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Analysis of B-52H Radar Returns from October 24, 1968

by

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Abstract

This paper describes various measurements made on a series of thirteen black and white photo-enlargements of a U. S. A. F. B-52H bomber's radar screen.[1] These moderate quality photos allegedly were obtained from an AN/ASQ-38 (Raytheon) bombing and navigation radar system on October 24, 1968 near Minot Air Force Base. Because a more complete report on this case may be prepared by personnel of the Sign Oral History Project, many background details are not provided here. Only facts pertaining to the present analysis are presented. The term unidentified aerial phenomena (UAP) is used here to denote the source of the anomalous radar return(s) seen on the radar scope. Several other technical details included here are taken from an interview with Col. U.S.A.F. (ret.) Patrick McCaslin by Tom Tulien of the *Sign Oral History Project* on February 25, 2001. McCaslin was navigator on this flight. These details are noted by (pg. & McCaslin). Finally, because this radar system could be manually set to different ranges and there are no specific range notations provided on the photos studied it is not possible to determine the range to the UAP, its velocity, or its relative size. Nevertheless, data from McCaslin's interview are used to calculate preliminary range and velocity values without any claim that they are accurate. When a radar return was identified that reappeared over a number of consecutive frames its velocity was found to vary between 60 and 383 mph.

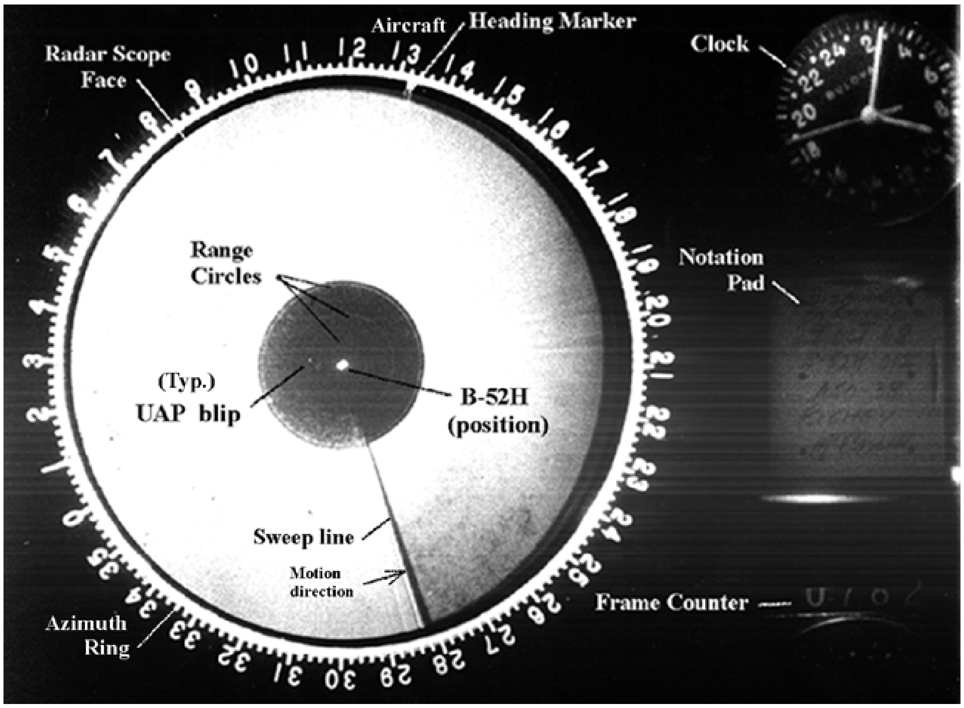
[1] The photographs studied here were received from Jim Klotz on March 13, 2003. An e-mail from Tom Tulien dated March 18, 2003 stated that of chief interest to the Sign Oral History Project were such facts as: (1) What is the extent of information that can be extracted from these photos? (2) Is it possible to determine the relative size of the "object?" (3) What could cause variations in the shape of the return? (4) Why does the return are known about the ASQ-38 radar system?

Methodology

<u>The Photographic Data</u>. Each Kodak "Picture Maker" photograph, (1) measured 7.70" x 10," (2) was printed on medium weight glossy paper, (3) was exposed over a reasonably wide range, and (4) contained the information shown in Figure 1 which is a copy of a typical frame operated in full scan mode, i.e., number 782.

Figure 1

Reduced Size Copy of Frame 782



Referring to Figure 1, the large, circular, radar scope face (left) included: (1) azimuth ring ticks possessing approximately one (1) degree arc accuracy, (2) an aircraft heading marker (the short white bar visible here at 131 degrees azimuth), (3) radar range arcs (three hemispheric arcs centered on central white dot which represents the B-52H), (4) real time, twenty-four hour military time clock (upper right corner) with under one (1) second accuracy, (5) rectangular notation pad (center left) on which is found written:

BISMARQUE
ST GEORGE
24 OCT 68
B 52H 01Z
ASO 38
RICHEY
Mc CASLIN

(6) photo frame number (here showing 0771), and (7) part of another flight-related instrument (lower right corner).

Radar System Details and Caveats. The AN/ASQ-38 radar system could be operated in three modes: Full Scan (360 deg rotation over 3 seconds; different power outputs), Station Keep (360 deg rotation over 3 seconds; low power output providing a maximum target range of from five to ten miles), and Sector Scan (variable fan angle centered on any required azimuth, oscillating back and forth; different power outputs).

If a target reflects sufficient amount of microwave radiation back toward the receiving antenna (neglecting frequency effects) a luminous spot will appear within the phosphor coating that lies inside the face of the radar screen. This phosphor is selected to decay in intensity relatively slowly (e.g., over four to seven seconds) so as to leave a faint trace on each of the following two (or more) sweeps of the beam. If a target appears to illuminate only one sweep and then disappears from the scope the reflected radiation must have fallen below the detection threshold of the system (within 3 seconds). This might occur for several reasons not discussed here. Explanations for the sudden occurrence of many radar returns is also beyond the scope of this paper.

Because the radar screen's azimuth remained in a fixed orientation relative to the aircraft's fuselage heading rotated as appropriate. As is noted below, aircraft heading did not vary during the period in question (from 09 06 14 to 09 06 50) by more than 0.5 degree arc. The three range rings were etched on the face of the display's glass face and, according to McCaslin, were fixed at 1, 2, and 3 miles distance from the aircraft (pg. 19, McCaslin). He also mentioned that the set was in "station keep" mode during this contact which means that the antenna rotated 360 deg over a three-second period but that a relatively high amount of microwave energy was pumped through it to ensure "contact" with nearby objects out to a range of from five to ten miles from the aircraft. (pg. 19, McCaslin)

Image Processing. Each photograph was subjected to the following measurements and processing steps:

1) Aircraft heading was noted along with clock time to one second accuracy.
2) The radar screen was digitally scanned at 170 dots per inch (dpi), enlarged and contrast enhanced in order to better discriminate the alleged UAP radar return(s).
3) Linear measurements were made from the digitized images of step 2 of the following:
   a) UAP to center spot (aircraft). (mm)
   b) diameter of UAP (if round) or maximum axis and minimum axis lengths if oval, etc. (mm).
4) Azimuth (magnetic) of UAP from aircraft. (degrees)
5) Diameter and radius of each visible range circle. (mm)
6) Percent density of selected targets and image locations such as the radar return(s), i.e., UAP(s), center aircraft spot, and screen background.[2]

[2] So-called "clutter" (uncorrelated radar returns) is visible in all frames with some spots so intense as to be indistinguishable from the primary (UAP) target. In these cases the "Eyedropper" tool of Adobe Photoshop was used (single pixel) to measure the percent density of each target/region of interest. These percent values range from zero to 255 (8 bit resolution) levels. It is not possible to relate percent density to absolute intensity nor would such a measure be meaningful due to many possible manual variations in the radar system's display settings.

Results

Table 1 presents selected measurement results from this analysis. Several points of particular interest may be noted: (1) The outer range circle radius remains relatively constant (mean = 26.12, SD = 0.38) which indicates that these photographs were all enlarged by approximately the same amount,[3] (2) The azimuth angle from the aircraft's fuselage to the UAP varies between twenty (20) degrees arc to thirty nine (39) degrees arc between frames 774 to 783 but not in any systematic manner as is illustrated in Figure 1. (3) The range between the UAP and the aircraft varies from as near as 8.8 mm (frame 783) to as far as 15.5 mm (frame 773) in an interesting manner. Of course it remains to correctly relate these relative distances in mm on the photo enlargements to actual range (cf. Table 2). (4) The shape of the UAP changes over time and also assumes different linear dimensions on the radar screen. (5) In frame 781 there are at least three possible UAP targets visible each possessing comparable intensities as the primary UAP imaged in other frames.

Table 1

Selected Measurements from Radar Screen Photos

Frame	No.	Clock Time	E.T. (sec.)	Range Circle Radius[1] Inner	Mid.	Outer	UAP (Blip) Parameters Azimuth (deg.)	Range (mm)	Shape	Size (mm)	Loc. o'clock
771	02	09 06 14	0	7.5	16.5	26.6	137	25.4	rnd.	1	8:00
772	03	09 06 17	3	8.0	16.7	25.8	244	13	oval	1.4x1.0	4:00
773	04	09 06 20	6	?	16.5	25.3	245	15.5	elong.	5.5x2.0	4:00
774	05	09 06 23	9	?	16.9	25.8	---	---	---	---	---[2]
775	06	09 06 26	12	?	?	26.1	---	---	---	---	---[2]
776	07	09 06 29	15	?	16.7	26.2	37	15.2	elong.	3.5x0.8	9:00
777	08	09 06 32	18	?	18.2	26.2	36.5	14.8	rnd.	0.9	9:00
778	09	09 06 35	21	?	?	26.2	38	14.3	oval	1.8x0.9	9:00
779	10	09 06 38	24	?	?	26.3	(a) 39	13.2	irreg.	1 x 1.0	9:00
							(b) 39	16.0	irreg.	1.5x1.0	9:00
780	11	09 06 41	27	?	16.6	25.9	38	13.9	oval	1.8x1.6	9:00
781	12	09 06 44	30	?	18.6	26.7	37[3]	12.8	rnd.	0.8	9:00

[3] Mean (SD) radius of the inner ring was 7.8 (0.26) and of the middle ring was 17.06 (0.74).

782	13	09 06 47	33	?	16.8	25.9	35	12.1	rnd.	1.0	8:30
783	14	09 06 50	36	7.9	17.1	26.5	---	---	---	---	---[2]

Notes:
1. These values are in millimeters and relate only to the current series of digital enlargements and not to absolute range units (e.g., meters, feet, miles). They are presented only to be able to compare these enlargements for consistency and to correlate with other linear image measurements.
2. No UAP return is visible on this frame.
3. At least three possible returns are visible on this frame. Only the return corresponding to the return seen clearly on the previous and following frames is included here.

Determining Actual Target Range. The two most important parameters are azimuth angle and distance of the UAP to the B-52H aircraft. Since the radar operator could manually change his radar range settings and no distinctive markings of these settings are visible on the present photos it is not possible to be sure of the accuracy of any calculations other than maximum values. One must refer to other sources of information when such is available. According to McCaslin (pg. 19, McCaslin), the radar was in "station keep" mode so that the three range markers were at 1, 2, and 3 miles range from the aircraft's antenna. These are the values used in Table 2.

Determining Target Velocity. If we can assume that the aircraft was in straight and level flight its indicated air speed (IAS) would be approximately 275 mph. If the UAP was seen to maintain a constant azimuth and distance from the aircraft over several sweeps of the radar antenna and the aircraft's heading did not change then the speed of the UAP would be equivalent to the speed of the aircraft. This would apply to Frames 776 - 777; the UAP would have traveled at the same speed as the B-52H Table 2 presents selected consecutive frame data from Table 1 in this regard.

Table 2

Consecutive Frame Data
(3-second sweep)

Frame	E.T.	azimuth angle (deg.)	Rel. Rng. to aircraft (mm)	Actual Rng. to aircraft (feet)	Calc. velocity to travel these dist.
771	02	137	25.4	15101	
					can't calculate[1]
772	03	244	13	7973	
					275 mph (est.)[2]
773	04	39.2	15.5	9715	
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776	15	37	15.2	9187	275 mph[2]
					88 ft/sec (60 mph)
777	18	36.5	14.8	8923	

					88 ft/sec (60 mph)
778	21	38	14.3	8659	
779	24	39	(a) 13.2	7973	229 ft/sec (156 mph)
			(b) 16.0	9662	334 ft/sec (227 mph)
					387 ft/sec (264 mph)
780	27	38	13.9	8501	

782	33	35	12.1	7392	
					704 ft/sec (480 mph)
783	36	24	8.8	5280	

Notes:
1. Single radar return on frame 771 is different from return on frame 772.
2. This assumes the same speed for the aircraft (whatever it was).

Determining What is a Valid Radar Return. It is one thing for an experienced radar operator in an aircraft to recognize a "blip" on his screen that appeared suddenly or that approached so quickly that it could not have been a conventional aircraft and who possesses many hundreds or thousands of hours of "hands-on" experience with his set to be able to discriminate artifacts that can appear on the screen from "solid" returns from another object or surface. It is quite another thing for a non-radar expert to try to identify a "real" contact from an array of other possible radar reflections when one only has a series of still photographs to go on. Photographs cannot capture the actual screen intensity nor dynamic traces of a UAP; discriminating valid radar returns becomes almost an art form at best and a gamble at worse. Each of the present photographs contained from zero to several small white dots that sometimes remained in the same location over several frames and then suddenly disappeared. Frame 771, for example, contained one "blip" (referred to as "A"), frame 772 another "blip" in a totally different location (three seconds later) (labeled "B"), while frame 773 showed both blips back in their original locations! It is as if "blip" "A" strobed off during frame 772 and reappeared three seconds later!

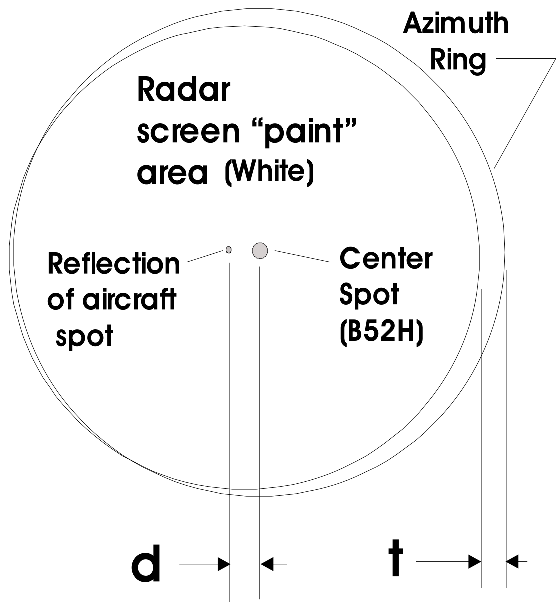
Also, the size and shape of these "blips" are unreliable characteristics to judge whether one is seeing the same return from frame to frame. Indeed, in frame 779 the "blip" seems to split apart, each virtually as large as the preceding "blip" in frame 778 and each having a slightly different shape (from one another). The "blip" that appears in frame 780 is again single and similar in size and shape to that in frame 778.

Other Screen Images. Careful inspection of these photographs revealed the presence of several other images that deserved consideration as possible radar returns. This is in spite of the fact that the interview with McCaslin mentioned only a single radar return. The most consistent of these images was found in *all but one* frame (no. 781).[4] It was located about 5.5 mm left of the bright central dot representing the B-52H aircraft. Figure 2 is a diagram of relevant details.

[4] It might be argued that if this illuminated spot was a reflection it should appear on every frame. In fact, a very dim spot is visible at this location, however, the contrast of the photograph was so low that many other spots also were visible (and probably not valid returns).

Figure 2

Geometry and Nomenclature for Image Reflection Hypothesis

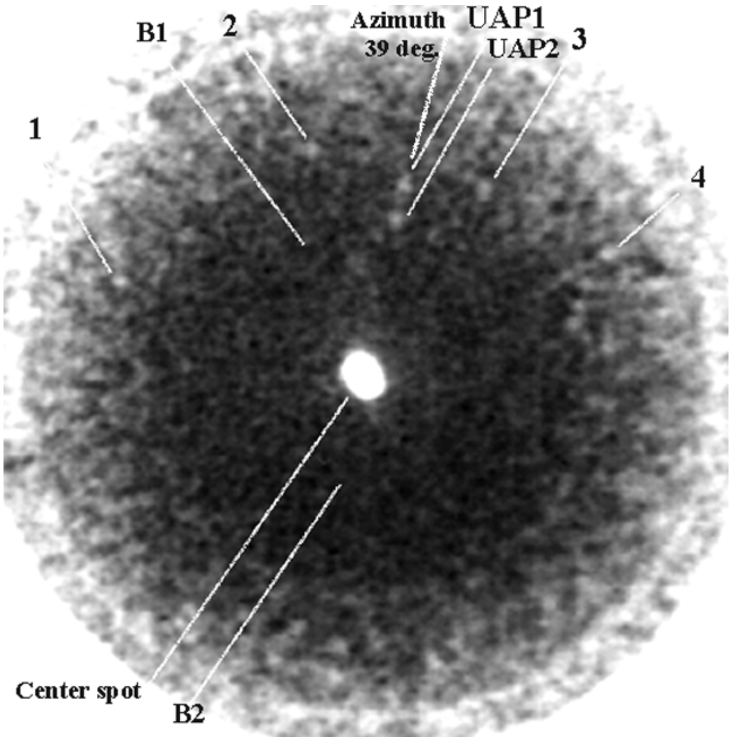


Distance "d" and offset "t" were measured in each frame to determine if a fixed relationship existed between them. It was found that a best-fit, linear curve showed that when "d" increased so did "t" (within measurement error). This tended to suggest that an optical reflection was the cause of the small, dim, spot seen to the left of the aircraft's spot. Then the horizontal and vertical diameter of the azimuth ring circle and the white illuminated radar return circle were measured in each frame. The azimuth ring and the radar's scope face (cf. Fig. 1) was round in all frames. Then what could explain the consistent lateral offset of the small, dim, round spot found to the left of the aircraft's spot in every frame? It is easily explained as a spurious reflection if the front surface of the radar's display tube was convex, the camera's objective lens reflected a small proportion of the much brighter white spot located at the center of the display back onto the radar tube glass surface, and the camera's optical axis was offset to one side of the radar's.

Frame 779 seems to present two strong (split?) returns, both lying on azimuth 39 deg. The center area of the screen was enlarged and contrast enhanced in order to try to clarify this matter. Figure 3 shows that there are actually many luminous dots around the center spot (B52H) labeled as shown. Each dot was checked for its relative density where 0 density represented the center (brightest) spot and 255 represented complete darkness.

Figure 3

Enlargement of Center Region
of Frame 779



The results of these measurements are given in Table 3 where it can be seen that not only are the two spots labeled UAP1 and UAP of equivalent density (i.e., screen intensity) but location 2 and 3 are likewise relatively intense. However, because the spots at location 2 and 3 do not appear on previous or following frames it is not likely that they are valid returns. Finally, two very dark spots were measured (B1, B2) to establish the relative density at the opposite end of the continuum; they show that the image's density spans the majority of the available (8 bit level) density.

Table 3

Luminous Density Measurements from Frame 779

Location	X, Y Coordinate		Density	Comment(s)
Center spot	756	648	0	(B52H)
1	634	599	17	
2	730	532	36	Comparative spots
3	819	551	40	
4	880	586	20	

B1	724	602	94	Dark background azim. = 345
B2	740	704	96	Dark background azim. = 217
UAP1	778	550	36	farthest from center)
UAP2	773	567	38	

It appears that the UAP return may have split into two segments in Frame 779

Radar Target Spreading. It is a well known characteristic of radar returns that the resultant image on the display scope face can spread or "bloom" to appear larger than it is otherwise. This is caused by several possible conditions: (1) reception of an excess amount of radiation from the target, (2) approach of the target, and (3) display screen phosphor characteristics. Such image enlargement of as much as thirty percent or more was common. Figure 4 illustrates this spreading phenomenon from frame 783 for the center spot (larger irregular white area) and the UAP return (smaller white area above the center spot). There is no way to

Figure 4

Enlargement of Central Area of Frame 782
Digitally Scanned at 170 dpi and Contrast Enhanced

know what degree of spreading occurred in the present frames. It is scientifically unjustified to calculate the size of a distant object on the basis of the size of its radar return. At best its size can only be estimated in relation to other targets of known size (e.g., other aircraft at known distances).

Summary and Conclusions

An analysis of these thirteen photographs of an alleged UAP encounter on October 24, 1968 near Minot A.F.B. has shown that an unidentified radar return was received (at least) over the course of a thirty six second period. If it is accepted that there was more than one UAP on several frames (e.g., Frames 773, 779, and 781) the UAP did not exhibit extraordinary speeds but appeared to simply pace the jet bomber maintaining a relatively fixed position off its left wing at a range of between 1.51 and 1.83 miles. The calculated velocity of the UAP between frames 776 and 780 varied between 88 and 563 ft/sec (60 and 383 mph, respectively). The lower velocity is well below stall speed of all large turbojet aircraft.