the National UFO Reporting Center's web site and decided to submit a report to them "in case someone might be interested in it." As mentioned above, he subsequently learned of NARCAP's existence and contacted us because of our interest in UAP and flight safety.

Camera-Lens-Film

Camera. A Minolta Maxxum Model 7000, 35mm, single lens reflex camera body was used with motorized film advance capability (permitting up to two frames/second in the continuous exposure mode). The camera was allegedly set to AE (automatic exposure) mode such that all the photographer had to do was aim, zoom, and shoot.

Lens. A Rokor zoom lens was used with focal length range from 28 to 80 mm. The f-stop range for this lens is from 3.5 to 4.5 for these limiting focal lengths, respectively.

Set to the full zoom position (28mm focal length), the angular width of the resulting photograph is approximately 57 degrees arc. At the manufacture's 'standard' setting the photo's angular width would have been about 40 degrees arc which value is used for calculations made in the present paper. Since the zoom setting was not recorded this value could be in error. Nevertheless, the overall conclusions of the analyses are not changed

materially if a different angular width were used.

In the A-E mode, this camera possesses a fixed exposure "program," i.e., the relationship between aperture and shutter speed at a given zoom setting is pre-established. Figure 4 presents the A-E program factors for this model camera. It shows that mid-way between f3.5 and f4.5 and its "TELE" lens setting, the resultant shutter speed would have been approximately 1/500 second. Likewise, if the zoom lens had been set at its mid-point the corresponding shutter speed would have been approximately 1/250th second. Finally, if the zoom lens had been set at its widest setting the corresponding shutter speed would have been about 1/30th second. In order to obtain a shot with the sailplane almost filling the entire frame the zoom setting would have had to be at least at its mid point or more; an assumed shutter speed of 1/250th second is used here which is consistent with the sharpness of the sailplane's image.

Figure 4

Automatic Exposure Relationships

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insert here 5" x 7" B&W print

Shutter speed is important because the longer the shutter is open the greater is the chance for image blur to occur due to chase plane/camera motion. Conversely, a sharply defined target object indicates a relatively stable camera and target during an exposure. This clearly was the case here. The upper and front edge of the UAP that appears to have a double boundary must be due to some other cause than camera motion.

Film. The negative stock was Kodak VPS 5026 which is also known as Vericolor III Professional Film. This 35mm, medium speed, color negative film possesses a nominal ASA rating of 100. "This film is designed for exposure with daylight or electronic flash at exposure times of 1/10,000 second to 1/10 second." (Kodak, Pg. 2, 1997) The grain size and image structure on the enlargement received by the author appears to be consistent with statements made in the Kodak specification sheet; their print grain index sets a value of 25 as the

"approximate visual threshold for graininess" (given various standardized viewing conditions). A higher number represents an increase in the amount of observed graininess. Kodak's published print grain index for a 35mm negative of Vericolor III film enlarged to 8" x 10" is 61. If further enlarged to 16" x 20" this value increases to 91. Inspection of the present 8" x 11" color positive print reveals obvious graininess, as expected. The yellow forming dye layer peaks in sensitivity at 425 nm and ends at a maximum wavelength of 525 nm. The magenta layer peaks at 558 nm and ends at 620 nm and the cyan-forming layer peaks at 660 nm and ends at 690 nm. Its modulation-transfer function curve is relatively flat at between 2.5 and 12 cycles/minute arc and then smoothly falls off to 32% response at about 75 cycles/minute arc. In short, this professional film supports relatively high resolution photography over a wide range of contrasts. Consult the following web site for more information:

<http://www.kodak.com/global/en/professional/techPubs/e26/f002_0475ac.gif>

On March 9, 2001 the author received a 4.25" long, color negative strip containing one exposed frame (no. 3A) connected to frames 4A and 5A that were unexposed for some unexplained reason." The single exposed UAP frame was in very good condition with no scratches at all; it did contain a lighter density, linear border measuring 2.05 mm wide on the vertical dimension and a 0.9 mm wide border on its lower edge. A positive print made by the author from this negative showed these two black borders which was absent on the 8" x 11" enlargement received from Williams (i.e., either they had been cropped out or his photo had been made from another negative). The total frame width was 36 mm as expected. The presence of these two visible borders that could not have been produced within the camera during exposure, coupled with the absence of any exposed frames after the UAP frame, strongly suggest that this was not the original negative but a copy negative. Where could this copy negative have originated if not from Mr. Williams?

Film Processing. Mr. Williams said that upon receiving his camera from his friend (R. C.) immediately after landing he placed the camera (with film still inside) into his nylon camera bag. He said he took the exposed film to a one-hour photo processor on Convoy Street in San Diego "that afternoon or the following day on his way to work" and, about a week later, picked up the processed film and standard size positive color prints. "I didn't even look at them then," he

explained. “I was going flying again that weekend and took them with me to show the guys how they had come out. We flew almost every weekend.” When they all noticed the frame of interest (UAP) the chase plane pilot said almost nothing while Mr. R. C. simply remarked, “Look what we got on that photo!” “He is a very stoic person,” observed Mr. Williams, who then ordered two (2) each eight by eleven inch color enlargements of the frame showing the UAP, one of which he submitted with the negative.[7]

Details of the Photo-Analysis

The author made a number of digital scans of this UAP frame as described below. The objective of these scans was to better understand the nature of various image details. The initial scan emphasized the left wing of the sailplane where the white (vapor?) trail passed through it. If this was a double exposure the (positive print) luminance of the wing in the region of the trail should be somewhat higher than in regions where the trail did not intersect it because of exposure additivity. Figure 5 shows the seven equally spaced lines (each normal to the wing’s surface) along which density measurements were obtained as well as ten locations along the white tail (see below).

Figure 5

Sailplane Left Wing and Vapor Trail Image

(250 dpi scan, B=-10, C=+5%)

insert here 8" x 10" color positive print

Happily, no evidence was found that would support the contention that a double exposure had been carried out (within a margin of error of +/- 2%). The luminance of the left wing was not measurably greater where the vapor trail intersected it as compared with the area where the wing was imaged against the clear blue sky.

[7] Is it likely that a copy negative was made at this point? If so, for what purpose? The author received the additional five frames from this roll on August 12, 2001. Since Williams did not take the photos he wasn't sure of their order on the film.

White Trail. Two separate tests were performed within the same region as Figure 5 to better understand details of the vapor(?) trail. In the first test the 'Posterize' filter (Adobe *Photoshop*) was set to five (5) levels to see if discrete edges could be extracted from the otherwise diffuse white trail behind the head of the object. As expected, several non-parallel, tapering gradients could be discriminated as shown in Figure 6.

Figure 6

UAP Vapor Trail Luminance Gradients

(650 dpi scan, B=5, C=5%, posterize=5)

insert here 8" x 10" B&W print

The second test performed used the 'Emboss' Filter that significantly accentuates low-contrast, micro-image grain details as a function of pseudo-illumination angle and pseudo-depth of the pixel luminance. Figure 7 presents the results of this test where areas of the image that are nearly 100% exposed areas (i.e., diffuse, very luminous white portion of the UAP tail) appear here as an oval shaped, smooth, gray region. Note the enhanced 'granularity' within the tail of the UAP (between lines X and Y) as compared with the clear sky (outside lines X and Y). This large granularity is probably due to sunlight scattered from greater turbulence within the tail. One possibility may be that the UAP's white tail represents ionized or otherwise excited air by emitted microwave energy from the UAP (cf. McCampbell, Pp. 23-37, 1973), a possibility that is further supported by Figures 8 and 9 related to the head or leading edge of the effect.

Figure 7

UAP Vapor Trail Grain Micro Structure

(1300 dpi scan, B=0, C=0, Angle= -66deg, Ht. = 10 pixels, Amt.=420%)

insert here 8" x 10" color positive print

The final test conducted was on the variation in luminance of the white tail streaming behind the UAP. It was scanned at equal distances along its entire length (equivalent to

approximately 27.3 degrees arc) at the positions shown in Figure 5. Due to luminance variations at each location an upper and lower value was recorded (Cols. 2 and 3). These relative luminance values are given in Table 1.

Table 1

Relative Luminance Distribution Measured on Each Side of a Central Line Along Entire Length of the Tail
(See Figure 5 for Exact Measurement Locations)

	Measurement Location* (see Fig. 5)	Lower Value+ (%)	Upper Value+ (%)	Angle (deg.) behind head A	Cos A
(End of tail)	1.0	60	62	27.3	0.518
	1.5	56	62		
	2.0	58	62	23.9	0.443
	2.5	56	64		
	3.0	57	60	20.5	0.374
	3.5	62	64		
	4.0	58	68		
	4.5	63	76	17.0	0.306
	5.0	60	70		
	5.5	58	67	13.6	0.242
	6.0	67	75		
	6.5	70	80	10.2	0.178
	7.0	77	85		
	7.5	95	98	6.8	0.119
	8.0	100	100		
	8.5	100	100	3.4	0.059
(Head of UAP)	9.0	100	100		
	9.5	100	100	0	0.000

* Approximately 0.5” apart along entire length of white tail on enlarged image.

\+ 100 % on this scale represents fully exposed film, i.e., highest luminance.

It may be noted that, progressing away from the "forward" end of the UAP, the luminance of the tail decreases very rapidly beyond measurement location 5.5 (just below and left of the sailplane’s wing in Figure 5) which suggests an almost exponential decay rate. If the tail was composed only of water vapor one would expect its reflectance (in the direction of the camera) to be approximated by the cosine of the angle (sun - UAP - camera) (cf. Col. 5 in

Table 1) which it clearly does not. Is the tail the by-product of a totally different process? Perhaps it is made up of a substance with a rapid luminous half-life on the order of a second or two or is composed of particles possessing directional reflectivity, or some other explanation?

Head of UAP. Another set of tests was performed on the region of the head of the UAP. This region is greatly overexposed - virtually to the point of making any discrimination of object edge or surface detail impossible. The 'emboss' filter was used first. The homogeneous gray, flat-appearing region in Figure 8 depicts the 100% over exposed area of the film and is very likely the actual UAP itself and part of its high luminance trail. The left tip of the tail can be seen here. The areas lying outside of this central, gray region are of more interest, however. Thin, parallel fingers are seen protruding from the rounded front of this image. It is interesting that most of these fingers diverge from ten to fifteen degrees arc from the UAP's

Figure 8
UAP Head Area Emphasizing
Coronal Micro-Structure
(450 dpi scan, B=10, C=15, emboss filter)

insert here 8" x 10" color positive print

Figure 9
UAP Head Area Emphasizing
Corona Macro-Structure
(450 dpi scan, B=10, C=15, RGB curves filter as described in text)

insert here 8" x 10" color positive print

flight path. What these short protrusions are is not known but may represent energy projections of some sort. These protrusions also appear in Figure 9 where the same part of the image was subjected to a sinusoidal filtering (RGB Curves function) using seven (7) equally

spaced cycles across the 255 bits of exposure depth. This yields artificially enhanced profiles of equal luminance. The luminance boundaries nearest the head of the UAP tend to include the projections that characterize the head itself while boundaries more distant do not. This effect seems consistent with a radiation effect that decreases in intensity with distance from the energy source.

The appearance of separated striations within the white tail behind the UAP appear to be consistent with condensation trails of a blunt-nose body in sub-sonic flight through Earth's atmosphere (Smith, 2001). Of course, the tail may be produced by a totally different mechanism. In addition, if the UAP was travelling at a supersonic velocity there would be a significantly different appearance of the bow shock wave than is seen in the photograph. Further, the sailplane pilot did not hear a sonic boom nor feel any sudden air buffeting during or soon after the UAP passed him which would be consistent with a vehicle travelling at sub-sonic velocity.

The last test performed on the head of the UAP consisted of "stretching" the exposure so that only thirty [about 12%] of the 255 total (245 minus 215) bits of *input* (exposure) "depth" were stretched over two hundred (200) bits of *output* "depth." This was done to see if very low contrast detail might lie buried within the greatly overexposed region of the UAP's head. Figure 10 shows what was found.

Figure 10

IAP Head Area

With Luminance Stretching

(450 dpi scan, B=-5, C=0, Stretched Exposure)

insert here 8" x 10" color positive print

The magnification and image centering of Figure 10 are similar to that of Figures 8 and 9 for sake of comparison. The luminance stretching was performed only within the smaller inset square to permit comparison of its diameter with the unstretched image (seen in the remainder of the figure. It may be noted that the front edge of the head is relatively circular

and (again) includes several short protrusions located near the top of the head. The spherical shaped object that Mr. Williams perceived likely corresponded to part of this rounded region.

Sun's Location, Sky Luminance, and Weather Analysis

On July 16st 1988 at 1400 PST the sun was at 56 deg. 37.8 min. arc elevation and 244 deg. 33.6 min. azimuth at this location. These values are useful in studying illumination and shadows on the UAP, sailplane, and chase plane windows. The reported heading of the sailplane (approx. 45 deg.) at the moment of the photograph is consistent with the location of the sun's shadow on its fuselage. In addition, a rather significant amount of sunlight is also reflected from the earth's surface upon the underside of the sailplane as seen in Figure 3.

No clouds are visible in the photograph which supports Mr. Williams' statement that clouds had not yet developed at this hour of the day.

The entire frame was scanned at 175 dpi and a brightness filter applied to emphasize the range of luminance along lines A and B (i.e., upper right to lower left). Figure 11 presents the resultant image. When the image is rotated about thirty degrees CW these measurement lines represent the sky's horizontal luminance gradient. Individual luminance values (3 x 3 pixel cursor) are shown at their measurement location. It may be noted that the sky in the upper right-hand corner of this image is visibly darker than it is in the lower left-hand corner. A luminance difference of about x 2.4 was found along line A which is larger than would be expected from usual atmospheric particle light scattering across this narrow an angle of sky (Allard, 1876).

Figure 11

Sky Luminance Distribution

(175 DPI scan, B=+22; c=+76)

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insert here 8" x 10" B&W positive print

Windshield and Side Window Optical Analysis

In order to better understand the possible cause of this large luminance gradient several hypotheses were formulated. The first is that sunlight struck the Mooney's right-hand window to create the veiling luminance seen in Figure 11. An attempt was made to obtain geometric details of the side window's rate of curvature and other geometry. A rough estimate of these parameters was made based upon inspection of a front-view photograph of this aircraft (cf. Figure 12). The passenger's side window possesses a large radius (approx. 24 ") horizontal curve over its upper half progressing to a nearly flat plane over its bottom half.

Figure 12

Nose View Photograph of Mooney M20S

insert here 8" x 10" color positive print

Assuming that the chase plane was beginning a left-hand bank away from the sailplane when the photograph was taken the camera's line of sight would probably have been through the lower, planar part of the window. With the Mooney's heading of approximately 360 deg. and sunlight azimuth at about 244 deg, sunlight could not have struck the tinted plexiglass side window. In short, the lighting conditions were perfect for this photograph with the sun illuminating the top and left-hand side of both the Mooney and the sailplane; the window and camera both were in shadow. The gradient of the sky's luminance seen in Figure 11 is not likely caused by sunlight falling on the Mooney's side window if the aircraft headings are those assumed here.

A second working hypothesis is that this large luminance gradient across the film plane may have resulted during its processing if a typical darkroom environment has been used. The Kodak film specifications state: "Do not use a safelight. Handle unprocessed film in total darkness." (Kodak, pg. 2, 1997) Fortunately, Mr. Williams was able to locate five other frames taken from the chase plane during the same flight. He indicated that the photograph

shown in Figure 13 is very likely the frame obtained just prior to the UAP photograph (Fig. 3; cf. footnote 7. This frame allowed a comparison to be made of the sky's luminance gradient with that of the UAP frame; approximately the same range of luminance was found in each which argues against the second hypothesis as well as a third.

The third hypothesis is that the UAP had somehow caused additional exposure of the film perhaps due to emitted radiation of some sort. Figure 13, taken many minutes before the appearance of the UAP, suggests that this possibility is very unlikely because of a similar amount of luminance gradient present here as well.

Figure 13

Photograph of Sailplane Taken Several Minutes Before the UAP Photo

insert here 8" x 10" color positive print

The fourth hypothesis is that this luminance gradient is merely that of the natural daylight sky under these conditions. Inspection of all photos provided by Mr. Williams tends to support this hypothesis even though the range is higher than would be expected (Allard, 1876, Koschmieder, 1924).

Calculations of Possible UAP Velocity

If the UAP (1) travelled in a straight line, (2) travelled at a constant velocity, (3) was seen for five or ten seconds (t) total, (4) travelled through the horizontal angles (Col. A - see below), and (5) was either one or two miles away from Mr. Williams (Col. D) it would have had to travel at the velocities (Col. V) shown in Table 2.

Table 2

Calculated UAP Parameters
for These Assumed Parameters

Total Horizontal Angle (deg arc.) UAP Travelled in Time "t"	Angular rate of UAP (deg./sec.)	Duration (sec.) t	Distance (st.mi.) from Sailplane D	Total Distance Traveled (st. mi.)	Velocity (mph) V
100	20	5	1	2.38	1,714
100	20	5	2	4.77	3,434
100	**10**	**10**	**1**	**2.38**	**857**
100	10	10	2	4.77	1,717
100	10	10	3	7.15	2,574
110	22	5	1	2.86	2,059
110	22	5	2	5.71	4,111
110	11	10	1	2.86	1,030
110	11	10	2	5.71	2,056
110	11	10	3	8.57	3,085

It appears that all of these velocities are too large in view of the likelihood that the UAP was travelling at sub-sonic speed for reasons given above. Either the sighting duration estimate was too short, the distance to the UAP was too large, the angle through which the UAP appeared to pass was in error, or some combination of these factors. Even the 857 mph (bold faced) value given above is supersonic. Clearly, a rather large error exists in these estimated parameters. Such perceptual errors are not at all uncommon when there are few if any stable, visual landmarks and/or time references available within the visual field (Haines, 1980). Even if the distance to the UAP was reduced to only one-half mile it would have had to travel at 428 mph over ten seconds and 100 deg arc; at 0.75 mile distance it would have had to travel at 644 mph over ten seconds and 100 deg arc given the other estimates.

The change in azimuth angle through which the sailplane traveled at 110 kts in a coordinated 20 deg banked turn (no side slip assumed) to the right over five seconds equals about 14 degrees and 27 degrees over ten seconds.[8] The sailplane would have traversed about 700 and 1,400 feet during these two durations, respectively. Since the UAP was seen initially on the left-hand side of the sailplane, i.e., on the outside of his right-hand turn, Williams would be turning in a direction to keep it in sight slightly longer than if he were in straight flight by about 2.7 seconds.

A UAP subtending a visual angle of 2 deg. 35 min arc at one and two miles distance would measure 238 and 475 feet across, respectively. At 0.25 mile distance it would measure 59.4 feet across.

Evaluation of Reporter Credibility

Mr. John Williams was confirmed to be a licensed pilot (S.E.L. and "Diamond" level soaring pilot with 18 years flying experience) at the time of the event. He did not possess any waivers or limitations. He claimed to have had 400 logged hours with 350 hrs. in high performance sailplanes "…in multiple flight envelopes and conditions." His reported directorship on a prominent California aerospace museum in the 1980s also was confirmed. His clear and detailed knowledge of aeronautics and flight details was found to be accurate in every respect. No evidence of any kind could be found that he ever attempted to capitalize on this photograph in any way.

Discussion

Two primary subjects will be discussed: (1) the differences (and possible causes) between what was reportedly seen and what was recorded on the photograph and, (2) the ambiguity of whether or not the negative submitted was original or a copy negative and reasons for accepting it for study.

[8] The radius of turn for these conditions = 2,944 feet given by $R = v^2/(\tan \text{theta} \times g)$ where: R = turn radius, theta = bank angle (deg.), and $g = 32.2$ deg/sec^2. Mr. Williams estimated (later, March 9, 2001) his bank

(1) Differences Between What was Seen and Photographed. Mr. Williams remarked that the UAP looked to him like a "large reflective sphere … almost like a large ball bearing." But this is not what his photo looked like. A quite similar situation exists with the 1956 report by Childerhose discussed earlier. And, when asked to comment on whether or not he remembered seeing a parallel upper edge to the vapor trail that is visible in his photograph he remarked, "The UAP looked more distinct and spherical than it does in the photo, with an area to the rear, several times its diameter that had a vapor quality." This perceptually-based description clearly implies the presence of an object with a polished metal surface and not a diffuse white ball with a vapor trail that is seen on the film. He did recall seeing a "tail" behind it.

Several possible explanations exist for these appearance differences: (a) Williams' memory may have been modified somewhat over the intervening years. Such examples of memory modification are well documented (e.g., Shepard, 1979). (b) Williams changed the visual description of the UAP for some unknown reason. The likelihood of this seems small in view of the fact that his description of the UAP didn't correspond at all to the photograph he submitted. This argues in support of his honesty and self-assurance in this sighting detail. (c) The radiation reflected or emitted by the "spherical" UAP affected this film differently than it affected his retina and visual system. This last possibility deserves further comment related to both the geometric and the spectral sensitivity aspects of the case.

Geometric Aspects. The author has conducted laboratory research on both the perceptual and photographic effects of using ultra-high luminance targets in support of the space program (Haines, 1965, 1966, 1968, 1969, 1971) and has photographed highly polished metal spheres and other surface shapes under full sunlight conditions (e.g., Haines, Fig. 39, 40; 1980). These studies clearly demonstrate that the normal human eye perceives very bright targets differently than they will appear on film that has been exposed under so-called "normal" conditions. Let us first consider the visual appearance of a polished metal sphere. For prolonged, light adapted viewing of a sunlit sphere one will see its entire outline and "metallic" surface (reflecting sky and other background) with a smaller diameter, reflected,

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angle to be from ten to fifteen degrees.

virtual image of the sun that is extremely bright. *But the entire surface of the sphere will not appear homogeneously bright*. Recall that Mr. Williams' perceptually based statement was that the UAP looked like "a large reflective sphere… a large ball bearing."

Now consider the visual appearance of a correctly exposed photograph of the same mirror surface target as above. Given the proper shutter speed and aperture much the same object detail will be seen as described above. On the other hand, if the shutter speed and/or aperture are not adequate to reduce the ultra high optical power coming from the spherical target what is produced is a much larger diffuse white area perhaps the same angular size of the entire sphere itself as is seen in the present photograph. Yet in the present photograph the sailplane was properly exposed so the shutter speed and aperture had to be approximately correct for these nominal conditions. The over-exposed UAP had to result only from its excessive output of optical power. It is likely that this is what occurred in the present case as well as in the earlier Childerhose case.

Now consider a sunlit sphere in the sky whose surface is not mirror but diffusely reflecting, like white chalk. It will appear both to the naked eye and on a photograph as an almost flat surfaced object, i.e., its third dimension will be significantly reduced. Its round edge will correspond with its angular diameter. Each point on its surface will radiate light toward the eye and camera. The difference between sunlit a mirror surface and a diffuse surface sphere is immediately discernable and will not be confused.

Another possibility in one or both aerial sightings is that the film may have undergone some poorly understood type of direct irradiation effect,[9] perhaps due to non-visible (near infra-red?) wavelengths from the source. Further research is called for to find out if this is possible.

Spectral Sensitivity Aspects. Another issue is the degree to which Kodak ASA100 color film faithfully captures the same target wavelengths as does the normal human visual system. In fact, there has been shown to be a relatively good correspondence in this regard (cf.

Kodak, 1997). Indeed, if this were not the case such film would not be sold as consistently as it is. People would not continue to purchase film that did not capture the same hues and contrasts as exist the perceived scene. At the shorter wavelength end of the spectrum of Kodak 5026 the yellow-forming layer's spectral sensitivity curve extends down to 400 nm while the normal visual sensitivity falls off to virtually nothing at 395 nm. (Prince, 1962). Much the same correspondence is found at the longer wavelength end of the spectrum as well where the (cyan -forming layer) of the emulsion is sensitive out to 690 nm which is just under the 730 nm cut-off of the normal eye. Thus, the eye can see slightly farther into the near infrared than can this particular film stock.

What is the possibility that this UAP emitted non-visible radiation that affected the film? There is no known published research on this important matter. Further research should be conducted to evaluate such a possibility, particularly microwave wavelengths in the 1mm to 1cm wavelength range.

(2) The Issue of Negative Originality. Of course it is important to study the original negative of an alleged UAP or other claimed anomaly whenever possible (Louange, 1999) unless it has been lost and a high quality copy, unaltered negative has been made. As mentioned earlier, it appears that the negative that the author received was not original but a copy. In addition, of the three frame negative strip received, the UAP was imaged on frame 3A with no exposures on frame 4A or 5A. When Williams was asked about this discrepancy (on March 9, 2001) he said he thought it was original "as far as I know." Whether or not this fact seriously impacts the value of the entire case rests on the personal motives and credibility of the primary witness. The only other two people who handled the film were the photographer and the technician at the one-hour film developing shop on Convoy Street in San Diego. Since the photographer did not remove the film from the witness's camera but simply handed it all to Williams upon landing it removes him from suspicion. It isn't known whether the copy negative was made by the technician. He had it for a full week according to Williams who further recalls that he did receive a full roll of negatives back but can't be sure if they were his originals.

[9] Irradiation refers to a lateral spread of light exposure on the film beyond the edge of the brighter target.

Consider the following: (1) Mr. Williams did nothing with the negative for 11.5 years as far as can be determined other than having two enlargements made - one of which he submitted to the author for study and the other for his office wall, (2) It is possible that the photographer had loaded a second roll of film and then stopped taking photos immediately after the UAP passed by. Williams though that they all headed back to land very soon after the sighting. (3) When the author visited him in his home-office located NW of Seattle, Washington it was noticed that (a) he was a former Naval officer, (b) There was no indication that he had any kind of an interest in ufo or anything occult, (c) At no time did he become defensive or belligerent about the apparent discrepancy surrounding the copy negative; he merely shrugged it off as something of no great importance. At no time did he contradict himself or give facts that were later found to be in error, and (d) He is well educated, a respected member of the community, and now a salesman of high technology, non-destructive testing hardware and is very precise in his vocabulary and knowledge of flying. All of these facts tend to support the contention that Williams is a trustworthy individual despite the fact that the negative analyzed probably was not original. Of course, theoretically, overall case reliability is lessened because of this fact.

(3) Other Issues. A check was made to determine whether other UAP reports had been made at this time, date, and location. No reports to the National UFO Reporting Center (Seattle, Washington) were found other than Mr. Williams' own abbreviated report submitted on January 10, 2000. It may be important to note that Mr. Williams did not include the day of the month of the incident in his report to NUFORC. He had to locate this date in his flight log book for them later. There also were no sighting reports found in the national data base maintained by Hatch (2001). A check was also made with an international astronomical clearing house in Czechoslovakia regarding meteorite and bolide sightings; none were reported by astronomers for this time and location.

Preliminary Conclusions

A number of tentative conclusions are offered as a result of this investigation: (1) There is no firm evidence of a double exposure or other deliberate hoax despite the fact that the

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pilot probably did not submit the original negative. (2) Whatever the UAP was it was most likely in sub-sonic flight, as suggested by visual characteristics of turbulence within the tail behind the UAP's head, the lack of a visible bow-wave effect, and the fact that no sonic boom was heard. (3) If the UAP was moving at sub-sonic speed then either the estimated sighting duration was too short, the distance to the UAP too great, the angle that the UAP appeared to travel through was in error, or some combination of them all. It isn't possible to determine which of these estimate(s) are in error. (4) The UAP's visual appearance did not match the appearance of the photograph, a finding that parallels an earlier aerial photographic case. This difference may be because the total optical power of the UAP was so great as to completely saturate the relatively "slow" film. Indeed, even with extreme computer "stretching" of the highly exposed area it wasn't possible to locate any significant detail within the central core of the 'white' head. (5) The diminution of the albedo of the UAP's tail with increased distance behind its leading edge is *not* consistent with sunlight reflected off of water vapor at these angles. It is as if the particles possessed directional reflectivity or some other non-mundane characteristic. (6) Very fine micro-structure details were discovered that extended outward from the "head" of the UAP. The nature of the UAP has not been identified as of this date.

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