A New Study of the British "Ghost Aeroplanes" of 1947

© Martin L Shough[1]
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Summary

When “flying saucers” began to be reported over the United States in the summer of 1947, bewildered US Army Air Force intelligence experts queried allied governments. The UK Air Ministry was able to inform them that it had already conducted an investigation into unidentified flying objects recently tracked on radar and that the mystery remained unexplained.

According to Capt Edward J Ruppelt, first chief of the USAF's Project Blue Book, the British “ghost aeroplanes” of 1947 were cited in a legendary TOP SECRET dossier prepared by air technical intelligence in 1948 and circulated as far as the Chief of the Air Force, Gen. Hoyt Vandenberg. Its name: Estimate of the Situation. Its conclusion: The saucers were probably interplanetary spaceships.

From just after the end of the Second World War until early 1947, at a time when the world had yet to hear of “flying saucers” and when the concept of UFOs still lay far in the future, Britain's radar defences reacted many times to what appeared to be fast, agile intruders entering UK air space at high altitude over the east coast. Interception attempts by RAF fighters repeatedly failed.

Officially these were treated as intrusions by unidentified aircraft, or X-raids after the 'X' designation given to uncorrelated radar tracks. Unofficially the radar operators gave the intruder a name - Charlie - and when the Air Ministry began a concerted effort to solve the mystery its code name was 'Operation Charlie'. To the newspapers and to the public they were “ghost aeroplanes”.

The following typical article appeared in the London EVENING STANDARD of April 29, 1947:

RADAR 'GHOST' MAY BE A V-1, RADIO-CONTROLLED

Evening Standard Air Reporter

A "ghost" airplane, plotted on Fighter Command's radar screens flying at night over the North Sea may have been a radio-controlled machine of the flying-bomb type. If it was, it was not British.

Twice the "ghost" airplane, which has still not been identified, showed on the radar screens.

That was several weeks ago. Since then Fighter Command radar watchers have been on the look out but, I understand, the "ghost" airplane has not reappeared.

Suggestions that smugglers were bringing contraband into Britain over the Norfolk coast at night can be discounted. The "ghost" did not cross the coastline.

It stayed on the radar screens only a short time, but long enough for Fighter Command's experts to work out that the "ghost" was a peculiarly

behaved machine.

There were sudden erratic speed changes, I was told at the Air Ministry. The "ghost" would travel at 425 mph, suddenly drop back to 120 mph.

Big variations in its height, too, were noticed, and it also had a rapid rate of climb.

A pilotless aircraft, controlled by radio from the ground or from a ship, could suddenly change speed and height without the life of any pilot being risked.

"Telemetering" devices would record to the controller the machine's performance.

Ufologists discovered the first official record of the ghost aeroplane sightings in the 1970s as a result of FOIA applications in the US, when a telex from the British Air Ministry turned up in FBI files. It described attempted interceptions by an RAF Mosquito on a high-altitude target inbound over the North Sea on January 16, 1947 and advised that the incident remained unexplained.

Modern research by Dr David Clarke uncovered further documents at the UK Public Record Office (now The National Archive) recording this incident and others. These included RAF squadron Operations Record Books and Station logbooks, confirming and amplifying information hitherto available. Clarke also collected newspaper articles from 1947 and conducted interviews with pilots who had been involved in pursuit of Charlie, revealing a series of incidents dating back to 1945. The present analysis draws heavily on the results of Clarke's research.[2]

In the main incident on the night of January 16 1947 (which had been heralded by a first tantalising glimpse of Charlie during a GCI exercise that noon), the radar track began at 38,000 ft over the Dutch islands, an altitude beyond the reach of any but the RAF's top oxygen-equipped interceptors. It was picked up on the wartime Chain Home coastal early warning radar, activated for a Bomber Command exercise. As Charlie descended erratically on a westward course towards the UK coast it was picked up also by Ground Controlled Interception (GCI) radar at RAF Trimley Heath, stopping occasionally then racing at speeds often over 400 mph. According to Flight Lieutenant David Richards, a senior controller and 2nd in Command of the filter room of RAF No. 11 Group, Bentley Priory, measured speeds of as much as 1000 mph were very firmly defended by the radar operators at the time. An RAF Mosquito was then vectored repeatedly onto the target under ground radar control, also obtaining contacts on its own Air Intercept radar several times (six times according to the contemporary radar log; only twice according to an Air Ministry summary prepared in August for the USAAF). The Mosquito pursued its quarry from 17,000ft down to 6000ft over the course of some 48 minutes (according to the Eastern Sector ORB; 30 min according to the Air Ministry summary), but each time the object eluded the RAF's premier interceptor by means of what the Air Ministry later termed “efficient controlled evasive action”. The target was finally lost inland over Norfolk.

The next day, January 17, with all UK radar stations put on alert by Fighter Command to interdict Charlie, a repeat performance ensued. That afternoon an “exceptionally good track” designated U294 was plotted by two Lincolnshire radar stations moving over the North Sea at 10,000ft. Meteor jets stood by to scramble but the track faded before coming within range. Then at 7:45 PM that evening one of the same radar stations again picked up a target at 10,000ft over the North Sea heading west towards the UK at more than 200mph. This plot, designated U306, was “followed

2 http://www.uk-ufo.org/condign/histcharlie.htm

continuously for 90 miles", turning South across the Wash towards the Norfolk coast. A Mosquito of 23 Squadron at readiness to scramble was brought to standby status, but once again the target apparently moved away and the Mosquito was stood down.

Then about 3 hours later that night the same or another similar target once again entered the RAF Eastern Sector area and Sector Control scrambled a Mosquito at 2337.

The interceptor, piloted by WWII night-fighter veteran Flt Lt William Kent, was vectored onto the "unidentified aircraft" at 18,000ft under control of GCI radar at RAF Neatishead. At a range of a few miles the target was also acquired on the Mosquito's on-board Air Intercept (AI) radar. Under instructions by his radar operator Kent attempted to close in, but in the words of the Neatishead Station Log the AI radar was "unable to hold it as the target was jerking violently". For 20 minutes Kent pursued the descending target, "getting within 1 – 2 miles several times" according to the Eastern Sector logbook, but each time it broke away by taking "violent evasive action". Finally both the unknown and its pursuer descended below 2000ft and were lost from the ground radar. With no GCI assistance now available Kent and his radar man were unable to reacquire their quarry, and after patrolling fruitlessly for a while they returned to base.

A further alert occurred on the night of 23 January under the noses of three senior officers from the Central Fighter Establishment. They were visiting Neatishead for an interception exercise but instead found themselves in the middle of Operation Charlie. The exercise was cancelled when a radar target thought to be Charlie appeared on the GCI radar at 28,000ft and Mosquitos were scrambled in pursuit, but because nearby aircraft of 23 Squadron were unavailable Mosquitos of 264 Squadron had to come down from Yorkshire and by the time they reached the area the plot had faded. Eastern Sector had tried to plug the gap with Meteor jets from 74 Squadron at Horsham St Faith, but the scramble was aborted before contact was made due to icing and approaching severe weather.

As a result of this latest fiasco Flying Officer Sewart of HQ Northern Signals Area was despatched to RAF Neatishead on a special assignment to investigate and report on "the unidentified high flying aircraft that have been plotted in recent months." Sewart's report suggested that some unidentified tracks may have been caused by radiosonde balloons released from Downham Market in Norfolk, home to the USAAF's 8th Weather Squadron.

The original report does not survive, so that Sewart's evidence and reasoning are unknown; but from references in other documents Dave Clarke infers that unusual strong East winds were implicated, associated with the abnormal weather pattern responsible for the legendarily fierce "winter of 1947". Normally such balloons climb until they burst, and in that season would typically climb away to the west, borne in the prevailing Atlantic airstream. But leaking balloons might descend, and abnormal easterlies might have blown them back inshore unexpectedly, counter to the usual direction of the prevailing winds.

However the change from prevailing westerlies to the abnormal weather pattern occurred about a week after the most puzzling sightings of Charlie. In fact the onset of abnormal weather coincides with the *last* known incident on the night of Jan 23. It is also true that the Air Ministry did not "buy" this theory officially, and by all accounts continued to regard Charlie as an unknown aircraft, probably a revolutionary type of Russian spy plane using captured Nazi technology and flying from a base in occupied Germany. No historical evidence appears to have emerged that such revolutionary aircraft were ever operational.

Analysis

Dr David Clarke's reading of the National Archive documents initially suggested that F/O Sewart's Jan 27 1947 report had offered a single general conclusion on the several radar trackings of Charlie between Jan 16 and Jan 23, i.e., that the targets were weather balloons from Downham Market, probably driven back inshore by an abnormal easterly windflow associated with the historically severe winter weather of 1947. However Dr Clarke notes that F/O Sewart's report itself is not extant and reference to it is vague, so this is speculative. Moreover RAF and Air Ministry sources continued to refer to Charlie as unidentified and unexplained over the following months.

After studying published Met Office synoptic summaries of the era, and surface wind/pressure charts for the dates in question, the present author began to doubt that FO Sewart, doubtless having the benefit of full details from RAF meteorological sources about the wind patterns obtaining over the UK at the time, could reasonably have reached such a conclusion. A request was therefore made to MoD/Met Office under FOIA for detailed records of all UK and North Sea radiosonde balloon ascents made during the period Jan 15 - 24, 1947, which produced a swift and very full response. Copies of these records prove that the author's doubts were well founded, and we can now see that a different interpretation fits the facts.

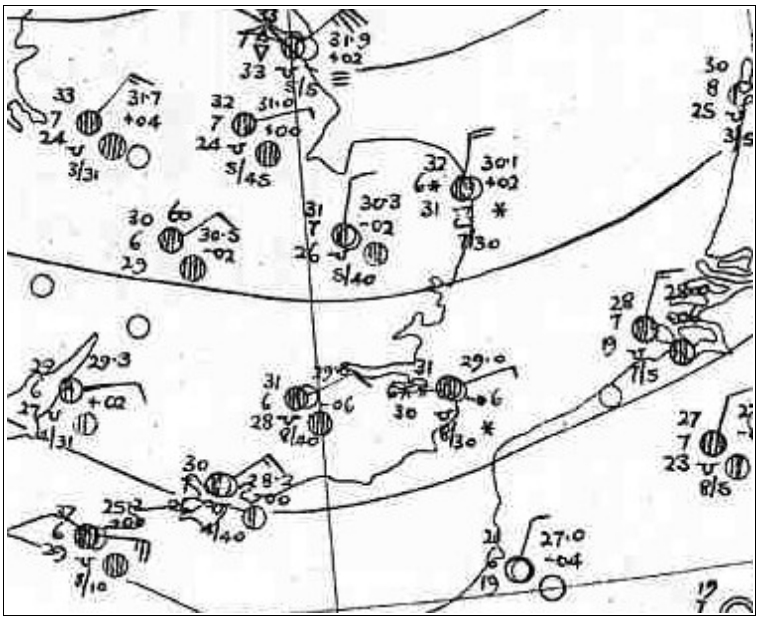

Fig.1. Detail from the Met Office Daily Weather Report for the British Isles at 06hr GMT, January 23, 1947 showing NE winds

Sewart's report is said to have been directly prompted by the event of Jan 23, which is not surprising given that on that occasion an exercise was cancelled when three visiting senior officers from Central Fighter Establishment saw what was thought to be Charlie for themselves. A focus on that Jan 23 incident would be natural in the circumstances. And indeed an easterly wind pattern implied by the Downham Market balloon theory does fit the weather situation that obtained from about that date onwards. But it does *not* fit the weather situation that obtained on January 16 - 17.

One interpretation is that F/O Sewart's report took as its focus the event of Jan 23 and that the balloon theory was offered in this context. This would explain why Air Ministry statements to the press in later weeks continued to refer to “unidentified aircraft”, why the Air Ministry admitted confidentially to the USAAF months later that the seminal Jan 16 incident was still unexplained, and why they also said it had “not been repeated”: they apparently accepted the Sewart theory as a

possible explanation of the weaker Jan 23 event, but did not officially adopt it for the main Jan 16 (and presumably Jan 17) incidents simply because it did not really address them.

According to Met Office and other synoptic summaries the reason for the unusual cold northeasterlies after about January 23 was a large region of high pressure which drifted from France northeast to Scandinavia, where it settled, blocking the flow of the prevailing Atlantic westerlies over the British Isles. Weather charts show (*Fig 1*) how the trailing edge of the anticyclone to the north now brought easterly and northeasterly winds across the UK and allowed a cold continental weather regime to replace the usual mild maritime regime, a change associated with the arrival of the bitterly cold weather that caused the attempted 74 Squadron Meteor interception of Charlie to be called off on the night of Jan 23 due to severe icing.

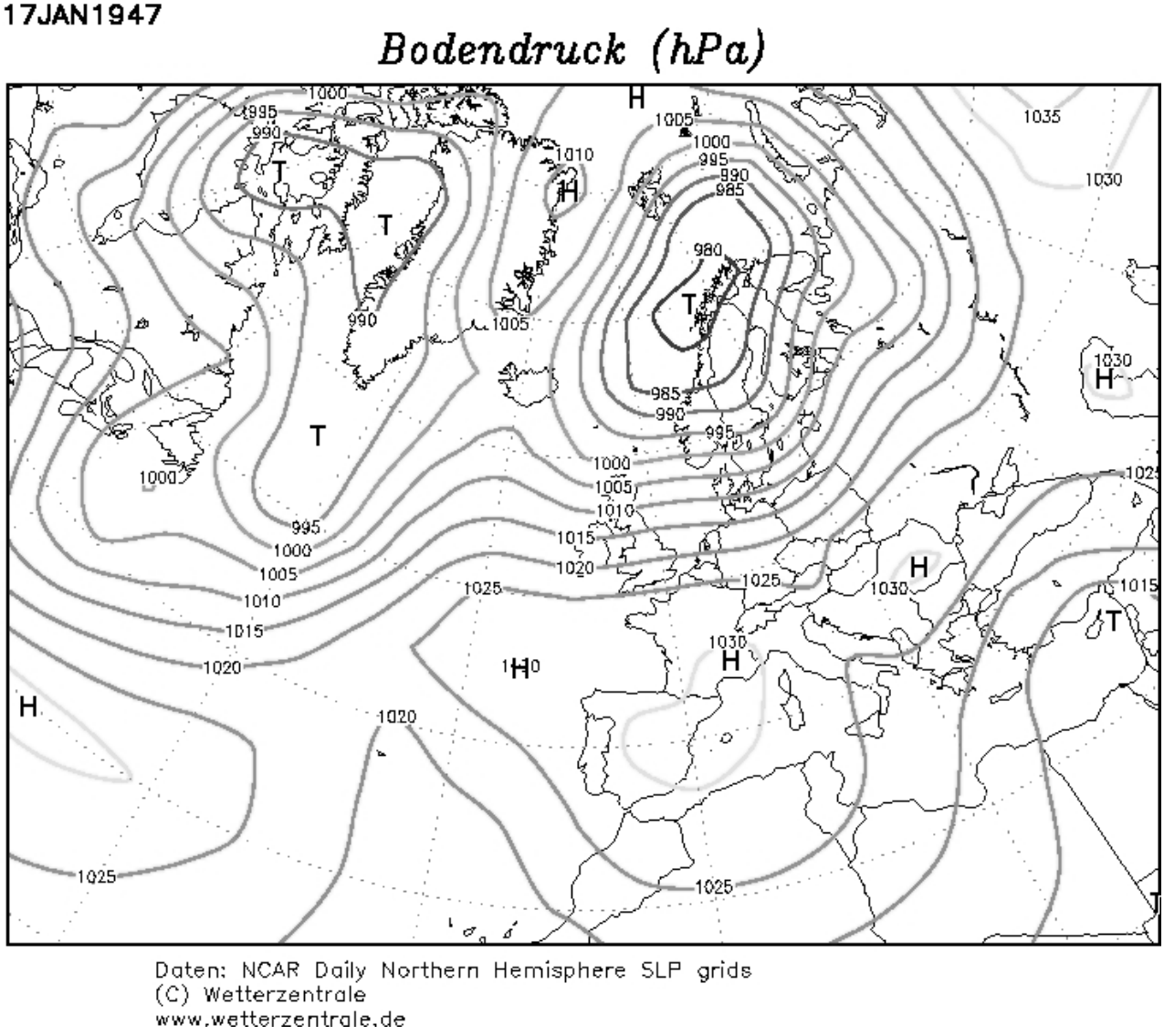

Fig. 2. Northern hemisphere isobar chart for Jan 17, 1947

However on Jan 16 - 17 there had been no sign of the bitter winter to come. It was still unusually mild over the UK with temperatures in double figures in many areas. High pressure was still sitting over the continent and the clockwise anticyclonic circulation (*Fig.2*) around the high was keeping a mild *westerly* Atlantic airflow established over the whole of Britain. The Met Office UK weather charts show that surface southwesterlies were typically around Beaufort 4 (11-16kt, moderate

breeze) over East Anglia and the North Sea on January 16. As we will show (See *Table 1*), radiosonde balloon ascents from Downham Market, Norfolk, now prove what looked highly probable on a synoptic scale - that winds aloft did *not* reverse direction to become violent easterlies. The direction at all levels remained southwesterly and quite brisk, a few tens of knots. (It is worth noting that none of the Downham Market balloons through the period investigated beginning Jan 15 and ending Jan 24 was recorded as lost.)

16th January 1947

According to official documents the first sighting of Charlie occurred shortly after noon on this day when RAF Neatishead GCI radar picked up an unidentified "aircraft" at 30,000ft over Norfolk during an exercise. Meteor jet fighters were diverted to intercept but were unable to pursue the intruder owing to low fuel. Another interceptor was scrambled, but not in time. The target left GCI radar coverage in a roughly northerly direction.

In terms of the time and direction of departure alone, this target could conceivably have been the Downham Market noon radiosonde balloon, which at a typical ascent rate would have reached 30,000ft in perhaps 30 minutes, climbing through 15 recorded wind levels averaging 53kt from 217º. So it ought to have been moving NNE at 60kt out over the coast somewhere near Wells-next-the-Sea at about 12.30pm. But this is not very satisfactory, since it seems unlikely that, without some other very good reason, RAF Neatishead controllers would have diverted fighters to intercept a balloon-like target at the time of a routine local balloon release.

(According to the files of the USAF UFO project, where the British "Ghost Planes" were listed as "UFOB report #9, SOURCE: British Military - RAF", the initial sighting on Jan 16 was of a 120 mph target "identified by Fighter Interceptors as another a/c - OXFORD". This identification - if indeed it applies to the same event - is missing from the ORB, which says that fighters were not successful in making any identification. Possibly another event entirely is referred to, inasmuch as 30,000ft would be significantly higher than the ~20,000ft service ceiling of the Airspeed AS.10 OXFORD. The ATIC document contains some other apparent errors, and may not be reliable.)

Howsoever, the main event occurred that same night. It is useful that there are several partial records in different official sources, but unfortunately these are slightly confusing.

Times given in different sources don't match perfectly. After the initial ground radar contact with Charlie over the Dutch Islands by Chain Home coastal radars, an early AI radar contact with unidentified target X-362 occurred at 2014, followed by the main pursuit under Trimley Heath GCI radar control from 2120-2202 according to one source, or from 2130-2200 according to a second source, or from 2230-2300 according to a third! Nor is this all: lat-long coordinates for the start of the chase given in an Air Ministry summary to the USAAF that August are 52º 52' N 02º 37'E which is stated to be 50 miles from the Dutch coast. But this location is not 50 miles from the Dutch coast, it is no closer than 85 miles from any point on it.

Just conceivably the time discrepancy between the second and third sources *might* be due to translation of the former January GMT time into the equivalent BST for a document compiled in August; but even then the 2120 v. 2130 discrepancy remains unexplained. And if the initial intercept point was 50 miles from the Dutch coast as stated then the pursuit covered more than 90 miles into Norfolk, which, taking the duration of the pursuit to be 30 minutes, gives a *mean* target speed approaching 200 mph. But if on the other hand the coordinates are taken to be exact (and not an approximation such as, for example, the nominal exercise location) then the pursuit covered only some 50 miles, implying a displayed mean westbound speed of around 100 mph.

The ORB of Eastern Fighter Sector HQ, RAF Horsham St. Faith (Norfolk)**,** further confuses the issue by stating:

> ‘An unidentified aircraft had been plotted in WC 9585 at 38,000 ft., and Eastern Sector Ops were requested by Group to scramble a Mosquito of 23 Sqdn. to intercept. '

Pressure (mb)	Jan 16				Jan 17				Jan 23				Height* (ft AMSL)
	0000	0600	1200	1800	0000	0600	1200	1800	0000	0600	1200	1800	
surface	180	190	220	180	190	240	260	240	60	no winds - radar unserviceable	40	70	120
1000	-	-	-	-	-	-	-	-	-		-	-	350
950	220	220	230	210	210	-	280	270	60		40	60	-
900	240	230	230	220	230	-	280	280	60		50	60	3220
850	240	230	220	230	240	-	270	280	60		50	60	-
800	240	230	220	220	230	-	270	280	50		50	50	6410
750	240	220	220	220	220	-	260	280	30		50	50	-
700	240	210	220	220	220	-	260	280	20		30	40	9950
650	230	220	220	220	210	-	260	280	10		30	30	-
600	260	230	210	220	220	-	250	290	10		20	20	13,900
550	230	230	210	220	220	-	250	290	10		10	20	-
500	230	220	210	220	220	-	250	290	360		10	30	18,400
450	230	220	210	220	210	-	250	280	10		20	30	-
400	230	230	220	220	220	-	240	270	350		20	30	23,700
350			210			-	240	270	350		20	30	-
300			210						350		10	30	30,200
250			210						340		10	30	-
200			210						340		10		38,700
170			210						350		10		-
150											10		-

Table 1. Radiosonde Balloon readings of Wind Direction, Downham Market, Norfolk Jan 16, 17 & 23, 1947.

Table compiled by Martin Shough from original data sheets kindly provided by the UK Met Office.

*(*Example heights AMSL are given for noon, Jan 16. Altitudes of pressure levels differ somewhat from ascent to ascent)*

'WC9585' refers to the Cassini grid or War Office grid introduced for military maps in WWII (see *Fig. 3*). This location is nowhere near 52º 52' N 02º 37'E, but it is not 50 miles from the Dutch coast. either. It, too, is about 85 miles from Holland, but far to the north and thus about 110 miles from Norfolk (see *Fig 4*). The location might refer not to the pick-up position but to the plot position immediately prior to the scramble decision, but this is unclear.

Howsoever, the above range of figures is not inconsistent with the reports that the object stopped and hovered occasionally and accelerated at times to over 400mph. A balloon travelling at this *mean* rate of at least 100mph in a direction opposite to the proven direction of the wind is clearly impossible. To save the balloon theory one would have assume that radar somehow picked up a succession of different balloons caught in local vortices that carried them each a short distance against the established anticyclonic circulation before they somehow dropped conveniently off the radar. But this would be a truly desperate strategem to explain a target which, whilst it *was* reportedly erratic in speed and height, nevertheless appeared to descend progressively Westwards at >100mph for tens of miles all the way from 38,000ft to 6000ft over the course of half an hour or more.

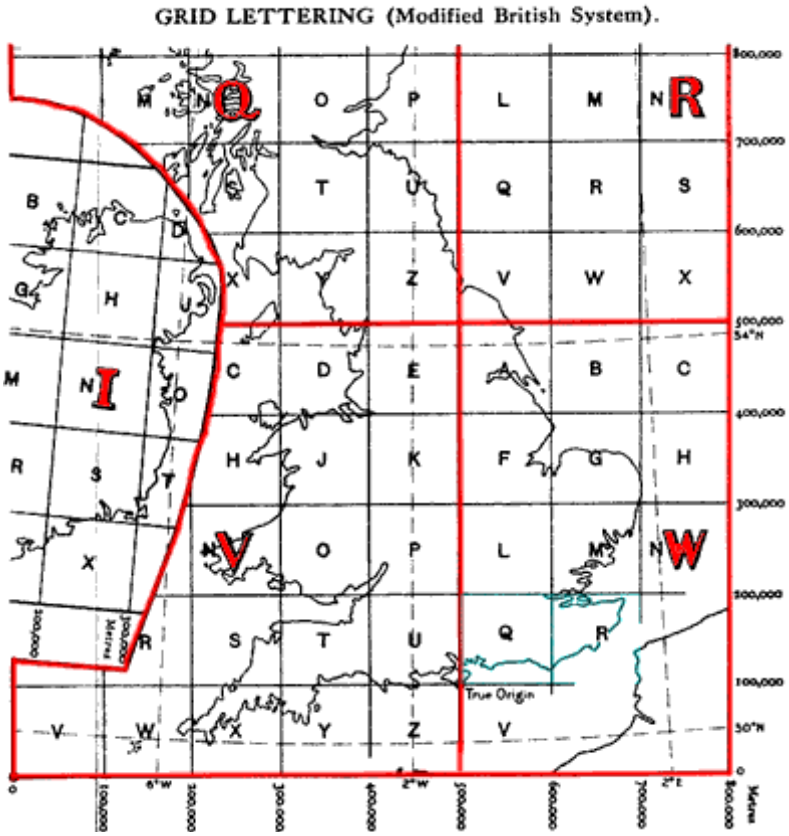

Fig 3. The Modified British System map (known as the Cassini Grid or War Office Grid). The 500km grid areas Q, R, V and W are subdivided into 100km squares A, B, C. . . so that WC identifies a square off the coast of Lincolnshire. Six-figure numerical coordinates further divide WC into 100m squares.

From '*Notes on Map Reading*' (The War Office, 1940)
See http://www.pillbox.org.uk/methodology/maps.asp

Clearly neither birds, insects, nor any other windborne objects can explain such a target. Insects - and even birds, except perhaps in large flocks - probably could not even have been detected at all on the long-wave CH radar. Flocks of birds might have given decent echoes on the AMES Type 7, but bird airspeeds are insufficient to do much more than just cancel the average westerly wind speed (about 45kt) during the track. Rapid opposing progress would be impossible.

Nevertheless evidence of *some* kind of 'solid target' is quite strong. Initial contact was by the Chain Home coastal early warning radar (probably RAF Bawdsey and/or RAF High Street). The Chain Home system operated at the very low frequency of 20-30MHz (>10m wavelength) and utilised direction and height finding by means of arrays of static aerials on >300ft towers emitting a fixed swath of radiation about 60 degrees wide. The GCI radar in use at this time was the metric (200 MHz) AMES Type 7, with a narrow shaped beam emitted by a rotating antenna. The AI radar fitted in the Mosquito was the 9 cm. helical-scan Mk.10. Thus several ground and airborne radars had different fixed and mobile locations, totally dissimilar radar lobe structures, different display timebases, different wavelengths ranging over two orders of magnitude, and very different pulse lengths and pulse-repetition frequencies (prfs of 25, 250 & 1500 pps respectively for the CH, GCI and AI radars). These differences make several types of explanation such as internal noise, electronic "spoofing" (a more-or-less nonexistent art anyway in 1947), mutual interference, sidelobe echoes and multiple-trip echoes (very sensitive to the pulse repetition frequency, which differs here by a factor 10, and is only capable of *reducing* - never increasing - the displayed speeds of targets detected beyond the unambiguous range of the set) extremely unattractive.

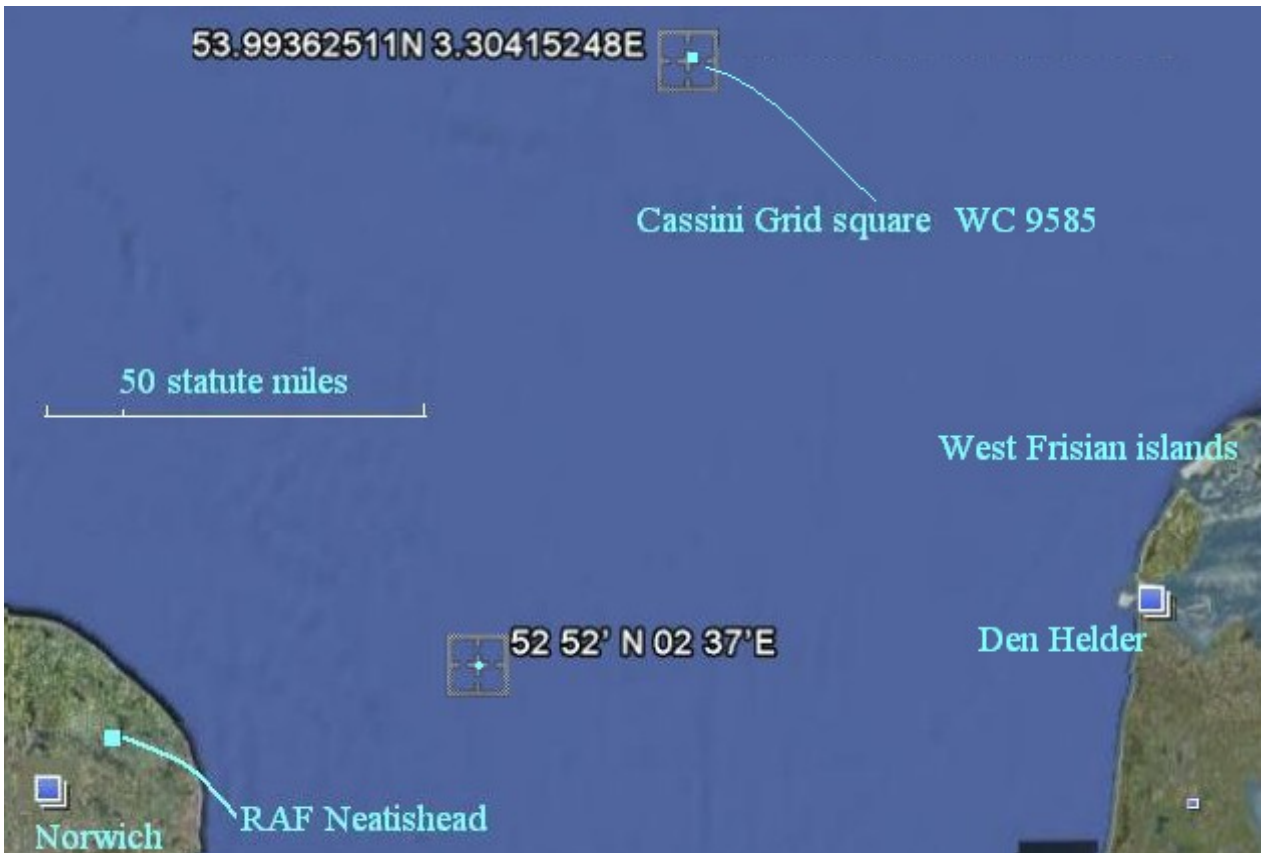

Fig.4 Recorded plot locations of 'Charlie' on Jan 16.

The small blue square shows the position of WC9585 converted to geodetic coordinates. Several grid converters are available on the net, i.e.
http://www.fieldenmaps.info:80/cconv/cconv_gb.html

The USAF file summary mentioned above contains the bald conclusion "Possible temperature inversion", without any quantitative or even qualitative justification. Whilst it seems incredible that this could be offered as an explanation of repeated correlating AI radar contacts when a fighter is vectored onto a multiple ground-radar plot at many thousands of feet, inversion conditions can cause false radar indications, so this needs to be investigated.

In fact the most relevant (midnight) radiosonde profile from Downham Market shows no inversion. The earlier 1800hr ascent did show a very small low-level inversion of 4ºF (48 - 52ºF, or 8.9 - 11.1ºC) between 1000-925mb or from 350 to about 3000ft AMSL (the latter figure interpolated from the nearest recorded height using a standard pressure lapse rate of about 30mb/kft) over an isothermal surface layer. This is a temperature gradient of only about 0.8ºC per thousand feet, which is negligible.

However we should note that humidity is in fact the more important factor for radar refractivity. The radiosonde profile shows no exact relative humidity for the top of the layer but interpolating we get values of 77% and approximately 72%. Calculating dewpoint from these RH figures gives us 5.9ºC and 6.24ºC, which translate to refractivities in *N*-units [parts per million of refractive index, or $N = (n - 1) \times 10^6$] of approximately 315 and 295 respectively. The refractive-index gradient is therefore about -7.5*N*/kft, which is essentially a standard atmosphere for radar purposes (near the middle of the refractivity range considered "normal", 0 to -24*N*/kft). There seems to be no evidence of anomalous propagation conditions (see *Table 2*).

Height (ft AMSL)	Pressure (mb)	Temp (ºC)	RH (%)	Dew (ºC)	Refractivity (*N* units)	N-gradient (*N*/kft)
350	1000	8.9	77	5.9	315	-7.5
3000	925	11.1	72	6.24	295	

Table 2. Downham Market radiosonde balloon readings, 1800hr, Jan 16 1947

One can never completely rule out the possibility of undetected sharp layers falling between the radiosonde data points, of course. But a consistent ground track on a steady heading from East to West over the ocean is not at all typical of sporadic AP, even allowing some erratic and intermittent phases. And radar anomalous propagation effects are also sensitive to wavelength. When a track is initiated at long range on 10-metre CH radar, then picked up on metric AMES 7 search radar, with simultaneous correlating readings on independent heightfinder radar, the probability of AP echoes is very small. When Air Intercept radar contact is repeatedly made with a target in the same location (six times according to the radar logs) the probability is so remote as to be effectively nil. Echoes on these different fixed and mobile radars separated in altitude by 22,000ft would be generated by very different ray paths through different regions of the atmosphere, so there is no common ducting mechanism or common ground reflector to explain correlating target behaviour.

It is true that discrete, moving false echoes can be caused by partial reflection from wind-driven waves or gravity waves moving across an inversion layer, or by scattering from domains of turbulence propagating across a layer. These would have been entirely mysterious in 1947 as the theory behind these effects was not developed until the mid-'fifties. However, the efficiency of scattering layers is quite poor at the metric wavelengths used by the CH and Type 7 radars, and partially forward-scattered echoes on westbound tracks would require *easterly* winds (e.g., a mean displayed speed of 1-200mph at 22,000ft would imply easterlies of 50-100 mph at about 11,000ft) which are conclusively ruled out by radiosonde records showing steady *southwesterlies* at all levels (60-70kt from 220deg at 11,000ft throughout the night). Also this mechanism would still offer no

plausible explanation of concurrent ground radar and AI radar contacts and cannot explain target motions which would be described by the phrase "efficient controlled evasive action."

Another possibility to consider is "ghost" reflections. These are caused when radar energy is scattered from one primary reflector (say, an aircraft) to a secondary reflector (a metal ground structure for example) and back along the same path to the antenna. The distance on the radar screen between the primary reflector and its ghost is proportional to the added trip-time to the secondary reflector, so separation varies as the aircraft moves and if it flies close to the reflector its ghost may appear to "intercept" it and fly by. But a ghost echo of the Mosquito would always appear on the same azimuth as the aircraft and at greater range, and it would never be possible for the aircraft to "pursue" its own ghost inbound (E-W) towards the radar site as reported. Moreover, the target was detected in the area before the Mosquito arrived; and this in turn suggests that GCI controllers would know which target was which, so that there appears to be little likelihood of a trailing inbound ghost being confused with the aircraft echo.

In any case a consistent ghost echo from a secondary surface reflector is scarcely conceivable over a track beginning tens of miles out over the North Sea and ending inland, with aircraft altitudes up to 22,000ft. The a/c altitude represents the *minimum possible* displayed closure distance between Mosquito and ghost for the case where the Mosquito is directly above the secondary reflector, which needs to be a highly efficient corner-reflector of an unusual kind. Clearly, when the aircraft's course covers tens of miles over sea and land at altitudes never below 6000ft (final minimum) a series of very fortuitously positioned corner-reflectors would be needed (on sea and on land), and even then the likelihood of a ghost ever being displayed closer than a few miles from the Mosquito is small.

A ghost echo caused by secondary reflection from another moving aircraft is possible in principle. But such ghosts are extremely rare and fleeting, very sensitive to small changes in the reflection geometry. Any ghost echo persisting for half an hour or more would be truly astonishing, and the notion that this mechanism could simulate a close “chase” all the way to Norfolk is extremely far-fetched. And once again, the AI radar contacts made by the interceptor are unexplained by any such mechanism.

The least unlikely conventional explanation of such a target might seem to be a high-performance military jet, the only type of aircraft capable of eluding a Mosquito. But despite being successfully vectored to engage the object at close range on five occasions, and acquiring contact on the Mosquito's onboard AI radar, nothing at all was seen visually by the pilot. This is not at all normal, and is more significant than might be thought, because even at night with AI radar assistance the standard interception proceedure at this time relied on visual identification by the pilot, who needed to estimate the wingspan by silhouetting the target against lighter sky in order to calibrate the GGS II electric gyro gunsight. The Mosquito night-fighter pilot would certainly have been *expecting* to sight his quarry, if it was an aircraft..

The wartime German Me 262 jet could have matched the best-attested of Charlie's height and speed maxima (*if* we neglect the 1000mph recently recalled by senior controller David Richards, 2nd in Command of the RAF No.11 Group filter room at the time) if not the extreme agility and hovering phases reported. But considering range limitations and the intruder's apparently reckless 'escape' inbound into UK airspace at only a few thousand feet, a domestic flight-plan mix up involving an RAF jet – one of the new Gloster Meteors just coming into service perhaps? - seems more likely than a foreign intruder. Again, however, the performance would be pushing the limit for a Meteor. And why was an RAF jet fleeing from a friendly fighter, in complete radio silence and showing no lights? Such a “misunderstanding” would surely have been quickly cleared up, if not during the 30 minutes of repeated interception attempts then subsequently. And could such a mix-up have recurred several times over two days - as the X-raids did - without being resolved?

The idea of a secret defense-readiness or air combat training test for jet pilots comes to mind, but not only would this seem incredibly risky for all involved, the RAF operations staff and Air

Ministry would clearly have been the only parties certain to be 'in the know'. Yet confidential official documents whose public release could at the time never have been foreseen show that the RAF ordered an internal investigation, and that seven months later the Air Ministry still regarded the incident as unexplained.

17th January 1947

The repeat performances of the next day might in some respects be thought more amenable to interpretation in terms of balloons. Nevertheless the winds aloft data are unarguable. U-306 - "an excellent track" was plotted by Humberston CHL at a mean groundspeed of 180 mph and at an altitude of 10,000ft for 90 miles on a north-south heading, against winds which that afternoon were 40kt from the SW at 10,000ft (thus, target airspeed over 200mph). A few hours later in the early evening a target was tracked heading west at 200mph almost directly into the eye of 30kt westerlies at the same altitude.

Later still that night a third target was picked up in grid square WN 6038 (see Fig. 5) at 18,000ft, and at 2327 GMT Kent's Mosquito was scrambled to intercept. In this case the track direction is not specifically stated in the ORB, but it may not be insignficant that the ground radar report describes the target Kent was vectored to as "an unidentified high-flying aircraft". This target must have been observed on GCI radar for a good many minutes before Kent's aircraft was scrambled and finally climbed into AI radar range at 18,000'. The question is, if it was a balloon why wouldn't it appear to be “an unidentified high-flying balloon”? If the compilers of the ORB knew well enough that there were brisk westerlies (not unlikely as the purpose of RAF Met Officers is to inform operational staff about the weather) blowing in the opposite direction to the object's motion this would be one very good reason for the target to be described as an "unidentified aircraft".

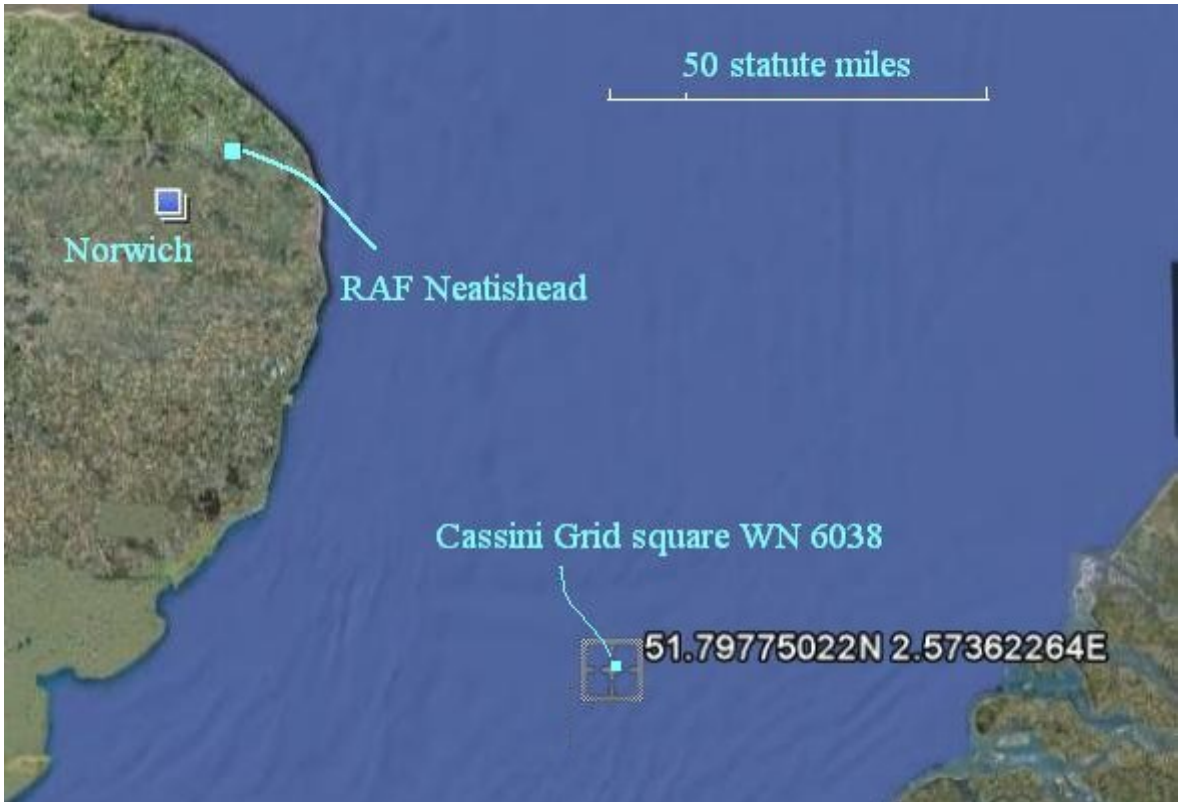

Fig.5 The small blue square indicates the 1km grid square WN6038 whose origin (SW corner) is at the lat-long coordinates shown.

Some confusion exists because the USAF Project SIGN summary cited earlier appears to say that this target was headed East. But as already noted the SIGN summary contains anomalies and may not be accurate. (For further examples, it says that there were three X-raids over the two-day period, whereas the ORBs clearly describe five. It also says that Kent's Mosquito was vectored to a target which "had descended to 15,000ft", but the ORB says initial interception was at 18,000ft.)

First of all, one naturally assumes that a plot which triggers the UK's eastern radar fence is approaching from off-shore and heading broadly west, and it would be hard to interpret the ORBs in any other way. Grid square WN 6038 (a square 1km on a side) lies in the North Sea about 53 miles (85km) off the Suffolk Coast and about 85 miles (137km) southeast of RAF Neatishead (see *Fig.4*). The Eastern Sector HQ Logbook certainly implies that the plot was inbound from the East towards the coast because it says the Mosquito had at one point been stood down from "standby" back to "readiness" when the target "turned South" (i.e., ceased to approach), but that Kent was brought back to "standby" and scrambled when the target "again headed into Eastern Sector area".

That the pursuit started at sea and terminated over Norfolk is also implicit in Kent's own account that he pursued the descending target "towards the ground" and that his AI radar operator finally lost it in "ground clutter". This would also fit the report that his aircraft and Charlie were finally lost below the GCI radar cover at only 2000ft, because such an altitude implies a range within perhaps 20 miles of the Neatishead radar, whereas a balloon initially detected over the sea in WN 6038 and swept still further out by strong westerlies (40-50kts at ~18,000ft) for at least half an hour or so would end up some 100 miles from the radar, at which range the radar horizon over the open sea would be about 5000ft in standard refractivity and it would not have been possible to carry the plots of the Mosquito and its quarry down to 2000ft.

Of course that last argument invites the suggestion that refractivity at this time may not have been standard, and that a strong low-level inversion might have expanded the radar horizon to several times its normal range. Once again we can investigate this from the Downham Market radiosonde data.

1800hr Jan 17

Height (ft AMSL)	Pressure (mb)	Temp (ºC)	RH (%)	Dew (ºC)	Refractivity (*N* units)	N-gradient (*N*/kft)
120 (surface)	1019	5.0	76	1.1	315	-10.2*
610	1000	5.5	73	1.05	310	

0000hr Jan 18

Height (ft AMSL)	Pressure (mb)	Temp (ºC)	RH (%)	Dew (ºC)	Refractivity (*N* units)	N-gradient (*N*/kft)
120 (surface)	1022	2.2	86	0.1	320	-14
690	1000	3.9	80	0.8	312	

Table 3. Downham Market radiosonde balloon readings, Jan 17, 1947, 1800hr & midnight.

* *By interpolation we can infer that a similar gradient extends up to 985mbar, which would be to approximately 1100ft AMSL assuming a standard pressure lapse rate. But in the absence of exact height and RH readings this datum is not tabulated.*

Both the 1800hr and midnight profiles do show small inversions near the surface that might be relevant to the radar horizon at 2000ft (which a small midnight inversion at 20,000ft, for example, is not). The measured values of the factors controlling refractivity are summarised in *Table 3.*

Running through the example of the midnight profile (the more relevant of the two), we can see a small inversion from the surface (1022mb) to 690ft AMSL (1000mb), with the temperature climbing from 36ºF to 39ºF and corresponding RH readings of 86% and 80%. Converting to centigrade we get temperatures of 2.2ºC and 3.9ºC with dewpoints of 0.1ºC and 0.8ºC. Entering these along with the pressure readings on a refractive index nomogram allows us to read off values of refractivity in *N*-units of approximately 320 and 312 respectively, leading to a gradient of about -14*N*/kft. With the the same proceedure the 1800hr profile yields an *N*-gradient of -10.2*N*/kft. These values closely bracket the mean (-12*N*/kft) of the spread of values considered typical of a standard atmosphere.

There is no evidence of a highly abnormally expanded radar horizon, and thus we conclude that signal loss at 2000ft does indeed indicate a terminal range from the radar of some 20 miles, which in turn is further strong evidence that Charlie progressed westward a *minimum* of about 30 miles against the wind between detection in WN 6038 and signal loss.

Winds aside, the details of the interception by the Mosquito do undeniably have some similarity to classic cases that are strongly suspected to have been balloons, typified by the 1948 Fargo, N.Dakota case. Repeated passes on a target in the same general area are a typical feature, and Gp. Capt. Kent (who had combat experience against enemy aircraft) confirms that the rate of closure seemed very rapid, suggesting that the target could have been slow-moving or nearly stationary (relative of course to the airstream in which the Mosquito itself was flying).

But a serious difficulty here is that both the Operations Record Book and the Sector Log agree that AI radar contacts were repeatedly broken by "evasive action" or "jerking" of the target, described as "violent", at ranges between 1500 yards and two miles, ranges several times as large as the range (a few hundred yards at most) at which the Mosquito would normally expect to approach an enemy aircraft before thinking about engaging it with weapons. (At 2 miles a target aircraft would still be a barely identifiable speck in the order of 10 arcmin across, and 20 seconds of flight time away even if closing at 400mph.) So this is not really suggestive of illusory relative motion due to the Mosquito overshooting a static target at very close range, as in cases of the canonical Fargo, ND, type.

Air Ministry Air Publication 1093D Vol.1 notes that the wider coverage of the then relatively new Mk X radar on the Mosquito NF 36 was more effective against evasive aircraft targets than the Mk. VIII (and earlier marks) which crews had used during the war. Even using the *narrowest* scan limits (which are reserved normally for the close-in final phase of an interception) the altitude and azimuth coverages at the ranges reported would be hundreds of yards across, and the wide AI scan limits (in the order of a thousand yards across) would almost certainly have been used to keep relocating a fugitive, apparently agile and - crucially - *invisible* target of the kind described. The angular velocities implied by “violent evasive action” at ranges up to 2 miles are therefore excessive and the similarity to balloon encounters becomes very strained.

When we add these considerations to evidence that this object, like the others detected over the two days, was in any case travelling westbound against the wind, we have to conclude that once again the likelihood of a balloon seems very small, which again leaves an unknown high-performance aircraft as the only plausible conventional suspect.

As on the previous day (Jan16) much of Charlie's performance might have been matched by an ME 262, but: *possibly not* the climb to 44.000ft recorded in the USAF Project SIGN file summary (the 262's ceiling is widely given as about 37,500ft); *probably not* the exceptional agility (according to http://www.stormbirds.com/squadron/common/technical.htm allied pilots had been "advised to enter into a turning battle if attacked, as it was discovered that the jet was not nearly as agile or

maneuverable as a conventional fighter"); and *probably not* the effectiveness at range from base since incursions over the UK would be at the very limit of the maximum combat radius of the ME 262 (~650 miles, at altitude) even if flown from the nearest Eastern European border under Soviet military control, and the engineering reliability of the 262's jets had been notoriously low.

Conclusion

In the absence of detailed original records no definitive scientific conclusion is possible today on events that occurred over sixty years ago. Nevertheless enough information survives to constitute an intriguing case.

The main plot on the evening of Jan 16 was detected sequentially on independent and geographically separated ground radars of very different design, then confirmed by multiple simultaneous air-radar and ground-radar contacts during an extended pursuit. An “exceptionally good” radar track carried by *two* different ground radar stations on the afternoon of Jan 17 is not any kind of noise or anomalous propagation echo, and another radar plot maintained “continuously for 90 miles” at the same steady height that same evening does not sound at all like a track imagined from a few random false echoes. A third target later that night was tracked continuously by ground radar and several times confirmed by AI radar on an RAF Mosquito in a manner similar to the previous night.

Although at least some of the ground radar plots appear to have shown erratic speed variations unlike an aircraft, which might appear diagnostic of an insubstantial "weather" echo of some type, bear in mind that each surveillance plot with height readings itself represents detection by multiple radars with different characteristics. And when this 3-dimensional fix is confirmed repeatedly by AI radar on a plane vectored to intercept then it becomes extremely difficult to construe these tracks as anything other than echoes from solid radar-reflective objects of some type.

Could the Jan 16 and Jan 17 objects have been errant radiosonde balloons carrying radar reflectors?

The five unknowns tracked over the two days followed three different stated height profiles: from 38,000ft down to 6000ft, steady at 10,000ft, and from 18,000ft down to 2000ft. One (the first, at noon on Jan 16) was heading North, and four were approaching the coastal radars from the North Sea, heading generally West or Southwest. Thus none of the tracks (if we except a single inconsistent and frankly doubtful reference in a USAF file summary) ascended as buoyant balloons are wont to do, and they all travelled at mean displayed speeds of 100 - 200 mph either *across* (one case) or *against* (four cases) winds which we have proven to be southwesterly/westerly at all levels. This finding rather conclusively validates the inference, drawn from several other parallel arguments, that balloons can be ruled out.

On the other hand the later Jan 23 incident which gave rise to F/O Sewart's investigatory visit to RAF Neatishead *did* occur when an unusual northeasterly airstream had become established over the British Isles. In this case no RAF interceptor was involved and no specific detail of target speed or behaviour appears to be available except that “Charlie” was detected at 28,000ft. It is possible that this event may have been the focus of Sewart's subsequent report implicating weather balloons, and if this event alone was considered to have been a possible balloon it might explain why that August the Air Ministry told the USAAF that the unexplained incursion of Jan 16 “has not been repeated” (conceivably the several similar events of Jan 16-17 were being lumped together).

No other explanations are apparent. The USAF Project Blue Book file carried the incidents without justification as "possible anomalous propagation" (radar mirage), but once again a quantitative

analysis of refractive index gradients calculated from radiosonde readings gives strong support to qualitative arguments that make this theory highly unlikely.

Air Ministry evidently continued to regard Charlie as one or more “unidentified aircraft”, and the apparently remarkable performance shown in repeatedly eluding experienced aircrews flying the RAF's premier interceptor led to speculation about foreign secret technology.

It is intriguing - if fruitless - to speculate about what would have been different had these sightings occurred a year or so later. There is little doubt that they would have been interpreted by the press and by personnel on the spot as well as officials in the Air Ministry as possible sightings of “flying saucers”, and we would be obliged to view them through a corrective filter allowing for the effects of that mythology on the perceptual set of the operators and airmen involved. But it is interesting that even without the “benefit” of that mythos it was possible for UK air defence professionals to conclude that they had detected flying machines of extraordinary performance and unknown origin. Of course a somewhat analogous mythos was available, in the form of secret Nazi/Russian technology, and the incidents appear to have been interpreted in this light.

In conclusion, more than 60 years after the event the Ghost Planes of 1947 appear to remain without a satisfactory explanation.