Analysis of Digital Video Aerial Event of October 23, 2004 at Osaka, Japan

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On Anomalous Phenomena**

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Abstract

This paper summarizes the results of analyses of a video taken on October 23, 2004 approximately 50 km ESE of Itami International Airport, Osaka., Japan at about 1730 hrs by Mr. K. Amamiya while using a hand-held, Hi-8 digital camera. He was recording the over-flight of a commercial jet aircraft enroute to the airport. Unexpectedly a small, intense, yellow-orange-white silent light (hereafter referred to as *unidentified aerial phenomena* – UAP) appeared in the lower right-hand corner of the camera's digital display but was not seen visually. It traveled on an apparently linear path toward the upper left of the display at a relatively constant angular rate of travel; it remained visible for three minutes and then faded out. We discovered that: (1) the UAP was nearer to the camera than the aircraft, (2) the UAP was at least as intense as the wing tip lights on the B777-300 aircraft and did not appear to fluctuate in intensity to any great degree, (3) the calculated average height of the UAP was on the order of five feet and its image size tended to increase slightly during the first five seconds of the video, (4) the calculated angular velocity of the UAP was about 1.25 deg/sec. during the early part of the video, (5) it is likely that the UAP was emitting radiation in the near infrared since it was not visible to the naked eye, (6) the number of UAP imaged varied from one to three, and (7) the aircraft involved most likely was Japan Airlines flight 1521 from Tokyo. The real significance of this case lies in its aviation safety potential since no such unidentified object or energetic phenomenon should be flying in the vicinity of commercial air lanes. If this phenomenon was visible it might have been seen by the pilots causing some unplanned emergency operation or other disruptive response. This UAP remains unidentified at this time.

Background Information

Whenever an airborne object flies near an airplane or an airport and cannot be identified or communicated with it constitutes a potential threat to flight safety. The UAP in the present instance was within the controlled air space of two airports: Kansai and Itami International Airports, at Osaka, Japan. The UAP that was captured on digital video was very nearly on the approach path to runway 32 at Itami airport. Flight crews who cannot identify or communicate with any nearby object may react to their presence in inappropriate ways. A collision is possible in such instances. As will be seen, it is not likely that the flight crew onboard the jet airplane saw the present UAP that approached them from their right-rear direction.

On November 16, 2004 the first author received an e-mail from Mr. Kiyoshi Amamiya (K.A.) in Japan with four attached jpeg (compressed) digital images. One of them showed a two-engine jet airplane seen against an evenly illuminated sky with a small orange-white object near its left wingtip. The other images were enlargements of this UAP that consisted of two small, self-luminous objects near each other. Nine initial questions were sent to K.A. the same day. A package was received from him on December 2, 2004 containing a Hi-8 video cassette and a 3" by 4" color print of the airplane and UAP. A request was then sent to all National Aviation Reporting Center on Anomalous Phenomena (NARCAP) Research Associates on December 6, 2004 requesting their possible assistance; William Puckett replied the next day; he possessed needed hardware as well as valuable technical expertise as a professional meteorologist. Several other NARCAP Research Associates also indicated interest in seeing the tape and providing further assistance.

The second author was sent the video tape and immediately transferred it to a VHS analog tape for viewing and also to a CD for other analyses. A list of thirty more questions was sent to K.A. on December 14, 2004. By December 22, 2004 the available UAP and airplane images had been measured in various ways as described below and the witness provided answers to all thirty questions as well as other useful information.

Local Geographic, Meteorological, and Related Features

This video event took place very near the town of Tenri City, about fifty km ESE of Itami airport[1]. Mr. K.A. stood in a farm field to take this video (Figure; photo taken early in 2005). The region is flat with low hills generally rising to the east and west. Note also that in this recreation the camera's line of sight was elevated approximately ten degrees arc above the local horizon to capture the passing airplane. Figure 2 illustrates both the witness's location and the approximate flight path of the jet airplane arriving from Tokyo. Mr. K.A. said that he began video taping the jet airplane on a magnetic bearing of about 220 deg and finished taping along a bearing of about 260 deg arc.[2]

<u>Airplane's Flight Path</u>. Mr. K.A. provided us with official flight path data he obtained from his country's aviation officials. The airplane, identified as one arriving from Tokyo[3], used two final navigation beacons called VHF Omni-Directional Range (VOR); they were "Ise" and "Yamato" found on aviation charts. Only Yamato is shown in Figure 2. Established on a heading of 276 deg. and approaching Yamato VOR from Ise farther east, the jet turned 48 degrees right to a final heading of 324 deg that ended at the airport runway. This afforded an almost straight-in approach to runway 320 as shown in Figure 2.

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1 Since September 1994 all international flights to Osaka land at Kansai Airport forty km SW of Osaka in Osaka Bay. Further airport details are found at: www2s.biglobe.ne.jp/~ito-nori/j_airline/jal_dom.html

2 At our request Mr. K.A. returned to the original site and obtained these bearings using a type HB-3 High Eye Point, Compass Glass accurate to about 0.5 degree arc. Of course the bearing angles he provided are only rough estimates because this was a reconstruction from memory and without any fixed object present in the sky.

3 Itami Airport serves eight airlines. However, it was discovered that the jet airplane in the video was a Japan Airlines B777 and that flight 1521 was scheduled to land at 1730 hrs (when the video was taken). cf. www.jal.co.jp/en/inter/time/dom/09/hndosa.html

Figure 1. Mr. Kiyoshi Amamiya Recreating Video Sequence
at Original Site
narcap#16_witness-field.jpg

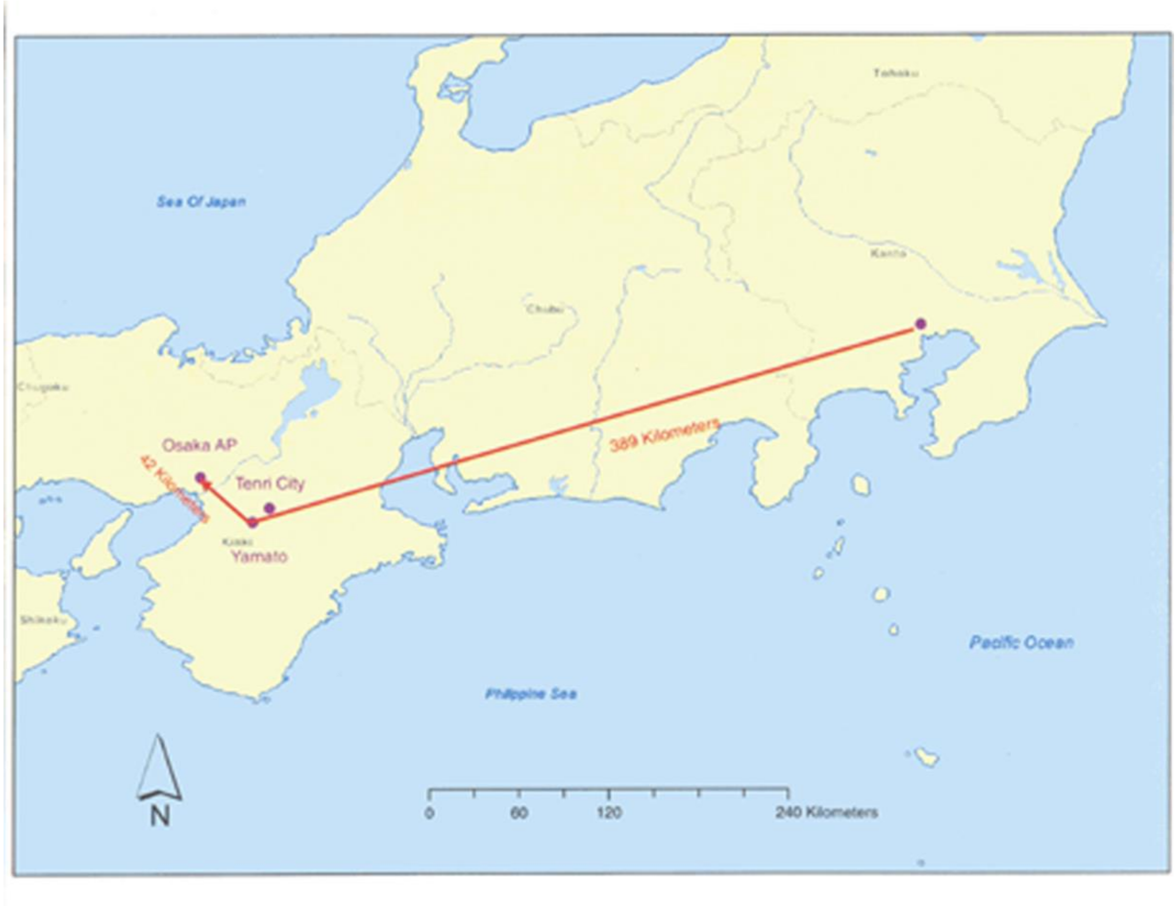

Figure 2. Chart of Approximate Flight Path of B-777 Jet,
Japan Airlines Flight 1521
narcap#16_chart-region.jpg

The airport surface is at an altitude of fifty feet above sea level at (Lat. 34.7855N; Long 135.4382E.). Both of its runways are parallel and oriented 140 and 320 degrees magnetic. Runway 32 right is shortest and is normally used by narrow body aircraft and 32 left by wide body aircraft because of its length and also noise abatement requirements.

Overview of UAP Video Imagery: Figure 3 shows the jet aircraft at time 00:08 (all values are elapsed time (ET) in minutes: seconds from start of video). Over the course of the next twenty eight (28) seconds the airplane did not change its aspect angle (shape) significantly. It only diminished in overall angular size (by approximately 4 %). This is consistent with an airplane travelling diagonally away from the camera on a linear path that lies approximately forty (40) degrees behind the side (elevation) view. This finding is significant in that it shows that the airplane had already completed most (or all) of its right-hand turn at the Yamato VOR (see Figure 2 and Figure 6) and was flying on the final 324 deg. approach radial from Itami airport. Figure 4 shows a Japan Airlines B777-300 in flight.

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The witness aimed his video camera at the UAP soon after it passed the airplane. This caused the jet to appear to leave the visual field rapidly. The evenly illuminated sky made it difficult to discern the airplane’s fuselage markings and also prevented any meaningful analysis of camera motion after the airplane had left the frame. Only UAP motion relative to the moving airplane could be determined with any precision.

Figure 3.
Video Frame of JAL aircraft
Near Start of Video

37sec_frame28.jpg

Figure 4. Japan Airlines B777 in flight
narcap_case16_jalb777-300_fltphoto.jpg

Weather and Astronomical Information. The meteorological conditions at Osaka's Itami International Airport [Latitude: 34.785528 Degrees North; Longitude: 135.438222 Degrees East; Elevation: 50 Ft (15 m) ASL; Time zone: UTC + 9] for: 17:30 hrs. Japan Standard Time were:

Temperature: 63 Degrees F

Dew point: 46 Degrees F

Relative Humidity: 55%

Wind: 030 Degrees (NNE) at 6 mph

Wind at 5,000 Ft: 060 Degrees (ENE) at 10 knots (11.5 mph)

Sky: Scattered Cloud (1/4 to 1/2 cloud cover)

Ceiling: Unlimited (No ceiling)

No significant weather observed (visibility 7 miles)

The area was under the influence of a high pressure system. This assessment is based on the 850 millibar (MB) chart (Figure 5). A solid arrow points to Osaka. This chart is for 1200 UTC on Saturday 23 October, 2004 and shows the entire northern hemisphere with the north pole at the center and ten degree latitude circles. It shows that the 850 MB pressure [height of 1,590 meters (5,215 feet)] was located near Osaka and was the highest in the region.

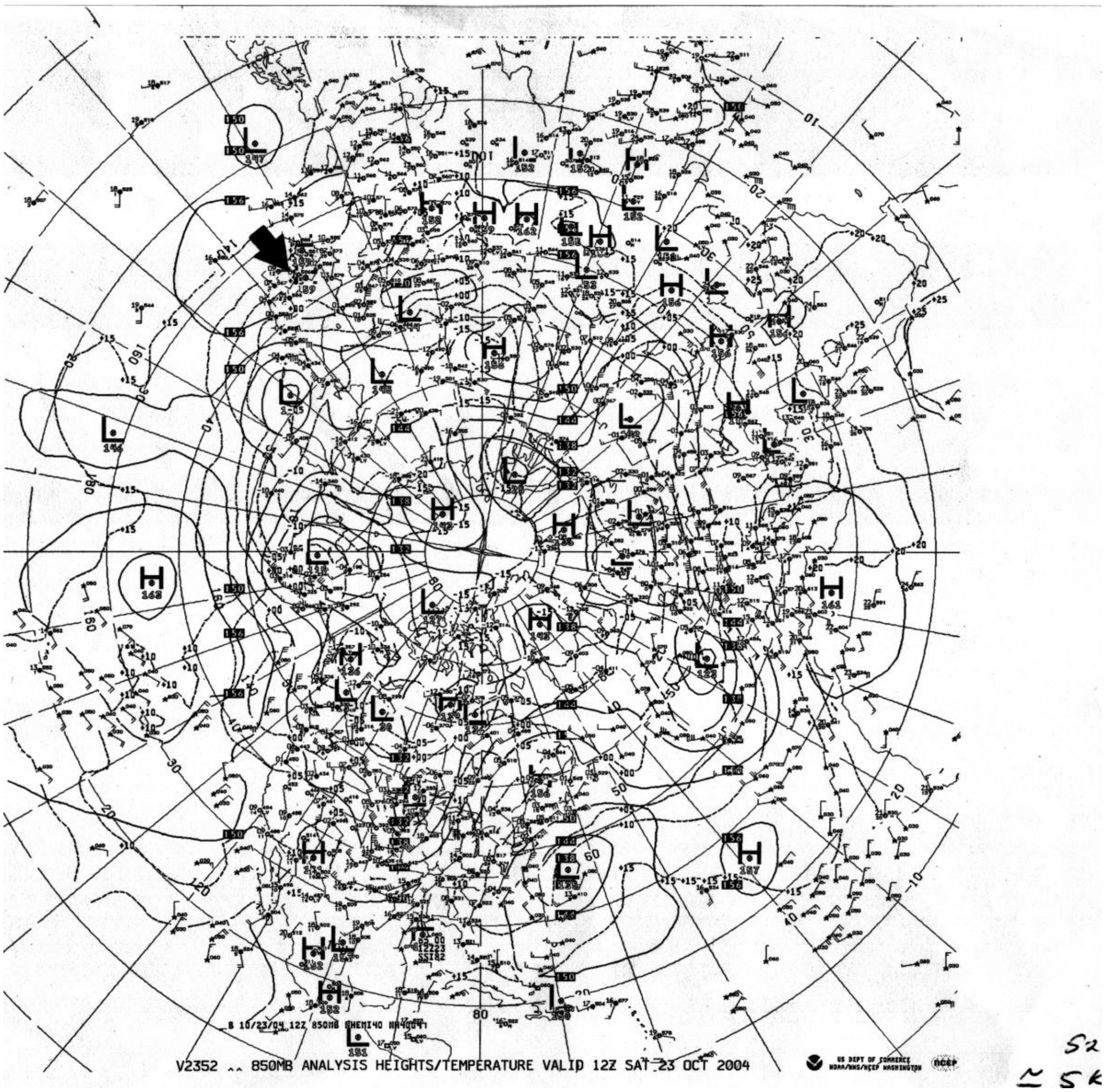

Figure 5. 850 Millibar Pressure Gradients for Northern Hemisphere

Other Information: Sunrise: 06:10 JST; Sunset: 17:13 JST: Civil Twilight: 17:39: JST; Nautical Twilight: 18:09 JST; Moonrise: 14:42 JST; Moonset: 00:28 JST; Moon phase 67%.

The sun had set at 1713 hrs JST on October 23, 2004 (at Osaka). The time recorded on the video was 1730 hrs. Later Mr. K.A. discovered a six minute error in the camera's time setting such that the actual time of the incident was 1724. He also stated that the sky was clear with no rain, fog, or mist present and winds very light when he took the video; he said "… about thirty minutes had passed, after sunset."[4] The Moon was in the SE sky (132 degrees azimuth) at an elevation of approximately 23 degrees at the time. If the witness' s assertion is correct concerning the azimuth angles through which he aimed his camera the UAP could not have been the Moon. The UAP was also angularly smaller and more intense than the Moon. No bright planets were visible. Mercury had just set (1737 JST) and Neptune and Uranus, both very faint, were located in the southeastern sky.

The above information is consistent with the homogeneously illuminated sky seen in the video; i.e., there are no useful spatially fixed details with which to determine objective motion either of the UAP or camera.

General Information about the Airplane: The airplane was positively identified by its outline shape as a B777-300: 73.79 m (242.09 ft.) long with a wing span of 60.93 m (199.8 ft.) and tail height of 18.52 m.[5] (60.7 ft.) Its fuselage is painted white with the large, dark, block letters JAL (cf. Fig. 4). Video image analyses showed the presence of the large but very faint block letters of JAL's logo located one third of the distance between the nose of the fuselage and the wing's insertion into the fuselage. The airplane was very likely Japan Airlines flight 1521 scheduled to land at Itami at 1730 from Tokyo's Haneda Airport 278 miles away. A second possibility could be flight 1520 scheduled to land at 1735, also from Tokyo. Edges of the solid red vertical stabilizer of all JAL aircraft was not discernible in this darkly shaded video image.

It should be noted that because the aircraft was generally flying obliquely away from

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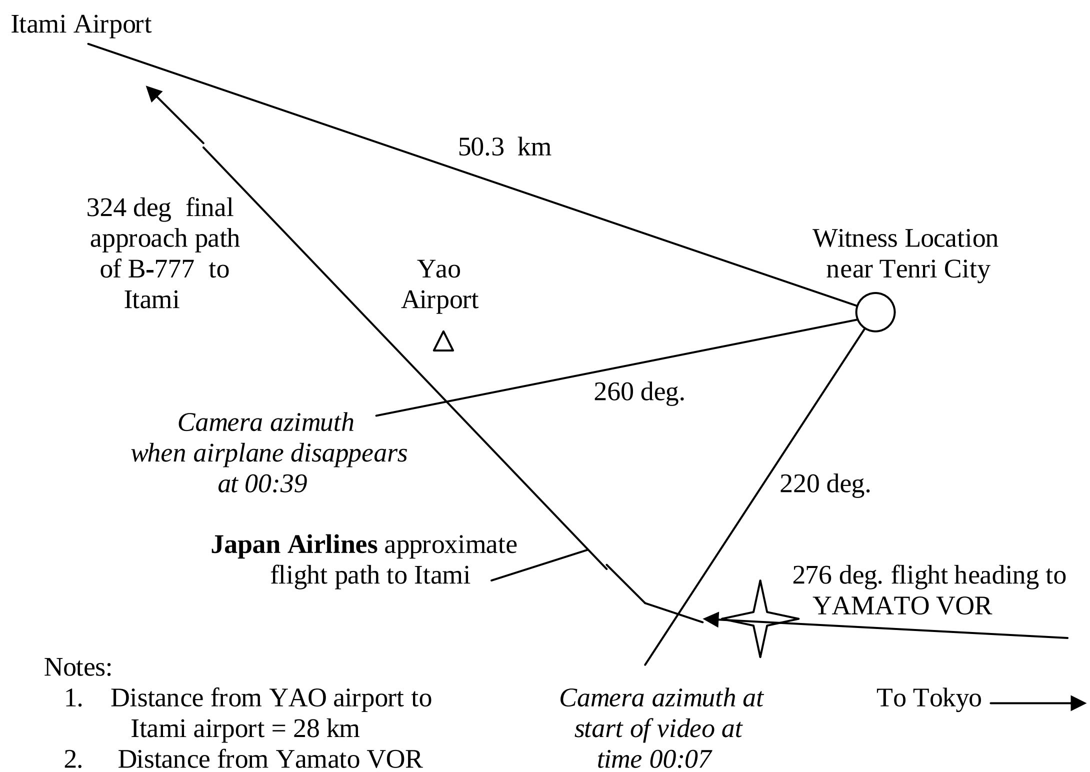
4 Correspondence received January 31, 2005. Video frame times are cited here.

5 www.geocities.com/CapeCanaveral/Lab/8803/tech_wb.htm. This dimension is measured from the ground with the fuselage level and supported on its landing gear.

the camera’s position (Fig. 6) neither its length or wing-span measurements from these photographs are accurate. If the horizontal angles on Figure 2 are approximately correct then the airplane's longitudinal axis would have been rotated through an angle of about 130 deg arc as is illustrated near time 00.39 in Fig. 6. The present measurements are only to indicate the relative change in image size over time.

narcap_case16_Fig6.doc
12/12/05 r.f.h.



Notes:

1. Distance from YAO airport to Itami airport = 28 km
2. Distance from Yamato VOR to Itami airport = 34.5 km
3. Approximate horizontal angle of camera pan = 40 deg.
4. Assume standard rate right turn and 15 deg. bank angle just beyond YAMATO fix.
5. Distance from witness to YAO VOR Navigation Point = 27.5 km.
6. Distance from witness to YAMATO VOR Navigation Point = approx. 25 km.

Not to scale

Figure 6. Flight Path Diagram with Distances and Notations

The exact location of the airplane at any instant during this incident is not known. Nevertheless, several useful parameters can be estimated to a reasonable degree of precision. If we assume that the airplane was flying at 6,000 feet altitude above ground level (AGL) over the Yamato VOR, initiated its final descent for landing there, and followed a constant three degree glide path to the ground then the 34.5 km. distance flown to the runway would be reasonable. And, if the airplane was at 6,000 feet altitude at and just beyond Yamato VOR (which is about 25 km from the location of the witness) the vertical angle between the ground (assumed to be flat) and the airplane would be 4 deg. 11 min. arc. The witness's reconstruction of the event shown in Figure 1 suggests a somewhat larger elevation angle than this by a factor of two for some unknown reason.

<u>Camera Information</u>: The Canon FV1 (S/N 1680154649) was released in the fall of 1998 and had the following specifications:[6]

Image Sensor: 0.25” interlace charge coupled device (CCD) (approx. 390,000 pixels); approx. 360,000 pixels (effective) The chip is sensitive to wavelengths from approximately 450 nm to approximately one (1) micron.

Scan: 525 lines interlaced 60 fields (30 frames/sec.) NTSC

Video Signal: NTSC (standard color video signal)

Operational Range: approx. 2 lux (low light mode) to approx. 100,000 lux

Lens: 46 mm diameter. 3.9 – 62 mm, F/1.8 (35mm – 560 mm in 35mm film format)

High-performance aspheric lens (2 double elements)

Zoom: 16 x optical, 64 x digital (variable speed)

Tele-converter lens was also used by Mr. K.A. providing an additional 1.4 magnification for a total zoom of 16 x 1.4 = 22.4 x.

Electronic Shutter: 1/60, 1/100, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000 sec.

Image Stabilization: optical image stabilization

Power Consumption: approx. 5.4 w during recording & auto focus); approx. 6.2 w using LCD viewing screen. Lithium button battery

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[6] www.canon.com/camera-museum/camera/dv/data/1998_fv1.html

Dimensions: 73 by 100 by 146 mm

Weight: approx. 720 g

Other Features: (selected) automatic wind noise reduction, digital video input recording, auto-date memory, shutter speed or aperture memory, light metering (center-bottom-weighted).

This camera incorporates a lens shifting image-stabilization system. A vibration-detection gyro sensor emits electronic signals (when the camera is shaken) that shift the lens group so that the resultant image remains steady on the CCD sensing surface. Manufacturer's brochures claim "…absolutely no degradation of image resolution." However, this claim should be independently verified over a suitable range of camera movement amplitudes and frequencies before being accepted without qualification.

The digital image resolution is given as 525 scan lines (vertical) by about 685 scan lines (horizontally) for 359,625 total pixels which effectively limits its ultimate image resolution. Mr. K.A. does not recall the lens' zoom settings or changes in zoom during any of his video capture.

Videographer's Verbal Comments: The faint but audible comments made by Mr. K.A. during his filming were recorded by the camera and translated later.[7] They are given in Table 1.

[7] The authors are indebted to Mrs. Samiko for her able assistance. Mr. K.A. also provided us with his own translation that is inserted above in Table 1 in parentheses.

Table 1

Verbalizations Made During Filming

Time on Tape (Min.:Sec.) (Approximate)	Translations by Mrs. Samiko (Mr. K. Amamiya)
01:02	It's not airplane. (Is this an airplane?) I don't know what they are [Japanese don't use plural/singular]. (what is this?)
01:30	I am trying to focus. (The image becomes dim when over magnifying)
01:43	I am trying to focus camera [mumbling]. (I should take a picture of this within the range of the optical zoom. Because the image becomes indistinct when becoming digital.)
02:03	What's that? What's that?
02:17	I wish I could see by my eyes [translator said that Mr. Amamiya meant that he could not see the light with the naked eye]. (I want to see with the unassisted eye. However, it is not good because it disappears when eyes are separated from the finder.)
02:30	It's flying away. (Oh! Do you go away?)
02:31	It is strange.
02:52	It's going away. Maybe focus of camera is not on. That is why it is disappearing. It is going out of sight. (The outline grows dim…)
02:57	It is now out of focus. I can't see by my eyes. If I saw this by eye, it could be different. - again he is reiterating that he can't see the light by the naked eye. (…and is out of focus.)

Measurements and Discussion

The following measurements were made of selected video frames: (1) Airplane dimensions, (2) Relative UAP dimensions and distance from camera, (3) UAP Image Dimensions, (4) UAP Physical Size Determination, (5) UAP Pixel RGB Intensity Characteristics, (6) UAP Spectral Characteristics, (7) UAP Shape, and (8) How the UAP Disappeared.

1. <u>Airplane Dimensions</u>: It is important to quantify various physical dimensions of this airplane in order to assess the possibility that (a) the airplane changed its attitude (yaw, pitch, roll), and (b) the camera lens was zoomed in or out during this incident. Both can be evaluated from the imagery. The airplane's fuselage length and wing span was measured from individual, enlarged

video frames between 00:10 and 00:38 seconds ET. Both measurements begin at the first clear frame containing the airplane and end twenty-eight seconds later at 00:39 just after the airplane leaves the field of view. These measurements are presented in Table 2. They are graphed in Figure 7 to illustrate the non-linearity of these dimensions over time. A straight reference line also has been added.

Table 2

Relative Dimensions of Airplane's
Length and Wingspan Over Time
(measured from enlarged computer screen image)

E.T. (min:sec.)	Length (mm.)	Wing Span (mm.)
00:10	142.5	86
00:12	133.5	85
00:14	124	84.5
00:16	112	84
00:18	100	82.5
00:20	90	81
00:22	81	80
00:24	76	78.5
00:26	68.6	76
00:28	62	73
00:30	56	70
00:32	50	68.6
00:34	45	66
00:36	41	63
00:38	38	60
00:40	airplane out of view	

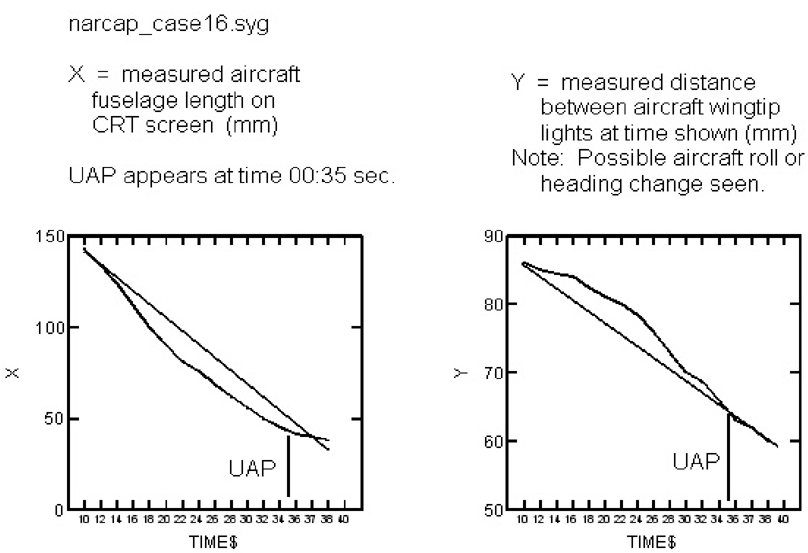

Figure 7. Change in Relative Aircraft Fuselage Length and Wing Tip Breadth Over Time

It is clear that these dimensions do not change in a linear fashion. The change in airplane length suggests that the camera lens' focal length (zoom) may have been changed slightly just as the UAP appeared. The change in wing span may suggest either the occurrence of a slight roll maneuver and/or a heading change of the aircraft. Theoretically, both of these dimensions should vary as a tangent function.

2. Relative UAP Dimensions and Distance from Camera: The CD data file received from Mr. K.A. was played using Windows Media Player at maximum (full screen) enlargement between ET 00:35.8 to 00:40 seconds. The UAP first appears in the lower right corner of the frame at 00:35.6 seconds. The width and height of the yellow-orange-white UAP was measured approximately every 0.2 second (i.e., every six frames) during this interval with the following (relative) results: mean width = 1.84 mm (SD = 0.95); mean height = 1.32 mm (SD = 0.78). Median width = 2.05 mm; median height = 1.50 mm. Figure 8 shows all eighteen data points during this 4.2 second-long period wherein a small increase in the relative horizontal and vertical dimension was found on the average that is not visually apparent. It isn't known whether this was the result of an increase in the size of the UAP, an approach toward the camera, or both.

file: case16-5.syg
12-21-04
r.f.h.

HORIZUAP = Measured width of UAP on computer screen at max. enlargement. +/- 0.3 mm std. error

VERTUAP = Measured height of UAP on screen at max. enlargement. +/- 0.3 mm. std. error

TIME$ = Elapsed time on original video (sec.)

Note: UAP first appears at 00:35 seconds E.T.

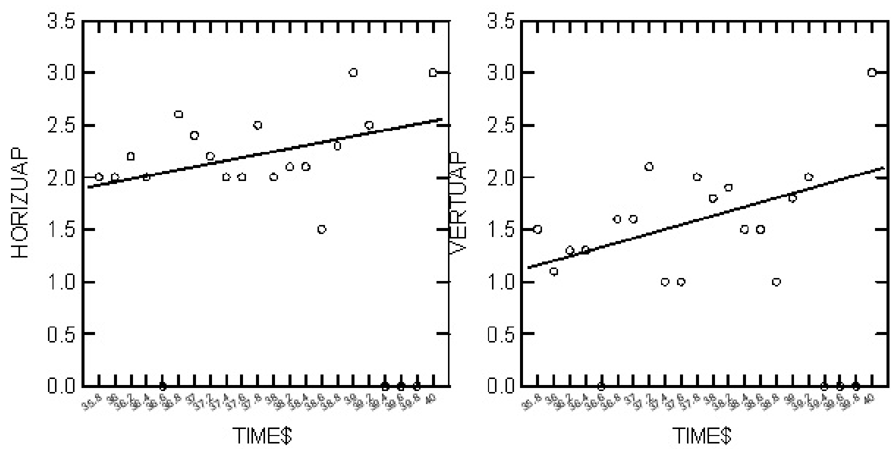

Figure 8. Change in Relative Width and Height of UAP Over Time

The video camera captured a generally round [or slightly flattened oval(s)] of intense light that possessed a short dark band above and another below it (see Figure 17 for an example). These dark bands are <u>not</u> likely an artifact of a contrast enhancing capacity within the camera's scanning circuit because they are not seen associated with the intense, white wingtip lights.

A critically important fact to be determined is whether the UAP was nearer or farther from the camera than the airplane. If the UAP occluded any part of the airplane during its flight it would have to be nearer than the airplane; if substantiated this would permit calculations to be made of its maximum size. In order to test this important matter several frames were enlarged and studied where the UAP passed by the left wing of the airplane. Figure 9 is an enlargement the airplane and UAP on frame 23 at 00:37[8] as the UAP approached the left wing tip. At this point in its flight the UAP was still too far from the wing to determine if it was nearer or farther than the wing. It is included here for comparison purposes. Figure 10 is an extreme enlargement of the wing area in question on frame 23.

Figure 9. Enlarged Image of Jet with UAP below Left
at Time 37 sec (Frame 23)

[8] The camera captured thirty (30) frames per second.

Left Airplane Wing with UAP Below

Standard JPEG image with
no other image manipulations

left wing tip light

UAP

Wing as seen from
behind and slightly below

Figure 10.

Enlarged Image of Aircraft's Left Wing Tip

at Time 37 sec (Frame 23)

Figures 11 is an enlarged image for frame 24 (1/30th second after frame 23) at 00:37 when the UAP has reached the tip of the left wing.

Left Airplane Wing with UAP Beneath Wingtip
Standard JPEG image with no other image manipulations

37 sec. frame 24
enlarged 1:1 to 100" x 75"
72 dpi

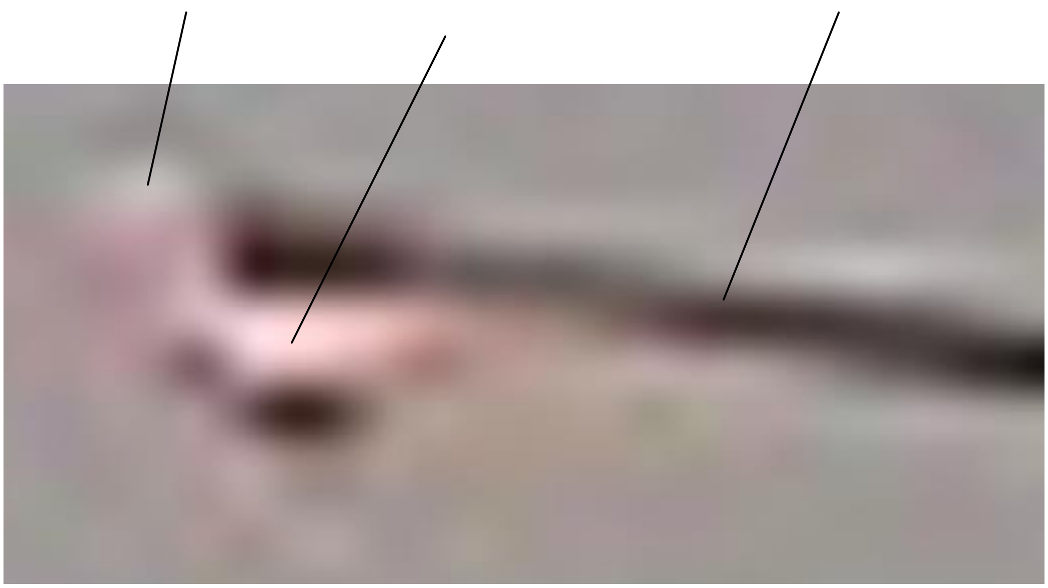

Figure 11. Enlarged Image of Aircraft's Left Wing Tip
at Time 37 sec (Frame 24)

Finally, Figure 12 shows frame 25 enlarged by the same amount as the previous images after the UAP has passed just beyond the wing tip (as noted by the location of the white wing tip light).

Left Airplane Wing with UAP Passing Just Beyond
Wing tip
Standard JPEG image with no other image manipulations

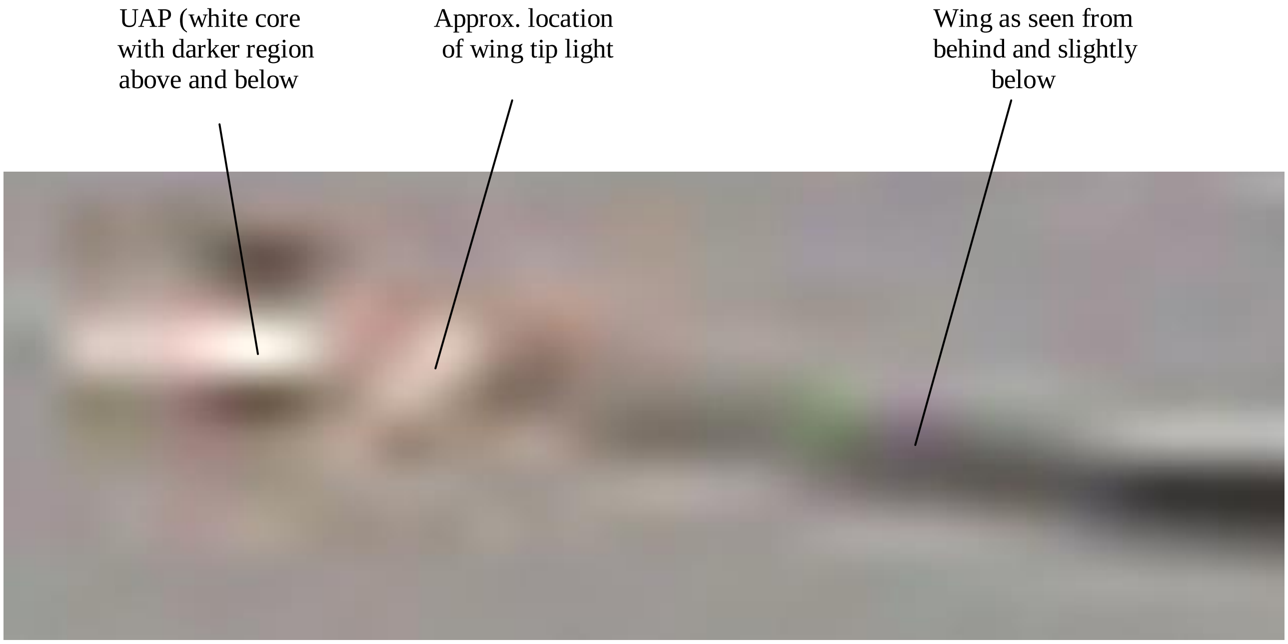

Figure 12. Enlarged Image of Aircraft's Left Wing Tip after UAP has Passed Wing Tip (Frame 25)

Of particular interest are the two darker areas (above and below) the central lighter area of the UAP that are seen in Figures 9, 10, 11, 12 and 13. While they are visible in every frame showing the UAP they are absent above or below the airplane’s intense, white wing tip lights. The cause of these darker regions is not known but might be related either to the presence of an opaque physical structure above and below the UAP's central lighted area that is of a dark color or other phenomenon where ambient light is not reflected toward the camera (perhaps absorbed?). These darker areas represent an interesting feature of these UAP that deserve further study.

3. UAP Image Dimensions: Table 3 presents the measured horizontal and vertical dimension, respectively, of the UAP's image(s) over a 2.5 second-long period soon after it appears (from 00:36.0 to 00:38.5). Column F gives the ratio of UAP image height (cf. Col. D) to airplane image tail height (cf. Col. E) for each of these 19 frames. When this ratio is multiplied by the actual height of the B777 tail[9] an approximation of the vertical height of the UAP can be obtained. Figure 13 shows that the corresponding data of Table 3 is variable; a straight line fit (by eye) is also shown.

Note that both the tail height and vertical relative dimension of the UAP in Figure 13 tend to decrease over this brief measurement period as if both are receding away from the camera while the horizontal dimension of the UAP tends to increase slightly.

Table 3

Relative Dimensions of UAP and Airplane Tail Height as Measured from Computer Screen Images at Constant Enlargement

Time (sec.)	Frame No.	Dimension (mm) Horiz.	Vert.	Airplane Tail[6] Height (mm)	Ratio D/E	UAP Shape	UAP Color(s)
A	B	C	D	E	F	G	H
36.0	1	5.0	3.4	13.6	0.25	rectangles	orange-white
36.5	15	5.0	3.4	13.5	0.25	rectangles	orange-white
37.0	1	3.6	2.7	13.3	0.20	rectangles	orange-white
37.17	5	3.0	2.5	13.5	0.19	rectangle	orange-white

[9] Boeing gives the height from the ground to top of the vertical stabilizer when the B777-300 is taxiing as 18.52 m (60.80 ft.). The vertical distance from the top of the fuselage (at the stabilizer's insertion point) to the top of the vertical stabilizer is approximately 9.1 m (29.9 ft.) which is used in calcu-

37.20	6	3.8	2.7	13.4	0.20	square	orange-white
37.27	8	4.5	4.4	12.8	0.34	diag./ rect.[1]	orange-white
37.33	10	3.8	3.0	14.9	0.20	rectangles	whitish
37.40	12	5.4	4.0 [2]	12.5	0.32	squares	white-orange
37.47	14	4.8	3.8	12.7	0.30	rectangles	whitish
37.53	16	5.0	3.5	12.4	0.28	rectangles [3]	grey-white
37.57	17	5.5	2.6	12.4	0.21	rectangles	white
37.63	19	4.2	2.5	12.6	0.20	rectangles	orange-white[4]
37.77	23	3.7	1.0	12.6	0.08	rectangles	whitish-yellow
37.80[7]	24	4.0	2.1	12.7	0.17	rectangles	orange-white
37.83	25	6.4	1.2	12.8	0.09	rectangle	very white
37.9	27	6.0	2.1	12.8	0.16	rectrangles	very white
37.93	28	3.8	1.2	12.8	0.09	rectangles [5]	orange-white
38.0	1	4.6	2.0	13.2	0.15	rectangle	orange-white
38.5	15	3.8	1.8	12.4	0.15	rectangles	orange-white

Min. = 0.08
Mean = 0.17
Max = 0.34

Notes:
1. Three rectangular areas arranged in upper-left to lower-right orientation.
2. Three connected light sources.
3. Pixels are almost square, arranged from upper-left to lower-right, slightly blurred.
4. Pixels are in a horizontally oriented rectangle, slightly blurred.
5. Orange-white pixels at UAP but a very white single pixel is located half-way between the UAP and the wing tip, embedded within an orange trail.
6. Tail height measured from its highest point to upper fuselage insertion point.
7. The UAP in this frame lies nearest the left wing.

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lations of the size of the UAP.

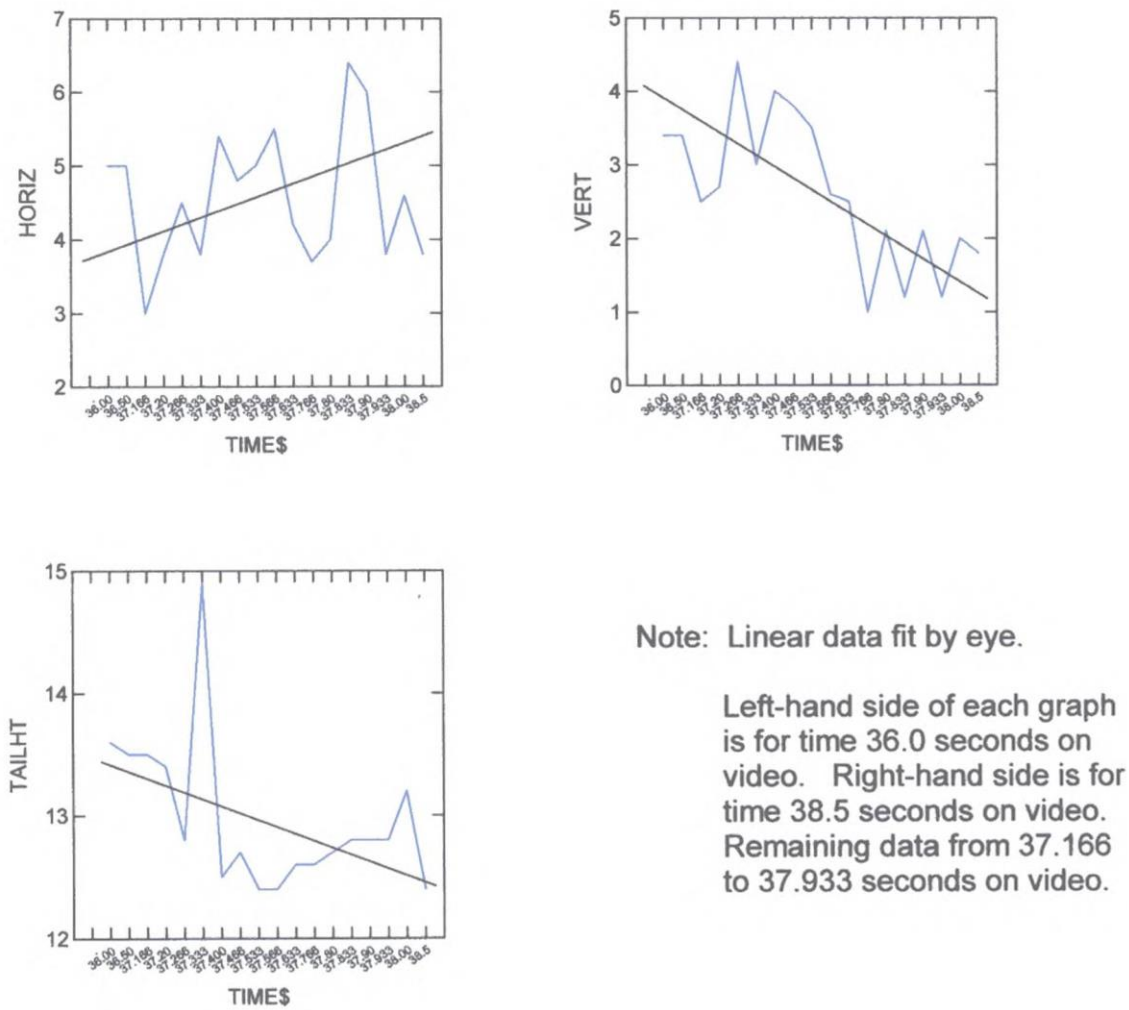

Figure 13. Width (upper left) and Thickness (upper right) of UAP and Aircraft Tail Height (lower left) over Same Time Period

4. <u>UAP Physical Size Determination</u>: The ratio of UAP height to the measured height of a visible airplane structure, viz., the vertical stabilizer, multiplied by the known height of the same structure provided an estimate of the approximate maximum physical size of the UAP assuming that the UAP was at about the same distance as the airplane (i.e., approx. 82,248 feet slant range)

from the camera. Column F of Table 3 provides these ratios. The minimum ratio of 0.08 corresponds to a UAP height of 2.4 feet. The mean ratio of 0.17 corresponds to 5.1 feet and the maximum ratio of 0.34 to 10.2 feet. The mean value is taken as the most reasonable estimate of the height of the UAP.

5. <u>UAP Pixel RGB Intensity Characteristics</u>: Enlarged digital frames were made in order to measure the relative, red-green-blue integrated intensity of selected 3 x 3 pixel areas making up the center of each UAP jpeg image. This was done over most of the period the UAP was visible and of relatively constant intensity. The results are presented in Table 4. Also shown are the number of apparently separate UAP visible (Col. E), its apparent shape (Col. F) and color (Col. G).

Table 4

UAP 'Red/Green/Blue' Pixel Intensity Data
(3 x 3 pixel area centered on UAP)

Time (min:sec.)	Rel. UAP Intensity (Lt. hight)	(Rt. light)	Left Wing tip light Intensity	No. of UAP	UAP Shape	UAP Color(s)	Comments
A	B	C	D	E	F	G	
00:35.0	n/a		0	n/a	n/a	UAP not visible	
00:35.5	1	0	0	2	rectangular	reddish-orange	
00:36.0	0	1	0	2	small point	whitish	
00:36.5	1	0	1	2	small point	pinkish-orange	
00:37.0	0	0	1	2	irreg. oval	whitish	
00:37.5	1	1	2	2	irreg. oval	orange-white	
00:38.0	0	1	1	2	rectangular	orange-white	
00:38.5	0	0	2	2	rectangular	orange-white	
00:39.0	0	0	3	2	circular		separated
00:39.5	0	1	4	2	irreg. ovals	whitish-orange	stacked diag.
00:40.0	note 1		note 5	3	irreg. ovals		
00:40.5	note 2			3	lg. rectangle		horiz. orient.
00:41.0	0			1	irreg. oval		
00:41.5	0			1	irreg. area		
00:42.0	note 3			3	elongated area		horiz. orient.
00:42.5	note 4			3	circular		connected

00:43.0	0	0	2	rectangular	horiz. orient.
00:43.5	0	0	2	irreg. area	horiz. orient.
00:44.0	note 1		3	rectangular	stacked diag.
00:45.5	0	0	2	irreg. area	

Notes:

1. Frame showed three separate luminous areas whose relative intensities were: left = 1, center = 0, right = 0
2. Ditto: left = 1, center = 0, right = 1
3. Ditto: left = 0, center = 0, right = 0
4. Ditto: left = 0, center = 1, right = 4
5. Airplane's left wingtip light is out of frame from here on.

It may be noted that these relative intensities range from minimum or dark (255 levels; i.e., 8 bit resolution) to maximum or most intense (0 level). It is not possible to determine how much the 0 intensity level pixels might be over-saturated. Indeed, it is likely that UAP intensity extended well above the maximum level (100,000 lux) measured by this camera. These values only represent relative intensity that cannot be quantified in usual photometric units. The airplane's left wingtip corresponding light intensity values are given in column D of Table 4. They are also at the extreme upper end of the intensity scale.

Figure 14 shows the results of relative intensity measurements made on the frame following Figure 12 along five vertical scan lines. The UAP has passed just to the left of the wing tip light. Note that the shadow on the underside of the wing is approximately as dark as the dark regions above and below the UAP's bright center area. The most intense regions are the wing tip light (value of 1) and the UAP (value of 0). The background sky luminance values range typically from 6 to 7.

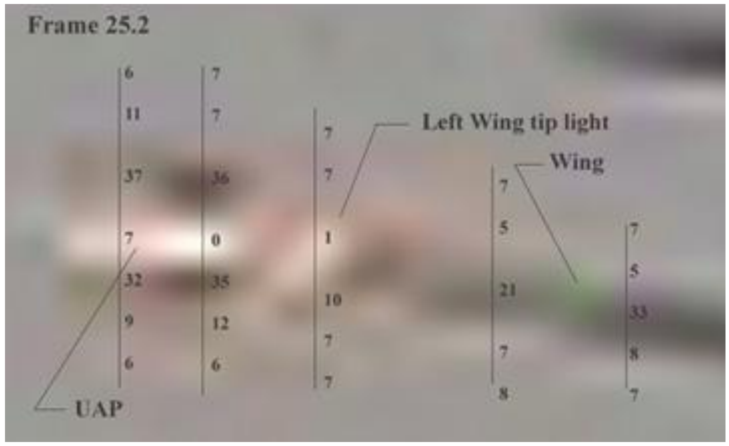

Figure 14. Left Wing Tip Area with Relative Pixel Intensity Measurements Across Five Vertical Scans

Frame 28/30 (of ET 37 seconds) was quantified because of the presence of a single white pixel that appeared about half-way between the UAP and the left wing tip as is shown in Figure 15. Relative pixel intensity values were obtained along the straight line shown in this figure.

Sky luminance was constant at around a value of 7 (as in all other frames), however the wing tip light and also what is called the “secondary UAP” had an intensity of 2. The most intense part of the UAP measured 0 as found in both the preceding and following frames. Again, it is not possible to determine the UAP's absolute intensity from these data but it was more intense than the wing tip lights.

Figure 15. Relative Pixel Intensity Measurements Along an Arbitrary Line Showing "Secondary UAP" Behind Main UAP

6. UAP Spectral Characteristics: Only relative spectral characteristics of the UAP were available from the digital video. Nothing was known about the camera's color balance, color calibration values or gamma setting. The Canon FV-1 uses a CCD whose spectral response extends out to approximately one (1) m just beyond the visible spectrum.[10] Human vision near the line of sight is sensitive to wavelengths extending to about 720 nm while more peripherally located rod-receptor vision extends only to about 670 nm. Since this UAP could not be perceived visually, but only while viewing it on the camera's digital display, it had to be emitting wavelengths longer than 720 nm, i.e., in the near infra-red.

General color names are given in Table 3 and 4 for the UAP. The UAP appeared to be an orange-white in most of the frames; this could be an artifact of the CCD used in the camera. Since the UAP was invisible to human vision, however, it is misleading to even refer to a color name that depends on human perception. More research is called for in regard to the appearance of digitally displayed images of infrared sources possessing different wavelengths.

[10] Wald, G. Human vision and the spectrum. Science, vol. 101, pp. 653-658, 1945.

Of particular interest is the single frame at time 00:37.933 (37 sec. frame 28; cf. Fig. 16) where a definite reddish trail is seen behind the UAP with a single very white, intense pixel located about half-way between the UAP center and the wing tip light. This is the only frame on which such a colored trail was found. Perhaps this very small “secondary UAP” might be some kind of atmospheric electrostatic discharge remnant left by the larger UAP. However, neither the reddish trail nor the single pixel appear in the following frame 1/30th second later.

7. UAP Shape: The digital resolution of the camera made it difficult to determine the shape of the angularly small UAP. Based upon a visual inspection of the non-enlarged frames the UAP appears generally oval, circular, or sometimes rectangular (cf. Col. F in Table 4). When selected frames were greatly enlarged (employing jpeg compression) one sees that the UAP now appears in familiar rectangular and square shapes (cf. Col. G in Table 3). Perhaps the safest generalization concerning UAP shape is that in uncompressed imagery it appears as a squashed, horizontally oriented oval of light with a darker area located directly above and below its center. This is shown in Figure 16 which is an uncompressed video screen capture of two adjacent UAP seen fairly late in the sequence after Mr. K.A. had zoomed in.

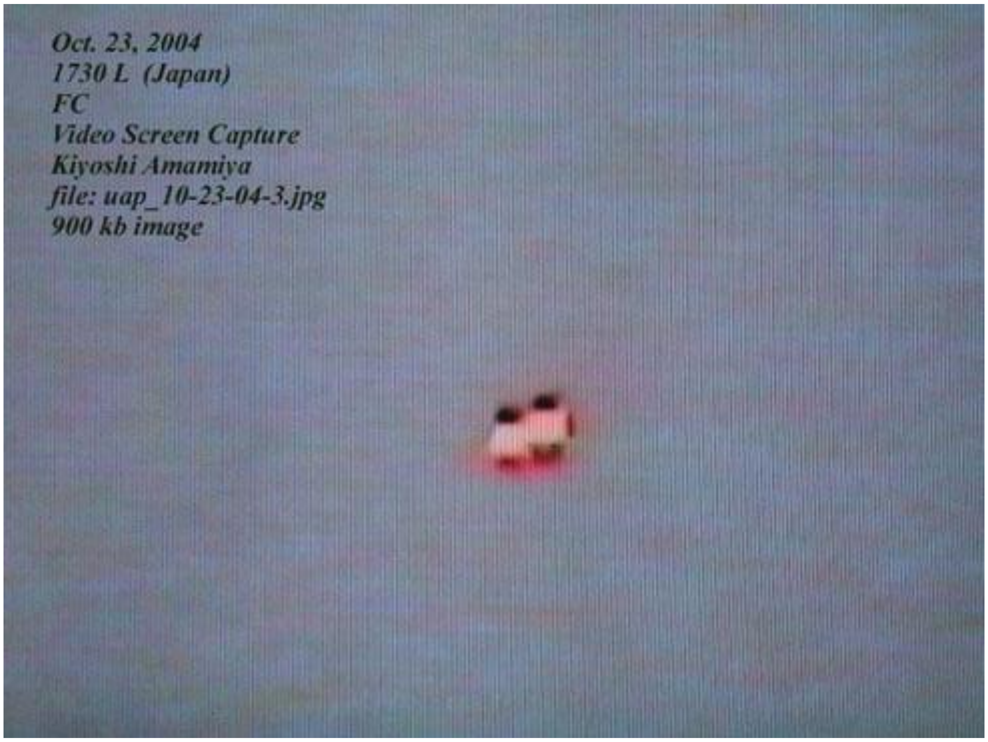

Figure 16. Vertical Raster (T.V.) Zoomed Screen Image Showing Double UAP with Dark Areas Above and Below Each Intense Center

8. <u>How the UAP Disappeared</u>: It is always instructive to understand how UAP disappear since this detail may help understand the energistic mechanism(s) associated with the phenomenon. The present UAP simply became dimmer over the last twenty seconds (starting at 2 min. 50 sec.) until it was no longer detectable by the video camera (at about 3 min. 10 sec). Since the level of optical zoom isn't known precisely nothing definitive can be said about the amount of photic energy from the UAP falling on the camera's CCD sensor. It is clear that the zoom level did not change during the final five to ten seconds before the UAP disappeared. Mr. K. A. wrote that the UAP dimmed when he zoomed in too far. This fact suggests that the UAP's photic intensity was so low after zooming in that by spreading the photons upon more and more pixels the lower sensitivity threshold of the CCD was reached and the image therefore no longer registered as being present. Of course this assumes that the UAP's photic output remained constant during this period. The lower level

of sensitivity is given as two lux (equivalent to 0.190 ft-c or 0.20 milliphot) by the manufacturer.

While the intensity of the UAP seems to decrease prior to its final disappearance its frontal area does not, suggesting that it did not merely flay away into the distance but reduced its energy output.

Summary and Conclusions

It is quite clear that this UAP was not any of a number of known kinds of light sources. For instance, it was not a flare launched from the ground because of its long duration, lack of smoke trail and the fact that it wasn't seen visually. The UAP was not an astronomical body such as a planet, star, the Sun or the Moon because it was too small, the Sun had already set and the Moon was in a different direction in the sky, and the UAP disappeared in a matter of minutes and a part of it appeared to split off. And it could not have been a meteorite due to its relatively long sighting duration.

This incident may or may not qualify as an aviation safety event depending upon several factors. One of them is whether the UAP was visible to the naked eye – particularly the eyes of the flight crew on board the jet airplane. If it was visible then its presence could have caused them to abort the landing or make another unplanned or uncoordinated flight maneuver. If the UAP could be seen from the airport tower then it might have disrupted normal approach and departure procedures there. Another factor is whether the UAP could have caused some kind of electromagnetic disturbance onboard the jet and/or airport electronic systems. It isn't known whether the UAP was detected on airport radar or witnessed by the airplane's flight crew. A third factor is how near the UAP actually flew to the jet airplane. Our analysis suggests that the UAP passed somewhere between the airplane and the camera and not beyond it, however, the airplane did not appear to alter its course or flight attitude during this event. The identity of the UAP remains unidentified at this time.

Acknowledgements

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