Study of an Unusual Phenomenon Observed by BOAC Aircrew over Labrador, Newfoundland June 29, 1954

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Summary

This classic observation was made by crew and passengers of a 4-engine Boeing Stratocruiser[3] of the British Overseas Airways Corporation. Flight 510-196 was a luxury flight bound for London on the "champagne and caviar run", departing New York at 1703 local (2103 GMT) on June 29, 1954 with 51 passengers aboard. Four hours later at sunset, 19,000ft over Labrador *en route* for Goose Bay, an apparently huge shape-changing UAP and a swarm of small attendant objects was seen against the bright sky off the left wing. The strange display persisted for 18 minutes.

After a refuelling stop at Goose where they were met and questioned by US Air Force intelligence officers the crew proceeded to London, where the story rapidly appeared in national papers and magazines. Capt James R. Howard was filmed for BBC TV and cinema newsreels. It became big news and went around the world within days *via* the Associated Press syndicated wire. The standing of the witnesses, in particular 33-year-old Capt. Howard, a highly respected former RAF Squadron Leader with 7500 hours commercial flying on 256 Atlantic crossings to his credit at the time of the sighting, has never been called in question. They were convinced that their airliner was followed for 80 miles by a formation of solid flying objects under intelligent control. To this day the case is still hailed by many ufologists as one of the most significant unexplained cases.

Several theories have been advanced. Were these objects spaceships, a giant flock of migrating starlings, balloons, or perhaps a mirage? Whilst the evidence is not conclusive, we present evidence that the most likely explanation seems to be an unusual mirage of a type which, whilst rare, appears to have been observed several times in similar conditions in other parts of the world.

Acknowledgements

The author acknowledges in particular Dr Andrew T Young (San Diego State University, Dept of Astronomy) for invaluable expert advice and assistance; Belgian researcher Wim Van Utrecht (www.caelestia.be) for information, suggestions and many stimulating and constructive discussions; Dr Ronny Blomme (Royal Observatory of Belgium); Herbert L. Taylor; G. David Thayer (formerly Environmental Science Services Administration, Boulder, Colorado, and Condon Committee); Brad Sparks; Dr David Clarke (Senior Lecturer in Journalism, Sheffield Hallam University); Eric Rush; Lt Col Al Kramer USAF (ret.); Claude Maugé; Roberto Labanti.

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[3] Boeing 377-10-28, construction number 15945, received British CAA registration mark G-ALSC on 15 June, 1949, was operated by BOAC as *RMA Centaurus* and sold to US operator Transocean Airlines on 8 Jan, 1959, subsequently acquiring FAA registrations N101Q and N406Q. Current status: Scrapped.

The report

Here is Capt Howard's first person account[4] from the December 11, 1954, edition of the British magazine *Everybody's Weekly*:

WE WERE SHADOWED FROM OUTER SPACE

Maybe it wasn't exactly a flying saucer. What I saw, on a recent New York to London flight, was more of a flying arrow, I guess you'd have called it at one stage. It seemed to keep changing its shape as it flew beside me, very much like a jellyfish assumes varying patterns as it swims through the water. Or maybe the apparent changes in shape were due to the different angles we viewed it from as it banked and turned about five miles off.

Whatever it was - a giant flying wing, jellyfish or saucer - of these things I'm quite certain: It wasn't a trick of light or a figment of the imagination. It wasn't any sort of electrical, magnetic or natural phenomenon. And it certainly wasn't a mirage.

No, it was something real and substantial; something that kept station with me for eighty miles and only sheered off when I got a radio call from the Sabre-jet fighter which had been sent up from Goose Bay to intercept the thing. It was something - the idea gives me slight goose-pimples when I think of it - which was keeping my Boeing Stratocruiser, Centaurus, under observation.

The date was June 29 this year. Just before sunset. Over Labrador. The sky was crystal-clear.

I had taken off from Idlewild airfield at five o'clock, New York time, on what we British Overseas Airways Corporation pilots have nicknamed the "champagne and caviar" run - the North Atlantic crossing from New York to London. It's a luxury flight used by film stars, stage personalities, diplomats and not-so-tired businessmen who can chalk it up to the expenses account.

Normally, we do the trip non-stop, but on this occasion there wasn't very much of a tail-wind and I had a pretty heavy load aboard - fifty-one passengers and a deal of freight - which meant a touchdown some place for refuelling.

The Great Circle Route which we follow takes us roughly midway between Gander airfield in Newfoundland and Goose Bay in Labrador. Gander, this time, was out as a refuelling base on account of foggy weather. But Goose Bay was wide open. So I was headed north-east across the St. Lawrence River. Dinner had been served on board about an hour earlier, and some of the passengers had already taken to their sleeping berths.

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[4] The narrative is 'by Capt. James Howard, a B.O.A.C. pilot, as told to Graham Fisher', but journalistic influence appears to be minimal (or merely nominal - in those days of "closed shop" trades unionism a staff byline would probably have been necessary). According to a letter from R.H.B.Winder (an engineer on the editorial staff of British magazine *Flying Saucer Review*) dated 30 August 1967 to Robert J. Low, Colorado University UFO Project Coordinator, covering transmissal of a copy of this *Everybody's* article obtained from Capt Howard, the latter personally endorsed the account as "the most accurate of the published accounts and . . . a faithful record of his experience" (original letter in Colorado U. Project files; Library of the American Philosophical Society, Philadelphia; copy courtesy of Dr David Clarke.)

We crossed the St. Lawrence and flew over Seven Islands, the small settlement rapidly becoming a latter-day boom town on account of the new railway being constructed from there to the mining centres of Labrador. There was low cloud at about 5,000 feet, but up where we were at 19,000 feet, cruising along at about 270 miles per hour, it was perfectly clear. The sun was just beginning to set, away to the left. At that height there is very little coloured tint on account of the rarefied atmosphere. The sky was almost silver in its clearness - perfect visibility.

It was 9.05 p.m. Labrador time and we were about twenty minutes' flying time north-east of Seven Islands when I first sighted the thing.

At first it looked like no more than an indeterminate dark blob in the distance, with several smaller blobs dancing attendance on it. The whole set-up looked, at first glance, like a cluster of flak-bursts such as I had encountered several times over Europe during World War II while bombing invasion barges lined up along the Dutch and Belgian coasts.

But the biggest blob was much bigger than any flak-burst I had ever encountered, and in some strange way it seemed to have definite shape. It didn't look, somehow, as though it was going to disintegrate into thin air, the way flak-burst does. As near as I can describe it, it was something like an inverted pear suspended in the sky.

I was on the port side of the control cockpit, looking out of the window nearest the thing. Beside me was my co-pilot, First Officer Lee Boyd, a 33-years-old Canadian from Saskatchewan who flew with the famous Pathfinder Force during World War II. I gave Lee a nudge.

"What do you make of that?" I asked. "I just noticed it", he said. "What in tarnation is it?".

As near as I could judge, the group of things was about five miles off, stretched out in a line parallel with our own line of flight. The big one was roughly centre of the group, with the smaller ones extended fore and aft like a destroyer screen convoying a battleship.

Watching puzzled - the Stratocruiser was flying by auto-pilot at the time - I realised something else, too.

"The damn things are moving", I said.

Even as we watched, the big central thing began to change shape - or maybe it altered its angle of flight, giving the appearance of changing shape. I wouldn't know. What I do know is that during the entire eighteen minutes it flew along with us it changed shape continually while the smaller attendant things switched position around it.

This is something lots of people are going to want to know a deal about later, I told myself. There's going to be a lot of questions fired at me once I make my report. I'd better know some of the answers. How many small ones, for instance.

(1) the "things", as the captain called them, with the bigger object in the shape of an inverted pear suspended in the centre between the wingtip of the Centaurus and the setting Sun;

(2) the central object changes into a huge flying wing that looks as if it is turning to close with the aircraft;

(3) the objects constantly change shape, the central object now looking like a giant telephone receiver on its back.

Fig.1 The three sketches which Captain James Howard drew in his log book (Carnell, 1954)

I counted, re-counted, counted again. Six. Always six. Sometimes there were three stretched out in front of the main thing and three behind. Sometimes five stretched out in line ahead and only one behind. I had the impression that just before I got round to counting them there were more than six, which ties in with Lee Boyd's idea that they were flying in and out of the large central object like aircraft entering and leaving a flight hangar.

Lee said, as though he didn't believe it himself: "There's a lot of Air Force traffic in and out of Goose Bay some days. Maybe it's a formation of fighters way out in the distance. Want me to call up Goose and check?".

It didn't look like any formation of fighters I'd ever seen, but I told him to go ahead.

He called up Approach Control at Goose Bay - told them what was going on.

"Hold it a moment and we'll check", they said. A minute later they reported back. "No other traffic in your area." "Well, there are a number of very strange objects flying parallel with us some distance off", Lee said. "There's one large one and about six smaller ones". "Can you identify them?". "No". "Okay. We'll send a fighter up to take a look-see".

Now, from the inverted pear-shape the big thing had looked when I first saw it, it turned into what looked like a flying arrow - an enormous delta-wing plane turning in to close with us.

There was a nasty moment as we watched the thing seeming to grow larger as though drawing closer. "It's coming towards us", I said.

But it wasn't. We watched, tense expectant, but it didn't come any closer. Suddenly the delta-wing appearance started to flatten down, stretching out, until it was now like a giant telephone receiver lying on its back in the sky, still with the smaller objects changing formation around it. Stretched out like that, assuming it was about five miles off, it looked about the size of an ocean liner. I grabbed paper and began to sketch. My memory might play tricks with me later about this.

The four other members of the crew in the cockpit with us had got the gist of what was going on, had caught something of our own expectancy and tenseness. They crowded forward now to look out of the windows with us: George Allen, navigating officer; Doug Cox, radio officer, Dan Godfrey, engineering officer and a grizzled old veteran flyer; and Bill Stewart, the other engineering officer.

They all saw it. So did the steward and Daphne Webster, the stewardess, a twenty-seven-years-old Londoner. They both popped their heads inside the cockpit to tell us that some of the passengers had seen it too and wanted to know what it was.

Their guess was as good as mine.

The objects were still parallel with us, still keeping station with us at the same altitude. George Allen, angling himself so that he could line them up with the window-frame, said that at one time they went a little ahead of us and then dropped back exactly parallel again.

I was tempted to change course and take a closer look at the things, but I didn't. After all, I didn't know what the blazes they were and I had fifty-one passengers to consider. I also had a hunch that the things might sheer off if we showed too much interest, and, with a fighter coming up to intercept them, I wanted to be in the audience to see what happened.

Soon the pilot of the intercepting fighter came through on the radio: "Those things still with you?".

I said they were.

"Okay. I'm about twenty miles off, heading towards you at a slightly higher altitude".

I looked out of the cockpit window again. The things were still there.

"How do they look now?" the fighter pilot radioed.

Even as he said it, I realised that the things were no longer there - not all of them. The half-dozen attendant things had suddenly vanished.

"What happened to the smaller ones?" I asked.

George Allen, who had had his eyes on them the whole time, said: "It looked to me as though they went inside the big one". At that moment the big one itself began to get rapidly smaller as though it was sheering away from us at terrific speed.

"They're getting smaller", I told the fighter pilot over the radio.

I looked out again. The big central thing was streaking away into the distance - getting smaller and smaller. In a matter of seconds it was no more than a pinhead. Then it was gone altogether.

And that was that.

What was it? Search me. It wasn't anything natural, I know that. And we had the whole group clearly in view for a full eighteen minutes - entered in the navigation log as appearing at 0105 Greenwich Mean Time and disappearing again at 0123, a flying distance of eighty miles - the strangest eighty-mile journey of my life.

Twenty minutes later we landed at Goose Bay where a U.S.A.F. Intelligence Officer interviewed Lee Boyd, George Allen and myself. We told him what I have told you here.

Sources and materials

As always, it's vital that we work with the most reliable information. Usually, this will mean that we favour a contemporaneous or near-contemporaneous account over one set down long after the event, when witnesses may have been exposed to speculations and questions that can influence their recall.

Some discussions of this case incorporate material from accounts set down years later, for example an article by Capt Howard that appeared in the magazine *Flying Saucer Review* (Howard, 1982). There are significant details in this late account which are not to be found in the earliest available published accounts.

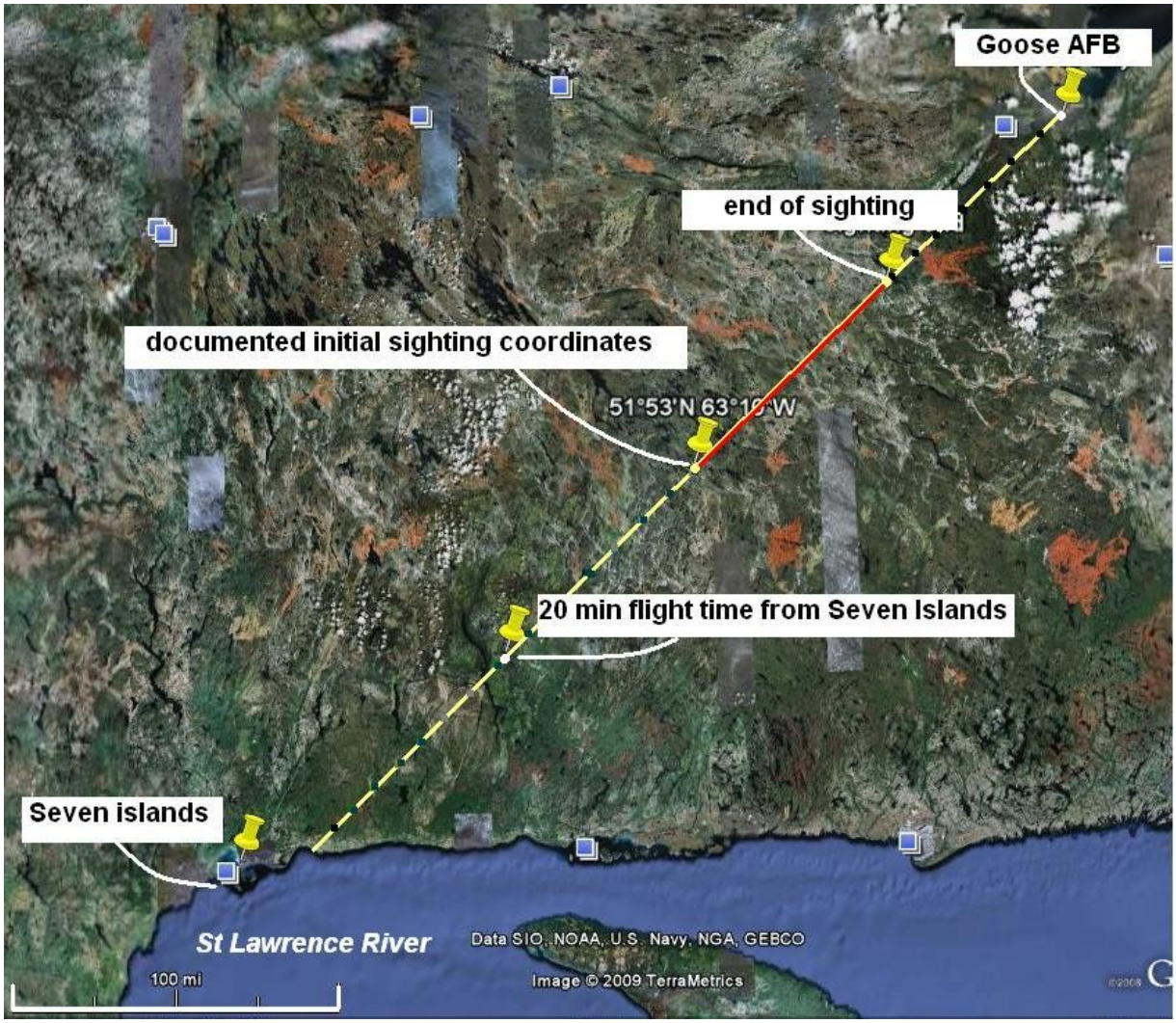

Fig.2 Map of the sighting area showing the flight track (approx 49° True), initial sighting coordinates (51°53'N 63°10'W) and other locations.

The primary narrative sources used here are the above December 1954 account by Capt Howard including a series of interesting contemporaneous drawings from Capt Howard's logbook (Howard, 1954) and his Voyage Report (Carnell 1954; *Appendix B*). Other primary sources include the 29pp USAF Project Blue Book case file (*Appendix D*).

Some 14 years after the event G. David Thayer, an ESSA radar propagation expert, considered this observation for the USAF-sponsored Colorado University study (known as the Condon Report, see: Thayer, 1970) basing his analysis on an 8pp "UFO Sighting Report" form filled out by Capt Howard on 01 December, 1967 at the request of the Colorado project.[5]

[5] David Thayer has confirmed to the present author that this handwritten form was the sole source made available to him at the time (personal communication, 13.08.2009). He appears to have assumed that it came from Blue Book, but on reflection he points out that his presentation on p.139 of the Condon Report does not have a "B-number" which would identify a Blue Book source. Indeed it is the only case in Thayer's chapter which doesn't have *any* case number (if not a B-number it should have an N-, C- or X number). The reason for this is unclear, but it appears that the materials in the Project case file were assembled by Robert Low, Project Coordinator, *via* visits and correspondence with intermediaries in the UK during 1967 (see Note 4)

(see also *Appendix B*) Thayer pointed to several features very typical of mirage, but had difficulty making the theory fit perfectly.[6] He famously concluded that it was some type of natural atmospheric phenomenon "apparently so rare that it has never been reported before or since".[7]

However a very similar observation made in similar circumstances by an Australian civil aircrew in August 1968[8] suggests a very similar phenomenon. There are in fact parallels with several other observations, most of them little-known but a few of them prominent in the popular literature such as the very influential sighting by highly-respected United Airlines pilot Capt E. J. Smith and his crew on July 4, 1947 (only days after the first "saucers" were seen by private pilot Kenneth Arnold) of a row of dark "discs" against the sunset sky over the mountains of Oregon.[9] A similar atmospheric-optical mechanism might be indicated.

Extant meteorological data for the region of Newfoundland and Quebec are sparse. More than forty years ago Thayer (1970) lamented the "very little meteorological data available" and was able to cite none. McDonald, an atmospheric physicist, referenced weather maps for that day, saying that "although there are not many reports in that part of Canada I get the impression there would not have been an extensive amount of cloud cover" (1969) and that they indicated "fair weather" and good visibility consistent with Capt Howard's report (1968), but he did not reproduce them. Probably these were the US Weather Bureau Daily Weather Maps (see later). As for upper-air radiosonde readings, apart from a US Weather Bureau chart of the 500mbar pressure surface we have none and thus no means of inspecting the vertical temperature profile of the atmosphere. All that survives is a tantalising comment in a telex from Pepperrel AFB (adjacent to Goose Bay), timed 1735Z 01 July, 1954 that "A TEMPERATURE INVERSION IN THE REFERENCED AREA MADE [MIRAGE] POSSIBLE" (see *Appendix D.5*). No balloon data appear in the file so we have no idea what levels (if any) or date/time this information refers to. The telex ends with the assurance that complete data are to follow. They never did, or if they did they don't survive in the file. There is a terse USAF surface weather report from the 641st AC&W Squadron, Goose Bay (see *Appendix D.4*) and thanks to the Canadian Weather Office some hourly and daily surface weather reports have been located for Goose and a few other scattered locations in Quebec, as discussed later (see *Appendix A*).

There are several other oddities worth noting in the Project Blue Book file.

On one typed sheet a brief reference is made to study of a photograph (*Appendix.D.19*). There is no explanation, and the "No" box is properly checked in the "photos" section of the Project

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[6] We will show that this is at least in part due to problems with the source material. One of several confusions arising from the UFO Project Sighting Report Form is the duration, which passed into the literature *via* Thayer's account as 0105Z - 0127Z, introducing a 4 minute discrepancy which has puzzled some commentators. The error appears to be in Capt Howard's 1967 recollection. The times he gave in 1954, quoting from the Navigation Log (see p.7), match the time recorded in contemporary USAF telexes (although ironically Blue Book's Project 10073 Record Card, whilst getting the 18-minute duration correct, perpetuates a *different* 4-minute discrepancy by quoting an incorrect start time of 0109Z from the original EMERGENCY priority telex from 641st AC&W, Goose, which was corrected in a later telex timed at about 0330Z. 0109Z appears to have been the time of the alert of the 641st radar, 2 minutes after the radio call to Goose AFB approach (see *Appendix B.i*) timed at 0107.

[7] http://ncas.org/condon/text/s3chap05.htm#c1d

[8] See: Norman, 1969. This observation was known to Dr James E. McDonald and referenced by him in his 29 Jan 1969 letter to James Howard (Colorado U. project files; Library of the APS, Philadelphia) with the comment that "it paralleled your experience closely."

[9] A small but significant number of similar cases is presently being catalogued by Wim Van Utrecht and will be available at http://www.caelestia.be/

10073 Record Card. No other known source refers to photographs in connection with this case.

It's possible that the photo is connected instead with another report in the file, forwarded to ATIC from HQ, USAF, Washington on 02 July.[10] This report was a telex (Appendix D.12) from a naval ship, the USS EDISTO, reporting an interesting observation on the same night, 30 June 0115Z, actually *during* the BOAC sighting, but from 55 55N 58 10W. This is about 60 miles off the east coast of Labrador, some 300 miles NE of the BOAC sighting area, and the sighting direction was SE across the sea

At an azimuth of 140° True and at 20° elevation a "bright reddish-yellow object" was seen changing shape, looking first like "a jellyfish swimming to the westward" and then like "a dart". It was "identified at the time as the planet Mars" according to the telex, and it was noted that "mirage effect had been pronounced during the day in its field".

Mars was indeed close to that bearing at 148° but only a couple of degrees above the horizon at that time, so a factor-10 error in elevation needs to be assumed. This would also be implied by the mirage interpretation since a 20° angle is far too high for mirage. Gross exaggerations in horizon elevation are commonplace even among experienced observers, and no other obvious astronomical source was in that part of the sky. So far so good, and taken together with the Pepperrell AFB telex cited above the USS EDISTO sighting is evidence that low-level inversion conditions might have existed that evening over a very wide area around Newfoundland. This is not by any means direct evidence of the temperature profile at 19,000ft but is at least suggestive.[11]

However Blue Book were not content with so modest an inference and instead pounced on the USS EDISTO telex to "explain" the BOAC sighting, even though the latter was a sighting of black silhouettes next to the sun on a bearing 150 deg away from the position of Mars. Incredibly, "the Planet Mars" is the official conclusion on the Project 10073 Record Card for Capt Howard's sighting, and this is the conclusion that was sent to the British Air Ministry who (the file reveals) had been in contact with ATIC *via* HQ USAF and made an official request for copies of "interrogation reports" and "any other info" generated by the ATIC investigation. Disingenuously, the Blue Book file summary describes the sighting as "a type of wavering light formation", presumably so as to make the Mars story sound less absurd.[12]

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[10] Notably, the detail of this telex was leaked to the press simultaneously, appearing in the following morning's 03 July edition of the Washington DC *Star* (Giles, John A., 'Mirage Called Possible Answer on Objects Seen by Flyers') along with another from NEAC, Pepperell AFB (Goose) also suggesting mirage. The article erroneously gives the Edisto's position as "in Ungava Bay", north of Quebec and generally NNW of the Stratocruiser, a ~350 mile error which - fortuitously or not - has the effect of placing the USS Edisto nearer the scene of the action.

[11] The Goose weather report shows a somewhat elevated surface atmospheric pressure NE of the sighting location of 30.13 inches of mercury (1020.32mbar) and Quebec weather reports NW of the flight track record an unusually warm afternoon, possibly consistent with an anticyclonic inversion (see p.27 and *Appendix A*).

[12] This was the Dark Ages of an emasculated Blue Book under Capt Charles Hardin, keen to drive down "unexplained" statistics following the CIA-sponsored Robertson Panel of 1953. But as Brad Sparks points out (personal communication 07.08.2009) it is interesting that by this date Blue Book had been shifted from the ATIC Aircraft & Missiles Branch over to the security-sensitive Electronic Intelligence Branch (office symbol ATIAE, for cover purposes called the "Electronics Branch") under Lt Col Harry C. Johnston, and that two British RAF intelligence officers, Sq Ldrs Wainwright and Bentley (assigned to the Pentagon at AFOIN Military Capabilities Division [East]/ Future Estimates Branch AFOIN-2C1) were still liaising with ATIC to pursue this case as late as mid-October. What is equally interesting given this apparent level of interest, in the context of possible new Soviet military activities, is that in March 1955 the UK MoD Deputy Directorate of (cont. over)

Analysis

1) flocking starlings (Sorta Sol) or other birds

This is among the more interesting explanations proposed over the years for the BOAC case (sometimes known as the *Centaurus* incident). The shape-changing behaviour of the amorphous black object suggested to the Belgian researcher Wim Van Utrecht[13] the intriguing idea that they saw a huge flock of starlings. The same theory was put forward by US researcher Brad Sparks.[14] The first reference to this theory (to dismiss it as "highly improbable" on the grounds of speed and altitude) appears to have been by Capt Howard himself in an 800-word entry in his Voyage Report written during the Goose-London leg of the flight (Carnell, 1954; see *Appendix B*), as also reported in the papers the next day.[15] [16] Another similar speculation was published in the London *Daily Mail* one week later.[17]

Such flocking displays can involve hundreds of thousands of birds and do resemble dark shape-shifting blobs in the sky, a phenomenon widely known as Sorta Sol which is Danish for "black sun".[18] One reason for the especially well-defined shapes of starling flocks is that the bird density increases towards the periphery of the flock, rather than towards the centre, which is believed to be related to defence against predators.[19] Capt Howard in fact used a related simile: "The large object was continually, slowly changing shape, in the way that a swarm of bees might alter its appearance." (Howard, 1982) Wim Van Utrecht proposed that the apparent stationing of the objects off the aircraft's wing for an extended time might be an illusion of distance perspective, akin to that whereby the moon appears to follow a moving vehicle.

Intelligence DDI(Tech) prepared a short RESTRICTED Air Ministry Secret Intelligence Summary (AMSIS) for the Assistant Chief of Air Staff (Intelligence) which concluded:

> *An investigation was carried out by the Americans who obtained a subsequent report from a ship at sea in the same vicinity. They described what was apparently the same phenomenon. Members of the ship's company, however, definitely identified the sighting as the planet Mars and gave full details of the mirage conditions which were prevailing on that day.*

This acquiesence in Blue Book's "explanation" is frankly witless and seems hard to credit, being on the face of it inconsistent with the type of concern revealed by UK intelligence activity in relation to the case, which included Air Ministry interviews with Capt Howard and others. This increases one's curiosity about the content of the 20,000-word report of which this 2500-word "restricted" AMSIS is said to be only a security-cleared extract Unfortunately no surviving copy has been located to date in the UK (David Clarke, personal communication, 23.08.09) or in the US (Brad Sparks, personal communication 26.08.2009).

[13] http://www.caelestia.be/

[14] Sparks, B., personal communication, 05.08.2009; Sparks, B., 'Comprehensive Catalogue of 1600 Blue Book Unknowns', 2001-2008 Case #938, http://www.cufos.org/BB_Unknowns.html

[15] 'Flying Saucers? Yes, says the Captain', *Daily Express*, 01 July 1954

[16] 'Sky "objects" Seen from Plane - Pilot's Report', London *Daily Telegraph*, 01 July 1954.

[17] K.R.May, (Salisbury, Wilts.) Letter to the Editor, *Daily Mail*, 07.07.1954, describing roosting flocks seen from a train in South India in 1945. An Editorial comment dismisses the idea on the grounds of altitude.

[18] Many extraordinarily beautiful videos of Sorta Sol can be found on YouTube, for example: http://www.youtube.com/watch?v=b8eZJnbDHIg&feature=related or http://www.youtube.com/watch?v=MIzlcH2q6Vo&feature=related

[19] Ballerini, Michele, *et al*., 'An empirical study of large, naturally occurring starling flocks: a benchmark in collective animal behaviour', Animal Behaviour 76(1), July 2008, 201-215. http://arxiv.org/ftp/arxiv/papers/0802/0802.1667.pdf

However, in this case the *minimum* relative velocity of the 230 knot (265 mph) plane and a starling (assuming the 40 knot maximum velocity of the starling[20] is parallel to that of the plane) is about 190 kt (220mph). In 18 minutes the starling falls aft the plane by a distance of 66 statute miles. Capt Howard said the UAPs stayed "parallel" and "paced" the *Centaurus* "exactly" for 18 minutes. This was checked by the navigation officer against the windshield post. (The only reported deviation described in early sources was that the UAPs appeared to move *ahead* of the aircraft a little at one point and then fell back to the same abeam position.[21] This could maybe have been yaw in the aircraft axis[22])

Clearly, to explain a 190kt airspeed difference in terms of differential tailwinds we require the flock of birds to be inside - and the aircraft outside - a very sharply-defined southwesterly jet with a core windspeed greater than this. There are strong reasons why this scenario is highly unlikely even in principle. The reader is referred to the lengthy discussion in Section 2 (stratospheric balloons) where extreme jet winds are the overriding requirement. It is sufficient to note here that the wind in the sighting area at the 19,000ft level (500mbar) measured by radiosonde ascents between 10:00PM and 11:PM EST June 29 1954 was only 25kt. (*Appendix A. ix*), an order of magnitude too slow. There is no indication of violent wind at 19,000ft in the sighting area. This fits the fact that due to a continental blocking high over Labrador the mid-latitude jet was not only abnormally weak in the East through June 1954, its average position (traced at the 700mbar level in *Appendix A.x*) was confined in a zonal flow far to the South.

In the absence of a violent jet stream we are reduced to considering parallax. Let us assume that despite the report of "exact" pacing the blob fell back over 18 min by as much as 10º, say, which might seem roughly a constant constant to a lay reader - although it is a large angle navigationally speaking. Perhaps a 10º drift was concealed by yaw, or perhaps the pilot and navigator didn't check the angle as accurately as was suggested. In order for this 66 mile distance to equate to 10º our starlings would have to be nearly 380 miles away. (If we require to respect a bearing accuracy of 1º then obviously the distance increases to 3800 miles!)

But if 10º were good enough, could a flock of starlings be observed at 380 miles? Capt Howard estimated the angular size of the main blob when in its "telephone" phase as equal to that of an ocean liner at 5 miles. If an ocean liner is on the region of 1000ft (typical for biggest transatlantic vessels in the then-familiar class of the *France* and *Queen Mary*[23]) then an angular width in the region of 2º is implied. In his Colorado Project Sighting Report form Howard answered question #36 ("What was the APPARENT size of the object compared with the following familar objects?") with "about the same size as the moon", or 0.5º. Of

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[20] Houghton, E., 'Detection, Recognition and Identification of Birds on Radar', 1964; cited in: Blackmer, R.H.*et. al,* 'Radar and the Observation of UFOs', in: Gillmor (ed.) & Condon, 'Scientific Study of UFOs", Vision, 1970 p.675.

[21] In his 01 Dec 1967 Sighting Report written for the University of Colorado UFO Project, Capt Howard draws a diagram of initial and final compass directions showing the LOS *advancing* fully 20º towards the nose of plane. This large and systematic rotation of angle cannot be accounted for by yaw and is in conflict with early statements that the objects "kept station" on the same (average) bearing. If reliable, of course, a steady 20º LOS overtake would be sufficient to rule out the Sorta Sol theory immediately.

[22] According to Capt Howard the aircraft track (autopilot setting) was 49º True and the instant heading would have been 49±5º, i.e. a possible variation of up to 10º (letter from R.H.B.Winder to Robert J. Low, 30 August 1967, forwarding Capt Howard's answers to question posed by Low. Colorado U. UFO Project files; Library of the American Philosophical Society, Philadelphia).

[23] According to http://www.ufoevidence.org/documents/doc1779.htm 'Captain James Howard later described the main object as the "the size of the Queen Mary"!' but if the source is the Voyage Report (*Appendix B.i*) then this was given only as an example of a range of possible sizes.

course this was many years after the fact. And not all ocean liners are as big as the iconic translatlantic superliners. If we make due allowances and split the difference we end up with an angular size in the order of 1º.[24] At 380 miles range that means the main flock would be nearly 7 miles across, and the outliers (spanning 5-10 times the angular width of the main blob according to Howard's drawings) would cover about 35-70 miles

According to all quoted witnesses (including crew, cabin staff and a New York BOAC employee flying as a passenger[25]) the blobs were "black", "dark", "solid", "substantial". Even allowing for optical contrast illusions in silhouette this implies a very substantial density of birds, and given a lower bound on flock diameter of several miles the absolute number of birds would be truly colossal. For example, a spherical flock of only 2 miles (3km) radius having a mean density of 1 starling per m^3 would contain some 36 billion ($36 \cdot 10^9$) birds, which exceeds the typical numbers in large flocks by 4 or 5 orders of magnitude. Indeed this is in the order of 10 times the estimated total spring and fall traffic of all migratory birds on all flyways throughout the continental US.

Consider also that although the sighting did occur close to the major East coast migratory route known as the Atlantic Flyway (even though not in a migratory season) the impressive dusk flocking displays always occur at low altitude when the birds are roosting, and are formed by the aggregation of very much smaller groups and individuals that pre-assemble in trees and other perching sites over a wide area.

The flock is actually not so much a blob as a pancake, tendingto form in a sheet which is relatively thin in the direction of gravity and extended in directions perpendicular to it.[26] The characteristic morphing-blob appearance occurs because the changing aspect when twisting and banking over the nesting site causes transient increases in the density of birds per unit angular area. The shapes change very rapidly for this reason, and the optical density of the blob thins out in between to the point where it becomes a faint smudge or streak.

This geometry means that if a Sorta Sol flock were to be transported to a migratory route at 19,000ft and made to fly straight and level alongside an aircraft then it would tend to be viewed along its axis of maximum optical density. But as already mentioned, these flocks are roosting displays and are not known to occur at altitude during point-to-point flight. Passerine birds (among which are included starlings) do not form concentrated flocks at all during their migrations[27] and although millions of birds may be involved the process may last many weeks.[28] For starlings in the US, for example, the mass northern migration back to the breeding grounds occurs from late September until the end of November.[29] (A million birds over this period would pass a given point at an average rate of only about 700 per hour, or 180 birds per 18-minute observation period) Other birds like geese that do form tight flocks at

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[24] This result can be cross-checked against Capt Howard's drawings (Fig.1) and the blueprint dimensions of the Boeing 377 from which we can calculate that the angular diameter of the engine nacelle ~36ft from the cockpit would be approximately 5º. The setting sun is of course 0.5º across. Scaling the angular width of the UAP in Sketches #2 and #3 using these two yardsticks yields values of about 4º and 0.5º respectively, and in ~1 the values are about 0.2º and 2º respectively. The overall mean of these six values is ~1.9º, reassuring us that an angular diameter of 1º is reasonable and probably conservative.

[25] 'Romford Man Sees Flying Saucers', *The Recorder* (Romford, Hornchurch & Upminster), Fri 2 July 1954 p.1

[26] Ballerini, Michele, *et al*. ,op.cit.

[27] Elphick, J., Atlas of Bird Migration New York, Random House 1995

[28] Kessel, B., 'Distribution and Migration of the European Starling in North America', The Condor, Vol.55 March-April 1953 #2 http://elibrary.unm.edu/sora/Condor/files/issues/v055n02/p0049-p0067.pdf

[29] Kessel, B., *op. cit.*

high altitude in order to migrate do so in small numbers in distinctive and recognisable formations, not in vast swarms.

The mass migrations of all species occur in local climatic spring and autumn, and although migratory dates in more northerly latitudes will tend to contract towards the breeding peak - so that Autumn migration in the Canadian High Arctic (10º- 20º or more N of the sighting area) is beginning erratically by late July[30] - late June is near the peak of the breeding season everywhere, when the vast majority of birds are near their nest sites.

It is true that the European starling is one of only two birds (the other being the lapwing[31]) found to have a secondary summer migration, composed of that year's juveniles which often fly a short distance (a couple of hundred miles) in the direction of the wintering grounds, as though to get a head start.[32] But a small sub-population of summer-migrating starlings trickling South does not in any realistic way help to explain our dense, black UAPs apparently heading North,.

Brad Sparks has suggested[33] that the Sorta Sol theory might be rescued if there were numbers of large high-altitude bird flocks distributed over a wide area of Eastern Canada, an abnormal mass migration possibly due to some freak climatic trigger, so that the witnesses saw different concentrations of birds in succession. If their visual attention was interrupted they might have missed the transitions and assumed they were seeing the same group of "objects". This might account for an illusion of a single object (or group of objects) appearing to "pace" the airliner, even though the individual bird speeds remain low.

No doubt each of the witnesses did take his or her eyes off the objects from time to time during the 18 minutes, but it seems safe to say that a lot of people were looking a lot of the time, with the front seaters probably watching most of the time. Yet there is nothing in any account to suggest that anyone ever thought the object(s) disappeared and reappeared at any time.

Nevertheless, allowing (despite absence of evidence) the conjecture that flocking behaviour comparable to the Sorta Sol might occur during point-to-point flight at 19,000ft, a relay of different flocks would allow us to reduce the range and reduce the absolute size of the flocks. But only to the same extent that the stationary average bearing can no longer be an illusion of vanishing parallax caused by great distance. So although individual birds in these flocks can be allowed to fly at arbitrarily low average speeds (speed can be zero in the limit of an infinite number of successive flocks!) the average position of the successive flocks must still advance at close to the aircraft speed.

In order to preserve an illusion of continuity how many "hand-overs of the baton" are necessary in this relay race?

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[30] Gudmundur, A., *et. al.*, 'Radar Observations of Arctic Bird Migration at the Northwest Passage, Canada', ARCTIC, Vol. 55, # 1 (March 2002) p. 21–43. http://pubs.aina.ucalgary.ca/arctic/Arctic55-1-21.pdf

[31] According to the American Birding Association the Northern Lapwing,*Vanellus vanellus*, is classified as an occasional non-breeding visitor to the northeast US and Canada,. The estimated global population of 7 million birds breeds in Eurasia and winters mainly in Asia Minor, India, and Southeast Asia. There are over 50 historical reports of Northern Lapwings from eastern Canada and the northeastern US, but large flights in December 1927 and January 1966 account for most of the records. I find no reference to extraordinary Summer visitations in 1954.

[32] Alerstam, Thomas, 'Bird Migration', Cambridge University Press 1990 p.41

[33] Personal communications, 08.09.2009

Let's keep an allowance of 10º for an undetected or unreported drift per flock before it needs to be replaced by a new one, but cut the distance assumption down by a factor 10 so the flocks are 3.8 miles (6 km) away. A drift of 10º is therefore 0.66 miles. A 1º diameter flock only 3.8 miles away is <400ft (120m) across and with a density of only 1 bird/m^3 the flock contains nearly a million birds, which is the right order for the largest Sorta Sol flocks of starlings. Assuming that *all* of the velocity of all of the starlings in the flock stays parallel to the aircraft (probably an unrealistic limit) then at the minimum relative speed of 225 mph it has drifted aft to our limiting 10º in about 10 seconds. This million-bird flock then needs to somehow dissipate and be replaced by a new one displaced angularly forward by 10º, and the same thing has to recur more than 100 times during 18 minutes - each time neatly missed by every eyewitness and each time reassembling a similar pattern of smaller sub-flocks deployed symmetrically fore and aft. The total number of birds in this amazing performance is in the order of a hundred million birds at least.

Brad Sparks suggests[34] trying to make the theory work with a lighter density than 1 bird/m^3, a smaller 0.5º degree UAP diameter, and an "accordion effect" in a continuous concentration of birds rather than successive discrete flocks. One can visualise this idea as an 80-mile ribbon of birds lying parallel to the aircraft track, having a sub-critical density of birds that becomes a visible blob only at the peak of a compression density wave propagating along the ribbon at the speed of the aircraft. Why this would happen - or why some other, more complex disposition of birds would create the effect of it happening - is not clear to me. But it's obviously true that we can reduce the absolute number of birds by assuming a lower peak density, although this is in tension with the need to maintain a "black", sharp-edged" and "substantial" appearance insisted on in early observer accounts.

An empirical study of starling flock parameters[35] measured bird densities in ten events. An average over the ten values gives 0.27/m^3, or about 1/4 of the value assumed above (within an order of magnitude - which is not a large difference in the context).Video evidence shows that the *average* effect of this typical density of birds in Sorta Sol displays is not by any means "solid" and "black", the flock is only intermittently dark in its most favourable aspect. We should therefore assume that this peak density is the *minimum* value necessary to maintain a constant black, sharp-edged silhouette for 18 minutes in flocks of comparable size.

Obviously the optical depth and edge-definition of a flock due to a given density of birds will also be proportional to the *physical* depth and thus to the absolute number of birds. We do not wish the absolute number of birds to drop too low. If the peak group is, say, 50m spherical diameter (for simplicity) and subtending 0.5º at the above distance of 3.8 miles (6 km) then at the typical density of 0.27/m^3 it contains only about 10,000 birds. Since the measured typical density provides only an unsatisfactory minimum opacity and definition in Sorta Sol flocks that regularly exceed this absolute number by a factor of 10 or 100, we should apply at least a factor 10 or 100 correction. Then for the same density a more comfortable 100,000 birds roughly doubles the diameter and range of the 0.5º peak-density group to 100m at about 7 miles (11km).

Let us plug this figure into the "accordian wave" model. Clearly the just-invisible medium for this travelling density peak has to be made of a very much larger number of birds at a density not far below the peak, thus for an 80-mile (130km) stream of birds the total must still be in the order of 1000 times the number of birds in the visible 100m peak blob, which implies,

[34] Personal communication, 09.09.2009.
[35] Ballerini, Michele, *et al*., *op.cit.*

conservatively, a number in the order of 10^8 or 10^9 birds concentrated within a few miles of the Stratocruiser during one 18-minute period on June 29 1954.

This reduced figure is still between 10% and 100% of the estimated total spring and fall traffic of all migratory birds on all flyways throughout the continental US today [36] and seems entirely incredible. The passenger pigeon, historically the most abundant US bird once comprising 25% - 40% of the entire US bird population, is believed[37] to have formed a migratory river up to 300mi (500km) x 1 mi (1.6km) containing up to 2.5 billion birds, or in the order of 1 million birds per km^2 of plan area, a density comparable to the $1/m^2$ oncentration in Sorta Sol flocks. But apart from the anomalous migratory date, the passenger pigeon was totally extinct in the US by about 1900. No other bird existed in remotely comparable numbers in 1954.

Add to an extraordinary number of birds the facts:

- that Sorta Sol is low-level roosting behaviour that occurs only where much smaller flocks and individuals, returning from feeding grounds, congregate over the nest sites,
- that passerines like starlings do not tend to flock densely when migrating,
- that starling migration is minimal on the Atlantic Flyway (most East Coast birds are resident, and most of what little migration there is comes from US populations flying south, not from Canada),[38]
- that very few birds migrate at all above about 7,000ft and that most starlings fly below 1,000ft
- that migration times across the US are Feb-March and Oct-Nov,[39] not during the midsummer breeding season.[40]
- and that there is no obvious mechanism by which the density peak in this hypothetical great river of birds would track the motion of the plane at a rather consistent bearing for 18 minutes

and we conclude that the Sorta Sol theory has several, collectively fatal, problems.[41]

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[36] Elphick, J., Atlas of Bird Migration New York, Random House 1995.

[37] http://en.wikipedia.org/wiki/Passenger_pigeon http://www.si.edu/encyclopedia_SI/nmnh/passpig.htm

[38] Kessel, B., 'Distribution and Migration of the European Starling in North America', The Condor, Vol.55 March-April 1953 #2 http://elibrary.unm.edu/sora/Condor/files/issues/v055n02/p0049-p0067.pdf

[39] Guarino, Joseph L., 'Bird Movements in Relation to Control', Wildlife Damage Management, Internet Center for Bird Control, Seminars Proceedings, University of Nebraska - Lincoln, 1968 http://digitalcommons.unl.edu/icwdmbirdcontrol/178/

[40] On 25 June Hurricane Alice hit Texas, flooding the Lower Rio Grande Valley with 27 inches (686 mm) of rain. US.90 was 30 feet (9.1 m) underwater (http://www.islandnet.com/~see/weather/almanac/diaryjun.htm). On 26 June an anomalous pressure jump tracked 800 miles from Wisconsin to the Atlantic coast near Washington bringing violent winds, lightning and hail to many areas (Holleyman, I. B., 'The Washington DC Storm of June 26 1954' Monthly Weather Review, July 1954 pp.200-208 http://docs.lib.noaa.gov/rescue/mwr/082/mwr-082-07-0200.pdf). Conceivably these or similar events could have disturbed huge numbers of birds from nesting sites in the central or southern states but I have so far found no evidence

[41] Wim Van Utrecht is now satisfied that the starling theory has been ruled out. (Personal communication 11.05.2009)

2) stratospheric balloons

A second theory proposed by Wim Van Utrecht is that what was seen could have been a train of high-altitude research balloons or the like. Such balloons can be huge, hundreds of feet in diameter when at float altitude, and when still only partially inflated at lower altitude (due to higher atmospheric pressure) might present a similar appearance to the morphing blob reported. Indeed, Capt. Howard remarks that his initial impression was of a possible balloon. Jet-stream winds blowing generally west to east might carry such balloons along at considerable speed.

The mean summer mid-latitude or polar jet roughly follows the Canadian border and curls ENE towards the Newfoundland area (Petterssen, 1958). In zonal flow it generally remains well south of the sighting location. During so-called meridional flow it can kink and curl sharply north so could in principle have been in the right area and blowing in a similar direction to the Stratocruiser's 49º flightpath. However meteorological evidence does not indicate that jet winds were a likely factor

First, as noted in Section 1, the wind in the sighting area at the 19,000ft level (500mbar) measured by radiosonde ascents between 10:00PM and 11:PM EST June 29 1954 (just after the sighting) was only 25kt. (*Appendix A. ix*), an order of magnitude too slow. There is no sign of violent wind at 19,000ft in the sighting area. This fits the fact that due to a continental blocking high over Labrador the mid-latitude jet was not only abnormally weak in the East through June 1954, its average position (traced at the 700mbar level in *Appendix A.x*) was confined in a zonal flow far to the South.

Secondly, the altitude of the jet core would typically be 30-40,000ft or more[42]. Even when apparently co-altitudinal with the plane at 19,000ft, the objects would have been well below the jet core. (In Capt Howard's 1982 account they were initially visible at a depression angle and climbed into view from below a broken stratocumulus layer which was well below the plane. If true this would further rule out jet-stream winds; but this detail does not appear in the 1954 account.[43])

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[42] Wim Van Utrecht points out that http://www.islandnet.com/~see/weather/elements/jetstream1.htm situates the polar jetstream "at an altitude from 7,600 metres to 10,600 m (25,000-35,000 ft)" and that according to http://weather.about.com/od/j/g/jetstream.htm it is "typically 20,000 feet or more". It's true that the height of the polar frontal jet varies widely and can be much lower than 30kft. Generally the jet occurs just below the tropopause, so the height is governed by the mechanisms that govern the height of the tropopause. There are 3 factors here: The latitude; the season; and the local synoptic pressure regime.

Height is greatest at the equator, least at the poles; greatest in summer, least in winter; greatest in stable high pressure weather, least just behind a deep low pressure weather front. Lowest global *average* height occurs at the N pole, where it's about 8km (26,000ft) *Average* height at 50ºN is 10km (call it 30,000ft). The sighting date is midsummer, favouring >30kft, and the sighting occurred over high pressure extending from the surface through at least the 500mbar level (~19,000ft), also favouring >30kft (see *Appendices A.viii-ix* and p.27 *et seq*). With information about the variance of these distributions we could be on stronger ground, but taken together probability favours a tropopausal jet core at least 10,000ft above the aircraft. See e.g.: http://www-das.uwyo.edu/~geerts/cwx/notes/chap01/tropo.html

The wind at the Stratocruiser's flight altitude that evening according the the US Weather Bureau 500mbar constant pressure chart (*Appendix A.ix*) was approximately SW, but only 25kt, and the dominating presence of an unusual "blocking high" (high pressure) over Labrador (see p.29 *et seq*) seems to have been responsible for keeping the Atlantic end of the 700mbar low-level jet abnormally weak and confined on average below about 40º latitude through June 1954. This may reflect a similar constraint on the higher level jet.

If the jetstream was unusually low, low enough to carry a balloon at the same altitude as the plane, and if the balloon was near enough to the plane to be observed as a substantial object subtending about 1º, then both plane and balloon must have been inside the jet (to save time and fuel transatlantic planes indeed often seek the jet, whose core would be typically 5º-10º of lat/long in width). This being so, the wind speed cancels out in both vectors and a balloon would still be outdistanced by the plane at its True Airspeed of 230 kts just as though the balloon were standing still.

The geometrical arguments against a flock of birds are even more troublesome for a balloon, which can only be a few hundred feet across. Its distance from the plane (given angular width ~1º for the main morphing blob) would be in the region of 1 mile for every 100ft of diameter, so it could only be a few miles away. To reduce its angular rate of displacement to the required ~0.5º of bearing per minute (or so) it would need to be hundreds of miles away, impossibly inconsistent with the required angular size.

Perhaps the plane and balloon happened to be near the edge of an exceptionally sharply-defined jet core, with a steep wind gradient between them, so that the plane just outside the core had a relatively small following wind whilst the balloon, perhaps a few miles away, was well inside the jet core?[44] It seems even more highly unlikely that this delicate situation could

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[43] And is almost certainly not reliable (see p.21 *et seq*.). But in any case it should be pointed out that the images "paced" the 230kt aircraft from the start, so a balloon needs the benefit of *all* of the relative velocity of winds in the core of a fast jetstream. Yet the balloon scenario assumes that the undistorted (pear-shaped) balloon is initially being seen at a lower altitude before climbing into the unusually sharply-defined fast jet and getting splatted.

Winds outside this hypothetical jet *must* be relatively very weak because we need all the advantage of wind speed to be on the side of the balloon within the jet, to enable it to keep up with the 230kt plane. So the relative velocity of plane and balloon during phase #1 of the sighting when the balloon is *not* yet in the distorting jet *must* be in the region of -200kt, meaning that the balloon falls aft the plane at about 3 miles/minute, or fully 20º of arc per minute even if the range is as much as 10 miles (the maximum balloon range consistent with the *angular size* argument, see later)

This would be very obvious and the balloon would have to have started out well *ahead* of the wing, off the nose of the plane, yet Capt Howard reported that it *kept station in the same position off the wing where it was first noticed,* not that they spotted it ahead and drew level with it*,* and this is shown in his contemporary *drawing* which has the initial "pear" phase in the same relative position off the wing.

Anyway a buoyant stratosphere balloon should have continued to climb *through* the jet layer, probably gaining more than 10,000ft and tens of degrees of elevation during the sighting. There is no "lid" on the jet. Is it likely to stop dead a balloon filled with hundreds of thousands of cubic feet of hydrogen and trap it for 80miles? I see nothing in the literature that says jet steams behave like this. Commercial planes fly in and out of jet cores negligently according to need (except for being careful of turbulence).

Perhaps a balloon was suddenly ruptured by extreme wind shear. But if it was drastically damaged (as the shape-distortion might suggest) it would catastrophically lose buoyancy and its payload would soon drag it down out of the (*ex hypothesi*) very narrow jet. The payloads of the 'Moby Dick' balloons of Project Genetrix (see later & *Appendix C*) were cubic-metre gondolas containing sensors, cameras and radio telemetry equipment weighing 400 lbs (180 kilos) and the weight of polyetheylene would not be negligible either.

That both the direction and speed components of the jet wind vector remained essentially identical to the direction and speed components of the totally independent aircraft vector for 18 minutes is already quite a coincidence. For a leaking balloon to also achieve neutral buoyancy just as it enters the jet and maintain it for 18 minutes is an added order of unlikelihood .

[44] Wim Van Utrecht concedes that this is a condition for the balloon theory to work. It is worth emphasising why it is a difficult condition to fulfill.

The plane has to be essentially outside the jet, with the "pacing" balloon in the jet core, thus for the observers to get near enough to see the balloon visually the wind shear gradient across the effective "side wall" of the.jet has to be steep. But:

'The jet stream is significantly wider than it is deep.... This produces stronger vertical wind shears than horizontal shears....We can best describe the basic structure of a jet stream as a river flowing

persist for 18 min,[45] but in any case mean wind speeds in the core of the summer jet (Petterssen, 1958) are given as about 50 knots. Relative speeds in this case are still going to be about the same as between a bird flock and the plane, or > 200mph. The balloon would be very rapidly left behind.[46]

And what sort of balloon train is this, one wonders, with little balloons or reflectors disposed to left and right (fore and aft) rather than suspended below, and for 18 mins?[47] Do we have a model, drawing or description of any contraption that might resemble this? I am not aware of one. Moreover, an intact balloon with positive buoyancy ought to climb thousands of feet during the 18min sighting, and at (say) 5 miles range 10,000ft. of ascent corresponds to about

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horizontally through the atmosphere. They are normally thousands of miles in length, hundreds of miles wide, and a few miles deep. Wind speeds in a jet stream vary along each of its dimensions' http://www.fas.org/spp/military/docops/afwa/atmos-U2.htm

Thus, a plane flying vertically above or below the jet core would be looking up or down along the minor axis of the jet's elliptical section and could have the closest view of a balloon (possibly a couple of miles) through the steepest wind gradients, but a plane flying along*side* the core is looking along the major axis of the jet and through a shear gradient typically in the order of ten times less steep. So for the plane to be "outside" the jet with the balloons having the full speed advantage of the jet core winds the plane has to be typically in the order of ten times as far away - a distance typically degrees of lat/long or many tens to hundreds of miles.

Note also that: 'Looking into the spiraling column in the direction of flow, you can see the change in speed across the jet stream width and through its height ... Notice the displacement of the core to the left and top within the jet stream. Therefore, change in wind speed over distance (speed shear) is greatest above and to the left of the jet stream core as you look in the direction of flow', i.e.the wind velocity lines are bunched on the N (cool) side and widely speaced on the S side. The *Centaurus* was flying so as to look from the warm S side of the core and thus along the axis of *gentlest* speed shear.

To underscore how far from the median the theory assumes conditions to be, note that the *average* gradient on the south (warm) side of the summer polar jet core - corresponding to the position of the *Centaurus* in this case - is about 1.5kt/degree lat according to Petterssen (1958, p.183) so that on *average* the plane would need to be 20º or ~1400 miles away from an *average* 30kt jet core for the balloon to have a 30kt windspeed advantage! Or more favourably http://www.tpub.com/content/aviation2/P-1246/P-12460039.htm says: 'The average rate of change in wind speed is 100 kts for every 100 miles to the north of the core and 25 kts for every 100 miles to the south of the core. (b) A decrease of 30 to 40 kts in 1,000 ft above or below the core of maximum winds is not uncommon' This figure would mean that the *Centaurus* need have been only 230 miles from the balloon.in an average jet!

But the "balloon" was clearly resolved in shape with an angular width comparable to "an ocean liner at 5 miles" which indicates an angular size in the order of a degree of arc. Note that this is consistent with Howard's sketch #1, showing the setting sun, to within an error factor of about 2, so I take the magnitude order as reliable. Take it to be 0.5º according to Howard's drawing (although as pointed out elsewhere the sun diameter may be exaggerated as is often the case). Then, even at a close distance of ten miles range a balloon would have to be approaching 500ft across - even though still *only partially inflated* at this level, tens of k/ft below its float altitude - to subtend this angle, and at the minimum physically realistic distance to permit 230kt of horizontal speed shear between balloon and plane the real size would be a factor ten larger than that.

[45] Wim Van Utrecht questions if this is really such a “delicate situation” In *Everybody’s weekly* Capt. Howard stated: “I was tempted to change course and take a closer look at the things, but I didn't”. So one might argue that it was the Captain himself who contributed to this delicate situation by consciously maintaining a steady distance between the plane and the objects.

However, reading his report further we discover that what he maintained was not his relative position but his *preset course.* He was on *autopilot* and did not disengage or over-ride it - "I was tempted to change ... but didn't" - so the autopilot was maintaining a straight magnetic heading. Jet streams are curving wind channels, and they do not respect gryocompasses - they flex and they have spiralling currents and waves propagating along them. These instability fluctuations are what make "delicate" an 18-minute persistence of the situation.

Such a situation also entails risk of clear air turbulence which is usually found alongside the jet, which can be highly dangerous and is proportional to the shear gradient, so the sharper the gradient required (and we require exceptional sharpness) the more the likelihood of turbulence. With a weaker jet most of the turbulence is on the low pressure side, where the wind isotachs bunch more closely, which would be on the

a 20º change of elevation, a very large angle with respect to the horizon and the plane's level wing. Yet these objects seemed to stay co-altitudinal with the plane, remaining no more than a degree or two above the horizon (see p.21 *et seq*). A slow-leaking balloon might have neutral buoyancy for many minutes, but it's another layer of unlikelihood.

So is the theory strong enough on other grounds to be worth defending a very contrived relationship between the plane and some very extreme and unusual winds, with the jetstream altitude anomalously low? At present I don't believe that it is.

3) mirage

The theory of an unusual mirage may appear at first glance to have fewer difficulties than either birds or balloons. Such a mirage would be formed by a layer of air in which temperature climbs rather than falls with altitude, called an inversion. These layers can occur adjacent to the earth's surface or, as in a case such as this, high in the atmosphere - a so-called elevated inversion.

As is well known, if the temperature gradient within the narrow inversion layer is steep it can refract light rays through angles large enough to trap or "duct" them, and a well-developed inversion layer in a highly stable atmosphere might be hundreds of kms (or miles) in horizontal extent, forming a curved sheet approximately following the curvature of the earth. Light rays from objects far away that enter the duct (at shallow angles) can be, as it were,

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opposite side from the Centaurus in the usual case. But because we need such an intense jet with very steep windshear amounting to 230kts in ~10miles or less on the *near* side of the jet (to get the balloon fast enough and the plane close enough) there should have been significant turblence on the near side also. I don't see any hint of such. Passengers had just eaten dinner, some were asleep or relaxing or shaving at the sink, weather was said to be perfect, crystal clear, no mention of a bumpy flight. According to an FAA source:

> Common dimensions of a turbulent area associated with a jetstream are on the order of 100 to 300 miles long,elongated in the direction of the wind, 50 to 100 miles wide, and 5,000 feet deep. These areas may persist for from 30 minutes to a day....The threshold windspeed in the jetstream for CAT is generally considered to be 110knots. Windspeed in jetstreams can be much stronger than 110 knots [*we need twice this*] and the probability of encountering CAT increases proportionally with the windspeed and the wind*shear* it generates....Moderate CAT is considered likely when the vertical windshear is 5 knots per 1,000 feet, or greater, and/or the horizontal windshear is 40 knots per 150 miles or greater.

[46] Of course these are mean windspeeds. The mean wind in the much faster *winter* jet is ~95kts (again as of 1958; Petterssen, op.cit.) but can exceed 300kts. Wim Van Utrecht points out that a peak of 364 kts (656 km/h) was measured on December 11, 1967 above South Uist in the Outer Hebrides (http://www.encyclopedia.com/doc/1O16-jetstream.html). *Pro rata*, the summer maximumcould be assumed to peak at 190kt. But these maxima occur in small domains that themselves shift down the jet at a few tens of knots, i.e. with the phase velocity of the short waves that run through the jet, periodically breaking up and reforming. In other words there is a *spectrum* of speeds within the jet at any one time, and the hypothetical balloon was not forced to rise into the jet just where a peak velocity zone happened to be, so the theory again tends to require a form of the jetstream model uncomfortably far from the median, where a balloon happens to enter and remain within a peak velocity zone (which happens to keep the same speed, direction and altitude as the *Centaurus*). It would be possible, but it's an added tension in the theory.

[47] Wim Van Utrecht proposes that 'strong turbulence, created by the horizontal and vertical winds inside the jetstream, may have caused a balloon to swirl around its axis with the smaller balloons and radar targets moving in a horizontal plane around the balloon, creating the impression of smaller blobs dancing around a much bigger object (personal communication, op.cit.). I don't see evidence of strong turbulence affecting the plane, which the angular size argument tells us cannot have been more than a few miles from a balloon at least hundreds of feet across in an extremely sharply-defined jet core, and that is already a highly strained scenario because typically the wind shear gradient required will occur over horizontal distances an order of magnitude larger, making the balloon probably *thousands* of feet in diameter. This in turn would make the fore-aft spread of "smaller balloons and radar targets" most likely in the region of a couple of miles. No known balloon project, including the then-SECRET 'Moby Dick' project (Project Genetrix; see *Conclusion* and *Appendix C*) was ever on this sort of scale.

piped over the normal horizon to the eye of the viewer. If the eye is in, or close to, a duct such as this then remote objects (such as mountain tops for example) far below the geometrical horizon can be lifted into view and optically distorted. These shapes may appear to hover detached in the air above the horizon. Such lifted images are called superior mirages.

It is typical that the images are confined in a narrow horizontal plane, as was the case in Labrador and in both of the other similar cases mentioned, and they often have a flat top or bottom edge, which corresponds to the edge of the mirage duct. Dr. Andrew Young, a mirage expert on the adjunct faculty of the Astronomy Department at San Diego State University, points out[48] that the main Labrador object swelled and changed shape at one point, interpreted as a banking approach, and assumed a shape that Capt Howard thought was like a "wing".[49] His drawing shows the appearance of a level top edge which might be interpreted as the image filling the top of the duct, after which it "flattened and stretched out" into a shape with a level bottom edge[50]. (In the Australian case cited earlier the small objects always maintained an orientation level with the horizon, as did Capt Smith's in the United Airlines sighting of 1947, in which case all nine narrow objects showed a flat edge on the horizon side and a "rough" upper profile.)

In the Labrador case mountainous terrain lay NW of the aircraft in the direction of the UAPs and the sun. In the 1968 Australian (Zanthus) case a mountainous region of SW Australia lay in the direction (NW) of both the UAPs and the sunset. In the United Airlines (Capt E J Smith) case of 1947, the objects once again lay in the direction of the mountains of Oregon near the setting sun.

With specific reference to the Labrador sighting, the main problems in the way of the mirage solution hitherto have been:

- the objects were said to have *climbed* to the same apparent altitude as the aircraft after being initially sighted at a *depression angle* through a lower cloud deck
- the sighting geometry is extremely *anisotropic*

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[48] Personal communication 04.03.2009

[49] Wim Van Utrecht comments (personal communication, 12.09.2009) that "a Northrop flying wing [YB-49] escorted by smaller planes would have been a great candidate (considering the captain's own reference to 'a giant flying wing'). Unfortunately, the last of the Northrop flying wings was dismantled in 1953." Indeed, and given the observed angular size a YB-49 or similar would be in the order of 1 mile distant or less. This is an extremely close approach in aviation terms and planes would normally be identifiable with perfect clarity. Mirage distortion is not a helpful theory when the target object is so nearby. Also, such proximity would be inconsistent with failure of radars on the ground and on the intercepting F-94 to detect the UAP(s) (see p.35).

[50] Wim Van Utrecht points out that this "level top edge" does not appear in the sketch that Capt.Howard made during his BBC interview of July 2, 1954. This drawing, which appears towards the end of the interview, shows an asymmetric arrow-shape, with the tip of the arrow pointing obliquely upward.

This is true, but the sketch was done for the camera four days after the sighting, when the concept of a "flying wing" had had the chance to become embedded in his mental imagery. The corresponding drawing *originally* done in the cockpit on June 29 *does* show the straight top edge of the "arrow" or wing shape as approximately level with the horizon. But it's a minor point, just another instance of an overall pattern of horizontal symmetry that would be typical of a mirage duct.

Wim adds another comment on this BBC interview: It begins with the mention that the sighting took place "on the day of the eclipse of the Sun", which is potentially confusing since the eclipse occurred the day after, namely on June 30, at 12:48 U.T. Dr Ronny Blomme, astrophysicist of the Royal Observatory of Belgium, points out that "it depends on the time zone you use. In Canadian time, the sighting occurred in the evening, but in UT it was already June 30. Probably that's what the BBC went along with" (personal communication to Wim Van Utrecht, 20.07.09).

- and nature of the *target object(s)* being miraged is obscure because of the 19,000ft flight altitude

i) The climb of the objects. The first problem arises from this account by Capt Howard:

> . . . we were crossing the St Lawrence estuary near Seven Island, Quebec. We were flying at 19,000ft above broken cloud at possibly 14,000ft, with the coastline clearly visible through gaps in the cloud. I then saw these objects for the first time . . . maybe 3 or 4 miles to the north west of us . . . . They were below the cloud at this time, at a guess at 8,000ft. Soon after crossing the coast into Labrador, the cloud layer was left behind and the objects were now clearly in view, seeming to have climbed more nearly to our altitude. At this time the sun was low to the northwest....(Howard, 1982)

The superior mirage image should appear up near the astronomical horizon (an eye-level plane parallel to a tangent plane touching the sphere of the earth vertically below the viewer), not at a depression angle of tens of degrees (see note 36, p.19), well below the geometrical Earth horizon as implied here. Types of mirage known as mock-mirages could produce images at *small* depression angles near the geometrical Earth horizon (in this case the dip of the GH would have been 2.4º below the AH[51]), but even then the idea of constant images being preserved through a smooth, seamless transition between two different types of viewing geometry is hard to credit. And in addition, the mock-mirage light rays would have to have been released from the top of an inversion duct below the clouds in order for these clouds to intervene in front of the mirage image. Yet the images appearing at the same apparent level as the Stratocruiser during the rest of the sighting require a duct at the aircraft altitude. So, *if* accurate the reported climb through low cloud makes a mirage explanation very difficult indeed.[52]

Why should this 1982 account - written expressly to "put the record straight"[53] - not be accurate? Well, it does contain estimates of cloud height, object height and object range which contradict earlier accounts; however these may be considered inessential details. The sighting of the objects below lower cloud when over the St Lawrence, and their climb thereafter to the plane's altitude, are the structurally important features. And if we go back to December 1967 Capt Howard was saying essentially the same thing in his Colorado Project Sighting Report form (relied upon by analyst G. David Thayer):

> Soon after crossing overhead Seven Islands at 19,000ft . . . both my copilot and I became aware of something moving along off our port beam at a lower altitude at a distance of maybe five miles, in and out of a broken layer of stratocumulus cloud. As we watched, these objects climbed above the cloud and we could now clearly see one large and six small. (Thayer, 1970; see also *Appendix B*)

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[51] Personal communication from Dr Ronny Blomme, Royal Observatory of Belgium 23.08.2009

[52] One may object that Thayer (1970) somewhat glossed over this issue, asserting that the images were "always within a few degrees of a horizontal plane containing the aircraft, thus satisfying the small angle requirement [for mirage]" but this feature was undoubtedly one reason for his ambivalence towards the mirage theory. McDonald, in a letter to Capt Howard seeking answers to questions for a "scientific rebuttal" of Thayer's analysis in the Condon Report, acknowledged the central importance of the angular ascent for a mirage theory and pointed out that "only if the tops of the clouds . . . were less than 1000 or 2000ft below your flight altitude would the dip-angle be small enough." (McDonald, 1969)

[53] Contradictions in FSR Editor Charles Bowen's editorial leader describing the case in Vol 27, #3 were criticised in a letter from US researcher Herbert Taylor, published in FSR Vol 27, #6, prompting Bowen to approach Capt Howard for a "correct version of the case" which was published in the same issue.

But in Capt Howard's earliest, December 1954, account things were rather different:

> We crossed the St. Lawrence and flew over Seven Islands [on the north bank of the St Lawrence] . . . . There was low cloud at about 5,000 feet, but up where we were at 19,000 feet, cruising along at about 270 miles per hour, it was perfectly clear.[54] The sun was just beginning to set, away to the left. At that height there is very little coloured tint on account of the rarefied atmosphere. The sky was almost silver in its clearness - perfect visibility. It was 9.05 p.m. Labrador time and we were *about twenty minutes' flying time north-east of Seven Islands when I first sighted the thing* [emphasis added].' (Howard, 1954)

According to Howard's 1982 account the objects were seen low and through the cloud for a significant time before the *Centaurus* had crossed the the St Lawrence, whilst heading NE with the north shore "clearly visible" ahead. In 1967 he said the sighting had commenced "soon after" passing Seven Islands, i.e. after crossing the north shore, but still (it is implied) not *too* far inland from Seven Islands - an implication reinforced by his listing of "small airport at Seven islands, harbour works etc" as landmarks in the vicinity of the sighting (Howard 1967). So these accounts are arguably at least somewhat consistent.[55] But according to the earliest complete account by Capt Howard himself, and endorsed by him (prior to December 1967) as a "faithful and accurate record" (see p.3, note 4), the sighting did not even *start* until *20 mins after* the plane had crossed the north shore into Labrador:

> . . . we were about twenty minutes' flying time north-east of Seven Islands when I first sighted the thing.

Assuming a ground speed of ~300mph (260kt = reported True Airspeed plus a 25kt tail wind[56]) this puts the plane about 100 miles NE of Seven Islands; but even Howard's recollected "twenty minutes" is probably an underestimate. The USAF telex from Goose

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[54] The description of low cloud at 5000ft near Seven Islands is consistent with the the Sept Iles (Seven Islands) hourly weather data [Appendix A(i)], according to which it had been cloudy all day, with relative humidity over 90% since mid afternoon and rising to 100% by 2100Z, drizzle from 1800Z and fog an hour later. Drizzle is a very fine sprinkle of small droplets originating from a layer of low and thus relatively shallow cloud, generally stratus below about 8000ft, where the droplets' journey through the layer is not long enough for many collisions to form large aggregate drops. Fog is essentially ground-level stratus. A Beaufort 3 breeze from the East would advect warmer, moist air from the Gulf of St Lawrence over land subject to evening cooling, so a mix of advection fog and radiation fog occurs which in effect brings the bottom edge of the low stratus down to ground level. In one source (Thayer, 1970) Capt Howard describes the low cloud as broken stratocumulus. This dull grey cloud is related to stratus and occurs at the same height (<8000ft) as stratus. Both indicate the likelihood of drizzle below and dry, stable air above, the latter being consistent with Capt Howard's report of exceptionally good visibility above the cloud (atmospheric extinction is strongly negatively correlated to humidity because hygroscopic aerosols are swollen by absorption of moisture).

[55] But only somewhat. Howard's 1967 statement gives the initial depression angle to the objects as 8º and the range as "maybe five miles" or "3 miles minimum" and the objects' height (in or below the "3/8 St Cu") as "perhaps 10,000ft lower" than the aircraft (i.e., at 9000ft). The implied depression angle here (cos. alt/slant distance) is in the range 22º to 39º. His 1954 estimate of the cloud height (and therefore the max initial object height) was 5000ft. This original lower estimate, which arguably fits better the characteristic height of stratocumulus (below 8000ft) and the report of drizzle at Seven Islands (App. A[i]), leads to a depression angle for the same distances in the range 32º to 62º. The overall mean of all these implied angles is nearly 40º, five times Capt Howard's explicit estimate in 1967, and explicit angular judgments are almost universally *over*estimated in recollection, not underestimated. Given the complete absence of a hint of any ascent at all in early sources one suspects a reluctance on Capt Howard's part to draw attention to how large is the implied angular ascent in his augmented 1967 account - even despite his having doubled the cloud height to minimise it. By 1982 Howard had increassed the cloud height to "possibly 14,000ft" with the objects 3-4 miles away below the cloud, shrinking the implied depression angle to possibly as little as 15º, still twice his explicit estimate.

(*Appendix D*) gives the initial aircraft position as 5153N 6310W. This position fits exactly the statement by Capt Howard quoted widely in the press on 01 and 02 July 1954 and logged in his contemporaneous 'Voyage Report' (see p.22) that they were 150 miles SW of Goose when they saw the objects, and his own early narrative placing the end of the sighting about 20 mins flight time SW of Goose. The position is >180 miles or nearly *40 minutes* flying time NE of Seven islands.[57] But in any case, the *first glimpse of the objects* was clearly many tens of miles and several tens of minutes after crossing the coast, not whilst still flying over the St Lawrence.

And in the original 1954 scenario there was no mention of having seen the objects below them, through cloud. Indeed Capt Howard's simile for his very first glimpse was "bursts of flak" suspended in the perfectly clear sky and his "Sketch #1" drawn in his Flying Logbook in real time (Fig.1) and showing the shape of the main object as he said it appeared "at first glance" (an inverted flat-topped 'pear' flanked by smaller blobs) puts the object at the same elevation above the horizon as do his Sketch #2 and Sketch #3 illustrating the later stages.

Consistent with this, an Associated Press wire story[58] the very next day quoted Capt Howard as saying that these flak-like objects "flashed into sight suddenly" which can be interpreted as expressly contradicting much later accounts in which they were first intermittently "glimpsed" or "become aware of" through gaps in low cloud.

All other contemporaneous reports known to this author either explicitly support this interpretation or are not inconsistent with it. For another example, a US radio news broadcast claimed to quote "the official report signed by every member of the eleven-man crew" as follows: "We were flying at 19,000 feet about 280 mph over Labrador. It was just after sunset . . . a beautiful clear evening. *Against the western sky we saw before us the silhouettes* of a large black object with six much smaller objects clustered around it [emphasis added]".[59] Press quotes cannot be relied upon as primary sources, but it might be thought significant that whilst all press and newsreel sources can be interpreted consistently with a narrative in which the objects first appeared as silhouettes apparently co-altitudinal with the aircraft, not one known contemporary account exists which even hints that the objects climbed from below clouds.

Further corroboration comes from Capt Howard's own description in a BBC TV interview broadcast on July 02, 1954, only two days after the event[60] in which he states that "the sun had just set" when the objects were first sighted. Early newspaper accounts also quote Howard to the same effect: "The sun had just set, and *the nearest cloud was many thousands*

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[56] Howard's recollection was of a following wind but "not much". A US Weather Bureau chart of the 500mbar pressure surface over Newfoundland (approximately the 19,000ft flight altitude) based on radiosonde ascents made between 10PM - 11PM, June 29 1954, indicates winds 25 kts from the SW. See *Appendix A.ix.*

[57] There is no way to recover Capt Howard's estimated "twenty minutes from Seven Islands" from the documented figures. We could *slightly* reduce the discrepancy if we were to assume that the given position marks not the start of the sighting proper but the time of the radio report logged at 0109Z, four minutes after the start of the sighting (c.f. an ambiguously worded report in the London *Times*, 01 July 1954: "Captain Howard radioed to Goose Bay, Labrador, that he had sighted the objects at about 150 nautical miles southwest of Goose Bay"). But this merely introduces a 4-minute inconsistency at the end of the sighting - which would become 24 minutes from Goose instead of the recorded "20 minutes from Goose" - without helping significantly.

[58] e.g. , 'Flying Jellyfish Tailed Plane, Crewmen Report', *New York Telegram & Sun,* Thursday July 1, 1954.

[59] MBS (Mutual Broadcasting System) broadcast by Frank Edwards, 01 July 1954 (typed transcript in Colorado University UFO Project file; Library of the APS, Philadelphia). This original signed source is unidentified.

[60] Most complete (but poor video and bad sound synch) is at http://www.youtube.com/watch?v=TQOa4KQJfe8

of feet below [emphasis added]".[61] The December 11, 1954 magazine account which Capt Howard himself endorsed as being "the most faithful and accurate record" reinforces the point: As they crossed the north shore of the St Lawrence near Seven Islands "the sun was *just beginning* to set [emphasis added]", then later "we were about 20 mins flying time NE of Seven Islands when I first sighted the thing." Howard's contemporaneous Logbook drawings agree (Fig 1), showing the final segment of the sun setting in Sketch #1 of 3.

The recorded time (0105Z) would be correct for the reported "just after sunset" at 19,000ft above the officially recorded map coordinates (position 150 miles SW of Goose). But over the St Lawrence, 40 minutes earlier at 0025Z and ~70 miles further West, the sun's lower limb would still have been about two solar diameters clear of the horizon.[62] Clearly the data are fully consistent only with the primary 1954 account(s).[63] .

Finally, just as this report was on the point of completion, the author finally managed to obtain a copy of the November, 1954 FATE article[64] quoting directly from Capt Howard's own "Voyage Report" believed to have been written whilst still in the air *en route* to London. The opening paragraph reads as follows:

> At 0105 GMT today (June 30) about 150 nautical miles southwest of Goose Bay, height 19,000 feet, flying in clear weather above a layer of low stratus cloud, I noticed on our port beam a number of dark objects at approximately the same altitude as our aircraft. . . . The visibility at this altitude was unlimited with no cloud other than low overcast. The sun had just set. (Carnell, 1954; see *Appendix B*)

This seems to prove rather conclusively that the climbing of the objects from below cloud over the St Lawrence, with the sun "low" but still many minutes from setting, was a later embroidery by Capt Howard. And given this, even the weaker claim of a slight increase in elevation to about 8º *above* the horizontal towards the end of the sighting (made in his 1967 University of Colorado UFO Sighting Report) must be in very serious doubt.[65] One might

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[61] 'Now Flying Jellyfish Zoom In', London *Daily Mail*, 01.07.1954

[62] From 19,000ft the visual line of sight would be tangent to the earth about 147 NM away, equivalent to about 2.4º of longitude (the same as the altitude of the astronomical horizon), so the sunset time at 19,000ft will be the same as the sea -level sunset where the LOS cuts the line of longitude 2.4º W of the sighting coordinates (51º53'N 63º10'W, autopilot setting 49º True, instant heading 49±5º; see Fig.2). Working from that we get an equivalent longitude around 65º34'W and a sunset time of 0049Z. By 0105Z the upper limb of the sun would be over 2º below the horizon so it had indeed "just set". In fact about 1/8 of the sun is shown above the horizon in Capt Howard's 1954 Sketch #1 and the sun is not shown at all in his later sketches. (a segment of the solar disc 1/16º deep would disappear completely below the horizon in less than a minute). But it does appear that Capt Howard's drawing of the vanishing sun should be taken as illustrative rather than exact. The sun had in fact, as he stated vocally and in writing, already "just set".

[63] It is interesting to see that in later accounts when the action had been shifted 150 miles and 40 minutes to the vicinity of Sept Iles, Capt Howard adjusted the position of the sun accordingly. In 1967 the first sighting was no longer "just after sunset" as stated in 1954, rather the "later" parts of the sighting occurred "just before and just after sunset". By the 1982 version the sun was still "at this time . . . low in the northwest" after the objects had been seen climbing through cloud up into the clear sky, and it was not until nearly 18 minutes after the initial sighting, when the F-94 was approaching, that "at about this time the sun set in the northwest." (Howard 1982)

[64] Thanks are due both to Claude Maugé and to Herbert Taylor for locating this source, and especially to Claude Maugé for providing a complete copy of the article and other materials.

[65] It's worth noting that there are anomalous accounts of increasing angular elevation in spectacular mirages. Mirage expert Andy Young's fascinating bibliography at http://mintaka.sdsu.edu/GF/bibliog/bibliog.html contains this account of G. M. Giovene 's observation on 9 Feb 1790:

"I thought I saw some clouds rising in the western part just along the horizon, which occupied about 20 degrees of the same. I determined to try to observe their path, with only the idea of being able to predict which

speculate that with time for mature reflection during the years between 1954 and 1967 Capt Howard came to see his early forthright rejection of the mirage theory as ill-advised and was thus unconsciously motivated to adapt his recollection a little.

Fig 3. Superior mirage images of the Fata Morgana type showing the Farallon Islands off the coast of San Francisco, photographed over the course of several hours by Mila Zinkova.
http://en.wikipedia.org/wiki/File:Farallons_islands_miragep.jpg

ii) The anisotropy of the images. The second main problem with the mirage theory relates to the fact that the images appeared over a very restricted sector at about the same bearing from the aircraft for the whole 18 minutes or 90 miles of travel. Because elevated inversion ducts in the free atmosphere are widespread thin sheets that don't have any appreciable horizontal structure (only vertical structure) one says that they are isotropic, or have the same optical properties in all compass directions for an observer inside them.

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way the wind would blow the next day, and consequently what could be the state of the air, which, as I found myself in the countryside, interested me. In fact, I observed that the supposed clouds rose more and more above the horizon until they had ascended about two degrees [probably an exaggeration, as Andy Young points out]. But suddenly they began to take various shapes, so that finally I realized they were quite different from clouds...." From “Discorso meteorologico-campestre su l'anno 1790 del Sig. Don Giuseppe Giovene, Canonico della Cattedrale di Molfetta,” *Opuscoli Scelti sulle Scienze e sulle Arti, Parte I, vol.* **14,** 3–21 (1791).

In 1968 Thayer speculated that it might be possible to avoid this limitation of the natural mirage theory if the plane was flying through a layer of barely sub-critical refractive index gradient which was pushed over locally into a mirage-producing gradient by the compression shock wave of the aircraft's own passage through the air. In other words, the plane might have been creating its own atmospheric "lens" in the immediate region ahead of the wing - where the images were located. However, Andy Young points out that this was a slow subsonic airliner and believes that the compression shock could not conceivably have been sufficient to cause this effect.[66] This idea was also receieved with great scepticism by atmospheric physicist James E McDonald.[67]

So there is no purely *optical* reason why one restricted sector of the compass should so persistently contain these mirages whilst other sectors in other directions do not, inviting instead a geophysical or other reason. In more typical circumstances mirages are seen with the eye near ground- or sea-level so that both the eye and a target object at the surface, such as a ship or an island, are found within the same horizontal inversion layer. A fine example of such a superior mirage is shown in Fig.3.

In this case the target is the Farallon Islands off the coast of California, a group of small islands and sea rocks about 27 miles from San Francisco. In conditions of normal refractivity they are entirely beyond the visual horizon from the sea-level camera position[68] but a surface inversion has ducted the light rays around the curve of the Earth. When compared with the BOAC observation the effect seems suggestive, but as Capt Howard put it at the time: "It has been suggested that what we saw was no more than a mirage. But at 19,000 feet, a mirage of what?" (Howard 1954).

iii.) The nature of the target objects Because of the shallow grazing angle requirements for entry to and exit from the duct, light rays cannot rise steeply from the Earth's surface into the duct, which for a duct at around 19,000ft means that target objects on Earth's surface - one immediately thinks of silhouetted mountain peaks in the rugged terrain of Quebec - would need to be at enormous distance. Great distance is already implied by the constancy of the sighting bearing, but it is concerning that these objects were reportedly very dark, almost black, with high contrast against the bright sky, which would not be expected if the miraged peaks were at very great distance.

Image contrast suffers already for objects miraged *via* long ducts because of sunlight scattering from air molecules and aerosols in the duct. This "fill-in" causes dark targets to yield progressively paler mirage images the longer the raypath through the duct. And if the objects imaged are surface features at enormous distance beyond the point where the rays couple into the duct then contrast must suffer further. Firstly, this is because landscape hundreds of miles beyond the apparent Earth horizon at local sunset will still be in full sun with minimal silhouetting and with shadows washed out by back-scattering from the still-bright sky. And secondly there is a already a large loss of contrast due to scattering on the long ray path through the dense lower troposphere from the mountain to the elevated duct.

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[66] Personal communication 01.03.2009

[67] McDonald, J. E., letter to Capt James Howard, 29 Jan 1969.

[68] Only the tip of the highest island, at 360 ft ASL (109m), would barely touch the horizon for an eye height of ~3m ASL

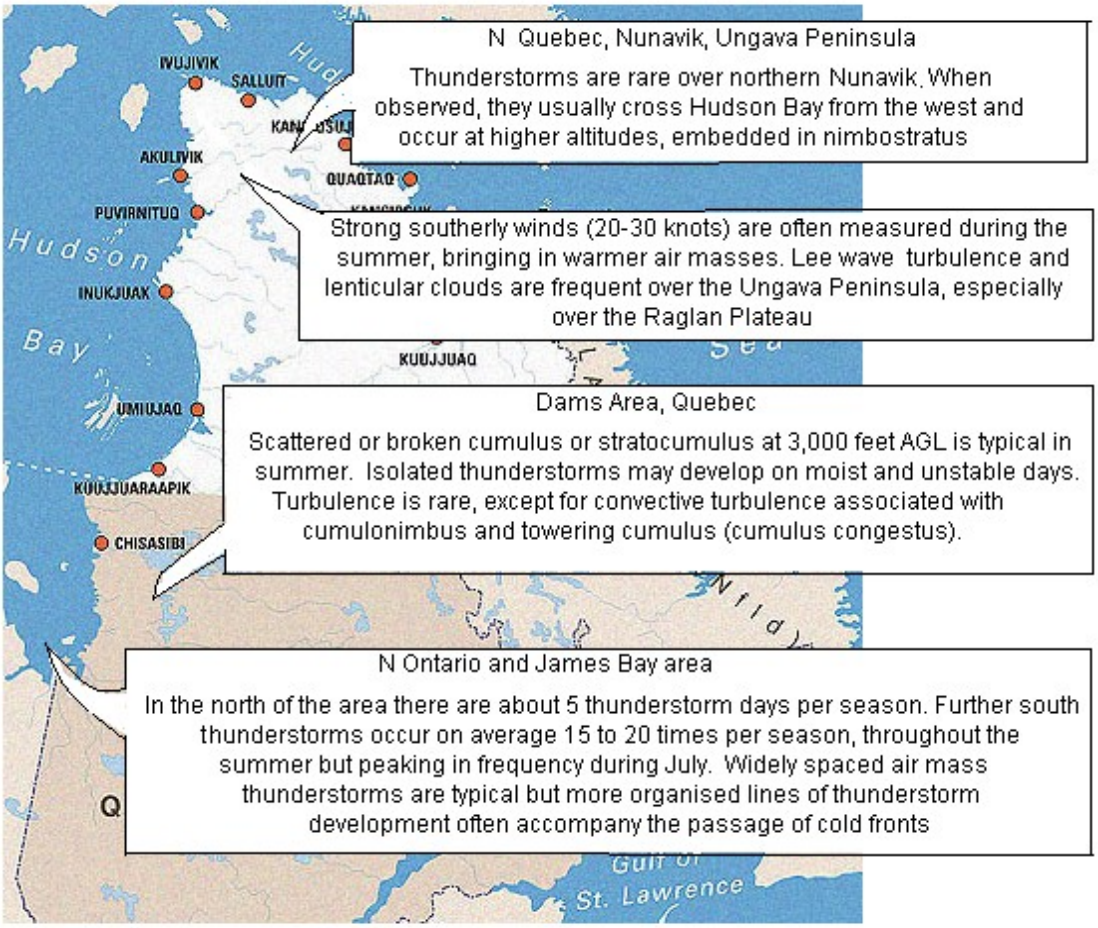

Fig.4. Significant summer weather patterns along the east Hudson Bay coast area, based on information in NAVCANADA's Local Area Weather Manual, Ontario & Quebec, Ch.3. http://www.navcanada.ca/ContentDefinitionFiles/publications/lak/OnQc/4-OQ33E.PDF

It is also noteworthy that if one plots the Stratocruiser flight path on Google Earth and explores the terrain elevation to the NW, whilst the landscape is rugged much of the way to Hudson's Bay with elevations generally ranging between about 1000 - 2000ft, only a few isolated ridges exceed 3000ft. No especially prominent range of peaks stands out. Indeed beyond about 300 miles from the flight track the landscape prominence diminishes, and we already know that to keep parallax displacement within 10º or so we need a range from the flight track approaching 400 miles. There are no tall mountains here, only rugged hill country up to about 1000ft, dipping towards coastal lowlands.

In the course of correspondence with Dr.Andy Young during summer 2009 an interpretation emerged that may solve some or all of the remaining problems of the mirage theory. Rather than enormously remote mountains the miraged objects may have been silhouetted high-altitude clouds, either lines of towering cumulus (*cumulus congestus*) which are sometimes known to punch up through an inversion layer[69] (often over 20,000ft, sometimes to 30,000ft

[69] This type of cumulus tower is sometimes called a "chimney cloud" or "turkey neck", developing an especially narrow form when the convection has locally penetrated the floor of an inversion and rises into moister air where

or more), more fully-developed cumulonimbus storm anvils (even higher and perhaps miles wide, the sort of scale implied by the reported angular width) or alternatively perhaps well-defined orographic clouds (standing-wave lenticular clouds, sometimes called mountain clouds) forming thousands of feet above the peaks. In what follows the reader may refer to the local weather information in Fig.4.

One relevant reference frequently cited in the mirage literature is a superior mirage of a cumulus cloudtop observed from an aircraft at high altitude in 1956. The authors remark: "Such phenomena as described in this paper do not appear to have been previously reported from aircraft in flight, unless some of the reports of 'flying saucers' may have been due to this effect." (Durst & Bull, 1956) Clearly observations of this type are relatively unusual, but a few reliable records including high-altitude observations of "green flash" mirages[70] "certainly suffice to show that strong inversions can occur at rather large heights in the troposphere. So mirages at aircraft heights are uncommon mainly because of a lack of objects at suitable heights to appear miraged."[71]

In investigating the likelihood of an extensive, strong, high-level inversion over Eastern Canada on the sighting date we are unfortunately reduced to inference. First of all, the basic continental synoptic situation described in the Monthly Weather Review for June 1954[72] is the unusual presence that month of dominating high pressure centred on Labrador, displacing the usual Canadian low-pressure cyclone. This high was present both at sea level (with average pressure for the month 4 mbar above a >10-year normal in the sighting area) and at the 700 mbar level (~10,000ft) where a large positive pressure-height anomaly of 260ft (*Appendix A.xi*) marks the centre of a slow-moving "blocking high" over Labrador, a situation controlling much of the weather over the Eastern continental US during the month, contributing to heatwaves, drought and unusual weather fronts.

For the day in question, US Weather Bureau Daily Weather Maps with limited coverage of NE Canada (*Appendix A.viii*) indicate a high off the Labrador coast and sea level pressure of >1020mbar over the sighting area.[73] Consistently, the Goose AFB weather report telexed just after the sighting time (but relating to an unspecified observation time) shows a surface atmospheric pressure NE of the sighting location of 30.13 inches of mercury, equivalent to 1020.32 mbar, which is unusually high,[74] and the Goose A Hourly Data Report shows temperature still over 20ºC at 9:00PM local time that evening (see *Appendix A.vii*). The only weather reports northwest of the flight track (*Appendices A.iii-iv*) also show an unusually warm afternoon. Winds SW of the sighting area were light easterly; NNW of the sighting area

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evaporation is inhibited. http://amsglossary.allenpress.com/glossary/browse?s=c&p=27

[70] e.g. Taylor, J.H, & B.T.Matthias, 'Green flash from high altitude', Nature 222,157(1969)

[71] Andy Young, personal communication 01.03.2009.

[72] Holland, J. Z., 'The Weather and Circulation of June 1954; Illustrating the Birth and Growth of a Continental Anticyclone', Monthly Weather Review, June 1954 pp.163-171. http://docs.lib.noaa.gov/rescue/mwr/082/mwr-082-06-0163.pdf

[73] http://docs.lib.noaa.gov/rescue/dwm/data_rescue_daily_weather_maps.html Thanks to Roberto Labanti for this and the previous source (Holland, 1954)

[74] Especially if this is uncorrected station pressure, which would need to be adjusted *upward* slightly to give sea-level pressure. Goose AFB is ~49m (160ft) ASL, which for a typical lapse rate would indicate a sea level pressure of about 1025mbar. Average global sea level pressure is significantly lower, at 1013mbar, and a semi-permanent summer low pressure centre to the north of the area (around Hudson Strait) means that the Goose Bay local sea level pressure tends to be significantly lower then the global value with a July average of just 1008mbar. (NAV CANADA Local Area Weather Manual, Ontario & Quebec, Ch.3, Weather Patterns, p.14. http://www.navcanada.ca/ContentDefinitionFiles/publications/lak/OnQc/3-OQ33E.PDF)

they were light southerly, following an anticyclonic circulation around the high pressure field centred off the northeast of Labrador. An anticyclonic temperature inversion under a stable high is the type of inversion normally most likely to lead to a low-level mirage duct of large horizontal extent (as indicated in a report by Navy icebreaker USS EDISTO; see p.10).

As for more important upper levels, the US Weather Bureau chart of the 500mbar pressure surface (*Appendix A.ix*) based on radiosonde ascents made between 10 and 11PM EST (just after the sighting time) shows the air temperature over Newfoundland at ~19,000ft as -10ºC, which, as expected from the presence of measured high pressure through at least the first 10,000ft of the atmosphere, is abnormally warm. The ICAO international standard atmosphere (ISA) has an average temperature lapse rate of 6.49°C/1,000 m (1.98 °C/1,000 ft) which would indicate -18ºC at 19,000ft above a sea level temperature of 20ºC. Unfortunately we have no direct evidence of upper-air temperature *gradients*.

It's true of course that cumulus or cumulonimbus development signifies vertical *in*stability, not stability, and would be inconsistent with these stable, anticyclonic conditions near the sighting area. McDonald (1968) rejected the mirage theory at least in part because of the absence of appropriate high-altitude targets such as clouds, remarking that the fair weather situation and observer reports did not indicate the presence of clouds. But by 1969, following the publication of Thayer's analysis in the Condon Report, McDonald appears to have realised that a mirage of horizon cloudtops needed to be considered, as disclosed between the lines of his letter to Capt Howard in which he noted that local weather conditions didn't indicate the likelihood of cloud tops rising to 18,000ft or more and emphasised repeatedly that it was important for Howard to be able to confirm the absence of high clouds (McDonald 1969). Howard had indeed done this. But the hypothetical cloud concerned would be far away over the hills of N Quebec, perhaps 400 miles or more distant and thus beyond the geometric horizon. Fully-developed thunderstorm systems tend to track in across Hudson Bay from the west. According to a study of thunderstorm activity in the west Hudson's Bay area "the convective storm season . . . [is] short but intense with a strong peak . . . during June and July"[75] but they only infrequently reach N Quebec. However towering cumulus can be triggered by mountain updrafts, and wave clouds are also caused directly by mountain winds.

Well-developed lenticular clouds do in fact require just the sort of sandwich structure of atmospheric layers that often occurs with an elevated temperature inversion. The second requirement is a stiff wind at the height of the mountain barrier. They commonly form in linear groups within a succession of wave-crests downwind from a hill or mountain area, sometimes many thousands of feet above the peaks and perhaps many miles downwind.

The problem as already mentioned is that the landscape prominence at a useful range from the Stratocruiser is not great. The NavCanada local weather information summarised in Fig.4 indicates the prevalence of lenticularis over the Raglan Plateau, at the tip of the Ungava Peninsula, but this is a low upland terrain no more than about 460m ASL (1500 ft) and the wave clouds form typically at only 6000-7000ft. It is also some 30º north of the visual bearing to the UAPs, which was closely limited on the north by the nearby sunset. Moreover the 20-30kt summer winds that cause the Ungava lenticularis blow rather uniformly from the SW and cause wave clouds to plume in a NE direction, increasing the mismatch with the visual bearing. Sporadic lenticularis does occur due to isolated hills at some coastal sites further

[75] Kochtubajda, B., *et al*., 'The Nature and Impacts of Thunderstorms in a Northern Climate', in: 'Cold Region Atmospheric and Hydrologic Studies. The Mackenzie GEWEX Experience', Springer, Berlin 2008, Pp. 383-402. http://www.springerlink.com/content/l883761701177w78/

south along the Hudson Bay coast, and inland. But everywhere at the required range the relief is lower than the Raglan Plateau.[76]

Unfortunately no detailed winds aloft data for June 29 1954 over Quebec are available. But at least some general weather data are archived by the Canadian Weather Office.[77] Hourly data reports are available for Kuujjuaq on the far north coast and Sept Iles, nearby to the SW on the St Lawrence coast. The most nearly relevant is Kuujjuaq, 400 miles NNW of the Centaurus' flight track and somewhat N of the line of sight but possibly indicative of conditions in the area. Kuujjuaq had cloud much of the day, with temperature climbing to a high of 26.7ºC in the early afternoon. This was the warmest day in a fortnight, well over the almanac average daily maximum of 15.3ºC, with a 5kt "slight breeze" (Beaufort 2) from the South. Relative humidity climbed from a low of 35% in early afternoon to 84% by early evening, with the onset of rain. These calm, warm,. humid conditions, if representative, do not strongly indicate unusual lenticularis but are at least not inconsistent with mountain-triggered convective cumulonimbus or cumulus congestus in the sighting direction. (The available data are tabulated at *Appendix A*)

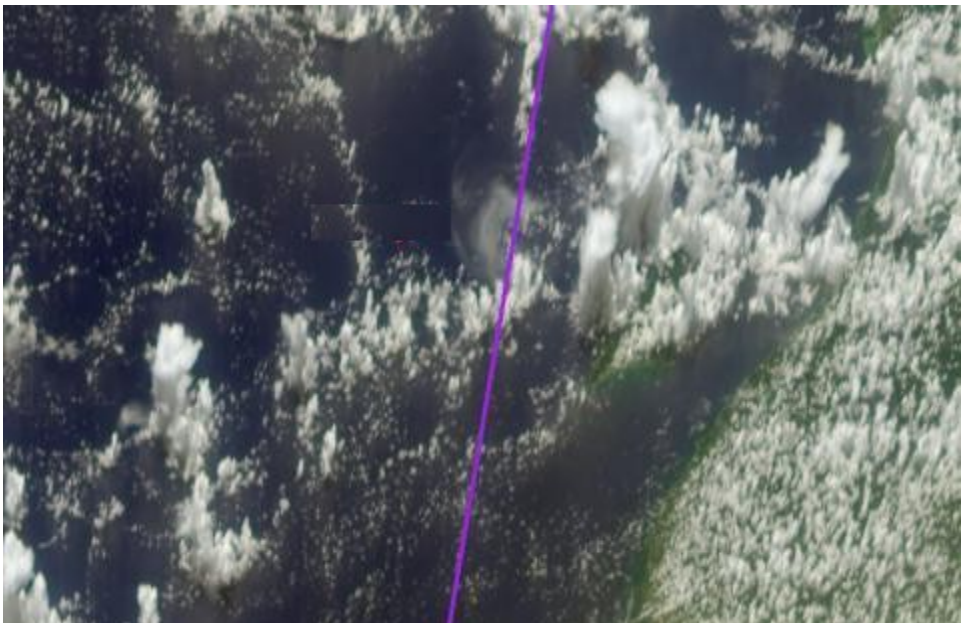

Fig.5 JPL satellite image of a line of towering cumulus plumes photographed from a high angle. A 3-D animation at the site http://photojournal.jpl.nasa.gov/catalog/PIA03719 shows well the extreme vertical development up to tens of thousands of feet (the purple line shows an aircraft track and is not relevant)

Another possible cause of towering cumulus is convective instability due to an off-shore evening breeze front over coastal waters. According to meteorologist Roger Edwards: "In weak large-scale low level flow, as the land cools faster than the water, dense and relatively cool air flows seaward late at night and near sunrise. Lift along the edge of this *land-breeze front* forms convective clouds . . . which can become strong thunderstorms if there is even more lift and/or instability. . . . lift along the land breeze front is usually strongest when the

[76] See also: http://www.navcanada.ca/ContentDefinitionFiles/publications/lak/nunavut/4-N3637E.PDF

[77] Thanks to Dr Ronny Blomme for locating these records at http://www.weatheroffice.gc.ca/canada_e.html.

low level winds [blow] directly toward the front."[78] The high pressure dome over the sighting area was possibly shedding a southeasterly (clockwise) isobaric wind towards the Hudson Bay coast, which might be consistent with conditions for humid convection along a land-breeze front.[79]

The raypaths from high clouds do not have to pass through the dense and hazy lower atmosphere but instead originate and remain within the duct, minimising contrast losses. Because the target is already within the duct, or at the duct altitude, it also does not have to be so far beyond the apparent Earth horizon (as would a target on the Earth's surface), and therefore can be closer to the sunset terminator where a dark backlit silhouette is more likely.

Fig.6 Superb photo of a line of spectacular towering cumulus taken by Roman Y. Korovin © from a Tupolev-134 in June 2007
http://picasaweb.google.com/lh/photo/kjodZKZJogHzQ03h9kMZng

There may have been rather special viewing conditions in this case (and related cases) that would help mirages of clouds to appear as black shapes with high contrast against the bright sky by minimising the "fill-in" due to Rayleigh scattering of sunlight by air molecules in the duct. As mentioned, at sea level the optical depth of the atmosphere dramatically reduces contrast in mirages, but at 19,000ft the air density is less than half the sea-level value and there are few aerosol particles. Moreover, as Andy Young points out, with the sun partly or completely set at the Stratocruiser's altitude this means that much of the elevated duct would be in partial or complete shadow during the sighting (see Fig.7). Loss of contrast caused by 'fill-in' (washing out or greying due to background scattering by particles in the duct) would thus be minimised along the path of ray *B* for these near-sunset mirages.

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[78] http://www.stormeyes.org/tornado/SkyPix/atlctcu.htm

[79] The surface pressure maps for the 12 hours after 1:30pm 29 June (*Appendix A.viii*) show a stationary front between cold and warm air masses lying over the South of Hudson Bay. Such a front is generally associated with cloud and precipitation and can also be a location of 'storm trains', multiple thunderstorm cells that track linearly along the front. http://en.wikipedia.org/wiki/Stationary_front

We get the source silhouette from the effects that routinely make low clouds look blackish against the sunset - in part atmospheric extinction reducing the intensity of low sunlight backlighting the cloud, and in part because near sunset the front illumination of the cloud by ambient scattered sky brightness is negligible. These effects, along with the 'normalising' effect of the human eye-brain that learns to see the lightest tone in the visual field as its "reference white" and the darkest as its "reference black", explain the existence of a high-contrast source image to start with.

Whilst preservation of the contrast in the mirage image would be aided by the shadowed duct which prevents fogging or fill-in of the dark areas, the ducting itself is of course not lossless because of leakage and extinction, and so the image *loses overall brightness* compared with the original scene. The effect of this might well be that the brightness of the more westerly sky imaged in the mirage strip is dimmed to match the lower ambient sky brightness at the viewing location, whilst the cloud darkness in the mirage strip becomes still *darker*.

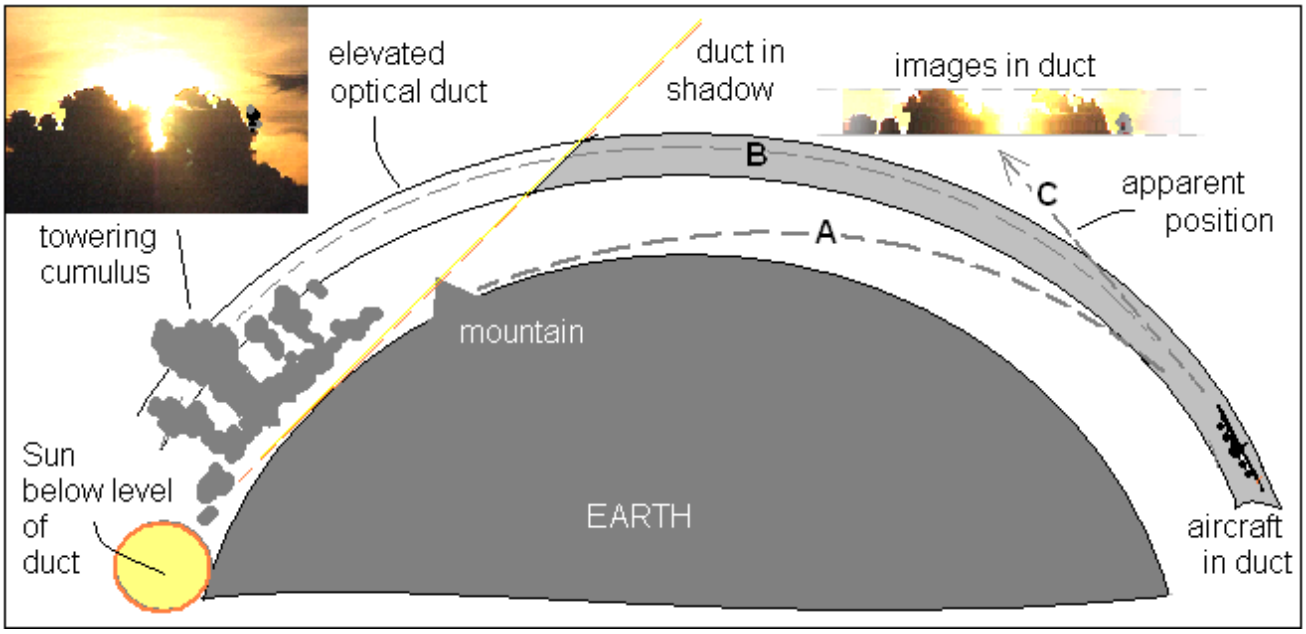

Fig.7 Highly schematic diagram of possible mirage geometry.

The high contrast possible for ducted mirages of high clouds is less likely for mountain peaks, because in the former case the image source can be *in* the 19,000ft elevated duct, not <15kft below it as Quebec mountain tops[80] would be. The ray from a relatively nearby mountain a couple of hundred miles away or less (e.g., ray *A* in Fig.7) not only has to pass through the scattering thickness of the lower atmosphere, incurring extinction and loss of contrast, but also intercepts the duct at an excessively steep angle of 1° or more.[81] The long, shallow grazing incidence required for rays from a mountain to couple into the duct means that the mountain must be much *further* away than a cloud need be, and being at much greater range (much further west, where significant peaks are in fact not to be found) it is being imaged

[80] Or indeed other surface targets such as the chains of islands in Hudson Bay. C.f. also p.38.

[81] Snell's Law of refraction tells us that a grazing incidence of 0.5° is becoming marginal for efficient coupling into a mirage duct with a trapping radius of cuvature (33 arcsec/km) equal to the curvature of the Earth.

longer before local sunset and is subject to more front illumination from scattered sky brightness, so has a lower original contrast.

Similar viewing conditions appear to have obtained in the 1947 United Airlines sighting and the 1968 Australian observation already mentioned.[82] In both of these cases the aircraft were lower at only ~8000ft, where fill-in due to scattering would be greater than in the Labrador case; but the sun was in both cases well below the horizon at the sighting time, with all or most of the hypothetical mirage duct being in shadow, again favouring good optical contrast, as reported.

The length of the BOAC *Centaurus* observation in particular (18 minutes) is certainly great and an inversion duct of large horizontal extent is also implied by this fact. Because such mirage ducts are very shallow - typically only tens of metres, or a couple of hundred metres in the most extreme cases - it might be thought very fortuitous that the Stratocruiser remained inside the duct for so long. But as Andy Young points out, the plane was flying on autopilot at the time which means that it is locked to the FL190 pressure level, and this guarantees that the plane will stay within the duct.

The disappearance of the objects might have occurred because the aircraft reached a point where the duct broke down. Or perhaps the cumulus tops sank below the duct, which might fit the time and duration of the observation. The convection that drives cumulus tends to die out near sunset. The tall cumulonimbus towers, reaching tens of thousands of feet, typically survive about an hour or so.[83]

Another possible objection to the mirage theory is that rays from the setting sun must have passed close to the rays from the target (clouds). Yet apparently no distortion of the adjacent sun was observed, either when a ~1/8 sun was visible simultaneously with the UAPs at the start of the sighting, or indeed when the sun would have been higher on the Earth (apparent) horizon before the objects were seen. There are two different answers to this objection.

At the sighting time the mirage image (*ex hypothesi*) is at the astronomical horizon, which is 2.4º above the geometrical earth horizon[84], and thus well clear of the sun[85], which cannot shine into the duct (or put another way, its rays intersect the duct at an angle too steep to be noticeably refracted by it) and thus shows no mirage distortion.

Prior to the sighting when the sun was a couple of degrees higher and passing through the astronomical horizon it might have been possible to see the sun's disc bisected by the duct (assuming it to have been well-developed by this time), in which case the presence of the duct

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[82] Another relevant clue in the Australian case (Norman, 1969) is that the aircraft lost radio communication with ATC shortly after the start of the sighting. The signal turned to hash. The signal was regained at about the same time as the objects vanished visually. If connected this suggests a radio duct, or rather that VHF didn't penetrate into the optical duct. Radio wavelengths can be miraged too, although normally in the lower atmosphere the major contributor to refraction at radio wavelengths is humidity, which is a negligible factor at optical wavelengths. Commonly, therefore, the onset of (or termination of) ducting for VHF would not be simultaneous with the onset of ducting for light waves. But humidity typically decreases with altitude. Possibly at 8000ft over the deserts of SW Australia even in August the air was very dry, and both optical and radio wavelengths were similarly refracted (to within a few percent) solely by the temperature gradient of the duct.

[83] "30 min to 2 hours" http://daac.gsfc.nasa.gov/precipitation/additional/science-focus/hurricane.shtml/

[84] Confirmed by Dr Ronny Blomme, Royal Observatory of Belgium, personal communication, 23.08.2009.

[85] Capt Howard's drawing seems to show the sun only around 0.5º or less below the line of objects, but the relative size of the solar disc may be exaggerated, as is commonly done even by experienced observers.

could be detected.[86] If the sun is shining into the open end of the duct its rays would suffer refractive distortion, but this is unusual. More likely is that the duct's presence would be betrayed in principle by the presence of a dim band called Wegener's Blank Strip, a narrow zone lying along the astronomical horizon from which light rays coming from astronomical sources beyond the atmosphere are excluded by the duct. However, in the "perfectly clear" air at 19,000ft the sun would still be painfully bright to look at when it crossed the Blank Strip. By the time the sun was sufficiently dim to look at easily, it would have passed below the distorting zone of the duct. For these reasons Andy Young is "not surprised that no distortions of the sun were reported"[87].

Conclusions & Questions

In most respects it seems possible to explain this sighting satisfactorily - if not conclusively - as an unusual mirage. Some of the difficulties with the mirage theory - such as those discussed in the Condon Report by Thayer in 1970 - can probably be overcome, as Thayer today agrees.[88] And thanks to the Australian Zanthus case (which occurred on the other side of the world even as the Condon Report was being prepared for publication) and a small number of others we can say that the BOAC phenomenon was after all not quite "so rare that it has never been reported before or since". We have seen that there are other cases, such as the United Airlines sighting of July 4 1947, that may show at least some of the same signature features, indicating that unusual mirages from aircraft at moderate altitude may occur more often than has previously been assumed.[89]

Despite some superficially attractive features the Sorta Sol or flocking starling theory is quantitatively and behaviourally unsupportable. The theory of a deflating stratosphere balloon caught in a jet stream is also a challenger, but highly improbable. A balloon does not explain the lateral merging of all the little objects, or the sudden dwindling to nothing of the big one (*ex hypothesi* 18 mins after any positive buoyancy of the balloon had already leaked away).

In terms of atmospheric optics, however, we could envisage a selection effect analogous to viewing a lateral line through a mask which has two near-vertical converging slits. If the mask is moved up or down, the visible small segments of the line approach or recede from one another, but no real lateral displacement occurs. In the BOAC and smilar cases different parts of a mountain horizon or the tops of cloud towers might be selected sequentially by an

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[86] This would have been about fifteen minutes before the UAPs were actually sighted, of course, and we have no evidence that the region of sky near the sun was being particularly observed at this time.

[87] Personal communication 06.03.2009

[88] David Thayer writes: "Based on Howard's first-hand account not long after the sighting near Goose bay, I am convinced now that what they saw was an unusually persistent superior mirage. In particular, Howard's description of the 'exit' of the assumed UFO forms an almost eerie parallel to my description of the behavior of a superior mirage on page 140 of the Condon Report: 'As the mirage-producing layer weakens ... or the viewing angle increases ... the mirage appears to dwindle to a point and disappears.' Compare that to Howard's description . . . If the observer thought he was observing a material object, it would be natural if to assume that the drastic shrinking effect represented a rapid recession in space rather than simply the change in size of an image. In retrospect, my 'rare event' may have been a bit ill-considered, although the material I had at hand with which to evaluate the incident was apparently somewhat slanted and included a few details that seemed to contradict the mirage theory, details that your investigation reveals may have been [witness] memory artifacts . . . I certainly would no longer tend to doubt the mirage theory.' (Personal communication 13.08.2009)

[89] See Wim Van Utrecht's catalogue which will be available at http://www.caelestia.be/

undulating duct in this way (or by other changes in relative viewing height) appearing to be small objects that move laterally. We don't have a quantitative model of this process but at least we can understand such an effect qualitatively.

Whilst balloon and mirage theories both require some supposition, the balloon theory suffers from the simple fact that there is no *natural physical relation* between the independent balloon and aircraft motions, necessitating some superadded and quite difficult explanation of how a balloon maintained a constant visual bearing for 18 min. In contrast there *is* a natural geometrical-optical relation between the eye and a remote miraged feature with small visual parallax. We do need to hypothesise the existence of an extensive elevated mirage duct and distant cloud (probably towering cumulus) punching through the duct; but these phenomena are consistent with known or likely weather and geography. The balloon theory requires a less economical set of requirements - statistically very unlikely (although not impossible) jet wind speed, a fortuitous identity of wind and aircraft vectors to explain a constant sighting bearing, a fortuitous onset of neutral buoyancy, and (more importantly) a windspeed s*hear gradient* that is physically very difficult to defend in order for the plane to get close enough to the balloon to even see it.

Another question for the balloon theory is its likely origin. Wim Van Utrecht searched archival information for stratospheric balloon launch sites in the area, finding none.[90] But he points out that the major USAF balloon programme Project Genetrix - nicknamed *Moby Dick* - was in full swing during this time. The officially stated purpose of the Genetrix balloons, some over 80 ft (25m) across when fully inflated at altitude, was to map high-altitude wind currents,[91] which would obviously include the jet streams. Some US-launched balloons in the early phase of the programme are known to have reached Europe, coming down in Spain and Scotland.[92] By 1954 Genetrix was getting into its stride.

A declassified USAF document dated January 1956 (*Appendix C*) states that Moby Dick launches had been ongoing from the US for two years previously and were now being expanded to other launch sites around the world including Pacific and Far East where launches had also been conducted during 1954-55. They probably 'lost' quite a few balloons during what was a huge project or series of sub-projects spanning some years. We note also the explicit statement in the Note 92 reference that some of the balloons were shaped like an “inverted pear” (exactly the same words were used by Capt. Howard to describe the unknown object when it was first spotted).

But such a balloon, hypothetically having a number of radar reflectors or instrument packages attached to explain the "satellite" objects, would not very well explain either the sudden disappearance, the dwindling in line of sight that is so characteristic of mirage, the absence of ground and air radar contact (see below), or the failure of the fighter pilot to see anything in the area. Additionally, Wim Van Utrecht concedes that none of the witnesses reported seeing sunlight reflecting off of the objects’ surfaces, although these balloons are usually made of a shiny transparent polyethylene and radar-tracking reflectors are wrapped in reflective tinfoil. Indeed, polyethylene balloons scatter "as much as 20-30% of incident light" both *through* and *off* their fabric (Lally, 1969) and 30% even of sunset light is a lot of light. They are typically

[90] Personal communication, 28.07.09

[91] In fact they carried powerful cameras and like the US Navy Skyhook balloons were part of a programme of surveillance of Soviet military assets which also employed high-altitude jet overflights. The effort was continuous with later black projects including the U2, which was deployed with a similar weather-mapping cover story.

[92] “Cold War Balloon Flights 1945:1965” http://www.vectorsite.net/avbloon_3.html

described as bright or silvery, especially at twilight, and the flapping, twisting fabric of a deflated balloon would offer changing reflection angles to the scattered sky-brightness (even when the balloon itself is in earth's shadow after the sun completely sets) so some detail should have been seen. It seems highly unlikely that a nearby Genetrix balloon could have provided the necessary optical contrast in this case, whereas the silhouette of a distant opaque cloud dimmed by lossy transmission through a duct might well have done so.

Having said this, a few awkward issues remain imperfectly resolved in the BOAC *Centaurus* sighting. For example, the implied precision of bearing-constancy from the moving aircraft still puts a strain on any realistic target object - including clouds - as the source of a mirage image.

To keep parallax drift below a possibly-acceptable 10º for a substantially stationary target the distance from the plane needs to be some 450 miles. This tends to locate the responsible clouds beyond the more mountainous part of the interior of Quebec and nearer the lowland region along the coast of Hudson's Bay, which is a problem for clouds depending on orographic lift such as mountain wave clouds (standing-wave *lenticularis*) or mountain-triggered *cumulonimbus*. On the other hand, towering *cumulus congestus* or even c*umulonimbus* might be triggered over coastal water by convective instability due to a hypothetical off-shore evening breeze front, which fits some of the topographical and meteorological information.

Also, this distance seems to be pushing the limit for a high-contrast mirage image with minimal fill-in, due to the optical thickness of this much atmosphere, even at 19,000ft. Mirage expert Andy Young's calculation suggests that a fairly good visual contrast might be expected in the reported conditions at a distance of perhaps as much as 300 miles (about 500km)[93], but this is still a good 30% short of keeping parallax drift down to 10º.

And yet, the above allowance of a 10º parallax drift between first and last sighting is already taking a small liberty with Capt Howard's 1954 account, which implies that the objects were "keeping station" within a much smaller tolerance than this. The Navigation Officer, George Allen "had his eye on them the whole time" (the aircraft was flying on autopilot) and checked their alignment against the edge of the cockpit window frame. Allen was reportedly able to observe only one brief departure from a constant bearing and this was not at the end of the sighting but in the middle, after which the objects "dropped back exactly parallel again". Given that 10º is a rather large visual angle on the windscreen, corresponding to nearly the span of one's hand at arm's length (and about 20 times the implied angular width of the largest object), the claim of "exact" station-keeping implies a not-insignificant angular error on the part of the Navigator.

On the other hand we do have to remember that 10º is also the likely order of variation in instantaneous heading around an average autopilot heading of 49±5º according to Capt Howard.[94] It is not inconceivable that yaw in the aircraft axis could fortuitously have masked at least some part of a drift in true bearing of this order,

Another issue is the remarkable lateral symmetry of form, and to some extent of motion too, shown in the BOAC case and in the very similar Zanthus case from Australia. In each case a

[93] Personal communication 02.03.2009

[94] Letter from R.H.B.Winder to Robert J. Low, 30 August 1967, forwarding Capt Howard's answers to question posed by Low. Colorado University UFO Project files; Library of the Am. Phil. Society, Philadelphia .

large central shape-changing object is flanked by smaller objects either side. The small objects appear to move laterally in and out, exchanging positions, all finally moving inward to merge with the large central object, which then dwindles in angular width and disappears. Because significant RI gradients in the free atmosphere[95] are exclusively vertical, mirage refraction only occurs vertically. True lateral bending of light rays cannot occur, so the reports of sideways motions in these cases (and also in the 1947 Eastern Airlines case) must be explainable as illusions, or perhaps as separate small parts of an angularly-much-larger miraged target object being selected in sequence by fluctuating conditions in the duct - perhaps where the floor of the duct is being undulated by slow wind-driven or gravity waves.

An alternative explanation suggested by Andy Young[96] depends on parallax. If we imagine that a number of different objects (dense cumulus towers in this case) at different *distances* are being miraged, then as the viewing geometry changes due to the aircraft's forward motion the relative angles of the lines of sight would vary and might even cross over. Objects nearer than the large one would appear to fall behind it; those farther away would appear to gain on it.

This might explain the appearance of motion, but does not of itself explain the bilateral symmetry of the arrays of moving images in this and in similar cases, which at the moment seems to be down to chance. This is not entirely satisfactory.

Whilst completing this report the author happened to look at radarscope photographs from a little-known USAF incident[97] and was startled to notice the date: 02 July 1954, or just two days after the BOAC incident. The reason for surprise: The photos were described as showing echoes from a large object and six smaller satellite objects tracked for 19 minutes passing under a B-36 at 14,000ft near Bermuda.

According to the meagre scraps of information in the original Blue Book file the B-36 crew checked for air or sea traffic in the area and found there was none. The very experienced radar operator was convinced the objects were not ships, as he was familiar with ship echoes on the equipment and had in fact been tracking a ship just before the UFOs appeared. He had never seen anything like it in 10 years and 1500hrs as a radar observer. But Blue Book "asked the Navy" and the file baldly asserts that the objects were positively identified as the "USS Mindora"[98] and six escort destroyers sailing from Naples to Norfolk, Virginia.

Considering the way in which Blue Book explained the BOAC sighting as "the planet Mars" with similar and (in that case) reckless bravado one is entitled to be sceptical of this completely undocumented claim; but it could be true.[99] Howsoever, there is no chance of the

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[95] 19,000ft above Newfoundland would be considered the "free atmosphere". Significant lateral gradients might occur in regions of extreme convective or radiative heat transfer, such as across the heat plume above a fire or adjacent to a vertical sun-heated wall.

[96] Personal communication 04. 03.2009

[97] Two photos from the series of 32 appeared in the photo section of a book by a scientific consultant to the USAF's Project Blue Book (Hynek, 1978) which gives the date as 03 July 1954. This is Zulu or GMT. Local time would have been on the evening of July 02. Hynek incorrectly recorded Blue Book's evaluation as a "battleship" - not a carrier - and six destroyers. The complete Blue Book case file is available at http://www.footnote.com/image/8714458/#8714457

[98] Actually the USS *Mindoro*, a 557ft carrier, see http://en.wikipedia.org/wiki/USS_Mindoro_(CVE-120)

[99] Repeated mis-spelling of Bermuda as "Burmuda" does not increase one's confidence in ATIC's thoroughness. It's hard to work out what's going on from the poor images. We can just see from the data plate that it's a K-3A bombing/navigation system, which was the state of the art system on the B-36D variant flying at that time. The K-3A incorporated an upgraded Western Electric K-band tunable AN/APS-23 radar with a 60 inch flush-

USS Mindoro and escorts having been anywhere near Hudson Bay if they were at Bermuda when stated. At 19kt it would take over 6 days to steam >2800 nmi, even if it were not the case that they had supposedly been coming from Naples. So if the Blue Book identification of the Bermuda objects is accurate the similarity of configuration can only be coincidence.

Nevertheless the coincidence prompted Wim Vam Utrecht to wonder if a formation of ships in Hudson Bay - perhaps another carrier group - could conceivably have been seen *via* mirage from the Stratocruiser, a theory which deserves a mention since one can imagine that relative motions among such a group of ships might explain motions of their mirage images.

But from 600 miles away, the angular length of the carrier would be only about 0.01 degree or 36 arcsec, only at best an unresolvable speck even in perfect laboratory conditions, and the angular height would be say 1/10 of this or a few arcsec, thus in practice scarcely perceptible. So to image this ship and its still smaller escorts we need an axially symmetrical distribution of refractive index gradient around the line of sight, to obtain a 'magnification' in the order 100x as if by a telescopic lens. Such a mirage phenomenon is unknown to science and meteorologically inexplicable. There are some anecdotal stories, in the old literature, of what the cataloguer of anomalies William R. Corliss has called "telescopic mirages", but modern mirage experts tend to regard such stories as being in the class of "sea serpent" tales.[100]

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mounted steerable antenna which could scan 360 degrees in PPI mode at up to 60 RPM, or in sector scans of 40º-180º, with a range of 5 - 200 miles. According to http://home.att.net/~jbaugher2/b36_6.html "At 30,000 feet, large cities could be detected at a range of up to 200 miles and shipping could be detected at ranges of 50 to 100 miles." Usually the 'scope cameras on radars of this type expose one frame per antenna rotation. Unfortunately the selected scan rate and range scale are not shown, and even the counter numbers are hard to read. The display can usually be north-up or heading-up and there will be a heading marker strobe. If the white line is a heading marker on a north-up presentation, then the B-36 was flying roughly West. If the ships were heading West also (as reported) then the plane's true ground speed would be the relative target rate plus the ships' headway. *If* the range ring interval is 5 nmi then the objects fell behind underneath at a relative speed (if I read the numbers correctly) of about 180 kts, which added to the 19 kt cruise speed of the USS Mindoro (Note 98) is exactly the normal B-36 cruise speed (200 kts, neglecting winds).

[100] Andy Young (personal communication, 03.05.2009) is very sceptical about many of Corliss's entries. I tend to agree. They are often anecdotal and lack probative detail. One such "telescopic mirage"record is as follows: *'X9. No date given. Near Port Danger, on the South African coast. Passengers on a vessel saw a mirage of a well-known English man-of-war, which displayed great detail. Expecting to find the warship at Port Danger, they were surprised to learn that it was some 300 miles away at the time of the mirage.'* (Corliss, 1984. p.145)

Corliss's source in this case is Liddel (1953). (Urner Liddel, employed by Bendix Corporation and the Office of Naval Research, was a close associate and vociferous supporter of Donald Menzel and Harlow Shapley and generally not very critical where optical "explanations" of UFO cases were concerned.) Liddel was himself quotiing a Victorian book (Bassett, F.S., 'Legends & Superstitions of the Sea & Sailors', Chicago 1885) which in turn was paraphrasing a tale in another "modern book of travels" published half a century earlier. I am indebted to Roberto Labanti (personal communications, 03.10.2009) for locating this book ('Narrative of Voyages to Explore the Shores of Africa, Arabia & Madagascar', Bentley, London 1833, Vol.1, pp.241-2). According to page iv of its introduction it was put together in the form of a continuous narrative "from the journals of Capt [W.F.W] Owen [of HMS Leven] and the officers engaged under him" by a London editor, Mr Heaton Bowstead Robinson, who puts the above tale into the mouths of some anonymous spokesmen for the crew of HMS Leven (the tale is told in the second person plural; the only crewmember excluded as an author is in fact Capt Owen himself, referred to therein in the third-person singular). Robinson's account tells us that it was on 6th April 1823 when "we" were surprised to see, not two miles off, the Leven's companion ship, the sloop HMS Barracouta, believed to have been "above three hundred miles from us." The story says that "many well-known faces could be observed on deck" which along with "the peculiarity of her rigging" convinced the observers that it was really the Barracouta, even though "she made no effort to join us, but on the contrary, stood away" beyond the above-mentioned two miles. The writer concludes that such a "strange and at present unaccountable fact" may be explainable "by natural and probably simple causes" such as "refraction". I am further indebted to Roberto Labanti for discovering the account of the corresponding period from the Journal of the 1st Lt of HMS Barracouta (Boteler, Thomas, 'Narrative of a voyage of discovery to Africa and Arabia,

In our case, the fact that ships at sea level would be 19,000ft below the elevated duct in which (*ex hypothesi*) the plane was flying presents a serious problem. To couple into the duct with a <30 arcmin grazing angle light rays would *first* have to travel through the atmosphere for at least ~450 miles. As we have learned, fill-in due to scattering should grey out even high contrast sources in this sort of situation, never mind inevitable added losses from whatever unknown 100x-magnification "telescopic" miraging is then applied. Yet the UAPs were "black". It's perhaps possible (if highly unlikely) that a duct could lie tilted away from the horizontal by about 20 arcmin and dip towards sea level over a distance of 600 miles (a frontal inversion lying over a wedge of cold air perhaps), but this doesn't help with the contrast problem. Therefore combined with the "telescopic" requirement this means ships are not nearly so useful as towering clouds inside the duct, which can be half the distance from the eye in the first place, with half the distance losses, and higher intrinsic contrast because nearer the sunset longitude and so having much less front-lighting from scattered sky brightness.

Ground and air radars were involved also in the BOAC incident, and had radar contact been reported this might have made a strong case against the mirage theory. Indeed the case has often been cited as a radar-visual observation, but without any clear evidence. The sources for this appear to be no more than misinterpretation and rumour, such as Bowen (1982) recounting a clearly confused memory of a conversation with Capt Howard 15 years previously. Capt Howard himself stated several times that he was not aware of any radar contact with the phenomena. It's true that Capt Howard was for the most part in radio contact with Goose GCA (Ground Controlled Approach), the Air Traffic Control radar, and would himself have been beyond the probable ~60 mile range of GCA at least for much of the incident, and he may not have been made aware of any contacts detected by Air Defence radars.[101] A rumour of an ADC radar contact in this case was recently mentioned on an

performed in His Majesty's ships, Leven and Barracouta, from 1821 to 1826, under the command of Capt. W.F.W. Owen, R. N.' Volume I, Bentley, London, 1835, pp.220-21) describing the eventual arrival of HMS Barracouta on 14th April at Simon's Bay, where HMS Leven had been awaiting them anxiously for a week, after "a tedious and rough passage of ten days" from Algoa. This seems to confirm the view of the storyteller(s) that Barracouta must indeed have been far away when apparently seen off Port Danger; but the rough seas and uncomfortable cold complained of by 1st Lt Boteler during the journey do not on the face of it suggest the sort of stable anticyclonic high-pressure regime that typically produces the widespread sea-level temperature inversions most likely to give rise to exceptional long-range superior mirages. "Rough passage" suggests that the strong winds characteristic of the Cape summer were persisting into autumn (a week earlier HMS Leven had encountered "variable" weather on the same route "with two or three severe gales and some dead calms" (Owen, op.cit, pp.240-241). The April climate of the Cape is typically temperate and very humid, 12ºC to 22ºC and RH 60%-90% the mean circadian ranges, daily probability of rain ~20%, suggesting less than ideal atmospheric transparency (http://www.bbc.co.uk/weather/world/city_guides/results.shtml?tt=TT000580).

Consider first the difficulty of identifying "many well-known faces" even at two miles distance "in the evening . . . at sunset", as it reportedly appeared, even in the clearest air; and then consider the difficulty when those faces are in fact 300 miles East of the observers, 5º of longitude nearer to Algoa. The extraordinary fidelity of this supposed mirage of "well known faces" over such a distance requires not only axially-symmetric telescopic refraction of an inexplicable kind, it also requires an almost lossless optical pathway and at least a well-lit scene to project. This distance corresponds to about 20 minutes of solar time. When it was sunset at Simon's Bay - as the crew of HMS Leven were watching their supposed counterparts on the Barracouta launching a small boat to retrieve a man overboard - at the location of the real Barracouta 300 miles to the East dusk was already well advanced, the sun's disk some 10 solar diameters below the local horizon, and the ship would be illuminated only by remnant scattered sky brightness. So should we accept this as evidence of a truly extraordinary "mirage"? Ought we not to require better and more cirumstantial evidence than an anonymous anecdote before ruling out the arguably more probable theory that some unnamed observers were mistaken as to the identity of the ship, and that to explain their mistake someone said "it must have been a mirage"?

[101] In his "Voyage Report" (see *Appendix B*) he did say that he had spoken with "Fighter Control" but this may be a confusion. Elsewhere he describes how he spoke with the fighter *pilot* -although it's true to say that if he was given the fighter's ground control frequency he may have been able to hear both pilot and controller.

internet forum for ex-airforce personnel stationed at the Canadian Pinetree Line air defence radar sites[102]. There was nominally no Pinetree Line radar at Goose until Nov 1954[103], when the Melville Radar Station was established attached to Pepperell AFB in nearby St Johns, but Air Defence radar was operated there at the time by 641st Airborne Control & Warning Squadron, and a telex (*Appendix D*) from the Commander, 641st AC&W timed at 0150Z, 27 minutes after the end of the sighting (just after the *Centaurus* had landed at Goose to be met by a USAF intelligence officer), states:

VECTOR FIGHTER NO INTERCETP [sic] MADE RADAR NONE.[104]

This suggests that the 641st AC&W radar was the fighter's controlling radar, except that the call-signs of that installation apparently were 'Capable' and 'Halfpint',[105] whereas the pilot of the fighter concerned recalls that the call-sign of his GCI at the time was indeed 'Pinetree'.

Recently, thanks to an internet lead located by a UK researcher[106], the author was able to make contact with Lt Col Al Kramer, USAF (ret), the pilot of the 2-man F-94 jet fighter dispatched to investigate. In 1999, Kramer had written about his experience on a message board for veterans of the 59th Fighter Interceptor Squadron, remarking

> Just before I got to them, the BOAC Captain announced that the objects were veering off to the north. Neither Pinetree nor us picked up anything on our radars. The event did cause a certain amount of commotion on the Goose.[107]

In communication with the author a decade later in 2009 Lt Col Kramer confirmed that Pinetree (located adjacent to to Goose Bay; "I don't know if it was a part of the Pinetree Line"[108]) had both his F-94 and the Stratocruiser on radar, but no unknowns, and more importantly that the F-94 radar operator did pick up the Stratocruiser on the plane's AI radar, but no unknowns.

Lt Col Kramer saw nothing visually, either. He had established radio contact with Capt Howard, who informed him when he was still 30 miles away[109] that the objects were "veering off". Early on Capt Howard reported that the F-94 said "I'm heading towards you at a slightly higher altitude" (Howard, 1954). Lt Col Kramer volunteered without prompting the information that his own altitude was 20,000ft.[110] The Stratocruiser is known to have been at the 19,000ft pressure level. If the objects were mirage images then a 1000ft altitude difference

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[102] Personal communication from Jan Aldrich, Project 1947, 07.08.2009

[103] http://en.wikipedia.org/wiki/CFB_Goose_Bay

[104] The first telex from 641st AC&W (*App. D..3/4*) gives the time of BOAC's radio report (to Goose GCA) as 0109Z, with the message being relayed to 641st radar three minutes later at 0112Z. Presumably radar then began to keep a watch, but the BOAC itself was not picked up until almost 0123. The next follow-up telex from 641st (*App. D..7/8*) states "when we and fighter got contact with the aircraft objects faded [visually]". The visual bearing to the UAPs would place them necessarily at greater range than BOAC from both ground and AI radars, so strictly speaking absence of radar contact is not positive evidence for the mirage theory..

[105] http://www.pinetreeline.org/site19.html

[106] Eric Rush, personal communication 12.08.2009

[107] http://www.picturetrail.com/sfx/guestbook/view/3234

[108] Personal communication, 25.08.2009. The 641st AC&W radar located adjacent to Goose Bay was on Mount Dome 6 miles NW of the airfield (http://www.pinetreeline.org/travel19.html) and was operational from August 1953 with CPS-6B and/ FPS-6 radars.

[109] Early accounts by Capt Howard give the range as 20 miles.

[110] personal communication, 29.08.2009

may well have been sufficient to keep the F-94 above the duct and beyond the critical angle for refraction, helping to explain why Lt Col Kramer saw nothing.

The F-94 approached the Stratocruiser from the East with guns and gun-camera both readied, and passed it heading West, then turned to the right in the direction the objects had reportedly disappeared. Lt Col Kramer had by this time flipped his armament switch from "guns and camera" to "camera only" with the intention of obtaining 16mm film, but finding nothing visually or on radar the crew gave up and went in for a landing at Goose, where both men were "quarantined" because "the US Air Force did not want us to say anything".[111]

One other significant point is confirmation that the F-94 was not scrambled from Goose as many accounts suggest, but was already in the air. This answers the argument[112] that North East Air Command (NEAC) would not have launched a costly and risky interception mission unless they had a radar target to go at. "We were returning from an intercept mission", said Lt Col Kramer, "and were diverted".[113] Indeed the absence of ground radar contact is implicit in the fact that the F-94 was instructed - very unusually - to make contact with the crew of the Stratocruiser for a final visual vector to the UAPs.

The only other (implicit) reference to radar in this case occurs in the Blue Book file, in a telex from 6607th Air Base Wing, Thule AFB, Greenland, timed 0545Z 30 June 1954, in response to a telex from 641st AC&W at Goose (see *Appendix D.9*). Thule AFB was the site of a NATO early warning radar station operational from 1953.[114] The cryptic message is only eight words long but the crucial two words are "negative report". In other words, ADC radar at Goose checked with Thule only to be told that no radar UFOBs had been detected there either. Of course, Thule is fully 1700 miles due North from Goose.[115] It may be that Thule was responding on behalf of other northern tier radars also, but even so this negative report is only indirect circumstantial evidence.

In conclusion, a couple of awkward issues remain that keep the mirage theory from being completely resolved; nevertheless several significant objections have been overcome and so many features are suggestive of mirage that it seems by far the least implausible explanation, bearing in mind the limitations of the available data. There is evidence that the observation is one of a hitherto unrecognised class of very similar mirage observations from aircraft which would repay further focused study.

A final note concerns Capt Howard's recollection (1967;1982) that soon after departing New York the *Centaurus* was kept in an unusual - indeed, unique in his experience - 10-minute holding pattern by Boston ATC before being allowed to proceed to Goose by way of a diversion to the East of Boston. No explanation was given. However as a result of publicity after the sighting Capt Howard received a letter from an American doctor who had been holidaying in a Massachussetts lakeside cabin on that evening. They had heard a "roaring" noise and looked up to see seven dark objects - one large and six small - heading NE across the lake. Capt Howard wondered if these might be the same seven "strange things" he had seen, and if so, whether they were responsible for Boston ATC radar re-routing his aircraft away from the area.

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[111] personal communication, 25.08.2009.
[112] Brad Sparks, personal communications, 13.08.2009
[113] personal communication, 25.08.2009
[114] See http://www.bwcinet.com/thule/PMtnJSite.htm
[115] The Thule surveillance radar was an FPS-3, a modified L-band CPS-5 with no more than 200-mile range.

The latter could be the case if we interpret these ill-described "roaring" objects as jets. Perhaps a sighting that had not seemed so strange to these witnesses at the time was re-evaluated after Capt Howard's story appeared in the press and on the newsreels. If so their description may have been influenced by it. Perhaps a military exercise of some sort or a mid-air refuelling operation was underway west of Boston that evening and had strayed close to a commercial airway? It is never desirable to invoke mere coincidence in a scientific treatment, but given the weight of circumstantial evidence favouring a mirage over Labrador this seems the most likely explanation.

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Internet pages:

Site with many interesting articles and photographs relating to the Boeing Stratocruiser
http://www.ovi.ch/b377/articles/first/

A great deal of useful theory, history and bibliography, along with some raytracing simulations of interesting and unusual mirages, may be found on Andy Young's mirage pages at http://mintaka.sdsu.edu/GF/mirages/mirintro.html

Stratocat (Stratospheric Balloon Launches & Sites)
http://stratocat.com.ar/bases/balloons-manitoba.htm

Canadian Weather Office
http://www.climate.weatheroffice.ec.gc.ca/climateData/canada_e.html

BBC TV interview woth Capt Howard, broadcast July 02, 1954
http://www.youtube.com/watch?v=TQOa4KQJfe8

ITV 'Strange But True' documentary, 1996, interview with Capt Howard and Air Stewardess Daphne O'Reilly
http://www.youtube.com/watch?v=4SQbYaEEguI

Appendix A. Weather data

(i) Hourly Data Report for June 29, 1954, SEPT-ILES A, QUEBEC

All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

Latitude: 50° 13.000' N **Longitude:** 66° 16.000' W **Elevation:** 54.90 m
Climate ID: 7047910 **WMO ID:** --- **TC ID:** YZV

Time	Temp °C	Dew Point Temp°C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Weather
00:00	12.2	10.6	90	7	10	25.0	101.46	Mostly Cloudy
01:00	12.8	10.6	86	7	6	25.0	101.44	Mainly Clear
02:00	12.8	10.6	86	2	16	48.3	101.36	Mainly Clear
03:00	12.2	10.0	86	7	18	48.3	101.40	Mostly Cloudy
04:00	13.9	10.6	80	7	13	48.3	101.43	Mostly Cloudy
05:00	13.9	10.6	80	9	13	48.3	101.47	Mostly Cloudy
06:00	13.9	10.6	80	9	16	48.3	101.54	Cloudy
07:00	14.4	10.6	78	14	19	48.3	101.55	Cloudy
08:00	14.4	11.1	81	11	16	48.3	101.55	Cloudy
09:00	14.4	12.2	84	11	24	48.3	101.52	Cloudy
10:00	15.6	12.8	84	11	23	48.3	101.51	Cloudy
11:00	15.6	12.8	84	11	27	48.3	101.50	Cloudy
12:00	13.3	11.7	90	14	19	48.3	101.50	Cloudy
13:00	14.4	11.7	84	14	13	48.3	101.50	Cloudy
14:00	13.3	11.7	90	11	16	16.1	101.47	Rain Showers
15:00	12.8	11.7	93	11	16	16.1	101.37	Cloudy
16:00	12.2	11.1	93	9	13	24.1	101.46	Cloudy
17:00	12.2	11.1	93	9	16	24.1	101.43	Cloudy
18:00	12.2	11.1	93	9	16	12.9	101.42	Drizzle
19:00	12.2	11.7	96	9	13	8.0	101.40	Drizzle, Fog
20:00	12.2	11.7	96	9	19	8.0	101.39	Drizzle, Fog
21:00	12.2	12.2	100	9	23	8.0	101.40	Drizzle, Fog
22:00	12.2	12.2	100	9	19	3.2	101.39	Drizzle, Fog
23:00	11.7	11.7	100	9	19	1.6	101.39	Drizzle, Fog

(ii) Sept Iles Almanac - Averages and Extremes for June 29 (all recorded years)

Average Maximum Temperature	18.4 °C
Average Minimum Temperature	9.3 °C
Frequency of Precipitation	47 %

(iii) Hourly Data Report for June 29, 1954, KUUJJUAQ A, QUEBEC

All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

Latitude:	58° 6.000' N	**Longitude:**	68° 25.000' W	**Elevation:**	39.30 m
Climate ID:	7113534	**WMO ID:**	71906	**TC ID:**	YVP

Time	Temp °C	Dew Point Temp °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Weather
00:00								
01:00	9.4	5.6	77		0	24.1	101.11	Mostly Cloudy
02:00								
03:00								
04:00								
05:00								
06:00								
07:00	14.4	9.4	73	18	5	24.1	100.77	Cloudy
08:00								
09:00								
10:00								
11:00								
12:00								
13:00	26.7	10.0	35	23	21	24.1	100.27	Mostly Cloudy
14:00								
15:00								
16:00								
17:00								
18:00								
19:00	15.0	12.2	84	18	10	24.1	100.58	Rain
20:00	no more data							

(iv) Daily Data Report for June 1954, KUUJJUAQ A, QUEBEC

Latitude:	58° 6.000' N	**Longitude:**	68° 25.000' W	**Elevation:**	39.30 m			
Climate ID:	7113534	**WMO ID:**	71906	**TC ID:**	YVP			

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm
01	M	M	M	M	M	M	M	M
02	M	M	M	M	M	M	M	M
03	M	M	M	M	M	M	M	M
04	12.8	M	M	M	M	M	M	M
05	12.8	-1.1	5.9	12.1	0.0	M	M	M
06	9.4	-2.8	3.3	14.7	0.0	M	M	M
07	22.2	-1.7	10.3	7.7	0.0	M	M	M
08	10.6	5.0	7.8	10.2	0.0	M	M	M
09	21.1	-1.1	10.0	8.0	0.0	M	M	M
10	25.0	11.1	18.1	0.0	0.1	1.0	0.0	1.0
11	6.7	2.2	4.5	13.5	0.0	0.0	0.0	0.0
12	7.2	0.6	3.9	14.1	0.0	0.0	0.0	0.0
13	14.4	1.7	8.1	9.9	0.0	0.0	0.0	0.0
14	23.9	2.2	13.1	4.9	0.0	0.0	0.0	0.0
15	28.3	6.7	17.5	0.5	0.0	0.0	0.0	0.0
16	30.6	9.4	20.0	0.0	2.0	0.0	0.0	0.0
17	25.6	17.2	21.4	0.0	3.4	10.2	0.0	10.2
18	25.0	9.4	17.2	0.8	0.0	7.6	0.0	7.6
19	20.6	2.8	11.7	6.3	0.0	2.5	0.0	2.5
20	16.1	8.9	12.5	5.5	0.0	0.0	0.0	0.0
21	22.2	3.3	12.8	5.2	0.0	1.0	0.0	1.0
22	12.2	3.9	8.1	9.9	0.0	0.0	0.0	0.0
23	10.6	2.8	6.7	11.3	0.0	0.0	0.0	0.0
24	21.1	-0.6	10.3	7.7	0.0	0.0	0.0	0.0
25	11.7	8.9	10.3	7.7	0.0	11.7	0.0	11.7
26	11.1	1.7	6.4	11.6	0.0	0.8	0.0	0.8
27	12.8	1.7	7.3	10.7	0.0	0.0	0.0	0.0
28	19.4	5.0	12.2	5.8	0.0	0.0	0.0	0.0
29	27.2	8.3	17.8	0.2	0.0	0.8	0.0	0.8
30	15.6	2.2	8.9	9.1	0.0	0.0	0.0	0.0

M = Missing

(v) Kuujjuaq A Almanac - Averages and Extremes, June 29 (all recorded years)

Average Maximum Temperature	15.3 °C
Average Minimum Temperature	4.0 °C
Frequency of Precipitation	45 %

Source: Canadian Weather Office

(vi) 641st AC&W Sq USAF weather report, Goose AFB, Labrador

A telex timed 0150Z from 641st Airborne Control & Warning Squadron stationed at Goose AFB contains the terse codes

CLEAR/VIS 30/73/4B/3013/NNW 8

which does not conform exactly to the format required under Air Force Regulation 200-2 for weather data to be collected in cases of UFO observations, but can probably be translated as follows:

Weather clear
Visibility 30 miles (= 48.3km, see *App.A.vii* below)
73% RH
Broken cloud at 4000ft
Surface pressure 30.13 inches of mercury (1020.319 millibar)
Wind NNW 8 knots

The conspicuous omissions are the *temperature*, the *time* of the observations, and the exact *source*.

Compare the Hourly Data Report for Goose archived by the Canadian Weather Office (*App.A.vii* below) which relates to the joint military/civil airfield of Goose Bay (Goose AFB) as distinct from the nearby facilities of Pepperell AFB centred around the former St John's Airport.

Comparison of pressure and RH alone tends to suggest that the USAF report is probably of an early-morning observation (local time), since which time surface pressure had been falling slightly from its high of >1020mbar. But none of the hourly observations at Goose corresponds exactly with the values recorded in the 6641st AC&W telex - presumably this may be because the USAF and Weather Office records relate to different observations made at different times at different (albeit nearby) airfields.

(vii) Hourly Data Report for June 29, 1954, Goose A Newfoundland

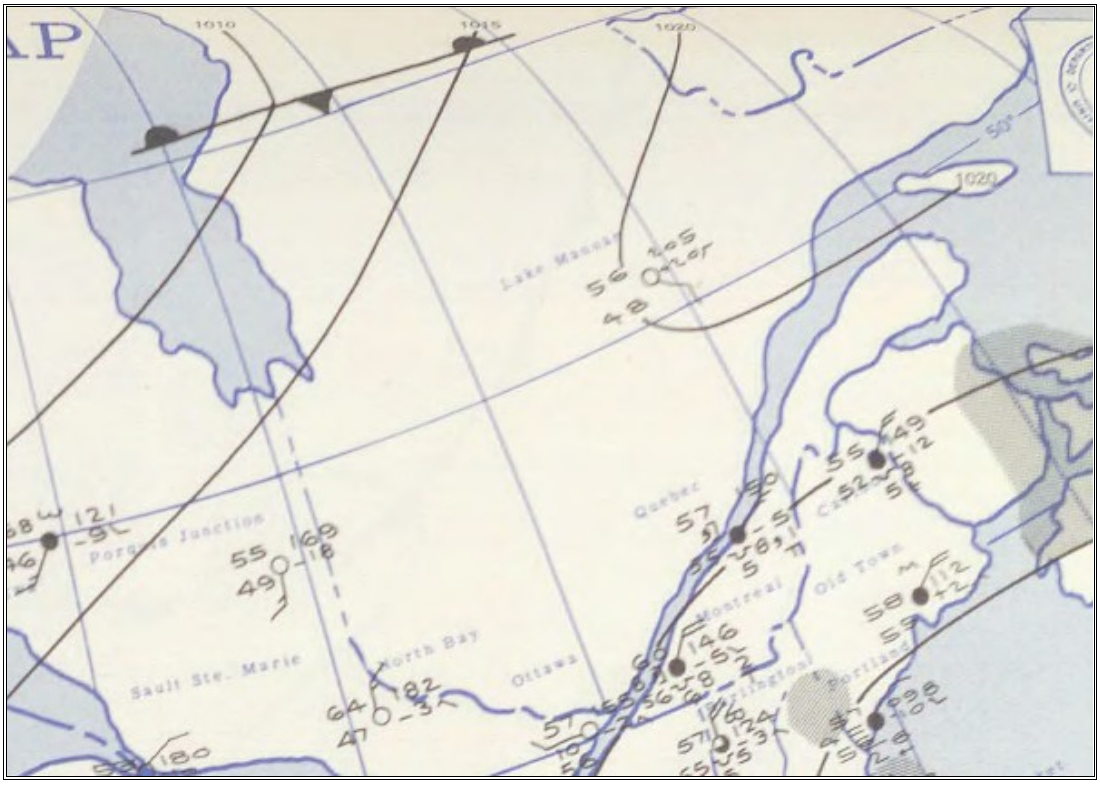
All times are specified in Local Standard Time (LST). Add 1 hour to adjust for Daylight Saving Time where and when it is observed.

Latitude: 53° 19.000' N **Longitude:** 60° 25.000' W **Elevation:** 48.80 m
Climate ID: 8501900 **WMO ID:** 71816 **TC ID:** YYR

Time	Temp °C	Dew Point Temp °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Weather
00:00	11.1	5.0	66	9	8	48.3	102.02	Clear
01:00	10.0	5.0	71	18	6	48.3	102.03	Clear
02:00	8.9	5.0	77		0	48.3	102.03	Clear
03:00	7.2	5.6	89		0	48.3	102.06	Clear
04:00	5.6	3.9	89		0	48.3	102.09	Mainly Clear
05:00	6.7	5.0	93		0	48.3	102.10	Mainly Clear
06:00	10.0	5.0	71		0	48.3	102.11	Mainly Clear
07:00	12.2	5.6	64		0	48.3	102.10	Mainly Clear
08:00	13.3	3.3	51		0	48.3	102.06	Mainly Clear
09:00	15.0	2.8	44	14	5	48.3	101.98	Clear
10:00	16.7	5.6	48	5	6	48.3	101.97	Clear
11:00	18.9	6.1	43	2	8	48.3	101.86	Clear
12:00	20.0	7.8	45	36	13	48.3	101.79	Mainly Clear
13:00	21.7	7.2	39	2	11	48.3	101.66	Mainly Clear
14:00	22.2	8.3	41	2	13	48.3	101.61	Clear
15:00	22.8	8.9	41	2	13	48.3	101.53	Clear
16:00	23.3	7.8	37	5	16	48.3	101.44	Mainly Clear
17:00	22.2	8.3	41	5	11	48.3	101.38	Mainly Clear
18:00	21.1	6.7	39	5	16	48.3	101.36	Mainly Clear
19:00	20.0	6.7	42	5	6	48.3	101.36	Mainly Clear
20:00	18.9	7.2	47	5	5	48.3	101.34	Mainly Clear
21:00	21.1	12.8	59	14	23	48.3	101.36	Mainly Clear
22:00	19.4	13.3	68	14	21	48.3	101.35	Mainly Clear
23:00	18.3	13.3	73	16	23	48.3	101.40	Mainly Clear

(viii) US Weather Bureau surface pressure charts, 29-30 June 1954*

01:30 PM EST, 29 June



01:30AM EST, 30 June

*http://docs.lib.noaa.gov/rescue/dwm/data_rescue_daily_weather_maps.html

(ix) US Weather Bureau 500mbar (~19,000ft) **c**onstant pressure chart, Labrador area, 29 June 1954*

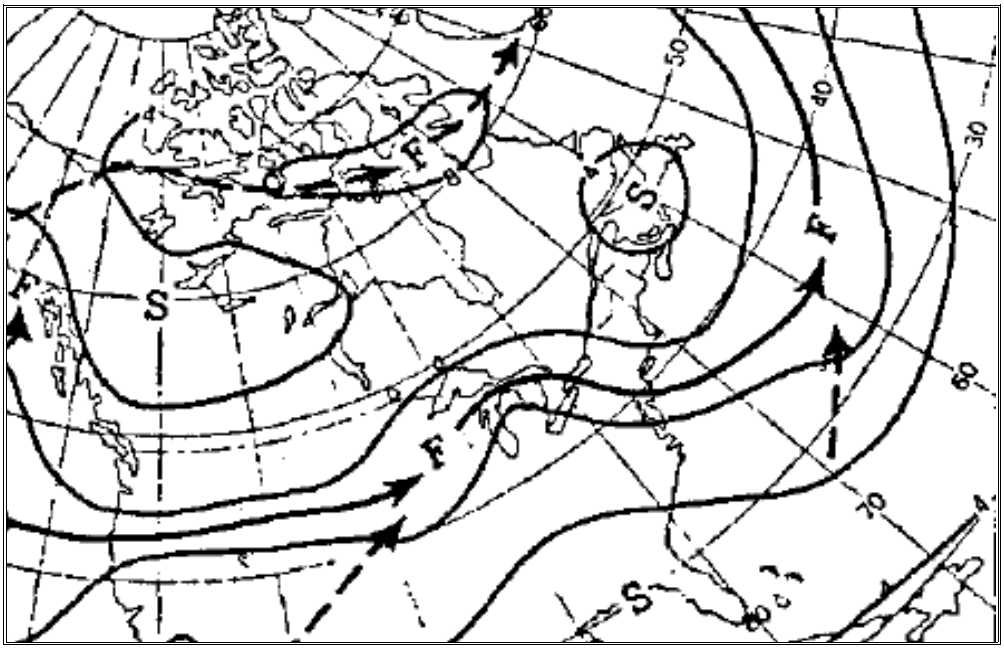
Detail from contour map of the 500mbar pressure surface based on radiosonde observations begun between 10:00PM and 11:00PM (EST) 29 June 1954 and collected by 0130AM (EST) 30 June 1954.

Continuous lines show height in feet above sea level. Dashed lines show temperature in degrees Celsius. Wind barbs show direction and force in knots.

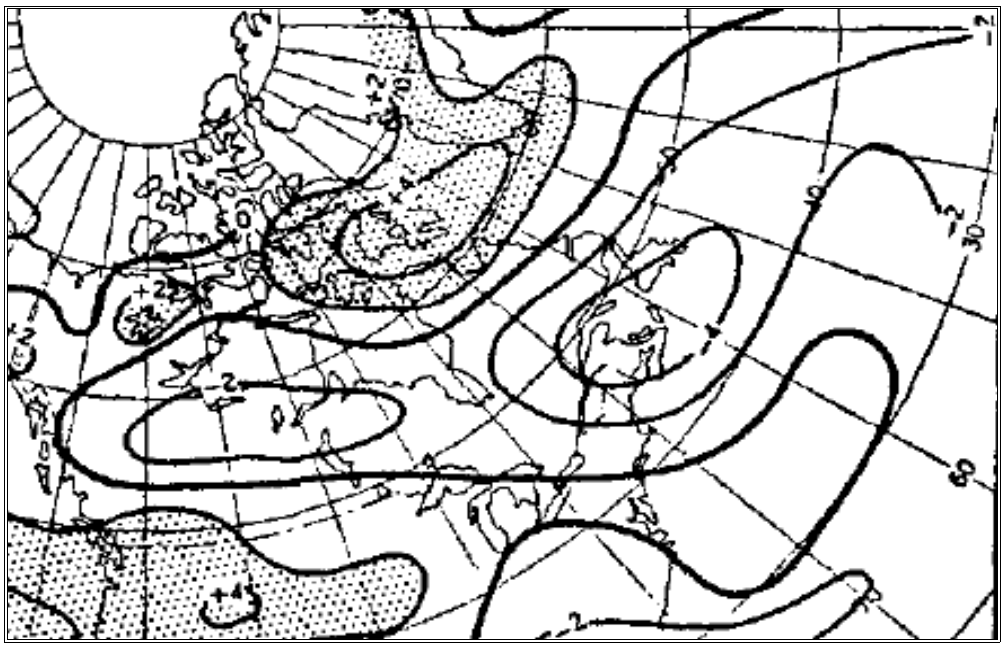
* US Weather Report, Daily Weather Map, Wednesday June 30 1954, US Dept of Commerce Weather Bureau, Washington DC 25. See:

http://docs.lib.noaa.gov/rescue/dwm/data_rescue_daily_weather_maps.html

(x) Mean 700mbar winds, June 1 - 30, 1954



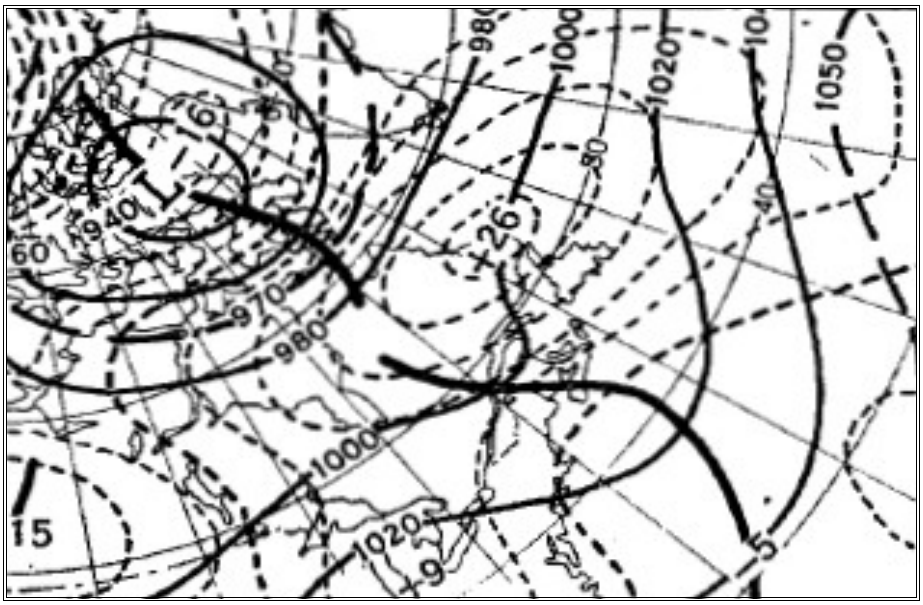
A. Mean 700-mbar (~10,000ft) isotachs (meters per second). Solid arrows indicate average position of the mean 700-mbar jet stream, while dashed arrows indicate secondary axes of relative maximum wind speed.



B. Departure from normal wind speed (in meters per second) The mid-latitude westerly jet was strong in the East Pacific but abnormally weak in the Atlantic averaging 6 m/sec (12kt), between -2 and -4 m/sec (-4 to -8kt) below normal.

After Holland, J.Z., 'Weather & Circulation, June1954; Illustrating the Birth and Growth of a Continental Anticyclone', Monthly Weather Review June 1954 pp.163-171.

(xi) Mean 700-mb height contours (solid lines) and departure from normal (dashed lines) over Eastern Canada, June 1-30, 1954.



Dashed contours in the centre of the chart show a pronounced positive pressure-height anomaly of +260ft coinciding with the slow-moving "blocking anticyclone"over Labrador, with low pressure (negative height anomaly averaging -160ft over the month) dominating to the northwest.

Detail of figure from: Holland, J. Z., 'The Weather and Circulation of June 1954; Illustrating the Birth and Growth of a Continental Anticyclone', Monthly Weather Review, June 1954 pp.163-171. http://docs.lib.noaa.gov/rescue/mwr/082/mwr-082-06-0163.pdf

Appendix B. Some witness statement extracts

i). From the Captain's Voyage Report, completed by James Howard en route from Goose Bay to London on 30 June 1954:

At 0105 G.M.T. today (June 30) about 150 nautical miles southwest of Goose Bay, height 19,000 feet, flying in clear weather above a layer of low stratus cloud, I noticed on our port beam a number of dark objects at approximately the same altitude as our aircraft. I drew the attention of the First Officer (Lee Boyd), to them. He said he had just noticed them also. I jokingly said they reminded me of flak bursts. He agreed (Sketch 1)

It then became apparent that they were movingalong on a track roughly parallel to ours and keeping station with is. The First Officer then called Goose approach to ask if there were any aircraft in out area (0107 G.M.T.) They said No. During this time the shape of the large object changed slightly - also the positions of the smaller ones relative to the big one. Some moved ahead, some behind. The First Officer then told Goose what we were watching and they said they would send a fighter to investigate. At this time the objects resembled Sketch 2.

The shape of the large one continually changed but its position relative to us did not - always about 90 degrees to port. The distance from us appeared not less than five miles, possibly very much more. During this time both engineers, both navigators, the radio officer, two stewards and the stewardess watched it and all of us agreed on its shape. The number of small objects accompanied it (usually six were visible) and all were agreed that we had never seen anything like it before. At about 0120 the fighter reported that he was approaching us. The objects immediately began to grow indistinct until only one was visible. This grew smaller and finally disappeared (0123 G.M.T.) still at the same bearing to us. I reported to the fighter which direction to head for and then commenced descent to Goose, landing at 0145 G.M.T. As we taxied in another fighter was dispatched to take over from the first.

A US Air Force Intelligence Officer met us and we gave him the story. I spoke to Fighter Control and he said he picked us up at 0113 G.M.T. (when we had the object in sight), but had nothing else on his screen but us.

All who watched the objects are sure that the large one at any rate was no sort of winged aircraft. The small ones were just dots. They left no vapour trails. No lights were seen, just black silhouettes. The visibility at this altitude was unlimited with no cloud other than low overcast. The sun had just set. A large flock of birds might explain it if they were birds that could fly at a true airspeed of 238 knots at 19,000 feet formating on a Boeing for about 80 miles. (quoted in: Carnell, 1954)

ii). From University of Colorado UFO Project Sighting Report Form, signed by Capt James R Howard, 01 December 1967:

I was in command of a BOAC Boeing Stratocruiser en route from New York to London via Goose Bay, Labrador (refuelling stop). Soon after crossing overhead Seven Islands at 19,000 feet, True Airspeed 230 KTS, both my copilot and I became aware of soimething moving along off our port beam at a lower altitude at a distance of maybe five miles, in and out of a broken layer of Strato Cumulus cloud. As we watched, these objects climbed above the cloud and we could now clearly see one large object and six small. As we flew on towards Goose Bay the large object began to change shape and the smaller to move relative to the larger.

We informed Goose Bay that we had something odd in sight and they made arrangements to vector a fighter (F-94?) on to us. Later I changed radio frequency to contact this fighter; the pilot told me he had me in sight on radar closing me head-on at 20 miles. At that the small objects seemed to enter the larger, and then the big one shrank. I gave a description if this to the fighter and a bearing of the objects from me. I then had to change back to the Goose freq for descent clearance. I don't know if the fighter saw anything as he hadn't landed when I left Goose for London. We were interviewed by USAF Intelligence at Goose, who seemed quite accustomed to such sightings in that area . . .

One object much larger than other six. All opaque, sharp-edged in silhouette. Position of small objects always in line with large one but moved about so that sometimes three either side, sometimes 1, 2, 3, 4 or 5 ahead, rest behind. Never more than seven total. Shape of small ones always globular but larger constantly, slowly changing shape. No colours or lights seen. . . . [Appeared] either solid or thick opaque gas.

When first sighted (my aircraft was at 19,000 ft which I maintained) the objects were approx. on my port beam but perhaps 10,000 ft lower. Maintaining their position laterally they climbed until they appeared to be at our altitude. Later, I think they climbed slightly before disappearing. When first seen the background was part cloud (3/8ths St.Cu) which they appeared to be moving through. Later the background was bright sky just before and after sunset.

[Speed of objects] 230 KTS . . . Same speed as airplane.

Small objects appeared to enter larger, then larger dwindled away to a pinpoint and disappeared.

(Files of the University of Colorado UFO Project, American Philosophical Society, Philadelphia)

Appendix C. Project Genetrix ("Moby Dick")

i) AIR 2/17903 Project Genetrix balloon-gondola recovery procedure

SECRET

From:- Headquarters Coastal Command
To:- Headquarters No.18 Group; Headquarters No.19 Group

Copies to:- Air Ministry (A.C.A.S. (Ops)); Air Ministry (D. of Ops. (M.&N.)); Headquarters Fighter Command; Royal Air Force Element, Maritime Headquarters, Chatham
Date:- 3rd December 1955
Ref:- CC/S.5901/25/ATC

Project 119L - High Altitude Meteorological Balloons

1. Information has been received from the Air Ministry that high altitude meteorological balloons will be launched by the R.A.F./U.S.A.F. unit at R.N.A.S. Evanton between the period 1st December, 1955, to April, 1956. The procedures outlined below are to be adopted to recover gondolas from balloons which drift into the sea around the British Isles.

2. The balloons will fly between 40,000 and 60,000 feet. An automatic release mechanism separates the balloon from the gondola at 30,000 feet. The object, therefore, is to damage the balloon by gunfire so that it sinks to 30,000 feet and releases its load over the sea. On release from the balloon the gondola will descend by parachute and is to be recovered from the sea. The balloon itself will fall into the sea but is not to be recovered, particularly as hydrogen trapped in the folds may make the envelope dangerous to handle.

Task

3. At the request of the Air Defence Operations Centre, Fighter Command, this Command will be responsible, through the appropriate Rescue Co-ordination Centre, for assisting in the recovery of the gondolas from the sea, where this is practicable, using aircraft and/or marine craft. Any assistance given by this command is not to prejudice search and rescue responsibilities.

Particulars of gondolas

4. The gondolas weigh approximately 400 lbs and measure 30" x 37" x 50". They are equipped with a hook to facilitate pick-up and will be painted bright yellow. Recovered gondolas are to be treated as "classified" equipment. Under no circumstances is a gondola to be opened.

Duties of Rescue Co-ordination Centres.

5. On receipt of a request from the A.D.O.C. Fighter Command for assistance in the location and/or recovery of a gondola from the sea, the R.C.C. Duty Controller is to take action as follows:-

(a) Despatch an aircraft to the position indicated by A.D.O.C. Fighter Command to search for and locate the gondola.

(b) When practicable despatch a surface vessel to the area when the gondala has been located. R.A.F. rescue craft should not normally be sent to an incident more than 180 miles from the base.

(c) [*page missing*]

ii) AIR 2/17903, Project Genetrix, USAF press-release instructions

SECRET

MESSAGE

NO UNCLASSIFIED REPLY PERMITTED IF THE DATE-TIME GROUP OF THE MESSAGE IS QUOTED.

(RECEIVED BY SECURE MEANS 9TH JANUARY, 1956).

FROM :- COMAIRDIV ONE DET ONE HIGH WYCOMBE.

TO : - COMDR AIR MINISTRY BRITISH WHITEHALL

PRIORITY. SECRET.

CITE 1 ADD 1 - 37.

ATTN: OPNS AIR DEFENSE FOR PROJECT 119L.
PASS TO SQDN LDR MARTIN.
FOR INFORMATION THE FOLLOWING CHIEF OF STAFF MESSAGE IN 6 PARTS HAS BEEN DISSEMINATED TO ALL USAF COMMANDS AND US AIR ATTACHES DIRECTLY CONCERNED WITH PROJECT (C) GENETRIX. QUOTE

PART 1. THIS HQ WILL ISSUE FOL PRESS RELEASE ON 9 JAN. '56:
QUOTE AN AIR FORCE METEOROLOGICAL SURVEY, COMMONLY KNOWN AS QUOTE MOBY DICK UNQUOTE HERE IN THE US IS BEING EXPANDED TO INCLUDE OTHER AREAS IN THE NORTHERN HEMISPHERE. THIS RESEARCH PROGRAM HAS BEEN IN PROGRESS FOR THE PAST 2 YRS TO OBTAIN METEOROLOGICAL DATA ABOVE 30,000 FT. LARGE PLASTIC BALLOONS, WHICH HAVE OFTEN BEEN MISTAKEN FOR QUOTE FLYING SAUCERS UNQUOTE WILL CARRY METEOROLOGICAL INSTRU[MENTS] INCL CAMERAS TO PHOTO CLOUDS AND RADIO EQUIP TO RECORD AND TELEMETER ATMOSPHERIC INFO. THIS METHOD OF OBTAINING METEOROLOGICAL RESEARCH DATA COULD BE OF GREAT USE IN THE INTERNATIONAL GEO PHYSICAL YEAR PROGRAMS THAT WILL BE CONDUCTED DURING 195

CORRUPT PORTION (APPROX. 3 LINES OF TEXT)

MANY METEOROLOGICAL PHENOMENA THAT EXIST IN THE VAST UNEXPLORED REGION SURROUNDING THE EARTH. THUS, INFO WILL BE OBTAINED THAT MAY BE OF IMPORTANCE WHEN A MAN-MADE SATELLITE IS FIRED INTO SPACE WITHIN THE NEXT FEW YEARS. THE PROGRAM IS DESIGNED TO OBTAIN METEOROLOGICAL OBSERVATIONS IN THE NORTHERN HEMISPHERE. IT IS EXPECTED THAT NEW INFO WILL BE OBTAINED ON JET STREAMS. PICTURES OF CLOUD SYS ASSOCIATED WITH FRONTAL SYS, AND STORM FORMATIONS WITH ELECTRO-MAGNETIC RADIATION AND RADIO PROPAGATION. BY STUDYING THE COMPLETE GENERAL CIRCULATION AND CLOUD PATTERNS WE CAN LEARN MORE ABOUT THE CAUSES OF SEVERE WEATHER. IT IS HOPED THAT THE INFO OBTAINED MAY HELP EXPLAIN RECENT UNUSUAL WEA OCCURRENCES IN THE US. THE 1955 HURRICANE PATHS SHIFTED FROM THEIR NORMAL COURSES AND BROUGHT DISASTER ALONG OUR EASTERN COASTAL AREA. DUST STORMS AND GALKE WINDS CAUSED EXTENSIVE DAMAGE TO CROPS IN THE MID-WEST. HEAVY RAINFALLS CAUSED FLOODS IN THE WEST AND NORTHEAST THEY HAVE NEVER BEEN EXPERIENCED BEFORE. THE US WEA BUREAU IS INTERESTED IN THIS PROGRAM AND THE DATA WILL BE ANALYZED IN AN ATTEMPT TO IMPROVE FORECASTING AND TO PROVIDE EARLY WARNING OF SEVERE WEA PHENOMENA. MORE THAN FOUR THOUSAND BALLOON FLT HAVE BEEN CONDUCTED WITHOUT INTERRUPTION OR HAZARD TO AERIAL NAVIGATION. IN ORDER TO PRESERVE AND CONTINUE THIS EXCELLENT SAFETY RECORD, FOOL-

PROOF SAFETY DEVICES ARE USED ON ALL BALLOON FLTS. EXPERIENCE HAS ALSO SHOWN THAT BALLOON FLTS ARE NO HAZARD TO AVIATION WHEN FLOWN AT ALTITUDES ABOVE 30,000 FT. SINCE COMM AVIATION AND MOST MILITARY AVIATION ARE PRESENTLY CONDUCTED BELOW 30,000 FT, BALLOONS ARE PREVENTED FROM FLOATING BELOW THIS LEVEL BY SAFETY DEVICES. A BALLOON THAT FAILS TO REACH 30,000 FT WITHIN 50-60 MINUTES AFTER ONCE PASSING THROUGH THAT ALTITUDE, IS ALSO DESTROYED. THE DESTRUCTION OF THE BALLOON IS RATHER SIMPLE. BY CUTTING AWAY THE ATTACHED EQUIP BY MEANS OF A SAFETY DEVICE, THE BALLOON RISES RAPIDLY INTO SUBFREEZING STRATOSPHERE WHERE EXPANSION OF LIFTING GAS WILL CAUSE IT TO BURST, JUST AS ORDINARY METEOROLOGICAL BALLOONS EXPAND AND BURST AT HIGH ALTITUDE., AS PLASTIC MATERIAL BECOMES BRITTLE AT SUB-FREEZING TEMPERATURES THE BALLOON, UPON BURSTING ACTUALLY SHATTERS INTO MANY SMALL PIECES THAT FLOAT HARMLESSLY TO EARTH. MOST OF THE BALLOON FLTS HAVE BEEN CONDUCTED IN THE US; HOWEVER, THE COOPERATION OF OTHER GOVERNMENTS HAS MADE IT POSSIBLE FOR SMALL METEOROLOGICAL RESEARCH STATIONS TO BE ESTABLISHED INTO THEIR COUNTRIES. METEOROLOGICAL BALLOONS HAVE BEEN FLOWN FROM BRAZIL, PANAMA, SCOTLAND, JAPAN AND OKINAWA. THE ADDITION OF RESEARCH STATIONS IN EUROPE, ALASKA AND HAWAII DURING 1956 WILL INCREASE THE SCOPE OF THIS PROGRAM.

PART TWO. FOLG TEXTS OF PRESS RELEASES FOR FEAF, ALAIRCOM AND PACAF HAVE BEEN COORDINATED WITH OFFICE OF INFO SERV, SCC/AF: (A) FEAF: QUOTE THE FAR EAST AIR FORCES ANNOUNCED TODAY THAT RESEARCH STUDIES INTO UPPER ATMOSPHERIC CONDITIONS ARE BEING CONTINUED FROM KADENA AFB ON OKINAWA. THE STUDIES, USING HIGH ALTITUDE METEOROLOGICAL BALLOONS, WERE BEGUN IN SEP FROM KOREA AND OKINAWA. LAUNCHES FROM KOREA HAVE BEEN COMPLETED. THE BALLOONS ARE USED TO GATHER INFO ON WIND PATTERNS, CLOUD FORMATIONS, FRONTAL SYS AND OTHER ATMOSPHERIC PHENOMENA AT ALTITUDES ABOVE 30,000 FT. THE STUDIES IN THE FAR EAST ARE PART OF A METEOROLOGICAL SURVEY WHICH IS BEING CONDUCTED IN OTHER AREAS OF THE WORLD UNQUOTE; (B) ALAIRCOM IN ALASKAN AIR COMMAND HQ ANNOUNCED TODAY THAT A METEOROLOGOCAL RESEARCH STA WILL BE ACTIVATED IN ALASKA, IN THE NEAR FUTURE. IT IS PLANNED TO LOCATE THE STA AT EIELSON AFB. THE RESEARCH STA WILL LAUNCH WEA BALLOONS TO GATHER METEOROLOGICAL INFO FROM THE ATMOSPHERE AT ALTITUDES ABOVE 30,000 FT. THE STUDIES ARE CONCERNED WITH WIND PATTERNS, CLOUD FORMATIONS, FRONTAL SYS AND OTHER ATMOSPHERIC PHENOMENA. tHE STUDIES WILL BE A CONTINUATION OF AN AF METEOROLOGICAL SURVEY BEING CONDUCTED IN OTHER AREAS OF THE WORLD; (C) PROPOSED PRESS RELEASE FOR PACAF: QTE PACIFIC AIR FORCE ANNOUNCED TODAY THAT METEOROLOGICAL RESEARCH STATION WILL LAUNCH LARGE PLASTIC BALLOONS TO GATHER METEOROLOGICAL INFO AT ALTITUDES OVER 30,000 FT. SIMILAR BALLON RESEARCH FLTS WERE CONDUCTED HERE DURING '54 AND '55. THE BALLOONS ARE USED TO OBTAIN INFO ON WIND PATTERNS, CLOUD FORMATIONS, FRONTAL SYS AND OTHER ATMOSPHERIC PHENOMENA. THE STUDIES THAT WILL BE CONDUCTED HERE ARE A PART OF AN AIR FORCE METEOROLOGICAL SURVEY

Appendix D: Key Project Blue Book File Documents

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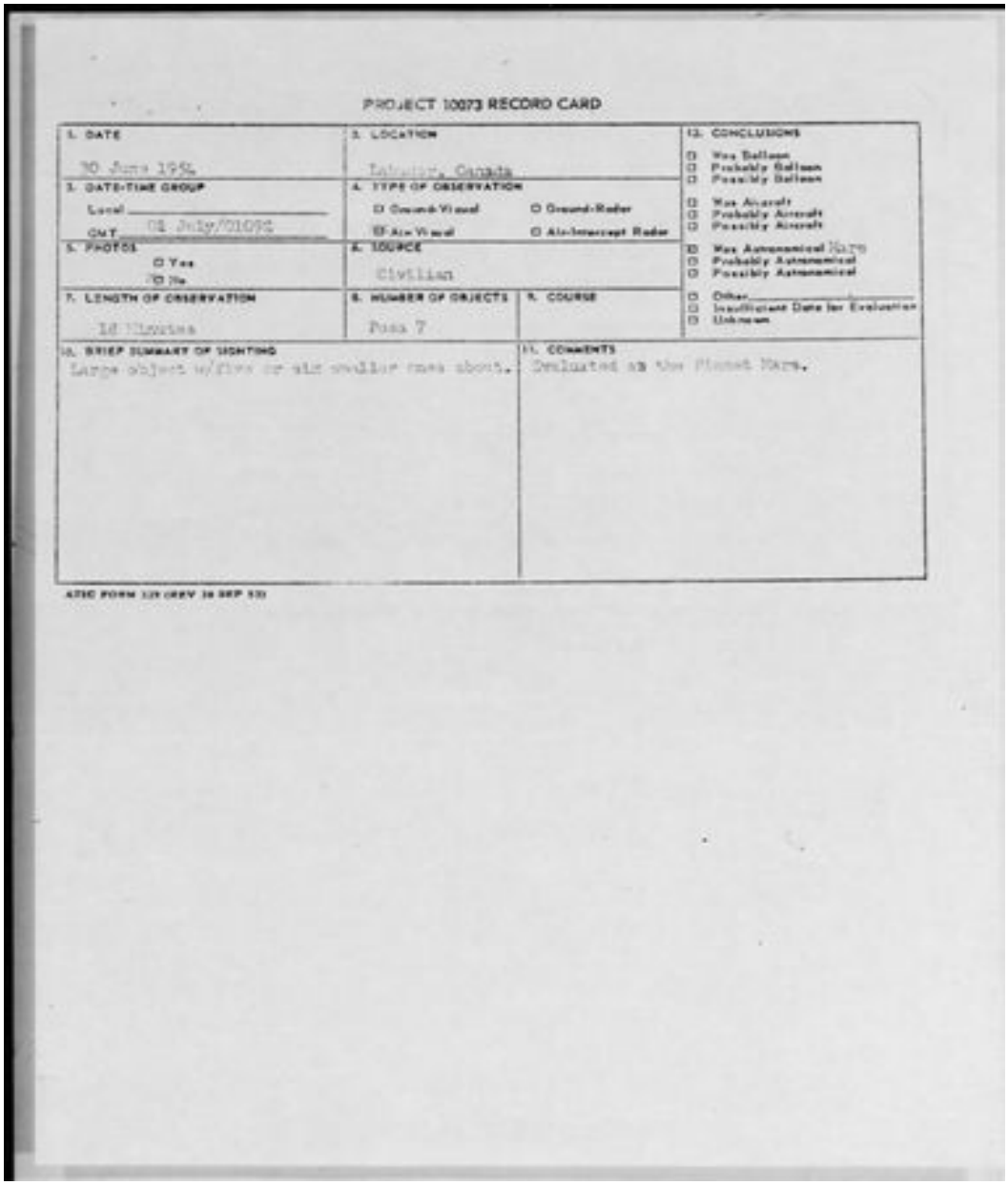
1. Project Blue Book Record



PROJECT 10073 RECORD CARD

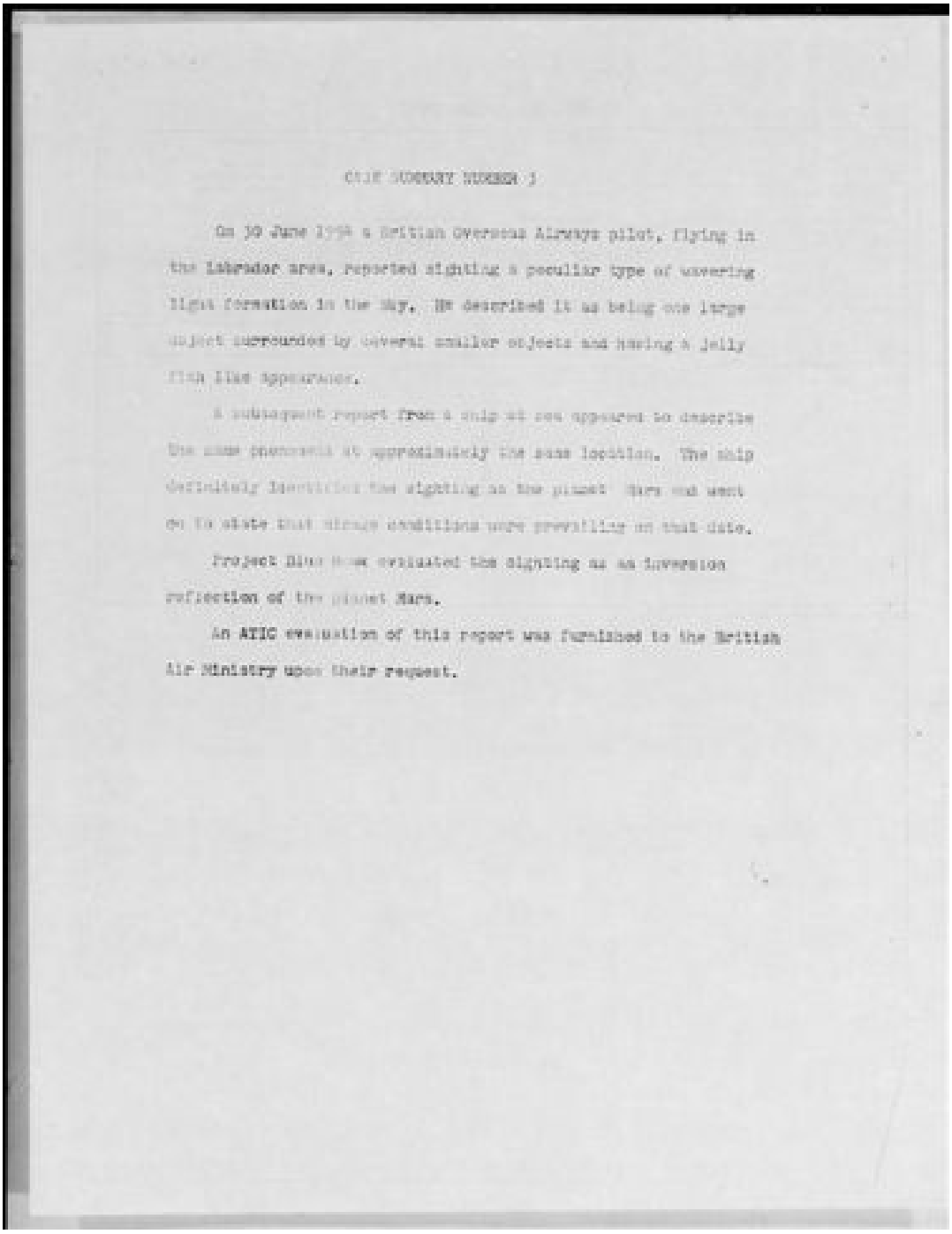
1. DATE: 30 June 1954	2. LOCATION: Labrador, Canada	12. CONCLUSIONS: ☐ Was Balloon ☐ Probably Balloon ☐ Possibly Balloon ☐ Was Aircraft ☐ Probably Aircraft ☐ Possibly Aircraft ☒ Was Astronomical Mars ☐ Probably Astronomical ☐ Possibly Astronomical ☐ Other ☐ Insufficient Data for Evaluation ☐ Unknown
3. DATE-TIME GROUP: Local ____ GMT 01 July/0100Z	4. TYPE OF OBSERVATION: ☐ Ground-Visual ☐ Ground-Radar ☒ Air-Visual ☐ Air-Intercept Radar	
5. PHOTOS: ☐ Yes ☒ No	6. SOURCE: Civilian	
7. LENGTH OF OBSERVATION: 10 Minutes	8. NUMBER OF OBJECTS: Four 7	9. COURSE

10. BRIEF SUMMARY OF SIGHTING: Large object w/five or six smaller ones about.

11. COMMENTS: Evaluated as the Planet Mars.

AFSC FORM 329 (REV 30 SEP 53)

2. Project Blue Book Case Summary



CASE SUMMARY NUMBER 1

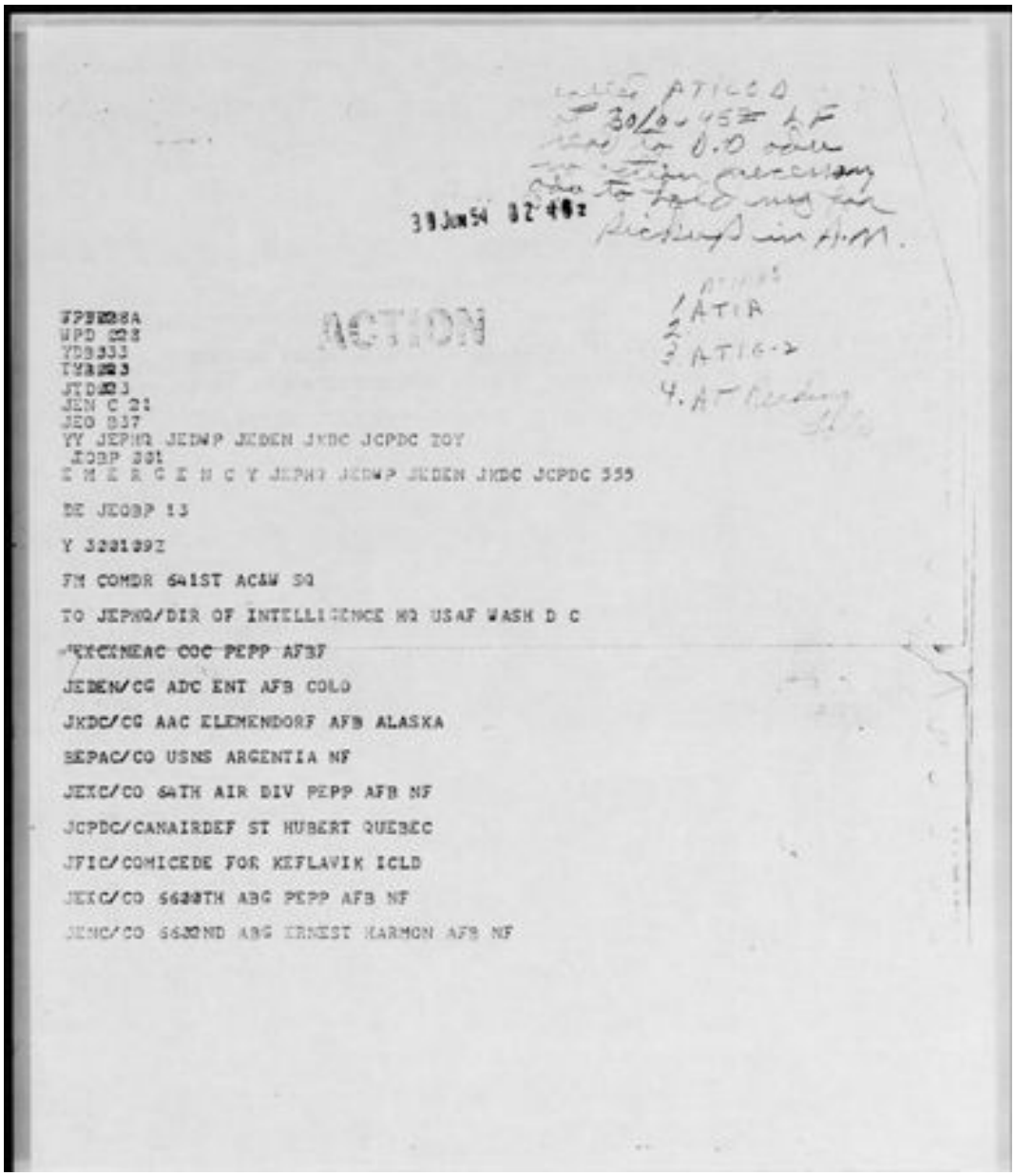
On 30 June 1954 a British Overseas Airways pilot, flying in the Labrador area, reported sighting a peculiar type of wavering light formation in the sky. He described it as being one large object surrounded by several smaller objects and having a jelly fish like appearance.

A subsequent report from a ship at sea appeared to describe the same phenomena at approximately the same location. The ship definitely identified the sighting as the planet Mars and went on to state that strong conditions were prevailing on that date.

Project Blue Book evaluated the sighting as an inversion reflection of the planet Mars.

An ATIC evaluation of this report was furnished to the British Air Ministry upon their request.

3. Telex from Commander, 641st Aircraft Control and Warning Squadron, Goose Bay, to various commands, 0150Z, 30 June 1954. Page 1.



30 Jun 54 02 48Z

ACTION

1 ATIA
2
3 ATIC-2
4. AF Reading

FP
WPD
YD
IY
JTD
JEN C 21
JEO 837
YY JEPHQ JEDWP JEDEN JKDC JCPDC ZOY
JCGBP 301
E M E R G E N C Y JEPHQ JEDWP JEDEN JKDC JCPDC 559

DE JCGBP 13

Y 3201Z

FM COMDR 641ST ACAW SQ

TO JEPHQ/DIR OF INTELLIGENCE HQ USAF WASH D C

~~EXCINEAC COC PEPP AFB~~

JEDEN/CG ADC ENT AFB COLO

JKDC/CG AAC ELEMENDORF AFB ALASKA

SEPAC/CO USNS ARGENTIA NF

JEKC/CO 64TH AIR DIV PEPP AFB NF

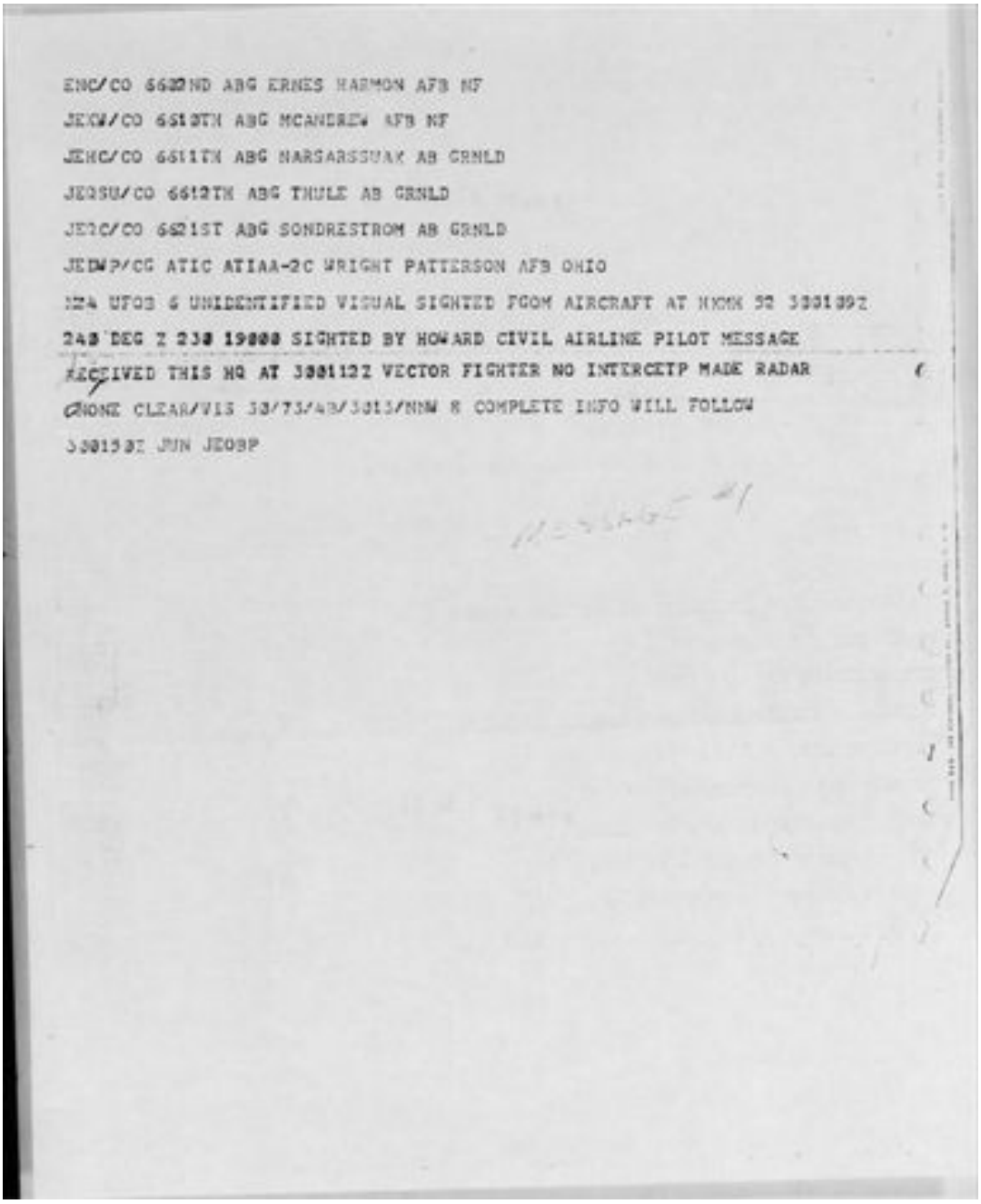
JCPDC/CANAIRDEF ST HUBERT QUEBEC

JFIC/COMICEDE FOR KEFLAVIK ICLD

JEKC/CO 5620TH ABG PEPP AFB NF

JENC/CO 5620ND ABG ERNEST HARMON AFB NF

4. Telex from Commander, 641st Aircraft Control and Warning Squadron, Goose Bay, to various commands, 0150Z, 30 June 1954. Page 2.



ENC/CO 662ND ABG ERNES HARMON AFB NF

JEKW/CO 6613TN ABG MCANDREW AFB NF

JEHC/CO 6611TN ABG NARSARSSUAK AB GRNLD

JERSU/CO 6612TN ABG THULE AB GRNLD

JERC/CO 621ST ABG SONDRESTROM AB GRNLD

JEDWP/CG ATIC ATIAA-2C WRIGHT PATTERSON AFB OHIO

1ZA UFOB 6 UNIDENTIFIED VISUAL SIGHTED FROM AIRCRAFT AT NKMN 30 3301302

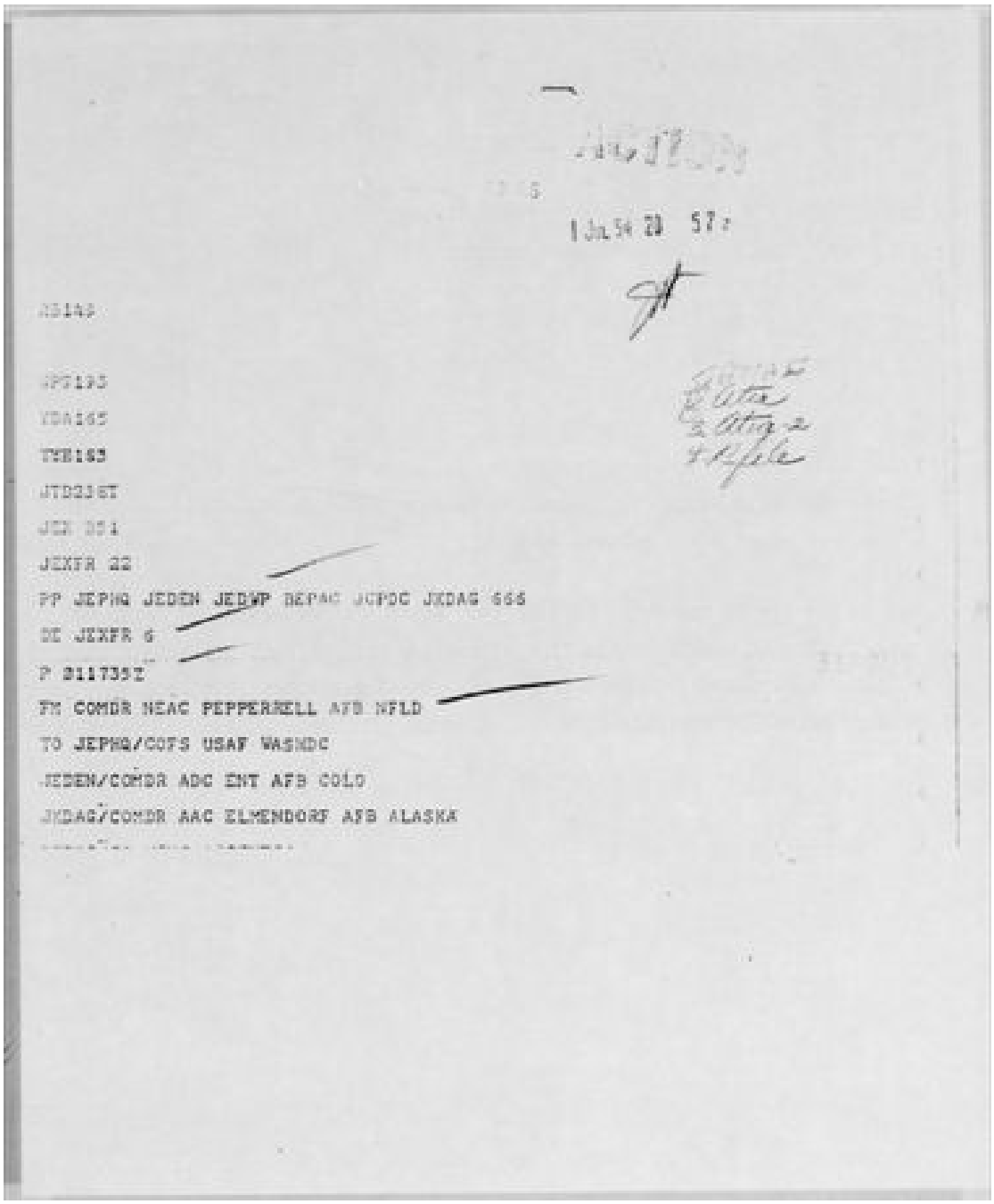
240 DEG Z 230 19000 SIGHTED BY HOWARD CIVIL AIRLINE PILOT MESSAGE

RECEIVED THIS HQ AT 3301122 VECTOR FIGHTER NO INTERCEPT MADE RADAR

NONE CLEAR/VIS 30/73/43/3013/NNW 8 COMPLETE INFO WILL FOLLOW

3301502 JUN JEDBP

5. Telex from Commander, North East Air Command, Pepperell AFB, Newfoundland, to various commands, 1741Z, 30 June 1954. Page 1.



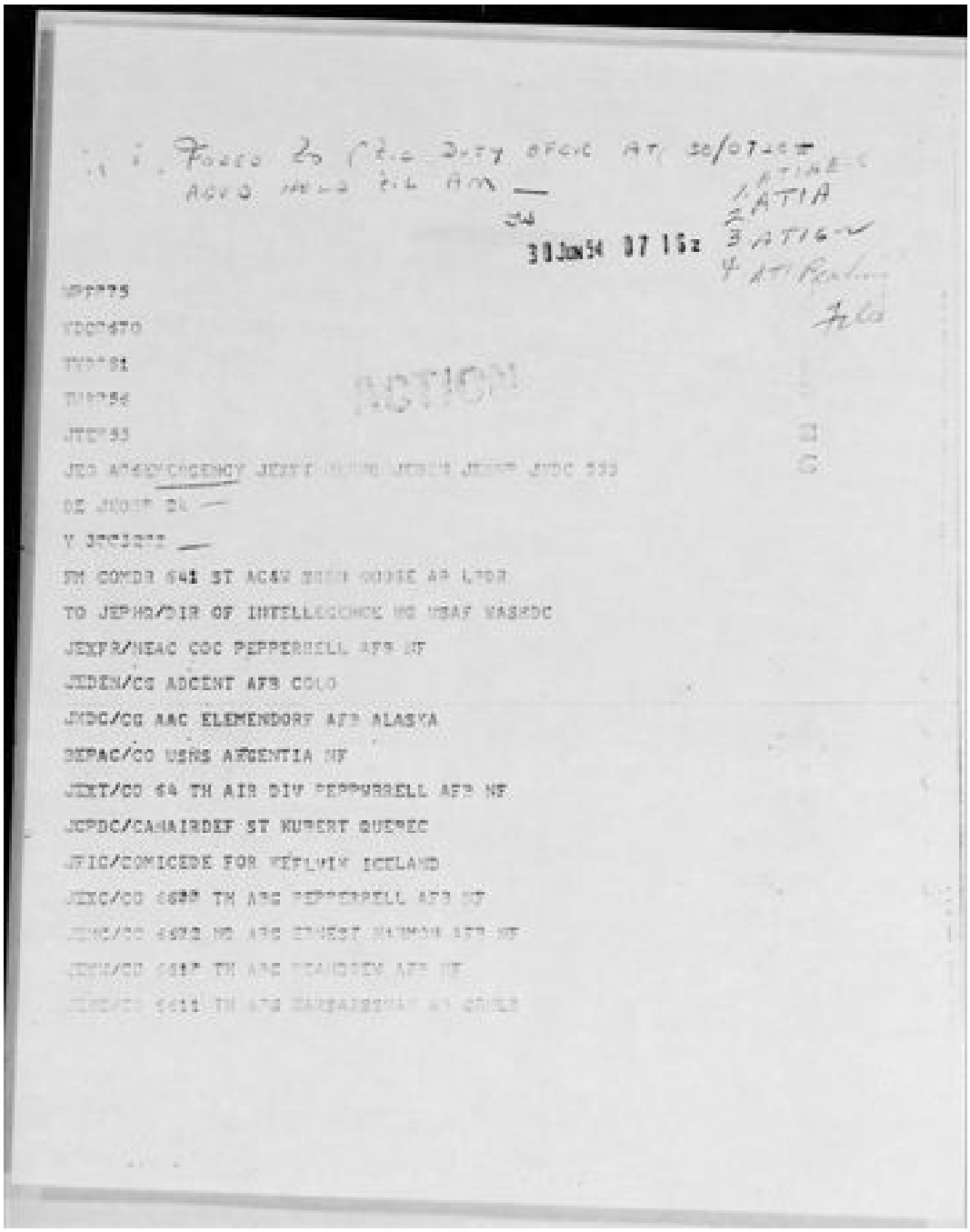
JEXFR 22
PP JEPHQ JEDEN JEDWP BEPAC JCPOC JKDAG 666
DE JEXFR 6
P 301735Z
FM COMDR NEAC PEPPERRELL AFB NFLD
TO JEPHQ/COFS USAF WASHDC
JEDEN/COMDR ADC ENT AFB COLO
JKDAG/COMDR AAC ELMENDORF AFB ALASKA

6. Telex from Commander, North East Air Command, Pepperell AFB, Newfoundland, to various commands, 1741Z, 30 June 1954. Page 2.

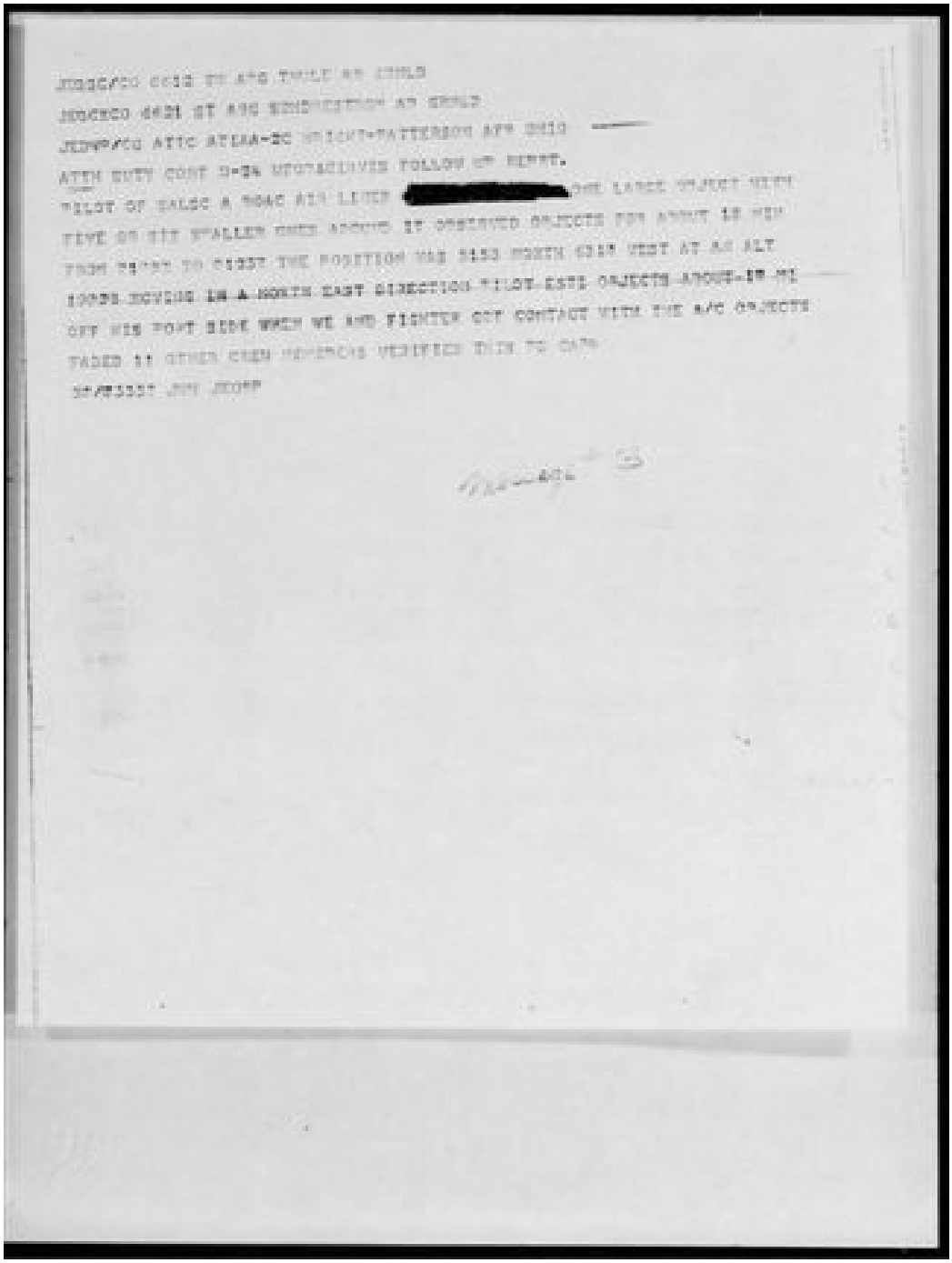
NEPRC/CO USCG ARGENTIA
ZEN/COMDR 64TH AIR DIV PEPPERRELL AFB NFLD
JCPDC/CANAIRDEF ST HUBERT QUE
JFIC/COMDR IADF KEFLAVIK APRT KEFLAVIK ICELAND
ZEN/COMDR 6624TH AB WG PEPPERRELL AFB NFLD
JENC/COMDR 6605TH AB WG ERNEST HARMON AFB NFLD
JEOC/COMDR 6606TH AB WG GOOSE AB LABR
JEDEC/COMDR 6607TH AB WG THULE AB GRNLD
JERN/COMDR 6610TH AB GP MCANDREW AFB NFLD
JENC/COMDR 6611TH AB GP NARSARSSUAK AB GRNLD
JEQC/COMDR 6621ST AB SQ SONDRESTROM AB GRNLD
JEDWP/COMDR ATIC WRIGHT PATTERSON AFB OHIO
JEOC/COMDR 641ST AC&W SQ GOOSE AB GRNLD
AF GRNC
NEOCOC-I-35D01 QD REFFRENCE MESSAGE FROM 641ST AC&W SQUADRON CMA DATED
300129Z PD NEAC EVALUATES SIGHTING AS UNKNOWN NATURAL PHENOMENA CMA
POSSIBLY A MIRAGE AS A TEMPERATURE INVERSION IN THE REFERENCED AREA
MADE THIS CONDITION POSSIBLE PD
01/1741Z JUL JEXFR

MESSAGE #2

7. Telex from Commander, 641st Aircraft Control and Warning Squadron, Goose Bay, to various commands, 0333Z, 30 June 1954. Page 1.



8. Telex from Commander, 641st Aircraft Control and Warning Squadron, Goose Bay, to various commands, 0333Z, 30 June 1954. Page 2.



9. Telex from Commander, 6607th Air Base Wing, Thule AFB, Greenland, to Commander 641st AC&W Squadron, Goose AFB.

1 ATIA
2 ATIAE-5
3 ATIS-2
4 ATI Galaxy
File

30 JUN 54 06 32z

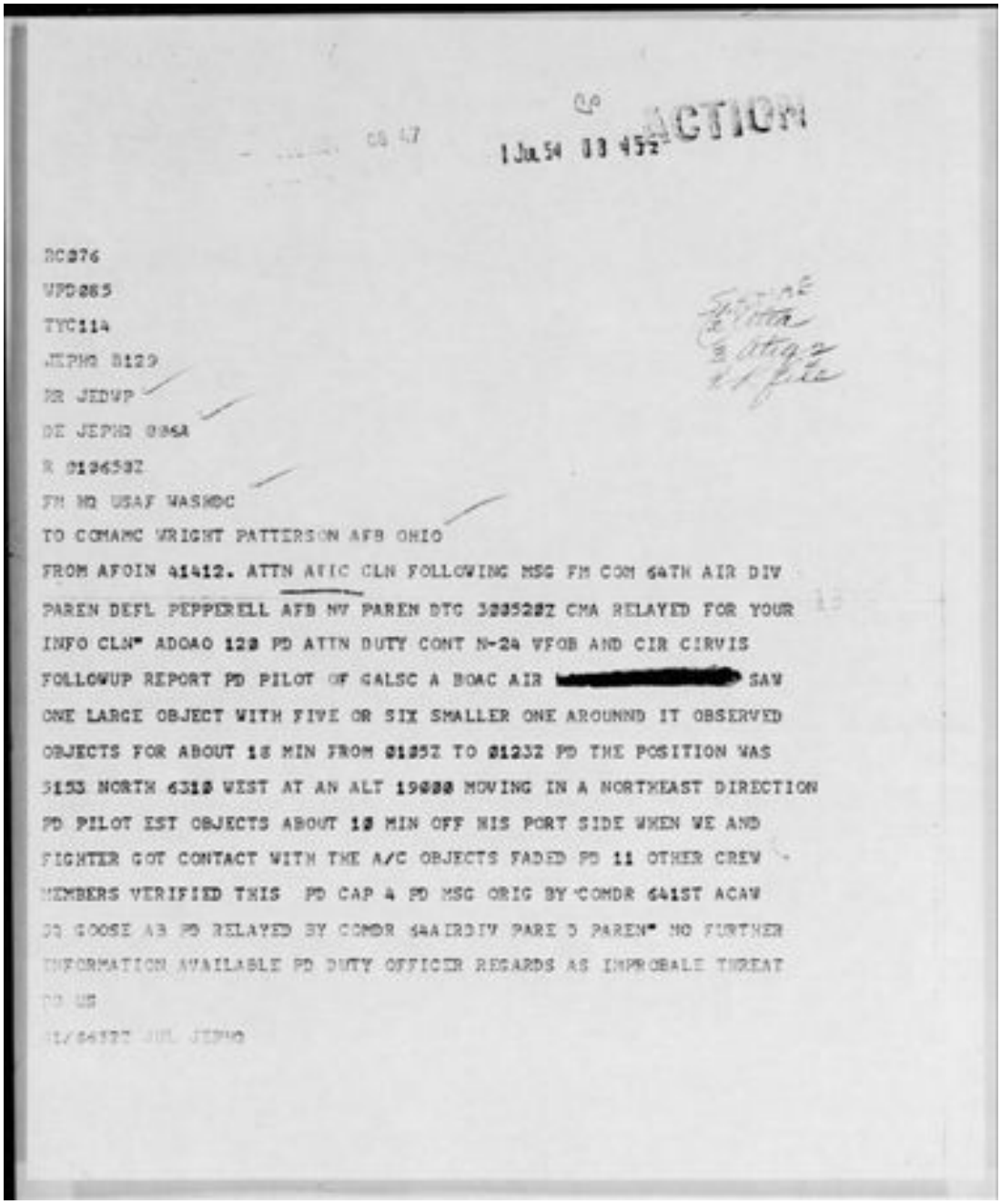
ACTION

5 3/0

Please to Major Hess ATIC OS at 340632Z - CZ - Read text and will pickup.

MJ0739
ZYA790
JFP738
JEO 374
JEQ A63
JEQS 337
EMERGENCY EOC JEXFT JEDWP 333
DE JEQSC 24
Y 300543Z
FM COMDR 6607THABW THUL AB GRNLD
TO JEOC/COMDR 641 AC&W SQ GOOSE AB ARPT
INFO JEXFT/COMDR 64TH AIR DV (DEF) PEPPERRELL AFB NFLE ATTN DUTY CONTROLR
JEDWP/COMDR ATIC WRIGH-PATERSON AFB OHIO
THOPI 5359
REF YOUR MESG M24 UFOB CLN NEG REPORT THIST PD
30/0545Z JUN JEQSC

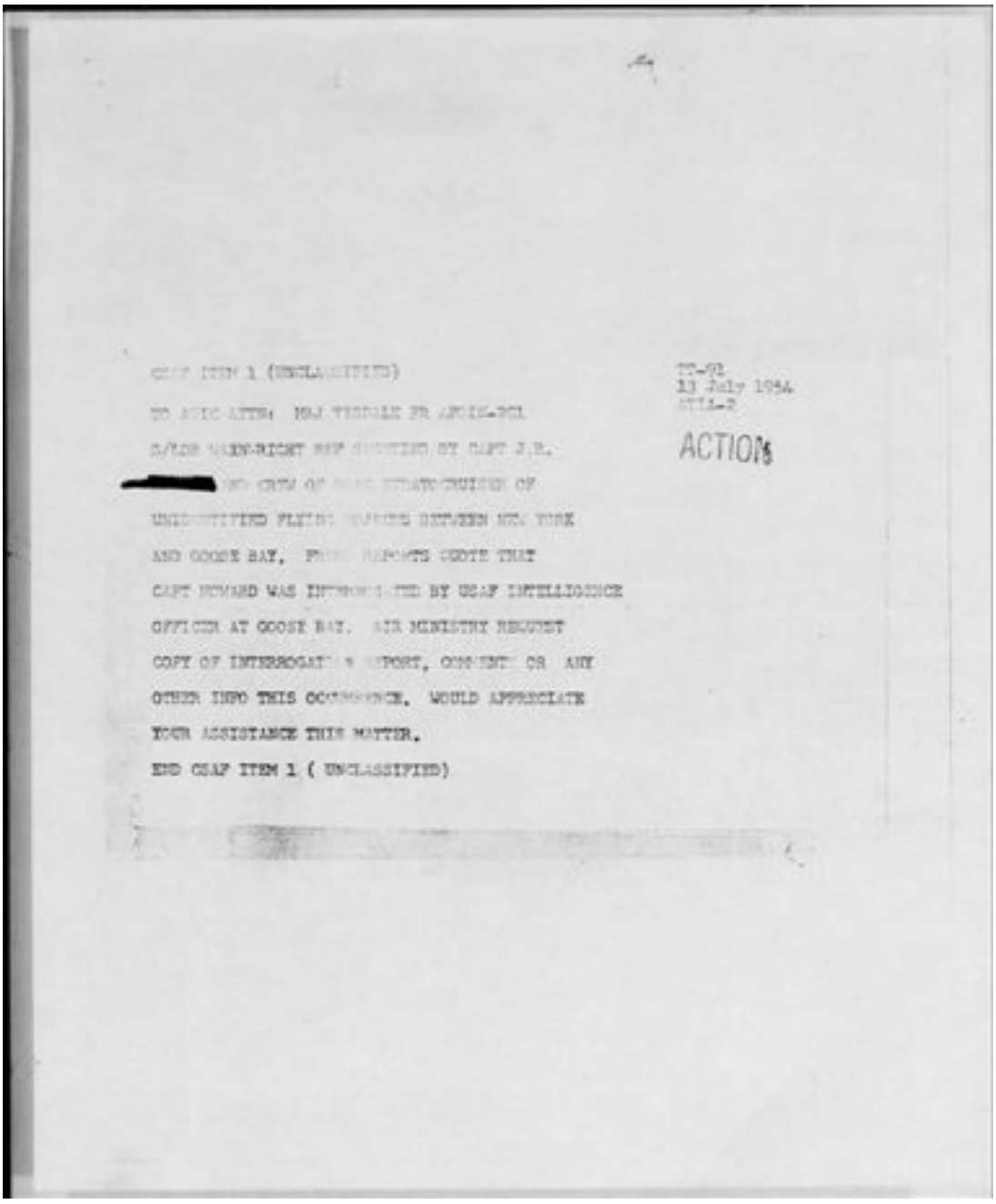
10. Telex from HQ USAF Washington forwarding report to Commander, Air Materiel Command, Wright-Patterson AFB, 01 July 1954



1 Jul 54 03 45Z ACTION

DC376
WPD365
TYC114
JEPHQ 8129
RR JEDWP
DE JEPHQ 0054
R 0136537
FM HQ USAF WASHDC
TO COMAMC WRIGHT PATTERSON AFB OHIO
FROM AFOIN 41412. ATTN AFIC CLN FOLLOWING MSG FM COM 64TH AIR DIV
PAREN DEFL PEPPERELL AFB NF PAREN DTG 3005282 CMA RELAYED FOR YOUR
INFO CLN" ADOAO 128 PD ATTN DUTY CONT N-24 VFOB AND CIR CIRVIS
FOLLOWUP REPORT PD PILOT OF GALSC A BOAC AIR [redacted] SAW
ONE LARGE OBJECT WITH FIVE OR SIX SMALLER ONE AROUNND IT OBSERVED
OBJECTS FOR ABOUT 18 MIN FROM 0135Z TO 0153Z PD THE POSITION WAS
5153 NORTH 6318 WEST AT AN ALT 19000 MOVING IN A NORTHEAST DIRECTION
PD PILOT EST OBJECTS ABOUT 18 MIN OFF HIS PORT SIDE WHEN WE AND
FIGHTER GOT CONTACT WITH THE A/C OBJECTS FADED PD 11 OTHER CREW
MEMBERS VERIFIED THIS PD CAP 4 PD MSG ORIG BY COMDR 641ST ACAW
GOOSE AB PD RELAYED BY COMDR 64AIRDIV PARE 3 PAREN" NO FURTHER
INFORMATION AVAILABLE PD DUTY OFFICER REGARDS AS IMPROBALE THREAT
TO US
01/0453Z JUL JEPHQ

11. Memo re request by UK Air Ministry for information and assistance from ATIC, 13 July 1954



13 July 1954

ACTION

AND GOOSE BAY,

CAPT HOWARD WAS

OFFICER AT GOOSE BAY.

COPY OF

OTHER INFO THIS

YOUR ASSISTANCE

12. From HQ USAF to Commander, Air Materiel Command, Wright Patterson AFB forwarding sighting report from USS EDISTO, 02 July 1954

[redacted]

[illegible] 16A JEPHQ 09 02 JULY 54

C-1

[illegible] JEPHQ 040

[illegible] 021731Z

FM HQ USAF WASH DC

TO COMAMC WRIGHT PATTERSON AFB OHIO

ACK 1ATI [illegible]

PARAPHRASE NOT REQUIRED. SEE CRYPTO-CENTER BEFORE DECLASSIFYING

[redacted] FROM [illegible] ATTN: ATIC

FOLLOWING [illegible] BY USS EDISTO, ARGENTIA, [illegible] DTG [illegible] RELAYED FOR YOUR INFO: [illegible] AIR MINISTRY [illegible] BRITISH AIRLINES SIGHTING FLYING OBJECT [illegible] LABRADOR X EDISTO POSITION THREE ZERO ZERO [illegible] LATITUDE FIVE FIVE FIVE FIVE NORTH LONGITUDE FIVE EIGHT ONE ZERO WEST X SIGHTED [illegible] X REDDISH YELLOW OBJECT [illegible] IN SKY ABOUT TWENTY DEGREES ELEVATION BEARING ONE FOUR FOUR DEGREES TRUE X IDENTIFIED AT TIME AS PLANET MARS X APPEARED TO CHANGE SHAPE LIKE A JELLY FISH SWIMMING TO THE WESTWARD X ALSO APPEARED AS A DART AT TIMES X NO SATELLITES SEEN X MIRAGE EFFECT HAD BEEN PRONOUNCED DURING THE DAY IN ITS FIELD.

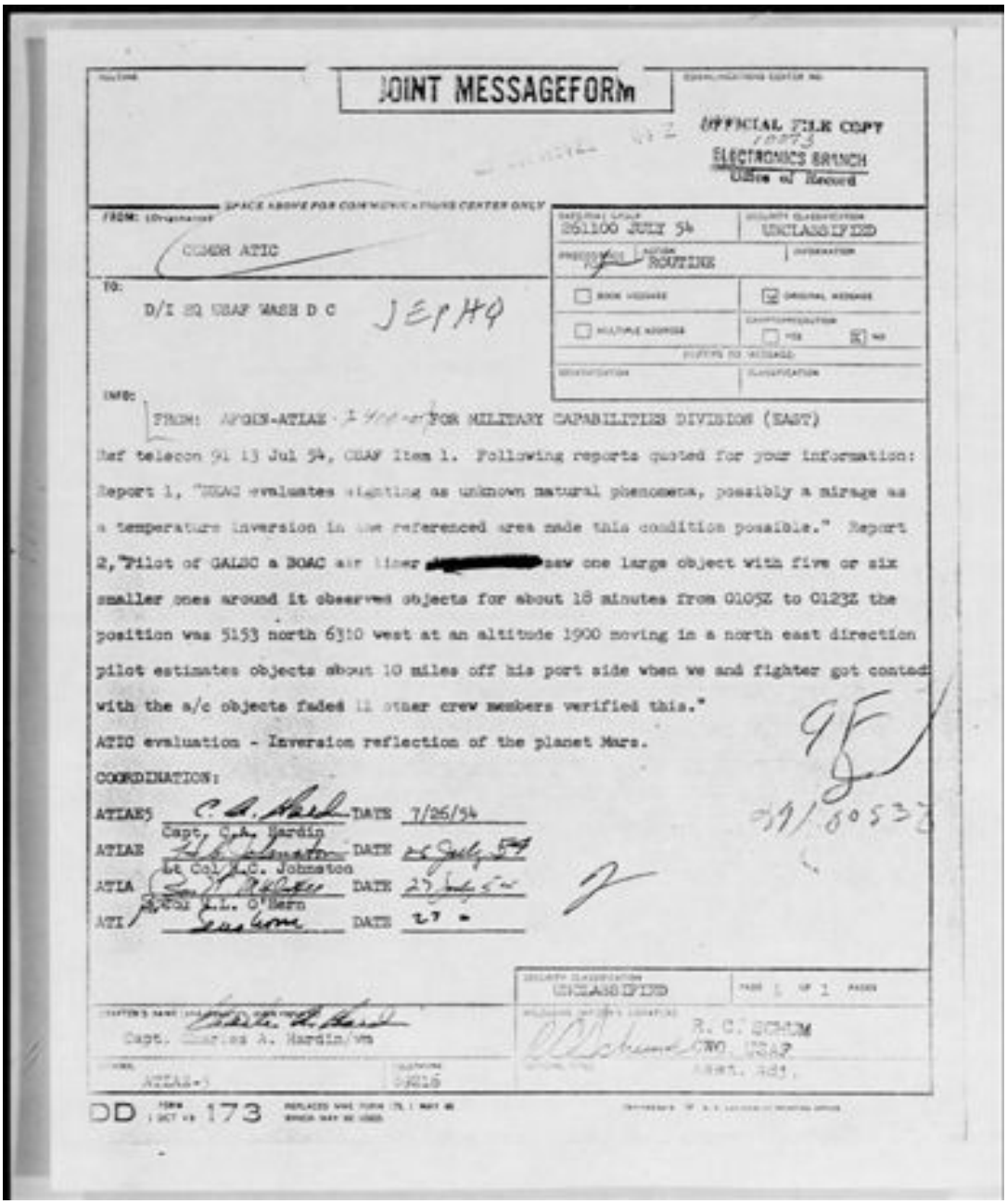
02/1140Z JUL JEPHQ

54MC-24869-

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10

[redacted]

13. Memo from Blue Book (ATIC Electronics Electronics Branch ATIAE) to Director of Intelligence HQ USAF Washington, response to request for information from UK Air Ministry (c.f. Appendix D.11) 26 July 1954



JOINT MESSAGEFORM

OFFICIAL FILE COPY
ELECTRONICS BRANCH
Office of Record

SPACE ABOVE FOR COMMUNICATIONS CENTER ONLY

FROM: CGMSH ATIC

261100 JULY 54 | UNCLASSIFIED

ROUTINE

TO: D/I HQ USAF WASH D C JEPHQ

INFO:

FROM: AFOIN-ATIAE FOR MILITARY CAPABILITIES DIVISION (EAST)

Ref telecon 91 13 Jul 54, CSAF Item 1. Following reports quoted for your information: Report 1, "USAC evaluates sighting as unknown natural phenomena, possibly a mirage as a temperature inversion in the referenced area made this condition possible." Report 2, "Pilot of GALSC a BOAC air liner [redacted] saw one large object with five or six smaller ones around it observed objects for about 18 minutes from 0105Z to 0123Z the position was 5153 north 6310 west at an altitude 1900 moving in a north east direction pilot estimates objects about 10 miles off his port side when we and fighter got contact with the a/c objects faded 11 other crew members verified this."

ATIC evaluation - Inversion reflection of the planet Mars.

COORDINATION:

ATIAE5 C.A. Hardin DATE 7/26/54
Capt. C.A. Hardin
ATIAE [illegible] DATE 26 July 54
Lt Col J.C. Johnston
ATIA [illegible] DATE 27 July 54
Major L.L. O'Mara
ATI [illegible] DATE 27 [illegible]

UNCLASSIFIED | PAGE 1 OF 1 PAGES

Capt. Charles A. Hardin/vm

R. C. GOMM
CWO, USAF

ATIAE-1 | 53610

DD FORM 1 OCT 54 173 REPLACES AAF FORM 76, 1 MAY 46 WHICH MAY BE USED

14. Memo from Blue Book (ATIC Electronics Electronics Branch ATIAE) to Director of Intelligence HQ USAF Washington, response to request for information from UK Air Ministry (c.f. Appendix D.11) 19 July 1954.

JOINT MESSAGEFORM

FROM: CMDR ATIC

TO: [illegible] JEPH9

ROUTINE

UNCLASSIFIED

FROM: [illegible]-7-377-E FOR MILITARY CAPABILITIES DIVISION (EAST)

Ref telecon [illegible] 13 Jul [illegible] Item 1. No formal report of subject sighting received by ATIC to date. Copy will be forwarded upon receipt.

COORDINATION:

ATIAE5 [signature] DATE 7/13/54
Capt. C. A. Hardin

ATIAE [signature] DATE 19 July 54
Lt. Col. H. C. Johnston

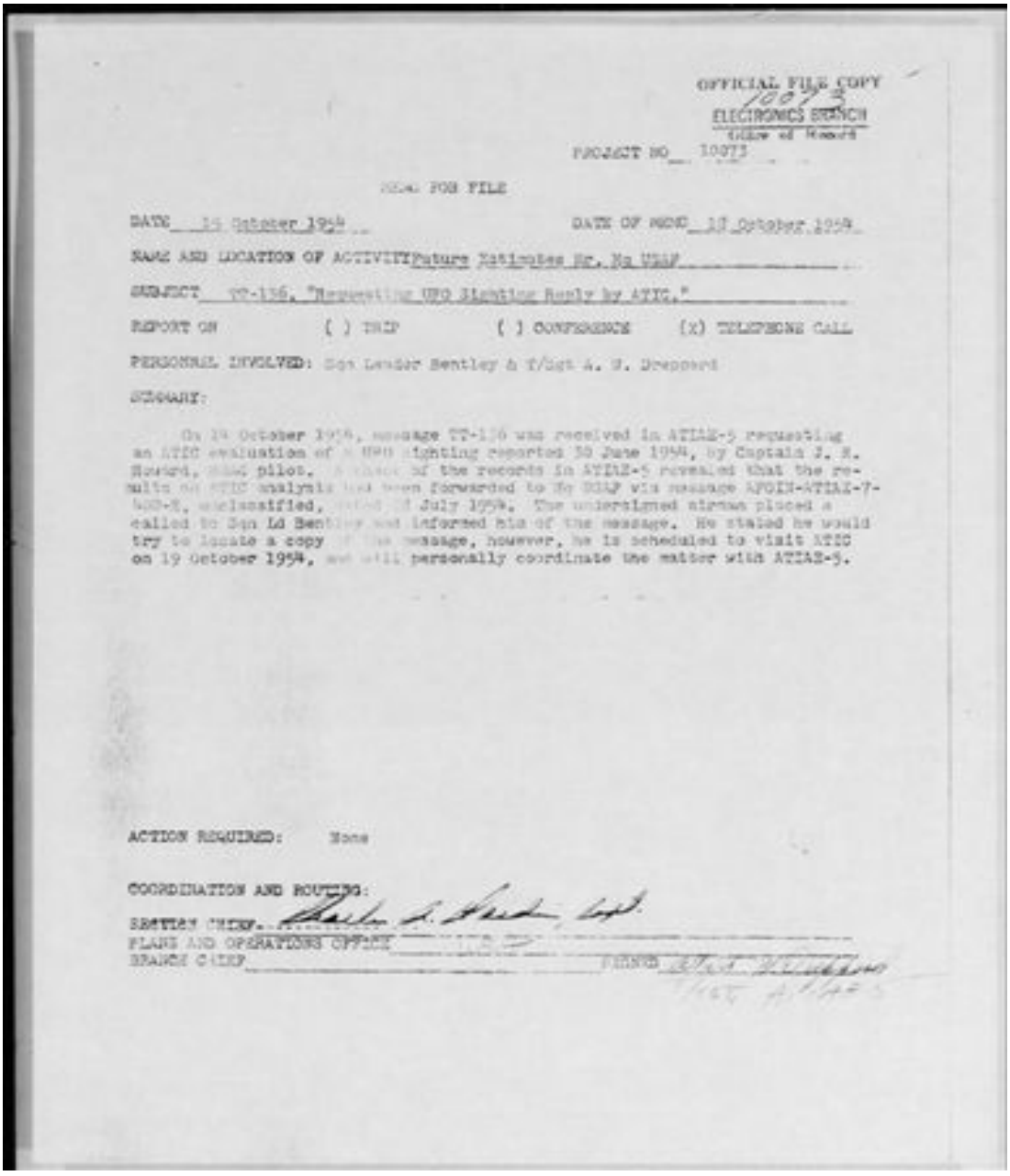
ATIA [signature] DATE 19 July 54
Col. W. L. O'Hern

ATI [signature] DATE 20 Jul 54

OFFICIAL FILE COPY
ELECTRONICS BRANCH

DD 173

15. Memo to ATIC re request (13 July, see Appendix D.11) by UK Air Ministry for information and assistance from ATIC, 14 October 1954



OFFICIAL FILE COPY
10073
ELECTRONICS BRANCH
Office of Research

PROJECT NO 10073

MEMO FOR FILE

DATE 14 October 1954 DATE OF MEMO 13 October 1954

NAME AND LOCATION OF ACTIVITY Future Intercepts Br, Wa USAF

SUBJECT TT-136, "Requesting UFO Sighting Reply by ATIC."

REPORT ON ( ) TRIP ( ) CONFERENCE (x) TELEPHONE CALL

PERSONNEL INVOLVED: Sqn Leader Bentley & T/Sgt A. B. Dreppard

SUMMARY:

On 14 October 1954, message TT-136 was received in ATIAS-5 requesting an ATIC evaluation of a UFO sighting reported 30 June 1954, by Captain J. H. Howard, USAF pilot. A check of the records in ATIAS-5 revealed that the results of ATIC analysis had been forwarded to Hq USAF via message AFOIN-ATIAI-7-400-S, unclassified, dated 13 July 1954. The undersigned almost placed a called to Sqn Ld Bentley and informed him of the message. He stated he would try to locate a copy of the message, however, he is scheduled to visit ATIC on 19 October 1954, and will personally coordinate the matter with ATIAS-5.

ACTION REQUIRED: None

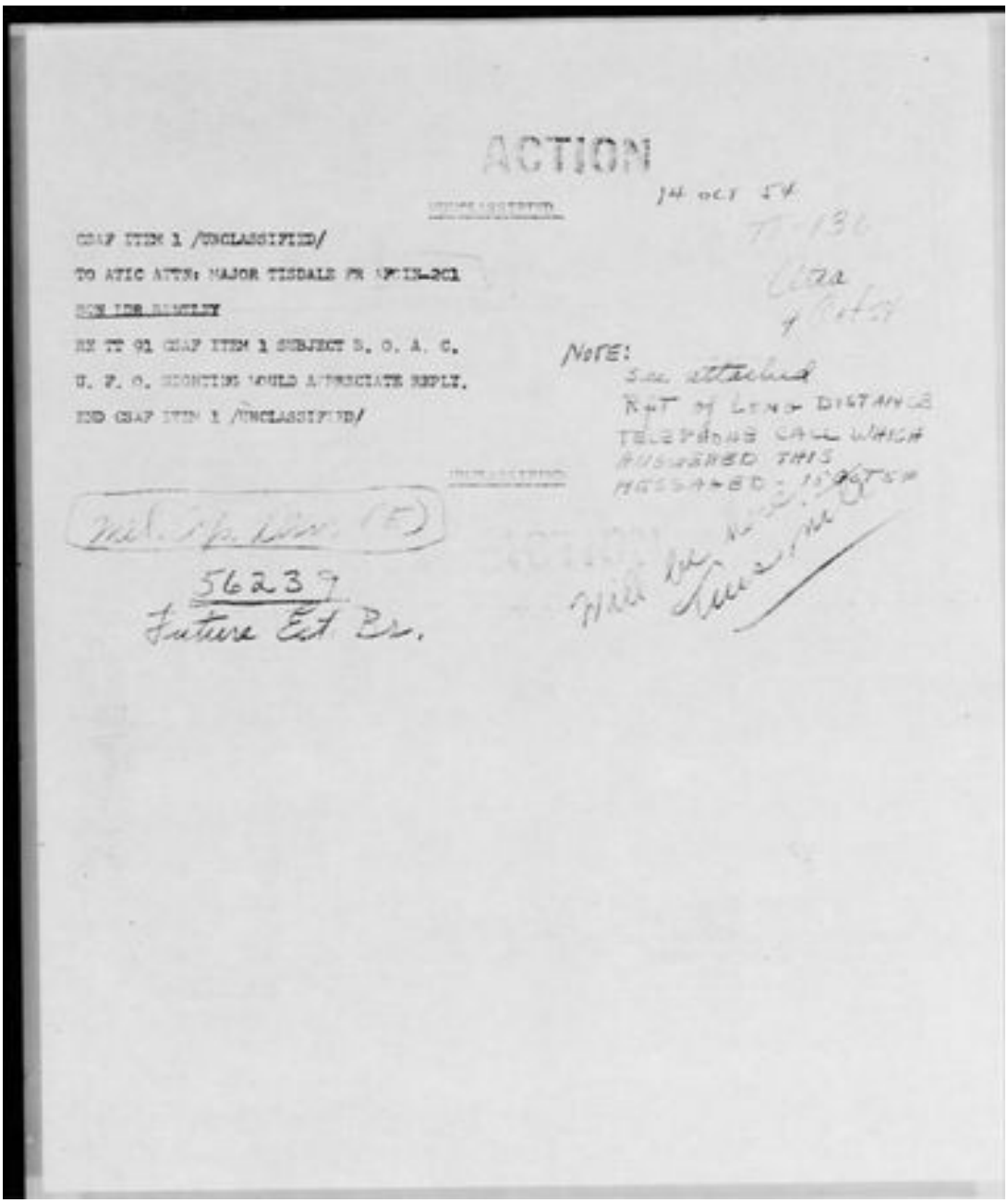
COORDINATION AND ROUTING:

SECTION CHIEF [signature]

PLANS AND OPERATIONS OFFICE

BRANCH CHIEF

16. ATIC file memo dated 15 October 1954 re telephone response to request for information from Sqd Ldr Bentley, attached to AFOIN Military Capabilities Division [East]/ Future Estimates Branch AFOIN-2C1, on behalf of UK Air Ministry



ACTION

14 OCT 54

CHAF ITEM 1 /UNCLASSIFIED/

TO ATIC ATTN: MAJOR TISDALE FR AFOIN-2C1

[redacted]

RE IT 91 CHAF ITEM 1 SUBJECT B. O. A. C.

U. F. O. SECTION WOULD APPRECIATE REPLY.

END CHAF ITEM 1 /UNCLASSIFIED/

NOTE:
See attached
Ref of Long Distance
Telephone Call which
Assigned this
Assigned: 15 OCT 54

Mil. Sp. Div. (E)

56237
Future Est Br.

17.

[redacted] of a BOAC Centaurus and others [illegible] objects flying along with them for miles [illegible] jets approached (near Goose Bay, Labrador). [illegible] identified, or is this unknown or insuffi[illegible]

18.

LABRADOR

[redacted] a British Overseas Airways pilot, flying in the Labrador area, reported sighting a peculiar type of wavering light formation in the sky. He described it as being one large object surrounded by several smaller objects and having a jelly fish like appearance.

19.

Studies of the photograph together with other extensive investigation indicated that the light was neither a material object nor a reflection from a material object.

20.

A subsequent report from a ship at sea appeared to describe the same phenomena at approximately the same location. The ship definitely identified the sighting as the Planet Mars and went on to state that mirage conditions were prevailing on that date.

21.

A subsequent report from a ship at sea appeared to describe the same phenomena at approximately the same location. The ship definitely identified the sighting as the Planet Mars and went on to state that mirage conditions were prevailing on that date.

22.

Project Blue Book evaluated the sighting as an inversion reflection of the Planet Mars.

An ATIC evaluation of this report was furnished to the British Air Ministry upon their request.

[redacted]

BOAC Airways Pilot

Labrador Area

30 June 1954 2000 hrs

One large object 5 or 6 smaller ones

Message from USS Edisto

Same object - Definitely identified as planet Mars

Appeared to change shape like Jelly Fish

" to dart at times

Mirage effect had been pronounced during day