UNCLASSIFIED
SECRET
UK EYES ONLY

ENCLOSURE NUMBER 25

Copy No 10 of 11 copies 196/469

Unidentified Aerial Phenomena in the UK Air Defence Region: Executive Summary

SCIENTIFIC & TECHNICAL MEMORANDUM - No. 55/2/00

DEFENCE INTELLIGENCE

December 2000 **Defence Intelligence Analysis Staff**

DIS

UNCLASSIFIED
UK EYES ONLY
SECRET

This document is made available through the declassification efforts
and research of John Greenewald, Jr., creator of:

The Black Vault

The Black Vault is the largest online Freedom of Information Act (FOIA) document clearinghouse in the world. The research efforts here are responsible for the declassification of hundreds of thousands of pages released by the U.S. Government & Military.

Discover the Truth at: **http://www.theblackvault.com**

UNCLASSIFIED

THIS DOCUMENT IS THE PROPERTY OF HER BRITANNIC MAJESTY'S GOVERNMENT, and is issued for the information of such persons only as need to know its contents in the course of official duties. Any person finding this document should hand it to a Service Unit or Police Station for its safe return to the **MINISTRY OF DEFENCE, DEFENCE INTELLIGENCE STAFF, LONDON, SW1,** with particulars of how and where found.

THE UNAUTHORISED RETENTION OF THIS DOCUMENT, OR ITS DESTRUCTION, IS AN OFFENCE UNDER THE OFFICIAL SECRETS ACT 1911-1989. (When released to persons outside Government Service, this document is issued on a personal basis and the recipient to whom it is entrusted in confidence, within the provisions of the Official Secrets Acts 1911-1989, is personally responsible for its safe custody and for seeing that its contents are disclosed only to authorised persons).

UNCLASSIFIED

UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY
SECRET

AN EXAMPLE UAP FORMATION OF THE TRIANGULAR TYPE

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

UNCLASSIFIED

SECRET

CONTENTS

	Page
PREFACE	*1*
INTRODUCTION	*4*
AIM	*4*
STUDY METHOD	*5*
SUMMARY OF FINDINGS	*6*
KEY SUPPORTING FINDINGS	*6*
KEY FINDINGS OF DEFENCE INTEREST	*10*
STUDY RECOMMENDATIONS	*11*
FIGURE 1 - ANNUAL UAP EVENT TOTALS	*13*
ANNEX A	*A1-A6*

UNCLASSIFIED

SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

UNIDENTIFIED AERIAL PHENOMENA IN THE UK AIR DEFENCE REGION: EXECUTIVE SUMMARY

PREFACE

"What does all this stuff about flying saucers amount to? What can it mean? What is the truth?. Let me have a report at your convenience".

W.S. Churchill, 28th July 1952

The topic of Unidentified Aerial Phenomena (UAP) has remained an enigma since well before the Prime Minister's remarks above. Since earliest recorded history probably only two key facets have changed - there are now more UAP reported, and there are also more objects in the sky which can be misreported. The Findings and Recommendations of the first detailed DIS UAP analysis for over 25 years are contained in this Executive Summary. (R)

The Main Report (Volume 1 - RESTRICTED), describes the Background, Methodology used, the Data Base and the Statistical Analysis. Supporting Technical Point Papers covering topics relevant to an understanding of the phenomena are at Volume 2 - RESTRICTED. (U)

Volume 3 (SECRET), considers XXXX

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

INTRODUCTION

1. Reports of UAP (popularly known as 'UFOs') are usually described as coloured lights and sometimes as shapes. They are typically spherical, disc, torroidal or cigar shaped. Very occasionally they are reported with sound and even with smell. Reports occur because they comprise unfamiliar and unexpected lights, shapes and patterns, in the context in which the observer sees them. The phenomena occur on a daily, world-wide basis. The UK annual reporting rate, which is for a relatively small part of the earth's total airspace, is summarised at Figure 1. That UAP exist is indisputable. Credited with the ability to hover, land, take-off, accelerate to exceptional velocities and vanish, they can reportedly alter their direction of flight suddenly and clearly can exhibit aerodynamic characteristics well beyond those of any known aircraft or missile - either manned or unmanned. (R)

2. The topic has, hitherto, defied credible description as to its actual cause. Any worth-while study of UAP, while maintaining the study aim, has inevitably required a multi-disciplinary approach and an understanding of the interaction of all the contributory factors. It is believed that the correlation of the overview of information reported over a period of about 30 years, with a more detailed examination of the last 10 years, together with the probable underlying science, may point to a reasonably justified explanation of the cause of this phenomena.(R)

3. For convenient cross-reference throughout this Executive Summary, the Contents Lists of Volumes 1, 2 & 3 are at Annex A.(R)

AIM

4. The aim of the investigation has been **to determine the potential value, if any, of UAP sighting reports to Defence Intelligence**. Consistent with MoD policy the available data has therefore been studied principally to ascertain whether there is any evidence of a threat to the UK, and secondly, should the opportunity arise, to identify any potential military technologies of interest. (R)

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

STUDY METHOD

5. UAP sightings are reported to MoD in a prescribed format and some 30 years of reports are held. A relational database has been designed to study the pattern and nature of UAP. From April 1997 it was decided that the DIS should receive only reports from 'credible' witnesses. This has significantly reduced the number of reports received and as a consequence made up to date records incomplete. For this study a statistically representative sample of the reports received between 1987 and 1997 have been examined in detail, using the database, and hundreds of other reports have been examined manually. The purpose of the **statistical analysis** was to:

- Provide graphical and tabular analysis of the number of reported UAP events by date, type, time and location.

- Allow clusters of events to be examined in greater detail, to determine whether any information of defence interest can be discovered, for example, relating to particular strategic locations, 'inspection' of our aircraft, etc.

- Identify, wherever possible, the atmospheric and terrestrial conditions for the occurrence or formation of a UAP. Although tenuous, in the absence of better quality data, this approach enabled probable causes of the UAP phenomena to be identified and thus eliminate some of the more extreme theses.(R)

6. **Flight Safety Aspects** Within the limitations of the UAP material available, an examination of all unexplained RAF aircraft fatal accidents was made, to assess the possibility, or otherwise, that past accidents may have been caused due to a startling (i.e. UAP) appearance, immediately ahead of military aircraft flying fast and low. An examination was also made for any possible UAP connection with near-miss aerial scenarios where the second air-object was never identified at the subsequent Civil Aviation Authority (CAA) enquiries.(R)

7. **Parallel Activities** The nature of all relevant types of atmospheric phenomena and human interaction have been studied, so that any items of defence intelligence interest could be identified. Factors which cause man-made objects to be misreported as UAP have also been studied. The study also necessarily involved a brief examination of the performance of the current UKADR surface and airborne sensors and whether the airspace could have been penetrated by potentially hostile air-objects in the form of UAP. (R)

8. **Science-Based Approach** A conscious effort has been made to distance the investigation from any external influences [e.g., such as may be found in the media] on the

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

topic of 'UFOs' and mention is made of these aspects only where absolutely necessary as part of the wider understanding of the enigma.(R)

SUMMARY OF FINDINGS

9. **Based on all the available evidence remaining in the Department (reported over the last 30 years), the information studied, either separately or corporately contained in UAP reports, leads to the conclusion that it does not have any significant Defence Intelligence value. However, the Study has uncovered a number of technological issues that may be of potential defence interest.** (R)

10. **Causes of UAP Reports** In the absence of any evidence to the contrary, the **key UAP report findings** are:

- Mis-reporting of man-made vehicles, often observed by perfectly credible witnesses, but with unfamiliar or abnormal features; or in unusual circumstances.

- Reports of natural but not unusual phenomena, which are genuinely misunderstood at the time by the observer.

- The incidence of natural, but relatively rare phenomena. These may be increasing due to natural changes and possibly accelerated by man-aided factors, such as smoke and dust.

Further:

- **No evidence exists to associate the phenomena with any particular nation.**

- **No evidence exists to suggest that the phenomena seen are hostile or under any type of control, other than that of natural physical forces.**

- **Evidence suggests that meteors and their well-known effects and, possibly some other less-known effects, are responsible for some UAP.** (R)

KEY SUPPORTING FINDINGS

11. Aerial phenomena of the type consistent with those reported as UAP, and with exceptional characteristics, certainly exist - but the available evidence suggests that apart from those which can be more easily and satisfactorily explained, they are comprised of several types of rarely encountered **natural** events within the atmosphere and ionosphere.

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

Some of these are still barely understood. It is clear that they have been reported as exceptional occurrences throughout recorded history, using the language of the times. In this respect the reader is especially referred to Annex A (page A4) for topics covered in Volume 2 Papers 2, 10, 13, 19, 21, 23 & 24 and to Volume 1 Annex C. (R)

12. Considerable evidence exists to support the thesis that the events are almost certainly attributable to physical, electrical and magnetic phenomena in the atmosphere, mesosphere and ionosphere. They appear to originate due to more than one set of weather and electrically-charged conditions and are observed so infrequently as to make them unique to the majority of observers. There seems to be a strong possibility that at least some of the events may be triggered by meteor re-entry, the meteors neither burning up completely nor impacting as meteorites, but forming buoyant plasmas. The conditions and method of formation of the electrically-charged plasmas and the scientific rationale for sustaining them for significant periods is incomplete or not fully understood.(R)

13. The key supporting findings are:

- [redacted] S.26

- Dependent on an object's colour temperature and aerosol density, it may be seen visually; either by its self-generated plasma colour, by reflected light or in silhouette by light blockage and background contrast. As an electrically-charged, but not ionised, gaseous mass, this may be either visible to the eye but not to radar sensors; or fully ionised and visible to both.

- **Occasionally and perhaps exceptionally, it seems that a field with, as yet, undetermined characteristics, can exist between certain charged buoyant objects in loose formation, such that, depending on the viewing aspect, the intervening space between them forms an area (viewed as a shape, often triangular), from which the reflection of light does not occur. This is a key finding in the attribution of what have frequently been reported as black 'craft', often triangular and even up to hundreds of feet in length.** (Volume 2, Paper 18)

- **The close proximity of plasma related fields can adversely affect a vehicle or person.** For this to occur the UAP must be encountered at very close ranges. **A probable modulated magnetic, electric or electromagnetic (or even unknown**

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

SECRET
UNCLASSIFIED

field), appears to emanate from some of the buoyant charged masses. Local fields of this type (probably either an electromagnetic near-field, or a direct magnetic field) have been medically proven to cause responses in the temporal lobes of the human brain. These result in the observer sustaining (and later describing and retaining) his or her own vivid, but mainly incorrect, description of what is experienced. Some observers are likely to be more susceptible to these fields than are others, and may suffer extended memory retention and repeat experiences. **This is suggested to be a key factor in influencing the more extreme reports found in the media and are clearly believed by the 'victims'** (Volume 2 Papers 1, 2 and (with experimental results) Paper 25)

- Those closest to the event but located in vehicles or behind obstacles, appear to be partially or fully screened from the radiated field and any radiant heat. Radiated effects are reported in some very rare instances to be sufficient to cause scorching of human skin and damage to nearby terrestrial objects. (Volume 2, Papers 1, 2 & 25)

- Within the influence of the field, and effectively in its probable near-field discharge path, coupling to vehicle electronic and electrical systems can occur and affect equipment operation. Although this effect has been limited to the temporary malfunction of internal combustion engines and radios within the UK, it is of importance that aircraft equipment could exceptionally be affected for a limited period, according to authoritative open scientific reports from the USA.

- **Although it cannot be completely ruled out, there is no firm evidence that aircraft or crews are exposed to a direct threat (e.g. collision risk) from a UAP, unless violent manoeuvres are undertaken to avoid or chase them. As a virtually inertia-less charged gaseous mass, the UAP will always be able to manoeuvre (much more rapidly than any aircraft) into a position demanded by the influence of the balance of electrical charges pertaining at the time.** (Volume 3)

- There is some evidence that the form and visual appearance of a buoyant entity, can be changed by the addition of external energy. It is possible that a natural body at a charge threshold level might change state if extra energy arrives. (This has led 'Ufologists' to imagine that an 'alien response' is being given to their signals!) (Volume 2, Paper 10)

- The increases in atmospherically-carried dust and other types of industrial gaseous emission, are likely to provide additional opportunities for electrically-charged aerosol formation (dusty plasmas). Dusty plasmas caused by this process are

UNCLASSIFIED
SECRET

probably not limited to occurring and remaining principally in those regions of the earth where volcanoes and earthquakes are natural events. (Volume 2, Paper 19)

- A Russian aerodynamics report shows that an otherwise 'indistinct, blurred or raggedly-shaped' charged aerosol formation (often a feature of UAP reports) can be naturally reshaped by the airflow in which it travels to look remarkably like a typically-reported 'classic UFO' shape. (Volume 2, Paper 19) (R)

14. At present the information is not available to accurately predict the condition for the formation of plasmas, which are believed to be responsible for many UAP reports. If the conditions for UAP formation can be predicted or even measured, it might be possible to enable formation probability forecasts to be made; **this may become an important factor in the future if the incidence (and hence the nuisance aspects) of UAP increases**. (R)

15. As part of the investigation other relevant factors have been taken into account:

- It is acknowledged that certain unfamiliar, friendly aircraft may be authorised, for covert entry into UK controlled airspace and this gives rise to some UAP reports. There is no evidence of the penetration of the UKADR by unauthorised air platforms. (Volume 2, Papers 6 & 9)

- No artefacts of unknown or unexplained origin have been reported or handed to the UK authorities, despite thousands of UAP reports. There are no SIGINT, ELINT or radiation measurements and little useful video or still IMINT, from the often short-lived UAP events. (Volume 2, Paper 22)

- A brief investigation into known or postulated 'exotic technologies' which might account for the phenomena has not revealed any likely exploitation of these by any known source. For any such capabilities to be viable, the technologies, reliabilities, manoeuvre capabilities, accelerations and velocities would apparently require an 'inertia-less vehicle'. For this to be the case a completely new understanding of materials, forces and fields would have to be in operation. The fact that the objects reportedly have the manoeuvre and acceleration attributes of an inertia-less vehicle re-inforces the hypothesis that they are buoyant charged bodies which move under the forces of both natural and man-made fields until they disperse naturally. (Volume 2, Paper 6)

- There is evidence, from openly-published scientific papers, that scientists in the former Soviet Union have taken a particular interest in 'UFO Phenomena'. They have identified the close connection with plasma technologies and are pursuing

related techniques for potential military purposes. For example, very high power energy generation, RF Weapons, Impulse Radars, air vehicle drag and radar signature reduction or control, and possibly for radar reflecting decoys. (Volumes 1 & 3) (R)

16. **Decoys** Charged masses can appear as visual, infra-red and radar targets. The potential use of these is noted, for example, as decoy targets. However, the means of generation and control of these in the atmosphere at the right time and place appears to be a significant challenge and it would have to be shown that there would be a clear advantage of plasma-type decoys over existing electronic warfare methods. There are clear analogies with the radar detection of UAP and specially constructed air vehicles which may use plasma to achieve signature modification. [Sensitive comparisons which might be made are discussed at Volume 3] (R)

KEY FINDINGS OF DEFENCE INTEREST

17. The overall analysis, which has included an examination of reports received during the Cold War, indicates that:

- **There is no evidence that any UAP, seen in the UKADR, are incursions by air-objects of any intelligent (extra-terrestrial or foreign) origin, or that they represent any hostile intent.**

- **There is no evidence that 'solid' objects exist which could cause a collision hazard.**

- **A small possibility may exist, suggested by the low density of such past reports, of a head-on encounter with a UAP.** If the increased density of UAP reports (as seen, for example during 1996/97) is an indicator of an increase in genuine sightings, this may indicate that the probability of head-on encounters could increase. This could be a startling event for very low flying aircraft and could, conceivably, result in a sudden control input from which recovery is impossible before ground impact. **Although the risk, based on all available evidence, is judged to be very low, it cannot be totally ruled-out.**. (Volume 3)

- **Attempts by other nations to intercept the unexplained objects, which can clearly change position faster than an aircraft, have reportedly already caused fatalities. However, there is no indication that deliberate 'UAP chasing' has caused this in the UKADR.**(Volume 3)

- **The conditions for the initial formation and sustaining of what are apparently buoyant charged masses, which can form, separate, merge, hover, climb, dive and accelerate are not completely understood.** Nevertheless, the underlying physics may have some military application in the future in the form of active visual, radar and IR decoys and passive electromagnetic spectrum energy-absorbers. [redacted] S.26 **(R)**

STUDY RECOMMENDATIONS

18. **Key Recommendation** Although the study cannot offer **certainty** of explanation of all UAP phenomena, the existing evidence is sufficiently persuasive to make **one** key and **4** subsidiary recommendations:

- **It should no longer be a requirement for DI55 to monitor UAP reports as they do not demonstrably provide information useful to Defence Intelligence. Therefore, Hd Sec (AS) should be advised.**

Subsidiary Recommendations

- Selection of a ten year UAP reporting period for detailed statistical studies, allowed material from both the Cold War and post-Cold War periods to be studied. **No significant differences were discovered in the results from these two time periods.** For this and other reasons it is not expected that further inputs to the database will significantly change the findings stated in this Executive Summary. Consequently, and **in keeping with the key recommendation, it is recommended that there be no further requirement for maintaining the database.**

- The flight safety aspects of the findings should be made available to the appropriate RAF Air Defence and other military and civil authorities which operate aircraft, particularly those operating fast and at low altitude.

In so advising:

- **It should be stressed that, despite the recent increase in UAP events, the probability of encountering a UAP remains very low.**

- **No attempt should be made to out-manoeuvre a UAP during interception.**

- **At higher altitudes, although UAP appear to be benign to civil air-traffic, pilots should be advised not to manoeuvre, other than to place the object astern, if possible.**

- **The reasons affecting the variability in radar detections of UAP by UKADR (and civil air traffic) sensors, should be passed to the appropriate operating authorities**.

- The relevance of plasma and magnetic fields to UAP were an unexpected feature of the study. **It is recommended that further investigation should be into the applicability of various characteristics of plasmas in novel military applications**. With respect to the possibility of the use of plasmas for military applications, such as target radar signature control and antennas, it is noted that the implications have already been briefed to the relevant MoD technology managers.

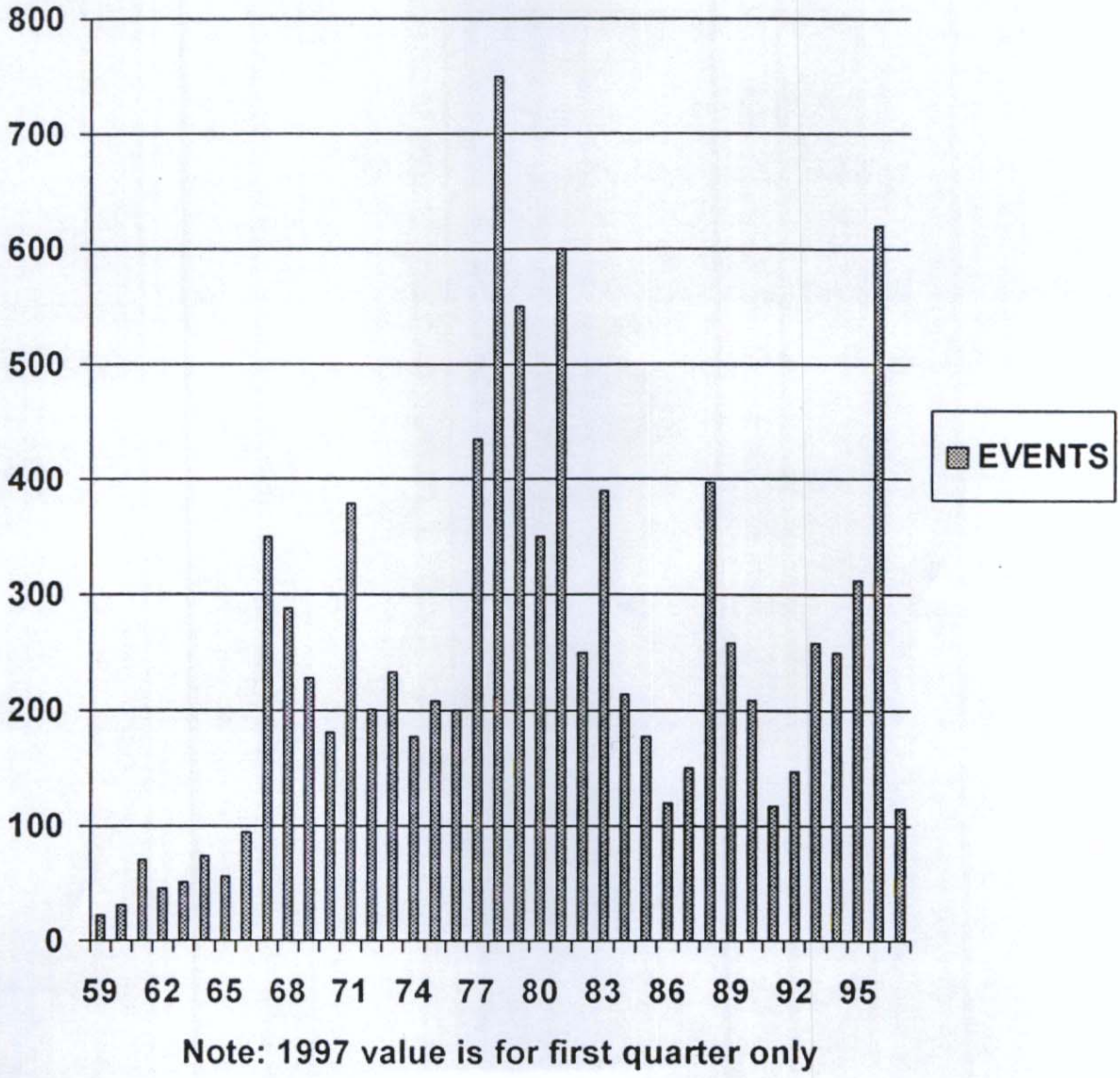


FIGURE 1 – NUMBER OF UAP ANNUAL REPORTS 1959-1996

ANNEX A
to Unidentified Aerial Phenomena in The UK Air Defence Region: Executive Summary

VOLUME 1 – BACKGROUND, DATABASE, & STATISTICAL RESULTS

PREFACE
INDEX TO ALL REPORTS VOLUMES

CHAPTER 1 – HISTORICAL STUDY BACKGROUND & AIM

INTRODUCTION
- Historical
- UAP Reporting Procedure
- Air Threats

AIM OF THE STUDY

CHAPTER 2 – ANALYSIS METHODOLOGY

RELEVANT INFORMATION
EXOTIC TECHNOLOGIES
UAP SIGHTING REPORTS
UAP CLASSIFICATION
LIGHTS & SHAPES
- Manual Interpretation of UAP Reports
- Further Identification
- Correlation of Incident Reports

ARTEFACTS & HUMAN EFFECTS IN THE UK

CHAPTER 3 –STATISTICAL

INTRODUCTION
STATISTICAL ANALYSIS – LIMITATIONS
GENERAL DEDUCTIONS FROM REPORTS
DATE-CLUSTERED REPORTS
ANALYSIS 1987/89
ANALYSIS 1996
- Peak Numbers of UAP

UAP REPORTS BY MAIN REGIONS
GEOGRAPHICAL LOCATION ANALYSIS
- Events Several Times at Same Location

Higher Numbers of Reports
NUMBERS OF OBJECTS PRESENT PER EVENT

UAP LIGHT & COLOUR ANALYSIS
Visual Emanations from UAP Beams
UAP SOUND & SMELL ANALYSIS
UAP SHAPE ANALYSIS
UAP MOTION ANALYSIS
CORRELATIONS STUDIES
With Time of day
With Month of Year
With Weather
With Solar Activity
With Meteor Activity
Similarity to UAP
RESULT OF METEOR INVESTIGATION
HUMAN FACTORS
Witness Gender & Age
Witness Location
STATISTICAL CONCLUSIONS

CHAPTER 4 – POTENTIAL RELATED MILITARY TECHNOLOGY

DEDUCTIONS FORM WIDER RESEARCH
Physical Observations & Human Responses
TERRESTRIAL & AIRBORNE BUOYANT CHARGED BODIES
'Foo' Fighters
Proximity to Strategic Assets
Nuclear Radiation
Sound & Smell
UAP Plasmas
Proof of Medical Effects
AIRCRAFT ACCIDENTS
RADAR DETECTION

CHAPTER 5 – SUMMARY OF STUDY FINDINGS

Unfamiliar Natural Phenomena
Items of Interest to Defence Intelligence
Human Medical Aspects
Dependence on Culture
Unexpected Encounters by Aircraft
Charged Plasmas in the Atmosphere
Radar Detection of Plasmas
Related Military Applications

Solar & Weather Conditions

STUDY RECOMMENDATIONS

Key Recommendation
Subsidiary Recommendations

CONCLUSIONS

ANNEXES

A Study Terms of Reference
B Example UAP Report Format
C Czech Project 'Zare'
D The UAP Access Database
E Initial Analysis Requirements
F Statistical Results
G Historical

SECRET
UNCLASSIFIED

VOLUME 2 - WORKING PAPERS ON ASSOCIATED NATURAL & MAN-MADE PHENOMENA

1 UAP EFFECTS ON HUMANS, ELECTRICAL/ELECTRONIC EQUIPMENTS & OBJECTS
2 BALL & BEAD LIGHTNING
3 POTENTIAL REASONS FOR HIGHER DENSITIES OF UAP SIGHTINGS
4 AFTER-IMAGES AS A RESULT OF FLASHES OF LIGHT
5 DETECTION OF UAP BY RADAR
6 EXOTIC TECHNOLOGIES
7 SIGHTLINE-RATES OF FLYING OBJECTS
8 RARITY OF UAP SOUNDS
9 'BLACK' & AND OTHER AIRCRAFT PROGRAMMES
10 LEY LINES, EARTHLIGHTS AND UK EARTH FAULT LINES
11 COLLECTED IMAGERY & CLASSIFICATION OF UAP SHAPES
12 EARTH'S MAGNETIC FIELD
13 VISUAL METEOROLOGICAL AND OTHER NATURAL PHENOMENA
14 METEOROLOGICAL BALLOONS
15 AIRSHIPS & HOT-AIR BALLOONS
16 SUNSPOT, AURORA & SEISMIC CORRELATIONS
17 VISUAL OBSERVATION OF SATELLITES
18 PROJECTED SHAPES & SHADOWS, FLUORESCENCE, LUMINESCENCE & SONOLUMINESCENCE
19 CHARGED DUST AEROSOLS
20 OPTICAL MIRAGES
21 IONOSPHERIC PLASMA
22 ARTEFACTS
23 LINKED VORTEX RINGS
24 SPRITES, ELVES AND BLUE JETS
25 OVERVIEW OF MAGNETIC FIELD EFFECTS ON HUMANS

UNCLASSIFIED
SECRET

SECRET
UNCLASSIFIED

VOLUME 3 – MISCELLANEOUS RELATED STUDIES

PREFACE
EXECUTIVE SUMMARY

CHAPTER 1 – RADAR DETECTION OF UAPs IN THE UKADR

RATIONALE
- Anomalous Propagation
- Natural Conditions

RADAR PERFORMANCE
- Plasma Cylinders & Vortex Rings
- Aircraft as a Charged Body

UKADGE RADAR PERFORMANCE AGAINST UAPs
- Target Characteristics
- Radar Characteristics
- Operator Procedures & Thresholds

SUMMARY

CHAPTER 2 – POTENTIAL HAZARDS TO AIRCRAFT

RATIONALE
- Unexplained Accidents

AIRMISSES
- UAP Event Correlation

HAZARD SUMMARY
CONCLUSION

CHAPTER 3 – POTENTIAL FOR EXPLOITATION OF UAP-ASSOCIATED EFFECTS

- Exotic Vehicles
- Propulsion

POTENTIAL APPLICATIONS
- Earthlight Replication

CHAPTER 4 – UAP WORK IN OTHER COUNTRIES

FORMER SOVIET UNION
- Plasma Research
- Former Soviet Union Ufology Institute
- Near Field Effects

UNCLASSIFIED
SECRET

Former Soviet Union Aircraft Incidents
FSU/Russian Experimental Vehicle
OTHER NATIONAL ACTIVITY
CHINA
SPAIN
USA & CANADA

ANNEX A . "RUSSIAN GENERATION OF PLASMA FORMATIONS BY PULSED DISCHARGES"

SECRET
UK RESTRICTED
UK EYES ONLY

DISTRIBUTION

No. of Copies

XXXXXX
XXXXXX
XXXXXX
XXXXXX

not relevant

XXXXXX
XXXXXX
XXXXXX
XXXXXX
XXXXXX

UNCLASSIFIED

UK EYES ONLY
UK RESTRICTED
SECRET

DIST
D154a2
collcopy

UNCLASSIFIED
SECRET
UK EYES ONLY

Copy No 7 of copies

Unidentified Aerial Phenomena in the UK Air Defence Region: Volume 1

Main Report

SCIENTIFIC & TECHNICAL MEMORANDUM - No. 55/2/00

MINISTRY OF DEFENCE
RECEIVED
7 DEC 2000
AFS - 3852
D154 REGISTRY

DEFENCE INTELLIGENCE STAFF

December 2000 **Defence Intelligence Analysis Staff**

DIS

UNCLASSIFIED
UK EYES ONLY
SECRET

SECRET
UNCLASSIFIED

AN EXAMPLE UAP FORMATION OF THE TRIANGULAR TYPE

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

UNCLASSIFIED

PREFACE

"What does all this stuff about flying saucers amount to? What can it mean? What is the truth?. Let me have a report at your convenience".

W.S. Churchill, 28th July 1952

The material researched is reported in three Volumes. Volumes 1 and 2 are classified RESTRICTED. Volume 3, SECRET, XXXX

SECRET
UNCLASSIFIED

UNIDENTIFIED AERIAL PHENOMENA IN THE UK AIR DEFENCE REGION

VOLUME 1 – MAIN REPORT

CONTENTS

	PAGE
PREFACE	ii
INDEX TO ALL REPORT VOLUMES	iii
CHAPTER 1 - HISTORICAL STUDY BACKGROUND & AIM	
INTRODUCTION	
Historical	1
UAP Reporting Procedure	2
Air Threats	3
AIM OF THE STUDY	3
CHAPTER 2 - ANALYSIS METHODOLOGY	
RELEVANT INFORMATION	1
EXOTIC TECHNOLOGIES	3
UAP SIGHTING REPORTS	6
UAP CLASSIFICATION	7
LIGHTS AND SHAPES	7
Manual Interpretation of UAP Reports	8
Further Identification	9
Correlation of Incident Reports	10
ARTEFACTS & HUMAN EFFECTS IN THE UK	10
CHAPTER 3 - STATISTICAL ANALYSIS OF THE UAP DATABASE	
INTRODUCTION	2
STATISTICAL ANALYSIS - LIMITATIONS	3
GENERAL DEDUCTIONS FROM REPORTS	4
DATE-CLUSTERED REPORTS	5
ANALYSIS 1987/89	5
ANALYSIS 1996	9
Peak Numbers of UAP	9
UAP EVENT REPORTS BY MAIN REGIONS	11
GEOGRAPHICAL LOCATION ANALYSIS	12
Events Several Times at Same Location	14
NUMBERS OF OBJECTS PRESENT PER EVENT	15
UAP LIGHT & COLOUR ANALYSIS	15
Visual Emanations from UAP Beams	15
UAP SOUND & SMELL ANALYSIS	17

UNCLASSIFIED
SECRET

UNCLASSIFIED SECRET
UK RESTRICTED
UK EYES ONLY

UAP SHAPE ANALYSIS 17
UAP MOTION ANALYSIS 17
CORRELATION STUDIES
With Time of Day 18
With Month of Year 20
With Weather 21
With Solar Activity 22
With Meteor Activity 25
RESULT OF METEOR INVESTIGATION 26
HUMAN FACTORS 26
WITNESS GENDER & AGE 27
WITNESS LOCATION 27
STATISTICAL CONCLUSIONS 27

CHAPTER 4 - POTENTIAL RELATED MILITARY TECHNOLOGY

DEDUCTIONS FROM WIDER RESEARCH
Physical Observations & Human Responses 1
TERRESTRIAL & AIRBORNE BUOYANT CHARGED BODIES 2
'Foo' Fighters 3
Proximity to Strategic Assets 4
Nuclear Radiation 4
Sound & Smell 5
UAP Plasmas 5
Proof of Medical Effects 6
AIRCRAFT ACCIDENTS 6
RADAR DETECTION 8

CHAPTER 5 - SUMMARY OF STUDY FINDINGS

INTRODUCTION 1
FINDINGS 1
Items of Interest to Defence Intelligence 1
Unexpected Encounters by Aircraft 1
Radar Detection of Plasmas 2
Related Military Applications 2
Unfamiliar Natural Phenomena 2
Solar & Weather Conditions 2
Charged Plasmas in the Atmosphere 2
Human Medical Aspects 3
Dependence on Culture 3
STUDY RECOMMENDATIONS
Key Recommendation 3
Subsidiary Recommendations 3

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET

A Study Terms of Reference
B Example UAP Report Format
C Historical Annex
D The UAP Access Database
E Initial Analysis Requirements

UNCLASSIFIED
SECRET

SECRET
UNCLASSIFIED

VOLUME 2 - WORKING PAPERS ON ASSOCIATED NATURAL AND MAN MADE PHENOMENA

WORKING PAPER INDEX

1 UAP Effects on Humans, Electrical/Electronic Equipments & Objects
2 Ball & Bead Lightning
3 Potential Reasons for Higher Densities of UAP Sightings
4 After-Images as a result of Flashes of Light
5 Detection of UAP by Radar
6 Exotic Technologies
7 Sightline-Rates of Flying Objects
8 Rarity of UAP Sounds
9 Black and Other Aircraft Programmes
10 Leys Lines, Earthlights and UK Earth Fault Lines
11 Collected Imagery & Classification of UAP Shapes
12 Earth's Magnetic Field
13 Visual Meteorological and Other Natural Phenomena
14 Meteorological Balloons
15 Airships & Hot-Air Balloons
16 Sunspot, Aurora & Seismic Correlations
17 Visual Observation of Satellites
18 Projected Shapes and Shadows, Fluorescence, Luminescence & Sonoluminescence
19 Charged Dust Aerosols
20 Optical Mirages
21 Ionospheric Plasma
22 Artefacts
23 Linked Vortex Rings
24 Sprites, Elves and Blue Jets
25 Overview of Magnetic Field Effects on Humans

UNCLASSIFIED

SECRET

UNCLASSIFIED
SECRET
UK RESTICTED
UK EYES ONLY

VOLUME 3 - MISCELLANEOUS RELATED STUDIES

	Para.	Page
PREFACE		ii
EXECUTIVE SUMMARY		iii
CHAPTER 1- RADAR DETECTION OF UAPs IN THE UKADR		
RATIONALE	1	1
Anomalous Propagation	2	1
Natural Conditions	4	2
RADAR PERFORMANCE	7	2
Plasma Cylinders & Vortex Rings	12	3
Aircraft as a Charged Body	16	3
UKADGE RADAR PERFORMANCE AGAINST UAPs	22	6
Target Characteristics	23	6
Radar Characteristics	24	6
Operator Procedures & Thresholds	26	8
SUMMARY	28	9
CHAPTER 2- POTENTIAL HAZARDS TO AIRCRAFT		
RATIONALE	1	1
Unexplained Accidents	8	2
AIRMISSES	11	4
UAP Event Correlation	13	5
HAZARD SUMMARY	17	5
CONCLUSION	20	6
CHAPTER 3- POTENTIAL FOR EXPLOITATION OF UAPASSOCIATED EFFECTS		
Exotic Vehicles	2	1
Propulsion	5	2
POTENTIAL APPLICATIONS	8	3
Earthlight Replication	9	3
CHAPTER 4- UAP WORK IN OTHER COUNTRIES		
FORMER SOVIET UNION	1	1
Plasma Research	3	1
Former Soviet Union Ufology Institute	4	1
Near Field Effects	5	1
Former Soviet Union Aircraft Incidents	8	2
FSU/Russian Experimental Vehicle	9	2
OTHER NATIONAL ACTIVITY		
CHINA	10	3
SPAIN	11	3
USA & CANADA	12	3
ANNEX A - GENERATION OF PLASMA FORMATIONS		

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

UNCLASSIFIED

"There seems to be a campaign building up to criticise government policy about the release of information on unidentified flying objects. The authors of the campaign are firmly convinced that extra terrestrial manifestations have appeared, whereas the Air Staff are by no means certain. As it is not possible to release official data which does not exist it is difficult enough to satisfy those with preconceived ideas to the contrary". Memo 19, August 1958

CHAPTER 1

HISTORICAL STUDY BACKGROUND & AIM

INTRODUCTION

1. **Historical** Objects in the atmosphere, sometimes on the ground, but often much higher in visible space, have been reported for millennia. Reports from within UK airspace alone, number thousands since the 1950s, as shown at Figure 1.1. Clearly these reports are of something not being understood at the time by the observer. Since manned flight commenced and with the advent of outdoor laser displays, space flight, unmanned aircraft and greater public awareness, caused largely by media hype, the phenomenon of "unidentified flying objects" (UFOs) has reached heights of unprecedented public interest. In the past this has undoubtedly distorted the clarity of approach needed for a scientifically-based analysis. It has been recent MOD practice to refer to such phenomena, in the absence of rational explanation, as Unexplained Aerial Phenomena (UAP). Further, from the record, it is clear that it was MOD policy from the outset that any interest in UAP is only necessary as an assurance that any such object is not a threat to UK airspace or assets. In August 1950 a Working Party was set up (at the suggestion of Sir Henry Tizard) who thought "flying saucers should be investigated". Records show that the 11th meeting of the Joint Technical Intelligence Committee (Ref. DSI/JTIC(51) Item 8 (1951)) received the Chairman's Report of the "Flying Saucer Working Party". The Committee decided that "the document should be regarded as the final report and, in view of the conclusions the Working Party should be dissolved". The Chairman (Mr. G.L. Turney DSI3) went on to say that, "following the lead given by the Americans on this subject, the Report should have as little publicity as possible and outside circulation should be confined to one copy, for Sir Henry Tizard". The Report was approved. The Department does not possess a copy of this report (it may exist within Sir H. Tizard's papers), but it is implied that nothing important was found. Great Britain was happy to allow the US studies to answer any outstanding questions. However, there must have been further concern and the Prime Minister's request, quoted at the Preface, came the following year and the brief subsequent reply, produced a few days later, is shown here at the Historical Annex.(U)

2. The United States Air Force had started to take an official interest in 1948 (PROJECT SIGN), later changed to PROJECT GRUDGE and then to PROJECT BLUE BOOK. Such was the concern in the US that by 1952 ××××× instigated a covert study group to investigate the "10% of incredible reports from credible witnesses". In fact, over 10,000 reports, spanning 19 years, were processed by 1965 (of which it was reported that about 7% were unexplained). It was also questioned whether any use could be made of the phenomena for psychological warfare. The covertness of this investigation subsequently contributed greatly to charges of a government 'cover-up' - a notion that has continued to this day. In 1952-3 the US had set up the Robertson Panel (Intelligence Scientific Advisory Panel) and observed that British experts (Prof R.V. Jones and others) were taking the increase in UAP sightings seriously. Meanwhile, it is noted, the S.27

UNCLASSIFIED

possibility of the USSR using a UFO scare as a means of jamming communication channels, while simultaneously attacking the West was considered a serious possibility - even though the investigation team had dismissed sightings of 'UFOs' as 'explainable'! In 1953 the USAF commenced a more detailed collection of sighting information which, according to US Government statements, ceased in 1958 with no proof of extra-terrestrial origin. However, the topic would not go away and by 1966 the USA's CONDON Report had studied and reported on 59 events in detail. The report concluded "While we do not think, at present, anything worthwhile is likely to come out of research (i.e. into UFOs), each individual case should be considered on its merits. No (separate) US Agency is required - but this may not be the case for all time". Great Britain took no part in this USAF study, and there is no record of the Air Ministry requesting or receiving this report within the Department. Other nations are also known to have shown a continuing interest in this topic, especially in China, the Czech Republic, the USSR and, subsequently, the CIS and Brazil, South Africa and Spain - who, in 1997, released 66 'UFO' files to the public. However, **no** reports have been received from any of these nations by UK intelligence staff; any information being casually noted through open sources and publications as a matter of passing interest. Unfortunately, public interest and suspicion in the UK has also remained undiminished, resulting in a 'UFO' demonstration outside MoD in March 1995, a spate of public letters and frequent Parliamentary Questions and even debates on the topic. The Department is not tasked to collect or examine anything other than reports sent on by Air Sec (2a). Until this reporting procedure was reduced in 1997 there was an increase in reports and hence in the departmental effort required. This is the first UK detailed and authoritative report which has been produced since the 1950s.(R)

3. **UAP Reporting Procedure** In the 1950s, the then Air Ministry, produced a 'minimum format', one page, 'UFO' reporting procedure for both public and military reporting of the phenomena. This procedure has remained unchanged and all event analysis in this report is based on an analysis of a voluminous paper database, which spans about 25 years. Further, it is not within the remit of the department to pursue witnesses to elicit any further information beyond that which they have provided to the MOD on the standard form. This information source has many inadequacies - and much of the initial work concentrated on the conversion of this material into computer database format. Only data which has originated within the airspace (comprising the UK Air Defence Ground and Air Environment, the UK Air Defence Region) is used in the database analysis, although the support of authoritative scientific reference sources world-wide has been made to come to a considered decision as to the most likely causes of the phenomenon.(U)

4. Access to individual official UAP sightings from other nations has not been possible. The MOD has no contact with other nations to supply such material and similarly, does not make UK sighting reports available to other nations - indeed, no such requests have been received.(U)

5. On receipt of reports from the general public, military, or other sources (e.g. police, coastguards, aircrew etc.), one report format is completed for each separate sighting and sent to MOD, usually via the police, military establishments or air traffic control centres. These are passed to MOD Sec (AS2a) and have been routinely copied to DI55 for brief scientific perusal. Reports older than 30 years are available to the public through the Public Record Office.(U)

6. **Air Threats** The Ministry of Defence, charged with the Air Defence of the Realm, are only interested in UAP reports if they are found to reveal a threat or a hazard. For the purposes of the study it has been assumed that a threat would **only be identified as such,** if:

UNCLASSIFIED
SECRET

- Controlled, unidentified, air-objects could successfully penetrate the defended airspace of UKADGE with hostile intent in PEACE, CRISIS or WAR.

- Damage (or potential damage or danger) could be caused in the form of physical effects or electronic effects, or if there is a possibility of an air hazard, such as a collision or damaging incident with civil or military air traffic.

- Objects within the airspace were found to be hostile if challenged and invulnerable to radar tracking and could out-manoeuvre our airborne or ground-based air defences.

- Controlled objects could enter and leave the UKADR, having possibly obtained intelligence data (e.g. Imagery, ELINT etc.).

(R)

AIM OF STUDY

7. The Terms of Reference of DI55's remit and for this investigation are at Annex A. In order to meet the aim, which is **to determine the potential value, if any, of UAP sighting reports to defence intelligence**, it has been considered necessary to pursue at least the following tasks:

(a) Assess whether the UKADR airspace has been breached by any potentially hostile flying object.

(b) Determine, if applicable, what intelligence, if any, is revealed on military capabilities of other countries.

(c) Ascertain whether any scientific and technical information of military significance is contained in the sighting reports.

(R)

8. This is interpreted, for the purpose of this Study, as:

- Determine, from the available UAP incident reports (example at Annex B), whether any scientific facts can be elicited from these phenomena - which may indicate military purposes.

- Use database technology to separate the useful from spurious information, thus providing a basis for any future analysis that may be tasked.

- Identify atmospheric and other conditions under which these sightings can occur thus enabling, if possible, their causes to be established and whether they can be disregarded or even predicted.

- Monitor reports (from any source) in case the underlying physical phenomena is already being exploited by another nation for potential future military purposes.

- Try to discover why some of the UAP events, seen by human witnesses, are apparently sometimes visible and sometimes invisible to the UKADGE and airborne radar reporting systems.

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET

- Investigate whether any UAP report can be correlated with any 'no survivor' air accident.

In order to meet the aim of the study a detailed understanding of all reliable information is essential and it was likely that, in the search for any information of interest to defence intelligence, other related information of interest to the air defence community might be revealed. (R)

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

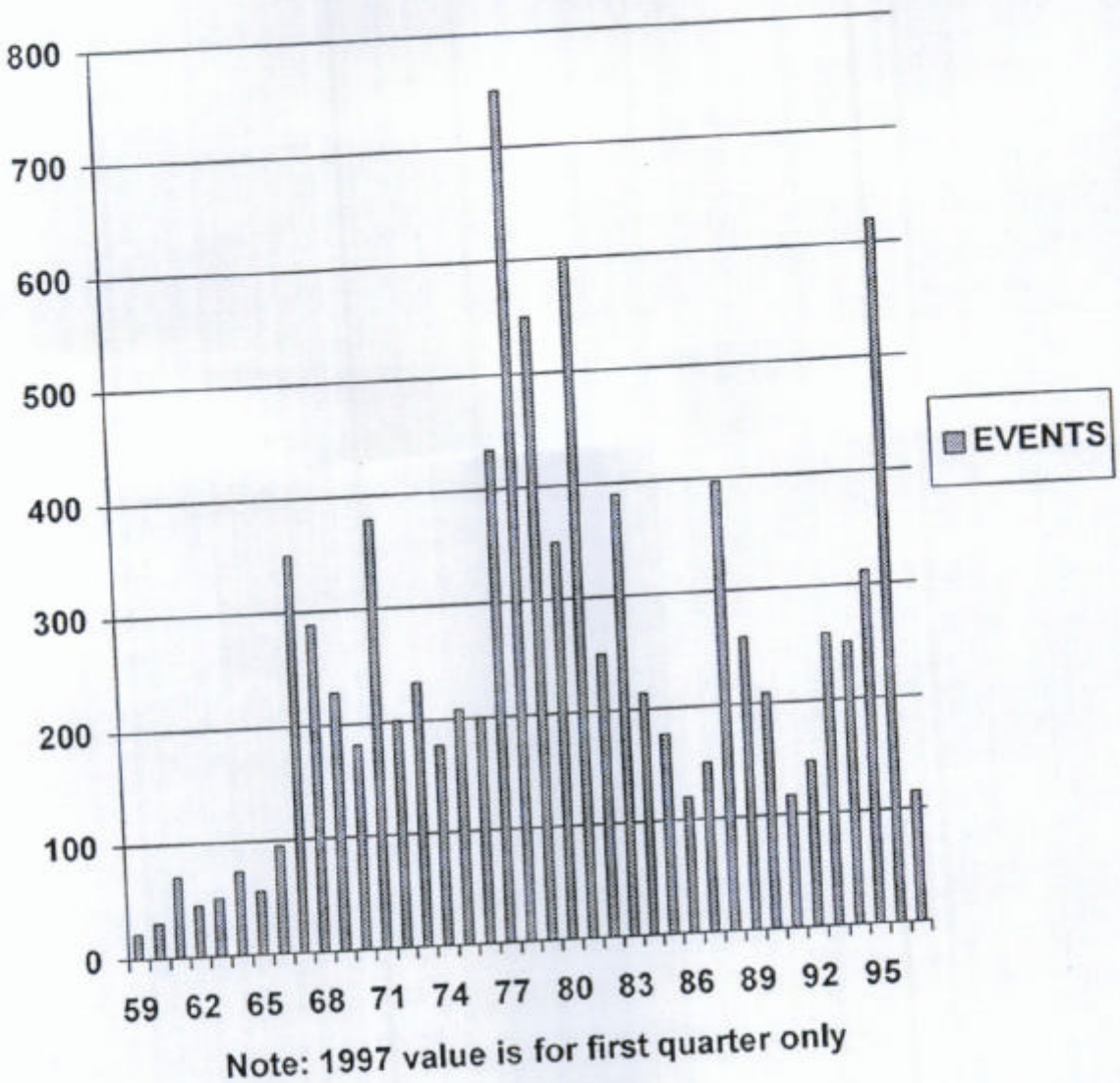


FIGURE 1-1 NUMBERS OF UAP REPORTED ANNUALLY 1959-1996(U)

UK EYES ONLY
UK RESTRICTED
SECRET
UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

CHAPTER 2

ANALYSIS METHODOLOGY

RELEVANT INFORMATION

1. In order to manipulate the available data and efficiently filter the known from the unknown (or incomplete) it was first necessary to identify key words and all known natural and man-made phenomena surrounding the topic. In so-doing the scope had, on the one hand, been carefully limited; but, on the other, it was essential to strive to capture as many **describable** attributes as possible to build an electronic database, so as to avoid the need for database re-design later on; should further investigations be found necessary. It was found that a considerable amount of relevant background information was obtained. While the tedious task of converting thousands of paper UAP reports into electronic form proceeded each of the key associated topics was researched and produced in the form of separate Point Papers which could be used as reference material during the subsequent manual and statistical analysis. An understanding of as many apparently associated familiar and unfamiliar aerial phenomena was considered to be an essential part of the methodology of analysis for the study. These are contained at Volume 2, which contains 25 Point Papers. For convenience here they are grouped into 7 main topic areas:

- **Man-made Air Vehicles** These are often mistakenly reported as UAP and those of appropriate shape or rarity to be reported as UAP are covered at Working Papers Nos 9, 14, 15 & 17.

- **Meteorological & Atmospheric Phenomena** These important factors are covered at Working Papers Nos 2, 13, 18, 19, 20, 23 & 24 and are fundamental to understanding the UAP events One of the more important findings is that of a 'total absorption' optical phenomena, which can exist in the space between charged buoyant bodies, giving the appearance of an airborne shape (for example, a 'shape' which is a visual triangular void, between 3 such charged bodies and from which no light is reflected). The findings on buoyant plasmas are of particular significance.

- **Reported Effects on Humans** Papers 1, 4 & 25. In the course of research (and on the assumption that some sort of field in addition to the (visible) electromagnetic emissions may emanate from a UAP), a brief investigation was made into medical effects of fields upon humans. The search for relevant information went beyond UK sources and an important and very relevant phenomena was reported in a Canadian medical journal which indicated that **certain magnetic field structures caused the human brain to respond in a very similar manner to that exhibited by 'close-encounter' UAP witnesses.** This is explained at Paper 25. The presence of a 'field' near UAP, which affects humans, has been reported in Russia.

- **Celestial, Ionospheric & Terrestrial Phenomena** These aspects are reported at Papers 10, 12 & 16.

- **Sighted Shapes, Motions & Sounds** A compendium of typical UAP shapes is shown at Paper No 11. Motion and Sound are at Papers Nos 7 & 8, and at No 18.

- **Detection by Radar** This important topic is considered in general radar terms at Point Paper No 5 and specifically in the context of the current UKADR radars at Volume 3

- **Exotic Technologies** Paper No 6 (R)

UK EYES ONLY
UK RESTRICTED
UNCLASSIFIED
SECRET

2. At the start of an understanding of UAPs, simple man-made airborne objects such as aircraft, para-wings or balloons are often the explanation. The range of options then progresses through a set of other relatively easily explainable man-made, atmospheric and natural and unusual, propagation and atmospheric phenomena (some of which are still not fully understood). In addition there are hoaxes. The final level is that of the extreme possibility of extra-terrestrial objects under some sort of control. There is always the possibility that some, relatively rarely, reported events have a supernatural basis or are due to a mental condition of a witness. Nevertheless, a variety of key factors can be used to filter the explainable from the inexplicable. In the past often the latter conclusion was reached, due to a lack of information, which was probably available at the time, but not noted on the sighting form. Unfortunately, even if a follow up had been possible, by the time event reports are received the 'trail has gone cold'. Ideally, some experience and scientific background would be essential **at the time of an event** to elicit the type of information required - the key items which are required to make a rational and credible judgement on the cause of the event. As DI55 are not permitted to make follow-up investigations after UAP events and not even to speak to witnesses to clarify the meaning of, (often cryptic or missing observations), analysis is dependent only on the paper report. (R)

3. Since it seems unlikely that all UAPs are reported (some researchers believe as many as 80-90% are **not** reported for a variety of reasons); the proportion of all types of events including those barely credible, are likely to be greater than received MOD sighting reports indicated at Figure 1-1. Some of the actual values are shown at Table 2-3. Unfortunately the great majority of UK Report Forms are incomplete or incompetently completed or are as vague as the typical example UAP report at Annex B. (R)

4. The spread of related science in attempting to find explanations for every object reported is significant, especially as this is an 'Air phenomenon' and which there are inevitably areas of atmospheric physics, optics, propagation, and atmospheric electrostatics and magnetics in which knowledge is known to be incomplete. Further, the study necessarily includes wider elements of physics, chemistry, aerodynamics, meteorology, psychology of perception, vision, geometry and human mental states. There is, at the beginning of such an investigation, even the possibility that some form of unknown field is an influence in how the unfamiliar object is formed, moves or disperses. A further understanding of some of these areas could well spell the end of the 'UFO' enigma. Sighting reports for the analysis are mainly drawn from the last 10 years, and in particular the last 5 years of a set of reports which are held back to 1968. (Previous reports having been destroyed and other related correspondence released to the PRO under the 30 Year Public Disclosure Rule). Various descriptions have been applied to UAP events by the media. These are ignored for the purposes of this analysis. Clearly a UAP is always something which is seen, apparently capable of 'flight' (in that it is the sky and on occasions it is seen on the surface) but which, although it may be proved otherwise, does not exhibit the expected characteristics familiar when viewing man-made vehicles. A UAP cannot be dismissed by the observer as irrelevant. Many of the public feel it their duty to make reports and they are very concerned that the authorities should be made aware of what they either believe they have seen or apparently seen. Often a report is made on the following day after some thought has been given. This means that a distortion of events can occur due to the time lag. Reports regularly show that witnesses are quite concerned about possible ridicule but they are equally adamant about what was seen.(R)

5. Many of the events are reported by trained observers, often members of the Armed Forces (both by Air and Ground Crews), Police or Coastguards or Civil Airline Pilots. Clearly one or more of the following occurs:

- The key stimulus is visual.

- A physical form is seen, which is then attributed a shape and/or colour, and sometimes a sound and, on rare occasions, even a smell.

- All attributes reported are subject to the witnesses own perception and interpretation.

- A visual picture is often 'seen', which may not necessarily equate with that 'seen' by another observer of the same phenomenon located nearby. This suggests that the 'picture' formed may have been mentally adjusted, possibly due to some other factor present at the time.

- A physical form may be reported as a result of a combination of what is actually seen with a pre-conceived or sub-conscious mental distortion (in the witness's own-cognition of the event).

-The object(s) is considered to be important, extraordinary and even frightening and a reported is made to the authorities because it might be a threat of some kind.

- Reports, exceptionally, may not be made or may be delayed, for fear of ridicule.

(R)

6. UAP Data is always inadequate. For example, within the department, there are no sound recordings to analyse, few still photographs (none close-up), some videotapes (none close-up), and no instrumented measurements. Inspection of (surface to air) photography has not revealed any useful evidence beyond that of explainable aerial objects and only a few memory sketches exist during the last 30 years of reporting. Any supposed UAP 'ground contact', (for which there are no photographs, only rough sketches) has been reported as 'leaving circular marks'. Also, on a few occasions there have been reports of depressions to rural surfaces and bending or other minor damage to hedgerows and at least one report of fire to some railway sleepers. Rarely have reports of animals being affected been received.

(R)

EXOTIC TECHNOLOGIES

7. Any investigation into exotic aerospace technologies goes beyond that of an examination of the UAP sighting reports. The aim of the study has been to thoroughly investigate any facts which might have a bearing on defence intelligence. Any extension of the research to attempt to 'fit' UAP report detail to potential technologies which could cause aerial devices to perform in hitherto exceptional profiles, must necessarily be limited. A strictly scientific line of approach has been taken, hence:

- Any research has been limited, based only on the available evidence and known science, so as to confirm or eliminate the possibility that some sort of aerial object(s) which **may (or may not) be a threat can enter and leave the UKADR, either undetected or detected but remain invulnerable to our current air defences. This has necessitated a brief study of related radar topics.**

- In an open scientific enquiry the likelihood of any unexpected, but nevertheless rationale finding, must be a possibility and no evidence has been disregarded.

- As no definitive scientific explanation (or even the most probable scientific probable explanation) of **has ever been given any UK report since the 1950s,** this study has provided an opportunity to encompass much more evidence that has hitherto been available.

UNCLASSIFIED
SECRET

- Initially, it could not be discounted that an extraordinary (even extra-terrestrial) finding **might** account for some events. It was also clear that to arrive at such finding, (given the exceptional attributes which some witnesses attributed to their aerial sightings), that this could only be the result of technologies which encompass scientific and engineering attributes which are well beyond even the far-term aspirations of any aerospace industry on earth. For example, attributes and abilities which allow a vehicle and any occupants to:

  (a) Carry out inter-planetary or possibly inter-galaxy travel.

  (b) Travel in the Earths exo and high endo-atmosphere at hitherto impossibly high velocities compared with all current air vehicles, yet with the capability of 'hovering' and possibly of landing and taking off again.

  (c) Move in the atmosphere with soundless or near-soundless motion, and in an aerodynamic manner which does not cause sonic-booms.

  (d) Possess manoeuvre capability which is significantly beyond our current capability and which certainly appears to be beyond that which it is believed humans might withstand.

  (e) Have a visual form which can be observed either by reflected light or by internally generated light from within and also appear to be opaque at times in contrast to the viewing background.

  (f) Not necessarily be seen always by radar.

  (g) Produce 'lights' which seem to have directionality (allegedly seen as 'portholes' or 'beams').

  (h) Exhibit characteristics, on occasions, which have been described as 'intelligent'.

  (j) Apparently emit some sort of invisible field, which, when in close proximity, can, reportedly cause humans and equipments to respond in unusual ways. At worst a close range exposure to a UAP can cause some disturbing mental and physical effects and cause electronics and electrics to temporarily malfunction.

- Finally, unless some unprecedented intelligence gaps have existed over many years, the possibility that the study finding would show that the presence of the unexplained proportion of UAP sightings is due entirely to man-made phenomenon, while not totally impossible, was clearly very unlikely. (R)

8. To attain the exceptional aerial performance, based on the reports studied, a UAP vehicle reportedly (but not always) often exhibits both propulsion and aerodynamic characteristics at or beyond the limit of current human design and engineering capability; leading to the certainty that, as a designed vehicle it would have to utilise, as a minimum, the following technologies:

(a) Some type of **propellant field or thrust reaction** which can provide air-vehicle performance far beyond conventional rocket or turbine technology. Examples might be:

- The use of anti-matter reactive-propulsion (see Working Paper No. 6).

- An inertia-less body, which does not disturb the atmosphere acoustically.

UNCLASSIFIED
SECRET

- The use of terrestrial and space fields not totally understood: e.g. gravity fields, magnetic fields, electrostatic fields, torsion fields (or a combination of these) or even field types not yet discovered on earth.

Einstein and others believed these latter fields existed. (see Working Paper No. 6).

(b) **Materials and Structures** The properties of which appear to be exceptional. Velocities are reported which would require materials and construction which is beyond any known technology. In addition, they would require special cooling, shaping, layering/sandwiching which we do not currently possess (even if we had the capabilities to accelerate/propel/sustain at what appear to be phenomenal velocities).

(c) An understanding of **surface-plasmas**, charges etc. which allows aerodynamic vehicle drag to be minimised to an unprecedented level and which would also affect their radar echoing area..

(d) An advanced understanding of at least the following technologies either beyond the level understood on earth, or capable of developments and exotic applications of:

- Superconductivity
- Transmitted Power
- Gyroscopic-related phenomena
- Sensors
- Thermo-dynamics
- New information/communication channel.
- Other technologies not yet known.

(e) Be based on a sufficiently advanced understanding of earth science to be able to visit earth's atmosphere, enter and fly about and leave, either as individual vehicles; or, as reported, by merging into a larger 'mother' craft. A mother craft which, presumably, would also have to have at least the same attributes as (a) to (d) inclusive. If a UAP was assumed to be an advanced 'craft', inplying intelligent control, then it might, conceptually, either be 'manned or unmanned'. Reports suggest (and note should be taken of the findings at Volume 2 Paper 25) that 'beings' are rarely reported as wearing special clothing or even helmets. At the very least a 'manned' craft would imply survivability during repeated exceptional accelerations, decelerations and manoeuvres. (R)

9. While there is no firm evidence that there is life of some form elsewhere in the universe - this does not mean that there is none - it may either be beyond our current sensor capability or may not be life as we know it. Other than the rare descriptions of 'beings' in or near UAP, which only occasionally occurs when a really close-up UAP event occurs, reports do not indicate that intelligent control is present. In fact, when near to the ground, (generally below ~5000ft) a UAP is often reported to make indecisive darting and bobbing motions. (U)

10. As this study proceeded certain data emerged which correlated unexplained aerial object phenomena with natural phenomena. Defence intelligence interests will not furthered by continued investigations which focus on potential extra-terrestrial sources. (R)

UAP SIGHTING REPORTS

11. The raw material supporting UAP events is only in the form of paper reports, with very few UK photographs or video records. Analysis is therefore based on:

- **Documented Data** This is sometimes supported by photos, sketches, video, recordings, rare radar sightings which are always short-lived.

- **Corroborated Data** An examination of a series of reports apparently describing the same phenomenon from either the same witness reporting at time intervals or several witnesses in the locality.

- **Timely Sightings** Sightings to which reaction has been made. For example, rare events after which some form of Air Traffic Control follow-up has occurred, other sources questioned, etc. Liaison between radar sites is rare, especially because detections are rare and of short duration. (R)

12. It is considered that every scrap of information is essential, however irrelevant these may seem to the layman. Hence, the information analysed on the database is based only on pre-April 1997 reports, working backwards in time. Only reports deemed to be from 'credible witnesses' have been forwarded to DI55 since that date. As these are in isolation they cannot be corroborated or correlated as regards time, form or motion. By and large, reports originate from someone who has seen an unfamiliar object or phenomenon, or a familiar object in an unfamiliar situation. If numerical data is involved it is usually the case that reports are imprecise, of limited accuracy, often inadequately completed and by untrained observers. Angles and directions are approximate. Late reports are undoubtedly embellished after the events and self delusion, falsification of facts or even deliberate hoaxes have been known. Stories grow in the re-telling, particularly in the popular media. Nevetherless, MOD has continued to treat the subject seriously. Despite the fact that the paucity of UK data compares unfavourably with the quality of witness reports which US scientists have examined - each US (openly published) report being nine pages long - the US Government do not appear to have resulted in any authoritative conclusions. Pressed for a comment, rather than a proper investigation in 1967, an internal UK intelligence reply on file, since released to the public, stated that UFO reports (as they were then known), following "an examination of the evidence" had resulted in the conclusion that the 'unknown' sightings pointed to

- Activity under extra-terrestrial control, or:

- Clandestine activity, or:

- Activity for which scientific explanations have yet to be found. (R)

13. Unfortunately, to this day, there remains a persistent lack of scenarios where solid scientific measurement can be made either at or directly after an event. What is required to identify causes beyond doubt is evidence in the form of artefacts, field or radiation measurements, physical disturbance of terrain and close-up UAP imagery; especially multi-aspect imagery.(R)

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

14. While not necessarily possible during the time-scale it was realised that algorithms could probably be derived to automate the analysis so as to rapidly identify the clearly known from the unknown. Resources were not available for automation, neither was this considered necessary - unless later analysis showed this to be essential.(U)

UAP CLASSIFICATION

15. While it is not the intention to use information produced by the host of 'Ufologists', who regularly correspond with Sec AS, often requesting information, note is taken of a system of classification of types of alleged UAP incidents developed by researchers and used widely in The West. Apart from UAP sightings at longer ranges, UAP watchers have, naturally, been especially interested in those where humans have been relatively close to aerial objects as these have often produced the most bizarre of reports and human responses. These are (in popular media terms) known as 'close encounters' (CEs), which have been classified into 5 distinct 'kinds':

- CE1 Observation of an unknown object within a range of 500 feet.
- CE2 Trace evidence, e.g. on radar, or of a 'landing'.
- CE3 Observation of a 'creature'.
- CE4 Abduction.
- CE5 Responses from UAP to human stimuli (e.g. signal lights). (U)

16. No comment is made on CE3 or CE4 in this report, other than it is clear that some reports, from different parts of the world, seem to have similarities beyond the normal expectation of coincidence. An open mind was kept on these two topics, until the research summarised at Working Paper No 25 was uncovered and examined alongside typical UAP reports where CE3 and CE4 effects had been reported . Even for CE1 and CE2 there is the classic logic dilemma - 'if we don't know what these things are, how can we determine if they are a threat'? The UK reports, held in DI55, include a few where adverse physical effects were experienced by UK witnesses and where vehicle equipments have reportedly malfunctioned.(U)

LIGHTS AND SHAPES

17. In order to embrace all reported UAP shapes into the new database a very brief survey of some of the UAP imagery which is in the public domain from both within and outside the UKADR was made. The locations of the most frequent numbers of UAP sightings are shown on the World Map at Working Paper No. 3. It was important to be aware of non-UK reports, if only to recognise shape and colour similarities and keywords to be used in the database. For example, the selected Czech Republic list at Annex C goes back to the year 1607. It is noted that in these Czech examples:

- Descriptions are much the same and often identical to those reported today.
- Listings go back far beyond the days of all manned flight, lasers or satellites. Hence, none of these familiar objects of the 20th century could have caused the earlier reports shown.

(U)

18. Today, it is often claimed that some 25% of reports fall into the simple categories of ball lightning and optical distortions of the sun and moon. The majority of the others are clearly due to the

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

whole range of possibilities covered in the diverse working papers at Volume 2. Because 'lights' in the sky play such an important part in the sighting reports it is necessary to consider the precise meaning of what is seen in visual terms, this has a significant bearing on the interpretation placed on what is seen. First, the term 'lights in the sky' does not (unless it is a manned aircraft) mean 'lamps' in the normal sense of the word. A bright object is the most normal anomaly which first attracts the attention of a witness. Thereafter, it is mainly described as 'a light'. In practice, while this often distinguishes the object from the fact that 'a clear shape' cannot be seen, the object is often fuzzy or lacks focus or concentration and usually leads on to the statement that the object 'is round'. In fact a bright light may be obscuring the fact that the object is a completely different shape altogether. (U)

19. It is inevitable, therefore, that the great majority of statistical information will be based on reports that were first seen as 'round lights'. Further a circle of separate lights may be described as 'round', whether they are very close together or further apart - even when there is no apparent solid object in the centre of the ring. Similarly, three or four lights may be perceived, respectively, as a'triangle' or 'rectangle', when there is no actual triangular or rectangular object present. [Due to physical phenomena it can be shown that there are conditions where, because of zero ambient light reflection, the intervening space between lights can appear to be filled with a solid shape.] A 'flashing light' does not necessarily mean a regular flash-rate or even that the flashing continued without a break. Often an object is described as 'glowing' when, in fact, it is very dimly lit but not a clear-cut shape. Sometimes 'a light', referring to the main object is said to project 'a beam'. In plasma terms this is a visible manifestation of charge-energy finding a discharge (i.e. leakage path). It is seen, therefore, that even the basic information obtained from almost every UAP sighting is a veritable minefield of inadequate data that can easily lead to misinterpretation when part of a statistical analysis. Further information is at Chapter 3. (U)

20. **Manual Interpretation of UAP Reports.** Sensing the presence of a UAP is almost always firstly visual, involving lights and shapes. Most of the known and unknown identifications can be shown and manually interpreted, in the first instance, in tabular form Tables 2 and 3, compiled as a result of initial investigations are intended as an adjunct to assist in the later interpretation of information gained from database analyses. However, there are many more attributes that must be included in the database tables, where known. It is assumed most hoax incidents will be perpetrated to represent the widely expected 'saucer-shape' spoof imagery/photograph or description. A compendium of imagery has been compiled at Volume 2 (Working Paper 18) as an aid to the identifying the most common shape categories, of which 'saucer shape' is only one. In fact the misnomer only came about because an early US pilot sighting described what he saw as 'like saucers skipping or bouncing across a pond'. It will be seen that a great number of events reported within the UKADR are of triangles, cigars and rectangles. (U)

21. For manual interpretation of a sighting Table 2-1 provides a frame of reference. This is the 'key' table but it is not intended to be a single reference table which can identify every sighting - rather a guide to the type of likely identification which must be backed up by further investigation using every scrap of evidence available. Unfortunately, it is the case that vital information - which could probably have been elicited from a witness by careful questioning cannot be included in many analyses. The Table is based on all known shape and colour attributes, as these are the most likely two keys which a witness reports. (U)

22. Having obtained a colour from an incident report and hopefully a reliable shape, a linkage made to other data to obtain the most likely identifiable cause. At this point other salient information (e.g. day or night, time, size, geometry, meteorology, motion and sound) can be checked and incorporated into

the decision. However, it is essential to cross-check against Table 2-2 before making a final decision 'explainable' or 'not explainable' (through lack of data), or 'inexplicable' (having considered significant data).(U)

23. Table 2-3 contains data usually attributed to those UAP events which have been impossible to categorise with certainty. While the format at Table 2-1 allows the cause to be identified, Table 2-2 (part 2) cannot identify the cause because these shapes, together with their reported colours cannot be attributed to definite air-objects. For example, if the desired shape with colour cannot be co-ordinated at Table 2-1 (e.g. there is no 'PINK DISC') then the attributes should be checked against Table 2-2 There, it is seen that silent, zero-to-fast-moving, silent pink discs are listed as unidentified objects. **Green discs**, it is noted, are not present on either table - since these have not been reported. However, green balls/spheres are often reported. (U)

24. There are several aspects of reporting where witness data, even from 'credible witnesses' may not be accurate. This must be considered when making judgements. For example:

- A sphere may be described in error as a disc or vice versa.

- A disc viewed other than in plan may often be described as a cigar, especially if it is viewed in silhouette and seen partly shadowed.

- A disc may be described as a cigar or a sphere or oval, depending on the aspect. Coloured lights, in a row from one aspect, may be described as a triangle, rectangle, diamond, or even a pentagon, when viewed in plan. For example, as all orientations are possible, the same diamond-shaped pattern of light centres, seen in plan by one observer can be described as a 'stack of coloured balls' by another; when it is vertically buoyant; while yet another, after it has rotated, sees it as a 'row of lights'.

- An aircraft may be described as a triangle (since some deltas are still flying) or as an aircraft because 3 lights are seen in a triangle (i.e. wing tips and tail).

- A helicopter may be described as a disc if an illuminated rotor path is seen, (usually this type of report can be separated by the distinctive noise, if reported).

(U)

25. **Further Identification** Likelihood is a strong factor in elimination of known from sightings which initially appear to be inexplicable. Key factors are geographical proximity to locations where, because of the inherent activity, aerial observations are likely to occur anyway:

- Airfields (Civil/military).

- Low-flying routes.

- Laser Displays.

- Thunderstorms.
- Possible reflections of light or shapes from water (e.g. lakes) or clouds.
- Marshy (swampy surfaces - methane burn off).
- Possible earthlight sources (e.g.rock formations/earth faults).
- Oil Rig flares.

(U)

Correlation of Incident Reports

26. Multiple witness reports, originating from the same location or adjacent locations, are a strong filter:

- They eliminate any mental illusions of a single witness.
- They enable independent multiple aspect viewing reports to be assessed.
- They enable confirmation of colour, shape, motion and noise.
- If spaced a few miles apart they can enable object velocity to be deduced and eliminate the reliance on, or provide confirmation of, witness velocity assessments.
- Multiple reports can provide up- wind and down-wind sound assessments as a help to identification.
- They can provide positive linkage between visual and radar (or other sensor) detection

(U).

ARTEFACTS & HUMAN EFFECTS IN THE UK

27. When the huge numbers of reports are considered as a whole , the lack of artefacts is a significant mystery - pointing away from the supposition of some UFO researchers who consider at least a proportion of the unexplained phenomena to be from an extra-terrestrial source (or sources). It seems beyond the realms of credibility, if UAP are 'vehicles', from whatever origin, that no one in the UK (or credibly in the wider world) has ever produced an artefact of proven non-terrestrial origin. This implies that the 'extra-terrestrial' entities have totally reliable, 'accident proof' systems extending **over a period of thousands of years**. One might speculate that the only exception to this situation would be if the capability of the perpetrators extended to total transportation and reconfigurability of matter (and beings) and the ability to remove all traces of failed matter/artefacts. The only examples of reliable

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

surface or human effects noted in the last 30 years, following a UAP incident in the UKADR and described in Department reports, are:

- Substance 'captured' in a jar (see Working Paper No. 22).
- Illness reported following an encounter in Wales.
- Disturbed bushes/hedgerows.
- Car radio inoperable, until UAP departed. (U)

28. The lack of evidence of signalling in the form of electronics communications signals is also an enigma if extra-terrestrial entities are involved. Despite considerable attempts in serious scientific monitoring programmes over many years, no evidence has been found which can correlate with vehicular activity on earth. Either there is none or the 'entities' are communicating using a medium which we do not have or even understand, which seems unlikely, based on all the evidence and the emerging evidence reported in this study. (U)

UK EYES ONLY
UK RESTRICTED
SECRET
UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

COLOUR OBSERVED (BODY AND/OR LIGHTS)

Main Shapes [6]	Red	Yellow	Orange	White/ Silver	Blue	Green	Grey/Black[1]	Pink	Mixed Colours
Sphere or Spheres	A M E N L Q	A L R B M E Q	A M F L	E L F N Q	L N	M	F	A	A F B C
Disc	-	-	-	G L s H	L	-	-	-	R
Cigar	D C	-	-	C H D	-	D C	C	-	D
Star/ Point	A	A	A	F J H K	J K	-	-		R
Oval	-	B	-	D H C G	L	-	C	-	R
Triangular Pyramidal Conical	-	-	-	E[3]	-	-	-	-	-
Rectangle	-	-	-	-	-	-	-	-	-
Diamond	-	-	-	-	-	-	-	-	-

TABLE 2-1: RELATIONSHIP OF COLOUR AND SHAPE TO IDENTIFIABLE OBJECT TYPES

/KEY TO TABLE & FOOTNOTES

UNCLASSIFIED

KEY	CONDITIONS	CAUSE	DURATION	SIZE	MOTION	SOUND
A	Daytime	Ball or Bead (joined spheres) Lightning, Flares	Seconds to Minutes	Small	0 to Fast	[8]
	Night	Moon Through Mist	Seconds to Minutes	Small	Nil	Nil
B	Daytime	Sun Dog	Minutes	Large	Nil	Nil
C	Daytime	Aircraft / Helos[2]				
	Night	Flashing and Steady Lights or Both	Seconds-Minutes	A/C Size	0 to Fast	Wind Dependent
D	Daytime	Airship (No Wings)	Minutes	Large	0 to Slow	"
	Night	Multiple Lights Airship				
E	Night	Birds (Reflective underbellies) seen as triangular formation	Seconds-Minutes	Smaller Flocks	0 to Slow	No
F	Daytime	Balloon / Sonde[4]	Minutes	Small and Large	0 to Slow	No
G	Night	Searchlights[5]	Seconds-Minutes	Small	0 to Slow	No
H	Night	Lasers[5]	Seconds-Minutes	Small	0 to Fast	No
J	Day/Night	Star	Minutes-Hours	Small	Nil	No
K	Day/Night	Planet	Hours	Large	Nil	No
L	Night	Moon	Hours	Large	Nil	No
M	Night	Meteor (often with tail)	Seconds-Minutes	Small	Very Fast	No
N	Night	Space Junk (Re-entry)	Seconds	Small	Very Fast	No
P	Night	Satellite	Minutes	Small	Slow	No
Q	Day/Dusk	Mirage	Minutes	Small	Slow	No
R	Night	Earthlights (e.g. Norway Hessdalen)[7] Methane Combustion over Marshes	Seconds-Hours	Small[5]	Slow	No

Notes:

UNCLASSIFIED
SECRET

[1] Reflected/Silhouette.

[2] Slow if viewed head-on or tail-on.

[3] 'V' or echelon formation.

[4] May appear 'flash' if partly coloured, as it rotates.

[5] May be more than one present at a time.

[6] All objects can give the appearance of automatic/random motion, (i.e. jerky/zig zag) around a fixed point due to anti-kinesis if viewed through optics (e.g. camera, telescope, binocular shake).

[7] Yellow form lasts 1-2 hours and changes to new position in 5-10 minutes. White/blue form flashes. Third form has strings of multiple colours moving together.

[8] In the form of crackle, pop or explosion.

UNCLASSIFIED
SECRET

	Colours Observed (Body &/ or Lights)					
Main shapes	**Black[4]**	**Pinkish/ White**	**Dull Metallic[4] Grey**	**Red/ Orange**	**Green**	**Blue**
Sphere or Spheres	S	T	-	-	-	-
Disc	S	T	U	D	-	-
Cigar	S	T	U	-	-	-
Star /Pointed	-	T	-	-	-	-
Oval , Egg or Elliptical	S	T	U	-		
Triangular,Pyramidal or Conical [5]	S		U	V	V	V
Rectangle	S	-	U	-	-	-
Diamond	S	-	-	-	-	-

Key	Conditions	Remarks	Duration	Size	Motion	Sound
S	Daylight Night	Unidentified silhouette. Triangle sometimes has slightly convex surfaces and round appendages. No light reflects from within triangle. Shape seen as shadow between lights at extremities.	Sec to mins	[1]	Zero to Fast	NIL
T	Night	Sometimes lights at extremities of triangle, pyramid, rectangle or diamond.	Sec to hours	[2]	Zero to Fast	NIL
U	Daylight	Seen as silhouette or as reflected light from surface of 'body'	Sec to min	2-10m	Zero to Fast	Hum, whine, or buzz
V	Night	Pulsating red or orange light underneath. Green and blue at extremities	Sec to hours	[3]	Zero to Fast	NIL

TABLE 2-2: RELATIONSHIP OF COLOURS AND SHAPES TO UNIDENTIFIABLE OBJECTS

/Footnotes

TOP SECRET
UNCLASSIFIED

Notes

[1] Sizes. Triangle at least 150ft. (~15 metres), often up to 250m

[2] All shapes ~5-30m across/diameter, but cigar often much longer. May have single or multiple lights.

[3] Sizes 5-30m diameter. Seen with pyramid. Pulsation rate reportedly increases with velocity.

[4] At night shadow shapes assumed to be black or grey.

[5] Witness uncertainty between triangles, cones and pyramids. Pyramids are usually reported as three sided. Triangles are usually reported as equilateral if the witness is well-educated, or a trained observer. Refer to Working Papers at Volume 2 for description of plasma-type bodies that appear to exhibit total absorption of ambient light – and do not even reflect the light from the normally bright spheres at the extremities. It is assumed that the large prevalence of 'equilateral triangles is the correct description

UNCLASSIFIED
SECRET

SECRET UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED

YEAR	SATELLITES & DEBRIS	BALLOONS	CELESTIAL	METEOROLOGICAL	AIRCRAFT	MISC[3]	UXP[2]	% UXP(Rounded)	TOTAL
1959	1	3	1	7	4	2	4	18	22
1960	-	8	2	7	10	1	3	10	31
1961	16	11	8	20	9	5	2	3	71
1962	11	6	5	8	9	4	3	6	46
1963	18	6	4	4	10	7	2	4	51
1964	43	3	6	-	10	7	5	7	74
1965	27	3	3	2	7	-	14	25	56
1966	38	10	5	5	17	15	5	5	95
1967	49	40	18	28	113	1	45	13	350[1]

TABLE 2-3(a): ANALYSIS OF REPORTED UAP EVENTS IN THE UKADR (1959-67) (846)

Notes:
[1] Of this number 56 were under investigation when the year ended and are not categorised.
[2] UXP = unexplained phenomena
[3] Miscellaneous covers hoaxes, light at edge of cloud - all were explainable

/Table 2-3(b) 1968-76

SECRET UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED

YEAR	SATELLITES & DEBRIS	BALLOONS	CELESTIAL	METEOROLOGICAL	AIRCRAFT	MISC[3]	UXP[2]	% UXP	TOTAL
1968									280
1969									228
1970									181
1971									379
1972									201
1973									233
1974									177
1975									208
1976									200

TABLE 2-3(b): ANALYSIS OF REPORTED UAP EVENTS IN THE UKADR (1968-76)

/Table 2-3(c) 1977-85

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED

UNCLASSIFIED
SECRET
19
UK EYES ONLY
UK RESTRICTED

YEAR	SATELLITES & DEBRIS	BALLOONS	CELESTIAL	METEOROLOGICAL	AIRCRAFT	MISC[3]	UXP[2]	% UXP	TOTAL
1977									435[1]
1978									750[1]
1979									550
1980									350
1981									600
1982									250
1983									390
1984									214
1985									177

TABLE 2-3(c) ANALYSIS OF UAP EVENTS IN THE UKADR (1977-85)

Note: [1] Although a House of Lords report quoted, respectively, 477 and 864 for these years.

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED

YEAR	SATELLITES & DEBRIS	BALLOONS	CELESTIAL	METEOROLOGICAL	AIRCRAFT	MISC[3]	UXP[2]	% UXP	TOTAL
1986									120
1987									150
1988									397
1989									258
1990									209
1991									117
1992									147
1993									258
1994									250

TABLE 2-3(d): ANALYSIS OF REPORTED UAP EVENTS IN THE UKADR (1986-94)

/Table 2-3(e)

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED

YEAR	SATELLITES & DEBRIS	BALLOONS	CELESTIAL	METEOROLOGICAL	AIRCRAFT	MISC[3]	UXP[2]	% UXP	TOTAL
1995									284
1996									595
1997									115[1]

TABLE 2-3(e) ANALYSIS OF REPORTED UAP EVENTS (1986-1997)

Note: [1] Reports received in first 3 months of 1997 only.

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

CHAPTER 3

STATISTICAL ANALYSIS OF THE UAP DATABASE

	Para	Page
INTRODUCTION	1	2
STATISTICAL ANALYSIS - LIMITATIONS	3	3
GENERAL DEDUCTIONS FROM REPORTS	6	4
DATE-CLUSTERED EVENTS	9	5
ANALYSIS 1988/89	10	5
ANALYSIS 1996	22	9
Peak Numbers of UAP	23	9
UAP EVENTS BY MAIN UK REGIONS	28	11
GEOGRAPHICAL LOCATION ANALYSIS	29	12
Events Several Times from Same Location	34	14
NUMBERS OF OBJECTS PRESENT PER EVENT	36	15
UAP COLOUR ANALYSIS	37	15
Visual Beam Emanations from UAP	39	15
UAP SOUND & SMELL ANALYSIS	42	17
UAP SHAPE ANALYSIS	43	17
UAP MOTION ANALYSIS	44	17
CORRELATION STUDIES		
With Time of Day	46	18
With Month of Year	49	20
With Weather	50	21
With Solar Activity	51	21
With Meteor Activity	53	22
RESULT OF METEOR INVESTIGATION	65	26
HUMAN FACTORS	66	26
WITNESS GENDER & AGE	67	27
WITNESS LOCATION	68	27
STATISTICAL CONCLUSIONS	69	27

UNCLASSIFIED
SECRET

CHAPTER 3

STATISTICAL ANALYSIS OF THE UAP DATABASE

"Prejudice will take you further from the truth than ignorance"

Bang Weng Gwang. ChineseJournal of UFO Research

INTRODUCTION

1. The attributes described at Chapter 2 and at Volume 2 in more detail were structured into database tables, in the UAP ACCESS format which is described at Annex D. Some of the **possibilities** for statistical analysis are shown at Annex E. The principle analysis **categories**, considered significant are:

(a) The overall annual monthly and daily frequency of UAP sightings.

(b) The overall frequency of UAP sightings of particular types in particular geographical locations, and from specific platforms e.g. from the air, ground, sea (or over the sea from land), Events with and without sound, with more than one `light' or `beam' and especially those described at close range.

(c) The possible correlation of sightings with specific weather patterns, solar/geomagnetic conditions, local geo-magnetic phenomena, earthquake or tremor events, and weather (electrical storms).

(d) Correlation with other known positions or routes of expected aerial platforms (e.g. proximity to low flying areas or routes, air lanes, airports, military airfields and exercise areas, balloon-launching sites, displays etc). The possibility of obtaining meaningful correlation is influenced by other events which raise public awareness and can lead to gross distortions of the facts. The most obvious candidates are:

- Media hype, which waxes and wanes and may re-occur at any time, given an approximate `trigger'. Examples are `Close Encounter' type films. `X' Files, `UFO' revelations on TV, and the periodic re-awakening of the `Roswell' or `Bentwater' incidents in peoples minds.

- Publication of new books on the topic- of which there were no less than 30 in 1997/8!

- Reports of unexpected or unexplained extreme effects on humans (eg `abductions').

UNCLASSIFIED

SECRET

- An identification of those sighting events which have resulted in specific human reactions, including health aspects.

2. Clearly a full statistical examination embracing all possibilities is a major task and beyond the study TORs. However, some of the material to carry out correlations is readily available. Hence, some researched analysis was made, taking into account the possibility that a higher confidence of explanations of UAP events might enable the department to dispense with the task of monitoring UAP events in the future. This proved to be the case when all of the results were finally considered. It is emphasised however that those conclusions drawn can only be as good as the reported data. Further, many **credible** researchers have unsuccessfully attempted to find the cause of 'UFOs' in the past. If a positive UAP link and credible explanation could be found with some natural physical conditions this could end the 'UFO' controversy. However, any such result within the study could only come about as a by-product of the basic investigation to determine the value, or otherwise, to Defence Intelligence.

STATISTICAL ANALYSIS -LIMITATIONS

3. Statistics deals with uncertainty. The UAP problem cannot be analysed as one would wish because:

- Some aspects of data are missing from every event, due to the limitations of the MOD reporting form, the elapsed time, the inevitable variability of the quality of the witnesses (as surprised observers of an unfamiliar event) and the incomplete nature of the reports.

- The natural (meteorological) conditions at the time are only barely known. For example, nothing is known of the pressure, temperature or humidity all of which significantly affect both visual and radar detection.

- It is difficult, if not impossible, to make scientific statements about phenomena which are not fully understood. However it is possible, with scientific knowledge and other data, to eliminate the majority of UAP sightings by correlation with known natural phenomena or manned vehicle activity (or satellites), or man-made artefacts.

4. It is possible, for example, to identify patterns of attributes which are repeated. Brief cross-references with other sources have shown that the reported UK UAP characteristics are remarkably similar to those noted from open sources world-wide. Location and population distribution might be expected to affect the frequency of reporting but the significance must not be distorted by the fact that more reports, although confirmatory, are not necessarily more authoritative in nature.

SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

5. No attempt can be made to consider specific human mental conditions which may have given rise to a UAP report; although attention is drawn to the psychological and temporal lobe effects UAP sightings have on some witnesses, described at Working Papers Nos 1, 2 and 10. Speculation as to extra-terrestrial causes is not entered into. All analysis is made on cold facts.

GENERAL DEDUCTIONS FROM REPORTS

6. For those objects which are not recognisable and therefore unexplained, given a shape, often without range and very rarely with imagery, the immediate deductions must be based on:

- Shape - likelihood of accuracy of description
- Ratio of lengths/widths/heights
- Angles subtended by the object (if reported)
- Colours

7. Although some measure of size is obtainable from angle subtended, mass is never obtainable. The method of motion of UAPs is not obvious and there is much inconsistency in the reporting, due to a variety of mainly human factors. A brief examination of the options, in the absence of sound (thrust), is that the UAP must move by some sort of field-reaction. Intuitively one might propose that this might be with the earths field or the lectrical and magnetic fields present continuously in the atmosphere. Unless there are undiscovered force fields, magnetic/electrical propulsion seems to be the only option. It is noted that the field forces generated on-board a vehicle would have to be significantly high (~ 10^9 Ampere Turns), but unpredictable because of the variation of the earth's own field.

8. From the written descriptive evidence there appeared to be the possibility, excluding those events that could be attributed to a known cause, that UAP, despite often appearing to be so, are not solid objects. Also, conventional science suggests that the energy required to support a solid object would be excessive (within our earthbound understanding of the problem). This, together with other evidence from the reports leads to the supposition that the objects might have little or no mass. One might further surmise that if the object had little or neglible mass, it could be buoyant or semi-buoyant and, importantly, that if it had electrical charge or magnetic properties it might be propelled by interaction with other charges present on the surface or in the atmospheric. Because of the absence of actual UAP field measurements the potential of these possibilities have been examined using the available theory.

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

DATE-CLUSTERED EVENTS

9. Although it is recognised that a well-described **single** sighting can provide valuable information, an attempt was made to identify firstly months and then days where an unusual number of events were reported. This was done on the assumption that if a large number were reported on the same day there may be some correlation between them, either geographically, in physical description, in motion, or in other attributes described in the individual reports. Further, there might be conducive atmospheric conditions (e.g. weather conditions) for UAP formation which might be identifiable. There was also the possibility that such an approach may expose a means of calculating the velocity of an object (assuming the multiple reports were from the same object and had different times and geographical witness locations). However, the possibility of **more than one such object** seen over the same time bracket cannot be ruled out, as reports are sometimes received of objects breaking into several parts, or of several merging into one. As an initial approach, clustered events were examined for two sample one year periods, separated by a suitable period so as to make them independent (for example) of the same sunspot cycle, of potential environmental changes and of public perceptions due to immediate media effects. For the purposes of the analysis it was necessary to use the data entered to-date (1987-1990 and 1995-1997). During the analysis durations are the period of time the observer (or more than one observer at the same spot) watched the object before it either disappeared suddenly or moved away at low or high speed. Hence, widely dispersed reports are not likely to relate to the same object, unless there is a time-difference which is longer than the expected life of the object and a velocity could be reached which would allow the transit between locations to occur. This is more likely to be possible at higher altitudes. Both event duration and apparent velocity are important parameters. A Volume 2 Working Paper has details of possible upper plasma speeds (e.g. 15km per second) and their duration. The statistical spread of UAP duration is considered below.

ANALYSIS 1987/89

10. Figure 3-3 summarises the days when three or more events were reported on the same day. Of these, seven days saw three or more reports during 1987 (of 121 reports in the year). Of the 366 reported events in 1988 there were 42 days when the number of events exceeded three per day, while 1989, which recorded an overall total of 226 events, had 16 occasions with three or more reports of UAP on a single day. Plots showing typical UAP activity with the time of day, month and year are at Figures 3-10, 3-11 and 3-12.

11. Specifically, it seemed important to determine that if large numbers of events occurred on consecutive days, this may indicate, exceptionally, that, the same objects were seen in more than one geographical area as well as into the next day's reports. This is assuming that the UAP(s) reported were due to highly charged masses which

TOP SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

had not dissipated as quickly as some others reported and may have persisted overnight.

12. In 1988, the most important daily UAP event dates were:

1988	Jan 17	8 Events
	Feb 12	6 Events
	Feb 17	7 Events
	Jun 18	12 Events
	Nov 14	7 Events
	Dec 20	13 Events
1989	Nov 16	7 Events

13. **Jan 17 1988.** All eight events were reported over 30 minute period (1700 - 1730 hrs) starting North of London and moving into Surrey. It seems likely that these were all from the same object.

14. **Feb 12 1988.** The six events on this day were spread in time from approx 1900 to 2200 hours. The earliest was in Northants, then again in Northants 90 mins later. However, an overlap of time occurred (i.e. an object was still being watched in Northants when a UAP was reported in Farnham, Surrey, hence these were clearly separate objects. Another was seen at Ellesmere Port at the same time as another at the Isle of Wight. Hence, there is nothing to be gained in analysing data from this set, from the correlation viewpoint or from attempting to extract a velocity profile. It clearly shows that more than one object is active at the same time at diverse locations within the UKADR. This suggests that, if there is a strong likelihood of many UAP sightings being due to plasmas (such a postulation could only be made **after positively eliminating mis-reports of other causes**) then it also seems likely that conditions can be favourable to form or sustain plasmas in different locations at the same time.

15. **Feb 17 1988.** The seven sightings on this date commenced at 0515hrs and ended at 1245. The 0515 sighting in Yorkshire was followed an hour later by another Yorkshire report, respectively Barnsley and Huddersfield. It seems likely that these were the same object. Nothing was reported during daylight until 1600 hrs in Northants, then later at 2030hrs in London and 2145 hrs in Oxford. But reports at 2130 from Birmingham and Barrow-in Furness were clearly unconnected with the southerly result, as their report times overlapped. It is, of course, possible that the early morning Barnsley and Huddersfield ones were connected and that, with the large

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

time elapsed, the latter sightings were also connected apart from those with time coincidence in widely different parts of the country.

16. **June 18 1988.** No less than 12 events were reported on this day. All were in Essex and the London suburbs, Surrey, and Herts. In general, around the periphery of GREATER LONDON. Although one report was at 17 30 hrs, all the rest were between 2015 and 2115. These seem to be connected/correlated both in time sequence and location:

20.15 hrs	Hayes Middlesex
20.20 hrs	London(NFI)
20.25 hrs	Godalming (Surrey)
21.00 hrs	Rochford (Essex)
21.07 hrs	Danbury (Essex)
21.10 hrs	Hemel Hempstead (Herts)
21.10 hrs	Norwood (Middlesex)
21.12 hrs	Highgate Hill (Middlesex)
21.15 hrs	Brentwood (Essex)
21.15 hrs	Danbury (Essex)
21.15 hrs	Brentwood (Essex)

17. A track of these events is at Figure 3-1, from which several options can be derived. This cluster could either be connected or comprise separate events. The earliest event, which appeared to move along a track from Hayes to Godalming covered about 19nm in ten minutes. This represents a mean ground velocity of about 116kts (just less than 60 metres per second). This object may have slowed and even reversed its track so as to form the series of reports either which commenced at Rochford at 2100hrs, and travelled NW to Danbury by 2107, or that at Hemel Hempstead, which apparently, from 2110, commenced the NSE sequence Hemel Hempstead-Highgate-Brentwood-Danbury. If it is assumed that this was a straight leg which was close enough to be reported by witnesses at Highgate and Brentwood, as it progressed, the distance of 39nm(72km) was covered at a ground speed of about 465kts (240 metres per second). It is, of course, possible that the object at Godalming at 2025hrs changed direction and moved towards Southend and formed the Rochford sighting at 2100hrs, but was unreported for 35mins. The reader is reminded that the

UNCLASSIFIED

calculated velocities rule out any wind-borne motion and re-enforce the postulation elsewhere in the report that these objects are most probably moving under the influence of electrical or magnetic attractive or repulsive fields.

18. **Nov 14 1988.** Seven events occurred. Coincidental reports at 00.45 hrs were received from the diverse locations of:

Washington, Tyne and Wear,
Leavesden, Herts
At 0050 Boroughbridge, Yorkshire, then 05.15 from Southend and two reports at 06.15 from Sheffield.
The remaining report was not until 1700 hrs from Nantwich.

The implication is that these were probably independent UAP events.

19. **Dec 20 1988.** Of 13 events the longest, was viewed for ~ 15 minutes and the shortest for ~ 15 seconds. In time sequence they commenced at 1115 hrs (two reports in Co. Durham). The rest were **all** in the evening:

20.05 hrs	Birdlip (Glouc)
23.30 hrs	RAF Leeming (N. Yorks)
23.30 hrs	Dewchurch
23.45 hrs	RAF Leeming (N. Yorks)
23.50 hrs	Richmond (N. Yorks)
23.50 hrs	Richmond (N. Yorks)
23.50 hrs	Scotch Corner
23.50 hrs	Scotch Corner
23.55 hrs	Cheltenham (Glouc)
23.55 hrs	Richmond (N. Yorks)
23.58 hrs	Harrogate (Yorks)

20. A ground track plot of the northernmost events is at Figure 3-2. The evidence suggests that the two Gloucestershire sightings are separate events, as they occurred at the same time and a great distance away from the northern events. Further, if it was a single object it either persisted for almost four hours, or, more likely, represents two

UNCLASSIFIED

separate objects. If it is assumed that an UAP on a southerly track from Scotch Corner to Harrogate was observed as it passed Leeming and Richmond, it covered some 55km(30nm) in 8 mins, which represents a ground speed of about 223kts (~115 metres per second or ~6km per min.). The UAP may have varied in speed, which explains why it was reported twice within 15minutes at each of two locations. Allowance must also be made for time inaccuracies in public reports.

21. **Nov 16 1989.** All seven reports, with the exception of one from Wales were in the London/SW Essex area and involved both daylight and night events. They were typical of those reported above.

ANALYSIS - 1996

22. During 1996 an unusually high number of reports were received, making this a significant year for UAP since, for example, there is no reason to suppose that mis-reported man-made objects should have been more in evidence to cause 'false alarms' in 1996, than in previous years. In fact, due to the continuing impact of the end of the Cold War, if anything, there was less military flying. Hence, there is no reason why man-made objects should cause an increase, compared with the years preceding or following. It is noted, however, that 1996 was reported as a year with a much larger incidence of meteors approaching Earth and therefore a high probability of these entering the atmosphere. [Although the potential meteor connection with UAP events and , in turn, the potential connection with plasma formation, is discussed elsewhere in the report and specifically below at para 53, where some positive statistical correlation results are reported].

23. **Peak Numbers of UAP** The peak number of reported sightings was 14 on 18th August. Twelve were reported from the evening of 25 February into 26 February and 12 on 1 May 1996. Seven events were logged on each of three other days, six on each of seven other days and five on each of 13 other days. On 21 days there were four reports and on 22 other days there were three reports each day. Of the remaining days in 1996, very few passed during the year without one or two reports. The peak events are discussed below.

24. **25/26 February 1996** The eight sightings reported on 26th were preceded by four logged on the evening of 25th and are therefore treated as a continuous sighting period. A distinguishing feature was the long duration of the majority of these sightings. Long duration always adds to the credibility from the point of view of having time to watch the object for an adequate period to allow a good description. Nevertheless, the event durations exceed what would be expected to be a credible time for a degrading natural event and there is clear evidence that many of the longer events (e.g. sometimes hours in duration) are, for example, caused by visual satellite sightings reported as UAPs. The events of 25/26 February were unusual, in that several occurred in daylight:

	Date	Time	Location	Duration
1	25 Feb.96	1740	Edinburgh	13min
2		1900	Persley	30min
3		1930	Redditch	30min
4		2030	Leith	4min
5	26 Feb.96	0001	Hereford	-
6		0610	Ardmair Bay	3min
7		0732	Birmingham	-
8		1530	Inverness	15sec
9		1530	Inverness	10sec
10		1845	Taunton	25min
11		1945	Inverness	75min
12		2000	Clacton	40min

25. **1 May 1996** All 12 events were over Scotland. Two very late evening events in England on the previous day were well-separated in geographical distance (York and Bedford). However, in view of the high speed attributed to some events, a connection cannot be ruled out, even though the first **reported** event on 1 May did not occur until midday. On the following day the only reported event was 24hrs removed from the Scottish cluster on 1 May:

	Date	Time	Location	Duration
1	1 May 96	1220	Loch Sunart	10sec
2		2119	Edinburgh	2sec
3		2215	Alness	5sec
4		2215	Greenock	-
5		2216	Lossiemouth(ATC)	2min
6		2218	Uddington	6sec
7		2220	Fort William	-
8		2220	Inverness	5sec
9		2220	Lanark	3sec
10		2224	Ayr	-
11		2230	Erskine Bridge	3sec
12		2300	Garve, Lochalsh	1min

26. **18 August 1996** Fourteen reports on this date were preceded by just three on the previous day, two well-separated in time with one on the evening of 17th and one on the following day. This analysis concentrates, therefore, on those on 18th, which commenced at 0120hrs and spread throughout the day to 2350hrs. Three were in daylight, seven in dusk and the rest in darkness:

	Date	Time	Location	Duration
1	17 Aug. 96	2200	Edinburgh	15sec
2	18 Aug.96	0120	Swindon	2min
3		0130	Dagenham	8min
4		1240	Southgate, London	5min
5		1400	Newton Flotman (Norfolk)	1min
6		1800	Kidderminster	3min
7		2000	Bordon, Hants	30min
8		2000	Birmingham	2min
9		2015	Leytonstone E11	2min
10		2028	Liversedge, Yorks	5min
11		2030	Birmingham	2min
12		2035	London W12	10sec
13		2128	Bramhall, Manchester	3min
14		2200	Belfast	3min
15		2250	S.Normanton	-
16	19 Aug.96	0230	Long Buckby	1hr

27. **17, & 21 July and 21 August 1996** Seven reports were received each day. On 17 July five of the seven reports were in daylight, with locations varying from, Scotland to Plymouth, N Wales and Northern England. On 21 July three of the reports were in daylight, and covered locations from Tayside to Southampton, Manchester and the London Area. On 21 August reports came in from Yorkshire, Lancashire, Wales and the London Area. From experience those events which last for more than an hour are probably planets.[See item 16 at para. 26 above, for 19 August].

UAP EVENT REPORTS BY UK MAIN REGIONS

28. Table 3-1 shows the event reports by UK main region. This is of limited interest, apart from the variations in population density, which is a key factor in witness opportunities. Further, during the Summer, Scotland has longer periods of daylight than either England or Wales and much lighter nights. If one ignores the possibility of Earthlights (which are near the surface in rocky regions) this, intuitively, suggests a lower number of sightings if dusk or darkness are a pre-requisite for higher elevation sightings. The occurrence of Earthlight activity (as both Wales and Scotland are predominantly mountainous) might have been expected to have shown some statistical evidence of reports which could be attributed to this cause but did not do so. In Scotland the bright phenomenon of the Northern Lights (Aurora Borealis), can itself not only affect visibility (reducing the probability of seeing light coloured objects in the sky) but can, conversely, also lead to spurious UAP reports. Therefore, for several justifiable reasons, any lack of numbers of sighting reports are not necessarily an indication that UAPs were **not** present - as most of Scotland is sparsely populated and many of the mountainous, forested and hilly areas away from the coast, and at lower altitudes, are often screened from both radar and human coverage. In

summary, lower UAP event numbers reported are therefore not necessarily evidence of UAP inactivity. Clearly, those events close to borders (eg Scotland/England and Wales/England) can be reports of the same objects but reported separately on some occasions from both areas.

GEOGRAPHICAL LOCATION ANALYSIS

29. Because of claims that UAPs, allegedly, have an 'interest in strategic sites' the frequency of reports originating from important geographical locations was examined. This could be a onerous task, since the obvious initial filter (postcodes) is missing from most of the reports and the attachment of a code to the thousands of reports, from an often approximate address, would be a considerable manual task. To avoid this an automated approach was taken using repeat place names, to determine whether they formed geographic clusters in areas of particular strategic interest. This method is not exhaustive in its basic form, since reports could come from a main location on one occasion (e.g the main town) and then from its suburbs (i.e with a different name) on another occasion - thus appearing to be from the different district names and not to be repeat visits. To obtain a good spread this investigation was over a four year period, for ~850 events and included the latter part of the Cold War.

30. The results for specific location repeated reports are plotted at Figure 3-3, and expressed as a percentage because of the wide variation in the number of locations. From this it is noted that, while hundreds of locations were 'visited' only once, between 60 and 70 locations were 'visited' twice (that is, two UAP reports were received during the four year period with the same place name), while at the other end of the spectrum the London area as a whole (taken as a single location), produced 43 reports in the same period. In considering any reports, clustered or not, it must be noted that a proportion could be due to misreporting of man-made objects and thus unless positively separated by analysis, are irrelevant as part of any investigation into the repeat appearances of genuine **unidentified** phenomena.

31. Any analysis must clearly be interpreted with care if meaningful results are to be obtained. For example, reasonable and credible account must be taken of increased population and aircraft density (leading inevitably to false reports) in some areas and the presence of likely places 'of interest' to (in the extreme) 'terrestrial entities', as is claimed in some quarters. It is instructive, for example to examine the scatter plot at Figure 3-4, where a random sample of UAP events over several months are shown as dots. Note the significantly higher densities near to towns and in the air corridors and ATC Control Zones. The solid lines on the map indicate the approximate centres of the civil air traffic corridors. It should be noted that an increase in density in the areas shown could be due to:

- Increased population density

- The fact that UAP, (if they are charged buoyant bodies), are likely to be attracted to airspace which contains a regular passage of aircraft. There seems to be a possibility that either the initial formation (or the subsequent life of a plasma UAP) may be affected by the presence of larger amounts of charged particles in the air over large cities and the airspace where large numbers of aircraft are flying.

- Distractors in the form of aircraft by day or night which are misreported as UAP.

32. Locations where a presence of trained observers - for example, where trained observers such as personnel interested in spotting aircraft might be present and distort the number of sightings (as they might be expected to be scanning the sky more often), should also be considered. UAP events reported from RAF Stations were examined, for example, for a four year period for a repeated UAP presence. Only six widely-dispersed RAF Stations reported one event each. These locations were found to operate in a variety of roles, rather than together representing a group with specific strategic (for example, nuclear) importance, which some have suggested attract higher than expected UAP activity. The RAF Stations which reported were Valley(Advanced Flying Training), Swinderby(Non-flying recruit training), Waddington (V-Bombers at the time), Leeming(AD), Dishforth(Flying Training) and Newton(Ground Training). It is probably the case, because of the radar and visual look out maintained, as part of the normal role of the station, that in most cases if any UAP is present near a RAF Station, it is quite likely to be seen and reported. From the information examined:

- Contrary to certain media suggestions that there is some sinister UAP agenda that there are repeated UAP visits to locations of national importance, no evidence has been found that RAF strategic sites are some sort of target at which UAP appear more often than over certain other areas (e.g. over highly populated areas or along air corridors)

- There is no evidence that regular or irregular repeat visits occur at any RAF site, strategic in nature or otherwise.

33. Alternatively, each of the 66 locations found during the analysis which provided even just two reports were examined to see whether they were (or still are) of particular importance and might even warrant, for some special reason, more than one occurrence by a UAP. Further, whether any of these locations could possibly have any local characteristics which might be connected to either the initial formation or the 'attraction' a UAP (due to some local characteristic, e.g. dust plasma, electrical power lines, earthlights etc). [Notwithstanding the fact that the place where a UAP is formed might not be the place where it is seen]. An examination of the 66 place-names where UAP have appeared twice, does not appear to focus on any of special strategic military interest. **There is, therefore, no firm evidence which points to the repeated presence of UAP at, for example, US or RAF strategic or tactical Bases**

(airfields), Army assets or RAF or Naval HQ or special assets (in particular, at nuclear assets, such as Faslane, Aldermaston, Capenhurst, etc). A UAP at Devonport was reported twice, but no particular significance can be attributed to this. The fact that UAP are seen at all, at some Service locations, is undoubtedly because they are manned 24hrs a day with staff who are likely to be observant by virtue of their normal tasks.

34. **Events Several Times at the Same Location** Although **three** reports came from each of 26 different locations, none appear to have any particular Defence significance. Of those (nine) locations, which each reported four times, it is noted that these are either actually at, or quite near to airports (Glasgow, Edinburgh, Gatwick, Slough, Hayes, Bridgend (Cardiff)). It is suggested that this increased frequency of reports could well be attributed to a number of causes:

- The presence of aircraft (possibly attracting plasmas)

- The increased presence of aircraft leading to the misreporting of aircraft as UAP.

- The attraction of UAP (as plasmas) to attracting electrical items on the surface or in the air. (These might comprise enhanced charged air-particles in the vicinity, large metallic structures such as hangars or electrical facilities on the ground).

- The likelihood of regular observers of aircraft to notice 'unusual aircraft', the presence of aircrew and air trafffic control staff.

35. **Higher Numbers of Reports.** Similarly, those locations from where five to eight reports were received over the four year period do not show any specific strategic military or civil significance. The seven events from Rotherham and (as in May 1998), as well as reports from Sheffield might indicate at least some 'earthlights' (near Moors earth-faultlines) but neither locations have any nationally strategic sites nearby. Only five locations reported nine or more events, respectively, Birmingham (nine), Manchester (ten), Hull (12), Sheffield (15) and, already mentioned, the Greater London Area, 43. It is again noted, that being high density population centres, these will inevitably generate more sighting and reporting opportunities, airports and overhead air corridors feature strongly in all locations. None of these locations are of nuclear strategic significance. Although they are of major civil importance as centres of national or regional government there is no evidence to locate the UAP reports as being specifically close to any buildings or infrastructures of any particular significance, rather, as can be seen at Figure 3-4 the scatter of locations seems to be more or less random within these areas.

NUMBERS OF OBJECTS PRESENT PER EVENT

36. Frequently, more than one object is present at the same time at one event. For example, in a 1987/91 sample of over 850 events, two objects (lights) were reported together on about 8% of occasions. The distribution is plotted at Figure 3-5. In 1996/97 the number of objects at any single sighting was smaller overall. However, two were seen on 13.5% of events and as many as eight objects in total were viewed at once on each of four occasions. Often a witness is uncertain of the number of objects, especially if they are 'manoeuvring'.

UAP LIGHT & COLOUR ANALYSIS

37. It should first be noted that colour may be seen alone, with its own inherent overall shape, or as a colour which is (or appears to be on) on a larger body. Often reports state that the object is exhibiting two or more colours, or as a colour apparently being 'carried' on (the surface of) an apparently 'solid' entity. Reference is made to Figure 3-6, where a colour analysis was made of over 700 events during 1996/97. On 47 occasions (6.6%) no lights were reported - that is, the UAP were perceived and reported as solid entities in the atmosphere. Of these events, 33% were reported as 'white'. The implication is that what is seen either represents a genuine white source, (for example, a white 'lamp'), a reflected source, (for example, of white light from another source, eg. from the sun) or finally, an object with a colour temperature high enough to produce white light. Many people are colour blind to some extent, hence together blues/greens, blues/blacks, yellow/orange/amber, grey/black, and silver/white can easily be misreported.

38. Grey or black indicates opaqueness or solidity to most observers, although it is shown in Volume 2 that the prevention of the reflection or passage of light can also occur for a gaseous/plasma entity, which would then give the **appearance** of a solid object when there is no such solid object is present. The other colours are less consistent with the idea of reflection. What, for example, is the source of a green beam which could reflect from an airborne body and be seen omni-directionally by several witnesses? Hence, it is clear that the red, yellow, orange, blue and green sources observed, (aircraft navigation lights (lamps) excepted) cannot be simple reflections but are inherent colour temperatures **or** are the result of colour filtering due to the physical 'construction' of the entity - which, it should be noted are frequently reported as being in motion, such as rotation. It is noted that, in certain conditions, red, yellow, orange and even blue light, can be associated with jet aircraft exhausts. However, these are easily eliminated as UAPs by the concurrent presence of a positively recognised sound.

39. **Visual Beam Emanations from UAPs.** Reports are occasionally made of 'beamed lights' and sparks (of various colours). If the UAP is near to the ground these are invariably described as 'being used to **inspect** objects on the surface' or 'a beam was **used** to shoot at me' - or **they** 'shot at me with a beam'. An almost

constant factor in these reports is that the human observer is very close to the object and almost certainly simultaneously within the influence of any other (invisible), e.g. magnetic field, which might be present. The potential field effects are explored at Volume 2 Working Papers 1 and 25, with an unexpectedly positive outcome. Characteristics of the 'lights' seen are shown at Figure 3-7.

40. This 'beam effect' is never reported when object's altitudes are higher than about 2,000 feet. When a beam is reported it is often described as a 'searchlight' (on occasions these are shown to be misreported aircraft landing lights). While there is insufficient reported data or indeed imagery for analysis, these 'beams' usually appear to be slightly divergent. It is suggested that where these objects are plasmas the beams described by witnesses could well be the discharge paths taken by charged particles which have found a way to escape from the confining forces within the plasma. Because the objects (i.e. the presumed buoyant mass) do not consistently accelerate away when this occurs, it is surmised that this emanation does not necessary represent any type of viable thrust, but is most probably what amounts to a charge leakage. On other occasions some sort of internal change seems to occur. The object apparently becomes more bouyant and as its residual charge has probably changed it moves away, sometimes at high speed and climbing. Indeed, in the interim the objects frequently 'hover' when this effect is observed, almost as though tethered while this discharge is going on. It is also likely that the discharge path contains dust particles which reflect any ambient light while this is taking place.

41. Often sooner rather than later, the object fades and disappears from view, sometimes re-appearing briefly. Although UAP motion is sometimes described as an acceleration away, it seems more than an anomaly that the object never seems to accelerate towards the observer - only away. This leads to the suggestion (and strong suspicion) that if an object rapidly diminishes in size (shrinking in diameter), giving the impression that it is fast-receding. This is re-inforced by the suggestion that the discharge has changed the balance of sustaining forces to a point which causes the shape of the object to collapse. Sometimes this is accompanied by a small explosion. This, in turn, gives rise to the supposition by the witness that he/she has heard a sonic boom, or has even been 'shot at' as the object sped away. The former is an obvious illusion - as any accompanying shock wave would be moving away, not towards the observer! It is concluded that there is no doubt that some UAP either emanate a beam of light which comes from an internal source, which, for some reason is not an omni-directional emission, or alternatively emit particles in a beam which, in turn reflect ambient light, thus appearing to form a beam of light. It is strongly suspected that a coincident electrical or magnetic field is emitted at the same time which can adversely affect some electronic and electrical equipment and the neural activity in humans.

UAP SOUND & SMELL ANALYSIS

42. The incidence of sound ande smell reports is low. In one sample of events on only 29 occasions out of over 700 (2.8%) were sounds reported. For another sample of 1014 events (1996/7), 46 reported sound (4.5%). For those UAP which are not identified later as aircraft the sound is invariably reported as 'humming', 'whining' or 'crackling', or electrical and these amount to only 1.1% overall. There are various reasons for lack of sound when aircraft are seen. These are considered at Volume 2 Working Paper No 8. The presence of odours (usually an obnoxious sulphurous smell) is very rare in UK reports and would only be sensed if the observer is quite close to the explosive demise of a plasma in relatively still air.

UAP SHAPE ANALYSIS

43. Figure 3-8 shows the shape analysis for 1014 reports for the 1996/97 period. Shapes were observed on 67% of occasions. It is noted that the shape may be that of the coloured light itself, where a 'light' is the only item seen. Alternatively, the shape may be on or in a body which also has lights/colours, or the shape may be a silhouette, with or without 'lights'. In combinational reports the object shape is often described as 'bright' (e.g. 'bright red sphere'). The shape may also be defined by an observer from several individual objects which form a shape (formation) but are individually generally round. Hence, three objects which become a triangle when viewed in plan together form a 'line' or 'bar' or even a 'cigar', when viewed sideways-on.

UAP MOTION ANALYSIS

44. Whereas satellites, meteors and manned aircraft exhibit a generally linear or curved flight profile, UAP produce a number of profiles, some of which match those of manned aircraft. These not only include 'hovering, but other motions that no manned vehicle could achieve. Figure 3-9 shows UAP motion analysis for a four year (858 event) series in the period 1987-91, where other than simple linear motion was observed. The following points are relevant:

- None of the events reported UAP **diving** - thus eliminating **diving meteors with visible trails.** (Most of the public know the difference anyway as these are seen nightly if the visibility allows, however see correlation with meteors below)

- Almost 10% of the events **climbed** - indicating negative buoyancy or lift from some force (e.g. due to electrical charge differentials). [Note also the natural affinity, reported in a Russian Open Scientific Paper at Volume 3, for (aerosols) plasmas to take up an 'aerodynamic' shape, possibly producing lift].

- Almost 22% of the reports (when combining slow, stationary and hovering) were expressy perceived by the witnesses **NOT** to be aircraft.

- About 9% were **moving fast.** [This eliminates satellites, which, when observed from earth, exhibit steady, rather than 'fast' motion.]

- A small percentage (~1.6%), were described as **'bobbing'** (sometimes as **'erratic'**). This condition, which admittedly can be due to optical propagation 'tricks of light', such as 'twinkling', indicated instability and eliminates aircraft. The public are well-aware of aircraft strobe lights. Further, the 'bobbing' motion is usually described as random.

- Some 14% of reports indicate **'spinning'**. This can be confused by some with **'pulsating' (1.6%), and by others who reporting a stationary light flashing on and off regularly as 'rotation'.** Taking these factors together, this indicates some sort of turmoil/turbulence within the object which is often consistent with the variability which might be expected in gaseous formations in motion, due to internal changes caused by both internal and external forces. It is also noted that the general public, in context, are more likely to **expect** any object seen to be 'spinning' rather than any other motion because of the widespread 'spinning-top', flying saucer analogy used by the media

45. In a proportion of the UAP events a combination of motion characteristics reportedly occurs. This often depends upon how long a UAP is observed by a single observer before it passes out of sight. For example, initial deceleration, followed by slow movement, 'hovering' (or the appearance of doing so), followed sometimes by either acceleration, disappearance or even explosion. During the phases of observation colour mixtures are often seen and colour changes occur during the period of observation. This indicates that the objects nature is in constant agitation. Indeed as many are reported to rotate the UAP is being viewed from all aspects, repeatedly showing all it's variations in colour.

CORRELATION STUDIES

46. **With Time of Day** As events are almost always first detected visually, it is no surprise that the greater proportion are sighted after dark. For example, of the 1014 events from 1996/7, 94% of events were seen first as lights and, as can be seen from Figure 3-10, a very high proportion are seen in the hours of dusk and darkness. One breakdown is shown at Table 3-2, taken as a sample of some 850 reports, between January 1987 and July 1991. Approximately 64% were reported during the hours of darkness, 19% in daylight 10% at dusk. About 6% were seen at dawn. These figures do not necessarily mean that UAP activity is influenced by the presence of darkness and that they are not present through a full 24 hour period. Sightings are also heavily dependent on viewing conditions:

- Visibility

- Contrast in daylight

- Luminosity of the object, compared with other lighted objects in the sky.

- The presence of motion.

- Availability of witnesses - This is dependent, not only on the prevailing weather conditions but also on population distribution.

47. The second sample was taken over ~700 event reports in 1996/7. In this example, perhaps predictably, almost 80% occurred during the hours 1800-0600. It seems that, for a maximum probability of being reported, either dusk and darkness is required. While there are not necessarily large numbers of people outdoors at any given time in the evening, (in fact there may be far less than in the daytime in most places), those present are more likely to see UAP because the sighting conditions exist. However, there is no evidence that UAP form at any particular time of day. Because of the wide range of UAP durations reported, it is possible that the life-span of some extends from daylight into dusk and darkness and vice-versa. Whatever their origins the statistics show that the number of UAP reports increase as dusk progresses into darkness, peaking at the time people are returning home after an evening out, walking the dog, etc., between 2200 and 2300hrs. Thereafter, with most people in bed the levels fall. This does not necessarily mean that there are less UAP about. Although there is no absolute evidence that this is the case, it seems most likely that UAP distribution occurs more or less throughout each 24 hours period, notwithstanding any peaks and troughs if the cause of UAP is due either to meteors or electrical conditions; both of which are variables (see Working Papers Nos. 2, 13, 17 at Volume 2). It is a fact, taking all known characteristics into account, that:

- Most of the 33% 'white' objects reported would not be seen in bright daylight, unless they were close to the observer.

- Only those objects attracting the eye's attention with adequate contrast with the viewing backgound are likely to be seen. [Pink/silver (against a bright sky), blue (against a blue sky), or yellow/orange (in a sunny sky) would be less likely to attract the eye's peripheral vision.

- Although motion attracts the eye, unless a visible, contrasting colour, is also present, any motion will be irrelevant.

- Aircraft lights- even if operating in daylight- will not attract attention by themselves. Their contrast will be much less than in darkness, coupled with the fact that an observer in the open will only be attracted if aircraft sound acts

as the additional cue. [Hence, aircraft lights as a cause of UAP mis-reports are eliminated in daylight].

- A large percentage of UAP reports at any time - day or night, are fleeting, often less than 5 seconds. The certainty of a witness is higher at night, than in daylight, because of the colour/darkness contrast. In daylight, even a second glance may not confirm the presence of anything unfamiliar, the object may have disappeared, dissipated or just moved quickly away.

- It is noted that the large triangular, oblong and diamond shapes reported at dusk or in the night do not appear in daytime reports.

48. The statistical distribution values obtained do not therefore necessarily mean that UAP presence is not evenly distributed through the full 24 hour period - or at least more evenly distributed than the probable skew caused by the contrast in the marked difference in visual detection conditions occurring between day and night. As a comparison with the earlier analysis, the 1996/97 analysis breakdown is: Daylight (0600-1700) ~17%, Midnight to 0600, also 17%, with over 56% between the hours of 1800 and midnight. Seasonal time variations have not been investigated but monthly values are considered below. Irrespective of these factors is is clear that sightings are a function of:

- Visibility at all times of day or night.
- Contrast in daylight.
- Luminosity of the object to attract attention.
- Presence of motion.
- Availability of witnesses - a function of population distribution and presence in a viewing position.

49. **With Month of Year** Figure 3-11 and Table 3-3 show the distribution of UAP reported sightings by month of the year, taken over a ten year period. The pattern is consistently clear that the number of reported events peaks during February and in the autumn and falls for about two months in April/May. Until the Meteor statistics were developed there was no apparent or obvious reason for this, apart from the fact that, from the visibility aspect, **fewer** UAP sightings would, as explained elsewhere, be expected when the weather is very bright, or when the evenings become lighter. However, more opportunities are available when the weather is warmer than in the spring and more of the population is likely to be outside in the evening/dusk, for example, in the autumn. This did not explain the peak UAP reporting, centred on February for most of the years plotted, until the results at para. 53(Figure 3-18),

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

below, were obtained. Table 3-4 shows the distribution of days per year with no reports.

50. **With Weather.** Weather statistics for the whole of the UK have been briefly analysed against UAP sightings, with the specific intention of searching for correlation between atmospheric conditions and days on which UAP events occurred. The information available from 23 weather stations included temperature, precipitation, sunshine, fog, snow, thunder, frost, dew point and pressure. Although the work involved to make a complete analysis (and the possibility of identifying conditions for the formation and sustaining of a UAP) is beyond the scope of this study, an initial analysis was made of the most obvious factor - that of the potential of enhanced electrical conditions in the atmosphere. A correlation was therefore sought between the incidence of thunder recorded in the weather statistics (and dependent on lightning) and UAP events. As these could not be done locally for every event, they were normalised as the numbers of days per month of thunder against UAP report frequency. Conversely, an analysis was made of days when UAP events occurred when there was no thunder. The results are plotted at Figures 3-13 and 3-14 for the years 1988 and 1996. They show that **UAP can occur when there is no thunder (lightning),** for example, in November 1988. December similarly shows a large number of UAP with a very low, negligible thunder rate. However, for the overall year the correlation co-efficient was -0.43 which shows that very small values of one set of data are connected with large values of the other set. When this was repeated for 1996, which was a year with more sightings and a preferable statistical situation, the correlation was positive (+0.62) showing correlation between thundery days and UAP reports. Finally, the sequence was repeated for 1988 for days of thunder against days when **no UAP reports were received**. This showed only a very weakly positive (0.19) correlation, meaning that the large values in one set are associated with the large values in the other set. In basic terms this shows that a large number of days can occur with no UAP even though it is thundery. The conditions for lightning occurred on those days but ball/bead lightning was not formed - or at least was not reported! **In summary it seems likely therefore that while a number of UAP reports are a result of misreported ball lightning (which is a rare phenomenon for most of the population), there are many occasions when UAP reports are received when there is no recorded thunder conditions and hence no enhanced electrical activity in the form of lightning. On these occasions (other man-made objects excepted) UAP must be caused by something else.**

51. **With Solar Activity** Because solar activity affects the earths atmosphere and electromagnetic propagation conditions it was investigated to ascertain whether the frequency of UAP reports could be correlated to solar flux, sunspot number or geomagnetic conditions. Some example plots are shown at Figures 3-15(a) and (b). It was postulated that some events, possibly many, might be plasmas' with their associated electrical fields, (and charged particles), so an examination was made of the UK daily Sun-Spot Numbers (SSN) and the geomagnetic flux (FLUX), compared with the daily number of UAP events. For convenience of the presentations of results,

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

this was done in 2 monthly (i.e ~ 60 day periods), for the overall period Mar 1995 to 1997 i.e. x 2 monthly samples. However, the overlap periods of the plots were also investigated - in case correlation happened to occur at one or more of these periods. Cogniscant of the fact that the appearance of UAPs transcends our terrestial calender, [which is purely a convenient set of markers to use as a time scale in this case]; data was investigated for possible relationships which might be significant:

- Direct correlation of UAP events within either high, level or low SSN, or FLUX periods.

- Apparent trend correlation of UAP events with the longer solar cycle trends. (To carry out this fully would ideally require at least 22 years of results; as the solar cycle lasts 11 years!)

- The possibility of a delayed correlation if the UAP event curve is shifted to the right (to test for UAP increased frequency of reports after the high (or low) solar activity).

- The probability that UAP events occur due to an amplitude change but not necessarily consistent with solar peaks or troughs.

- The probability of a correlation when the SSN/FLUX reaches a minimum level or, conversely falls below a certain level; or remains level (i.e. constantly high or low) over a correlated period of reported UAP activity. It is reiterated that this can only be a loosely based analysis because of the possibility that many more events have occurred, possibly in geographical clusters and possibly on certain days - but these have not been seen; or have been seen but not reported.

52. **Results** No direct solar correlation was established. Much more work would be necessary to establish whether combinational effects are responsible - for example combinations of certain weather conditions. However, the tentative link with meteors (see below) seems more tangible.

53. **Correlation Studies - Meteors** While it has become clear during investigations that a large number of variables are involved in the consistency of UAP reporting, and it is acknowledged that there are likely to be more meteors mis-reported as UAPs when, for example, the sky is clear, the weather is fine and warm (inducing more people out of doors in the dark), and when there is a higher forecast meteor activity; further analysis of the reports and correlation with UAP dates, has revealed some interesting facts which may have a direct bearing on at least one possible cause of the unexplained object phenomenon.

54. Meteor activity is continuous in the earth's atmosphere. Every year it is estimated that some 40 tons of matter hits the earth's surface, but this is only a small

proportion of that which enters the atmosphere and, in theory is said to burn-up. If it is postulated that a proportion of the material neither impacts the surface or burns complet up it is necessary to conjecture what form this might take, whether it exists at all and how long it might persist if it exists in another form etc. It is not clear why there is a dearth of information in the scientific press on this possibility. It seems unreasonable to assume that all meteors will either burn up completely or reach the surface, without the possibility of some intermediate state. It also seems reasonable to assume that any material which, having sped through the atmosphere at enormous velocity and attained a very high ionisation temperature, must exist in gaseous form before dispersing. It is postulated that it may, instead of (or as well as) forming a gaseous plasma viewed as a visible luminous stream, form (due to variations in atmospheric density and other factors) a single or several plasma bodies. A plasma is a charged body of gas. Rather like ball, or bead lightning, which is formed during a lightning strike it seems possible that multiple rather than single gaseous entities may be formed which might be seen as visible shapes. Meteoroid definitions are at Figure 3-17.

55. It is postulated that a plasma formed from the vaporisation of a solid meteor of sufficient size will comprise millions of particles. These particles will have collected an electrical charge due to a combination of friction and currents which could be expected to flow as the stream passes through both the earths natural electrical field and any other enhanced fields that may be present at the time due to electrical storm activity. Many meteors are of no consequence being microscopic in size. They would not produce a plasma with sufficient energy. However, some of the meteors which have reached the surface as meteorites are known to contain magnetic and other elements. On entering the atmosphere they may already have properties (e.g. electrical or magnetic currents) of unknown magnitude, of which we are unaware and which may influence their final form as they come towards earth.

56. **Similarity to UAP**. While lunar activity generates ambient light and this determines, even on a clear night, whether the meteors can be seen as they approach, it is assumed that statistically, seen or unseen, meteors will enter the earth's atmosphere at any position around the earth. They will either completely burn up, impact as meteorites or, from the rationale above, it is therefore suggested that under certain conditions the residual material from a meteor could form a buoyant plasma or 'fireball' in the lower atmosphere. During its life, and before natural dispersion, it is likely that such an object would be reported as a UAP. Meteor arrive singly or in multiple showers. These often overlap for significant periods during the year. A plasma formed as described above would appear to have most, if not all the attributes of the objects which are regularly reported as UAP. Therefore, the investigations and findings related to meteors are of special interest.

57. Details of meteor activity are constantly monitored and meteor showers can be predicted using the Meteor Shower Calendar, produced by the International Meteor Organisation (IMO). Meteor shower data was obtained for the years 1995-1998. As

explained in the Working Paper at Volume 2, there are both predictable meteor showers and sporadic meteors. An investigation was therefore made into the incidence of UAP reports and the arrival of one or more coincident meteor showers. According to the IMO there are 38 named meteor showers which were forecast to arrive in the year 1996. Since this was a high incidence year for UAP reports it was appropriate to make statistical studies for this year.

58. Meteor showers arrive singly or in multiple showers. These often overlap for significant periods during the year. For 1996 up to eight named showers arrived at the same time and lasted for a period of several days, sometimes for up to 30 days. However, it is important to note that the showers build to peaks on specific named days. Each type arrives with differing velocities and different densities (rates per hour). The arrival of meteors in the atmosphere is the cause of meteor **trail reports which are often visible to the unaided eye.** As most members of the public are aware of and recognise them as such, they do not report them as UAP. The object of this part of the study was to ascertain statistically whether there was an increase in UAP reports **when meteor activity was high** but when **meteor trail reports were low**. This would suggest that the public reports would most probably be as the **result of meteor activity** even though the reports did not report meteors. If it could be further shown that a statistical variation of UAP with meteor activity exists, then this would explain many of the hitherto inexplicable UAP events and re-enforce the exceptional correlation which was becoming evident with the attributes of gaseous plasmas.

59. For analysis it was assumed that, statistically, the phenomena was likely to occur when the IMO predictions suggested that:

- Several showers of different types occur at the same time.

- A meteor 'peak day' occurs.

60. Some significant 1996 correlation results are plotted at Figure 3-18. The curves show three sets of data, plotted, for convenience, in increments of five days: the UAP rate over each five day interval, the coincident number of different shower types in the same five day interval and, finally, the hourly meteor arrival rate forecast within each five day period. The maximum five-day rate for UAP reports in 1996 was 30 and the lowest was zero. The maximum number of coincident meteor showers was eight. The maximum arrival rate was 143,000 per hour, boosted particularly by 'Geminids', 'Quadrantids' and 'Perseids', each contributing over 100,000 meteors per hour when they were near. Even the least active shower releases 2000 per hour. It should be noted that although not all meteors will approach UK airspace, when the highest density rate is expected then the probability of an increase in UAP reports is clearly present. The objective is to discover whether this ic coincident with a correlated increase in UAP reports

UNCLASSIFIED SECRET

61. From the Figure it is immediately evident from the coincident rise and fall of the curves that there is correlation between the number of meteor showers present and the meteor hourly rate (known as the ZHR). This is expected. The important fact is the correlation between the meteor curves and the UAP report curve The mathematical correlation taken over the year is over 60% (0.62). **This is a reliable positive correlation which would probably have been much higher if man made sources of UAP reports were filtered out.** As has been proved, many reports will be due to over 20 types of other natural aerial phenomena, plus man made phenomena, ranging from lightning and fireworks to laser displays. Perhaps an even more stringent test is that of comparing the actual dates of peak UAP sightings with the actual dates of the meteor peaks, rather than those grouped into 5 day intervals:

Meteor Peak	UAP Peak	Meteor Velocities (km per sec)
January 4	January 7	28, 41*, 65
February 7	February 8	23, 30, 56*
February 25	February 26	23*, 30, 56
March 14	March 18	23, 30, 56*
March 25	March 30	30*
May 6	May 4	30, 66*
August 18	August 18	25*, 31, 34, 42, 59, 66
November 13	November 13	27, 29*
November 25	November 25	27, 28, 29, 60
December 6	December 6	22, 28, 40*, 42, 58
December 14	December 14	22, 28, 35*, 40,42, 58, 65

Note : * indicates that this day was a peak for that particular meteor shower type. However, at present, with insufficient evidence, there is no suggestion that one meteor shower type is likely to cause UAP to form, more than any other.

62. Significantly it is noted in conclusion that the correlation is date-exact on several occasions and nearly so on the others. There seems little doubt, therefore, that natural UAP reports are correlated with high incidence of meteor activity and, from this evidence it seemed a strong possibility that meteor activity accounts for some UAP reports.

63. It is noted that the co-incidence of peak meteor dates and UAP reports is statistically very high and cannot be due to chance. The fact that sometimes the UAP peak occurs before the meteor peak is not a problem - it is merely that, as the meteor peak date approaches and the entry rate increases, more UAP are seen on adjacent days, than on the peak day itself. This variation could easily be due to the weather (overcast and low visibility) and that (meteor-generated) UAP did in fact occur where there was no one to see them! - or just that the meteorological conditions present in

UNCLASSIFIED SECRET

the atmosphere on the meteor peak days was not suitable for plasma formation. The other key factor, of course, is that gaseous body plasmas did not fall within the airspace of the UKADR on that day - or even if the opportunity to form a plasma occurred, it's subsequent reporting was not viable. The position at which a plasma is eventually formed, assuming a meteor does not burn-up or impact after diving, must depend on the angle of entering the atmosphere, the velocity and the atmospheric conditions (e.g. temperature layers, dust, electrically charged layers, wind). It is clear that an observer noting the falling trail of a meteor may be hundreds of kilometres from its eventual landfall.

64. The final meteor-related investigation was to examine each of the UAP reports on the peak dates to ascertain that they were not merely reported as meteor trails, but more tangible and representative of the exceptional bodies often reported.

RESULT OF METEOR INVESTIGATION

65. **The investigation showed that on only 27 occasions out of 1014 UAP events reported for 1995 and 1996 did UAP have 'trails', 'tails' or were 'comet like' or 'meteor like'. Many of those with tails were reported not as meteors but as other types of event which happened to have tails. It is concluded therefore that the pblic are well aware of the difference between a familiar meteor trail and an unusual phenomenon. It is not unreasonable to suppose that, disregarding any man-made objects which were misreported during 1996 (and in other years) there is a high probability that the remaining events were largely due to meteor plasmas. Some may have been due to other atmospheric electrical events such as lightning. The peak reporting periods which co-incided with meteor shower peaks were not mistaken reports for falling meteors, but were clearly events which occurred after the plasmas had been formed, were usually at low altitude and exhibited the regularly-seen erratic, bobbing, hovering and climbing motion which would not be mistaken by the public and other credible witnesses.** In fact, it is clearly to the public's credit that they rarely report meteors as UAP.

HUMAN FACTORS

66. No attempt has been made to separate so-called credible reports from all others, as in intelligence analysis **all information, however innocuous, is valuable for correlation purposes until decided otherwise by the analyst.** For the sample of events taken from the period 1987 to 1991, 36 reports were from Police Officers, 278 from witnesses in declared professions, many from ex-servicemen and women, only nine were from 'ufologists'. These together with all reports from undeclared observers were treated as corroborating evidence where possible in individual cases and as a body of reports which cannot be ignored or dismissed lightly. In the 1014 1996/97 reports 15% were corroborated and often were seen at the same time by a dozen or more witnesses who must be considered reliable. Very few (for example 1.2% in a sample of over 1000 UAP events) were seen on the surface or close enough to surface objects to cause surface effects to the countryside, property or to humans.

Exceptionally, some railway sleepers were set on fire and sometimes the ground was scorched. Effects on humans were minimal, mainly being limited to fright, 'car following', often for several miles and, occasionally, interference with vehicle electronics. Taking all the currently reports held (~30 years), there is insufficient data to carry out a statistical analysis on human effects.

WITNESS GENDER & AGE.

67. A very small proportion of witness reports involve children, usually aged ~8-15. Sometimes adults have been alerted by children, leading to a multiple witness event. In a sample of 850 reports although 64% were submitted by men (who are more likely to walk outdoors in the evening and night by themselves), many hundreds of reports were correlated and confirmed by multiple witnesses of both genders, located at the same place and time, and often accompanied by the civil police, called to the scene. The viewing and reporting of UAP is therefore not a function of gender or age. However, as pointed out at Volume 2, Working Paper No 25, certain types of person may be more susceptible to the apparent fields which emanate from some UAP. These fields are only effective when the recipient of the energy approaches the source to a short distance and enters what appears to be the source 'near field', using the terms of conventional field theory.

WITNESS LOCATION

68. While using individual circumstances to enable the filtering of the most obvious misreports (reflections through glass, etc.), no consistent occasions have been found which have caused obvious misreporting due to the location of the observers, causing, for example, optical errors. The incidence of these is small. Valid reports are received from witnesses from all walks of life and in diverse locations, and few, if any can be attributed to an aberration caused by the location. For example, a phenomenon initially viewed through a car or building window is usually still present when the window is opened or the observer goes outdoors for a better view. The number of optical aberrations causing misreporting are probably very small for surface-based observers and more likely from aircraft, where curved and sandwich windows, rather than flat glass/perspex is used, the duration and field of view is often limited, and for obvious reasons the windows cannot usually be opened. Few observers are up in the mountains at night so there are few opportunities to obtain a view of a UAP from above, from a stationary position, although, (see Volume 2 Working Paper No 13), other unfamiliar, atmospherically-produced phenomena can occasionally be seen.(U)

STATISTICAL CONCLUSIONS

69. The key conclusions are based only on analysis of the available data. No attempt is made here to apply the popular conclusions which the public reach, following a set of UAP behaviour. The key to the enigma of the hitherto unsolved proportion of UAP reports is undoubtedly the proven link with meteor activity and the UAP reports which coincidentally follow if the conditions pertain:

- It is clearly of no consequence as to whether a human is present or not. There have never been any reports that a human has attracted a UAP, however a vehicle may do so. This is attributed to its possible net field charge.

- **UAP can climb as well as fly level or dive, do so more than once and do so rapidly and repeatedly.** This is believed to be caused by a change in buoyancy or charge, or in both. Sometimes this phenomenon occurs after more than one UAP have merged together, or, it is believed, new UAP magnetic or electrical charge or temperature conditions have occurred.

- **The merging of UAP together is frequently reported - but for this to occur they are always in fairly close formation to start with.**

- **There are isolated occasions when UAP in motion close together diverge.** It is believed that this occurs when the attraction between them becomes weak and one or other is attracted away by a stronger field.

- **The charged nature of UAP appears to result in forces which enable motion to take place in a direction against the wind.**

- **Some UAP have been reported emanating a beam or beams of light. Either these have a finite internal source of energy at optical wavelengths or continuously change or retain some form of energy which is emitted as visible light. The only reasonable alternatives are that the UAP emanation comprises charged particles, which either themselves emit light (luminescent) or they reflect ambient light from their particles, viewed in a similar manner to a sunbeam. If charged particles are involved then the presumed discharge path rapidly starts to affect the life and physical nature and position of the plasma. These conclusions are made because observations of this phenomenon is often described as a 'beam' or 'beams' and is often downwards, after which the body invariably changes its charateristics or motion or even disappears altogether.**

- There are a limited number of occasions when an apparently solid object is reported in daylight often as a silhouette. This is believed, when a plasma is involved, to be due to total internal reflection. Descriptive shapes, such as triangles, are usually accompanied by a 'light'. This, from the evidence, appears sometimes as what seems to comprise several separate gaseous plasmas, often brilliant in intensity and colour in a loose aerial formation. The outlying plasmas at each extremity are used by the observer to describe the overall shape. The shape described is dependent on the position of the observer. It is noted that aspect plays an important part in shape description. A formation of plasma balls forming a 'triangle' or a 'diamond' when viewed in plan, takes the form of a 'cigar' when viewed side-on. The presence of bright spots in a plasma formation can easily be described as a row of lit 'portholes'.

- Sound is a very rare event from a UAP, indicating that air is not being thrust, as in a normal propulsion mode. This is generally reported as 'electrical', humming, 'whining' or 'crackling'.

- Smell is similarly a rare event and again is described as 'electrical.'

- Because light is the primary mode of observation the statistics show 64% are seen in darkness and 10% in dusk conditions.

- UAP reports can originate from single or multiple sightings at the same location. Because, **once formed, UAP can travel at all altitudes, sometimes at high speeds for their duration**, the same object or objects can be seen by observers at large geographical separations.

- **UAP life can vary from seconds to, exceptionally, tens of minutes.** If the UAP is a plasma its life is limited and it probably starts to disperse from the moment it finds a discharge path. At this point its life either ends abruptly, or its internal characteristics change (a probable change in charge and buoyancy). These usually cause it to move. It may have sensed a more attractive electrical or magnetic field.

- **It has been shown that more than one UAP event can be present in UK airspace on the same day and at the same time at widely spaced locations. There is no indication that these have initially diverged or subsequently have merged. Those that diverge or merge appear as a group within the same location over a limited volume of airspace, usually a few hundred metres in diameter.**

- **UAP reports are not evenly spread from day to day.** The daily sighting reports vary between zero and up to several tens per day. There is no doubt that 99% of these are genuine reports irrespective of whether they are from trained or untrained members of the public.

- The UAP peak in February was unexpected - as during cold winter nights fewer reports would be expected as fewer observers are outdoors. Clearly, despite fewer observers, more reports are generated, because more UAP are apparently present.

- **UAP events, plotted as date and frequency, have been shown beyond doubt to be statistically-correlated to the dates and densities of meteor activity on the assumption that the proportion of meteors entering the Earth's atmosphere are sensibly distributed across the UKADR .**

- Apart from aircraft passenger reports (very rare), few, if any, public reports could be rejected due to the credibility of location (e.g. distortion and misunderstandings

produced by viewing through glass). After initial contact those indoors usually obtained a direct sight line by going outdoors or opening windows.

- **Repeat UAP sightings at different times and dates through the year which have occurred at the same location cannot be shown to have any relevance to the location.** However, it is suspected that the likelihood of UAP may be enhanced by certain locations where electrically-charged plasmas would be expected to be attracted. For example, towards aircraft and aircraft environments such as airfields and air corridors, electrical pylons, electrical rail-lines, charged dust particles in industry or over towns. There is no evidence to suggest that UAP favour militarily strategic locations.

- While a proportion of the large numbers of reports received in the vicinity of airports, military airfields and air corridors are due to misreports of aircraft, most of **the public who live in these areas are quite capable of discerning the difference between something which is a part of their daily lives and something which has characteristics out of the ordinary.**

- Relatively few reports are received from Wales, Scotland, the IOW, NI, IOM and the Outer Isles and from ships in UK waters and from aircraft crews, compared with land-based observers in England. This fact is attributed to a combination of the many factors which must affect aerial observation, including population distribution, airports and air corridor densities, work patterns in the big cities and terrain.

- Lightning can be present for some two hours after a storm and also present when a storm has taken place elsewhere. **Ball lightning, which is a plasma form, and which has been replicated in the laboratory, accounts for a number of UAP sightings.**

- Statistical investigations, using weather data, have shown that **UAP can occur when there is no thunder present anywhere in the UKADR**. Hence the conclusion can be drawn that some events reported as UAP (after filtering out known mis-reports of aircraft, satellites etc.) must be due to other causes.

- Statistical analysis of UAP colour has shown that, either by day or night, the UAP is reported as having a 'light' or 'lights'. One third of all sightings reported more than one (and as many as eight) white light(s).

- On the majority of occasions a single light was reported as a 'round' object, even when the observer could only see the light and not the actual shape if there was one.

- On about 7% of occasions UAP were perceived as 'solid' objects. [Working papers at Volume 2 describe the physics of how it is believed this can occur].

- **There is no statistical evidence to show that UAP form at any particular time of day.** It is believed that UAP which cannot be explained as man made or by other less well known atmospheric activity are spread more or less randomly in time and date and caused partially by lightning but mainly by meteor activity. It is inevitable that more will be reported when the eye is attracted in dusk or darkness, especially if unusual motion is taking place.

- About 14% were reported as 'spinning', 1.6% as 'pulsating' and 'bobbing' or 'erratic'. Usually reports are made because this is an unfamiliar motion of lights in the sky. It is believed that a body of gases which may have varying internal processes taking place, including effects which vary buoyancy and electrical charge may exhibit such motion.

- **Positive (+0.62) correlation was shown between thunder (lightning present) and the presence of UAP reports.** This was taken as a whole over the country. No attempt was made to link UAP locations with thunder locations from the reporting meteorological stations. However, the opposite (UAP present **without lightning present),** was also confirmed; as is the case that **even with thunder present there were many days when the lightning did not produce UAP reports.**

- **No correlation of UAP reports was found with Solar Flux or Sunspot number.**

- Although 64% of reports were forwarded by men, the statistics showed that UAP could be observed by either gender and by children (who frequently called adult attention to unfamiliar sights).

- Over the period 1987-1996 the number of days per year on which there were **no reports** of UAP has been **significantly decreasing** (from 280 down to 130).

	1987	1988	1989	1990	Mean
ENGLAND [1]	109(87%)	319(89%)	200(89%)	102(83%)	87%
SCOTLAND	6(4%)	23(6%)	11(5%)	12(10%)	6%
WALES	10(8%)	15(4%)	13(6%)	3(7%)	6%

TABLE 3-1 PERCENTAGE OF REPORTS BY NATION

Note: The number of sightings from Northern Ireland, The Isle of Man, the Outer Scottish Isles and The Isle of Wight are negligible and are included in the appropriate mainland totals.

	1987	1988	1989	1990	Mean(%)
DAWN	3	25	18	10	7
DAYLIGHT	18	87	42	12	21
DUSK	22	39	20	4	11
DARKNESS	88	211	192	40	60

TABLE 3-2 EXAMPLE BREAKDOWN OF TIME OF DAY OF REPORTS

Year	Jn	Fb	Mr	Ap	My	Jn	Jl	Au	Sp	Oc	Nv	De	Rounded Total
1987	2	7	6	5	6	1	8	26	16	16	19	19	120(150)
1988	41	48	38	21	24	28	17	28	30	31	28	32	365(397)
1989	17	12	14	7	9	9	26	21	28	32	39	11	225(258)
1990	15	11	7	-	-	-	-	-	10	24	8	15	90
1991	10	9	3	2	4	5	14	7	10	13	5	4	85(117)
1992	7	18	2	-	-	-	-	8	1	11	-	5	147
1993	1	-	1	-	2	4	3	9					(258)
1994*													(250)
1995	40	16	28	10	22	27	21	29	22	36	33	20	284
1996	19	71	38	42	44	24	79	80	53	52	55	35	595
1997	35	28	32										95*

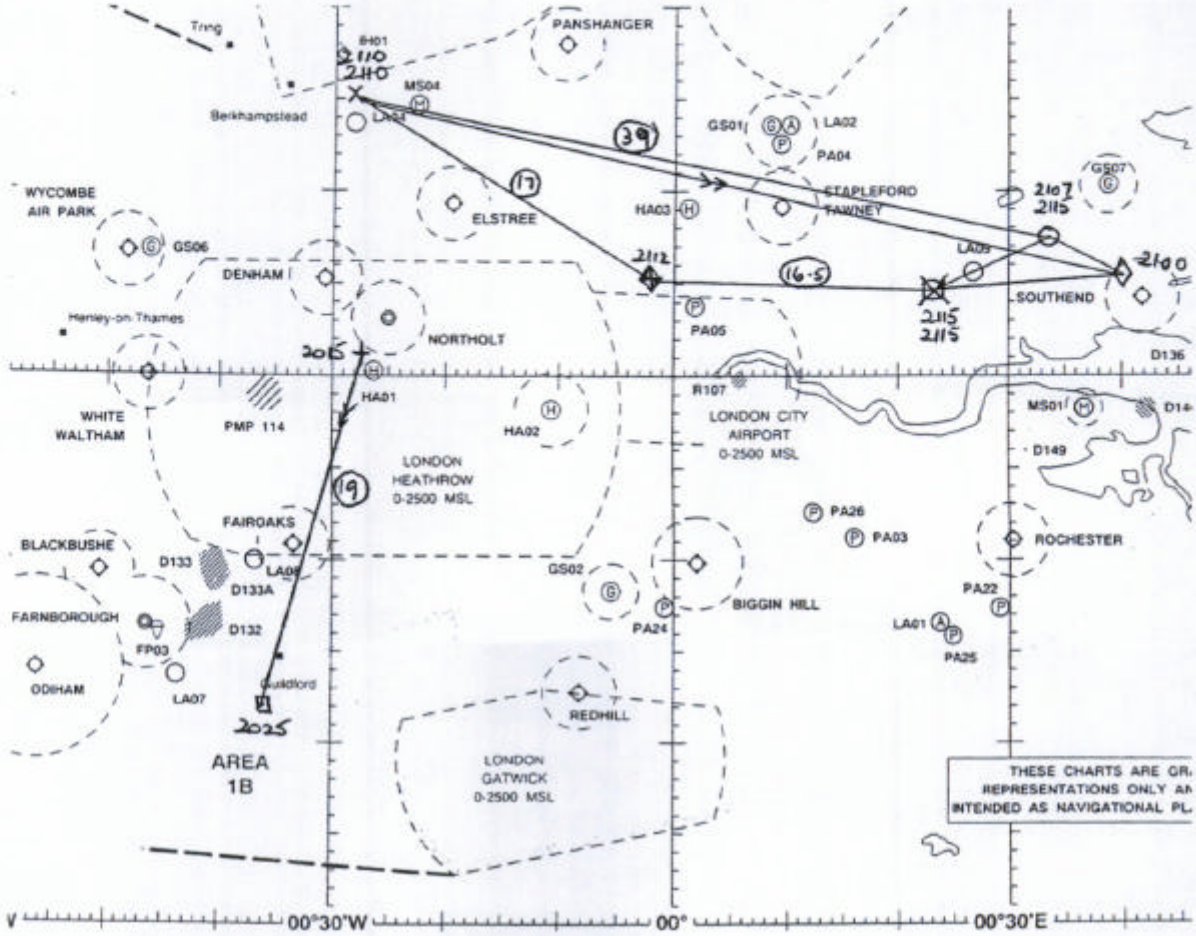
Notes: *Report details incomplete. 1995 figures for first 3 months only.

Bracketed figures show some differences in overall totals due to inaccurate report counts, pre1994.

TABLE 3-3 NUMBERS OF EVENTS PER MONTH OVER 10 YEARS (U)

Year	Jn	Fb	Mr	Ap	My	Jn	Jl	Au	Sp	Oc	Nv	De	Monthy Average	Rounded Totals
1987	29	21	25	26	26	29	24	15	21	20	21	22	21	280
1988	12	8	11	18	17	17	19	15	13	17	15	22	15	180
1989	16	18	21	24	23	23	16	19	11	12	12	23	18	220
1995	13	16	15	24	18	17	20	13	15	14	12	18	15	185
1996	19	8	15	9	9	19	7	6	4	10	10	16	13	130
Mean	18	14	17	20	18	21	17	13	13	14	14	20	16	

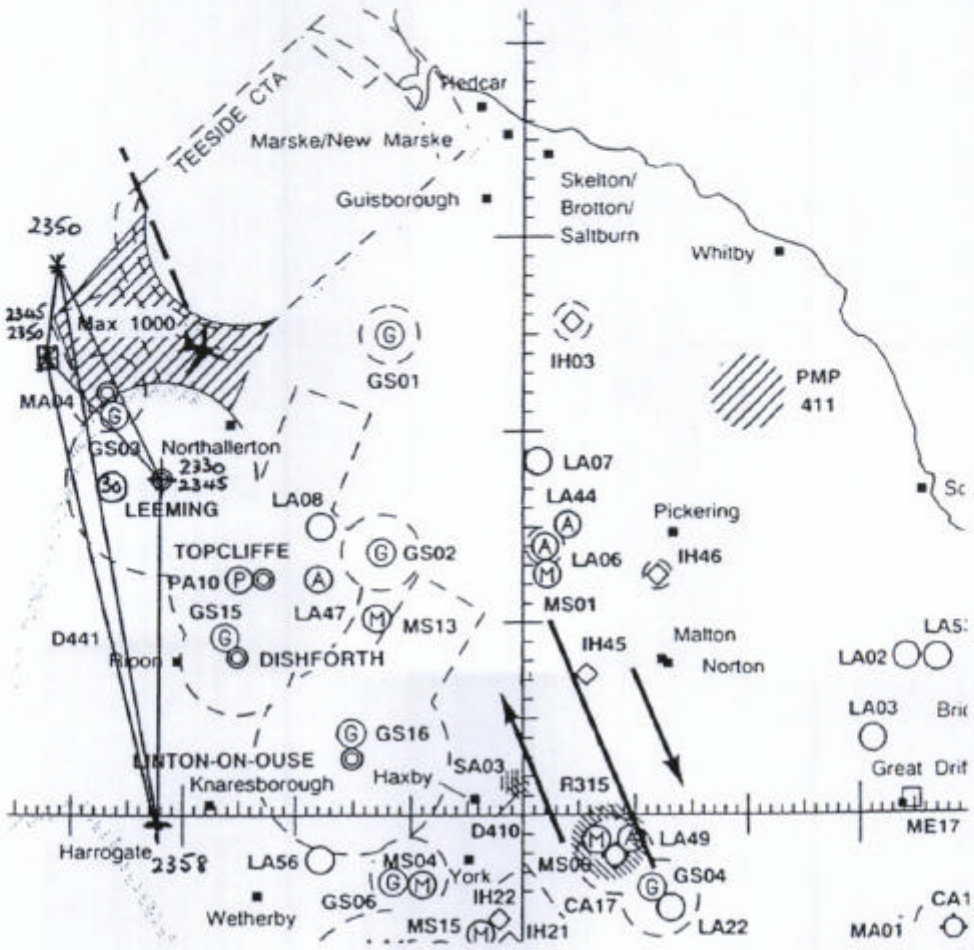
TABLE 3-4 NUMBERS OF DAYS PER YEAR WITH NO SIGHTINGS REPORTED FOR 5 YEARS BETWEEN 1987-1996 (U)



Notes: The tracks could represent one or several UAP. After leaving Godalming(S of Guildford) the UAP may have remained unreported an re-emerged in the Southend area and towards Danbury for 7 minutes. A track appears to start N of London at 2110, where it was seen twice (or there may have been two objects) and proceeded roughly SSW towards Danbury. Alternatively, the 2115 hrs Danbury event may have been a second sighting of the 2107 event, as may have beeen one or both of the Brentwood events. Danbury is on a hill. only on exceptionally clear conditionswould it be possible to see an event at Danbury from Brentwood or vice versa. However, an observer at both places would be jointly able to see a target midway between these locations. A time error in the Rochford report would result in the complete (double arrow) track sequence from Hemel Hempstead to Rochford.

FIGURE 3-1 PLOT OF UAP ASSESSED TRACK

(Date: 18 June 1988)



NOTES: An approximate 60nm per degree has been assumed for plotting purposes at this latitude. The most Northerly observation point is Scotch Corner, with Richmond to the SSW. It is not known whether the object described a zig-zag, curved or straight southerly path.

FIGURE 3-2 PLOT OF ASSESSED UAP TRACK

(Date: 20 December 1988)

SECRET
UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED

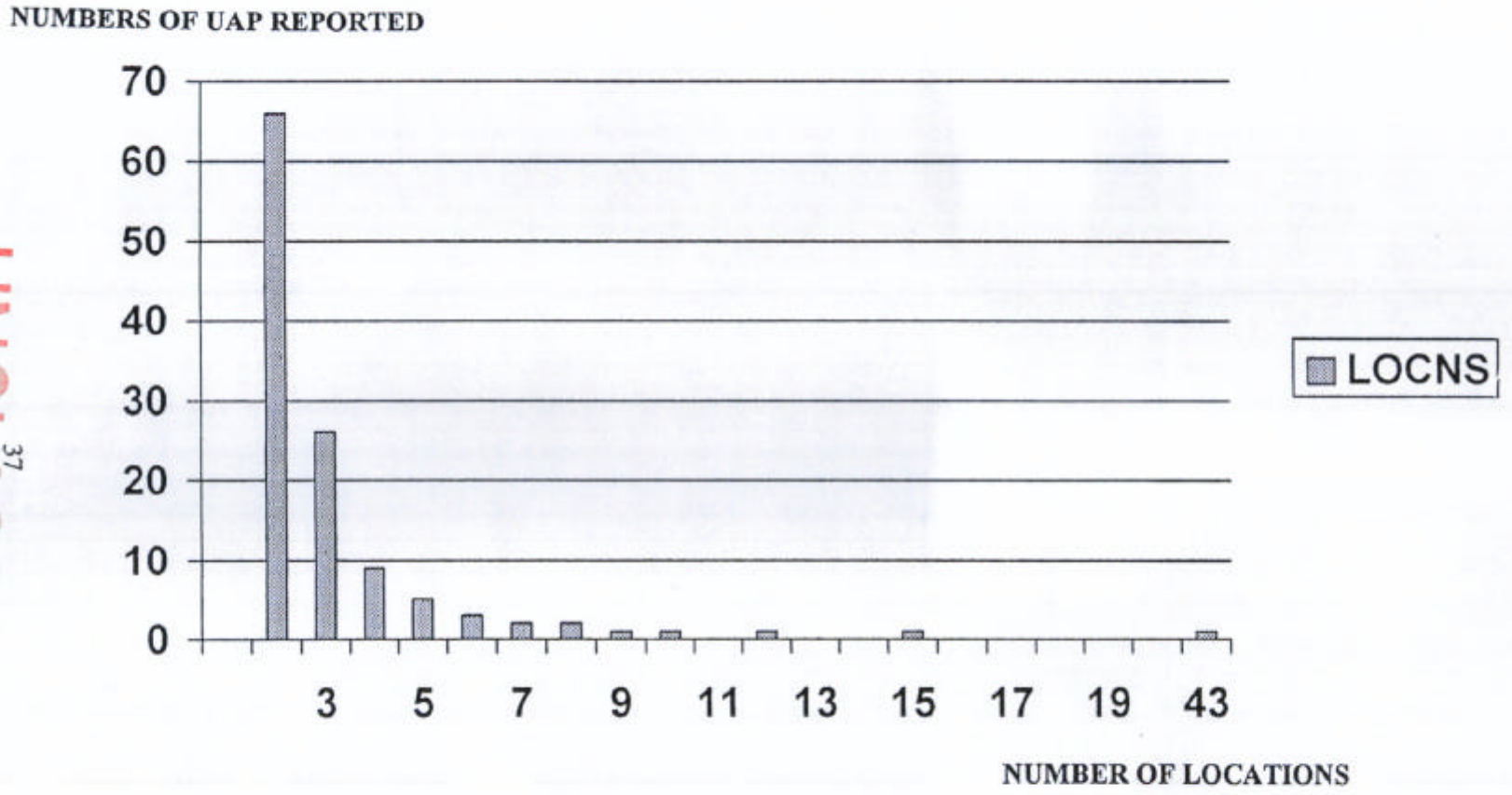


FIGURE 3-3 FREQUENCY OF REPEAT SIGHTINGS AT SAME LOCATION FOR PERIOD 1987-1991(U)

SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

RED 1987-91

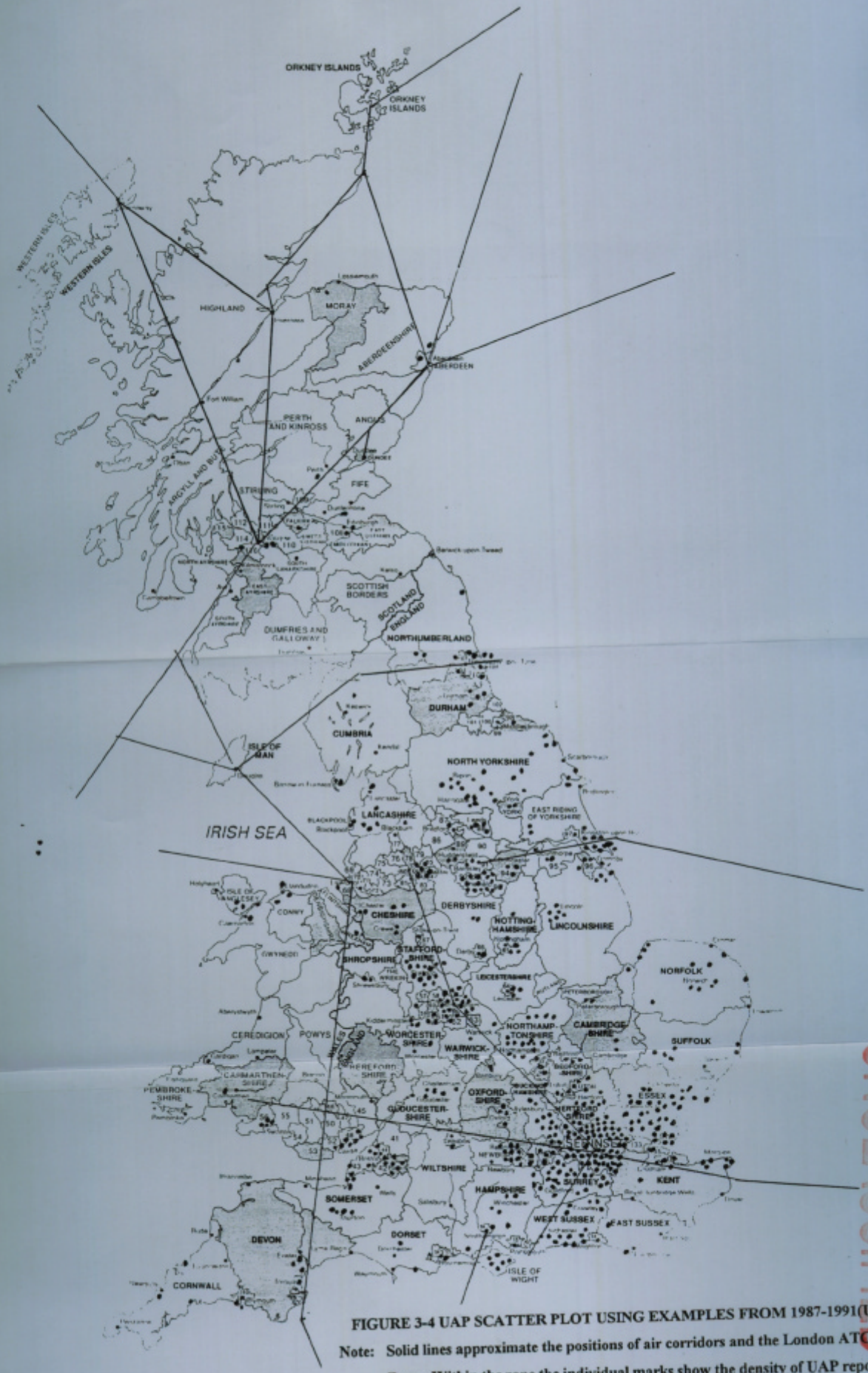


FIGURE 3-4 UAP SCATTER PLOT USING EXAMPLES FROM 1987-1991(U)

Note: Solid lines approximate the positions of air corridors and the London ATC. Zone. Within the zone the individual marks show the density of UAP reports They are, for reasons of clarity, not all in precise positions

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

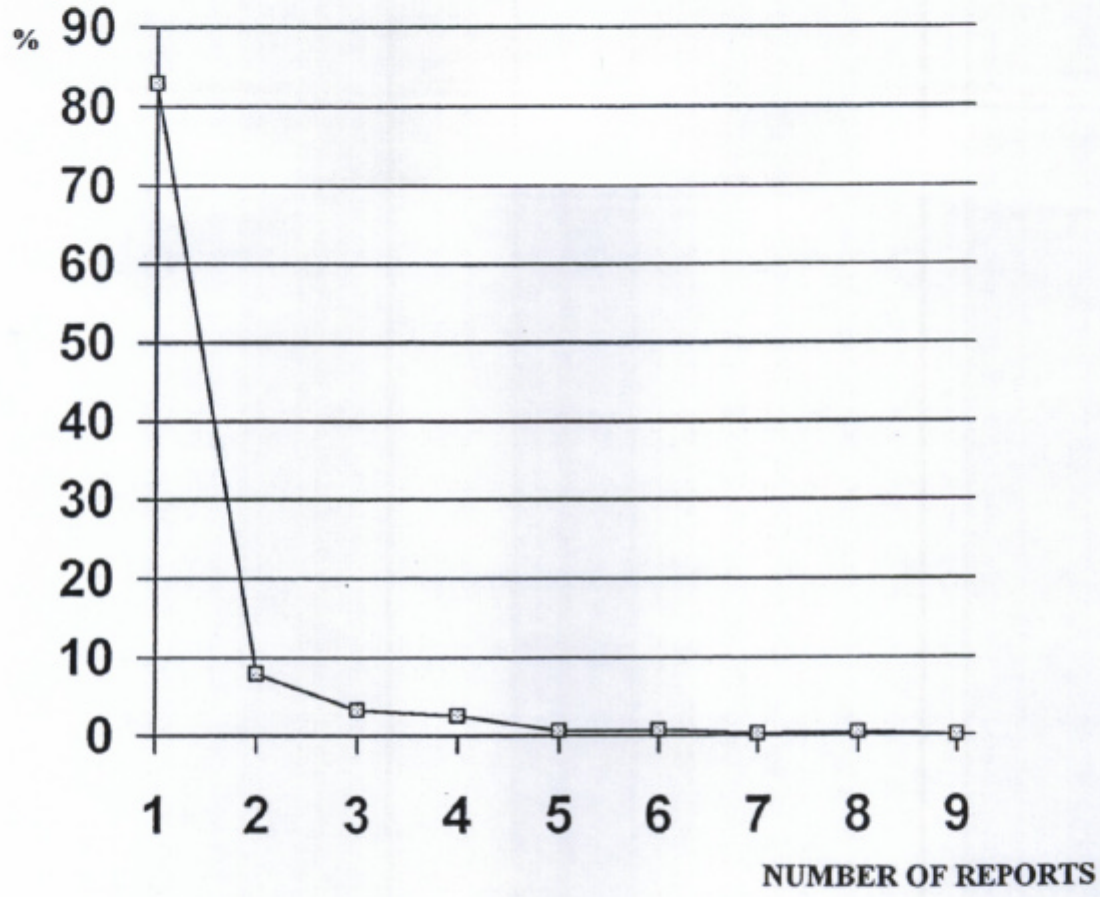


FIGURE 3-5 NUMBERS OF UAP SEEN IN EACH EVENT(U)

(Date: 1987-1991)

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

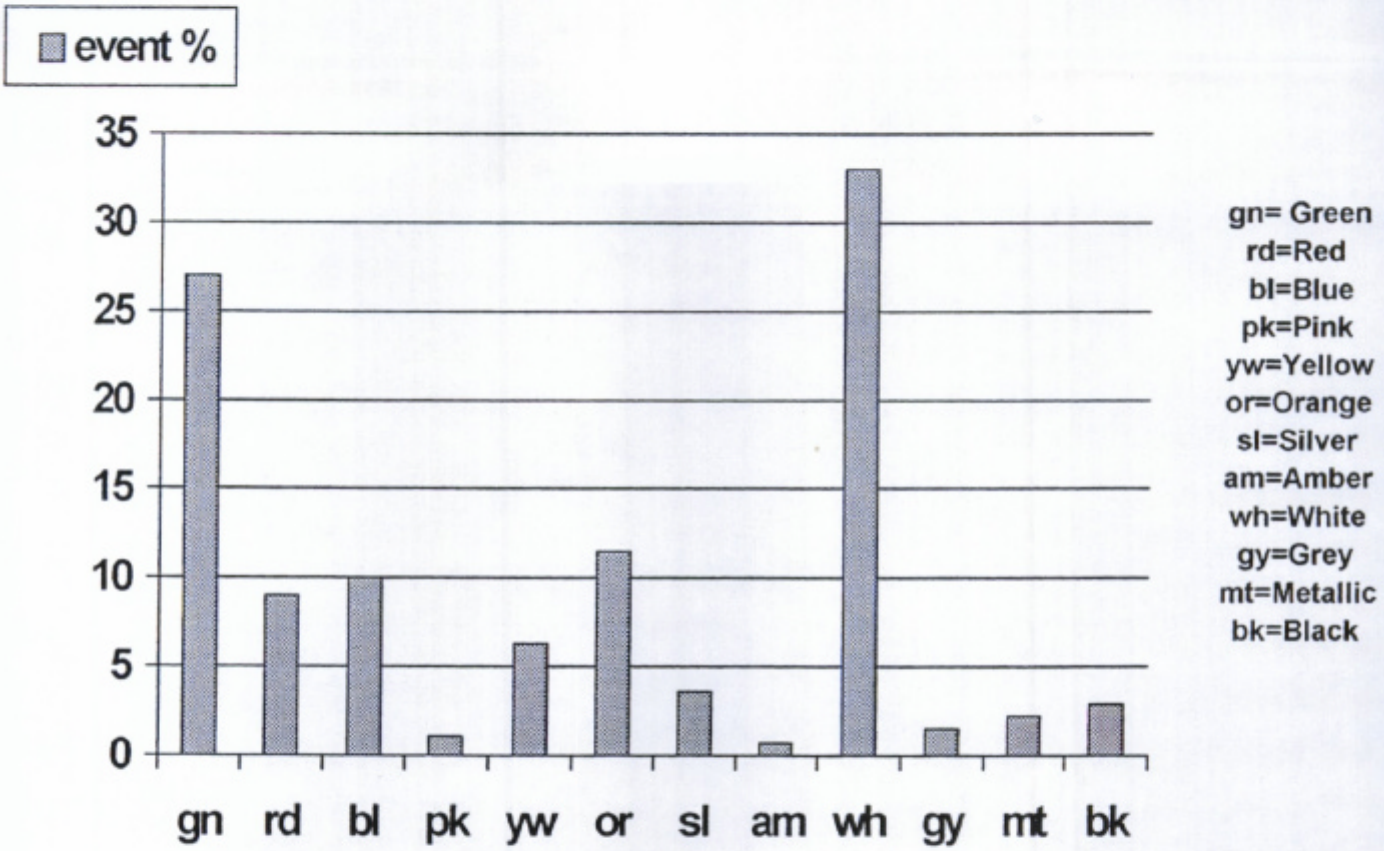


FIGURE 3-6 ANALYSIS OF UAP COLOURS(U)

(Dates: 1996/1997)

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED

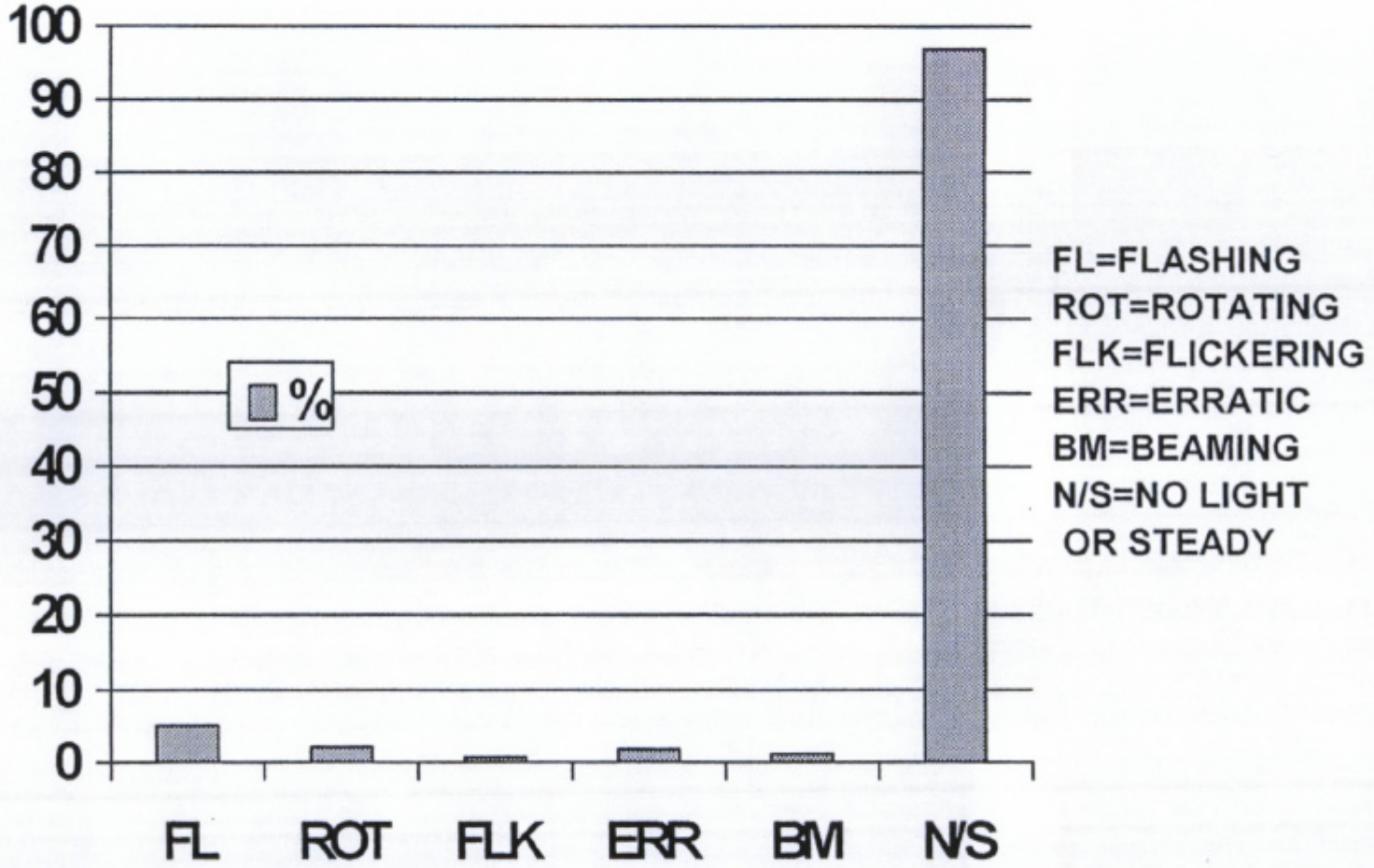


FIGURE 3-7 ANALYSIS OF UAP LIGHT ACTIVITY (U)

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED

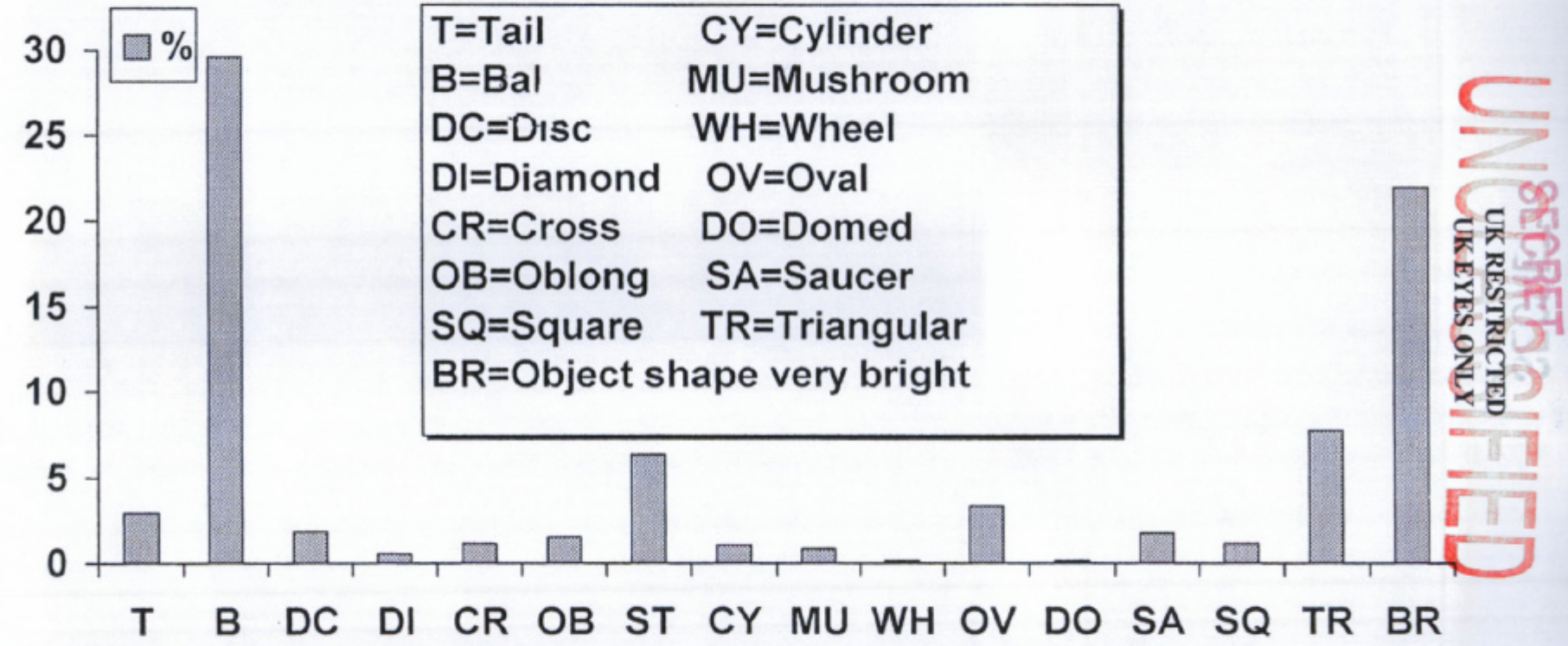
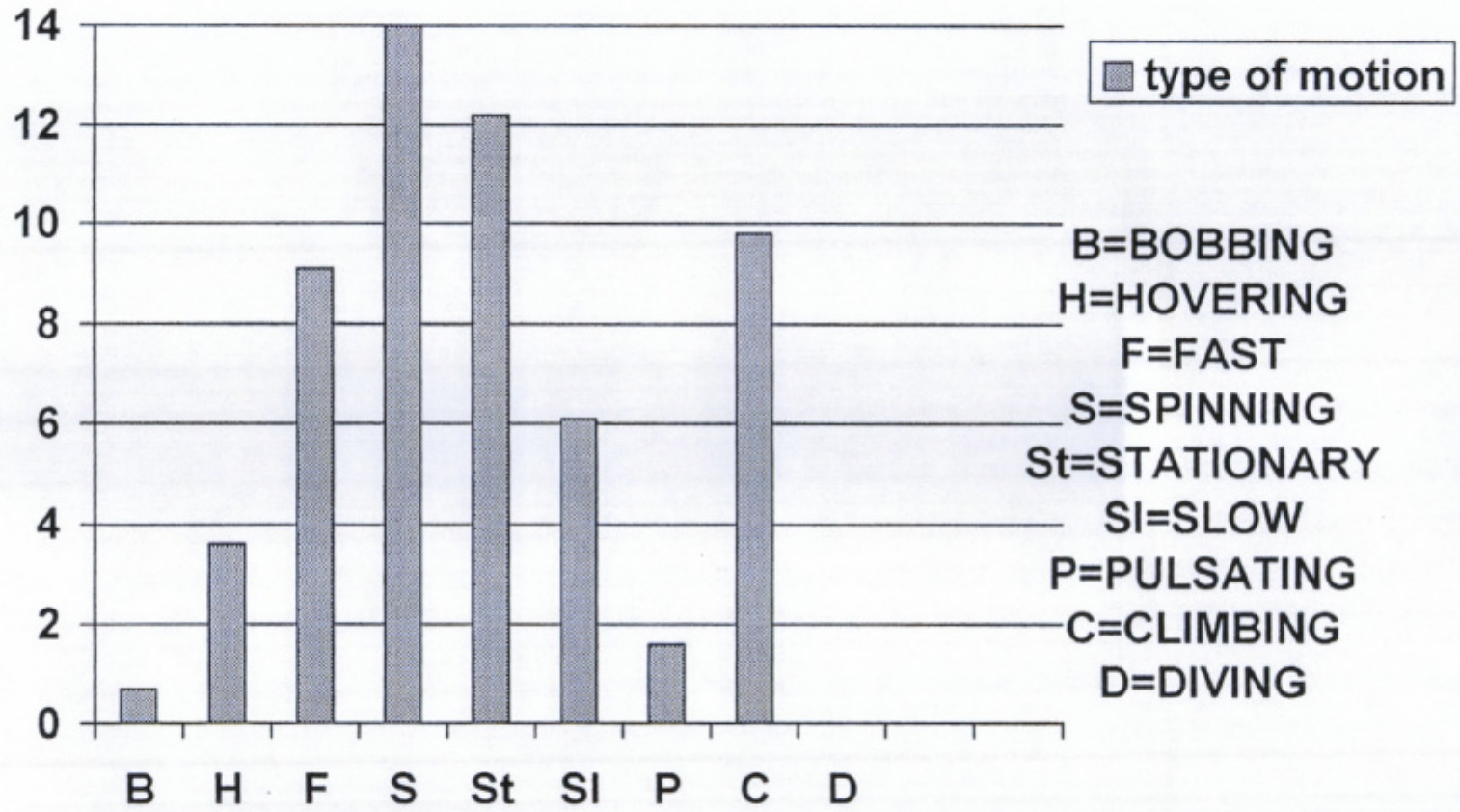


FIGURE 3-8 ANALYSIS OF UAP SHAPES(U)

(Dates: 1996/1997)

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED



UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

FIGURE 3-9 ANALYSIS OF UAP MOTION (U)

UNCLASSIFIED
SECRET

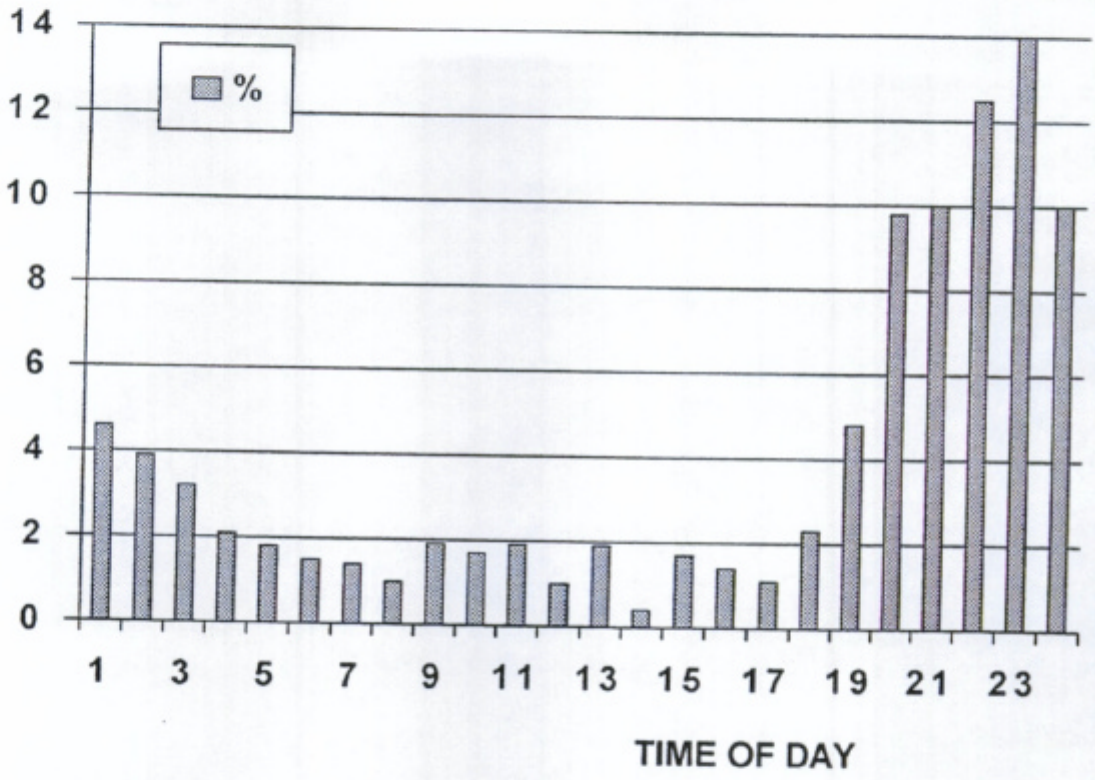
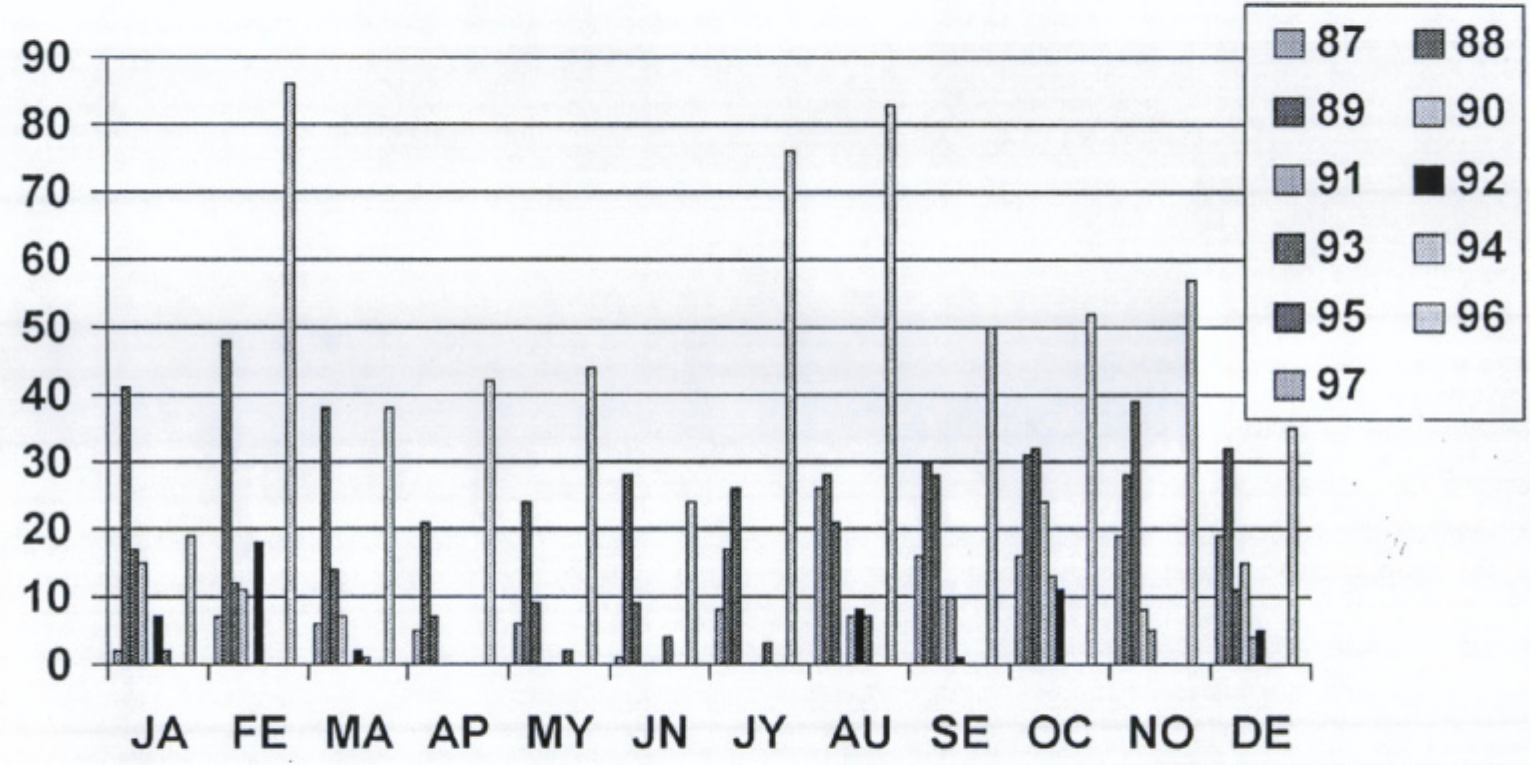


FIGURE 3-10 CORRELATION OF UAP ACTIVITY WITH TIME OF DAY(U)

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED



SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

FIGURE 3-11 CORRELATION WITH MONTH OF YEAR(U)

(Events in period 1987-1993 & 1996-1997)

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED

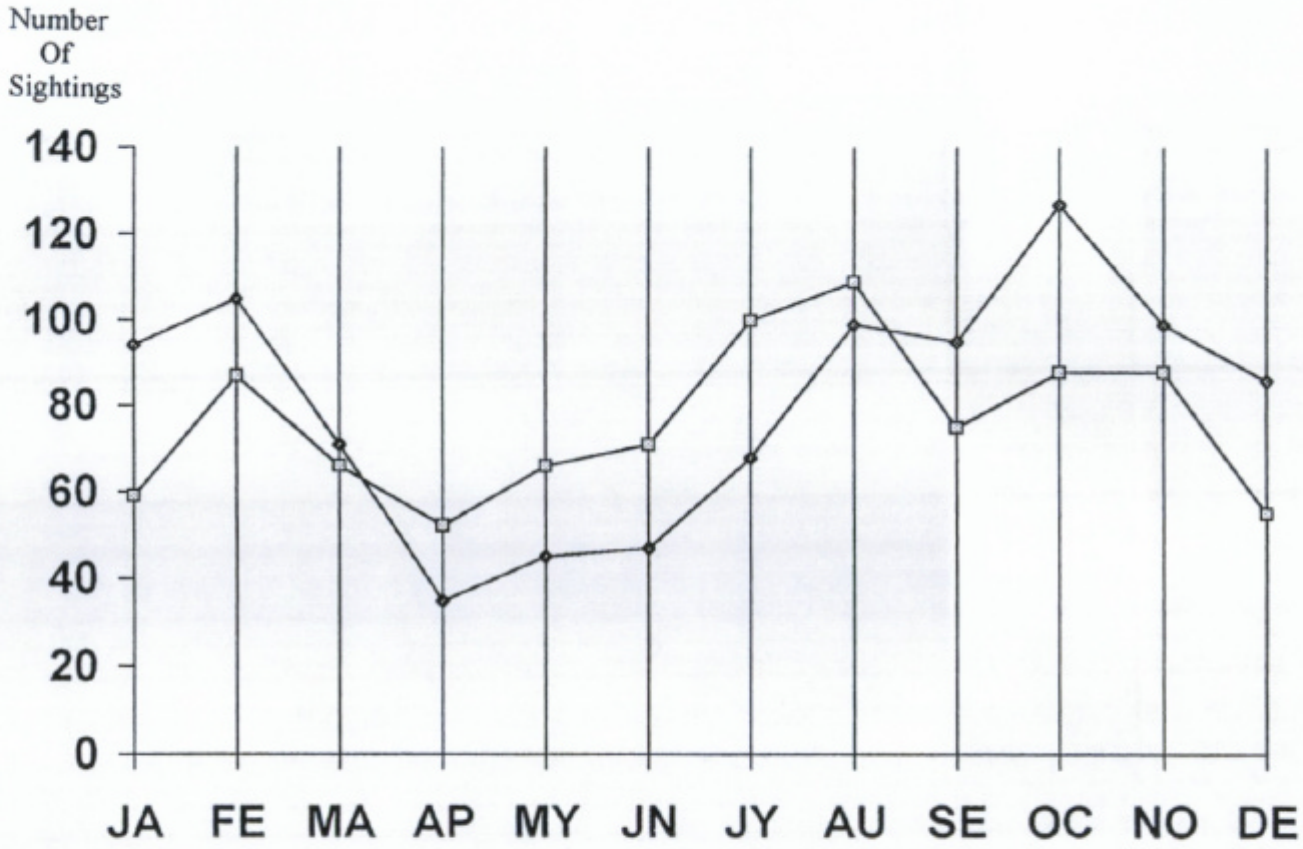


FIGURE 3-12 COMPARISON OF ANNUAL MONTHLY SIGHTING TRENDS(U)

(Events in Period 1987-93 with period 1996-97)

SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED

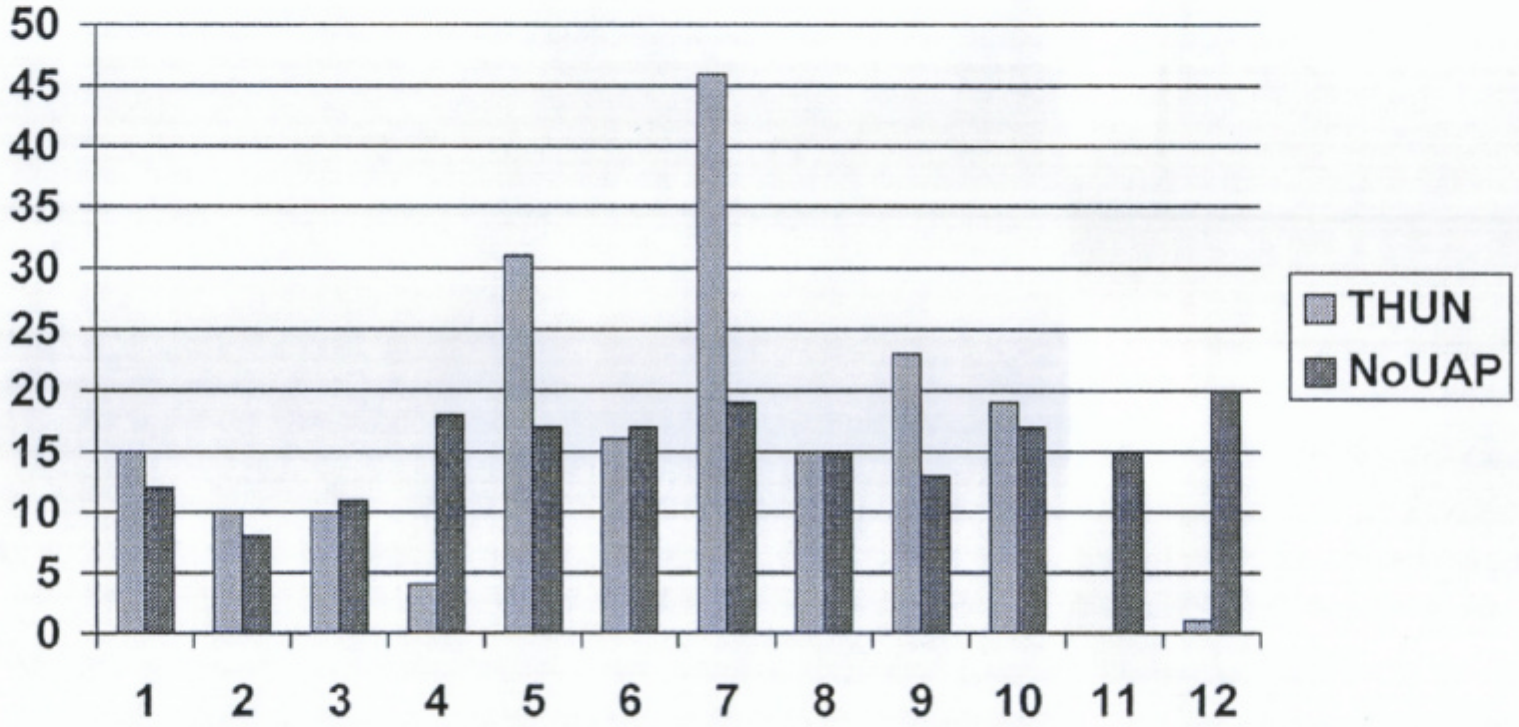


FIGURE 3-13 DAYS OF ELECTRICAL ACTIVITY COMPARED WITH DAYS WITH ZERO UAP REPORTS (U)

UNCLASSIFIED
SECRET
UK RESTRICTED
UK EYES ONLY

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED
SECRET

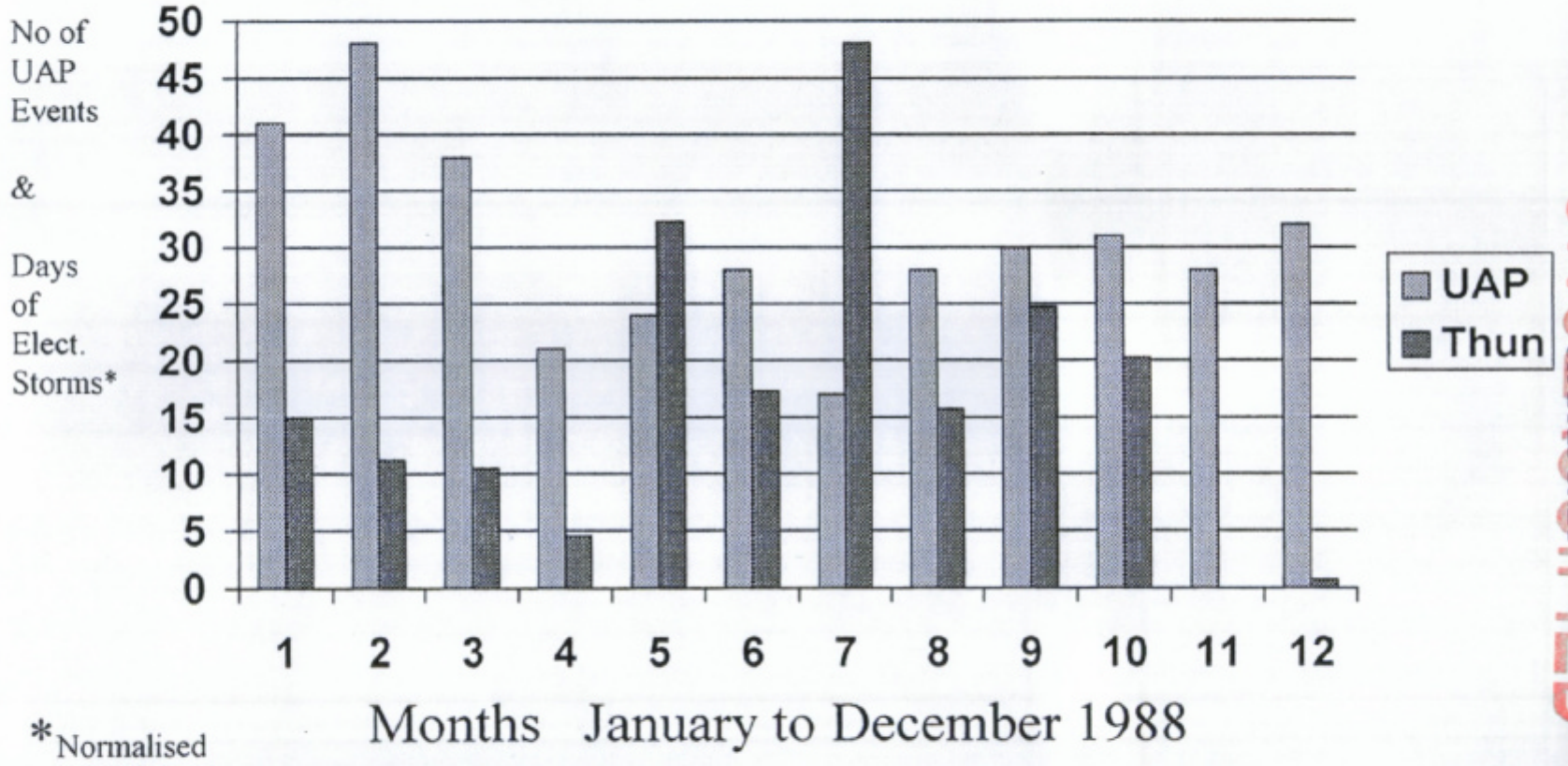


FIGURE 3-14 DAYS OF ELECTRICAL ACTIVITY COMPARED WITH DAYS WHEN UAP REPORTS OCURRED IN 1988(U)

UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY
SECRET

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED

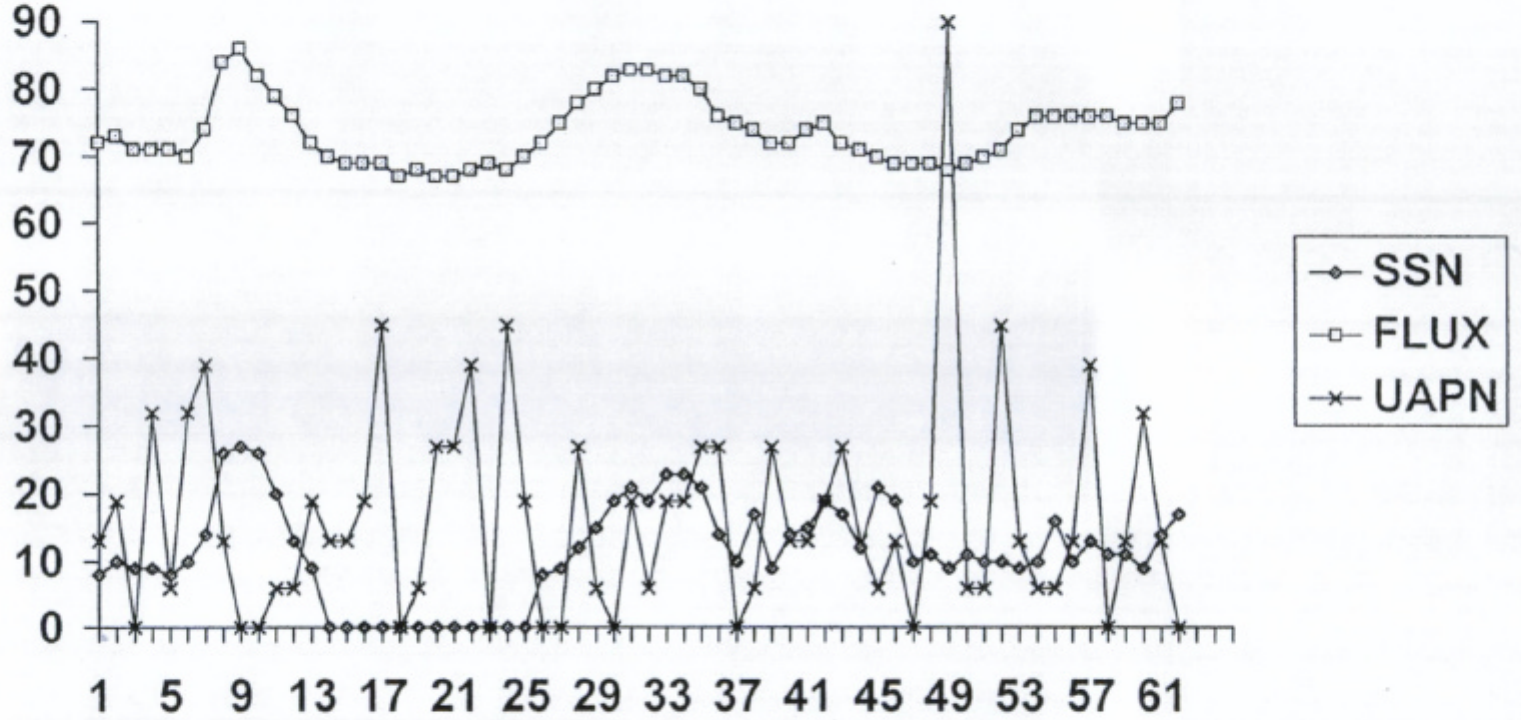


FIGURE 3-15(a) UAP EVENTS V SOLAR EFFECTS(U)

(SUNSPOT NUMBER & SOLAR FLUX JULY/AUGUST 1996)

SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

UNCLASSIFIED
UK EYES ONLY
UK RESTRICTED

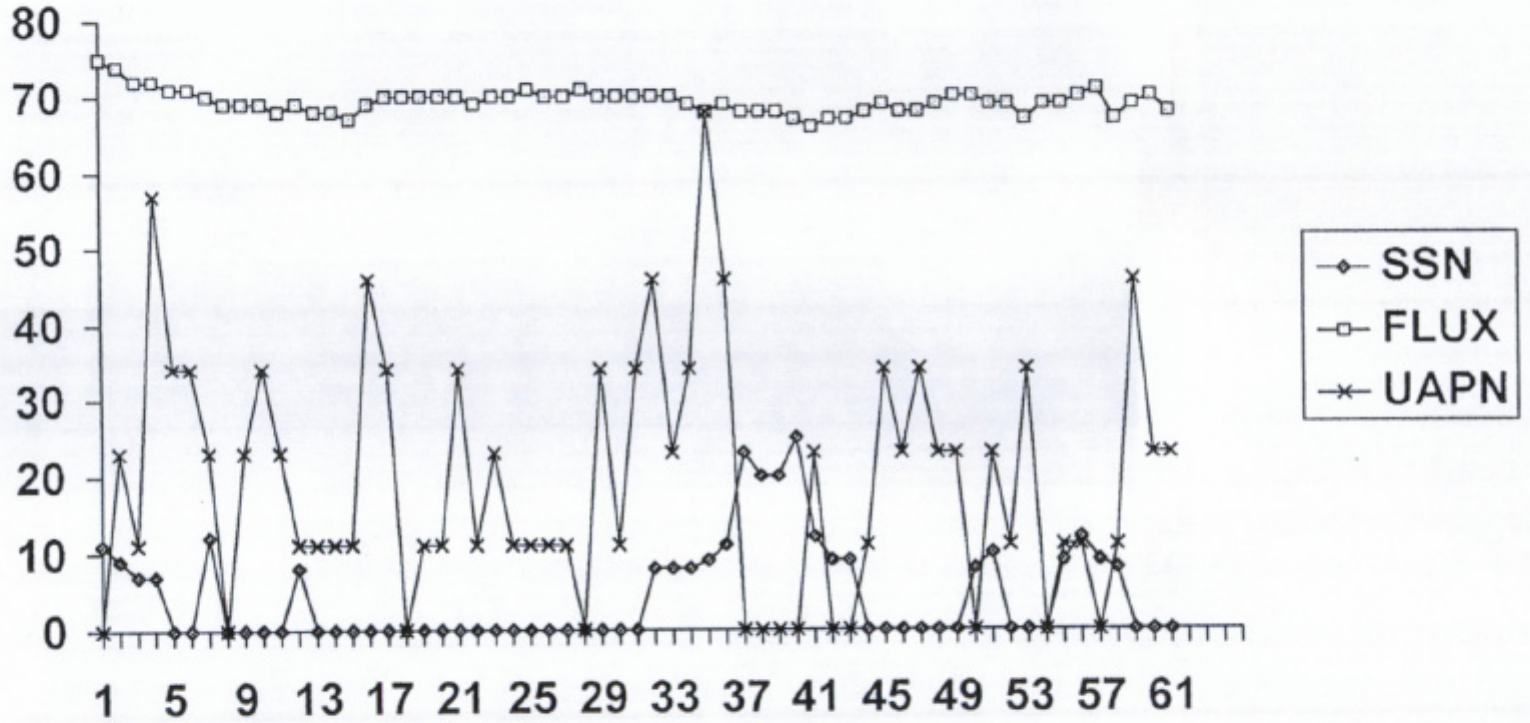


FIGURE 3-16(b) UAP EVENTS V SOLAR EFFECTS

(SUN SPOT NUMBER & SOLAR FLUX MAY/JUNE 1996(U)

TOP SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

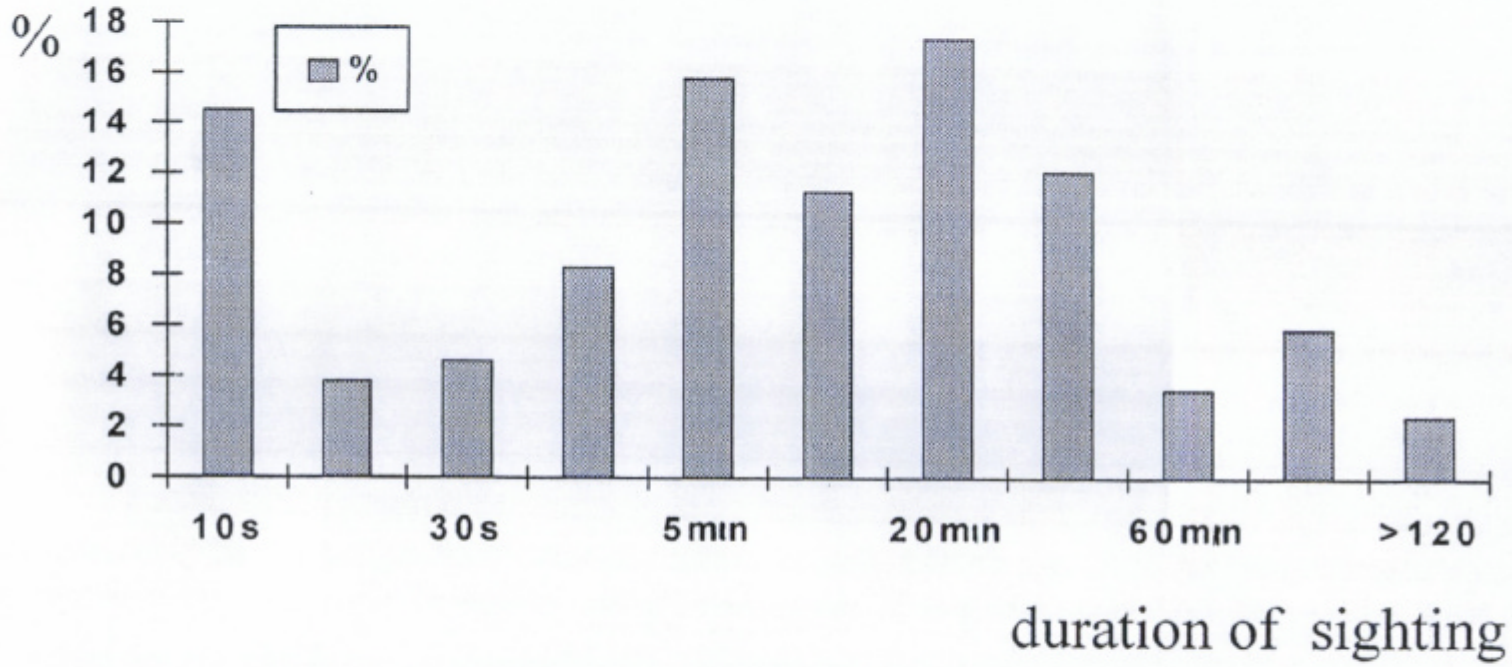


FIGURE 3-16 UAP EVENT DURATION 1996-1997

UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED
51
SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

Meteoroid: Physical body (rock) in space before it enters the Earth's atmosphere and creates the flash of light, known as a meteor.

Meteor: From the Greek, 'phenomenon in the sky' when a meteoroid enters the atmosphere at high speed and burns up.

Micrometeoroid: A small meteoroid, such as expected from the debris of a comet. Diameter 0.01-0.05millimeters.

Meteorite: Any piece of meteor which survives and hits the surface.

Asteroid: Pieces of rock or iron, which mostly orbit the sun between the orbits of Mars and Jupiter. The orbits are occasionally perturbed and cross the Earth's orbit, where they are the primary source for sporadic meteors and certainly the major source of meteorites.

Meteor Shower: All meteor showers have been associated with the encounter of the Earth with the debris cloud of a parent comet.

Meteor Storm: These occur about every decade. The most intense of which occurred last on November 17, 1966. The 'Leonids' shower appears always in November, with varying intensity and is only so-named because it appears to come from the direction of the constellation Leo. [The effect of the November Leonids can be clearly seen on the 1996 UAP-meteor correlation plot] The next intense meteor storm, following the recent passage of the comet responsible, is due in November 1998. The majority of the particles in the comet's trail are small and will not enter Earth's atmosphere, but even these, with the dramatic increase in hourly arrival rate can damage satellites.

FIGURE 3-17 Definitions for Meteoroid Events(U)

SECRET
UNCLASSIFIED
UK RESTRICTED
UK EYES ONLY

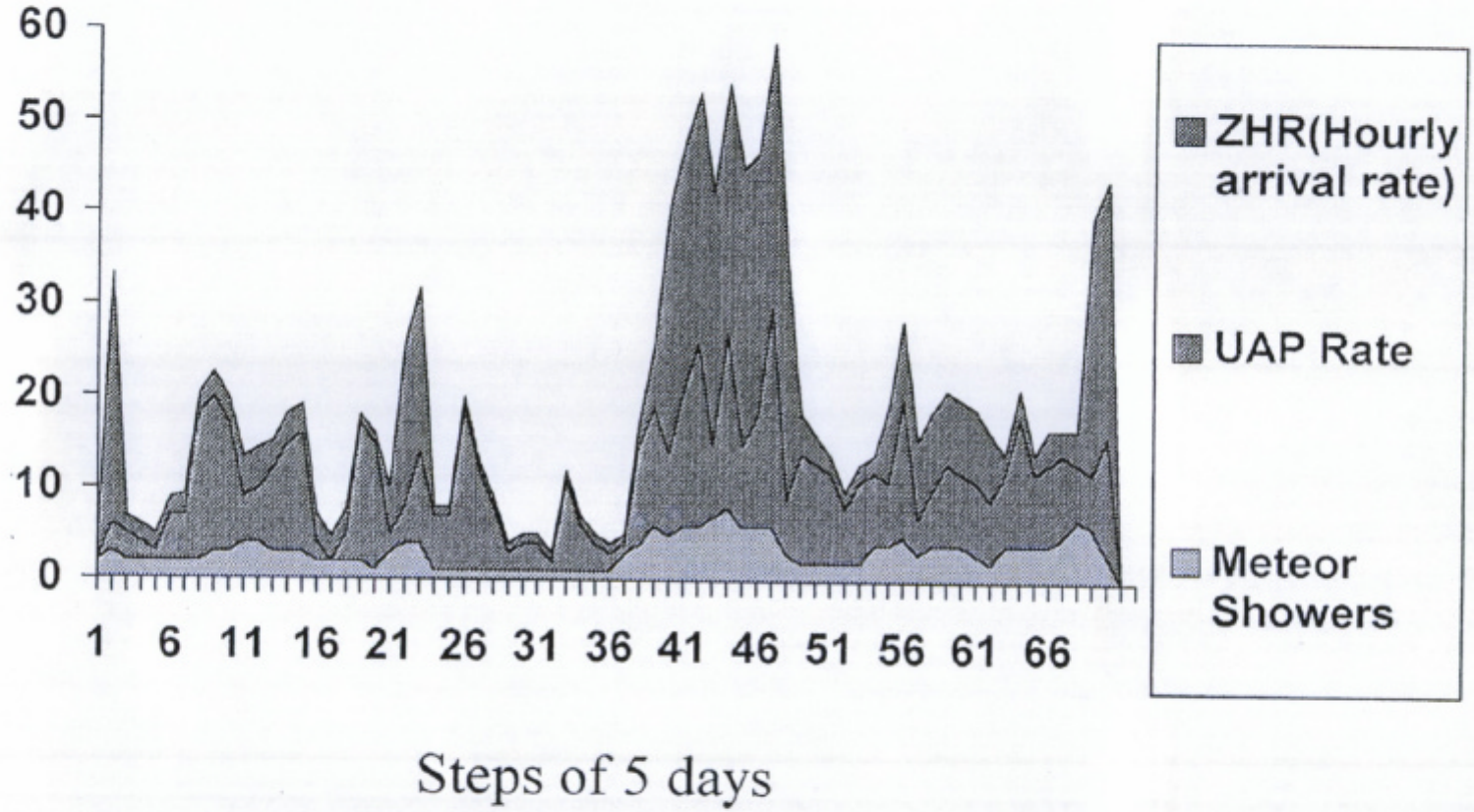


FIGURE 3-18 CORRELATION OF NUMBER OF METEOR SHOWER TYPES & METEOR ENTRY RATE (ZHR) WITH UAP REPORTS 1996(U)

UK EYES ONLY
UK RESTRICTED
SECRET
UNCLASSIFIED

CHAPTER 4

POTENTIAL RELATED MILITARY TECHNOLOGY

1. As a necessary adjunct to UAP database construction a large number of scientific papers were researched for any relevant information on atmospheric natural phenomena because of the distinct possibility of this being misinterpreted or misrepresented as UAPs. It was envisaged that, as the phenomenon can cause radar alarms and visual distraction that a deeper knowledge of the effect might reveal a possible military application that a hostile power, given the ability to reproduce the same effects might exploit, possibly as some sort of decoy or countermeasure. At the same time the possibility of man-made objects causing UAP events necessitated a brief survey (at Working Papers Nos 9, 14, 15 and 17) of the clearly possible mis-reporting of aircraft (black programmes or otherwise), satellites, balloons etc. The possibility of air-objects within earth's atmosphere with characteristics beyond or at the limits of the current technological capability of any of earth's aerospace industry having already been considered briefly at Chapter 2 and at Working Paper 6. A brief examination of whether the phenomenon could be replicated and whether or not any other nation was attempting to exploit the same or derivatives of the phenomena is reported at Volume 3.

DEDUCTIONS FROM WIDER RESEARCH

2. **Physical Observations & Human Factors.** Evidence, (measurements taken during Canadian medical investigation of False Memory Syndrome using modulated magnetic fields), has shown that creativity and the capacity to generate vivid images are correlated both with suggestibility and indices of elevated temporal lobe sensitivity. This human response has been briefly examined in the context of unusual human reactions when exposed at close ranges to UAP. It has been further discovered that if incidental/peripheral information is pre-absorbed, however sub-consciously, then this is heightened by unexpected additional influences. It is of importance therefore to note (and detailed at Working Paper No.25), that 20th Century apprehensions are to the fore. Hence, contemporary illusions of satanic cults, aliens, spacecraft, beam weapons, extra terrestrial 'examinations' and 'abductions' and the like; have replaced the old anxieties of fairy tales, spiritual abductions, ghosts, 'old hags', invasion by the Spanish or (in the USA in particular) by the Communists! It seems likely that the locations of tribal ceremonial sites (e.g. Stone Circles) were knowingly placed to enable humans to interact with 'earthlights' (See Working Paper No.10), so as to enhance mystical experiences. Later when satanic and other forms of rite were practised, Churches supplanted the old structures on these sites. Hence, many are currently located on 'Ley Lines', earth fault lines, (Working Paper No.10), which still produce earthlights, most probably due to seismic activity from time to time. Earthlights are illuminations produced at the point of earth movements.

3. The attraction of Earthlight sites in the first place was the medieval propensity to use them as indicators of buried minerals, such as iron, gold, zirconium and copper. However, there are no measurements of fields available to investigate possible correlation and to discover whether these are the same type of field(s) which cause the human experiences listed at Working Paper No 25. Earthlight energy is not currently fully understood. Further, it is not understood why some are seen on radar and others not unless they are comprised of some type of variable (electron) density plasma.

4. Timing is important in the responses of the human brain to these events. In particular, at night time (e.g. 0400hrs) certain individuals' cyclo-rythmic profiles are heightened, for example, their right hand side brain intrusions. These enhancements are also associated with transients above normal activity in both left and right brain hemispheres. The enhancement of the left being especially associated with

SECRET
UNCLASSIFIED

intense linguistic processing, connected with creativity and inspiration, where enhanced profound understanding of self and surroundings prevails.

TERRESTRIAL & AIRBORNE BUOYANT CHARGED BODIES

5. If it is assumed that at least some UAPs are buoyant electrically charged bodies, comprising aerosol particles, gas clouds, and plasmas, then intuitively one would expect that any changes in the electrical environment would modify the movement of the charged body. The internal charge equilibrium and hence vertical and horizontal position of the body is dependent upon the ambient earth/atmospheric electrical charge, in which the body is immersed. Sources of local electrical and magnetic field energy for the charged body appear to be:

- Electrical charges, caused by particle friction due to wind, weather, and turbulence.

- The addition of extra chargeable particles, due to dust clouds, emissions from industry, power stations, jet aircraft exhausts and volcanic or earthquake activity.

- Charged atmospheric conditions, caused by electrical storms.

- EM energy from very high power radio/radar transmitters.

- Electrical fields surrounding open power distribution lines, rail electrification lines, transformers, sub-stations, etc.

- Charges on moving bodies due to their motion in the earth's magnetic and electrical fields.

6. The spread of energy levels is considerable. Some of the fields, though relatively weak, are known, for example, to attract ball lightning - which can dart towards what is presumably sensed as an attractive opposite charge. It is believed that the combination of buoyancy, due to the prevailing temperature and pressure conditions and the earth's local electrical and magnetic field conditions at the time are primarily responsible for the presence, positioning, velocity, direction of motion and altitude of the plasma-type UAP. The presence of an aircraft (with it's own accompanying electrical and magnetic fields), together with it's electromagnetic field emanating from radios, radars, altimeters, etc., must also be a potential source of attraction, repulsion or modification of other fields (or of the total vector-summed fields) present in the location. This must have the potential to influence any charges bodies which happen to be present nearby in an equilibrium-charged condition, and hence susceptible to external fields.

7. The key question is whether the balance of charges, which might be expected to keep a UAP (of the charged mass type) otherwise continuing at the same speed and height will be diverted by another charged body (either airborne or on the ground) and at what range this attractive or repulsive force might act. It must, however, be remembered that electrical forces are not the only ones present. If there is a body temperature differential, heated gas buoyancy forces will also be acting on the body and, if there is forward motion, aerodynamic forces. One can therefore postulate a charged mass which reaches some equilibrium, where both buoyancy and earth's local (surface and atmospheric) electrical charges control

UNCLASSIFIED
SECRET

altitude, while a combination of wind and horizontal electrical charges control motion in the horizontal plane.

8. If more than one such body is present at the same time (as is often reported), then presumably additional interactive forces come into play which may or may not keep them in close proximity to each other. Similarly it is suggested that charged bodies which come within close distances of aircraft may either do so coincidentally or as a result of the changing electrical potential in the atmosphere as an aircraft passes through. Researches in this area show that the US Scientific Advisory Panel (1953) was probably close to the truth when it commented that the 'Foo Fighters' (acknowledged to be 'balls of fire' when they came close to aircraft, both in Europe and the Far East during WW2) were believed to be 'electromagnetic phenomena - unexplained but apparently not dangerous'.

9. **'Foo Fighters'** It is logical to question both why few aircrew reports of 'foo fighters' are currently received - and of the currently reported phenomena to question whether these are the same or not. There are a number of reasons which may be postulated for reduced numbers of 'foo fighter' reports, compared to the World War 2 period:

- During WW2 very large numbers of relatively slow military aircraft were flying for long sorties at an altitude of up to ~20,000ft. The majority of aircraft today, (except light aircraft, helicopters and FGA types on low flying) rapidly climb to economic flight levels. Hence, there are now fewer aircraft flying in the region where UAPs are most likely to be seen.

- It is believed that the majority of plasma formations will be short-lived, reducing observation opportunities, unless the aircrew happen to be in the right place at the right time.

- During WW 2, all large military aircraft, used many more 'Mk1 Eyeballs', than currently is the case, to view as much of the sky as possible. This was essential to avoid collision, for navigation and to spot attacking aircraft. Look-out was kept from the tail, the astrodome and by the Waist Gunners - all with opportunities for spotting any rearward following objects.

10. If it is postulated that the 'foo fighters' are the same as UAP, with mainly neutral buoyancy, they probably move towards a set of attractive electrical forces at constant altitude. It can be further suggested that a formation of large aircraft (as in World War 2) would have presented an even greater electrical attraction force, for any oppositely-charged mass. If the foregoing postulations are correct, then the inevitable conclusion is that today one should expect to find that:

- The highest proportion of airborne encounters will be between the ground and ~15,000ft.

- UAP reports could be expected to be concentrated where mainly ascending and descending aircraft are present (e.g near busy airfields, air-traffic zones, holding patterns and air corridors).

11. It is important to note that while it is **not suggested that aircraft are the cause of UAPs, the presence of aircraft may encourage the presence of a UAP, once formed**, as it seems that the aircraft position and velocity can influence UAP activity. It is noted that there is an electrical current flow in an airframe due to the Earth's magnetic field. This is dependent upon the aircraft size and its velocity.

SECRET
UNCLASSIFIED

Further, with its much less streamlined shape and rougher surfaces, there were many opportunities for friction-induced electrostatic energy to build up on older aircraft. It is suggested that if the 'foo fighters' were due to charged buoyant bodies, then they may have had more of an attraction to the WW2 aircraft than present aircraft. It is also possible that the charged combustion particles from these older aircraft, using petroleum rather than kerosene, caused some further differences in charge and, finally, that there may have been a significant influence of overall charge in the atmosphere when huge formations of aircraft were flown.

12. It should be noted that the foregoing, in the mind of the reader, be it ball lightning, charged aerosol, gas plasmas etc., will undoubtedly be imagined as a wholly visible event which can also be seen by observers from the ground or from an aircraft, despite the fact that this is most probably happening invisibly for much of the time. It only becomes a UAP when it can be seen! We have always assumed that there is no collision threat to aircraft if nothing which appears solid can be seen in the way ahead!

13. A plasma is the fourth state of matter, comprising charged particles, electrons and ions. Plasmas in a magnetic field form a particular anisotropic media in which various electromagnetic and electrostatic waves can propagate. The electron plasma frequency can be determined from the electron plasma density. An ion plasma density also exists, which, because of the ion mass, is at a much higher frequency than the electron plasma frequency. It is often forgotten that the magnetosphere of the earth comprises low density plasmas and weak magnetic fields. While interest in radiation phenomena in plasmas has become a topic of interest in space communications (e.g. to and from spacecraft), in the UAP context the interest is in ionised plasmas which become visible. It can be shown, in anistropic plasma wavefronts, that cylindrical and cone-types can be produced from point oscillating sources, in addition to standard spherical and spheroidal wavefronts. This may be relevant to some reported UAP events.

14. **Proximity to Strategic Assets** It has been suggested (even claimed in some quarters) that 'UFOs' are 'spying'on strategic installations, such as power stations, airfields and nuclear facilities. There is no evidence whatsoever from the statistical analysis made to substantiate this claim. Several points are considered significant in this respect. For example, events of the 'close encounter' category (which can cause human effects) occur less often in city or in urban areas. It is believed this is due to the large number of electrical discharge paths which cause the UAP to dissipate quickly when near to dense population areas. Further, as they are not as visible because of the ambient light, they are less likely to be approached. In rural terrain (especially in mountains and hillls) and open country in general there are fewer discharge paths via buildings. This is likely to cause charged bodies to be attracted to the few attractive areas where electrical activity, gases and particles in suspension and dusts (e.g from plant, power generation stations, power sub-stations and pylons) are located. They are similarly attracted towards isolated structures, and moving isolated vehicles, overhead rail electric lines and telephone lines.

15. **Nuclear Radiation** It has been claimed in some circles that residual traces of nuclear radiation, above normal background levels have been measured, where a 'UFO' has reportedly 'landed'. There is no UK evidence to support this. However, it has been reported by UK (Culham) researchers, that there **may** have been slight radiation rises at the earth's surface (above natural levels) following **lightning.** Two conclusions can be drawn:

UNCLASSIFIED
SECRET

- The fact that there is no UK 'post-landing' evidence is because no timely measurements have ever been made.

- Follow-up measurements (no measurements are known to MOD), for example, taken by other organisations, may well be due to a lightning/plasma cause, not fully understood.

16. **Sound & Smell.** Comments are made in Volume 2 on the probable reasons for lack of sounds on well over 95% of the reported UAP events. It is further noted that when sounds are reported (excluding those from unfamiliar but misreported aircraft) they are personal perceptions and would probably have been reported quite differently **had they not been accompanied by a visual stimulus - and sometimes by a temporal lobe stimulus.** Thus, plasma/ball lightning phenomena (even spherical) can quickly turn into a 'saucer with a dome above and beneath' Such an entity is 'expected' to hum or whine (and increasingly so on 'take off'). It is pointed out that electrical phenomena in air (Working Paper No 1) in the form of arcs, discharges and fields, often hum and crackle and that the electrical activity (in the presence of nitrogen), causes obnoxious odours. It is well-known that electrostatic fields cause hair to bristle (in addition to any fear factor in the scenario the observer believes he or she is seeing.

UAP PLASMAS

17. The most important facts, discovered as a result of the supporting research at Volume 2, are that several types of charged mass can exist in the atmosphere and ionosphere. These are:

- EARTHLIGHTS

- CHARGED AEROSOLS

- BALL (& BEAD OR GLOBE) LIGHTNING

- IONOSPHERIC PLASMAS

- FIREBALLS (Possibly a variation of ball or 'globe' lightning)

- All are sufficiently rare in their visible forms to be categorised as 'UFOs' by the average witness. **It is postulated that plasmas are the result of incompletely burnt-up meteors, which do not reach the earth as meteorites and which are probably responsible for the hitherto unidentified phenomena which cannot be attributed to other known causes.**

- BALL LIGHTNING & EARTHLIGHTS appear to radiate both visual wavelengths and (probably) electromagnetic waves, or/and fields of an unknown nature.

- It is postulated that the plasma formations formed from some meteors also emit, not only visual and IR wavelengths, but some form of probable modulated magnetic field or fields.

- Calculations (from generic UAP body sizes as a radiating aperture) appear to confirm that these radiations have been experienced/encountered by many witnesses. They have always been within

what is known, in the theory of electromagnetic waves, as the 'Near Field'. Some, but not all have suffered adverse medical effects, while others have apparently experienced temporary biological changes described as 'lost time', 'abduction' and even 'medical examination', invariably accompanied by descriptions of 'alien' entities. Despite the vivid recollections no non-human physical evidence ever remains after the event. For example, no magnetic after effects are traceable on vehicles, despite their engines reportedly stopping or their radios becoming inoperable. This inevitably points to the temporary presence of a non-permanent magnetising influence (i.e. **not** a direct current magnetising force); in other words a fluctuating/alternating field.

- Plasma-type events sometimes cause lights in the sky. Further, it is possible to influence charged masses by the application of external energy. [Ufologists call this effect a Close Encounter of the 5th kind (see paragraph 17)]. An irradiation of a 'UFO', using external energy (e.g. a laser beam), can apparently cause some 'lights' to change form. There is also a scenario where radar energy can cause a non-visible, but highly charged gas plasma to cross a charge threshold and become 'triggered' and thus become visible. (Working Paper No 24). It is easy to see how the uninitiated interpret this as a 'response' from the 'craft' or it's supposed 'occupants'.

- Only on the rare occasions when lights are seen at very close range (probably within 10-20m outdoors or within the same room indoors) do reports change from purely visual events to reports of exceptional experiences and descriptions. It is therefore deduced that if an observer is exposed (in the open) to a 'close encounter' (much closer than the Ufologist's CE1), then they are likely to come within the influence of a field (or fields). It seems likely that in particular, if, as described (at Working Papers No.1 & 25) a 'hot spot' from the charged mass irradiates the witness (often described as a beam of light), then extra-ordinary descriptions follow. There seems to be strong evidence (from the Canadian medical measurements) that at least one component of the field is magnetic in nature and modulated, causing excitation of the brain's temporal lobes. It also seems significant that when similar objects are approached when in a road vehicle or aircraft, the more extreme experiences are not reported.

- 'Hotspots' within the plasma bodies can occur. These reportedly have different colours than the rest of the mass and presumably have different internal temperatures. If they suddenly appear, they are often reported as hatches opening, or lights at portholes or beams.

18. **Proof of Medical Effects** The medical evidence is persuasive (Working Paper No 25) but it does not prove conclusively that magnetic fields **exactly** of the same type used in the Canadian experiments [1] emanate from UAPs and are always the cause of some of the more bizarre reports (e.g. alien abductions, creatures, etc.); since there are no known actual field measurements taken in the presence of any UAP, certainly in the UK and probably there are none taken elsewhere in the world. Neither does it conclusively prove that all UAPs emit **only** magnetic fields - there may be others, including even fields of which there is little current knowledge. Nevertheless, one important finding is that people are not equally susceptible to the magnetic syndrome induced in the experiments. This probably explains why reports are occasionally received of close encounters but without the more bizarre effects.

AIRCRAFT ACCIDENTS

19. Based on the postulation that the sudden appearance of a UAP immediately ahead of an aircraft might cause an accident, the investigation (reported in detail at Volume 3) concentrated on filtering a

large number of military aircraft accidents, which occurred over a thirty year period, where there were no survivors and where the cause was not absolutely determined. Expert air accident advice and access to records was provided by IFS, RAF Bentley Priory.

20. In the majority of cases accident records could show that technical reasons - albeit unknown or impossible to confirm - were the cause. However, a small number of unexplained accidents remained, almost always while flying at high speed and low altitude. These were re-examined in some detail and the UAP database was interrogated in a search for the tenuous connection of reported UAP sightings in the immediate accident vicinity; or of unusually high numbers of UAP reports in UKADGE on the same day and in the same time bracket.

21. For about half the accidents identified (pre 1976) the UAP records no longer exist in DI55 - correlation studies could not be made. For the remaining (very few) accidents, no firm UAP event correlations could be established, although the correct atmospheric and electrical conditions must have existed for the formation of UAP on those particular days, as UAP reports were received. **While this neither confirms or denies the cause of the accidents, the sudden and startling presence of a UAP cannot be totally ruled out**. The probability of this occurring seems to be very low - certainly much lower than the probability of a bird strike. However, it should be noted that while even a large bird would not necessarily be seen by the crew (and hence no evasive action taken), the reported visual size of many UAPs is much larger than an aircraft and would almost certainly cause a major control input because of the surprise factor if a UAP ahead was not spotted until it was very close.

22. There are several other factors to consider:

- Why, if there is a finite probability of a low altitude 'head-on encounter', have there not been at least some instances where a UAP has appeared and the aircraft and it's crew survived? Where are these air-miss/near-miss/close proximity reports?

- As there is no reason, in theory, for the scenario to apply only to low-flying aircraft, it could be argued that aircraft flying at higher altitudes might have, by now, encountered and evaded what seemed to be an imminent collision? The only records are airprox reports, where it was too late to manoeuvre but no damage was caused.

- On the assumption that at least some of the UAP phenomenon is caused by plasmas developed from diving meteors, at worst, statistically, could not an aircraft flying at high altitude have suffered damage or even destruction and gone unrecognised as such?

23. Although a few unexplained 'near-misses' have occurred (see below), there is no evidence of any deliberate or hostile activity, harassment of aircraft in the UKADR, repeated or closing, buzzing, or evidence of a near miss causing airflow disruption. There is no reported evidence of passenger or crew alarm or physical effects on passengers or crews. No reports have been received of any adverse effects which can be attributed to UAP fields on aircraft systems, radios, radars, controls or instruments. It is interesting that no reports have been received of UAP **overtaking an** aircraft in flight, although this has been reported by passengers and drivers in road vehicles. All reports concerning aircraft seem to be of UAP crossing an aircraft's track or approaching, 'keeping station' abeam or of 'following'. As reported below, the time for evasion of approaching UAP is minimal. Reported elsewhere in this report are rare incidents where plasmas (ball lightning) have entered airline cabins. Although there are no reports held

in the Department of this occurring in the UKADR this may have been reported through other channels. However, there is no recollection of this being reported in the UK media either, and it is suggested that it is an extremely rare event and probably more likely in areas of the world where electrical storms are more prevalent.

24. The final part of the collision investigation therefore sought access to air-miss reports where, **in the subsequent air investigation, the second platform was not identified. (that is - it was not necessarily a manned aircraft)**. All the **Airprox Reports** falling in this category in the past 10 years were provided by the Joint (MoD/CAA) Airprox (P) Section at Uxbridge. Although it was not possible to correlate this civil aircrew reporting directly with specific UAP events reported by terrestrial observers, it was noted that:

- On five of the seven occasions when near-miss reports were submitted the electrical storm weather conditions reported were almost certainly those conducive to the formation of lightning plasmas.

- Only on one of the occasions of a near-miss had the pilot made a 'UFO' report - in the other cases the reports had decided that the 'other object' was a real aircraft. Lights seen were reported, for example, as 'navigation lights', despite the fact that the subsequent enquiry could find no evidence of another manned aircraft.

25. In most near-miss situations in daylight the object was **always** too close to take evasive action and it passed very close to the aircraft and no damage was found after landing.

- Descriptions were very similar to the many thousands received from surface observers, including the 'black' objects - about the size of small fighters. (eg. Hawk size)

- There have been no recorded aircraft collisions with UAP.

RADAR DETECTION

26. From the available reports it was clear from the outset that credible witnesses have regularly reported unidentified flying objects, which, from their visual descriptions, could reasonably be expected to be sufficiently substantial objects to produce radar reflections. [redacted] S.26

[1] Dittburger T L & Persinger M A "Intensity of Amnesia is Positively Correlated with Human Abductions.....False Memory Syndrome" Behavioural Neuro-Science Laboratory. University of Ontario. Perceptual & Motor Skills No 77 1995.

TSECRET
SECRET
UNCLASSIFIED

CHAPTER 5

SUMMARY OF STUDY FINDINGS

INTRODUCTION

1. This investigation has depended upon the available reports submitted by a widely representative portion of the population over at least 30 years. Some have been trained observers and others have been members of the general public who have responsibly reported a phenomenon which is unfamiliar and even frightening. In many reports the information required is incomplete. Only by statistical analysis is it possible to extract major attributes and form a credible view as to the value to Defence Intelligence. In so doing, the application of several diverse scientific fields have been necessary.

2. A new database was constructed and populated with as many items as possible in the timescale of the study, to enable a number of basic investigations to take place. This amounted to ten years of data, entered from the UAP reports. The Department is aware that, quite apart from the very high media and public interest in the topic, serious 'UFO' research organisations and other Governments have made efforts to identify the UAP enigma. No UAP reports from other nations are available to the Department, other than occasional open-press information and all results have been obtained independently by a scientific analysis of all aspects of the availalble information. It is recognised that some of the information 'released' by other nations may be deliberate debunking or disinformation. This public information has been ignored and, in fact, was deliberately not read-into until conclusions had been reached using purely the data held in the department and appropriate scientific papers and sources.

FINDINGS

3. **Items of Interest to Defence Intelligence** As a result of the studies and considering all the available information, no evidence either of intelligent control of the objects, alleged 'inspections of UK strategic assets' or any hostility or threat has been found. Although there are some allied topics of potential military interest there are no findings in the category of direct interest to defence intelligence.

4. **Unexpected Encounters by Aircraft** Based on the available evidence it is concluded that although unidentified objects regularly appear in the UKADR there is no hostile threat from them to our aircraft, they do not belong to another nation and there there is no evidence of extra-terrestrial activity apart from the very high probability, in some cases, of their connection with meteors.

5. There is a marginal possibility of danger to RAF aircraft flying low and fast due to the potential for distraction and sudden avoidance manoeuvres but not from collision risk. Following the Russian experiences, it would be prudent to avoid trying to 'chase' UAPs and it does not seem to be necessary to take violent evasive action if they are encountered head-on by any aircraft, including civil aircraft.(see Volume 3)

UNCLASSIFIED
TSECRET

UNCLASSIFIED

6. **Radar Detection of Plasmas** There are strong technical reasons, supported by the nature of plasmas, to justify why the radar detection of UAP events is inconsistent, xxxxxx S.26
xxxxxx xxxxxxxxxxxxxxx

7. **Related Military Apllications** xxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx S.26

8. **Unfamiliar Natural Phenomena** It was found that, apart from misreported manned aircraft, satellites, manned or unmanned balloons and birds, there are at least 20 naturally occurring visible phenomena which can appear in the atmosphere - of which both the general public and even trained observers (e.g. aircrew, police, coastguards, etc.) are largely unaware. When these are seen they are reported to the appropriate authority as unidentified (or unexplained) flying objects because the observer genuinely believes that something, not only mysterious or exciting is happening; but an event has been seen which might even be a threat of some sort. Although these objects are usually airborne, on rare occasions they are seen on the ground.

9. **Solar & Weather Conditions** While no direct correlation was found between the incidence of UAP reports and solar events, it is strongly suspected that there is a UAP connection with weather conditions - especially electrical storms, the naturally occurring electrostatic fields and with meteor activity. In particular, the correlation of UAP sightings and meteor activity indicates that UAP are formed (given certain atmospheric temperature, water vapour, density and electrical conditions) when meteors neither completely burn up or impact the earth's surface.

10. **Charged Plasmas in the Atmosphere** There is strong evidence to suggest (manned aircraft, satellites and other more widely known atmospheric phenomena excepted) that the remaining UAP events are most likely due to highly charged plasma entities which can take more than one form, and are apparently formed from more than one cause. These, mainly bouyant, objects can remain stationary, or can move at variable velocity and flight profile under the influence of naturally occurring atmospheric fields and man-made fields. While known fields (Magnetic, Electrostatic and Electromagnetic) are believed to play a significant part in the formation, sustenance and motion of UAP, the possibility of other physical affects, hitherto not characterised, it cannot be ruled. There is much evidence to point to ball lightning as the source of formation of some plasmas which are reported as UAP. There also is evidence, confirmed statistically, to suggest that other plasmas, which are reported as UAPs and not as plasmas are formed by incompletely destroyed meteors (i.e. which have not completely burnt-up but have penetrated to low altitude but not reached the earth's surface as meteorites).

11. It is probable that the occurrence of UAP reports may also be additionally influenced by the presence of highly charged particles in the atmosphere. Apart from the influence of those particles which occur naturally in the atmosphere, such as dust, the frequency of UAP formation may also be influenced by extra air pollution which has undoubtedly increased this century. The precise electrical and atmospheric conditions for UAP formation cannot be determined from the evidence available. While the evidence examined appears to suggest that formation may occur in a combination of certain electrical and possibly sustained in moist air conditions, it was beyond the scope of the study to examine all the relevant past meteorological records. The increased frequency (taken as a trend which does not continuously increase year on year but does so overall) in UAP reports received by MoD over the last 50 years suggest that

UNCLASSIFIED

UNCLASSIFIED

changing climatic conditions and UAP reports are somehow connected. This, it is suggested is almost certainly enhanced by the corresponding increase in meteor activity.

12. No further investigations were made to determine whether there is correlation between certain combinations of atmospheric conditions and UAP events. One of the considerable difficulties of such an investigation - which is beyond the scope of the TORs of the study (quite apart from cost and effort which would be involved), is the key factor that a UAP might be formed in one place where conditions are conducive to its formation, but remain unseen until it has travelled to another location where, for the time being, it is sustained by it's own and other ambient attributes, moved around by extant external influences, but no longer in an environment in which it would have originally been formed. This motion clearly affects UAP (plasma) life and shape.

13. **Human Medical Aspects** No attempt was made to consider furher the physiological and psychological aspects which impinge on the topic of UAP, when 'close encounters', including the 'abductee' and 'contactee' scenarios allegedly occur. Such events are relatively few in the UK, none have included measurements and the department has no knowledge of any follow-up medical investigations which may have taken place. They do not impact on the findings. It is clear, however, that such events only happen (such as can cause physical injury or equipment interference on occasions) when a human is quite close to the phenomenon. In this respect, the most important finding is the potential connection between the modulated magnetic fields, used in the Canadian medical experiments which seem to produce the same effect on the human mind as those experienced by those few witnesses who have been very close to a UAP.

14. **Dependence on Culture** No attempt was made to consider further 'cultural tracking' - other than to note that in the late 19th and early 20th centuries (well before the time of this Department's Reports!) UFOs were reported as 'Airships' - complete with propellers and cupolas. [As an independent check it is particularly important to note that the examples given at Annex C (Czech examples years 1607 to 1985) have exactly the same basic descriptions as those reported today]. The first 'saucer' description was erroneously given this name by a journalist in the USA in 1947: ever since, witnesses expect to see this shape. The presence of domes, portholes and landing gear, inevitably in the form of tripod legs and the like, soon followed!

STUDY RECOMMENDATIONS

Key Recommendation

15. Although the study cannot offer **certainty** of explanation of all UAP phenomena, the existing evidence is sufficiently persuasive to make **one** key and **five** subsidiary recommendations:

- **It should no longer be a requirement for DI55 to monitor UAP reports as they do not demonstrably provide information useful to Defence Intelligence.**

UNCLASSIFIED

Subsidiary Recommendations

- Selection of a ten year UAP reporting period for detailed statistical studies, allowed material from both the Cold War and post-Cold War periods to be studied. **No significant differences were discovered in the results from these two time periods.** For this and other reasons it is not expected that further inputs to the database will significantly change the findings stated in this Executive Summary. Consequently, and **in keeping with the key recommendation, it is recommended that there be no further requirement for maintaining the database.**

- The flight safety aspects of the findings should be made available to the appropriate RAF Air Defence and other military and civil authorities which operate aircraft, particularly those operating fast and at low altitude.

In so advising:

- **It should be stressed that, despite the recent increase in UAP events, the probability of encountering a UAP remains very low.**
- **No attempt should be made to out-manoeuvre a UAP during interception.**
- **At higher altitudes, although UAP appear to be benign to civil air-traffic, pilots should be advised not to manoeuvre, other than to place the object astern, if possible.**

- **The reasons affecting the variability in radar detections of UAP by UKADR (and civil air traffic) sensors, should be passed to the appropriate operating authorities.** [redacted] S.26

- The relevance of plasma and magnetic fields to UAP were an unexpected feature of the study. [redacted] S.26

- **It is suggested that the findings of this report could be used to provide the public with a balanced view of UAP reports and MoD involvement. It is recommended that this report be made available in a suitable form for public release. (R)**

16. **The Way Ahead.** In view of the public sensitivity on the topic (and the media vested interests in keeping the topic in the public eye), it is suggested that the technical and other relevant knowledge gained in the Department as a result of this study may be of value in any wider policy decision on the way ahead. While this can be seen as ensuring accuracy and consistency in any statement which might be made, it would also protect the DIS involvement which has, unfortunately, become public knowledge due to

circumstances beyond our control. Above all there will, most likely, be a need to respond to the inappropriate statement that the MoD has not carried out any UAP investigations, which was issued in a written reply, by another Department.(R)

ANNEX A

STUDY TERMS OF REFERENCE

1. **Aim** The aim of this task is to determine the potential value, if any, of UAP sighting reports to defence intelligence.

2. **Method** A limited analysis based on an electronic relational database containing data extracted from UAP sighting reports, over a period to the present date. The period will be dictated by the time available to input data to meet the task deadline, but should be sufficient on which to justify the analysis tasks

3. **Database** The database should, at least, record:

   a. A discrete event number for each event.

   b. Details of location(s), including any potential military or economic targets.

   c. Times and dates.

   d. Details of person(s) reporting the event and witnesses.

   e. Details of the event to include size, shape, colour, speed(s), noise, other effects such as effects on electronic equipment or ignition systems.

   f. A categorisation of the event as follows:

   - Probable Military/Civilian aircraft
   - Probable space-associated event, such as meteor, re-entry vehicle or planet.
   - Probable Hoax or publicity stunt.
   - Unidentified.

   g. Any possible explanation, such as military exercises etc.

4. **Report** A final report is required which should include:

   a. A description of the database.

   b. Discussion of the analysis.

   c. Findings and Recommendations

5. **Security** The classification for this task is **RESTRICTED UK EYES ONLY.**

UNCLASSIFIED

ANNEX B

MODCIS (RAF10)

ANNEX A TO
SOP 502

101

REPORT OF AN UNIDENTIFIED FLYING OBJECT

1.	Date, Time & Duration of Sighting	262050 Local Apr 93 several minutes
2.	Description of Object (No of objects, size, shape, colour, brightness)	Like a puff of cloud, then circular, very light with a red light flashing (note - crossing from right to left)
3.	Location, indoor/outdoor, stationary/moving	Outside
4.	How observed (naked eye, binoculars, other optical device, still or moving)	naked eye
5.	Direction in which object first seen (A landmark may be more useful than a badly estimated bearing	Going from Wimbledon towards Roehampton
6.	Angle of Sight (Estimated heights are unreliable)	Not known
7.	Distance (By reference to a known landmark)	None estimated
8.	Movements (Changes in 5,6 & 7 may be of more use than estimates of course and speed)	Seemed to be about the speed of an aircraft
9.	Met conditions during observations (Moving clouds, haze, mist etc)	Clear sky
10.	Nearby objects (Telephone lines, high voltage lines, reservoir, lake or dam, swamp or marsh, river, high buildings, tall chimneys, steeples, spires, TV or radio masts, airfields, generating plant, factories, pits or other sites with floodlights or night lighting)	Nothing of note
11.	To whom reported (Police, military, press etc)	AFDO
12.	Name & Address of Informant	XXXXXXXX XXXXXXXXX just off Wimbledon Common

S. 40

UNCLASSIFIED

UNCLASSIFIED

13. Background of Informant that may be volunteered

Sensible, was partially mollified by the Airship Ford Mondeo

---

14. Other Witnesses

---

15. Date, Time of Receipt (in AFOR)

261955Z Apr 93

---

16. Any Unusual Meteorological Conditions

---

17. Remarks

Would have believed the Airship Ford Mondeo but for the fact that we were told it was operating in the Ilford/Romford area. **May we have a Telephone No for the operators of the airship so that we may check its operating area? That would be very helpful.**

---

xxxxxxx S.40

Date: 26 Apr 93

RO2
Duty Operations Officer
Air Force Operations

Distribution:

Sec(AS)2, Room xxx Main Building
AEW/xx, Room xxx Main Building
DI 55, Room xxx Metropole Building
File D/AFOPS/2/5/1
NB. Please note that the format of this form accords with Civpol formats

not relevant

TO ALL AFDOS: PLEASE USE THIS AS A MASTER COPY AND IMMEDIATELY ON OPENING USE THE "SAVE AS " FUNCTION TO MAKE A COPY FOR THE ACTUAL REPORT! SORRY BUT IT WAS NOT POSSIBLE TO PUT THIS REMARK AT THE START OF THE REPORT,AS IF TRIED ALLTHE BLOCK SETTINGS ARE DESTROYED!!!

UNCLASSIFIED

U N C L A S S I F I E D

CYO044 23/1254 266C1360

FOR CAI

ROUTINE 221545Z SEP 97

FROM RAF WITTERING
TO MODUK AIR

U N C L A S S I F I E D
SIC Z6F
ATTN FOR SEC(AS)2A
A. 210115 SEP 97
B. 2 REVOLVING LIGHTS MOVING ROUND EACH OTHER, FLASHING AT DIFFERENT SPEEDS
C. XXXXXXXXXXX WERRINGTON, PETERBOROUGH S.40
D. NAKED EYE
E. OVERHEAD XXXXXXXXXX S.40
F. 15 DEGREES
G. 200-500FT HIGH
H. EAST TO WEST
J. SKY CLEAR
K. HOUSING ESTATE AND COUNTRY LANE
L. RAF WITTERING S.40
M. XXXXXXXXXXXXXXXXXXXX , WERRINGTON, PETERBOROUGH, XXXXX

PAGE 2 RBDBYL 0013 UNCLAS
N. AREA MANAGER FOR A TRADE ASSOCIATION
O. WIFE
P. 221515Z SEP 97
BT

DISTRIBUTION Z6F
F
CAB 1 SEC(AS) ACTION (CWE 1 DCMC REG DUTY(AIR))
CXL 1 DD GE/AEW
CAI 1 DI 55

REPORT OF AN UNEXPLAINED AERIAL SIGHTING

1. Date, time & duration of sighting	25 OCT 96 ONE MINUTE 5:35AM
2. Description of object (No of objects, size, shape, colour, brightness, noise)	KITE SHAPED. 4 WHITE + GREEN LIGHTS. 4 "FINS" UNDERNEATH. 6 RED LIGHTS IN THE CENTRE
3. Exact position of observer (Indoors/outdoors, stationary/moving)	INDOORS
4. How observed (Naked eye, binoculars, other optical device, camera or camcorder)	NAKED EYE
5. Direction in which object first seen (A landmark may be more useful than a roughly estimated bearing)	
6. Angle of sight (Estimated heights are unreliable)	280 feet HIGH.
7. Distance (By reference to a known landmark)	
8. Movements (Changes in 5, 6 & 7 may be of more use than estimates of course and speed)	CIRCLING ROUND ABOVE HIS FLAT THEN SHOT OFF AT HIGH SPEED.
9. Met conditions during observations (Moving clouds, haze, mist etc)	MILD
10. Nearby objects (Telephone lines, high voltage lines, reservoir, lake or dam, swamp or marsh, river, high buildings, tall chimneys, steeples, spires, TV or radio masts, airfields, generating plant, factories, pits or other sites with floodlights or night lighting)	PAGE 2.

11. To whom reported (Police, military, press etc)	
12. Name, address and telephone no of informant	XXXXXXXXX XXXXXXXXX S.40 XXXXXXXXX RUNCORN CHESHIRE. XXXXXX
13. Any further detail volunteered	ALSO SEEN IN NOVEMBER 94.
14. Other witnesses	
15. Date and time of receipt	27 JAN 97. 11AM
16. Remarks	REPLY REQUESTED.

ANNEX C

Code (date)	Location	Description of object
1607.11.27.KO1	BM-Brno-JM	during a storm a fiery sphere landed on the ground, illuminating the entire vicinity for an hour
1619.06.11.KO1	SY-Odranec-VC	resembling a mill wheel with letters, blood-red colours, 3 mornings, 3 pieces of metal fell to the ground
1624.11.00.KO1*	CC-Bohemia-CC	a rotating sphere, white to blue and dark red, flying from west to east on all occasions in afternoon
1684.10.13.KO1	KV-Jáchymov, Boží Dar-ZC	a strange body flew over Jáchymov and later over Boží Dar
1744.07.06.KO1$_1$	LI-Hrádek n. N-SC	two luminous spheres
1796.03.08.KO1	CC-Bohemia-CC	an enormous flying sphere, exploded on ground, a frothy material subsequently remained
1874.04.24.KO1$_1$	AB-Prague-Pha	a strange body flying across the face of the moon
1908.06.28.KO1	LT-Dolánky u Terezína-SC	bright yellow tube with flames coming out of both ends
1908.06.29.KO1	LT-Dolánky u Terezína-SC	red glowing [object] with distinct smoke trail

TABLE C-1 TYPICAL REPORTS – CZECHOSLOVAKIA (1607-1985)

Notes: 1. These reports are included as a confirmation of the consistency of descriptions, which apppear to be unchanged, compared to today's reports.
2. The Czech letters in column 2 are believed to represent: 'S' = 'North'; 'V' = 'East'; 'J' = 'South'; 'Z' = 'West'. 'St' may stand for 'Central', 'C' for 'Bohemia' and 'M' for 'Moravia'.

/contd.

1913.11.KK.KO1	BI-Brno-Židenice-JM	6 red stars which rotated around an imaginary centre for approximately 7 minutes
1938.00.00.CO1$_{=}$	MM-Moravia-MM	3 shiny crosses in sky, 1 large and two smaller ones on the sides, strange light
1938.10.07.DO1$_{=2}$	JC-Slatiňany/Miličeves-VC	a red sphere surrounded by grey-black rotating rays, low flying, vicinity red
1939.00.00.DO1$_{=}$	BV-Pohořelice-JM	orange glow across entire half of sky
1944.LL.KK.DO1$_{+1}$	PJ-Blovice-ZC	silver cigar-shaped object with lighter area at bottom, flying to NE
1945.05.00.DO1$_{=}$	PV-Prostějov-JM	in a break in clouds 5 red oblong objects, without wings, noiseless
1951.00.00.KO1	CC-Western Bohemia-ZC	yellow-green luminous sphere, big as the moon, moving in various directions
1955.07.00.KO1	NJ-Trojanovice p. Radh.-SM	3 stationary orange spheres, then movement towards observer, then suddenly disappeared
1956.06.00.KO1	PI-Předbořice u Kovářova-JC	5 disks, at circumference [? yellow, white & red lights], howling of dog, sound resembling buzzing of bee, sailed to SW
1958.06.00.DO1	SU-Střelnice Hill, near Loštice-SM	isosceles triangle with rounded corners the colour of a red sky
1960.00.00.KO1	BM-Brno-JM	irregularly moving disk, intercepted neither by radar nor by fighter aircraft
1961.08.00.DO1$_{=}$	PI-Milevsko-JC	noiseless overflying by 5 orange, shining, oval objects above the town

1961.09.17.DO1$_2$	HB-Ledeč n. Sáz.-VC	golden-pink sphere, stopped for 30 sec. in front of the church tower, then circled upwards
1963.10.00.KO1	VS-Střelná-SM	strongly shining disk flying from N to S, something forced witness to turn round
1965.00.00.DO1$_1$	AB-Prague 10-Malešice-Pha	box-like object, hovering above spot, then suddenly disappeared
1965.11.LL.PR.DO1	PC Mníček p. Brdy-StC	two shiny, lenS-shaped, rainbow colour formations, each climbing in a different direction
1965.04.05.KO1	CC-Čechy-CC	4 to 6 luminous objects with a long luminous trail, reappeared after 12 minutes
1969.08.00.DO1$_{*2}$	OT-Vítkovice-SM	silvery figure above the witness and sleeping colleague, immobilization, avoided being touched
1970.10.18.DO1$_{*1}$	BE-Drozdov u Cerhovic-StC	point of light, in telescope sphere with rainbow around it
1973.10.07.KO1*	OT-Ostrava-Poruba-SM	moon-like sphere with orange spot at bottom left, stationary, then flew upwards
1974.00.00.DO1$_1$	PH-Mstětice u Zelenče-StC	round to oval orange object not more than 50 m from observer
1974.08.00.DO1$_1$	NA-Jaroměř-VC	metal disk/by day/orange light from sides, slowly rotating, size 200 m x 10 m
1974.08.DP.DO1$_2$	LN-Vršovice u Ohře-SC	unpleasant whizzing, cone of light searching the ground
1975.07.00.NO1$_1$	LI-Ještěd-SC	45-min. loss of consciousness, found stone in shape of head

1976.LL.00.KO1+	PA-Pardubice-VC	large metal disk, glowing and manoeuvring, observed by fighter pilot
1976.04.16.KO1	SC-all of Bohemia, Moravia and Slovakia	5-6 lights, flying in formation
1977.07.02.DO1UO	Kunvald-VC	triangular structure with 4 red lights, flying in a curve and disappearing beyond the horizon
1977.08.00.CO1=	RA-Zdeslav u Čisté-StC	2-m orange sphere which emerged from the water of a lake and disappeared again
1978.01.01.DO1+	UL-Ústí nad Labem-Sc	disk with two brighter spots (like eyes), jerky movement flying between clouds
1978.08.08.KO1	PM-Plzeň district-ZC	formation of 6 yellow and red lights, pursued by L-29 aircraft
1979.01.24.DO1	BR-Rudná p. Pradědem-SM	yellow and red sphere with sparkling tail circling in sky
1982.00.00.DO1+	AB-Prague 8-Čimice Pha	two luminous circles, the top one with variegated lights, stationary in sky
1982.JJ.KK.DO1=	TP-Dubí-SC	complicated, variegated but transparent formation, only the edges illuminated
1982.LL.00.UO1'	KH-Suchdol u Kutné Hory-StC	yellow and white point of light moving across the sky in a rectangular turn
1982.LL.00.DO1	AB-Prague 3-Žižkov-Pha	yellow and orange sphere, stationary, then flew upwards in a split second
1983.LL.00.DO1=	CH-Cheb-ZC	projectile-shaped object with rounded tip, flew away rapidly

1983.10.09.D01	BR-Bruntál-SM	rotating disk giving off yellow and red flashes
1983.10.29.D01	BR-Nová Rudná-SM	two red pulsating lights
1983.11.21.D01$_2$	UL-Labské udolí	lens-shaped body powerfully illuminating the area with a cone of cold light
1984.01.01.D01=	PC-Černošice-Mokropsy-StC	3 white shining spheres, flying in formation
1984.01.09.K01*	BV-Dolní Dunajovice-JM	white point with bright red, long and thin tail, straight flight 4-5 secs.
1984.01.13.K01*	BN-Vlašim-StC	brightly shining object with fuzzy tail, flying noiselessly along a straight path
1984.10.00.K01$_2$	HO-Hodonín/Kopčany JM	pear-shaped body, 3 m away a figure in a metal space suit, conical head
1985.02.02.D01=	UL-Ústí nad Labem-SC	star, later more of an oval, illuminating the area underneath it with a conical variegated light
1985.06.05.K01*	PE-Horní Pravíkov-JC	bright yellow line from N to W - possibly the trail behind a body, interrupted by clouds
1985.07.05.D01*	PH-Srbín u Mukařova-StC	luminous object, its angular contours illuminated by small coloured luminous points
1985.08.03.D01=	AB-Prague 9-Pha	white luminous sphere flying low above the street lights in Prosecká ulice [street]
1985.08.14.D01=	FM-Ostravice-SM	slow-flying red potato-shaped object the size of a family house, blinking row [of lights? - LSlc]

ANNEX D

THE UAP ACCESS DATABASE

1. The ACCESS database for UAP analysis has been designed around 13 input Tables. The key table is the 'Base Table' and 12 are assigned to input information arising from UAP Sighting Reports. Table 12 is a location for storing and categorising the identification/cause of each event and is generated (currently) manually by reference to the input information. In order to complete Table 12 for each event, reference may be made to the manual interpretation tables (Tables 2 and 3) in the Main Text of this report; and for detailed phenomenal information to the Working Papers included at Volume 2. The database was designed so that it could accommodate future expansion, should this be required. It was recognised that if this turned out to be the case it might be possible to largely automate the identification process by constructing algorithms on which to evaluate the information. However, it was also recognised that it would always be necessary to interpret some reports manually, in order to try and extract meaning and detail. Often, due to the lack of information necessary to make a full identification, a number will always remain unidentified for this reason. In the ACCESS database software a **Table** is shadowed by its own '**Form**'. A **Form** has a more user-friendly display layout than a **Table,** allowing information to be grouped for easier interpretation for the task. Hence, although TABLES are initially useful for the insertion of bulk data (as many events can be listed in compact format on a TABLE and viewed at once), FORMS display individual events. For example, in the UAP database the consolidated Base-Table, lists the leading/overview attributes of every sighting entered, while there is a separate BASE FORM for each event and for each aspect of the event.

2. The data entry methodology is to first generate the BASE TABLE, which entails manual examination of every paper sighting report. This is a time-consuming task and was the main reason for limiting the detailed data entered to a ten year period . After the initial work new data can thereafter be entered or modified in two ways - either directly by calling up a blank BASE FORM, orindirectly, by filling-in/adding to the existing BASE TABLE.

3. **Table Specifications** The specification of the BASE FORM and the supporting sub-items, shown as TABLES are at page D1. As two examples, the FORM layouts for sub-FORMS LIGHTS and AUDIO EFFECTS are respectively shown at the end of the TABLES. The rationale for the selection of the attriibutes for each TABLE and FORM is described at paragraph 10, below.

4. **Sub-FORM Data** It is, of course, possible that insufficient data is available to complete one or more sub-FORMS for a particular event. It is, for example, most likely that a LIGHTS sub-FORM will exist, whereas SOUNDS and ODOURS are much rarer occurrences; as are occurrences on some of the other sub-FORMS. To avoid wasting storage space a sub-FORM is only raised if the attribute is present. The fact that an attribute (e.g. ODOUR) is present is flagged on the BASE FORM and can be called at once from that FORM by clicking on the flag.

DATA KEYS

5. The data key for each record is its EVENT NUMBER. This number is unique to every sighting (even if more than one witness reports the same object at the same time, providing he/she submits a separate UAP report form). Hence, every individual paper report on the Department files has a unique identifier. This identifier appears on the top of the event BASE FORM, in the left-hand column of the DATA TABLE and on top of every Sub-FORM relating to the same event.

6. For ease of correlation with the paper records the EVENT ID number runs sequentially, re-starting at each New Year and is of the form 96/001...96/002 etc.

7. Because the data is entered going backwards in time, occasionally temporary numbers are used until the years input is complete. Hence, 96/A01 to 96/A28 has been used. This is because the final numbers cannot initially be allocated, this is because the paper files do not coincidentally start or end with the years. It is noted, however, that there is no particular reason why the length of a calendar year or the start or end of a year has any relevance to the number of sightings recorded in a year, since this depends on many factors. The useful evidence is, perhaps, in the frequency of events at different periods of the year or in combination with atmospheric conditions which are present. Hence, no particular importance can be placed on an annual record - it is just a convenient recording key. The correlation of sightings may or may not turn out to have any obvious major factors. For completeness it would have be prudent to fully check the correlation of UAP reports with, for example solar flare activity. As the main solar cycle is 11 years it will take some time to prove the fact or otherwise! Correlation tests over shorter periods have been made.

8. For statistical analysis, emphasis is placed on positive values. For example, a flag showing that no sound occurred does not necessarily mean that there was no sound present - just that it was not recorded on the form - even though it may have been heard. and missed off the report in error. The paper report forms do not call for nil returns in each field and often just have blank spaces. Hence, the YES/NO flag, apparently signifying the presence or absence of an attribute, does not always mean exactly what occurred in practice. A blank entry is not an assurance that the witness was even asked the questions. Statistical analysis must therefore proceed with caution. This is a clear limitation of the current reporting forms, which do not have 'computer friendly' format which computer analysis ideally requires. This is important, as, for example, if sound was definitely **not heard**, then the data must be examined further to see if the observer was or was not downwind of the object - a fact that should have been checked by the person supervising the reporting at the time. In this case sub-FORMs 9 (Observer Geometry) and 7 (Meteorological Conditions), would be appropriate. Before reaching this stage it would be appropriate also to consult sub-FORM 7 (Observer Location) to ascertain whether the witness was inside a house or car, for example, in which case sound may not be heard anyway. [Sub-FORM 7 has three sections - Meteorology, Observer Location and Viewing Background]

9. It was decided that a YES/NO flag would be adequate for many conditions, providing caution was exercised during any analysis carried out on the data. Each sighting would have to be examined and all available information extracted from the few sentences of expansion which occasionally accompanies the more formal part of the reports.

SECRET
UNCLASSIFIED

DATABASE TABLES

10. The need for separate database tables to describe the attributes reported in the paper database was established after a review of as many of the salient features of UAP as possible. Paragraphs 12 to 25 below, briefly describe each TABLE, examples of which are attached.

11. As the content of TABLES can also be displayed as FORMS, 2 examples of these, for LIGHTS and AUDIO, are also included. There are some visual advantages in using FORMS for updating and viewing data. A new event number is given to every sighting and heads every TABLE relating to the same event. Hence, to examine everything about a certain sighting a set of FORMS makes a complete record. There will be inconsistencies, since one sighting may general several of the attributes - for example there may be lights, sound, meteorological data and odours. Another may only describe lights. By this method the amount of computer storage is minimised. From the BASE FORM (or TABLE) it is possible to see at a glance how many of the SUB-FORMS apply to a sighting. If several witnesses see the same UAP event and each separately submit a report, then each report is given a different and unique identifier. The fact that more than one report has been received on the same event, or more than one person was present at the same event is recorded by the CORRELATION FLAG on the base form.

TABLE DESCRIPTIONS

12. The purpose of each TABLE (and hence, it's corresponding FORM) is each briefly described below. Most of the samples at Appendix D1 are self-explanatory.

13 **Tables 1 & 2: Base Table & Proximity Log** Table 1 provides a summary overview and is known as the **BASE TABLE**. Table 2 is the **Proximity Log** and acts as an aid to the elimination of spurious and misreported information, by recording the data for nearby objects, installations and events which might be mistaken for 'genuine UAP'.

14. **Table 3 Observer Description** For analysis it is useful to have a brief profile of the witnesses, and their addresses. Almost all sightings by the general public happen at home or within a few miles of home. Credibility can nevertheless range from fully trained observers - such as HM Coastguards, Pilots of Civil and Military aircraft to the humble man walking his dog - who often turns out to have military or police background - and is exercising his citizenship by reporting what is clearly an unusual and inexplicable event. All of this information is useful for cross-correlation purposes. **There is no other reason for maintaining this record**. Names have been freely given by the reporting public who have the option of leaving their name off the report form; although only a small number do so. Hence the inclusion of these details makes the database confidential and not releasable in the public domain.

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET

15. **Table 4. Physical Description.** This form contains the shape, size, 'portholes' and any other useful information for analysis. As there are perhaps a dozen descriptions given for shapes and patterns. some rationalisation has been necessary. For example, where possible the term sphere is used when a sphere was clearly observed. On other occasions some objects which were spheres will inevitably be included as 'round'. There is a particular problem here in that, for example, this does not clearly filter ball lightning from a plasma disc - which is round in plan but elliptical, egg, saucer or even cigar shaped when viewed side-on.

16. **Table 5 Object Motion** This is a critical attribute when filtering manned aircraft from the slower buoyant bodies which are often seen. An important filter is that of erratic motion.

17. **Table 6A Odours** These, it seems, are associated with an event as a result of an electrical discharge and the chemicals in the air at the time.

18. **Table 6B Technical Effects** The table records any effects reported on humans, buildings or on the terrain. For example, ball lightning has been known to boil water. In particular, this table is used to record anomalous effects on electrical equipment, such as police or public radios.

19. **Table 7A Meteorological Conditions** This information sets the background for visual viewing, for example the use of reflected light or silhouette and wind, which affects the probability of hearing noise, seeing contrails, etc.

20. **Table 7B Observer Location** Certain 'UAP' events can only be seen in mountains and hills or at sea. Hence, observer position can be very important. This table also records factors such as viewing outdoors compared with observing an object through glass which may be curved and introduce distortion.

21. **Table 7C Viewing Background** Viewing over lakes and smooth water can clearly provide different optical effects than over rough land. Surface effects, such as charring etc. caused by UAP events and remaining as evidence on terrain, cannot be determined over water.

22. **Table 8 Optical & Radiation.** This table records any device which may have influenced what was seen. For example, use of viewing aids, such as binoculars or use of still and video cameras, or any other visual recording or sensing device.

23. **Table 9 Observer Geometry** The main purpose of this table is to record the position of the observer of the incident with respect to the position of the sun. This is critical in filtering out satellites in UAP reports and silhouettes and colours.

24. **Table 10 Final Description** This is necessary to describe what happened at the end of the sighting, as the UAP went from view - enabling, once again elimination of collapsing entities - such as the pop or explosion when ball lightning finally decays. The direction in which the UAP went helps to correlate with other witnesses' reports as the event progresses across country. Events at the end of a sighting often do not resemble those at the start.

25. **Table 12 Event Categorisation Log** The table is an assessment of the most likely cause of the event.

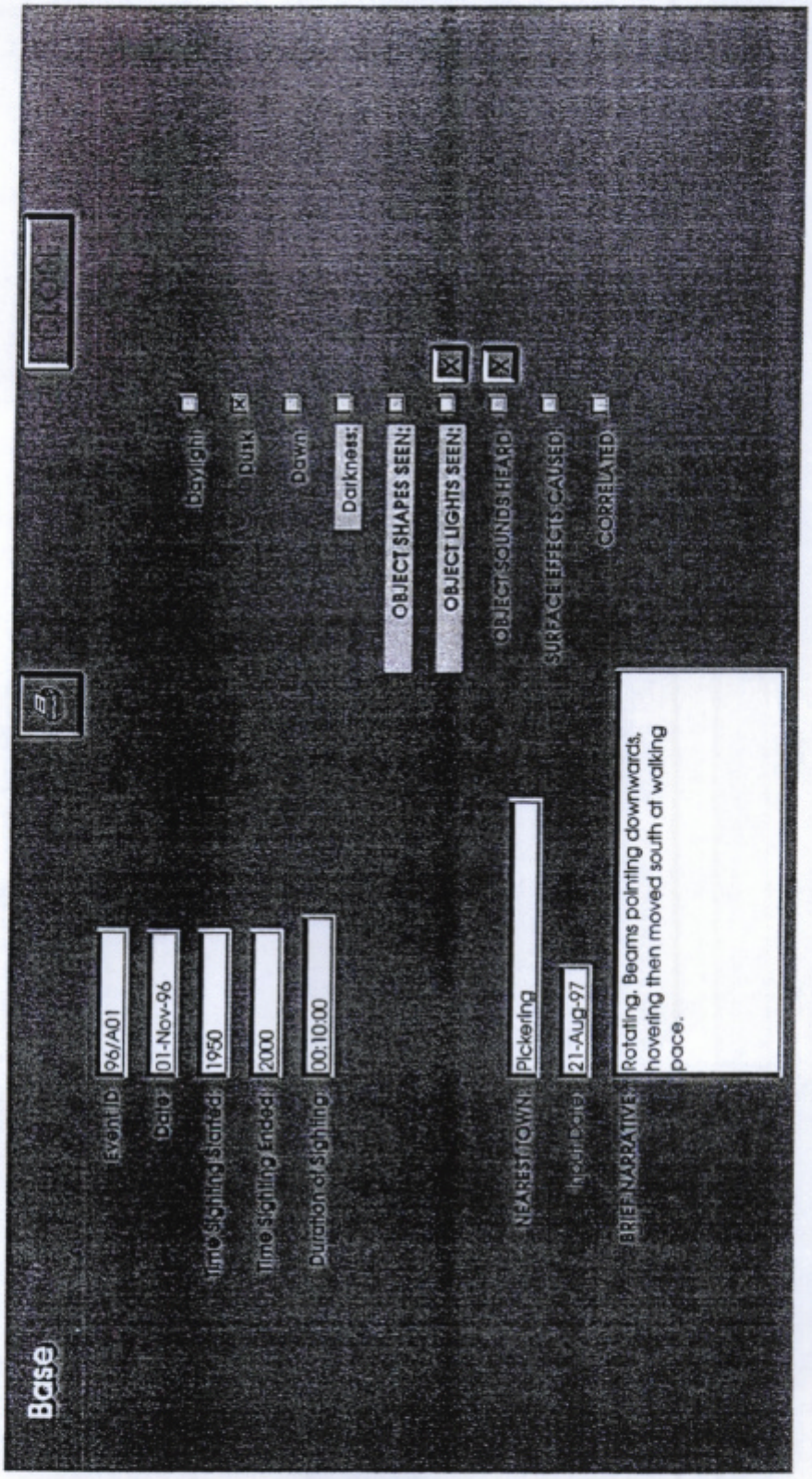
UNCLASSIFIED

UNCLASSIFIED
SECRET

26. **Table 13 Imagery & Audio Log** The log indicates the presence of any imagery, JARIC report, video records, etc. which may have become available to support the compilation of Table 12.

27. Table 11 was allocated but not required.

UNCLASSIFIED
SECRET


Base
Event ID:
96/A01
Date:
01-Nov-96
Time Sighting Started:
1950
Time Sighting Ended:
2000
Duration of Sighting:
00:10:00
NEAREST TOWN:
Pickering
Hour Date:
21-Aug-97
BRIEF NARRATIVE:
Rotating. Beams pointing downwards, hovering then moved south at walking pace.
CLOSE
Daylight
Dusk
Dawn
Darkness:
OBJECT SHAPES SEEN:
OBJECT LIGHTS SEEN:
OBJECT SOUNDS HEARD
SURFACE EFFECTS CAUSED
CORRELATED

BASE FORM

Event ID	Date:	Time Sig	Time Sig	Duration	NEAREST TOWN:	Day	Dust	Day	Dar	OB	OB	OB	SUI	CC
96/A01	01-Nov-96	1950	2000	00:10:00	Pickering	☐	☒	☐	☐	☐	☐	☐	☐	☐
96/A02	07-Nov-97	0515		00:20:00	Shotts	☐	☐	☒	☐	☒	☒	☐	☐	☐
96/A03	06-Nov-96	2100		00:20:00	Mill Hill	☐	☐	☐	☒	☐	☐	☐	☐	☐
96/A04	07-Nov-96	0015	0135	00:35:00	Lark Hill	☐	☐	☐	☒	☒	☒	☐	☐	☐
96/A05	05-Nov-96	1830			Whelan Green	☐	☒	☐	☐	☒	☒	☐	☐	☐
96/A06	01-Nov-96	0400	0430	00:03:00	Willlowdale	☐	☐	☐	☒	☒	☒	☐	☐	☐
96/A07	05-Nov-96			00:40:00	Bewers	☐	☐	☐	☐	☒	☒	☐	☐	☐
96/A08	09-Nov-96	1945		00:02:00	Headington	☐	☒	☐	☐	☒	☒	☐	☐	☐
96/A09	08-Nov-97	2345		00:00:10	Stoke-on-Trent	☐	☐	☐	☒	☒	☒	☐	☐	☐
96/A10	10-Nov-96	1650	1705	00:20:00	Swindon	☐	☒	☐	☒	☒	☐	☐	☐	☐
96/A11	09-Nov-96	1800		00:00:02	Edinburgh	☐	☒	☐	☐	☒	☒	☐	☐	☐
96/A12	07-Nov-96	1950		00:05:00	Glenrothes	☐	☐	☐	☒	☒	☒	☐	☐	☐
96/A13	09-Nov-97	2330		00:15:00	Dalry	☐	☐	☐	☒	☒	☒	☐	☐	☐
96/A14	12-Nov-97	0207		00:00:30	Wirral	☐	☐	☐	☒	☒	☒	☐	☐	☐
96/A15	12-Nov-96	2330			Hull	☐	☐	☐	☒	☒	☒	☐	☐	☐
96/A16	12-Nov-96	2200			Peterborough	☐	☐	☐	☒	☒	☒	☐	☐	☐
96/A17	13-Nov-96	2125		00:15:00	Tockwith	☐	☐	☐	☒	☒	☒	☐	☐	☐
96/A18	15-Nov-96	0915			Gatwick	☒	☐	☐	☐	☒	☐	☐	☐	☐
96/A19	14-Nov-96	1830		02:00:00	Norwich	☐	☒	☐	☐	☐	☒	☐	☐	☐
96/A20	14-Nov-97	0800			Haverford West	☒	☐	☐	☐	☒	☐	☐	☐	☐
96/A21	14-Nov-96	1818			Amersham	☐	☒	☐	☐	☒	☒	☐	☐	☐
96/A22	14-Nov-96	1930			Chorley Wood	☐	☐	☐	☒	☒	☒	☐	☐	☐
96/A23	15-Nov-96	0500			Dunstable	☐	☐	☒	☐	☐	☒	☐	☐	☐
96/A24	15-Nov-96	2345	0005	00:20:00	Irvine	☐	☐	☐	☒	☐	☒	☐	☐	☐
96/A25	18-Nov-96	0230			Edinburgh	☐	☐	☐	☒	☐	☒	☐	☐	☐
96/A26	14-Nov-96	1137		00:10:00	Stoke Newington	☒	☐	☐	☐	☐	☒	☐	☐	☐
96/A27	24-Nov-96	0200	0400	02:00:00	Tadworth	☐	☐	☐	☒	☐	☒	☒	☐	☐
96/A28	28-Oct-96	1900			Sandon (Herts)	☐	☒	☐	☐	☒	☒	☒	☐	☐
97/001	13-Jan-97	1915			King's Lynn	☐	☐	☐	☒	☐	☒	☐	☐	☐
97/002	20-Jan-97	0655		00:03:00	Chorley	☒	☐	☐	☐	☐	☒	☐	☐	☐
97/003	16-Jan-97	0845			Pitcorthie	☒	☐	☐	☐	☒	☒	☐	☐	☐
97/004	20-Jan-97	0800	0815	00:15:00	Kidderminster	☒	☐	☐	☐	☐	☒	☐	☐	☐
97/005	20-Jan-97	0700	0705	00:05:00	Rochdale	☒	☐	☐	☐	☒	☒	☐	☐	☐
97/006	13-Jan-97	2100		01:00:00	Brockton	☐	☐	☐	☒	☐	☒	☐	☐	☐
97/007	13-Jan-97	1935	1950	00:15:00	Peacehaven	☐	☐	☐	☒	☒	☒	☐	☐	☐
97/008	13-Jan-97	1740		00:00:30	Oxford	☐	☒	☐	☐	☒	☒	☐	☐	☐
97/009	13-Jan-97	2230		00:05:00	Lowestoft	☐	☐	☐	☒	☒	☒	☐	☐	☐
97/010	20-Jan-97	0100	0330	02:30:00	Woodford Green	☐	☐	☐	☒	☒	☒	☐	☐	☐
97/011	14-Jan-97	2000	2200	02:00:00	Acaster Malbis	☐	☐	☐	☐	☒	☒	☐	☐	☐
97/012	20-Jan-97	0650		00:00:20	Plymouth	☒	☐	☐	☐	☐	☒	☐	☐	☐
97/013	20-Jan-97	1901	1904	00:03:00	Inveraary	☐	☐	☐	☒	☐	☒	☐	☐	☐
97/014	20-Jan-97	1915	1935	00:20:00	Bradford	☐	☐	☐	☒	☒	☒	☐	☐	☐
97/015	20-Jan-97	0700			Henley on Arden	☒	☐	☐	☐	☒	☒	☐	☐	☐

BASE DATASHEET

UAP1-DTG & LOCATION

Event Number	Number	Unique identifier for each sighting
Date	Date/Time	DTG Zulu Time
Time Sighting Started	Date/Time	Time of first contact with sighting
Time Sighting Ended	Date/Time	Time of last contact with sighting
Duration of Sighting(mins)	Number	Use decimal fractions if necessary eg. 15sec=0.25
Geographical Location (1) Lat/Long	Text	LAT/LONG WITHIN UKADGE
Geographical Location (2) GEOREF	Text	Grid Ref
Geographical Location (3) OS Ref	Text	Ordnance Survey Location Reference
NEAREST TOWN	Text	
Input Date	Date/Time	This should be set automatically
Daylight	Yes/No	
Dusk	Yes/No	
Dawn	Yes/No	
Darkness	Yes/No	
OBJECT SHAPES SEEN	Yes/No	
OBJECT LIGHTS SEEN	Yes/No	
OBJECT SOUNDS HEARD	Yes/No	
SURFACE EFFECTS CAUSED	Yes/No	
CORRELATED	Yes/No	CORRELATION TO OTHER SAME DAY SIGHTING
BRIEF NARRATIVE	Text	

UAP2-PROXIMITY LOG

Event Number	Counter	Same count as all other tables in UAP database
Nearest Town	Text	Nearest Main Town
Distance to Town	Number	kilometres
Nearest Airport/RAF Stn	Text	Name
Distance to Airfield(km)	Number	if within 50km
Nearest Airway	Text	eg RED ONE
Distance to Airway(km)	Number	in km
National Grid Line Distance	Number	if within 25km
Lighthouse/Beacon Range	Number	if within 25km of visual flashing beacon
Smoke Stack Presence	Yes/No	if within 25km
Steam Source Presence	Yes/No	if within 25km
Lit Low Flying Obstacle	Yes/No	if within 25km, eg Radio Mast
UK Strategic Site	Text	Name
Distance to Stategic Site(km)	Text	km
Building Gantry	Yes/No	New/existing high structure lit or unli
Power Station	Text	Name if within 25km
Waterfall	Text	Name if within 25km
Major Landmark	Text	eg TOR, Cathedral Tower.
Ley Line	Text	Distance if within 25 km
Earth Fault Line	Text	Distance if within 25km
Air Display	Text	Name if within 50km
Laser Display	Yes/No	Name if within 25km
Distance to Laser Display(km	Number	km
Military Range Air Force	Text	Name if within 50km
Military Range Army	Text	Name if within 50km
Approx Distance to Range(km	Number	km
Lake	Text	
Distance to Lake(km)	Number	If within 25km
Sea	Yes/No	
Distance to Sea(km)	Number	If within 25km
Motorway	Text	Name if within 15km
Electrified Rail	Yes/No	if within 5km

UAP3-OBSRVER DESCRIPTION

EVENT NUMBER	Counter	COMMON TO ALL UAP DATABASE
HOW MANY WITNESSES?	Number	
WITNESS NAME(1)	Text	
WITNESS NAME(2)	Text	
WITNESS NAME(3)	Text	
WITNESS NAME(4)	Text	
WITNESS ADDRESS	Text	
CONTACT PHONE NO	Number	
REPORTED TO	Text	NAME/ORGANISATION
WITNESS PHONE NUMBER	Number	
WITNESS AGE <15 YEARS	Yes/No	
WITNESS AGE <25 YEARS	Yes/No	
WITNESS AGE <50 YEARS	Yes/No	
WITNESS AGE >50 YEARS	Yes/No	
WITNESS AGE >70 YEARS	Yes/No	
MILITARY STYLE TRAINING	Yes/No	e.g. incl. cadet/Air Trng Corps/Police
ARMY SERVICE	Yes/No	past or present
NAVY SERVICE	Yes/No	past or present
AIR FORCE SERVICE	Yes/No	past or present
FOREIGN AIRFORCE	Yes/No	e.g.Foreign Airforce
GROUNDCREW	Yes/No	e.g.Civil or Military Aviation
AIRCREW	Yes/No	MIL OR CIVILTRAINING
ATC(VISUAL WITNESS)	Yes/No	e.g. In Tower or off duty
ATC(RADAR WITNESS)	Yes/No	e.g Radar Op or Supervisor in ATC
ATC(CONFIRM BOTH)	Yes/No	e.g. Visual & radar sighting
AIRPORT WORKER	Yes/No	
TECHNICALLY TRAINED	Yes/No	Science or Engineering
PROFESSIONAL OCCUPATI	Yes/No	
CIVIL POLICE	Yes/No	
MILITARY POLICE	Yes/No	
RNLI	Yes/No	
COASTGUARD	Yes/No	
CUSTOMS OFFICER	Yes/No	
SHIPS CREW	Yes/No	
FIRE SERVICE	Yes/No	
AMBULANCE SERVICE	Yes/No	
AA/RAC	Yes/No	
UFOLOGIST	Yes/No	
OTHER BACKGROUND	Text	E.G RELEVANT WITNESS INTERESTS/HOBBIES

UAP4-OBJECT PHYSICAL DESCRIPTION

EVENT COUNTER	Counter	Common with other tables
Object(s) were seen	Yes/No	Describable in shape, size or pattern etc
Object(s) seen clearly	Yes/No	
Object(s) Blurred	Yes/No	
If several, all the same	Yes/No	
Object shape can be seen	Yes/No	
Length Estimate	Number	In Metres
Diameter Estimate	Number	If applicable (m)
Length/Thickness/Diameter r	Number	If applicable - estimate
Viewed continuously	Yes/No	
Seen intermittently	Yes/No	
More than one object?	Yes/No	
How many Objects?	Number	
Spacing of Objects Constant	Yes/No	If more than one
Spacing of Objects Varies	Yes/No	
Spacing Formed a Geometric	Yes/No	Yes if recognisable in layout
Pattern is Triangular	Yes/No	
Pattern is Square	Yes/No	
Pattern is Oblong or Rect	Yes/No	
Pattern is Circular	Yes/No	
Pattern is a Diamond	Yes/No	
Pattern is Concentric Rings	Yes/No	
Patterns are Oval/Egg-Shape	Yes/No	
Object has long Dimension	Yes/No	
Object Oriented Horizontal	Yes/No	
Object Oriented Vertical	Yes/No	
Object Tapers at one end	Yes/No	
Object Blunt at front end	Yes/No	
Object Sharp at front end	Yes/No	
Object moves it's direction irre	Yes/No	i.e. does not seem to have a front/rear
Object is parallel-sided	Yes/No	
Object Varies in Length	Yes/No	
Object has a Tail	Yes/No	
Object Tail Length Varies	Yes/No	
Object Shape Spherical	Yes/No	
Shape is Cylindrical	Yes/No	
Shape is Round	Yes/No	
Shape is Cigar-Shape	Yes/No	
Shape is Variable	Yes/No	
Shape is Diamond	Yes/No	
Shape is Saucer	Yes/No	
Shape is Tadpole	Yes/No	
Shape is Oblong	Yes/No	
Shape is Square	Yes/No	
Shape is 'egg shaped'	Yes/No	
Object has Protuberances	Yes/No	
How many?	Number	
Appear as 'Legs'	Yes/No	

/CONTINUED

Number of domes	Number	
Domes are on Top	Yes/No	
Domes are Underneath	Yes/No	
Object has 'Port Holes'	Yes/No	
Number of Port Holes	Yes/No	
Portholes are round-shaped	Yes/No	
Portholes are Square in Shap	Yes/No	
Portholes are Regularly Spac	Yes/No	
Porholes are Irregularly-Spac	Yes/No	
Portholes are lit-up	Yes/No	
Object has Hatches	Yes/No	
Location of Hatches	Text	
Object has Surface Markings	Yes/No	
Descibe Surface markings	Text	
Object has Engines	Yes/No	
Object Structure Changes/Va	Yes/No	
Object Glows at front end	Yes/No	
Object Glows all Over	Yes/No	
Object has 'Bumps'	Text	
All Objects the same?	Yes/No	

UAP5-OBJECT MOTION

EVENT COUNTER	Counter	COMMON TO ALL UAP DATABASE
OBJECT STATIONARY	Yes/No	NOT THE SAME AS 'HOVERING'
OBJECT MOVING	Yes/No	
OBJECT MOTION VARIES	Yes/No	ie. MIXED MOTION, STOPS AND STARTS
HOVERING	Yes/No	
HOVERING NEAR GROUND	Yes/No	
ROTATING	Yes/No	
GYRATING	Yes/No	
MOVING SLOWLY	Yes/No	
MOVING STEADILY	Yes/No	
MOVED RAPIDLY	Yes/No	
MOVING RANDOMLY	Yes/No	
MOVING TOWARDS OBSER	Yes/No	WHEN FIRST SEEN
ACCELERATING TOWARDS	Yes/No	WHEN FIRST SEEN
MOVING AWAY FROM OBSE	Yes/No	WHEN FIRST SEEN
ACCELERATING AWAY	Yes/No	WHEN FIRST SEEN
WITHDREW FROM OBSERV	Yes/No	WHEN APPROACHED
FOLLOWED BY OBSERVER	Yes/No	
FOLLOWED THE OBSERVEI	Yes/No	
OBSERVER FOLLOWED OB	Yes/No	
FOLLOWED IN VEHICLE	Yes/No	
PASSED OVER THE OBSEF	Yes/No	
ASCENDED SLOWLY	Yes/No	
ASCENDED RAPIDLY	Yes/No	

/CONTINUED

UNCLASSIFIED
SECRET

DESCENDED SLOWLY	Yes/No	
DESCENDED RAPIDLY	Yes/No	
TURNED BY 'BANKING'/TILT	Yes/No	
ROTATED AS IT WENT	Yes/No	
ROTATED CLOCKWISE	Yes/No	
ROTATED ANTI-CLOCKWISE	Yes/No	
MOVED UPWARDS FROM G	Yes/No	
FIRST APPEARED AT GROU	Yes/No	
FIRST APPEARED/SEEN IN	Yes/No	
MOVED FROM CLOUD TO C	Yes/No	
MOVED FROM EARTH TO C	Yes/No	
MOVED FROM CLOUD TO E	Yes/No	
EMERGED FROM CLOUD	Yes/No	
MOTION BOBBING	Yes/No	
MOTION CREEPING	Yes/No	
MOTION SPIRALLING	Yes/No	
MOTION SWAYING	Yes/No	
MOTION FLOATING	Yes/No	
CLIMBED AFTER FLYING LE	Yes/No	
DIVED AFTER FLYING LEVE	Yes/No	
ALWAYS WAS FLYING LEVE	Yes/No	
TURNED SLOWLY IN AZIMU	Yes/No	
TURNED RAPIDLY IN AZIMU	Yes/No	
CHANGED DIRECTION INST	Yes/No	IN EITHER PLANE

EXECUTED A CURVING DES	Yes/No	
REPEATEDLY MANEOUVRE	Yes/No	
MADE RANDOM MANEUOVI	Yes/No	
MADE AVOIDING ACTIONS	Yes/No	OBJECT APPEARED TO AVOID OBSTACLE
OBJECTS CONVERGED	Yes/No	
CONVERGED RAPIDLY	Yes/No	
CONVERGED SLOWLY	Yes/No	
OBJECTS MERGED	Yes/No	
OBJECTS DIVERGED	Yes/No	
DIVERGED RAPIDLY	Yes/No	
DIVERGED SLOWLY	Yes/No	
OBJECT PATHS CROSSED	Yes/No	
COULD MOVE SIDEWAYS	Yes/No	
MOTION SYMETRICAL	Yes/No	
MOTION ERRATIC	Yes/No	

UNCLASSIFIED
SECRET

UAP6-TECHNICAL EFFECTS

EVENT NUMBER	Counter	Common to all UAP database
ON TERRAIN	Yes/No	
MARKS ON GROUND	Text	DESCRIPTION OF MARKS SEEN
EFFECT ON ATMOSPHERE	Yes/No	
EFFECT ON CROPS	Yes/No	
EVENT CAUSED MIST/HAZE	Yes/No	
EVENT CAUSED TEMPORA	Yes/No	
EVENT CAUSED SMOKE	Yes/No	
EVENT CAUSED CONTRAIL	Yes/No	
ON EQUIPMENT	Yes/No	
CAUSED CAR TO STOP	Yes/No	
AFFECTED CAR LIGHTS	Yes/No	
AFFECTED AIRCRAFT	Yes/No	
TEMPERATURE ROSE	Yes/No	
TEMPERATURE FELL	Yes/No	
AFFECTED ELECTRONICS/I	Yes/No	
AFFECTED BOAT EQUIP	Yes/No	
DISTURBED FOLIAGE	Yes/No	
UPROOTED FOLIAGE	Yes/No	
FLATTENED FOLIAGE	Yes/No	
AFFECT ON OBSERVER(S)	Yes/No	
IMMEDIATE EFFECTS	Yes/No	
CAUSED TINGLING	Yes/No	
CAUSED BURNING	Yes/No	
CAUSED FRIGHT	Yes/No	
CAUSED INJURY	Yes/No	
EFFECT ON SKIN	Yes/No	
CAUSED SHAKING	Yes/No	
CAUSED EYE EFFECTS	Yes/No	
CAUSED BREATHING EFFE	Yes/No	
KNOCKED OVER	Yes/No	
FELT BODY HEAT RISE	Yes/No	
FELT BODY TEMP FALL	Yes/No	
FELT WIND PRESSURE	Yes/No	
FELT HAIR BRISTLE	Yes/No	
FELT NAUSEA	Yes/No	
OTHER EFFECT	Text	
AFTER EFFECTS	Text	
EFFECT ON ANIMALS	Yes/No	
ANIMAL SOUND ALERT	Yes/No	eg. BARKING, MOOING.
ANIMAL HAIR BRISTLES	Yes/No	
ANIMAL COWERING	Yes/No	
ANIMAL WIMPERING	Yes/No	
ANIMAL INJURED	Yes/No	
HERD AFFECTED	Yes/No	eg. COWS RUN ABOUT.

UAP7-METEOROLOGICAL CONDITIONS

EVENT NUMBER	Counter	COMMON KEY TO ALL UAP DATABASE
WEATHER CYCLONIC(low)	Yes/No	
WEATHER ANTI-CYCLONIC	Yes/No	
COL	Yes/No	
WINDSPEED	Number	
WIND DIRECTION	Number	
WIND TURBULENT	Yes/No	eg. GUSTING
DRY SURFACE	Yes/No	IF NOT, ASSUMED WET OR LYING SNOW
VISIBILITY CLEAR	Yes/No	
MISTY	Yes/No	
FOGGY	Yes/No	
SEA FOG	Yes/No	SEA FOG CAN BE MOVING
RAINING	Yes/No	
SNOWING	Yes/No	
DRY SURFACES	Yes/No	
ICY SURFACES	Yes/No	
SLEETING	Yes/No	
SUNSPOT PERIOD	Yes/No	
AURORA PERIOD	Yes/No	
CLOUD COVER(%)	Number	
CLOUDS WHITE	Yes/No	
ELECT STORM NEAR	Yes/No	WITHIN 50KM
CLOUDS OVERCAST	Yes/No	
CLOUDS SILVER	Yes/No	
CLOUDS BLACK	Yes/No	
CLOUDS GREY	Yes/No	
CLOUDS BROKEN	Yes/No	
SKY BLUE	Yes/No	
CONTRAIL CONDITIONS	Yes/No	
CONTRAILS SEEN	Yes/No	
CLOUD HEIGHT	Number	
CLOUD AMOUNT	Number	OCTAS
CLOUD ILLUMINATED	Yes/No	BY SUN/REFLECTION
CLOUD TYPE	Text	CUMULUS etc.
RAINBOW	Yes/No	
TEMPERATURE DEG	Number	
TEMPERATURE INVERSION	Yes/No	YES IF CORRECT CONDITIONS

UAP7-OBSERVER LOCATION

EVENT NUMBER	Counter	COMMON KEY TO ALL UAP DATABASE
OBSERVER ON FOOT	Yes/No	
OBSERVER IS PASSENGEF	Yes/No	
IN CAR	Yes/No	
CAR MOVING	Yes/No	
CAR DRIVER	Yes/No	
IN AIRCRAFT	Yes/No	
AS CREW	Yes/No	
SHIP AT SEA	Yes/No	
BOAT ON LAKE	Yes/No	
OBSERVER IN BUILDING	Yes/No	
ON TOP BUILDING	Yes/No	
CYCLING	Yes/No	
WALKING	Yes/No	
RIDING	Yes/No	
CLIMBING	Yes/No	
HILL WALKING	Yes/No	
GLIDING	Yes/No	
SWIMMING	Yes/No	
OBSERVER BELOW OBJEC	Yes/No	
OBSERVER ABOVE OBJEC	Yes/No	
OBSERVER LEVEL WITH OE	Yes/No	
OBSERVER ALTITUDE	Number	IF IN/ON HILLS OR MOUNTAINS
AIRCRAFT ALTITUDE	Number	IF CREW OR AIRCRAFT PASSENGER

UAP7-VIEWING BACKGROUND

EVENT NUMBER	Counter	COMMON KEY FOR UAP DATABASE
LOCATION RURAL	Yes/No	
LOCATION WOODED	Yes/No	
CONIFEROUS	Yes/No	
DECIDUOUS	Yes/No	
MIXED TREES & BUSHES	Yes/No	
FIELDS-GRASSLAND	Yes/No	
FIELDS MIXED	Yes/No	
PLOUGHED	Yes/No	
FIELDS-CROPPED	Yes/No	
CROP COLOUR	Text	
SURFACE SWAMPY	Yes/No	
OVER FRESH WATER	Yes/No	
OVER SALT WATER	Yes/No	
OVER SMOOTH WATER	Yes/No	
OVER RIVER	Yes/No	
OVER LAKE	Yes/No	
LOCATION 0- URBAN	Yes/No	
LOCATION CITY/TOWN	Yes/No	
DARK BACKGROUND	Yes/No	
CONTRASTING BACKGROU	Yes/No	CONTRASTING BACKGROUND WITH OBJECT COLOUR
FLAT TERRAIN	Yes/No	
OVER HILLS	Yes/No	
OVER MOUNTAINS	Yes/No	
IN A VALLEY	Yes/No	
OVER TREES	Yes/No	

UAP8-OPTICAL & RADIATION

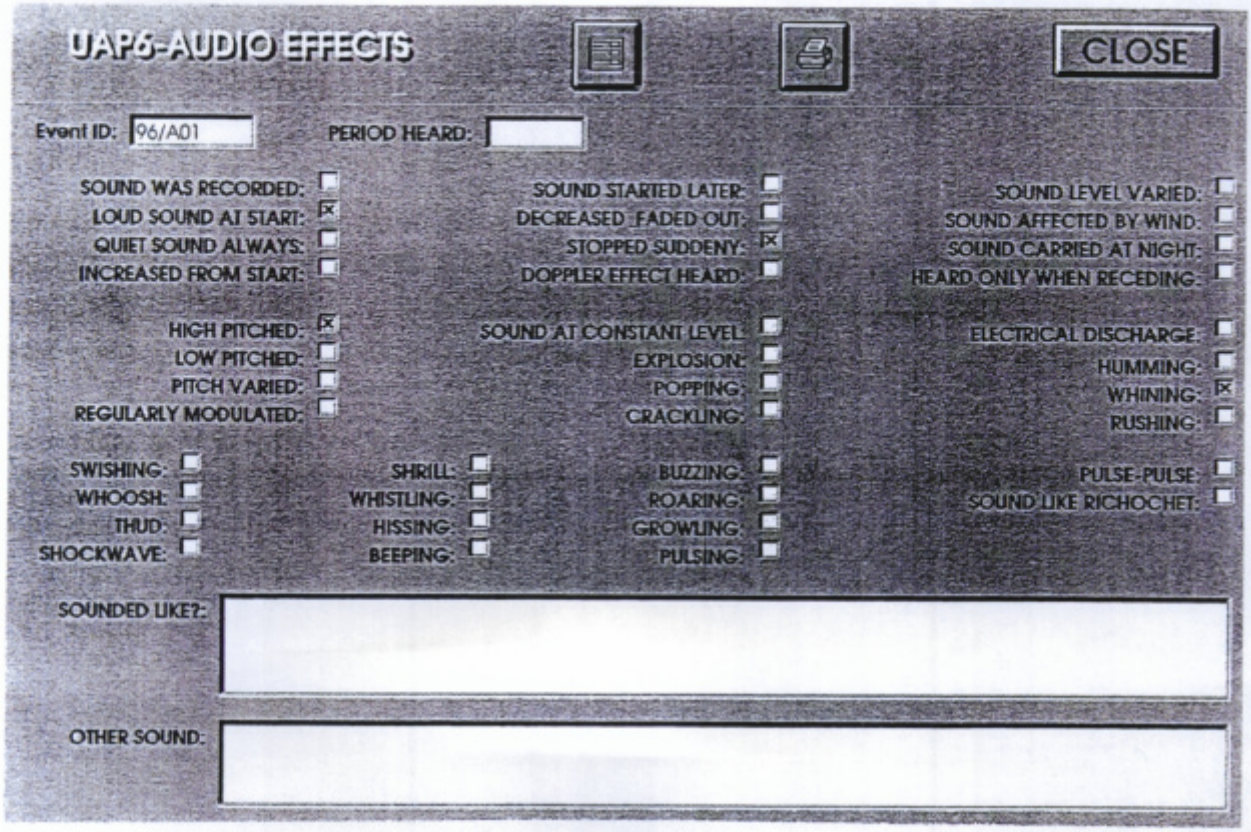
EVENT NUMBER	Counter	COMMON IDENTIFIER THROUGHOUT DATABASE
NAKED EYE	Yes/No	
WEARS GLASSES	Yes/No	
SEEN THROUGH GLASS	Yes/No	
FLAT GLASS	Yes/No	
CURVED GLASS	Yes/No	
SANDWICHED GLASS	Yes/No	
BINOCULARS	Yes/No	
BINOCULAR MAGNIFICATIO	Number	
TELESCOPE	Yes/No	
ZOOM DEVICE	Yes/No	
DAYLIGHT VIDEO	Yes/No	
LLTV (VIDEO CAMERA)	Yes/No	
LLTV(LUX SPEC)	Yes/No	
VIDEO CAMERA TYPE	Text	
STILL CAMERA	Yes/No	
CAMERA TYPE	Text	
AUTO FOCUS	Yes/No	
ACOUSTIC SENSOR	Yes/No	TAPE RECORDER OR VIDEO AUDIO
RADIATION SENSORS	Yes/No	ONE OR MORE RADIATION SENSORS USED
INFRA-RED SENSOR	Yes/No	IR EQUIPMENT USED DURING SIGHTING
IRST	Yes/No	IMAGING IR RECORDING MADE
IR HOT SPOT SENSOR	Yes/No	HOT SPOT DETECTION MADE
RF RADIATION SENSOR	Yes/No	RF RADIATION SENSOR PRESENT
RF REFLECTED FROM OBJ	Yes/No	ACTIVE RADAR DETECTION
RF RECEIVED FROM OBJ	Yes/No	OBJECT SELF RF RADIATION DETECTED
ELECTROSTATIC FIELD	Yes/No	ES FIELD MEASURED
NUCLEAR RADIATION	Yes/No	NUCLEAR RADIATION MEASURED
NUCLEAR DESCRIPTION	Text	TYPE OF RADIATION, MEASURED AT TIME OR LATER
MAGNETIC SENSOR	Yes/No	
COMPASS AFFECTED	Yes/No	MAGNETIC COMPASS DISTURBED
LIGHTMETER	Yes/No	EFFECT IF USED BY PHOTOGAPHER

UAP9-OBSERVER GEOMETRY

EVENT COUNTER	Counter	COMMON TO ALL UAP DATABASE
OBJECT AZIMUTH BEARINC	Number	COMPASS BEARING FROM OBSERVER
TOTAL AZ ANGLE MOVED	Number	eg. OBSERVED THROUGH 60 DEGREES OF AZ.
CARDINAL DIRECTION	Text	eg. WSW, NE, etc.
FIRST ELEVATION ANGLE	Number	eg. HORIZON EQUALS ZERO DEGREES
FINAL ELEVATION ANGLE	Number	CAN BE THE SAME AS FIRST ANGLE IF OBJECT STATIONARY OR LEVEL
TOTAL ELEV ANGLE MOVEI	Number	eg. 90 DEGREES IF MOVED TO OVERHEAD
SUN SHINING	Yes/No	
SUN YELLOW	Yes/No	
SUN RED	Yes/No	
SUN REFLECTED	Yes/No	
SUN ELEVATION ANGLE	Number	
SUN BEHIND OBSERVER	Yes/No	
SUN BEHIND OBJECT	Yes/No	
OBSERVER BELOW OBJ	Yes/No	
OBSERVER LEVEL TO OBJ	Yes/No	
OBSERVER ABOVE OBJECT	Yes/No	
OSEST RANGE TO OBJ	Number	IN KILOMETRES/FRACTION OF KM, ESTIMATED
CLOSEST MINS	Number	eg. 15 SEC EQUALS 0.25

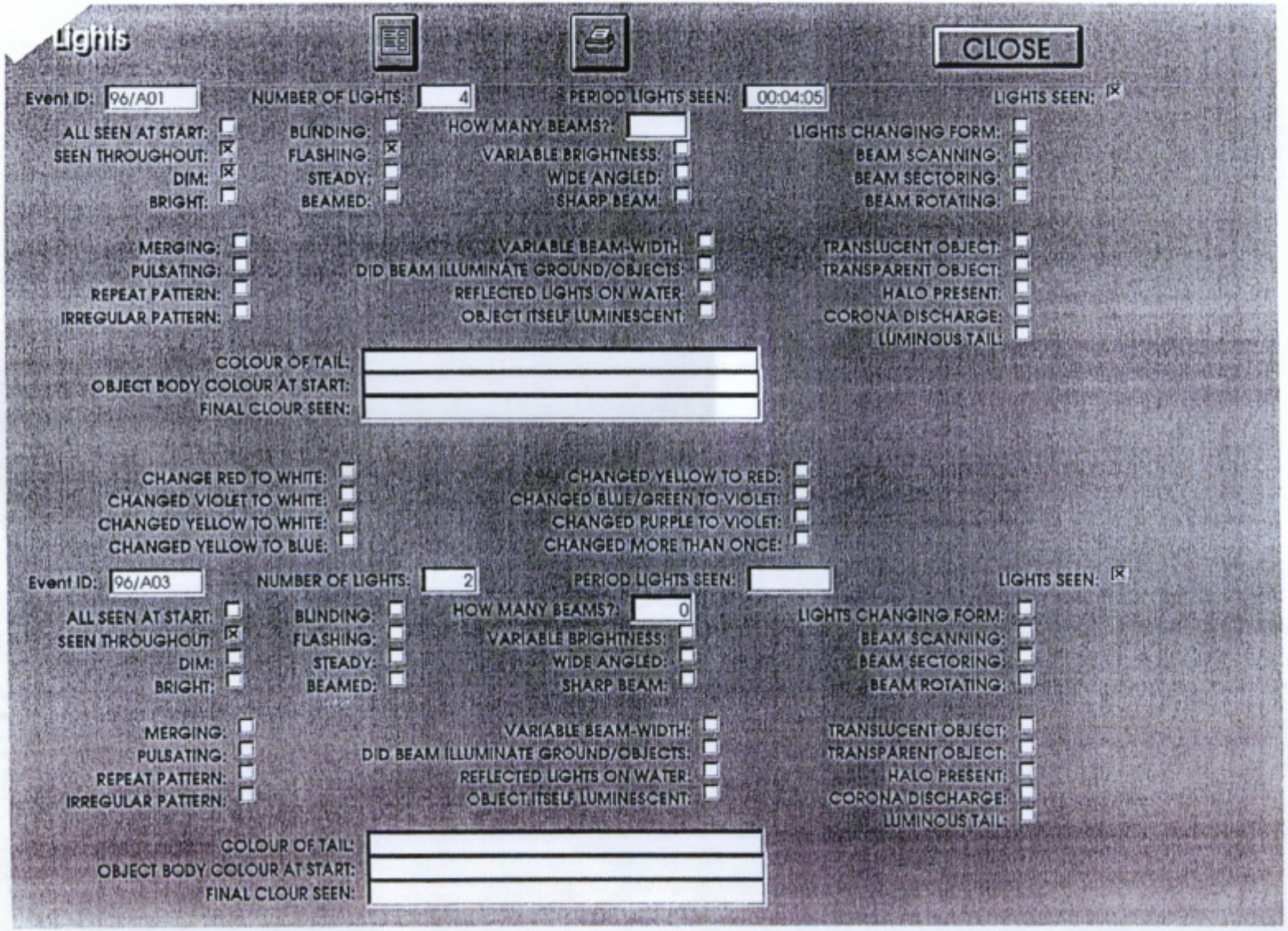
UAP10-FINAL DESCRIPTION

EVENT COUNTER	Counter	
DISSAPEARED SLOWLY	Yes/No	
DISSAPEARED SUDDENLY	Yes/No	
FADED	Yes/No	
EXPLODED	Yes/No	
LANDED	Yes/No	
TOOK-OFF	Yes/No	
VANISHED	Yes/No	
VANISHED NO SOUND	Yes/No	
ACCELERATED AWAY	Yes/No	
LAST VELOCITY HIGH	Yes/No	
LAST VELOCITY LOW	Yes/No	
LAST VELOCITY STEADY	Yes/No	
FINAL COMPASS AZIMUTH	Number	
FINAL CARDINAL	Text	
FINAL ELEVATION ANGLE	Number	
ALWAYS LOOKED THE SAM	Yes/No	
CHANGED APPEARANCE A	Yes/No	
CHANGED SHAPE	Yes/No	
FINAL SHAPE	Text	
CHANGED COLOUR	Yes/No	
FINAL COLOUR	Text	
CHANGED GEOMETRY	Text	OF OBJECTS IF MORE THAN ONE
LIGHTS WENT OFF	Yes/No	
LIGHTS FADED	Yes/No	
MORE LIGHTS CAME ON	Yes/No	
DESCRIBE LIGHTS	Text	
SOUND AT END	Text	



UAP13-IMAGERY AUDIO (IMAGE & AUDIO RECORDING)

EVENT COUNTER	Counter	COMMON KEY TO ALL UAP DATABASE
CAMERA USED	Yes/No	
STILL IMAGERY	Yes/No	
NO OF SHOTS	Number	
OBSERVER SKETCH	Yes/No	
JARIC DIAGRAM	Yes/No	
JARIC REPORT	Number	
VIDEO RECORDING	Yes/No	
VIDEO DURATION	Number	MINUTES
AUDIO RECORDING	Yes/No	
RECORDING DURATION	Number	
MAP OF AREA DRAWN	Yes/No	BY OBSERVER AT THE TIME OF REPORTING
ARTIFACTS IDENTIFIED	Yes/No	



UNCLASSIFIED
SECRET
UK EYES ONLY
UK RESTRICTED

UAP12-EVENT CATEGORISATION LOG

EVENT NUMBER	Counter	COMMON KEY THROUGHOUT DATABASE
MULTI-ASPECT VIEWING	Yes/No	
MULTI-SENSOR VIEWING	Yes/No	
ARTIFACTS PRESENT	Yes/No	
SURFACE EFFECTS	Yes/No	
EXPERIMENTAL FLYING	Yes/No	
UNMANNED AIRCRAFT	Yes/No	eg. DRONE, TARGET, RECCE DRONE ETC
MET BALLOON	Yes/No	
TETHERED BALLOON	Yes/No	
HOT AIR BALLOON	Yes/No	
HELICOPTER	Yes/No	
AIRSHIP	Yes/No	
GLIDER	Yes/No	
HANG GLIDER	Yes/No	
SATELLITE IN ORBIT	Yes/No	
SATELLITE GLOW	Yes/No	
METEORITE RE-ENTRY	Yes/No	
SATELLITE RE-ENTRY	Yes/No	
FLIGHT REFUELLING	Yes/No	
MILITARY FLYING	Yes/No	
CIVIL FLYING	Yes/No	
BIRDS	Yes/No	
RNLI/COASTGUARD FLARE	Yes/No	
SHIPS/RNLI SEARCHLIGHT	Yes/No	
AIRCRAFT FLARE	Yes/No	
AIRCRAFT SEARCHLIGHT	Yes/No	
HELICOPTER SEARCHLIGHT	Yes/No	
HEADLIGHT(VEHICLE)	Yes/No	
LANDING LIGHT(AIRCRAFT)	Yes/No	
GROUNDBASED SEARCHLIGHT	Yes/No	
LASER DISPLAY	Yes/No	
LIGHTHOUSE/BEACON	Yes/No	
CONTRAIL	Yes/No	
SONIC BOOM	Yes/No	
OPTICAL MIRAGE	Yes/No	
INDUSTRIAL LIGHTING	Yes/No	
TOWN/CITY LIGHTS	Yes/No	
ADVERTISING LIGHTS	Yes/No	
MOTORWAY LIGHT/SOUND	Yes/No	
MILITARY EXERCISE	Yes/No	
BATTLE AREA/RANGE	Yes/No	
PARACHUTES	Yes/No	
JET AIRCRAFT GASES	Yes/No	EG SHOCK DIAMONDS IN REHEAT
WAKE VORTICE	Yes/No	
VERTICAL VORTICE	Yes/No	
LINKED VORTICES/TWISTER	Yes/No	
SUNSET/RISE EFFECT	Yes/No	
PROJECTED SHADOWS	Yes/No	

/CONTINUED

PROJECTED LIGHTS	Yes/No	
CLOUD FORMATION	Yes/No	
PUBLICITY STUNT	Yes/No	
PSYCHOLOGICAL	Yes/No	
PARAPSYCHOLOGICAL	Yes/No	
OCCULT RELATED	Yes/No	
DRUG RELATED	Yes/No	
ALCOHOL RELATED	Yes/No	
ATMOSPHERIC EFFECT	Yes/No	
REFLECTION	Yes/No	
BEAD BALL LIGHTNING	Yes/No	
BALL LIGHTNING	Yes/No	
VAPOUR VORTICE	Yes/No	
ICE CRYSTALS	Yes/No	
HALO	Yes/No	
CORONA	Yes/No	
ST ELMO'S FIRE	Yes/No	
MIGRATING BIRDS	Yes/No	
SINGLE LARGE BIRDS	Yes/No	
MOCK SUN	Yes/No	
MOCK MOON	Yes/No	
UNKNOWN PLASMA	Yes/No	
ASTRONOMICAL EFFECT	Yes/No	
COMET	Yes/No	
METEORITE	Yes/No	
SMALL PLANET	Yes/No	
MAJOR PLANET	Yes/No	
STAR	Yes/No	
SUN RAY HALATION	Yes/No	
EARTHLIGHT	Yes/No	
TRIBOLUMINESCENCE	Yes/No	
SUNSET FLASH	Yes/No	
AURORA	Yes/No	
PARASENENIC	Yes/No	
PARHALIAN	Yes/No	
UNIDENTIFIED	Yes/No	
IONOSPHERIC EFFECT	Yes/No	
LOCATION RELATED	Yes/No	
STRATEGIC LOCATION RELATED	Yes/No	
FAULT LINE RELATED	Yes/No	
UAP	Yes/No	

UNCLASSIFIED

ANNEX E

INITIAL ANALYSIS REQUIREMENTS

1. An initial examination of the raw reports suggested that a certain amount of manual and machine manipulation would be required before entry into the database. This was partially done in language 'Perl'. Once adequate data became available it would be possible to make an analysis which contained at least the following, with plots as required:

a. Number of events in timescale of weeks, months, years as histograms.

b. Events plotted against geographical locations (may have to use expanded maps or postcodes, as required if clusters fall on top of each other).

c. Events plotted against time of day (i.e. day, night, dusk, darkness).

d. Events plotted against proximity to:

- Airports
- Power Stations
- HV Power lines (including Rail)

e. Tabulate all events with sound.

f. Tabulate/plot all events with same shape reported (i.e. triangle, oblong, sphere or cigar/oval),

g. Identify all events where item seen:

- Was first stationary
- Was first low then climbed
- Was seen on radar
- Was seen both on radar and visually

h. All events with a tail.

j. All events with a smell.

k. All events reported by aircrew/coastguards/police as witnesses.

l. All events with more than one witness.

UNCLASSIFIED

UNCLASSIFIED

m. All events where 'portholes' or ' beams of light' are reported.

n. All events near ley lines.

p. Combinational events for:

- Stationary with 'portholes'
- Triangular plus white lights only
- Blue lights plus any shapes.
- Mist present or given off, plus coloured lights.

q. Sighting on same day but different sources.

r. Motion – events where time seen, sector passed through, together with either range or altitude are given. (needed for approximate velocity check).

s. Number of sightings for given duration.

t. List any sightings seen with:

- Terrain disturbance
- Animal reaction
- Human injury or after-effects

u. List al events where witness name appears more than once.

v. Co-locate sightings against geological rock formations.

w. Plot against civil air lanes and RAF low flying routes.

UNCLASSIFIED

UNCLASSIFIED

ANNEX F

AIR MINISTRY,
WHITEHALL,
S.W.1.

PRIME MINISTER

The various reports about unidentified flying objects, described by the Press as "flying saucers", were the subject or a full Intelligence study in 1951. The conclusions reached (based upon William of Occam's Razor) were that all the incidents reported could be explained by one or other of the following causes:-

(a) Known astronomical or meteorological phenomena

(b) Mistaken identification of conventional aircraft, balloons, birds, etc.

(c) Optical illusions and psychological delusions

(d) Deliberate hoaxes.

2. The Americans, who carried out a similar investigation in 1948/9, reached a similar conclusion.

3. Nothing has happened since 1951 to make the Air Staff change their opinion, and, to judge from recent Press statements, the same is true in America.

4. I am sending a copy of this to Lord Cherwell.

L.L.B.

9th August, 1952.

UNCLASSIFIED

DIST
DISA2
Collection

UNCLASSIFIED
SECRET
UK EYES ONLY

Copy No 7 of copies

Unidentified Aerial Phenomena in the UK Air Defence Region: Volume 2

Information on Associated Natural & Man-Made Phenomena

SCIENTIFIC & TECHNICAL MEMORANDUM - No. 55/2/00

MINISTRY OF DEFENCE
RECEIVED
7 DEC 2000
A31 - 3853
D154 REGISTRY

DEFENCE INTELLIGENCE STAFF

December 2000 **Defence Intelligence Analysis Staff**

DIS

UNCLASSIFIED
UK EYES ONLY
SECRET

UNCLASSIFIED

THIS DOCUMENT IS THE PROPERTY OF HER BRITANNIC MAJESTY'S GOVERNMENT, and is issued for the information of such persons only as need to know its contents in the course of official duties. Any person finding this document should hand it to a Service Unit or Police Station for its safe return to the **MINISTRY OF DEFENCE, DEFENCE INTELLIGENCE STAFF, LONDON, SW1,** with particulars of how and where found.

THE UNAUTHORISED RETENTION OF THIS DOCUMENT, OR ITS DESTRUCTION, IS AN OFFENCE UNDER THE OFFICIAL SECRETS ACT 1911-1989. (When released to persons outside Government Service, this document is issued on a personal basis and the recipient to whom it is entrusted in confidence, within the provisions of the Official Secrets Acts 1911-1989, is personally responsible for its safe custody and for seeing that its contents are disclosed only to authorised persons).

UNCLASSIFIED

UNCLASSIFIED

SECRET

UK RESTRICTED

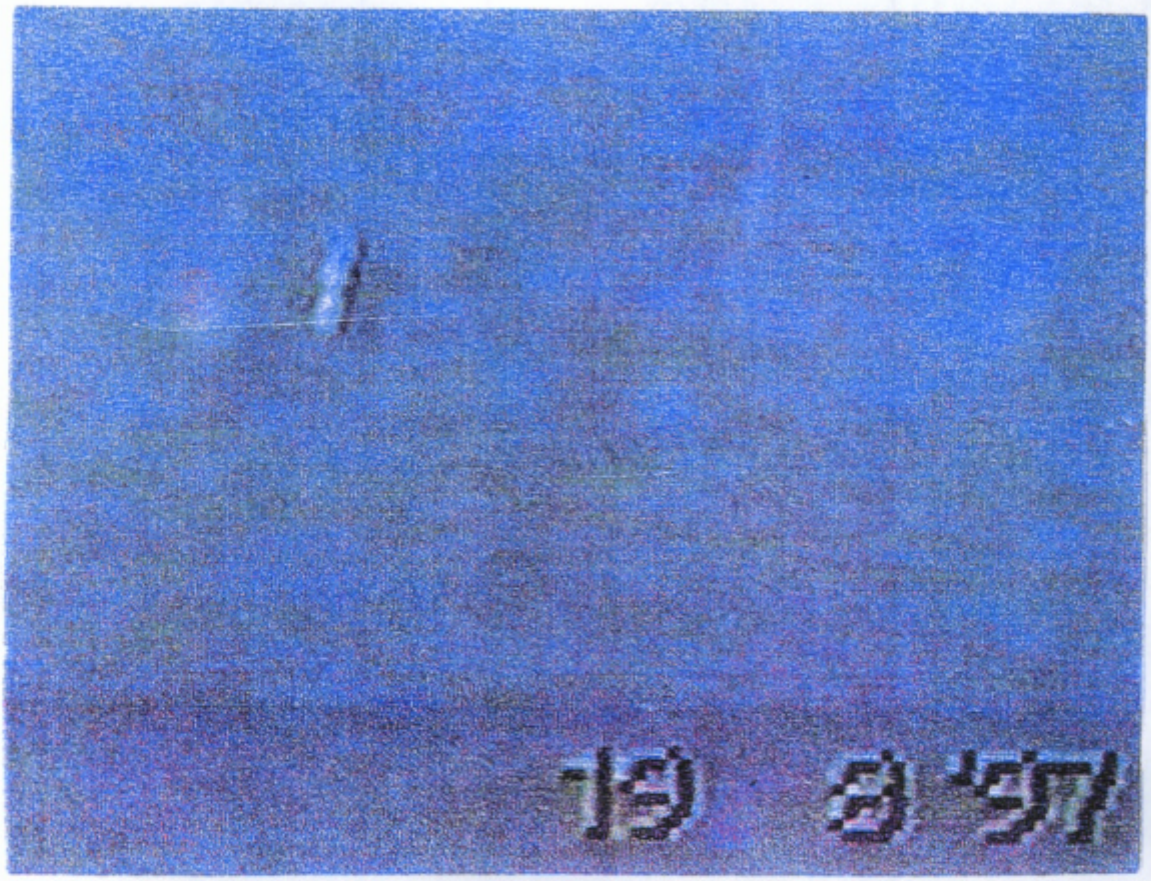
DIS SCIENTIFIC & TECHNICAL MEMORANDUM 55/2/00

INFORMATION ON ASSOCIATED NATURAL AND MAN-MADE PHENOMENA

VOLUME 2

XXXXXXXXXX XXXXXXXXX

UNCLASSIFIED
SECRET



LOWESTOFT 1997

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

PREFACE

1. This is Volume 2 of a three-volume 'Report on Unidentified Aerial Phenomena (UAP) in the UK Air Defence Region'. A complete index for all three volumes is at Volume 1. Volume 2 contains working papers, in no particular priority order, resulting from information collected and conclusions drawn from a wide variety of phenomena which have been applied to the study of UAP. (R)

2. This wide spread of background information is required in order to understand the relationship between UAP sightings and their probable explanations. While the majority of UAP reports can easily be explained as aircraft, satellites, clouds etc., it has been necessary to investigate some phenomenal aspects in much more detail. A significant, but rare phenomenon, for example, particularly in the study of alleged UAP effects on humans, potentially causing them to see (and possibly to hear) exceptional events due to UAP field effects and the reported degradation of vehicle electrics and electronics, is that no actual UAP electro-magnetic or other field measurements exist. (R)

3. The aim of the attached papers was to act as a reference source during UAP report analysis, interpretation and identification. In many cases much more information is available on most of these topics. That which is included is judged to be suffucient for an understandiung in the UAP context. (U)

4. The copyright of reference material used is given wherever this is known..(U)

February 2000

Issued by XX DI55 not relevant

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET

CONTENTS

1	UAP Effects on Humans, Electrical/Electronic Equipments and Objects
2	Ball and Bead Lightning
3	Potential Reasons for Higher Densities of UAP Sightings
4	After Images as a Result of Flashes of Light
5	Detection of UAPs by Radar
6	Exotic Technologies
7	Sightline Rates of Flying Objects & Meteorites
8	Rarity of UAP Sound Reports
9	Black and other Aircraft Programmes as UAP Events
10	Ley Lines, 'EARTH LIGHTS' and UK Earth Fault Lines
11	Collected Imagery and Classification of UAP Shapes
12	Earth's Magnetic Field in the UKADR
13	Visual Meterological and other Natural Phenomena
14	Meteorological Balloons
15	Air Ships and Hot Air Balloons
16	Sunspot, Aurora and Seismic Correlation
17	Visual Observation of Satellites
18	Projected Shapes/Shadows, Fluorescence & Luminescence
19	Charged Dust Aerosols
20	Optical Mirages
21	Ionospheric Plasma
22	Artefacts
23	Linked Vortex Rings
24	Sprites, Elves and Blue Jets
25	Overview of Magnetic Field Effects on Humans

UNCLASSIFIED
SECRET

UNCLASSIFIED

WORKING PAPER NO. 1

UAP EFFECTS ON HUMANS, ELECTRICAL/ELECTRONIC EQUIPMENT AND OBJECTS

	Para. No	Page
SENSING THE PRESENCE OF A UAP	1	1-1
Animals	2	1-1
ELECTRO-MAGNETIC FIELD LEVELS	4	1-1
Magnetic Fields	(a)	1-1
Electric Fields	(b)	1-1
Electromagnetic (EM) Fields	(c)	1-2
MAGNETIC FIELD EFFECTS	5	1-2

ANNEXES:

A SOUND

B ODOURS

C TASTE

D EM EFFECTS ON EQUIPMENT & OBJECTS

E DIRECT THERMAL EFFECTS

F NON-IONISING EM EFFECTS ON HUMANS

February 1, 2000

XXXXXXXXXX S.40

UNCLASSIFIED

UNCLASSIFIED SECRET

UAP EFFECTS ON HUMANS, ELECTRICAL/ELECTRONIC EQUIPMENT AND OBJECTS

SENSING THE PRESENCE OF A UAP

1. The ACCESS Database tables generated for the UAP study encompass all the sensing methods and descriptions, of which humans are capable, except touch. This paper provides an initial overview. Some of the topics are considered in further detail in following working papers. The sensing methods are:

- Aided or unaided visual sight (including colours, shapes etc.)
- Sound (Annex A)
- Heat (Annex E)
- Smell (Annex B)
- Feeling (excluding actual touch), for example sensing air pressure, electrical fields (static effect on skin/hair, burning of skins) - Direct Thermal Effects (Annex D)
- Taste (Annex C)
- Description of the Sighting Location and Environment
- Non-Ionising Electromagnetic Effects. (Annex F)

2. **Animals** Several of the effects are also found to extend, in some parameters, to other animals such as farm and domestic animals.

3. The following sections and subsequent working papers consider each of these effects briefly, as an aid to future analysis of UK sightings. The following review is not in any specific order of priority. Although it is very rare for the initial contact not to be by a visual sighting. The combination of more than one sensing effect, (at para. 1, above) is present on only some occasions.

ELECTRO-MAGNETIC FIELD LEVELS

4. On the assumption that some sort of field emanates from a UAP, though not necessarily on all occasions, and is apparently only influential on humans when at close range; there are three field options, using the most familiar types of field to consider. These are:

(a) **Magnetic Fields** A magnetic (H) field can be either natural (e.g. Earth's natural field), generated, or stored (permanent). Familiar magnetised ferrous-based materials form permanent magnetics, while solenoids generate fixed or varying magnetic fields. In the UAP context this would either mean the presence of large (and heavy) field generators on a substantial and solid 'craft', or a magnetic field being generated in a UAP comprised of, perhaps, a plasma. As is well-known a magnetic field is polarised, with lines of force (flux) travelling towards the opposite polarity either on the same source or towards the earth's surface. A magnetic flux can be modulated, although the rate and shape of the resulting energy time distribution is affected by the presence of inductance, capacitance and resistance.

(b) **Electric Fields** Electric (Electrostatic) fields are set up between objects of opposite electrical potential. Familiar manifestations of the presence of an E field is hair standing on end/bristling. For an E field to exist a non-conducting (free space, dielectric/gas) material must be between the charged entities. In the UAP context the E field, (for human effect) would conceptually pass between the UAP 'body' and earth, with the human in between. The human may be 'earthed' (i.e. standing on the surface), depending on the scenario.

UNCLASSIFIED SECRET

(c) **Electromagnetic (EM) Fields** These are often described generically as Radio Frequency (RF) fields as they are widely used for radio/radar emissions although the EM spectrum extends over a much wider range in practice, including IR, UV and the visible bands. An EM field is taken to comprise both E and H (Electric and Magnetic) components, which are separately detectable and measurable. Close to their origin (normally known as the source or transmitter) their relative amplitudes and phase are usually complex, but after a short distance the resultant wavefront becomes stable. In the UAP context the main interest is in whether a UAP body radiates EM waves, other than those in the visible part of the spectrum - which are present anyway, as the means by which a UAP is most often seen. The polarisation of an EM field is defined by the orientation of its E field to the horizon, but since an EM wavefront might be rotated, then both elliptical and circular emissions can occur.

Currently, the field characteristics of a UAP are unknown but it is a corroborated fact that, in addition to light (and sometimes heat), some sort of field is emanated which has adverse effects on some people when they are close to the source. A search was therefore made to identify possible effects on people exposed to all three of the main options (a) to (c) above, both physical and mental. The following information is included because of its applicability to the subject, to assist in future analysis and elimination, and especially because of the discoveries at Working Paper No. 25.

Annex D considers EM effects on Equipment and Objects and Annex F non-ionising effects on humans.

MAGNETIC FIELD EFFECTS

5. The findings due to purely magnetic effects are considered to be of prime importance in the UAP content because of the response of the human brain and the similarity to UAP reporting. This has warranted the separate Working Paper No. 25.

A first general effects summary chart for electromagnetic (microwave) effects on humans is at Table F-1.

ANNEX A

SOUND

1. Sounds which are sometimes reported accompanying sightings are not unusual in nature (see para 3, below), but the reasons for hearing (or not hearing) an airborne object can be complex. Further, there is wide scope for mis-reporting of those sounds which are heard. (Working Paper No. 8 considers this aspect further). They range from the violent roar or even explosion, to the low hum. The more violent can clearly come from the explosion which sometimes occurs when ball lightning disappears. However, there are reports that objects which seem to emit other sounds (e.g. whistling) or may glow very brightly, can also cause an explosive (i.e. shock-wave effect) as they 'leave the ground' or 'take-off'. These events are apparently sometimes accompanied by the formation of a mist. If an object changes its temperature or surface pressure, condensation can occur if the air is moist.

2. If microwave fields are also involved, the formation of mists may be as the result of water molecule absorption wavelengths forming resonances. (These occur at $\lambda = 0.017$m and at four other values when $\lambda < 0.001$m). However, it is not clear how, or if, this causes the sounds which are reported.

3. The most likely reported sounds, described as normal acoustic waves, are humming, buzzing, whistling, beeping or pulsing; and they are either low or high-pitched. Observers use their own perception of sound and a wide range of descriptions are therefore used.

4. Whistling sounds are reported to be equal or louder in intensity than those of jet aircraft, even to the point of being heard inside an aircraft. Changes in pitch have been noted - not as a familiar Doppler effect, but abruptly, suggesting very high sightline (i.e. observer crossing) rates or abrupt changes of direction.

5. Animals can be 20-30% more sensitive than humans. Frequent reports suggest extreme animal reaction to unexplained sightings. Human audio upper cut-off frquency is at 20kHz. The cut off, for example, for cats, is 60kHz and the microwave density for sound to be induced in cats is about one quarter of that for humans.

6. It is well established that microwaves can be sensed, i.e. 'heard', as well as normal acoustics. Experiments show that this is likely to occur at RFs between 200 and 3000MHz. (λ = 1.5m to λ = 0.10m), with peak power densities of 300m.W. cm^{-2}. Hence PRFs of 50-100Hz can be heard as humming.

7. An entirely different audio mechanism can occur where human biological tissue absorbs energy, which, in turn, increases temperature, causes expansion and pressure - which then propagates as vibration and cause sounds to be heard by the auditory nerve.

8. Sound effects caused by microwaves are dependent on head size (and clearly vary from person to person and animal type). The microwave density levels for humans to receive sound effects is several hundred times the current microwave safety limits. Subjects recieving these extreme levels often describe them as producing very highly pitched whistles.

SUMMARY

9. In summary, there are two mechanisms which can produce sounds which humans have described when in close proximity to unexplained phenomena. For weak intensities and low prfs (or CW) the low audio acoustic range is the normal human reception mechanism. However, when microwaves are present, if the mechanism of tissue vibration is caused, then the noise heard is described as having a much higher pitch. About 6% (of over 300 humans tested experimentally) could hear' S(E/F Band) EM emissions as 'buzzing'.

SECRET
UNCLASSIFIED

ANNEX B

ODOURS

1. Some cases have occurred where peculiar odours have been reported. These seem to be produced by microwaves or high energy electrical fields.

2. These effects are well understood and can be replicated in the laboratory. Normally the smell is described as 'sulphurous', 'electrical burning' or ozone-like.

3. During electrical discharges in the atmosphere many electrical compounds are formed. Nitric oxide, for example, reacts with other atmospheric gases to form nitro-benzene, which smells like bitter almonds.

4. The slow decay of activated nitrogen can exhibit a white glow and may be the reason for white trails (or 'tails') sometimes described by witnesses, whether or not the witness has smelled the chemical reaction.

5. Reports have been received where a 'strange odour' hangs in the air for some time after an event.

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

TASTE

1. This effect is usually described as the taste one can experience when placing a low voltage (e.g. dry battery) electrode on the tongue. It is often described as 'metallic' and 'tingling'. The effect is created, for example if dissimilar metals are placed on the tongue, creating a battery, with an extremely low (μA) current flow. However, the presence of 'taste' in the vicinity of UAPs occurs without touch.

2. The taste is immediate but the decay much longer. It is reported that this effect can occur by pulsing and by alternating currents up to ~1000Hz. The affect is attributed to the breakdown of the chemicals in saliva. Since the human body is conductive, it is believed that bursts of EM energy could cause the 'taste' effect. Estimates are that a current of >100μA (DC or AC) is required. Less than 1% of a 300+ sample of humans could 'taste' the presence of microwave energy. This may well be modified by the presence/absence of metallic teeth fillings.

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

EFFECTS ON EQUIPMENT AND OBJECTS

1. The reported effects, which seem to be due to electrical charges, magnetic and microwave energy are known to have caused:

- Overheating of car batteries.
- Metallic objects rising in temperature.
- Magnetisation, which is sometimes retained.

MAGNETIC EFFECTS

2. Objects close to reported UAP sightings have been subject to:

- Permanent magnetism (fences, flag poles). This seems to imply DC or very slowly varying magnetic fields.
- Radio interference. Radios can appear to off-tune (or go off their stations, since, presumably, they move to a non-receiving wavelength). This is possibly due to the magnetisation of the ferrites used as the antenna cores (i.e. part of the tuning loop) in modern communications/radio receivers.
- Interference with magnetic compasses.

3. In the latter case compass rotation rates have been noted. The effect (and speed) can be replicated by exposing the compass to an appropriate pulsed or varying magnetic field.

4. France is known to have measured magnetic field strengths in the vicinity of sightings as early as the 1950s when an extensive field measurement system (network of sensors) was set up for nuclear effects and the earth's geomagnetic field. Measurements to 1 part in 1000 established the change in field (in the presence of a UAP) and extraordinarily-high magnetic fields were sensed. When this level was translated (i.e. scaled) to a reported distance of a few hundred metres between UAPs and radio receivers, from other reports elsewhere, the magnetic flux was consistent with the levels needed to cause the radio receiver effects reported.

5. High frequency magnetic fields, presumably from nearby UAPs, are reported as causing battery acid heating (conducting medium), and other conductors to warm-up, while non-conductors, e.g. rubbers, plastics have reportedly remained cold to the touch.

6. French reports suggest that the slowly varying magnetic fields suspected do not appear to noticeably cause any body-currents in humans. The effects of EM fields on humans is covered at Annex F.

7. A report from Finland in 1977, which involved 170 troops on the Finnish border reported RF equipment 'jammed' and no telephones.

UNCLASSIFIED
UK RESTRICTED
SECRET

ANNEX E

DIRECT THERMAL EFFECTS

1. Short-range observations, in almost every reported instance, have been accompanied by a sensation of heat, ranging from mild warmth to severe burning. Normally (but not exclusively) these appear to be line-of-sight effects.

2. If an object is surrounded by a plasma (usually described as 'a glow'), it can radiate broad-band energy well beyond the visible spectrum. If an object is without plasma (i.e. seen to have a 'metal' surface), it can radiate IR radiation from any gases or body heat which may be present, or energy at UV wavelengths.

3. Reports of 'sunburn', severe sunburn, and even eye-pain and loss of vision have been reported. In one event the witness, a policeman, suffered arm-burns through a long-sleeved uniform. But his body was otherwise protected by the car door; behind which he was standing.

4. All indications are that the phenomena at paragraph 3 above could not be IR or UV but must have been microwave penetration at very (ultra) high frequency(s), where even for humans 'skin effect' (i.e. surface rather than absorption microwave heating) can occur.

5. In the 1950s several reports were received (France and South America) of combined vehicle failure and mild shocks or 'tingling' in proximity to 'hovering' objects.

6. At the time of vehicle failure several reports (Canada) have resulted in apparent temporary paralysis of humans until the nearby object moved away. It is possible that some muscular control (motor-control) nerves can be affected by electrical potential. This can be replicated by medical scientists. One explanation is that either constant or pulsed microwave, coupling into the nervous systems may cause this affect. Pulsed interference with the human system is possible because of the 500 milliseconds muscle relaxation delay.

7. At least one fatal incident is reported, following what was believed to be radiation-induced from one or more energy levels, including the possibility of x-rays, or protons. Effects, ranging from minor skin burns (i.e. sunburn - like) to the level of blisters have also been reported (USA).

UNCLASSIFIED
SECRET

ANNEX F

NON-IONISING EM EFFECTS ON HUMANS	Para. No
EM FIELD FROM A PLASMA	1
Near Fields	2
UAP Near Fields	3
Variation with RF	7
Athermal Effects	8
Modulations	10
Near Field Coupling	11
Radiation Pattern	12
POTENTIAL NEUROLOGICAL EFFECTS	13
APPLICABILITY TO UAP EVENTS	18
SUMMARY	20

UNCLASSIFIED
SECRET

ANNEX F

NON-IONISING EM EFFECTS ON HUMANS

EM FIELD FROM A PLASMA

1. The EM field from a radiating plasma is assumed to be present in three forms:

- The Radiation field which diminishes with range at $\frac{1}{R^2}$.
- Induction components which diminish at $\frac{1}{R^2}$.
- A Quasi-Static field which reduces at $\frac{1}{R^3}$.

2. **Near Fields** The induction and quasi-static fields are near field components, only of significance close to the source and thus of particular interest in the study of those UAPs which might be caused by plasmas or electrically charged bodies. Assuming that the dimension D (effective linear 'aperture') of the plasma is large compared with the wavelength (λ), then the near field is taken to extend to a distance $2D^2/\lambda$ from the source. The Radiation Field (far-field) is not of interest in this study. In the normal case of an EM source (for example, antenna emission) the radiation field beyond the near field stabilises with spatially uniform distributions of the E and H field components, which are at right angles to each other and transverse to the direction of propagation, they are in phase and have a constant amplitude relationship.

3. **UAP Near Fields** Assuming that EM radiation may be present in at least some of the UAP sources (e.g. ball lightning, bead lightning, 'earth lights' and other charged air-masses, it is possible to calculate, as shown at Table F-2, some expected near-field distances.

4. For effects on humans calculations are made to determine power flux-density (watts/m^2). In the near field this value is determined from the vector product of the E and H fields, making calculation more complex than the familiar terms ($S\text{-}PGi/4\pi R^2$) used, for example, for radar calculations. For the near-field there is an arbitrary phase and amplitude relationship between E and H which must be taken into account for every point in the near-field region if power flux-density values are required. To simplify calculations for the near-field a 'plane-wave equivalent' value is sometimes used. If the E field or H fields are known, power density is evaluated respectively from E^2/Z_o or H^2/Z_o. Z_o is the familiar characteristic wave impedance of free space 377Ω.

5. It is not clear whether single, multiple or broad-band radiation frequencies are emitted from the airborne sources of interest (UAPs). Unfortunately there are no electric or magnetic field strength measurements taken, the majority of UAP events only being present for a few seconds.

6. Standard radiation hazard calculations assume that at MF/HF the frequencies are below whole human body resonance frequencies and direct hazard effects can be high. Most of the work concerning radiation levels concentrates on the specific absorption rates (SAR) in biological tissues (for thermal reasons). The maximum amount the body absorbs depends on the rate between body length and the free-space wavelength of 0.4. For the human body a significant absorption maximum therefore occurs at ~80MHz (λ = 3.75m), varies with adults and children and is dependent on whether the subject is in contact with a conductive ground or in free space.

7. **Variation with RF** Below an RF of ~30kHz, thermal effects can be neglected in comparison to stimulation effects on nerve and tissue cells. In the RF range from ~100kHz to 1MHz the thermal and stimulation effects are of the same order. Figure F-1 shows the combined experimental results for RFs up to 100kHz. For the study of possible radiation

from UAPs the following zones on the shaded diagram are of interest. Lines A and B (Figure F-1(d) & (e) are the value of electric current densities occurring in tissue. The information at Figure F-1 is converted into incident E and H fields at Figures F-2 and F-3. Since, for this study it seems likely that UAP radiation affect the human temporal lobes, a sphere is used as the model at Figures F-3 and F-4, with the same current densities as at Figure F-1.

8. The source of these values[1] recognises that the maximum current densities may be in error by up to an order. Hence, they can only be used with caution. In general, from 3 to 300MHz power densities $<1 mW.cm^{-2}$ are considered 'weak' fields.

9. **Athermal Effects** Very little agreed scientific knowledge exists about athermal effects other than stimulating effects. Localised absorption is known to occur, for example at 3MHz around the ankles and head, indicating a higher likelihood of higher current distributions (see Figure F-1) in the body area where brain stimulation may be affected. This is not to imply that adverse effects are certain - because no biophysical action model exists to produce reliable information on which to base a firm hypothesis. It is not known whether UAP emissions produce mixed frequency effects.

10. **Modulations** Effects on humans are also concerned with any modulation which may be present and this clearly affects total received energy and may therefore affect human brains in different ways, depending on the coupling mechanism.

11. **Near-Field Coupling** Due to complicated near-field structures, with temporal phase differences between the E and H fields, a considerable variation can occur in polarisation. Very few investigations have been made to determine near-field coupling and absorption. Optimum coupling into a body can only take place when its orientation (polarization characteristic) is identical to the incident wave at that point. It is clear from this that it might be possible for a human to be close to a UAP radiation, in fact within its near-field with little effect, while a short distance away the coupling conditions may cause another human to receive stimulation resulting in quite different description of what is being seen. The generalised values deemed to be acceptable radiation hazard levels do not necessarily apply in the case of UAPs, where it is suggested that very low levels of radiation in the near-field (and possibly containing unknown modulations) may couple with the human brain. There is also some evidence that some humans are more susceptible than others to this phenomena. This may well account for the fact that often the same person repeatedly 'observes' UAP events while others do not.

12. **Radiation Pattern** Although it may be assumed that the (idealised) shape of the radiating UAP is spherical and that its radiation pattern is uniformly omni-directional, in practice this may not be the case. Frequent reports suggest that the (assumed plasmas) take up a variety of shapes and have 'hot spots' which are visible. Conventional logic is that the inhomogeneity and shape variation will lead to a non-uniform radiation distribution. Hence, there may well be 'hot spots' of radiation emanating along some axes - which the close observer may or may not be exposed to. Further, the objects of interest are often observed/approached by witnesses travelling in cars which will provide some screening. On other occasions the screening is supplied because witnesses are in aircraft. Finally, there are cases where people have left their cars and suffered both immediate and after-effects.

[1] "RF Hazards Exposure Limits". European Union Geneva 1995 Tech. 3278-E

POTENTIAL MENTAL EFFECTS ON HUMANS

13. Neurological, rather than biological effects may be the clue to some human behaviour after exposure in the near field of UAP radiation. Particularly sensitive are the temporal lobe areas of the brain. Unlike other parts of the brain, the temporal cortex can be rendered el ectrically unstable. The connection between RF fields and brain activity was confirmed by the 1980s. In the last 20 years much of the work has been concerned, on the one hand with protection of humans against RF hazards and secondly to understand the viability of microwave weapons. The amount of scientific papers on human interaction with RF fields in prodigious - 4500 papers alone between 1978 and 1984! The linking of brain activity to UAP events, where the witness is presumably within the near field influences, is currently only partially understood, since assumptions must be made (in the absence of real values) as to the type of fields being encountered. Within the UKADR these close encounters occur only a very few times each year. The well-reported Rendlesham Forest/Bentwaters event is an example where it might be postulated that several observers were probably exposed to UAP radiation for longer than normal UAP sighting periods There may be other cases which remain unreported. It is clear that the recipients of these effects are not aware that their behaviour/perception of what they are observing is being modified. The E field strengths which are known to affect the brain are of the order 50 multivolts per centimetre at between 1 and 100MHz and experiments have shown that effects can be produced at levels of 10^{-7} to 10^{-8} volts per centimetre.

14. An important fact is that the reported effect of (presumed) UAP radiation on humans is that it is quick-acting and remembered - although, curiously, following the event there is little or no recall of events as a continuum. In short, the witness often reports an apparent 'gaps' or 'lost time' - often not accounting for up to several hours. It is described as though the exposure causes a temporary memory erasure. Experiments (on animals) have shown that low ($3mW.cm^{-1}$ at 450MHz) exposures affect brain calcium ions and that these are known to play an important role in the transmission of nerve impulses. Various modulations (e.g. 5Hz, 16Hz) were imposed on the radiation. However, whereas earlier experiments went on for tens of minutes - or even for hours: as such they were not (and not intended to be) representative of the very short UAP exposure times of a few seconds In 1981 it was discovered that E fields (at ELF) of 10-50 or $V.cm^{-2}$ at a modulation of 5Hz for only 5 to 10 seconds could increase the excitability of nerves for hours.

15. It is concluded therefore that if some UAPs, as is believed and correlated by actual reports (collateral effects on, for example, car electrical equipment) produce EM radiation then there is a high probability that they can affect the human brain.

16. It would seem that this effect can occur when close to a UAP, either outdoors or indoors. This causes the brain to interact in an unusual way with the imagination 'library', causing reports of visual activity which are not in fact a true representation of the facts. It is of particular :interest that a perusal of a limited number of old UAP reports (pre- 20th century), while often similar or even identical to madern reports, does not produce evidence of 'space-craft' aliens (grey or green), 'portholes' or 'searchlight' beams!

APPLICABILITY TO UAP EVENTS

17. As there are few, if any, measurements of UAP radiation anywhere in the world, one option is to eliminate those RFs, modulations and radiation values which are known **not** to affect the human brain. For example, research has been done in this area in programmes which try to identify human susceptibility to mobile phones. In particular, operating at 160, 350 and 915MHz; and the new RF for mobiles at 1700MHz. Of course any pursuit of this process of identification or elimination is pointless if it turns out that UAP radiation is

other than EM radiation as we currently understand it.

18. For experimental purposes RF energy has been launched using resonant dipole antennas in both E and H orientation[2]. The amount absorbed was greatest at lower RFs (longer wavelengths) and at E field polarisation. However, it is recognised [for the UAP Study of Effects] that it may not be the **amount** of energy absorbed which causes unexpected brain responses to close encounters with a UAP, but possibly some sort of modulations at much lower energy levels.

19. A wealth of other international experimental measurements (in 18,000 research papers) have been taken using devices which radiate at most RFs, including ELF (e.g. 50Hz). Much of this work is based upon the necessity to understand hazards from, mobiles, AC mains and equipment such as VDUs broadcast stations, etc. It is of interest, in the UAP context, that maximum absorption (and logically the maximum effect is in the human head irrespective of wavelength. See Figure F-1. This also appears to be the case irrespective of human orientation (i.e. facing or side-on to the source). Near-field exposure deposits a far greater rate of absorption in the head than when in the far-field. It is also clear that time-varying electric fields, acting on nerve axons, can given rise to sensory stimulation. Further, the effect will not be the same on every person. Unfortunately, the stress on experimental measurements has always been human (or animal) biological changes, rather than possible neurological effects. It is of interest that at some RFs (e.g. at 900 and 1700MHz) some field focusing occurs in the head and it must be considered that while this may occur at other RFs; it may be some focusing effects or even the occurrence of several interacting frequencies from a UAP which cause the reported effects.

[2] "RF Energy, Deposition in a Heterogeneous Model of Man: Near Field Exposures M.A. Stuchey et al. IEEE Trans. Biomed. Eng. Dec 1987

SUMMARY

20 Because few persons are exposed to the postulated UAP radiation, the following points are pertinent:

- There is no history of after-effects of "UAP exposure" reported beyond "feeling unwell for a few hours".
- Unlike other EM radiation sources no cumulative effects are reported or studied.
- It is not certain that the radiation/fields are conventional and electromagnetic in nature.
- No other known (even repeated) exposures to EM radiation (with conventional modulations) causes the "loss of time" syndrome reported by many (close encounter) witnesses world-wide.

		Microwave	Microwave Threshold ($mW.cm^{-2}$)	Radio Frequency (MHz)	PRF (Hz)	Pulse Duration (μsec)
Heard as:	Shockwaves	YES	?	>60,000	?	?
	Low Pitch	YES	12	200-3000	50-100	1-100
	High Pitch	YES	~2000	Any	Any	Any
Smell		YES	?	Any	[3]	Any
Taste[4]		YES	<13.1	Any	<1000	Any
Felt as:	Heat[5]	YES	~8.4	30,000	Any	Any
	Shock[2]	YES	?	Any	Any	Any
	Burns	YES	?	30,000	Any	Any
	Internal Burns	YES	?	<3,000	Any	Any
	Paralysis	YES	?	~3,000[11]	>500	Any

Table F-1 HUMAN EFFECTS THRESHOLD (U)

Notes

[1] Reportedly enhanced if >500Hz

[2] Electrical shock

[3] Reportedly enhances smell

[4] >100μ Amp

[5] Added to those microwave heating effects can be the effects of IR

Object (UAP)[1] Diameter (m)	λ(m){f(MHz)}[2]				
	100{3}	10{30}	1{300}	0.10{3.000}	0.01{30,000}
0.5	0.005	0.05	0.5	5.0	5.0
1.0	0.020	0.20	2.0	20	200
1.5	0.045	0.45	4.5	45	450
3.0	0.180	1.80	18.0	180	1800
10.0	2.000	20.0	200	2000	20.000
20.0	8.000	80.0	800	8000	80.000

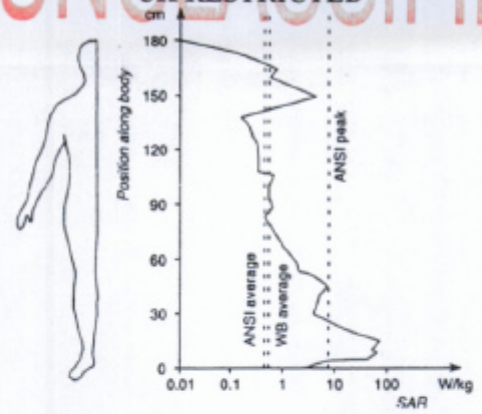
TABLE F-2: NEAR FIELD DISTANCES[3] (m)

Notes: [1] Assumes that UAP is a radiation plasma or charged mass source with effective aperture shown. The recorded appearance of plasma balls exceptionally reaches the largest value shown. However, this should not be confused with the large triangles, rectangles and other large shapes reported. These possibly have radiating peaks (e.g. at the 'corners' but, as they do not appear to be (visually) homogeneous seem unlikely to represent a total radiation aperture.

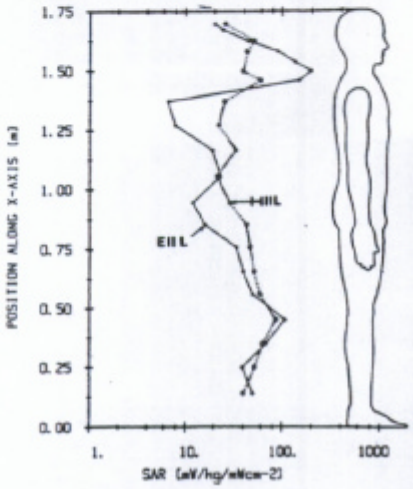
[2] It is not known whether UAPs radiate narrow or wide-band RFs.

[3] The standard near-field criteria is used ($2D^2/\lambda$).

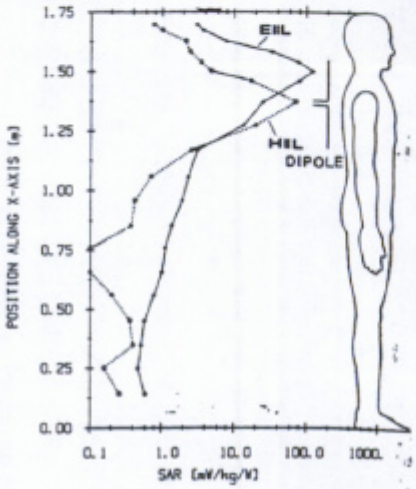
(a)



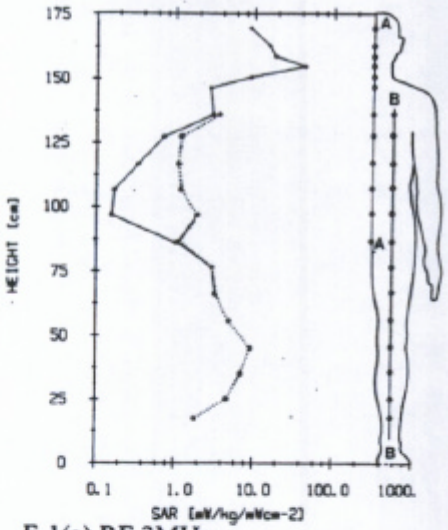
(b)



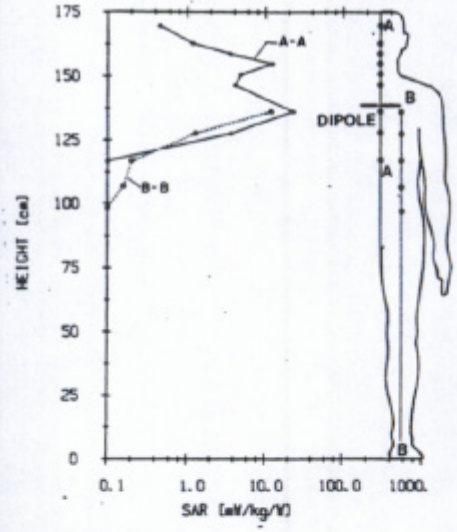
(c)



(d)

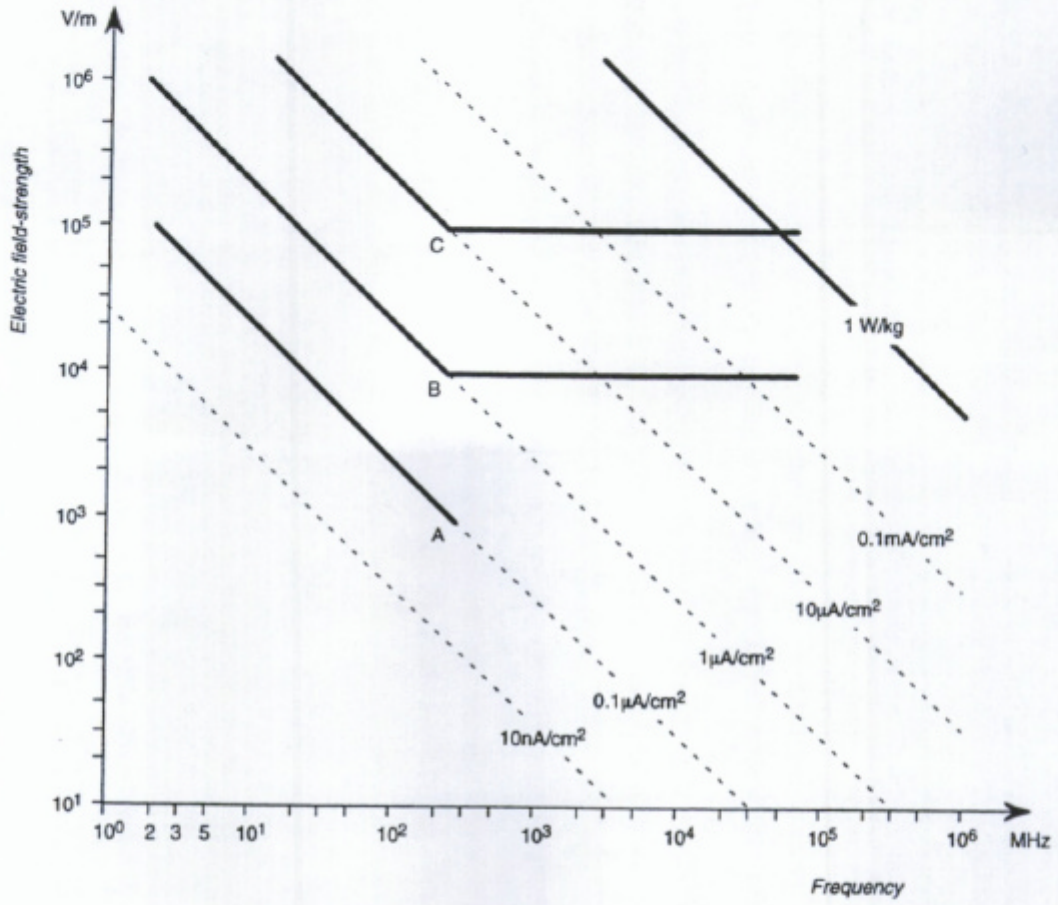


(e)



Notes F-1(a) RF 3MHz
Figure F-1(b) RF 350MHz Far Field (1mW.cm^2)
Figure F-1(c) RF 350MHz Near Field for same far field
Figure F-1(d) RF 915MHz Far Field
Figure F-1(e) RF915MHz Near Field

FIGURE F-1: DISTRIBUTION OF ABSORBED RADIATION

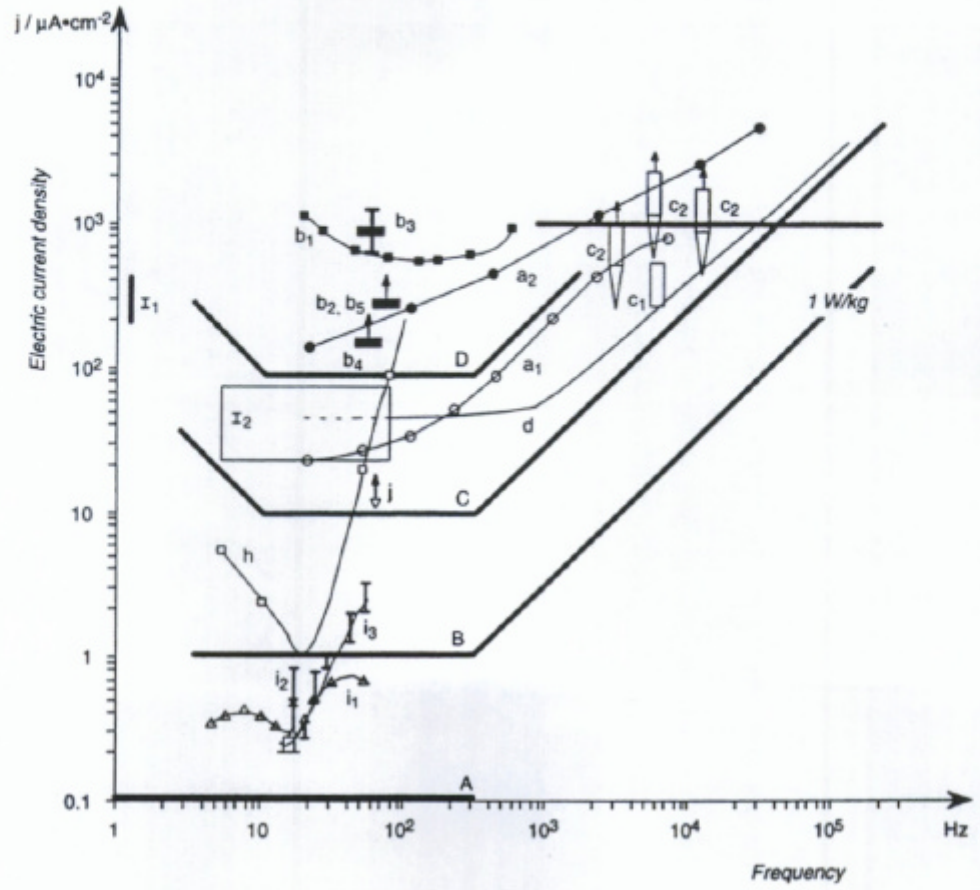


Notes:

1. The longitudinal axis of the man is parallel to the orientation of the field.
2. Numerical RMS values apply to the undisturbed field.
3. In other parts of the body (e.g. wrists or ankles), depending on the exposure conditions, current-density values up to tenfold greater are possible.
4. For curves A, B and C, see the notes given in Figure F-3.

FIGURE F-2: ELECTRIC FIELD-STRENGTHS WHICH INDUCE APPROXIMATELY THE INDICATED CURRENT DENSITIES IN THE HEAD AND IN THE CARDIAC REGION OF A MAN

UNCLASSIFIED
SECRET
UK RESTRICTED

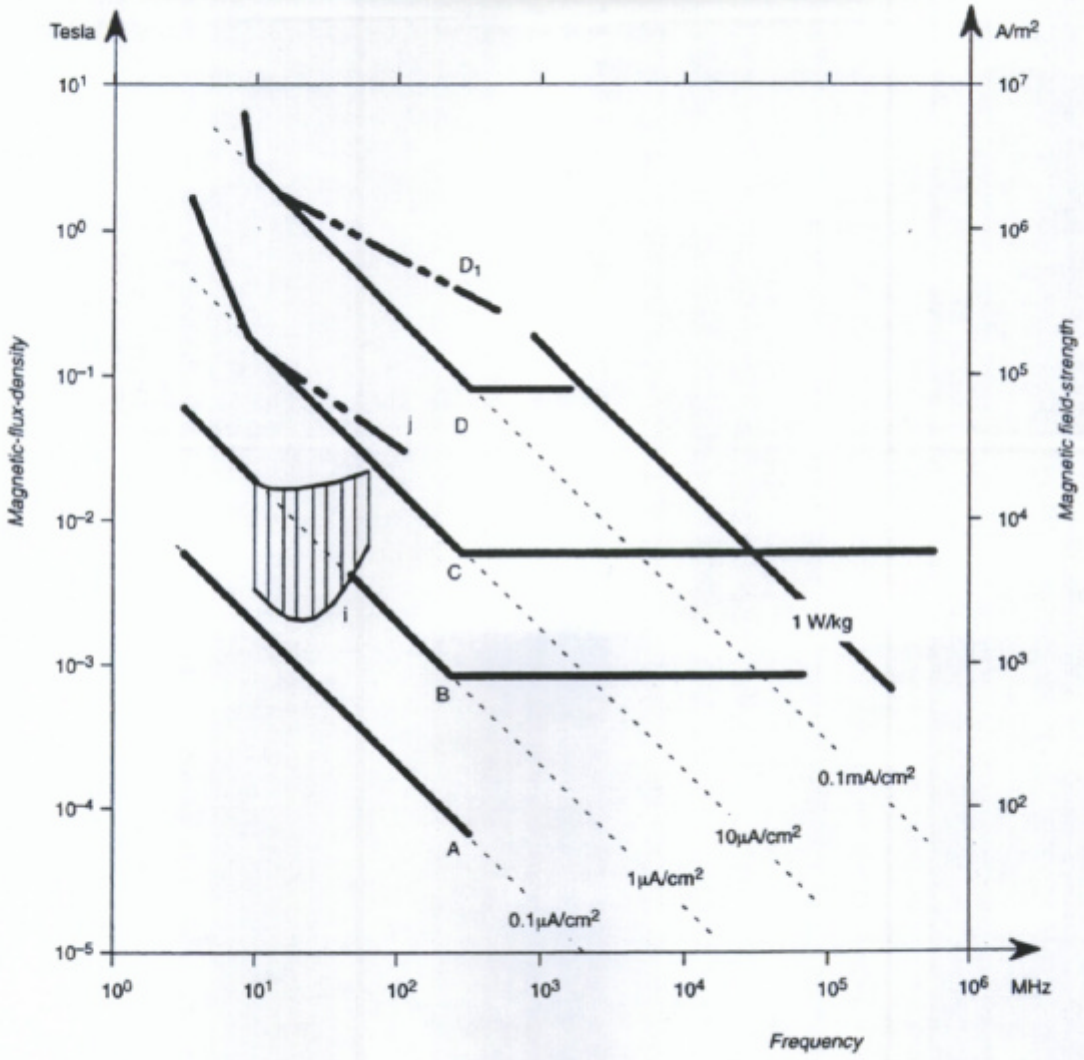


Key:

a_1, a_2	Stimulation of sensory receptors immediately underneath surface electrodes (Geddes et al., 1969).
$b_1 - b_5$	Ventricular fibrillation thresholds for stimulation times of 1 sec or longer (b_1: Imich et al., 1974; b_2: Roy et al., 1976; b_3: Jacobsen et al., 1974; b_4: Osypka, 1963; b_5: Watson et al., 1973).
D	"Envelope" threshold curve for extrasystole elicitation and ventricullar fibrillation; stimulation, 1 sec or longer (injury threshold).
c_1, c_2	Extra-cellular stimulation thresholds of single cells (c_1: Roberts and Smith, 1973; c_2: Ranck, 1975).
d	Frequency dependence of stimulation thresholds for nerve/muscle systems (modified from Schaefer, 1940). This curve may be used as a lower "envelope" curve for excitation thresholds for single unidirectional pulses or pulse sequences.
I_1	Threshold for modulation among different neurons (Chan and Nicholson, 1986).
I_2	Modulation of neuronal excitability in rat hippocampal slices (Bawin et al., 1984).
C	"Envelope" threshold value curve for stimulating effects (possibly hazardous).
h, i, j, B	Calculated current densities for the threshold values of electrophosphenes (h: Adrian, 1977) magnetophosphenes (calculated current densities; i_1: Silny, 1981; i_2 and i_3: Bernhardt, 1985) and variations of optically-generated reaction potentials (j: Silny, 1981). B shows the range over which biological effects are expected and observed.
A	Average value of naturally-flowing current density in the body tissue; the values of the current densities due to the electrical events in the brain or in the heart are usually much larger at a microscopic level. Below this current density, absence of detectable effects is assumed.
1 W/kg	The current density range above which additional thermal effects have to be considered.

FIGURE F-3: THRESHOLD VALUES OF ELECTRIC CURRENT DENSITY FOR DIFFERENT BIOLOGICAL EFFECTS

UNCLASSIFIED
UK RESTRICTED
SECRET



Key: i Threshold values for magnetophosphenes; the upper curve corresponds to magnetic fields where phosphenes were observed as patterns.

j Changes in visually-produced potentials (from Silney, 1981).

D_1 Experimental values for cardiac stimulations, calculated for humans from experiments conducted on animals (from Silney, 1986).

For curves A, B, C and D, see the notes given in *Fig. 16*.

Notes: 1. The magnetic field is varying sinusoidally.

2. Due to larger conductivities and current loops at a local level, induced body-current densities may exist at levels which are higher by one order of magnitude than those indicated.

FIGURE F-4: MAGNETIC FLUX DENSITIES WHICH INDUCE APPROXIMATELY THE INDICATED CURRENT DENSITIES IN THE BRAIN AND THE HEART OF A MAN

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 2

BALL AND BEAD LIGHTNING

	Para.	Page
INTRODUCTION	1	2-2
Ball Lightning	2	2-1
Bead Lightning	3	2-2
SHAPES, SIZES AND STRUCTURES	7	2-2
MOTION	10	2-3
Velocity	11	2-3
SOUNDS	12	2-3
DURATION	13	2-4
RADIATION-HEAT AND LIGHT	14	2-4
Light	15	2-4
Heat	16	2-4
EM Radiation	17	2-4
ODOURS	19	2-5
EFFECTS ON HUMANS	20	2-5
EFFECTS ON ENVIRONMENT	21	2-5
EFFECTS ON EQUIPMENT	22	2-5
SUPPORTING THEORIES	23	2-6
LABORATORY PRODUCED BALL LIGHTNING	31	2-7
PLASMOID	38	2-8

February 1, 2000

XXXXXXXXXX S.40

UK RESTRICTED
SECRET
UNCLASSIFIED

UNCLASSIFIED
SECRET

	Para.	Page
AURORAL LOOPS	39	2-8
Ball Light Ozone Spheres	39	2-8
Power Intensive Plasma Formations (PPFs)	40	2-8
BALL LIGHTNING AND AIRCRAFT	41	2-8
PLASMA SHAPE CHANGES AND SIZE	46	2-10
SURVEY OF COLOURS	47	2-10
OPTICAL 'THICKNESS' OF BLACK RADIATORS	48	2-11
THERMO-CHEMICAL REFRIGERATION	49	2-11
SUMMARY OF BALL LIGHTNING CHARACTERISTICS	50	2-11
Near-Terrestrial Events	51	2-11
In-Structure Phenomena	52	2-12
Demise	53	2-12
SUMMARY - RELEVANCE OF BALL & BEAD LIGHTNING TO UAP REPORTS	54	2-12

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

THE CHARACTERISTICS OF BALL AND BEAD LIGHTNING

INTRODUCTION

1. A review of the nature of Ball and Bead Lightning has been made, because of the possibility of this being reported:

- As a visual unexplained UAP sighting - since this phenomena can exist up to two hours after a storm and the luminous globe can be retained on the human eye (as an after image on the retina) and reported as an object.

- As a potential UAP phenomena which can occur in all weather situations - even in a clear sky.

- The sounds and colours which can be produced by ball lightning are frequently similar to those which appear on UK UAP reports.

Lightning, as a topic, has only been seriously (scientifically) investigated for the last 200-300 years. Reports go back to at least 'Globes Igneous', (St. Gregory of Tours 6th Century AD), Aristotle 4th Century BC and others in the First Century BC. On occasions the Ball variety of lightning is known as a 'solid' or simply 'fireball'. The phenomenon of Ball Lightning is assessed to involve the disciplines of chemistry, meteorology, physics, electrostatics and electromagnetics. Chemical, optical and various electrical models and explanations have been proposed. These are only investigated here to a depth to show the consistency of characteristics as an aid to the identification of many UAP events as ball lightning or its similar relation phenomenon 'Earth Lights'. Of the numerous explanations there is generally at least one important aspect that is not totally fulfilled and a variety of theories are put forward to explain the missing link. Either lifetime (duration) is explained and stability not, or for example, colour does not match expected temperatures. For other theories, for example the vortex explanation, does not explain electrical properties. Apart from Ball Lightning and Earth Lights, many such occurrences are known simply as 'atmospheric spherical formations'. While the probability of the occurrence of ball lightning somewhere on earth has been calculated as between 10^{-9} and 10^{-8} per square kilometre per minute (equating to about 100 to 1000 balls world-wide per hour); it can only be seen at close range and many events must be unrecorded. Some, of course, are black, others translucent, both have weak thermal radiation. Reportedly bright spots or 'beams of light' are likely to occur when the phenomenon approaches a conducting object. [Comment: This is important in the context of reports, often by car owners who report supposed 'extra terrestrial' objects with illuminated 'portholes']. The 'beams' often converge unlike, for example, searchlights and this appears to be due to lens effects caused by the high electric field intensity of the surface, or 'shell' of the ball (or other shape seen)

2. **Ball Lightning** A study of Ball Lightning can be classified under the following headings:

- Conditions and locations for occurrence.
- Shapes, sizes and structures
- Motion (Velocity and Trajectory)
- Sounds
- Duration
- Radiation (Heat and Light)

UNCLASSIFIED
UK RESTRICTED
SECRET

- Effect on Humans
- Effect on the Environment
- Effect on Equipment
- Odours
- Electrical/Chemical theory

Ball Lightning decays in a variety of ways - see Sounds/Colours, below.

3. Ball Lightning is believed to be formed from an 'ordinary' flash of lightning - for which the familiar 'electrical' storms are a generator. However, it can also occur without the presence of a storm or of visible/conventional lightning. Apart from these conditions, once present, the 'balls' or 'beads' can last for a few seconds up to minutes. Ball lightning can enter rooms (usually through apertures (e.g. chimneys, doors, windows) and can either leave by the same method or dissipate within the enclosed space. Instances have been reported where ball lightning has entered aircraft (BOAC 1938 and TWA 1948 Easter Airlines 1963, USAF KC-97 in 1960 and in Russia). In Europe 65% of all reports identified as ball lightning occur in the summer months. 95% are reported in the hours 1300-2359 hours and mostly clustered in the period 1600-2000 hours . It has even been seen in snow. Frequently the effect has been reported in the vicinity of marshes, volcanoes (lee-side) and during earthquakes. The balls/globes appear in rain, in clear skies, in still conditions or wind, move against the wind, can be vortex associated, in snow, near the ground and at altitude. Undoubtedly the largest occurrence is during storms/cyclonic conditions. Conditions for ball lightning formation appear to be:

- Charge particle connected
- Frictional action of dust (hence Volcanic links)
- Dependent on the presence of very high electrical charges and fields
- Possibly dependent on the formation of natural EM radiation
- Emitted from a 'bend' in conventional lightning
- Drop from clouds (initially)

On occasions ball lightning has no apparent connection with a storm. It can also leave a meteor-like trail.

4. **Bead Lightning** Bead lightning (5-15%) is much less prevalent than ball lightning (85-95%) and is the residue of cloud-to-cloud or cloud to surface lightning strokes where a row of balls are seen separated by darker regions in a string-like form. Bead lightning is generally observed at a distance, in contrast to ball lightning which is observed nearby. As for ball lightning, the incidence of the occurrence of bead lightning is quite low. One survey found only 1600 reports between 1850 and 1978! Bead lightning is also sometimes called 'pearl' lightning. Some 'strings' have been reported as quasi-sinusoidal in form, while elongation of the beads (or balls) suggests sausage or cigar-shapes [often a feature of UAP reports].

5. Most reports of ball and bead lightning occur at low altitude - most probably because that is the location of most observers; hence this limitation may not be true in practice (see para. 22 below). Insufficient evidence exists to be certain of all the conditions for ball and bead lightning formation. No single theory appears to satisfy all the criteria. The ball is sometimes seen with a halo.

6. Ball lightning is sometimes mistakenly reported as St. Elmo's fire.

SHAPES, SIZES AND STRUCTURES

7. On some occasions bead lightning, often described as a 'string of sausages' (i.e. elongated beads), converts or 'breaks off' into a single glowing ball as the pinching effect which separates the components disappears, leaving a single glowing ball (or balls). Shapes are invariably described as globes. Sometimes flames seem to be revolving inside the globe. On rare occasions, two balls have been reported linked together (a metre or two apart), while on others oval, or pear-shaped forms are reported. On even rarer occasions 'torus' and

UNCLASSIFIED SECRET

'rod-shaped' systems have been seen, and also 'hollow' spheres.

8. Ball dimension reported vary from a few centimetres to 12-15m in diameter. Some examples had ball diameters of 22cm (inside eastern Airlines Aircraft, 30cm, 50cm, 60cm, 8.5m, 12.8m, and a 38cm (rod). A summary of the scientific factors which control plasma sizing is at paragraph 30, below. Optical illusion effects can clearly change the perception of size. It is important to note that an increase of light intensity can be perceived as an increase/change in size or shape. The balls are sometimes hazy in outline and may not be truly spherical (when not one of the other shapes).

9. Within the bounds of the shapes, described above, there appear to be three structural types:

(a) Balls with a solid appearance with a dull or reflecting surface, or with a solid core in a translucent envelope (often 30-50cm in diameter).

(b) A rotating structure.

(c) A burning appearance (often <40cm diameter).

Reports suggest that single balls can break up into smaller ones (or disperse - see para. 12 below).

MOTION

10. The motion attributes reported are, firstly direction/profile, where the phenomena is reported as moving in one or more of the following directions or types of movement:

- Cloud-to-cloud
- Earth-to-cloud
- Cloud-to-earth
- In a horizontal path (55% of occasions and usually of the 'burning' type)
- Climbing and bouncing/rebounding
- Changing course
- Movement opposite to wind direction
- Very rapidly point to point (jumping or darting)
- Attracted to enclosures (e.g. indoors/in vehicles/aircraft)
- Rolling (on earth's surface, wet or dry)
- Emerge from Lake
- Turning sharply/abruptly
- Executing parabolic curves
- Spinning or spiralling
- Floating
- Motionless/hovering
- Diving (at high speed)
- Apparently moving at windspeed
- Jumping (to a few metres in height)
- Darting to a conductor (especially water, fences etc.)
- Attaching (to an object) or 'pushing' at an object
- Detracting (and floating away from an object)
- In complex trajectory (20% of reports)
- Vortex-associated
- Float ('squeeze') through a small hole and then expand to a large ball-shape.

11. **Velocity** Secondly the ball lightning often has velocity in one or more of the following categories.

- Often low velocity (including zero)
- Estimated 100-1200ms^{-1}.

Frequently the speed is reported (when near the ground) as that of a man walking or running. The spiral or rotational form, which is often vortex-associated, appears to take the form of a hydrodynamic or plasma vortex.

SOUNDS

12. Many sightings have been made when the ball makes no sound, while others have:

- Hissed (hence confusion with St. Elmo's fire)

UNCLASSIFIED SECRET

- Exploded (after which they disappear either with a pop, a mild bang or a significant explosion)
- Possibly imploded
- Buzzed or 'fluttered'
- Sparked (when colliding with foliage, objects)
- Crackled.

These sounds occur quite separately from thunder or precipitation - in fact there may be no storm present. Termination often occurs after a colour change (see para. 15 below). Sometimes a residue is left after an explosion (no further information).

DURATION

13. The duration of ball lightening varies from a few seconds to several minutes. However, most seem to last for up to five seconds, with the longest on record as 15 minutes.

RADIATION - HEAT AND LIGHT

14. Almost all ball lightning reports are visual in the first instance. After they have disappeared (either peacefully or explosively), the observers recall the added features of sound (paragraph 12, above) and any damage caused, which is dealt with below at paras 20 to 22.

15. **Light** Attention is drawn to the phenomena visually, and although there are variations, most sightings fall into the categories of:

- Blue or blue/green
- Red (or pink/rose-pink)
- Red changing to white
- Violet changing to white
- Yellow
- Yellow changing to white
- White to red (observation on one occasion for 65 seconds)

Most sightings fall in the red or red/yellow category. They often disappear noisily after a colour change. Some structures seem to favour certain colours. The main attributes are:

- Rod structures are often purple/violet
- Solid types (see para. 9) often appear as green/violet
- Rotating types can have a combination of colours
- Burning types are mostly red or red/yellow in appearance
- Colours described and classed as atmospheric luminescence
- Hovering or horizontal motion types are often red or red/yellow
- Predominantly red if 'floating'
- Blue or blue/white occurs on only 5% of reports
- Red or yellow types occur on 60% of reports, sometimes reported as being in a bluish envelope
- Less than 1% change colour
- Can emit sparks, fireworks-like
- Can leave behind smoke-colour trial
- Emit, on occasions, bright flashes
- Reported blue or white 'hollow'
- Leave behind a mist (seen as direct light) or blue or white (in reflected light) in moist air
- Smelly types leave behind a brown mist
- Colours may be pulsating.

16. **Heat** Reports both of intense heat and of no apparent heat can be found. The attributes reported are:

- Apparent colour on the surface and a hot core
- "Ball fell into water tank and boiled the water"
- Absence of heat, despite intense light
- ~1% (of those closer than 15m) were reported to emit heat

- Temperature emitted burns humans (see paragraph 20, below).

17. **EM Radiation** An intense E field, set up during storm conditions can charge sharp protrusions. This is thought to account for the attraction (often erratic darting movements) of globes/balls to sharp edges, pylons, fence etc. The presence of these fields causes sparking, incandescent traces (and radio interference/static). The electrical potential is quoted as 3-400kVm^{-1}. Pyrotechnic 'streamers', like a fireworks 'burst', accompany the high potentials. EM radiation (E plus H fields) are present, but little magnetic (H field) measurement has been made. Radiation (measured as RF) in storms can be at 6kHz to 450MHz. When lightning is present the radiation is very wideband 100Hz-4000MHz, vertically polarised. The power present is reported to fall off as $1/f^2$. The logic for the radiation is considered at paragraph 23, below.

18. There is no indication of gamma radiation from either ball or bead lightning.

ODOURS

19. Odours are frequently present. Most are reported as:

- Sharp
- Repugnant
- Ozone-like
- Sulphurous
- Nitric oxide/dioxide
- Methane
- Burning.

It is known that an increased nitrogen level persists for long periods after passage of a lightning ball.

EFFECT ON HUMANS

20. Serious burns and other effects are reported. [It is of particular interest that many of these are similar to those reported by UAP observers]:

- Humans burned on hands, feet and arms etc. (This seems to be unpredictable/inconsistent as sometimes **no heat** is reported).
- Startling and fright (specially with noisy/explosive types of ball-lightning). Some effects of fright are reported in animals. Hairs bristle, dogs/cats cower, farm animals stampede in fields.
- Humans knocked over.

Potential electromagnetic mental effects on humans, separate from these other, more tangible physical effects, are considered at Working Paper No. 1 Annex F.

EFFECTS ON ENVIRONMENT

21 The following effects have been reported:

- Holes in the ground (reportedly up to 1m in diameter and over 1m deep)
- Furrows in the earth
- Trees uprooted
- Granite boulders broken/cracked
- Water boiled (see 'heat' above (para. 16) and discussion at para. 26 below)
- Electrically-excited atomic/molecular species, causing single and multiple atmospheric discharges and micro-discharges
- Charging of atmospheric dust particles
- Luminosity from water droplets
- Bio-luminescence and chemical luminescence/due to chemical reactions (not due to thermal sources)
- Production of visible light at room temperatures (and at other temperatures)
- Atmospheric trails/traces (usually terminating at the ball, or persisting afterwards). Pyrotechnic in appearance.

EFFECTS ON EQUIPMENTS

22 Apart from the reported 'static' on receiving equipment (see also EM Radiation (para. 17 above), example effects are:

- Attachment to power lines/electrical wires/pylons (but no effect on the system reported)
- Entry of 'balls' of various diameters into aircraft cabins
- Stopped (Russian) aircraft engine (1956)
- Military fighter destroyed (1948)
- Moved ahead of aircraft (Russian 1956)
- Russia (1959) caused 100° compass error.

The aircraft incidents above were at altitudes from 2500m to 3400m. Some general EM effects on equipment (not necessarily ball lightning) are also discussed at Working Paper No. 1 Annex D.

SUPPORTING THEORIES

23. No single theory seems to support all the criteria. The phenomena appears to be sighted only when one or more of the following are present:

- Charged particles or droplets
- High electrical charges in the atmosphere (not necessarily caused by lightning)
- When dust particles are generated (e.g. during volcanic activity)
- When high concentrations of nitrogen and ozone are created
- When marsh gas (methane) is given off
- Vortices (incandescent gas vortices).

24. Luminosity is observed from water droplets of opposite charges. The plasma (plasmoid) appears to be a mass of charged luminous material with sizes, structures and shapes as described, (at para. 27-30 below).

25. It is known that ball lightning is a natural electromagnetic radiation formation. However, it has been impossible to produce in the laboratory, unless the object has some sort of containment and, once formed, does not rely on external field(s) to maintain equilibrium.

26. There are several unusual features and questions:

- If the body is hot, why does it not rise?
- What constraints could be keeping it at level altitude (floating type)
- Is the plasma rotating? If so is this the means of storing it's energy?
- Is the spiral action (seen in vortices) due to the Earth's E and H fields.

27. The energy stored (E) must be proportional to volume, and E must be proportional to the cube of the cloud dimension. Similarly the light emitted is proportional to the surface area. Hence, the light is proportional to the square of a dimension. Plasma theory shows that a 10cm diameter ball could glow for 0.01 sec. The maximum energy which, in theory, could be stored in a ball appears to be less than could sustain it. In theory if the ball is lighter or heavier than air, then it should, respectively rise or fall. For equilibrium (hover or 'float') the ball density must be 1.29×10^{-3} gm. $cm.^{-3}$.

28 To achieve colours, one associates this with temperatures:

Yellow	λ =5800 Å =	5000°K
Red	λ =6300 Å =	4600°K
Blue	λ =4700 Å =	6200°K
White	-	10,000°K to 14000°K

This, of course, does not accord with the perception of colours reported when no heat is reported. It may be, of course, that, although present, no heat was felt/sensed for various reasons (e.g. long range, cooling wind, etc.)

29. The logic is that to glow for longer than the 0.01sec (at para. 27 above) energy must be received from somewhere.

30. The diameter of a spherical ionic plasma is determined by the resonance of the ball with the EM oscillations of the external wave at which energy absorption is most efficient. Resonance occurs when (for a sphere), the λ of the external radiation is 3.65 times the sphere diameter. To get typical ball

sizes reported, λ would have to be 35-100cm. Hence, the upper limit would be $3x10^8/1=300MHz$ (whereas 30 and 50MHz are reported from microcharges). It should be noted that rarely are there any measurements from real ball lightning; any measurements quoted are from experiments attempting to simulate the phenomenon.

LABORATORY-PRODUCED BALL LIGHTNING

31. Many attempts have been made to produce ball lightning under laboratory conditions and it is reported[1] that (in the USA) it is routinely possible to produce a specific type of this phenomenon. Golka also claims that plasmoids can be produced by combustion inside a 'microwave oven'. However, it is not proposed that the ball lightning generated accounts for all types. In the experiments the fireballs lasted from two to five seconds but with only diameters of ~1cm. This has been achieved by short-circuiting 60Hz currents as low as 1200A across copper and aluminium electrodes under ~2cm of water. Another researcher (Silberg, unreferenced) describes how this phenomenon, produced green fireballs in a submarine engine room, using 260 Volts and 156,000 Amperes. Ball diameter was 6 to 10cm. For a 10cm diameter ball (volume $515cm^3$) there are 1.4×10^{23} molecules. When the medium (used in the switching contacts) is nitrogen and an ionisation energy of 15eV per ion pair for the single ionisation, it can be calculated that there must be 3.4×10^4 Joules contained in the ball. The ball quickly disperses unless a source of replenishment energy is present.

32. The fireballs produced rise to the surface and remain until exhausted, 1-2KJ of energy having been deposited. The type of lightning balls produced are reported to be similar to those observed in aircraft during flight and, strangely, in submarines during WWII. With higher power the 'ball' can be made to travel higher from the surface and 'bounce' and 'dance'. It is postulated that the more power applied, the larger the diameter which may be produced. Hence, the phenomenon might be scaleable.

33. Other characteristics clearly depend on the materials and size of the electrodes and their burning temperature when a tremendous energy level is applied to a very small surface area. For aluminium this is of the order 4400°F. As might be expected, as the fireballs surface they sizzle and hiss, some leave the surface and produce spiralling smoke trails, leading to the supposition that the fireballs are spinning (see below). Different electrode types produce more or less smoke. Those remaining on the water exhibit random motion until they decay.

34. Experiments were only made with the electrodes under water because this method enabled measurements to be made before the fireballs darted off in all directions, making measurements difficult. Whereas previous researchers had expected high voltages to be a prime requirement, these experiments were made at 40-50 volts. Even so, enough energy overall was deposited on occasions to make the balls leave the surface of the experimental tank and leap onto the floor.

35. Aluminium electrodes produce white fireballs, while iron-to-iron electrodes produce yellow. Either the outer surface or the kernel appears to be spinning. As soon as the ball stops emitting light, it shrinks to sugar-grain size. If over water these particles sink.

36. It is postulated that if the sphere is spinning a boundary layer phenomena will be set up, retarding thermal radiation in the same way that the filament of an incandescent lamp forms sheath layers which keep the filament at a higher temperature.

37. As a result of these experiments the author suggests that, as ball lightning has only very rarely been reported inside pressurised aircraft, that the product of the balls was due to natural lightning attachment to the aircraft skin forming a small hole (at 4400°F) with consequent formation of a plasma ball on the **inside** of the aircraft.

[1] "Laboratory-Produced Ball Lightning" R.K.Golka, Journal of Geophysical Research Vol. 99 No. D5 May 20 1994.

PLASMOID

38. A plasmoid is postulated as formed by a small volume of plasma (small as compared with $\frac{\pi d^2}{6}$), where d is the diameter of the final ball. The energy is formed by RF at $\lambda/3.65d$, and ionisation grows - but eventually becomes stabilised and expands but eventually deviates from resonance and cools and returns to $d=\lambda/3.65$. A weak shock is formed on collapse when the RF energy is cut off suddenly - but if the RF field reduces gradually the extinction progress becomes smooth and noiseless. It is reported that spherical plasmoid shapes can be sustained by RF energy at low pressure, and the concept of a phase-locked loop of EM radiation at a wavelength stable to the circumstances previously has also been suggested. It is suggested, in this instance, that the stable standing wave excites the ambient gases to glow and that the colour is dependent on the constituents, such as dust etc. in suspension. In some cases it is claimed that ball lightning has the ability to absorb light, hence it can be grey or black in appearance.

Ball Lightning
- sometimes has glowing tentacles
- rapid rotation of sphere despite slow linear path motion
- light given off can which is ascribed to electronic excitation

It is theorised (Ashby and Whitehead, Aldermaston 1971), following the collection of remotely sensed signals during thunderstorms, that because gamma-ray levels soared dramatically (X50), on several occasions (for several seconds) that more complex explanations than hitherto might be responsible for the plasma production - perhaps involving minute particles of anti-matter (micrometeorites). However, it is not clear how the plasmas remain in suspension or even enter aircraft on occasions - a well documented occurrence by multiple witnesses.

AURORAL LOOPS

39. **Ball Light Ozone Spheres** The gravitational force on a sphere of ozone a metre in diameter is 430g and it would descend. A 0.5m diameter sphere would experience a force of 54g. If the sphere was visible ozone, on sudden expansion when conversion occurs to oxygen (20 litres for a 50cm sphere of ozone), it produces explosive energy. Ozone is the only gas denser than air produced in quantity under stress in air, as distinct from production from a streaming spark discharge. The earth's surface and ozone spheres are both generally negatively charged. Although blue in colour, if nitrogen is present the explosion colour is yellow.

40. **Power Intensive Plasma Formations (PPFs)** In the search for the key characteristics of ball (and bead) lightning PPFs, a related phenomenon appeared to show some further similarities to UAP reports; of which the most relevant are:

- PPF dimensions extend to tens of cm.
- They can disappear in one point of space and simultaneously appear in another.
- Sound propagation speeds in PPF are much higher than the speed of sound in gas and may reach 1600 ms^{-1}.
- The plasma temperature inside is <1000°K.
- PPFs can burn metals leaving holes (but not affect dielectric material).
- PPFs do not disturb the gases they pass through in movement.

Large PPFs (e.g. 1m diameter) are known as METEOXTRONES. Working papers 19, 21 and 24 describe other types of atmospheric plasmas.

BALL LIGHTNING AND AIRCRAFT

41. The reported incidences of ball lightning 'flying' ahead or behind aircraft have brought about some investigations into the expected characteristics of ball in the aircraft airstream. It seems likely that the incidence of sightings of 'foo fighters' (as they became known in World War 2) would increase, purely

because of the huge numbers of aircraft flying - certainly much more night flying than had been carried out in the short history of manned flight.

42. It is stated that large radius ball lightning (similar plasma bodies) can 'chase' aircraft while maintaining shape and more or less constant distance from the aircraft. The 'ball' is able to do so because it is not solid (otherwise a thrust force of thousands of Kg would be needed)! It is postulated that the layer of air adjacent to the surface of the ball loses its viscous properties. The ball follows the aircraft even in manoeuvres. Observations of ball lightning show that its characteristics do not change appreciably during its lifetime. When it is in the airstream of an aircraft it is postulated that it behaves as a non-deformable solid sphere in the airflow which holds its position due to the electrical/magnetic charges, described elsewhere in this Working Paper. The main reason for interest in close encounters of aircraft with ball lightning is one of flight safety. It is reported that large balls can be comparable with body diameter of large aircraft and can be 'captured' by the exhaust from engines and 'chase' the aircraft at a velocity of 150-200m.s^{-1} (278-370kts), maintaining an apparent constant range from the tail assembly.

43. One (TU134) pilot reported that at an altitude of 10,000ft and flying at a velocity of 800km hr^{-1} (~220ms^{-1}), the ball (in this case green) "appeared as though tethered behind the aircraft". Another (Russian) crew report, when flying at 7500ft altitude were 'followed' by a huge ball which was still in 'pursuit' after a fast descent to 4500ft. It refused to leave despite manoeuvre - which was limited for an airliner.

44. If the moving object were solid it would take the force of many Newtons to make it follow an aircraft. Clearly the ball is sensibly weightless (apart from the mass of the gases it contains). It is believed that the electrical charge of the ball diminishes as ionisation of the air-layer in contact with its surface occurs. The USSR treated the ball lightning phenomenon as very important and Gaidukov [3] reported after modelling the interaction that:

- All efforts should be made to avoid lightning seen ahead (before a ball is formed).
- To avoid the chance of an encounter with a ball, pilots should 'encircle around a vertical line passing through the centre of the lightning'.
- Pendulum-like undulations in altitude may be seen (by balls ahead), and every effort should be made to place the ball astern, where it will assume a stable position.
- The balls cannot 'catch up' the aircraft once the pilot has ensured that the ball is astern.
- The ball will dissipate. Reports of 10km (tail chase!) are not unusual.

45. Several comments can be made:

(a) The instances of phenomena of ball lightning ahead of, or behind, aircraft is relatively rare, but the Russian research suggests, apart from initial lightning avoidance, that the aircraft would be safe with the ball astern.

(b) Reports of balls above aircraft 'pushing or forcing' an aircraft to descend are of concern, even if the ball does not cause physical damage its presence is clearly menacing to the uninitiated - especially as it occurs suddenly.

(c) A 'collision' from astern is not considered likely.

(d) A 'collision' head-on is possible and its imminence might cause violent pilot (control) reaction even though the contact may not (at the last moment) have actually occurred.

The 'stand off' of the ball lightning from an aircraft seems to be very much like the situation encountered in several scenarios where pilots have been scrambled to investigate 'UFO' sightings. A scenario where this occurs not only involves the 'stand-off' described here

UNCLASSIFIED SECRET

but also the 'black' centre described, below, at para. 48

PLASMA SHAPE CHANGES AND SIZE

46 It can be argued that the buoyancy of the plasma is balanced by charged ion droplet mass, with the actual shape make-up dependent on the distribution of forces within the ball. Although some have suggested that the oval shapes occasionally reported are due, not to the mass of the droplets/particles (which gravity may pull into a pear shape, individually), but to the presence of a strong D.C. field, elongating the ball in the field direction. It is believed that the production of nitric acid (note the section on nitrous smells) leads to an inflow of air which aids ball stability. The size of the ball seems to be determined at its creation[4] and it is believed the cycle of change in electric field, of ion production, of water demand, and then evaporation might change the temperature gradient in the ball but not its size. In the many attempts to develop a theory to explain ball lightning (and by so doing possibly understanding the 'earthlights' phenomenon), it is always postulated that a source of energy is essential within the phenomenon for it to exist and be sustained. It has been difficult to apply recognised theory, although at the turn of the century it was recognised that Maxwell's equations could be generalised to include magnetic charge and current as the mirror-partners to electric charge and electric current. Since then 'new physics', has postulated the 'magnetic photon' as a corollary to the more widely known conventional optical photon. Hence, some theories concerning the ball lightning phenomenon have developed using the 'magnetic photon' and 'magnetic charge'. 'Vortons', in turn, are postulated to occur in pairs and create a rotating magnetic field. [Comment: This is of particular significance when related to the discovery that humans exposed to rotating magnetic fields can produce responses strikingly similar to those reported from close encounters with a UAP].

SURVEY OF COLOURS

47. Smirnov[2] analysed over 4100 ball/bead reports (indicating that the Former Soviet Union must have a considerable database on UAP-type topics). The total power radiated by a black body obeys the Stephen-Boltzmann Law of proportionality to the fourth power of temperature and in 4112 samples the temperatures produced the following statistical colour distribution:

White	20.4%
Red/Pink	17.7%
Orange	23.1%
Yellow	20.2%
Green	1.4%
Blue/Violet	11.4%
Mixed Colours	5.3%

From this it can be seen that for the atmospheric luminous phenomenon seen as a ball, there is around an 80% likelihood of the ball (or bead) colour being either white, Red/Pink, Orange or Yellow and around a 20% chance of it being one of these four options, rather than green, blue or mixed.

An apparent paradox in the understanding of the intensity (and hence colours) has been that the calculated radiant power (using colour temperature to determine intensity) has resulted in intensities that seem to be far too large to be in agreement with actual observations of heat and light. One of the later theories resolves this by suggesting that the vortons (see para. 46 above), moving as a gas, exhibit positive Doppler shifts of the radiant black-body energy to a higher colour temperature (moving towards the observer) and to a lower colour temperature for movement away. Variable cloud shapes other than balls can occur, it is claimed, if a ferromagnetic-like interaction of the dipole forces of the individual vortons occurs.

[2] Smirnov B.M. Sov. Phys. USP 35 650 (1992) and Phys Rep No. 224 151 (1993)

UNCLASSIFIED SECRET

UNCLASSIFIED SECRET
UK RESTRICTED

OPTICAL 'THICKNESS' OF BLACK BODY RADIATORS

48. A supportable theory suggests that some balls have a coherent core which is too cool to radiate in the optical visible spectrum - hence such a volume would appear totally black. The visible appearance of the phenomenon depends on optical 'thickness', where:

- If the body (of gases/particles??) is hot enough to radiate, then its intensity is uniform over the surface; independent of the angle the surface makes with the sightline of the observer.
- When the radiator is too cold to radiate a significant amount of energy in the optical region, it will completely absorb any optical radiation which falls on it and hence would be 'seen' as a totally black object.

NOTE: This later statement would seem to have a significant read-across to frequent UAP sightings where a black shape (often rectangular or triangular) is seen between visible lights at the extremities. Although, Black and grey-body radiators are, respectively, 'thick' and 'thin' optical sources.

THERMO-CHEMICAL REFRIGERATION

49. Considerable evidence exists to show that the incidence of ball lightning, especially with a longer lifetime, is higher when conditions of high humidity are present. Further, because of rapid ion motion and a higher temperature than the surrounding air, ions escaping from the plasma become hydrated and this action adds heat to the system; keeping the hydration zone (boundary) fairly hot. However, if the ions survive long enough to become hydrated by ~5 water molecules it is postulated that cooling occurs. To this thermochemical action is attributed the characteristics of the reported harmlessness of occasional human brushing contact with a ball and the reason for the cloudiness/indistinct appearance of the edges of the ball.

SUMMARY OF BALL LIGHTNING CHARACTERISTICS

50. A survey of literature on ball and bead lightning and its relevance to UAP reports, has shown that:

- There is a near constant brightness, size and shape, which can exist from a few seconds to minutes.
- The balls/beads have considerable mobility.
- It is possible for an electronically-charged body (possibly including ball lightning) to 'attach itself' to an aircraft in flight; where, apparently due to a balance of fields (electrostatic/magnetic or EM), it can remain in close proximity (formation abreast or astern).
- Ball lightning can enter houses and structures including aircraft and can actually exist within closed metal structures
- Sounds and smells are present on rare occasions. These are both often described, respectively, as 'electrical' (e.g. buzzing sounds, or explosions) and smells witnesses associate with electrical equipment, such as insulators overheating or rotten eggs.

51. **Near Terrestrial Events** There is a tendency for ball lightning not to rise - most sightings remain at low level near the earth in a near horizontal path. This is explained, in theory, in the reasonable expectation that the balance of charges between the ball in its environment (either indoors or outdoors) is such that the postulated radially-moving negative ions form a static charge on nearby surfaces which tend to repel the negative body of the ball; keeping it at a distance. This, it is argued, is the most likely reason for the balls to reportedly try to pass through any aperture (i.e. window, door, chimney). In short, as it moves it creates a field which tends to hold the ball in position (e.g. at constant altitude outdoors, or across the centre of a room. Further, since no charge builds on the aperture, the ball can proceed - presumably sending a positive charge somewhere ahead. This may also account for

UNCLASSIFIED SECRET
UK RESTRICTED

the propensity of balls to 'dart' towards power cables or any object where the radial does not exceed the local positive value.

52. **In-Structure Phenomena** The fact that the plasma phenomena can reportedly exist in closed metal structures suggests that, contrary to expectations, the existence of the ball is apparently not dependent on an external source but must retain it's own electric or magnetic field in order to exist and, once formed, is self-sustaining until its demise. Within the past year some researchers have suggested that atmospheric plasmas may owe their duration to a combination of both vertical and horizontal (i.e. orthogonal) magnetic looped fields which contain and sustain the phenomena. If this is the case the process may be applicable to any atmospheric plasma - however formed, if the field are strong enough. It has been proposed [6] that the stability of a volume (ball) of air at 16,000 to 30,000 degrees Kelvin might be contained within linked magnetic lines. Discharge arcs (e.g.lightning) advance along narrow tracks 50-100μm in diameter in air. These streamers would only occupay a small volume of the ball. It is postulated that some of these form short circuits, resulting in circulating currents, each loop acting as a coil. the physical appearance of the charge-contgined ball would be shining and diffused. It can be shown by Maxwell's equations that a 'magnetic knot' is feasible and this has now been observed under laboratory conditions. The conducted energy cannot be stationary and is postulated to produce a slowly-varying magnetic field. The magnetic energy is a function of the ball radius, the vacuum magnetic permeability, the number of magnetic lines which are linked and a field normalising function. It is not within the scope of this study to pursue this important phenomenon further, other than to emphasise the likely connection between this, the formation of plasmas by meteors and the effects of varying magnetic fields on humans (Working Paper No 25), in the UAP context.

53. **Demise** For those balls/beads visible to humans it is reported that the silent demise is normally a simple fade in brightness and diameter, while the explosive demise is sometimes preceded by an increase in brightness and a colour change. Similarly, plasmas of other origins than ball or bead lightning may also decay in the same way. Hence, in the UAP sighting reports it is almost impossible to determine the origin of a particular UAP because, it is believed, the behaviour is very similar. Further, if the premise that meteors (see Working Papers and statistical results at Volume 1) also cause the formation of UAP, then a UAP could be formed during a thunderstorm (as well as from ball or bead lightning) and similarly persist afterwards.

SUMMARY - RELEVANCE TO UAP

54. An examination of a wide range of research into ball and bead lightning has shown that it is certainly connected with a proportion of the UAP reports received from within the UK airspace. Descriptions of these particular forms of lightning correlate in time, colour and motion with qualitative description often given by reliable UAP witnesses. Because those UAP which are formed and then reported as a result of lightning are, of course, transitory in nature and their form is apparently changing as they head towards demise, it is reasonable that the colour descriptions vary, that they exhibit strongly influential electrical field characteristics, exceptional motion and pyrotechnic displays. All of which are unfamiliar to the majority of the population.

REFERENCES:

1. "Ball and Bead Lightning" J.D. Barry Plenum 1980.
2. "The Nature of Ball Lightning" S.Singer Plenum 1971.
3. "Hydrodynamic Model of the Interaction of Ball Lightning with the Airstream of an Aircraft in Flight" N.I. Gaidukov. Technical Physics 38(9) Sep 1993.
4. Turner D.J. "Ball Lightning" Phil Trans. Royal Society, London 1994.
5. Fryberger D. "A Model for Ball Lightning" Ostfold College Norway Report No. 1997:5 Part 1 (1994) Proc.

UNCLASSIFIED
SECRET

First International Workshop on ULAP, Hessdalen.

6. "A Model of Ball Lightning as a Magnetic Knot with Linked Streamers" A F Ranada, M Soler & J L Trueba. Journal of Geophysical Research, Vol 103 Sep.1998.

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 3

POTENTIAL REASONS FOR HIGHER DENSITIES OF UAP SIGHTINGS

	Para	Page
INTRODUCTION	1	3-1
POPULATION DENSITY	4	3-1
WEATHER/VISIBILITY	5	3-1
TIME OF YEAR	6	3-1
TIME OF DAY	7	3-2
LOCATION	8	3-2
AVAILABILITY AND COMPETENCY OF WITNESSES	9	3-3
HIGH INCIDENCE LOCATIONS	12	3-3
AIR CONTAMINATION	15	3-4

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED SECRET

POTENTIAL REASONS FOR HIGHER DENSITIES OF UAP SIGHTINGS

INTRODUCTION

1. In the current database analysis it has been important not to misinterpret the reasons for UAP occurrences, by drawing the wrong inferences from a statistical analysis. One of the first analyses was to ascertain the density of UAP sightings across UK aerospace to look for high incidence areas - in the hope/possibility that this may shed some light on the nature of the phenomena, lead to more focused scientific work and possibly to obtain more data when sightings occur (e.g. correlation of visual sightings with coincident radar coverage). As the unknown is being investigated, preconceptions are no part of initial assumptions.

2. Taking the extreme case - that UAP are more than natural occurrences - it cannot be assumed that locations where the objects occur will necessarily be of obvious importance to humans. Further, it cannot be ruled out that these appearances may only take place at certain intervals and be entirely unrelated to our concept of time. They may even be related to the relative disposition of the gravitational fields of various bodies in space, or even of other fields of which we may have scant or even no knowledge at present.

3. On the initial assumption that the phenomena of a UAP sighting can occur anywhere, then the presence of larger numbers of sightings in a particular part of UK will be dependent, at first sight, upon:

(a) The population density

(b) The weather/visibility

(c) The time of year

(d) The time of day

(e) The location

(f) Availability and competence of witnesses.

POPULATION DENSITY

4. It would seem logical that if there are a greater number of potential observers, and on the assumption of an equal probability (i.e. equal distribution of UAPs in the UK air space), then sighting clusters could be expected to occur in more highly populated areas. However, in areas of greater population there is also a much higher night-time background lighting level, making observation of flying objects much less likely to be seen (as evidenced by astronomical observatories, which have been forced to move away from lit-up areas). The contrary situation is that more sparsely populated areas have fewer potential observers, but little or no interference from ambient surface lighting. It is thus difficult to immediately connect the number of potential observers available in a geographical area against the likelihood of expectation of UAP sightings, since other factors are present. As an initial guide Table 1 shows the population distribution for the UKADR[1].

WEATHER/VISIBILITY

5. A brief analysis to determine the relative prevalence of sightings in cyclonic and anti-cyclonic conditions has been made. There was no clear evidence of correlation with temperature, dew point, wind, etc. However, the continued prevalence of UAP reports whether thunder (i.e. Lightning, as a pre-requisite - see Working Paper No 2) was present or not on the same day in the same area was of particular importance in an attempt to discover whether atmospheric conditions are key to the formation of UAP. However, adequately clear visibility for viewing low and

[1] Oceania World Index Johan van der Heijden 1996

UNCLASSIFIED SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

medium altitude UAPs can exist in both weather patterns; although the high pressure clear conditions, rather than the misty conditions in high pressure are likely to provide the best viewing conditions. There is, nevertheless, a possibility that UAP sightings might be connected to weather patterns.

TIME OF YEAR

6. It is instinctive to imagine a larger number of reported sightings during dusk and darkness - simply because the greatest number of reports are ones where 'lights' are seen - and this is rarely the case reported in daylight. Of course, this does not necessarily mean that there are fewer UAPs present during daylight (assuming that their occurrence is indifferent to the presence or absence of light). [Since we do not know what they are we cannot assume any attributes]. In addition to weather, it may be shown that the electrostatic and electromagnetic nature of the atmosphere correlates with sightings (see Working Papers No. 1, 2 and 10). It is known that sightings occur in the vicinity of volcanic activity - possibly connected with the presence of electrical charges caused by particle friction in the dust which is present and its velocity. The potential connection between UAP and ball lightning are summarised at Working Paper No 2.

TIME OF DAY

7. Although a time-of-day connection with **UAP reports** is inevitable because of the relative daylight and darkness viewing conditions for 'lights' in the sky, the actual occurrence of the total of these phenomena, within the atmosphere at any given time may not be time-dependent. One must not fall into the trap of assuming that the presence of unexplained objects in the atmosphere (or in near space) is necessarily connected to our world measurement cycle of time or that the rate of occurrence is somehow connected to the routine of life. As this study only involves sightings within the UK's airspace, this investigation will not be in a position to correlate UK sightings with successive sightings (if they were reported or even if they were present) in Europe or over Ireland, in the Atlantic, North Sea or Bay of Biscay. However, if there is shown to be a cycle of sightings, we shall have no other option than to measure it in terms of time as we know it. If, for example, this (to our eyes) appears to recur at regular intervals, the problem will then be to fit this time period to a meaningful pattern, perhaps sidereal. It may, of course, be shown not to fit any known pattern (e.g. celestial, seasonal, etc).

LOCATION

8. It is sometimes claimed that UAP sightings are more likely to occur in some locations than others. Apart from the volcanic connection, claimed by some observers (clearly not applicable to UKADGE), it has been suggested that the location list at the database (Table UAP-2, Volume 1) may be connected with sightings. Before useful statistical work can be done on locations, the following must be considered for a rigorous analysis to be made:

(a) The location of a sighting is often given crudely. A 'place name', 'near a place', 'between two places', 'out to sea off xxxx', 'on holiday near xxxx'. The address of the witness may not be the location of the sighting.

(b) Lat/Long co-ordinates and Grid References are rare (but could be generated approximately from most of the witness reports).

(c) Post codes might be a good method.

(d) Plots (maps) of the following are required in electronic form:

- National Grid/Local Power lines down to main sub-station level
- Airfields - Civil
- Airfields - Military/Experimental Establishments
- Air corridors

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

- Low Flying Routes for Military Aircraft
- National strategic sites
- Power Stations (including nuclear)
- Locations of ancient monuments/ fault lines (to investigate the claim of heightened probability of UAP sightings electromagnetic/gravity/ earth's field changes claimed at these sites).

AVAILABILITY AND COMPETENCY OF WITNESSES

9. Clearly only a proportion of UAP phenomena is reported. There is no way of ascertaining what proportion this may be. It can only happen where people are present, therefore there may be large areas of the UK, with high UAP activity, but never seen or reported. The phenomenon of the lack of radar correlations is considered at Working Paper No. 10 and at Volume 3 for specific in-service systems.

10. The decision to report activity depends on the witness. The more 'responsible' are likely to do so because the UAP sighting is a unique event in most cases: it has caused fright or concern and there is a 'need' to tell someone in authority. Because the sighting is 'airborne' the preferred reporting option is the nearest RAF Station, followed by the coastguard or the police. Dating of reports compared with sighting dates clearly indicates that some witnesses often wait a day before making a report. [As for all delayed reports there is always the possibility of forgetfulness on detail or embellishment!]. Many witnesses delay because of concern about their credibility. A comprehensive report is not usually obtained from the very basic UAP (UFO) reporting form - and the accuracy and detail obtained from a witness depend significantly on the attitude and care taken by the police or other reporting authority. Hence, there is no reliable consistency of reporting - even from the ATC/CAA sources.

11. It is wrong to separate so-called competent/reliable witnesses from others because every scrap of evidence has the potential of being important. For example several single-witness crude sightings can complement a 'reliable' sighting, since these extra sightings:

- Allow multiple angle/aspects to be registered
- Allow object velocities, colours, altitudes and sizes to be established independently
- Allow geometry to be used to eliminate heavenly bodies (i.e. planet sightings)
- Allow both silhouette as well as reflected-light viewing
- Allow multi-aspect viewing to ascertain shape, colour and flight profile
- Eliminate the retained after-image sighting of single witnesses - so establishing true sighting times
- Confirmed UAP geometries and spacings independently.
- Eliminate single-human events (e.g. occult, drugs, psychological etc.)
- Usually eliminate the hoax option
- Reinforce credibility of each others reports from a group of independent witnesses
- Allows multiple photography/video to be taken.

HIGH INCIDENCE LOCATIONS

12. Within the UKADR it is reported by researchers that the greatest incidence of UAP events are centred on:

- Lothian (Scotland)
- Luce Bay (Scotland)
- South Wales
- Warminster (S. England)
- Pennine Hills

UNCLASSIFIED
UK RESTRICTED
SECRET

SECRET
UNCLASSIFIED

13. Elsewhere in the world concentrations of events occur at 20 prime general locations. These, include France, Belgium and Scandinavia - all which have airspace adjacent to the UKADR

14. Hence, reports are sometimes received of UAPs entering from, or leaving towards, these nations. Only NE Italy and Spain are among the other NATO nations reporting large numbers of sightings (although these are not shared or reported through official channels to UK MOD).

AIR CONTAMINATION

15. It is postulated by some plasma and other atmospheric researchers that the presence of

particles (from whatever sources), as well as the introduction of various industrial gases, will affect the conditions for the formation of atmospheric plasmas. This is considered further in the relevant Working Papers, principally Number 19. It is noted, in passing, that those nations with higher atmospheric dust-producing conditions(e.g. Volcanic and Earthquake Regions), reportedly have a high incidence of UAP reports. Further, if this theory is true, one would expect to find more UK reports at, or close to, centres of the older smoke or gas producing industries and possibly nearer to areas such as airports where exhaust particles of various types are likely to be in higher concentration.

UNCLASSIFIED

UNCLASSIFIED
SECRET

FIGURE 1: HIGH INCIDENCE UAP LOCATIONS (J. RANDLES)

UNCLASSIFIED
SECRET

		area in km²	population census 1991
Avon	Bristol	1,346	920,000
Bedfordshire	Bedford	1,235	514,000
Berkshire	Reading	1,259	717,000
Buckinghamshire	Aylesbury	1,883	620,000
Cambridgeshire	Cambridge	3,409	641,000
Cheshire	Chester	2,329	937,000
Cleveland	Middlesbrough	583	541,000
Cornwall	Truro	3,564	469,000
Cumbria	Carlisle	6,810	487,000
Derbyshire	Matlock	2,631	915,000
Devon	Exeter	6,711	998,000
Dorset	Dorchester	2,654	645,000
Durham	Durham	2,436	590,000
East Sussex	Lewes	1,795	671,000
Essex	Chelmsford	3,672	1,496,000
Gloucestershire	Gloucester	2,643	521,000
Greater London	London	1,579	6,378,000
Greater Manchester	Manchester	1,287	2,456,000
Hampshire	Winchester	3,777	1,512,000
Hereford & Worchester	Worchester	3,927	668,000
Hertfordshire	Hertford	1,634	952,000
Humberside	Hull	3,512	835,000
Isle of Wight	Newport	381	127,000
Kent	Maidstone	3,731	1,485,000
Lancashire	Preston	3,064	1,365,000
Leicestershire	Leicester	2,553	861,000
Lincolnshire	Lincoln	5,915	574,000
Merseyside	Liverpool	652	1,377,000
Norfolk	Norwich	5,368	736,000
Northamptonshire	Northampton	2,367	573,000
Tyne & Wear	Newcastle	5,032	301,000

TABLE 1(A): POPULATION DISTRIBUTION UKADR

/Cont'd.....

UNCLASSIFIED SECRET

Southend on Sea	153,700
Peterborough	148,800
Blackpool	144,500
Colchester	141,100
Brighton	133,400
Blackburn	132,800
Poole	130,900
Newport	129,900
Preston	126,200
Reading	122,600
Torbay (Torquay)	122,500
Saint Albans	122,400
Norwich	121,100
Ipswich	115,500
Oxford	109,000
Exeter	101,100
York	100,600

North Yorkshire	Northallerton	8,309	699,000
Nottinghamshire	Nottingham	2,164	981,000
Oxfordshire	Oxford	2,608	554,000
Shropshire	Shrewsbury	3,490	402,000
Somerset	Taunton	3,451	459,000
South Yorkshire	Barnsley	1,560	1,249,000
Staffordshire	Stafford	2,716	1,020,000
Suffolk	Ipswich	3,797	630,000
Surrey	Kingston	1,679	998,000
Tyne and Wear	Newcastle	540	1,087,000
Warwickshire	Warwick	1,981	477,000
West Midlands	Birmingham	899	2,499,000
West Sussex	Chichester	1,989	693,000
West Yorkshire	Wakefield	2,039	1,985,000
Wiltshire	Trowbridge	3,480	553,000
Total England	London	130,439	46,168,000

Cont'd.....

UNCLASSIFIED SECRET

UNCLASSIFIED

cities	population 1991
London	6,803,100
Birmingham	934,900
Leeds	674,400
Glasgow	654,542
Sheffield	500,500
Bradford	449,100
Liverpool	448,300
Manchester	432,600
Edinburgh	421,213
Bristol	370,300
Huddersfield	367,600
Dudley	300,400
Coventry	292,600
Sunderland	286,800
Belfast	279,237
Cardiff	272,600
Leicester	270,600
Newcastle	263,000
Nottingham	261,500
Walsall	255,600
Bolton	253,300
Kingston upon Hull	252,200
Rotherham	247,100
Stoke on Trent	244,800
Wolverhampton	239,800
Plymouth	238,800
Derby	214,000
Aberdeen	201,099
Southampton	194,400
Swansea	182,100
Northampton	178,200
Saint Helens	175,300
Portsmouth	174,700
Luton	167,300
Dundee	165,548
Bournemouth	154,400

UNCLASSIFIED

SECRET
UNCLASSIFIED
UK RESTRICTED

Cont'd.....

Borders	Newtown St.Boswells	4,698	103,000
Central	Stirling	2,700	268,000
Dumfries and Galloway	Dumfries	6,425	147,000
Fife	Glenrothes	1,319	339,000
Grampian	Aberdeen	8,752	493,000
Highland	Inverness	26,137	209,000
Lothian	Edinburgh	1,770	724,000
Strathclyde	Glasgow	13,773	2,218,000
Tayside	Dundee	7,643	385,000
Island Areas	-	5,566	71,000
Total Scotland	Edinburgh	78,783	4,957,000

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 4

AFTER-IMAGES AS A RESULT OF FLASHES OF LIGHT

	Para	Page
BACKGROUND	1	4-1
Primary Sensation	3	4-1
Results of Experiments	4	4-1
Flash Duration Dependency	6	4-2
Observer Variability	8	4-2
SUMMARY	9	4-2
RELEVANCE TO UAP SIGHTINGS	10	4-2

February 1, 2000

XXXXXXXXXXXX S.40

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

AFTER-IMAGES AS A RESULT OF FLASHES OF LIGHT

BACKGROUND

1. Illusions observed in darkness or low light conditions, after exposure of one or more eyes to a bright light are known as 'positive after-images' and are often similar in colour to the inducing light. Those illusions seen in moderate illumination are called 'negative after images' and are often of the approximation to complementary colours. In practice the actual appearance of after-images is complex and likely to depend on many factors. However, adaptation from dark to light takes much less time than from light to dark - hence there is an awareness of the appearance of a light in dark conditions much more quickly than the appearance of a shadow in lighter conditions. Excessive eye stimulation, as is well known, produces blindness in the limit.

2. Within the eye the sequence of changes which occur in reception after light is absorbed differs between rods and cones, classes of cones, and suffers further adaptation by the nerve cells of the retina and of the brain. However, the result is the persistence of the sensation of light after the stimulus has been removed.

3. **Primary Sensation** Human eye response is from $\lambda = 0.4$ to $\lambda = 0.7\mu m$ with an unaided peak at $0.55\mu m$; and a detectability from 10^{-6} cd.m^{-2} to 5000 cd.m^{-2}. There is a range of conditions over which the primary sensation produced by a flash of light depends on its luminance-time product (i.e. in general, the integration of luminance with respect to time). This is independent of temporal distribution. This was proved experimentally by regularly repeated flashes as long as 150 years ago and confirmed this century using extremely short flash durations now possible. The practice holds for flash values down to ~ $4x10^{-7}$sec and is considered valid for high intensities. For longer duration flashes the measurements are less researched. Hence, the integration of flashes is less reliable as a guide at an illumination intensity of 0.5cd.m^{-2} at which pulse durations of 27 millisec may be the eye integration limit (3° fovea fov). The time duration may be greater than 27 millisec for dimmer flashes and shorter in period for those which are brighter.

4. **Results of Experiments** Preliminary experiments [1] to investigate after-image conditions for eye stimuli of different lengths produced the following results:

- Stimuli ~2 sec maximum. The whole course of the (positive or negative) after image, excluding its first 15 sec, was dependent on total light in the stimulus and not on the light's intensity distribution in time.
- Stimuli 2-5 sec. The result only differed slightly from the 2 sec stimuli length above, but with some time distribution differences. In particular, there were some differences between positive (dark background) and negative (bright background) after-images.
- In the after-image observation time t=10 to t=30 it is believed that the retinal illumination decays exponentially (from white light stimuli), but the after-images caused by other colours may decay at other rates. The actual detection threshold is inversely proportional to flash duration.

5. The human eye can nevertheless distinguish between extremely short spaces between flashes (pulses of light). Experiments have shown that 4 millisec intervals can be distinguished from intervals as little as 0.28 millisec. Hence, in the context of UAP observations, pulsed (i.e. modulated) lights should be distinguishable by observers, even with very short durations - and should not get mis-reported as steady lights. This is

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED
CONDIGN

important, for example, in the context of lights which are 'chopped' by helicopter blades (~50Hz for a main rotor four-bladed Helo).

6. **Flash Duration Dependency** An important finding is that a given amount of light produces the same after-image (except for the first 15 sec), irrespective of whether it is delivered within 15.7 millisec or spread over 1.68 sec. This, is consistent with the hypothesis that the after-images of a brief stimulus from the 15th second until its disappearance at t=100 to 300 seconds later, depends upon photochemical effects. It does not depend upon adaptation or neural mechanisms in the retina or brain (as a result of the activity it is presumed the brain undertakes immediately after an eye stimulus).

7. It is probable, from the evidence available, that, after the first 15 seconds, neural effects contribute to the perception of the image seen. Up to five seconds after a stimulus (flash) it is nevertheless believed that neural as well as retinal (chemical) image perceptions are formed particularly if the event is from an unexpected source. At t=10 seconds the after-images are nearly alike (when using the alternatives used for experimentation). By 15 seconds they are seen as alike.

8. **Observer Variability** Observer contrast, for 50% probability of detection (against a plain background), is a function of object luminance, size of illuminated field, object size, edge sharpness, shape, time seen, position in field of view, colour, motion and experience. Detection thresholds are largely independent of shape up to an expected ratio of 7:1.

SUMMARY OF RESULTS

9. Based on the limited data available; to a first order level:

- After-images in the eye are based on the total amount of light available, independent of time.
- The persistence depends on the chemical consequences in the eye's receptors, not in (5-10 sec case) the adaptation of the image by the nerves/brain response.
- For very short flashes (e.g. less than 4 millisec) high intensities have more effect than lower intensity stimuli when viewed against either bright or dim backgrounds.
- Colours observed following a flash of a particular colour are dependent on the viewing background thereafter.

RELEVANCE TO UAP SIGHTINGS

10. A large number of UAP reports are of very intense lights of diverse colours, some of which are only reported as being of very short duration. Some of these could be the after-images of even briefer flashes. Longer duration reports apparently (see para. 6) of up to five minutes in duration, could be attributed to flash stimuli, followed by an after-image. It would appear that sightings are unlikely to be caused by after images for longer than five minutes. After 10-15 seconds the human involved will be interpretging and adapting what is seen well beyond what is actually registered chemically, due to the flash, within the retina.

11. There is, of course, the possibility of the after-image being 'replenished' by successive intense flashes. However, many flashes are separate (i.e. single) events, e.g. lighting, unexpected (i.e. non-continuous) electrical flash-over from (national grid) power lines or overhead train power lines.

12. It seems unlikely that, on the occasion of multiple witnesses of UAPs, that they will all receive the same phenomena (after-image); since apart from human observer variability in eyesight, it is unlikely that they would all receive the same stimulus at the same time unless they were located very close together.

[1] "Discrimination of After-Images" G.S. Brindley, J. Physiology 147 (1959).

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED
CONDIGN

[2] "Further Studies of the Positive Visual After-Image C.A. Padgham Opt. Acta Vol. 4 1959.

UNCLASSIFIED
SECRET

SECRET
UK RESTRICTED
UNCLASSIFIED

WORKING PAPER NO. 5

DETECTION OF UAPs BY RADAR

	Para	Page
DETECTION OF UAPs BY RADAR	1	5-1
Possible Explanations	3	5-1
Current Detection Minima	4	5-2
RADAR REFLECTIONS FROM PLASMA	5	5-2
BALL LIGHTNING AS A RADAR REFLECTOR	10	5-3
Radar Echoing Area	12	5-3
DUSTY PLASMAS AS RADAR REFLECTORS	13	5-3
DETECTION BY UK-BASED RADARS	19	5-4
RADAR SIGHTING REPORTS	21	5-4

UNCLASSIFIED
UK RESTRICTED
SECRET

DETECTION OF UAPs BY RADAR

1. S.26 [redacted] Conventional theory and radar system operation suggests that (given a radar sightline), the following conditions should occur for radar (UAP) detection to take place:

(a) The target must be radar-reflective. (See Appendix A5)

(b) A minimum detectable signal must return to the radar receiver to satisfy the radar receiver - S/N requirements (i.e. minimum detectable signal).

(c) The signal must be displayed (i.e. in a modern system which uses preset thresholds the display/processing threshold must be adequate for the target being inspected).

For a target track to be formed (a), (b) and (c) must be repeated at the radar's inspection (i.e. update) rate. In modern systems supposed 'spurious' random responses are likely to be rejected/filtered and unless they fulfil 'plot' requirements, will never be declared from successive plots into 'tracks'. Hence, they will not be seen as targets.

2. There is a significant absence of radar plots/tracks on UAPs. It should be borne in mind that, statistically, it is inconceivable that **all** UAPs in the UKADGE are reported by direct (human) sightings). In fact, there must be many more UAPs unreported which are within radar coverage but not within human sightlines (e.g. due to cloud cover, reduction of observers in sparsely populated parts of the UK etc.). Why, therefore, are not at least even a reasonable proportion of these reported by military or civil radars, either at sea, over land or by aircraft radars?

3. **Possible Explanations** A number of explanations are possible. The conditions at para 1 above are not being met for one or more reasons:

a. For some reason the radar reflectivities of these unidentified objects are extremely low.

b. Because they do not 'communicate' or appear where aircraft are expected, they are ignored by the operators (or the automatic processing systems) as spurious/short-lived observations.

c. Those seen are taken to be caused by flocks of birds.

d. When moving fast they exceed the upper Doppler/Velocity capability of the system. This may be, firstly, beyond the Doppler measurement capability of the particular type of radar [redacted] S.26

e. The target cannot be seen because there is no radar sightline (e.g. terrain screening/low altitude). This can only be the case on a limited number of occasions, subject to range.

f. [redacted] S.26

g. The object absorbs RF energy at least at the usual wavelengths in use and hence is not detected.

h. [redacted] S.26

UNCLASSIFIED

i. The objects are above the upper radar coverage capability (~100,000ft).

4.

S.26

RADAR REFLECTIONS FROM PLASMA

5. A plasma is an assembly of small particles of three kinds, +ve, -ve and neutral; moving at random and colliding with each other. In all except very high current discharges there are many more neutral particles than charged particles. Electrons oscillate about a mean position, with angular frequency $\omega_0 = 2\pi f_0$, where $\omega_0^2 = 4\pi N_e e^2 / m$. The oscillations are linear and stationary and do not progress as waves. A plasma will reflect radar energy at all microwave frequencies below the "plasma frequency". A critical-density surface can be formed according to the density relationship:

$N_e = 1.2\,4 \times 10^{10} f_o^{\,2}\ (cm^{-3})$

f_o is in GHz. For example, a value of $\geq 1.2 \times 10^{12}$ cm^{-3} will reflect X(I) Band and all frequencies below. Using these relationships the direct RF to density expression can be derived:

$$f_0 = \sqrt{\frac{N_c . e^2}{\pi m}} \quad \text{or} \quad f_0^{\,2} = \frac{N_c . e^2}{\pi m} + \frac{c^2}{\lambda^2}$$

where m = mass 9.11×10^{-28}g.

e = electron charge 4.8×10^{10} e.s.u. (1.6×10^{-20} emu or 1.6×10^{-19} coulombs)

This can be rearranged such that:

$f_0 = 8980\sqrt{N_c}\,H_z$

6. A plasma thickness may vary, hence:

- The location of the critical density 'mirror' is not necessarily at the outer extremity of the plasma.
- Some absorption of the incident energy can occur in the lower density region which the energy encounters before it penetrates to the depth of the critically dense region. This depends on the ambient air pressure.
- Incident radar energy may arrive at the plasma at various angles (θ), hence:

$$N_c = 1.24 \times 10^{10} f_0^{\,2} \cos\theta . cm^{-3}$$

- The refractive index of a plasma is always less than 1, given by:

$$\mu = \sqrt{1 - \omega_\rho^2 / \omega^2}$$

where ω is the radian frequency of the EM wave

UNCLASSIFIED

and ω_p is the plasma frequency which is related to N_e by:

$\omega_p = 5.64 \times 10 \sqrt[4]{N_e}$

7. Thus radar energy entering a medium of lower refractive index is a similar situation to total internal reflection in optics.

8. Calculations show that to reflect 10 GHz microwaves a plasma should be at least 1-2 cm in thickness and less than -20dB through-transmission. It is possible for very high RF energies to be reflected (although the case here is much attenuated by the arrival of a radar pulse having suffered propagation attenuation $\alpha 1/R^2$ (which will be repeated on the reverse journey for a monostatic radar inspection).

9.

5.26

10. It should also be noted that the greatest visual luminosity occurs when the frequency of the oscillation of ions and electrons is equal to the applied frequency:

$4\pi_e^2 / m\omega_0^2 = 1$

BALL LIGHTNING AS A RADAR REFLECTOR

11. As stated at Working Paper No. 2, ball and bead lightning (which do not always appear as spheres), may have diameters as small as a few cm and as large as 12-15 metres. For the ball lightning sphere to 'float', its gaseous density is known (1.29×10^{-3}gm cm^{-3}), but its plasma density is not known, unless this can be deduced via its colour/temperature characteristic.

12. **Radar Echoing Areas** The radar echoing area of ball lightning would be expected to be of the order calculated from its physical size. A transition between a strongly reflecting target and an almost completely absorbing target occurs. The possible RCS values for plasma spheres are different from that of metallic spheres (who's RCS is a function of sphere radius and radar wavelength), with the radar echoing area of plasma spheres dependent also on ionisation level. An 'overdense' plasma sphere (or other shape) may be treated as a perfect reflector. However other plasmas depend, for their RCS, upon interference effects between the backscattered wave and tightly bound surface waves. This gives the plasma the properties of a dielectric, even when it is overdense. For example, a collisionless homogeneous plasma sphere with low electron density may have a RCS value of -60dB, peaking between 1 to $8m^2$ as the density increases, but falling to $1m^2$ as the density increases yet further. These values are for D/E(L) Band assessments.

DUSTY PLASMAS AS RADAR REFLECTORS

13. It is argued that 'dust' particles, possibly of ice, form noctilucent clouds. (These are of the type, see Working Paper No. 13, which are sometimes reported as UAPs) A more recent understanding of dusty plasmas is at Working Paper No 19 ''Charged Dust Aerosols'). It can be postulated that the plasmas containing these particles comprises two ionic components (one single charged atomic or molecular ion and a positive, or negative, multiple charged dust particle). Due to the tendency of the plasma to charge neutrally, a kind of charged cloud forms

around each charged particle in such a way as to compensate its charge.

14. In a two-component plasma with equal electron and ion temperatures it can be shown that the charge of the dynamic cloud of a single charged ion is composed of 50% attracted electrons and 50% of repelled ions. The roles of electrons and ions is reversed for the case of a negative ion. Hence, the number of electrons in the neutralising cloud may be small or large, depending on the densities and temperatures of the plasma components. Under these conditions a (EM) wave illuminating the plasma will set in motion the electrons in the clouds and if the scale of the dynamic cloud (Debye length) is much smaller than the wavelength of the illuminating wave, either coherent or collective scattering (from the electron component of the cloud) will occur.

15. It is beyond the scope of this brief paper to pursue the detail of the scattering, other than to note that for radar-wave scattering to be enhanced there must be no interaction between the dust particles.

16. The intensity of the scattering, as a function of the incident radiation λ_o, equals $2\pi/k_o$, where k_o is the wave vector number. There are two regimes with little intensity for long wavelengths ($2k_o\lambda_D^2 \leq 1$) and a regime at shorter wavelengths ($2k_o\lambda_D^2 \geq 1$). The radar scattering is caused by fluctuations of electron density. The scattered power per unit volume of illuminated plasma within an interval of solid angle, within a frequency interval $d\omega$ and at wave vector k can be calculated from the Thomson electron cross section;

$$\sigma_T = r_e^2 = 7.95 \times 10^{-30} m^2;$$

where $r_e = 2.82 \times 10^{-15}$m is the classical electron radius, E_o is the incident (E field) amplitude and $\varphi(\Omega)$ is a polarisation factor defined as:

$$\varphi(\Omega) = \left| \frac{k_s (k_o E_o)}{k_s^2 E_o} \right|^2$$

For backscatter $\varphi(\Omega)$ equates to 1. The full derivation is at[1].

17. Anomalous radar scatter has been received at RFs of 50, 224 and 933MHz, using experimental radars. The plasma is not fully ionised.

18. Strong backscatter from this cause occurs principally at high latitudes, in the summer and at considerable altitude (~80km).

DETECTION BY UK BASED RADARS

19. Backscatter from 'dusty' plasma at an altitude of, say, 80km could theoretically be obtained at a slant range of ~190km from a radar with a maximum elevation angle of ~25°. Those radars with a height-finding capability would soon reject the returns because the range/angle/altitude combination would place the target at an impossible altitude for manned aircraft. S.26

20. The detection of phenomena other than mesosphere plasmas is also considered at Volume 3 and is necessarily classified SECRET as it involves the current detection performance of military operational systems.

RADAR SIGHTING REPORTS

21. In an attempt to correlate simultaneous or sequential radar sightings with radar types, only limited UK information is available. In December 1989 5 NATO radars, part of ACCS, were within coverage range of a UAP report. Three radars had detections but two did not. Unfortunately, the radars have since been replaced and records of their parameters,

---

[1] LaHoz.C "Radar Scattering from Dusty Plasmas" Physica Scripta 45. Univ. Of Tromso, Norway 1991.

UNCLASSIFIED SECRET

in use at the time, are no longer available. In the 1960s, Preston Air Traffic radar had unexplained detections and, over various years, the F-16 Air Interception radar has occasionally made UAP detections. More recently, RAF Neatishead, RAF Waddington Airfield Approach Radar and the CAA radar at Claxby, apparently had simultaneous detections. In all these cases the electron density of the target must have been high enough for the RF in use to produce reflections.

22. Clearly, UAP response to radar is variable, otherwise all the radars would see all the objects which entered their respective coverage zones all the time. The implication of this would seem to be that at least the surface offered to a radar wavefront by a UAP target is not a consistent solid object. This variability may be due to aspect or orientation, material composition or both. If UAPs are plasmas, their intensity would proabably be diminishing as their physical life decays.

23. In the absence of firm radar cross-correlation the number of occasions where velocity could be deduced from actual measurements (compared, for example with purely 'eyeball' estimates of speeds obtained from some members of the public) are few. On one event a triangular (visual) formation was tracked on radar with an acceleration from 100 to 980kts in two seconds and an altitude change from 7000 to 3000ft in 1 second. This, of course, is feasible if the entities are charged bodies which are moving under the forces of electromagnetic or electrostatic fields. The Hessdalen lights, in Norway, for example, were reportedly tracked at a velocity of ~8.5km.s^{-1}.

UNCLASSIFIED SECRET

APPENDIX A5

DETECTABILITY OF PLASMA TARGETS

1. If it is assumed that, in the first instance the target is a spherical plasma body, the following conditions could exist:

- The sphere could be large in dimension compared with the radar wavelength

- The radar echoing area of the simple sphere is a function of its ratio of circumference to the illuminating wavelength [$2\pi a/\lambda$ (where a is the sphere radius)]

- For large values of $2\pi a/\lambda$, the RCS approaches the optical RCS (πa^2)

- The sphere, if homogeneous and perfect would be aspect-insensitive. (U)

2. In theory it is seen, therefore, that if a UAP was a stable plasma sphere of adequate electron density, a metre in diameter and comprised of entirely reflecting gaseous material, then its maximum radar echoing area for all practical purposes, when illuminated by a E/F Band(0.10m) radar, could be about ~16 square metres. For D/E(L) Band radars the value computes to ~five square metres. However, there may be several other factors of importance for a plasma UAP which could significantly affect its detectability; and in practice (as mentioned at page 5-3, paragraph 12), the real values (L Band) are estimated as falling somewhere between -60dB ($0.000001m^2$) and $+8m^2$. Any **surface absorption** of the radar signal, which, in theory, should have little effect when the wavelength is large compared to the target dimensions, is not necessarily the case here, as it is by no means certain that the UAP plasma (inside it's outer shell, or surface) can be considered a resonant body. Or, indeed, that it's surface remains a consistent and constant reflector, especially as many UAP reports indicate that the body is constantly changing colour and often varying slightly in shape. The response of the body as a **reflector** when compared against the characteristics of the radar is clearly a key factor. (R)

3. **Target Characteristics** Target RCS fluctuation plays a significant role in the detection performance of all radars. In general, radars, (apart from Weapon Control/Tracking Radars, which may dwell for relatively long periods on their chosen target) inspect their targets at repeated and sometimes regular intervalsin the form of dwells or scans, and by illuminating them with bursts of pulses. If it is reasonably assumed that a plasma UAP is a cloud of swirling ionised gases with variable electron density (possibly interspersed with periods of greater plasma stability), then for much of the time the radar reflectivity may vary rapidly, possibly uniquely from pulse-to-pulse (Swerling Case 2), rather than from scan-to-scan (Swerling Case 1). Further, the fluctuations may vary continuously from scan-to-scan (Case 3); or finally, so rapidly as to vary from pulse-to-pulse (case 4). (U)

4. If the plasma entity has several, possibly variable-density cores (as sometimes visible and reported as variable colour centres within a single buoyant body, and as always the case where a UAP comprises a grouping of multiple bodies (e.g. 'Triangle', 'Oblong', or Balls either 'in a row', or 'stacked'), this further adds to the complexity and variability of any radar reflecting characteristics the

UNCLASSIFIED
SECRET

object might have. The steady (non-fluctuating case), sometimes called Case 5, is extremely rare in normal radar practise, due to the inherent nature of flying targets.(R)

5. **Practical Effects** The detection capability of a radar depends upon the signal (wanted) to noise (unwanted) ratio. The practical effect of RCS fluctuations, applicable to the UAP scenario, is most simply illustrated by one example. For a typical radar with a requirement of probability of detection of 0.95, against a steady target, a signal/noise ratio of 4 (~6dB) is required. If the target is fluctuating according to Case 1, above, a ratio of ~48 (16.8dB) would be necessary. In radar range terms this turns out to be a range performance reduction by a factor of 3.28. This effect can be mitigated somewhat by illuminating the target with a larger number of pulses and averaging them out. However, there is a limit to the number of pulses emitted, and which impinge on a target from an early warning-type radar during its typical continuous-scan mode of operation. For targets which exhibit Case 3 and Case 4 fluctuations the situation is even worse - and it is believed that this is the case for most, if not all, of the plasma UAP events. Hence, the factors which account for the intermittent detection of most UAP events on the radars, can be well justified in engineering and scientific terms. The precise limitations on the UKADR radars are discussed at Volume 3.(U)

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 6

EXOTIC TECHNOLOGIES

	Para	Page
INTRODUCTION	1	6-1
Exotic Solutions	2	6-1
UAPs AS PROPELLED VEHICLES	4	6-1
ANTI-MATTER (ANTI-PROTON) PROPULSION	8	6-2
Material Storage	9	6-2
NATIONAL CAPABILITY		
USA	10	6-2
UK	11	6-2
Former Soviet Union	12	6-2
France & Italy	13	6-2
Rest of The World	14	6-2
ELECTRIC PROPULSION TECHNOLOGIES	15	6-2
Arcjets	16	6-3
Stationary Plasma Thrust (SPT)	17	6-3
Ion Thrusters (ISP)	18	6-3
Field Emission Propulsion (FEP)	19	6-3
PROJECTED ENERGY	23	6-3
TORSION, GRAVITY AND LASER FIELDS		6-4
Torsion Fields: Definition and Properties	24	6-4
Laser Propulsion	27	6-4
MICROWAVE PROPULSION	28	6-4
Summary	31	6-5
OVERALL SUMMARY	32	6-6

XXXXXXXXXX S.40

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

EXOTIC TECHNOLOGIES

INTRODUCTION

1. UAP reports usually describe objects seen at a distance and these reports can only provide, at best, approximate angular speed and size (and often a very vague diameter). For this reason, in the absence of mass or linear velocities the information is almost useless when trying to apply the laws of physics controlling the ability of a 'craft' to land (or hover) and take off again.

The thrust of any object must be slightly less than the body mass on landing and twice its weight for an acceleration on lift-off of 1g. If an object of say 5 or 20 metres diameter were to lift off, using (conventionally understood) thrust then a **significant** blast and scorching effect must be expected on the surface. No such after-effects are reported in the thousands of UAP reports held in MOD.

2. **Exotic Solutions** Exotic solutions may be postulated but these often lead to the necessity for some form of force beyond human understanding and contrary to the laws of physics as we understand them. This leads to such ideas as:

- Gravity Cancellation
- Teleportation
- Propulsion without reaction
- Force Fields

3. Intergalactic travel requires ~four million years for a return trip (travelling at just less than the speed of light), or three years, even to a nearby planet at a velocity of 20Km sec^{-1} - a planet on which we can determine no sign of life in the form which would indicate 'beings' and their technology.

UAPs AS PROPELLED VEHICLES

4. The majority of UAP sightings can be attributed as relatively easily explainable natural or human phenomena - explainable, for example, as one of the many options explored at the database auxiliary tables. There are, however, the remaining, relatively few events which are not so easily explainable. One of the extreme postulations is that these 'residual' UAPs are, in fact, genuine constructed air vehicles, which use potential scientific and engineering principles which are beyond currently applied knowledge. Thus they must have some sort of propulsion systems which would provide the extraordinary range of velocities and accelerations (and presumably both endo- and exo-atmospheric capabilities) frequently reported. It is only possible to explore the propulsion possibilities which fall within the human realms of conceptual thinking. It must therefore be recognised that there is a limit to real engineering (as within the current limits of understood technologies) and that, if the postulation is true, that methods of propulsion may, in fact, be possible beyond our current understanding in the UK.

5. Several side-issues in which current aeronautical engineering may progress and which may be relevant may also be explored. These include:

- The use of plasmas to reduce airframe drag.
- Plasma 'coatings' as a method of RCS reduction.
- Combined chemical and electric nuclear propulsion.
- Magnetic propulsion.
- Hypersonics.

6. It is surmised that the requirement would be to propel the object at ~> Mach 8 or more and that alternatives (as understood within currently accepted engineering capabilities) would be capable of exceeding scramjet or conventional rocket velocities. Research and development on hypersonic technology is expanding, principally in the

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED SECRET

technology is expanding, principally in the USA. The projected (USAF) priority plan is to produce unpiloted air-breathing aircraft with a Mach 8-12 capability and transatmospheric vehicles which can operate between the upper-air-breathing and sub-orbital flight regimes, as well as highly supersonic vehicles at Mach 4 to 6.

7. It is assumed that the fuel options are intrinsic (fuel carried internally), partially extrinsic (some part of the fuel is obtained externally e.g. from the atmosphere) or the propulsion energy is entirely extrinsic (e.g. from some sort of external field). The foregoing examples are understood as, respectively, chemical or electric or nuclear (e.g. rocket), air-breathing (e.g. jet engine), or a system which uses a field (e.g. magnetic field) - of which the only vehicular example is terrestrial (e.g. levitated train).

ANTI-MATTER (ANTI-PROTON PROPULSION)

8. A variety of conceptual engine types are potentially feasible. The following performance capability would be possible, using just **one gram** of the anti-matter:

- 100Kg payload accelerated to a velocity of the order 1000Km s^{-1} (Rocket)
- Launch a 1000 Ton payload into a Mars mission (Rocket)
- Payload/gross weight ratio improvements by a factor of three to five (Air-breather). This would involve the use of anti-matter to amplify the SI of standard cycle engines.
- Possibility of 'fusion engine'.

The rocket (i.e. exo-atmospheric mission) potential is encompassed by the relation $M(\Delta)^2 \sim 10^5$, where M is the mission mass (metric tons) and ΔV the velocity increment (measured in $km.s^{-1}$). It is believed that the application of anti-matter can be developed for solid core, gas core, plasma core and beam core rocket motors with adaptations for the air-breathers. Parametric studies have been made to this effect in the USA.

9. **Material Storage** Cooling is among the most serious problems to be solved. Portable storage for containing the 'anti-matter', in the form of rings and ion traps, would be necessary. The particles are typically confined within a plasma volume (e.g. 200cm (long) by 5cm (dia) with a vacuum $<10^{-12}$Torr and a magnetic field of 10T). This could all fit into a large truck, including all support equipment and provide ~30 to >100 days of storage time. The dimensions given might store $\sim 10^{13}$ anti-protons at 20-50KeV and is considered to be a factor of 100 down on the limit. According to authoritative sources a few milligrams of anti-matter might be produced annually by a nation with the resouces to do so.

NATIONAL CAPABILITY

10. **USA** In 1987 it was stated that the US could construct an intense source of low-energy anti-protons in three to four years and thereafter deliver (store) 10^{14} low energy protons annually. It was hinted that a five to seven year programme might be started (or already had been). This information, given in a 1987 closed seminar, was given public-release in 1994. One of the prime applications envisaged is for air-vehicle propulsion. The cost of a R&D programme would be ~$400M, over a ten year period. In addition to propulsion, non-propulsion applications of anti-matter have been proposed in medical (tomographical imaging), therapy and bio-medical detectors.

11. **UK** That anti-matter is a key topic of interest is confirmed by a series of papers, and, in particular reports of CERN activities in which UK participate. A recent review paper (P T Greenland, Imperial College London) relates Newton's search for a cause of gravity and the relationship between gravitational mass and inertial mass. Anti-hydrogen has been produced at CERN, but the trapping and control of the anti-hydrogen is not yet achieved to enable instrumentation and measurement to

UNCLASSIFIED SECRET

be obtained, for example for a comparison with conventional hydrogen. The approach is to produce traps to contain, separately, anti-protons and positrons both at liquid helium temperatures. Anti-hydrogen is then obtained by the combination. The work so far has used the highest energies achieveable by the Low Energy Anti-proton Ring (LEAR). No anti-hydrogen has yet been trapped at low temperature. There are no indications of any current experiments or early developments of future potential applications of anti-matter for propulsion purposes.

12. **Former Soviet Union** Scientific papers report the conceptual design of anti-matter storage devices, for example, positron storage rings. These, including the 'IREN' project are at the design experimental and very early development stages. In particular, important work is proceeding on the use of Gamma-Ray Lasing in the matter and anti-matter research fields.

13. **France & Italy** French aspirations seem to be significantly aimed at whether some stars (and even some entire galaxies) may exist which are made up of anti-matter. The possibility of this scenario will, in theory, be proved if anti-matter (single anti-helium nucleus in cosmic ray flux) are detected in cosmic rays. Results are awaited from the a current Shuttle project. Further work is being funded by NATO and the EU. In 1996, two scientists at the Italian National Nuclear Physics Institute reviewed anti-matter as an area of future research and proposed future experimental projects. They pointed out that the possible existence of anti-matter was first postulated in 1928, and that recent exo-atmospheric experiments were delayed following the Shuttle disaster. As a result four balloon-borne experiments had occurred and the planned work (Italy-Russia) will also examine anti-matter components of cosmic rays. The possible existence of cosmological ant-matter, with a symmetric universe and matter and anti-matter separated into domains remains a fundamental question.

14. **ROW Nations** There is no evidence that any ROW nation has scientific or engineering capability, leading to real developments in the field of anti-matter.

ELECTRIC PROPULSION TECHNOLOGIES

15. Chemical propulsion requires large propellant mass compared with electrical methods. Hence, assuming that a UAP of undetermined origin could somehow enter and leave earth's atmosphere, (with the capability of some unknown propulsion method) the remaining journey (from wherever it came from and returned to) could presumably use one of the 'electric' propulsion methods for which the technologies are currently understood. However, these produce low thrust levels (mN), as shown at Table 1.

16. **Arcjets** produce an arc typically in the exhaust nozzle of a chemical thruster. For electric propulsion (EP) although their thrust is higher than other EP methods, there is the mass penalty of the chemical propellant required.

17. **Stationary Plasma Thrust (SPT)** produces ionised xenon, which draws in electrons from a cathode after the xenon propellant passes through electric and magnetic fields in a discharge chamber.

18. **Ion thrusters (IPS)** also use ionised xenor propellant.

19. **Field Emission Propulsion (FEP)** is a future concept assessed to produce a higher specific impulse (Isp) but at low thrust levels.

20. None of the methods at Table 1 were conceived as primary methods of spacecraft propulsion.

21. On board power requirements (for a 18mN UK IPS design with an Isp of 3466) is ~600W, worst case. The thruster exhaust velocity is ~40,000m.s^{-1}. For satellite position-keeping, 40Kg of propellant held in a titanium storage tank (mass ~10Kg), would provide a planned life of ten years. Even a small thrust,

UNCLASSIFIED

coupled with orbital dynamics could be used to escape from earth orbit.

22. Despite the foregoing possibilities there is no evidence that an extra-terrestrial vehicle (comprising solid matter as we know it and using any of these techniques has visited earth and left again. Any visitation **must** be followed by a departure, otherwise artifacts would remain. The basic requirements of space travel, atmospheric entry, descent and landing must be followed by take off, ascent and escape atmospheric/gravity back to space again. In earth-science terms this could only be currently achieved with mixed propulsion technologies.

PROJECTED ENERGY

23. Much has been postulated in the scientific press on the possibility of transferring energy to an air vehicle (which would then convert it to thrust), either continuously or in pulse form. Technology has reached the stage where it is possible (with proof of principle tests) to transmit RF or laser energy to a moving platform, where it is collected for on-board use. This is dependent on providing and maintaining a suitable tracking system. A US Air Force Research Lab. Laser system, tested in 1997 allows a small rocket-mounted parabolic mirror to collect pulsed laser energy from the ground which is concentrated onto inlet air, which in turn becomes a plasma. XXXXXXXXX
XXXXXXXXXXXXXXXXXXX
S.27 XXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXX

There are no indications from any UAP event that observed phenomena can be using propulsion of this type, since the laser energy required to achieve this over extra-terrestrial distances would be not only enormous, but seen/detected on earth.

TORSION, GRAVITY AND LASER FIELDS

24. **Torsion Fields: Definition and Properties** Torsion fields are generated by a scalar field and spin. A torsion field is present even if there are no spins. Attempts have been made to describe torsion fields by the use of Maxwell's theory on a post-Remannian space-time equivalence principle to electromagnetic phenomena. These fields have been the subject of research since 1913 (EINSTEIN) and E. CARTON, BLONDO (France), MYSHKIN AND SHIPOV (Russia), HALT (NASA-USA). Torsion Engines, Generators and Torsion waves have been researched (especially in the Former Soviet Union, at the Inter-Industry Innovative Research Centre, MOSCOW). These are claimed to be waves which travel at 5 to 20 times the speed of light. Main Russian/CIS workers are KOZYREV, YEGANOVA, L. PUGACH.

25. Large scale studies of 'torsion fields' and their manifestation in nature have been made in Russia [1] and, it is claimed, "have resulted in the development of several unique methods and technologies unparalleled anywhere in the world and with which important fundamental and applied problems can be tackled in many areas of science and technology".

26. It is claimed that applications exist in the areas of:

- Remote Sensing
- Geovision and Geo-scan
- Modelling planets, the sun and other space objects.

In particular it is claimed that extraction, filtering, visualisation, processing and analysis of torsion field information which is embedded in aerospace imagery, both surface and subsurface (e.g. oil deposits). There is no indication in the papers discovered of the potential use of torsion fields for direct propulsion.

27. **Laser Propulsion** A (CO_2) laser-powered test rocket was flown in 1997. Although only 15cm in diameter and some 50 grams in mass, it is envisaged that this may be a forerunner for future space (or orbital) travel.

UNCLASSIFIED

SECRET
UNCLASSIFIED

Projections and modelling claim a Mach 5 capability, to 100,000ft altitude. The laser provides thermal energy (collected from the beam) and used to produce air-breathing thrust. At altitude, conventional rocket fuels would be used to boost to escape velocity.

MICROWAVE PROPULSION

28. Low frequency microwave beams are not suitable for on-board energy collection. The problems are those of diffraction, and the requirment for large antennas on board the vehicle. Also, the low breakdown threshold of the atmosphere limits the received power density. The selection of high frequencies is limited by the EM atmospheric windows (e.g. 34, 94, 140 or 220GHz). Atmospheric attenuation also increases with increased RFs. It is assessed[1] that a 15m diameter craft could logically use a 35GHz system with the high power rectifying antenna ('rectenna'), which is a solid state converter. Within the atmospheric propagation breakdown limits ($4KWcm^{-2}$) this antenna could receive ~5.6GW. At an RF of 200 GHz Benford and Myrabo[2], suggest an array of focused 10KW gyrotrons could provide a launch station. With the overall power assessed at 30MW a huge 550m diameter array would be required to ensure adequate energy (10MW on a one meter diameter receive antenna), reaches the vehicle at the extremity of the atmosphere because of the extinction loss en-route (even using the 220GHz atmospheric 'window'). Conceptually, a space-based, (LEO) passive relay station could be used to pass the EM energy beamed from a terrestrial station onto the vehicle in space, where the energy would be converted this time for use in an ion thruster engine.

29. It is beyond the scope of this report to include fine details of the design of such a craft other than to list the key features which might have a bearing on the potential UAP connections in answering the enigmatic question - "Can a craft capable of extra terrestrial travel with the reported characteristics be conceived within the limits of 'earthbound' capabilities"? The key features follow with UAP-related comments in square brackets

(a) **Size** The microwave craft proposed has a 15m diameter. [This falls within some reported UAP diameters].

(b) **Mass** A launch mass of 1400Kg is proposed (surface area loading $7.9Kg.m^2$). This is an aerodynamic (e.g. wing) loading similar to that of ultralight aircraft. This leads to the conclusion that every conceivable means must be used to lighten the mass even to the point of carrying no propellant - hence the idea of using a microwave-induced 'air spike' and beamed energy sources. The point that immediately diminishes the UAP connection here is that energy conversion is used and atmospheric thrust is produced. Hence, there will always be, as far as can be deduced, some type of acoustic effect. [In other words an observer will hear very loud sounds, contrary to UAP reports] However, if it is possible to place all the electromagnetic air acceleration technology on the outside of the body this may not be the case.

(c) **Materials** Thin film materials with adequate tensile and compressive strength could, conceivably, be made. Silicon Carbide based materials (exotic fibres) have been suggested. The thin film materials might be microwave-reflective, acting simultaneously as the rectenna. Any collected spare power could be used, for example, to power the air-spike.

(d) **Propulsion** Several propulsion configurations have been proposed. The first is the pulsed detonation engine (PDE), or 'microwave-thermal

[1] "Hyper Energetic Manned Aerospacecraft Propelled by Intense Pulsed Microwave Beam" L.K. Myrabo. SPIE Vol. 2557 1995

[2] "Propulsion of Small Launch Vehicles using Millimetric Waves" SPIE Vol. 2154 1994

UNCLASSIFIED
SECRET

SECRET
UNCLASSIFIED

air breathing engine'. The PDE uses microwave-supported detonation to heat the air working fluid and is based on what, in principle, is the air-breathing ramjet. A combined cycle engine (i.e. air-breathing and rocket) might be envisaged for a transatmospheric role. Clearly this would only operate in the atmosphere and velocities of Mach 5-6 are claimed to be possible without an air spike. [Hence, to return to the possible 'UAP' similarities this type of craft could not be extra-terrestrial unless it used another type of propulsion outside the atmosphere] Another endo-atmospheric option is the Magneto-Hydro Dynamic Fanjet (MHDF), where powerful Lorentz body forces are exerted on external air working fluid. In effect the active microwave-powered 'armature' accelerate the passive 'field coil' - which is the air channel used for momentum exchange.

(e) **Rectenna** For microwave on-board collection an off-board source must exist. [In the UAP context there has been no detectable source on earth or from space which, using conventional EM-waves at any wavelength someone on earth would have surely intercepted; especially in view of the huge power requirements].

30. There are several other key factors in the completion of the design, for example the production of a heatshield (if re-entry is required), artificial gravity, aerodynamic stability and control, plasma radiation shield (hazardous radiations), life support, and communications. [It is, however, seen that even this vehicle, if possible with today's technology, would be unlikely to achieve the characteristics attributed to UAP events]. It is of interest that the conceptual body shapes tend to be saucer-like. This is probably pure co-incidence - as many UAP events reported are, in fact, not necessarily 'saucer shaped!!

SUMMARY -PROPULSION OPTIONS

31. Propulsion mode is the key factor in considering whether it would:

(a) Be possible to construct a vehicle with reported UAP attributes and potentially (until proved otherwise) with an extra-terrestrial capability, using existing 'earth' technology.

(b) Be possible to conceive such a craft which can move with zero or near-zero sound and change the direction of movement almost instantly.

CONCLUSIONS

32. In attempting to explore the potential technologies which would be essential in order to construct a craft with the exceptional characteristics, attributed to UAP it is important to note that:

- No reliable report exists of a landing and take-off of an object known to contain 'beings'.

- No spacecraft or occupants can be seen anywhere on earth and not even small artifacts have been left on earth to confirm the existence of a 'spacecraft' in the form of metals or other materials. None have apparently ever crashed, despite sighting reports for thousands of years.

- There is no evidence of attempts at communication between the alleged occupants of the 'craft' and humans - or messages/items left behind as a form of communication.There is no evidence that any nation has a current capability to produce and trap anti-matter for propulsion purposes.

33. Hence, there are no new technologies or methods which could be exploited beyond those already known or being researched. There have been no

UNCLASSIFIED

SECRET

SECRET
UNCLASSIFIED
UK RESTRICTED

opportunities for accurate size or shape measurements, no examinations of unknown or special materials or of any types of devices which could aid in the dtermination of what the phenomena comprise or be used in order to replicate the UAP as an air-vehicle as a result of the presence of UAP in the UKADR. In the absence of measurable artifacts, the best estimate of the nature of UAP can only be assessed by a careful analysis of all the available reported characteristics and the hope of correlating not only reports from diverse sources but the frequency of reports with other measurable events, such as weather, meteors, etc.

UK RESTRICTED
UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

	Thrust (N)	Isp (S)	Uses
CSP	1-500	<320	Extensive
ARCJET	<1	550	Wide
SPT	0.04-0.20	1600	Limited
IPS	0.062-0.25	3000	Experimental
FEEP	<0.001	4000	Future

TABLE 1: ELECTRIC PROPULSION OPTIONS

UK RESTRICTED
SECRET
UNCLASSIFIED

UNCLASSIFIED

WORKING PAPER NO. 7

SIGHTLINE RATES OF FLYING OBJECTS

&

METEORITES

	Para	Page
INTRODUCTION	1	7-1
SIGHTLINE RATE GEOMETRY	2	7-1
PARAMETERS	5	7-1
INTERPRETATION	6	7-2
EXO-ATMOSPHERIC OBJECTS	9	7-2
Meteorites	9	7-2
Satellites	13	7-3
PLASMAS, CHARGED AEROSOLS AND SPRITES	17	7-3
THE ILLUSION OF OBJECT MOTION	18	7-3
VELOCITY ILLUSION	19	7-4

February 1, 2000

xxxxxxxxxx S.40

UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED

SIGHTLINE RATES OF FLYING OBJECTS

INTRODUCTION

1. This brief paper is intended to relate to frequent UAP reports where objects cross through the observer's field of view at what are often, reportedly, extra-ordinarily high velocities. Typical examples are those of satellites and meteorites.

SIGHTLINE RATE GEOMETRY

2. The basic geometry assumption is that, from the initial visual contact, the object continues in a straight line until it goes out of sight due to some local obscuration or reaches the observer's visual horizon. The largest angle through which an object can pass is from horizon to horizon. Usually the angular sector crossed (or at least seen by the observer) is much less. The angle crossed is usually viewed either in azimuth or elevation. On occasions the object is diving and often disappears during the process - and these are usually explainable as burning-up meteorites or space debris. The greatest tangential velocity occurs when either the object is passing exactly overhead or when at a 90° azimuth offset. Velocities always appear to be greater when objects are closer to the observer, even though they are identical to those at greater range which pass through the same enclosed angle but take longer because the distance subtended is greater. The human perception of speed is often distorted by any accompanying sound. Many UAPs are reported as 'silent'. However, it is borne in mind that if any sound is present it can give added perception of speed (see Working Paper Nos. 1 and 8).

3. On the spur of the moment, accounting for surprise and even incredulity, later embellishment, misunderstanding and over or under estimation; it is clear that the time and velocity figures given by a UAP witness can be wildly inaccurate. Further, more than one witness at the same event may provide conflicting evidence. Often, events are reported as duration of 'about ten seconds' or 'two to five seconds' and through small angles. Further, those not regularly concerned with aircraft can only be expected to give very approximate altitudes (ranges). However, the evidence cannot be ignored, as taken together with other information from the same sighting and with other witnesses, which may come from nearby. --Crude target track construction can be made - hence a process of elimination of options is assisted. Further, untrained observers regularly have difficulties with range assessments and grossly misrepresent objects as being "beyond the moon", or "about 2 fields away".

4. The Field of View(FOV) available is clearly much larger when the observer is in an advantageous position, e.g. open countryside, on a hill, or (without obscuration) viewing over the sea or, finally, in the air. Even so, for often inexplicable reasons, and with clear FOVs, objects are sometimes only seen fleetingly. Velocity discrimination/estimation is much more difficult - even for aircrew in this case, unless in a parallel course or catch-up/overtake/being overtaken scenario.

PARAMETERS

5. The attached plots at Figures 1 and 2, although accurate, are intended as a guide in the analysis of a UAP sighting, where the witness provides one or more of the following.

- Start (elevation angle) and finish (elevation angle)
- Time of observation together with some idea of the angle passed-through
- Time and altitude of an objects' passage.

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED

The plots are for objects 'flying' at constant altitudes. If an object is either climbing or diving then a different calculation is needed.

INTERPRETATION

6 Figure 2 (for both endo-and-exo-atmospheric targets) enables a target speed to be approximated, based on witness assessments of angle traversed (az or el), range and time of observation:

$$v = \frac{R\varphi}{t}$$

where φ = Angle traversed (radians) = Deg/57.29

R = Witness estimate of target range

t = Witness estimate of duration of sighting

7. The same approximation applies to space-based objects. In this case it is assumed that exo-atmospheric objects can be at any altitude above the earth.

8. It is important to note that the method used is based on the assumption that moving objects travel tangentially through the estimated angle, with respect to the observer's position. Any movement at other angles with respect to the observer would increase the track-length flown and thus, in a given time, increase the object's velocity.

EXO-ATMOSPHERIC OBJECTS

9. **Meteorites** Diving objects (e.g. often shown to be meteorites/meteors) are frequently reported. These are high velocity ionised trails caused by meteor-body friction with air molecules, which then ionises; usually with a fiery tail/trail, lasting only a few seconds. RF reflection from trails (utilised for scatter HF communications purposes), occurs in the (approximate) 30 to 120MHz range. Meteor-trail duration is measured in hundreds of milliseconds. Two categories describe the **rate** at which meteors strike the earth's atmosphere. The **periodic** group (known as meteor 'showers'), which have a yearly cycle and the **sporadic** group which are, though more random, occur year-round. In the context of UAP sightings:

- 'Showers' occur for periods from hours to days at a rate of the order 20 to 50 per hour.[1] These are often present, though not necessarily visible, due to the interference of moonlight. The forthcoming occurrence of showers can be predicted, because both the earth's (and the meteor stream's orbits) are known - hence the intersection can be calculated. What is not known is the shower density. There is a shower density cycle repeating every 33 years. There is no connection between meteorite activity and sun spots or solar flares.

- 'Sporadics' exhibit a Poisson distribution but with a diurnal variation.

- In addition to the familiar largest fire-ball-producing meteors there are tiny grains not visible to the human observer. Radio and radar methods allow the latter to be detected. As the meteorite rate may have a bearing on the production and presence of some types of 'UAP', attempts will be made to correlate meteorite density against the trend of UAP reports.

10. This latter condition reflects the fact that at dawn (local time) a meteor will cut the longest path in the atmosphere, while at mid-day the meteor will appear to strike the atmosphere vertically. As the size of meteors varies between smaller than a grain of sand to those that survive and impact the earth's surface, the initial mass varies inversely with its probability of arrival. Consequently, smaller meteors make up a significant proportion of all meteors arriving and are not large enough to be seen visually.

[1] Lovell A.C.B. Meteor Astronomy UP 1954 P248.

UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED

11. Associated with the size is the electron line density (ELD). These are classed as either 'over' or 'under' dense: Under-dense ELD is $<2x10^{14}$ electrons per metre. Over-dense trails are considered to be a tubular plasma cloud (hence the links with other phenomena of interest to this study). The duration of over-dense trails is generally longer than that of under-dense trails. Trails can be manipulated by the effects of both wind-shear and high altitude winds, which distort their tracks. A brief examination of recent UK meteorite velocity measurements shows velocities from about 11km per second minimum to 72km per second maximum, with a mean of around 40km per second. The International Meteor Organisation produce a Meteor Shower Calendar, which is used elsewhere in this report as the basis for some statistical analysis against the UAP report rate. (see Volume 1 Annex F)

12. The probability of observing meteor trails visually is low and apparently not equally distributed over the earth. For communications purposes it has been found that the best trails occur according to the distribution at Figure 1, and it might be supposed that this density also reflects the most likely locations where higher visual opportunities occur. This changes according to geographical latitude. The meteor scenario, in relation to reported UAP events is an enigma. Firstly, it is important to note the increased presence of more UAP reports in coincidence with periods of high (or higher) meteorite activity. This does not necessarily mean that observers are only seeing meteors. Further, it does not mean that UAP reports are always caused by meteors. There are bound to be reports generated by a host of other causes. On the other hand it could mean that some UAP are formed by meteors as the residual effect of the meteors enormous energy. These postulations are examined further, statistically, at Volume 1 Annex F, where it is clear that this is the case.

13. **Satellites** Other, frequently reported objects, almost always described as 'steady lights' are probably satellites in low earth orbit (LEO) (see Working Paper No. 17). The sightline rate of these is clearly dependent on orbital altitude and speed.

14. Observation curves are at WP No17, and assume an observer is stationary on the earth's surface. Geo-stationary satellites can be ignored, as by definition they have no sightline rate. Low earth orbit satellites have a practical maximum altitude of ~1000Km and orbit at a velocity of ~7Km sec^{-1}. This equates to an angle-rate of about 4° per minute.

15. If an observer spotted a satellite from rise to set (most unlikely) covering a full 180° (45 minutes), or even for 15 minutes, current public knowledge is such that it would be identified as such and not reported as a UAP, or even reported at all.

16. In UK latitudes the satellite orbit would have to be at an inclination >50°. Viewing conditions must also be correct to observe a satellite:

- It is unlikely in daylight.
- Its size must be large (small debris is not seen).
- The light falling on the satellite, which is then reflected must be adequate. Other data concerning the observation of satellites and hence the probability of being mis-reported as UAPs, is at Working Paper No. 17.

PLASMAS, CHARGED AEROSOLS AND SPRITES

17. It is evident that when plasmas, particularly sprites and any higher altitude phenomena, which depend on luminosity due to electrical charges, that sightline rates can be extremely high. These phenomena, often described as 'nocturnal lights' are described at Working Papers Nos. 2, 5, 19, 21, and 24. They frequently appear as having significant angular size and, because of their high speeds (despite being at altitudes from a few kilometres to tens of kilometres), are often

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

perceived and reported as flying much lower than they actually are.

THE ILLUSION OF OBJECT MOTION

18. It is important to note that (other types of actual flying objects excepted), with those visual phenomena which are due to certain atmospheric effects, **little of substantial physical substance actually moves.** It is the **light** seen by the observer that moves from place to place and it becomes visible in those places because the atmospheric conditions (electrical, particle etc.), allow it to become visible. Hence, the observed variation in colours seen, the duration for which an object is seen, and the time for which a sightline rate is discernible. The visualisation (wavelength) of a UAP, from an electrical charge source, also depends upon air pressure.

VELOCITY ILLUSION

19. The illusion of velocity in receding objects is particularly important in UAP reports, where, as they are often in the dark, leave the observer with no surface references with which to relate speed. This is especially the case when the sky background does not offer a simultaneous view of any aircraft, with which to compare sightline motion. Similarly, in bright sunlight the velocity of a small receding spherical object is particularly difficult to assess. This is dependent on whether the object being viewed is just a spherical (i.e. 'round') light, (which may be bright or dim) or whether it is being viewed as a silhouette. The surface area of a receding sphere is seen purely as the area of a circle (Πr^2) and the enclosed angle resulting (i.e.subtended) from its diameter, as range increases, will reduce linearly as the ratio of its diameter to range. However, its area appears to the observer to have shrunk according to the square law. The important feature here is that a sphere comprising plasma, which might not be accelerating away (or even be moving away at linear speed) but is in fact shrinking in size (as its, often brief, lifetime comes to an end as the electrical forces holding it stable collapse), can appear, from the observer's viewpoint, to be receding; whereas, it is actually an illusion and the object may hardly have moved in range.

It is easily seen, therefore, that a reported 'receding light', may in fact be a light which is reducing in intensity but remaining in exactly the same spot. Similarly a 'rotating' light may be a fluctuating light, which is the same light giving the impression of rotation.

UNCLASSIFIED
UK RESTRICTED

UNCLASSIFIED
SECRET
UK RESTRICTED

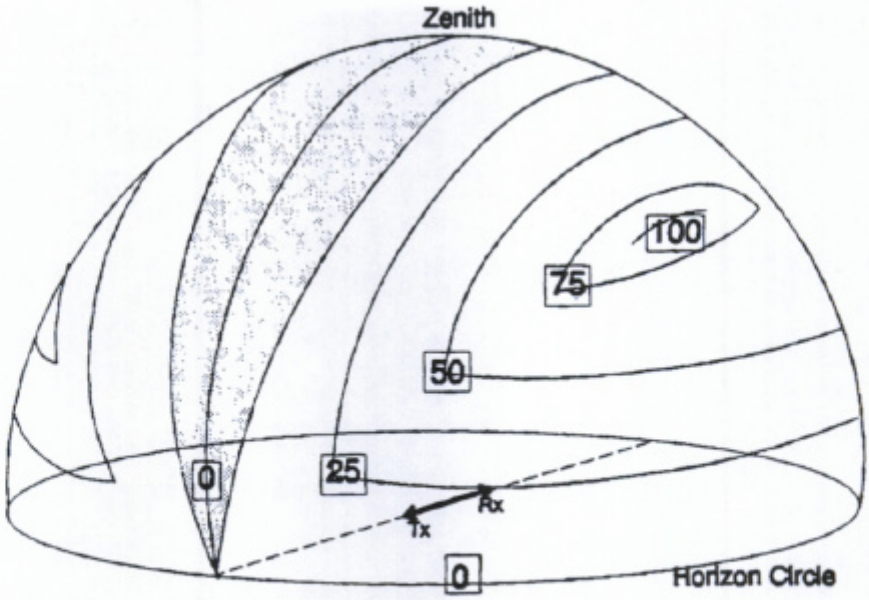


FIGURE 1: METEORITE TRAIL DISTRIBUTION (U)

UNCLASSIFIED
UK RESTRICTED
SECRET

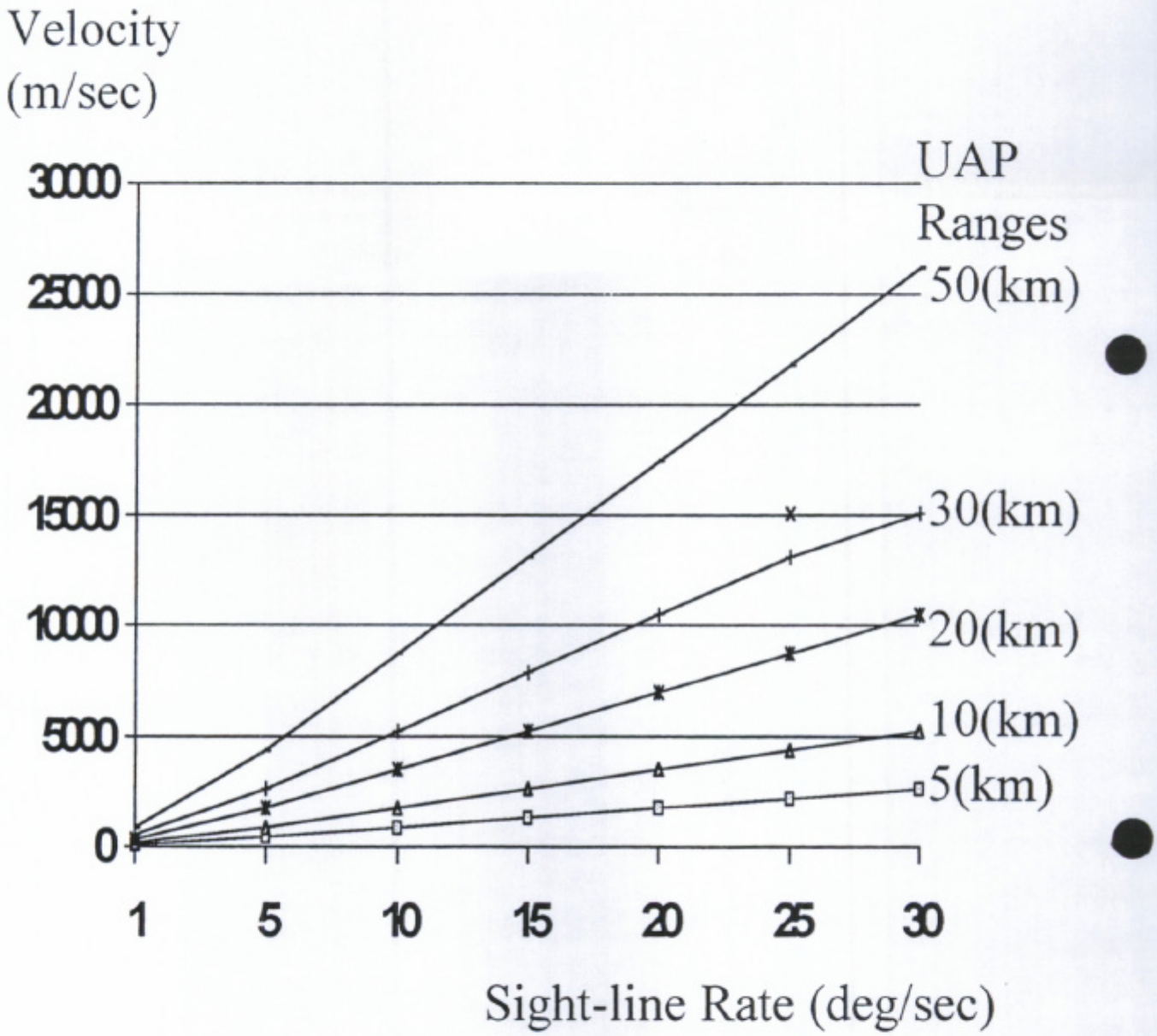


FIGURE 2 SIGHT-LINE RATES(U)

UNCLASSIFIED

WORKING PAPER NO. 8

RARITY OF UAP SOUND REPORTS

	Para	Page
INTRODUCTION	1	8-1
Anomalies	2	8-1
Discussion	3	8-1
Geometry	4	8-1
Future systems	5	8-1
Mis-reported sounds	6	8-1
SUMMARY	7	8-1

February 1, 2000

XXXXXXXXXX S.40

UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED

RARITY OF UAP SOUND REPORTS

INTRODUCTION

1. An initial overview on UAP sound is at Working Paper No. 1. This paper further sound in the context that there appears to be a contradiction between the occasional report of sounds, the frequent lack of sound when high UAP velocities are reported when, unusually there are no corresponding reports of 'sonic booms' nearby. Normally, sound is either generated and then emitted by a stationary body due to some inherent mechanical or electrical vibrating, oscillating or rotating device mounted internally or on its surface. A moving body produces sound due to bulk or frictional displacement of air. Sound may also be caused by electrical discharge or chemical action.

2. **Anomalies** When an object is in the air and, however erroneously is considered to be a 'vehicle', a witness normally expects to hear some sort of noise. The faster a UAP is perceived as travelling, then the greater is the expectation of sound. The lack of sound at the witness location may be due to:

- An over-estimate of the object's actual velocity.
- The presence of some atmospheric conditions (e.g. wind absorbing cloud) that suppressed the sound to an inaudible level.
- The probability that, while reported as being in the atmosphere, the object is in fact in space.
- The object - though travelling sometimes at high speed, has not actually disturbed the atmosphere through which it has clearly seemed to pass.
- The fact that the 'object' seen may have no mass, or negligible mass, compared with its surrounding atmosphere (i.e. it is a 'visible mass' only, caused by reflections from its ionised gases or an internally-generated colour temperature).

3. **Discussion** The first effect above is not unexpected as most UAP witnesses are untrained. The second can occur when the sonic shock wave is distorted and the conical pattern of the shock front does not reach the ground. It is also noted that the classic bow and tail shocks may not both be heard as they are at different intensities. Hence, as the public are aware (and may recognise a double shock as a supersonic aircraft), a single shock 'bump' may not be recognised as coming from a genuine aircraft. Further, the lateral extent of a supersonic shock wave causes a variation in intensity. This effect coupled with windspeed can either reinforce or weaken the sound heard.

4. **Geometry** Unless the observer is along the track of the target, ± a few kilometres, the double (or even single) 'boom' may not be heard. Airframe aerodynamic design can reduce shock wave effects, though not eliminate them.

5. **Future Systems** It is of interest, here in the UAP context, that the first experiments to modify airflow using electromagnetic fields (and plasmas) took place in the 1960s, and is a topic of current interest with its 'read-across' to target signature control (i.e. RCS reduction). It is not clear, at present, how much the reduction of drag will affect the overall audio noise generated. Intuitively the majority of noise heard on the ground is generated by the engine thrust, relatively little being generated by the airflow over a smooth vehicle body.

6. **Mis-reported Sounds** Finally, one must consider that sounds may be mis-reported (e.g. mistaken description of the noise itself) or are a figment of the imagination engendered and embellished with the rest of the alleged phenomena. For example, it is as easy to imagine a charged mass to have a dome and portholes as it is to attribute a whine when it 'takes off'! Sound reports, as with other attributes, suffer from not having a first-hand debrief immediately after the event and before reports become forgotten or the information of interest is lost.

UNCLASSIFIED
SECRET
UK RESTRICTED

UNCLASSIFIED

SUMMARY

7. It seems most likely that the reasons for few reports of sound (for those sightings in which nearby aircraft can be eliminated) are that many objects are beyond the range at which sound would be heard, are mis-reported in range, they are satellites; or are 'charged' air masses of various sorts which emit little or no sound.(e.g. Charged aerosols or plasmas, etc.)

UNCLASSIFIED

SECRET
UNCLASSIFIED

WORKING PAPER NO.9

'BLACK' AND OTHER AIRCRAFT

AS UAP EVENTS

	Para	Page
WESTERN PROGRAMMES	1	9-1
SR-71 programme	2	9-1
XXXXXXXXX	3	9-1
XXXXXXXXX	6	9-1
RUSSIA	7	9-1
UAVs	9	9-2
GLIDERS	10	9-2
PARAWINGS, HANG-GLIDERS & MICROLIGHTS	11	9-2
MIXED AIR ASSETS	12	9-2
HELICOPTERS	13	9-2
AIRCRAFT LOW FLYING ROUTES	14	9-2
VISIBILITY FOR LOW FLYING	15	9-3
AIRCRAFT LOW FLYING AT NIGHT	16	9-3
AIRCRAFT IN FORMATIONS	17	9-3
SPEED WHEN LOW FLYING	18	9-3
USE OF RE-HEAT OR AFTERBURNER	19	9-3
FREE-FALL PARACHUTING	20	9-3

S.27

UNCLASSIFIED
SECRET

UNCLASSIFIED SECRET

OBSTRUCTIONS & POWER LINES	**21**	**9-3**
PROHIBITED & AVOIDANCE AREAS	**22**	**9-3**

SPECIAL NOTE:

This working paper contains NATO RESTRICTED information on the UK low Flying Zone, for use in UAP report filtering and analysis, which must not be divulged to the public.

UNCLASSIFIED SECRET

UNCLASSIFIED

'BLACK' AND OTHER AIRCRAFT AS UAP EVENTS

WESTERN PROGRAMMES

1. It is acknowledged that some UAP reports can be attributed to covert aircraft programmes – in which unusual air vehicles may be seen, either at the experimental stage or in service. UAP reports often describe the shapes that are shown at Figures 1 to 9. It is noted that certain viewing aspects of these vehicles may be described as 'saucer like' – hence they are not ignored by observers – as more conventional and familiar aircraft shapes would be, but are frequently reported as UAPs.

2 **SR-71 Programme** Figure 1 shows an SR-71. Flights have been conducted since the 1960s. It is known that this was a US supersonic (M3+) reconnaissance aircraft that operated over the UK. This aircraft was also known as 'SENIOR CROWN'.

3.

4. Figures 7 and 9 show head-on silhouettes of the F117 and B2 'Stealth' aircraft and of other aircraft, the body/fuselage shape of which can be reported respectively as 'saucer or arc/boomerang shaped' under certain silhouette and lighting conditions. These aircraft types are unfamiliar as they are rarely spotted in UK airspace.

5. It is important to note that since these aircraft cannot hover then accelerate, they cannot be the cause of reports where these phenomena occur.

6.

RUSSIA

7. In 1992 Russia announced a new flying machine, called a thermoplane, constructed by designers of the Moscow Aviation Institute, according to Moskovskaya Pravda newspaper. This unusual airship, outwardly resembling a **flying saucer**, is intended to be used for ecologically sound highly effective technologies in the field of superblock construction; control and remote exploration of the environment; and large scale life-saving operations.

8. According to experts the fuel and economic efficiency of the thermoplane will exceed that of an aeroplane by five to seven times, two to three 2-3 times for an automobile and can be compared with seagoing vessels up to 20 thousand tonnes displacement. Tests on the thermoplane are being conducted in Ulyanovski Aviation Industrial Complex (Volga region). The diameter is ~40m and depth 16m.

UNCLASSIFIED

UAVs

9. There is a significant UAV programme in the USA and Israel and to a lesser extent in the European NATO Nations. It is possible that experimental versions may be flown principally over coastal or sparsely inhabited regions of the UKADR in the future. Some of these may be reported as UAP.

GLIDERS

10. Gliding objects are of particular interest in the UAP context, as they make very little sound. Further para-wings and hang-gliders often appear to an observer to hover, move, climb and descend. On occasions, depending on livery, a glider has briefly reflected light and has been reported as a UAP, insufficient of the rest of the machine being seen to permit the observer to recognise the sighting as a glider. Both freeflight and powered gliders fall in this category.

PARA-WINGS, HANG-GLIDERS & MICROLIGHTS

11. There is an increase in the use of sport para-wings and hang-gliders, both unpowered and powered. The small size (and often similar span to length ratio), make these more likely to be misreported as a UAP than ignored, as would be the case for a more conventional aircraft. Hang-glider avoidance areas are specified, therefore the possibility of an erroneous UAP report can be minimised by referring to Figure 10 and Figures 15 to 33. These types do not normally fly after dark.

MIXED AIR ASSETS

12. Except for towing aircraft for gliders, other fixed wing aircraft, especially fast low jet aircraft, are prohibited from glider and hang-glider sites. Hence, within those areas, a useful filter is that UAP events cannot be misinterpreted as other military or civil operations. UAP reports from within these areas are therefore due to either gliders or hang-gliders, or other natural or man-made objects, which may enter the airspace, (e.g. birds, balloons); or 'genuine' UAP events. Note should be taken of the fact that these sport aircraft, though in use at all times during daylight, when weather conditions allow are more likely to appear at weekends and holidays.

HELICOPTERS

13. Although helicopters can be seen anywhere and under certain conditions (rotor disc illuminated from above or below) are reported as a disc-type UAP event, this is more likely to occur within the UK helicopter routes shown in Figures 11 to 14.

AIRCRAFT LOW FLYING ROUTES

14. Although, in principle, the whole of the UKADR is available for low flying (down to an altitude of 250ft), in practice, and excluding the prohibited and restricted areas, such as danger areas, major conurbations and other specified areas, low flying is limited to the designated low flying areas. In three areas aircraft can fly down to 100ft. Although they are theoretically available for 24hrs per day, low flying is prohibited **over land areas**, between 2300 and 0700hrs, with few exceptions for non-jet aircraft. This is rare enough to warrant special permission and then only for Monday to Friday. Weekend and Public Holiday flying is only permitted for small-scale, pre-arranged exercises, and only from 0800 to 1900, with the exception of some aircraft used for parachute training. An obvious exception is that of Search and Rescue operations and helicopter training over sea at weekends and on Public Holidays. Use of the UK Low Flying System is exclusively for UK aircraft, UK aircraft based in Germany and NATO aircraft on approved

UNCLASSIFIED SECRET

flights. Special approval is required for other (non-NATO) nations, who must not fly below 2000ft AGL. Exceptionally UK light fixed wing aircraft may fly down to 50ft.

VISIBILITY FOR LOW FLYING

15. Strict rules apply to visibility for low flying. This is of interest in the UAP context, as clearly this filters out all manned aircraft if certain conditions exist:

- For low flying aircraft (in excess of 140kts), there must be a forward visibility of at least 5km and 150ft horizontal and 500ft vertical separation from cloud.
- Light aircraft must have a forward visibility of at least 2km, be clear of cloud and sight of the surface
- Helicopters, (flying at 140kts, or less) must either be clear of cloud and in sight of the surface, or apply the same rules as for low flying aircraft above.

AIRCRAFT LOW FLYING AT NIGHT

16. The UK Night Low Flying System (UKNLFS) is a source of potential UAP erroneous reports. Restrictions apply as shown at Table 1, with timing that can be taken into account for UAP event analysis. Normally, low flying night flights will show navigation lights.

AIRCRAFT IN FORMATIONS

17. In the UK Low Flying System a formation is not normally to exceed four aircraft, but North of 54 degrees North formations of up to 8 aircraft may be flown permitted for various operational activities. Special permission is required to exceed these rules and the incidence of larger formations is very rare.

SPEED WHEN LOW-FLYING

18. The maximum speed (all aircraft types) is 520kts.

USE OF RE-HEAT OR AFTERBURNER

19.A characteristic of some UAP reports is that of glowing objects in the sky. Except for emergencies, it is unlikely that after-burners will be used overland at low altitude at less than 1000ft for most aircraft. The Jaguar is an exception (500ft)

FREE-FALL PARACHUTING

20.A brief glimpse of a parachute can be sufficient to produce a UAP report. Manned aircraft are prohibited from the designated parachuting areas. Normally, parachuting only takes place in daylight.

OBSTRUCTIONS & POWER LINES

21. During analysis it should be noted that while a UAP (e.g. Ball Lightning) may be observed near to tall structures, aircraft, the crews of which will be aware of these, can be eliminated, as they will not fly close by. UK towers below a height of 500ft are not lit. Slow inspection aircraft can be expected in the vicinity of electrical power lines.

PROHIBITED & AVOIDANCE AREAS

22. For the purpose of evaluation of UAP reports it is possible to filter out fixed wing aircraft (not withstanding any infringement), where sufficient UAP evidence exists to determine that its altitude was observed below the avoidance area minimum altitude (2000ft AGL)

UNCLASSIFIED SECRET

MONTH	START	END
JAN	1630	0800
FEB	1730	0700
MAR	1830	0600
APR	1930	0430
MAY	2000	0330
JUN	2100	0300
JUL	2030	0330
AUG	1930	0430
SEP	1830	0530
OCT	1730	0600
NOV	1630	0700
DEC	1600	0800
	NOTE: All times Zulu	

TABLE 1 LOW FLYING NIGHT-TIME PERIODS

UNCLASSIFIED
SECRET

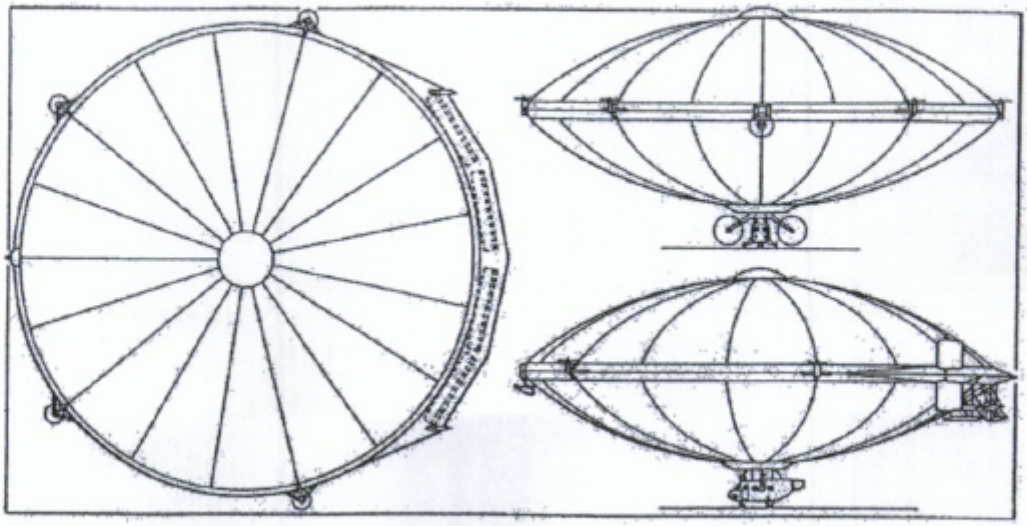
FIGURE 1: SR-71 IN FLIGHT (NASA PHOTO)

S.27

FIGURE 2:

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
NATO RESTRICTED



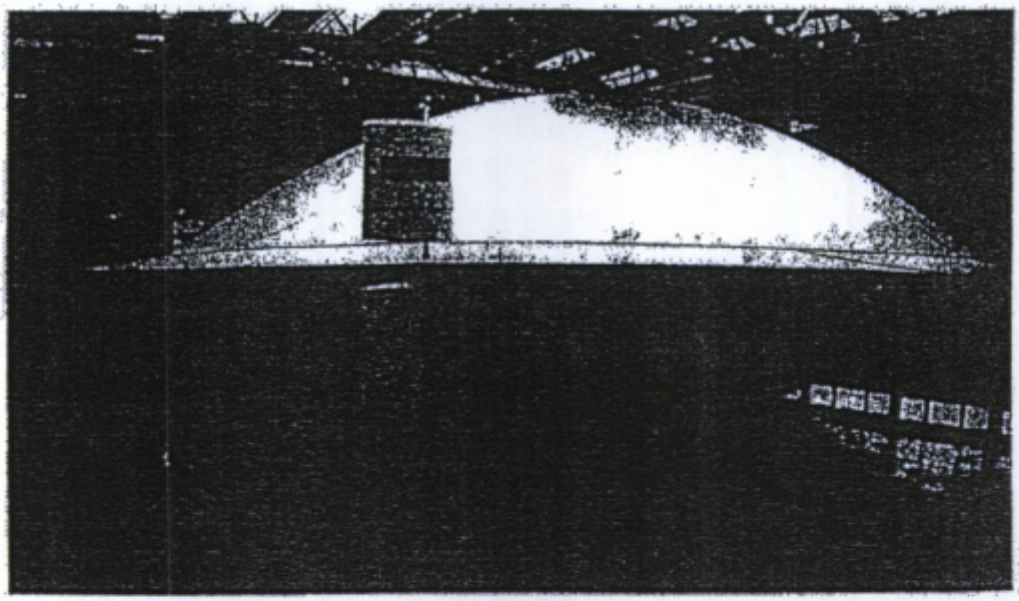
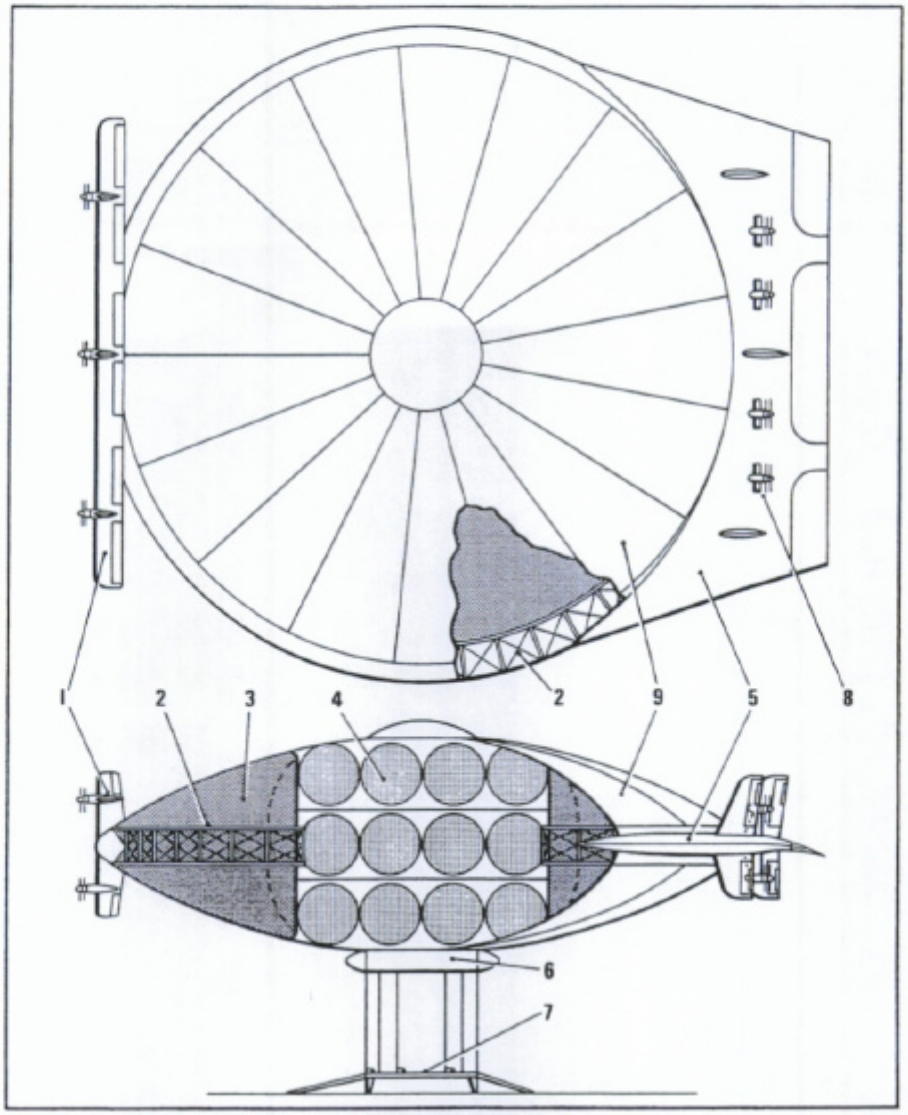


FIGURE 3: THE ALA-40 PROOF OF CONCEPTMTHERMOPLANE UNDER TEST AT ULYANKOVSK IN MID-1992 (P. DUFF)

UNCLASSIFIED
NATO RESTRICTED
SECRET

UNCLASSIFIED
NATO RESTRICTED



Structural details of the Thermoplane ALA-600:
1. Front vertical and horizontal stabilisers
2. Internal hull construction
3. Hot air/natural gas volume
4. Hydrogen or helium spheres
5. Rear stabiliser
6. Fuselage module
7. Cargo platform
8. Engines
9. Hull skin

FIGURE 4: ALA-600 THERMOPLANE (RUSSIA)

NATO RESTRICTED
UNCLASSIFIED

UNCLASSIFIED

S.27

FIGURE 5:

UNCLASSIFIED

UNCLASSIFIED

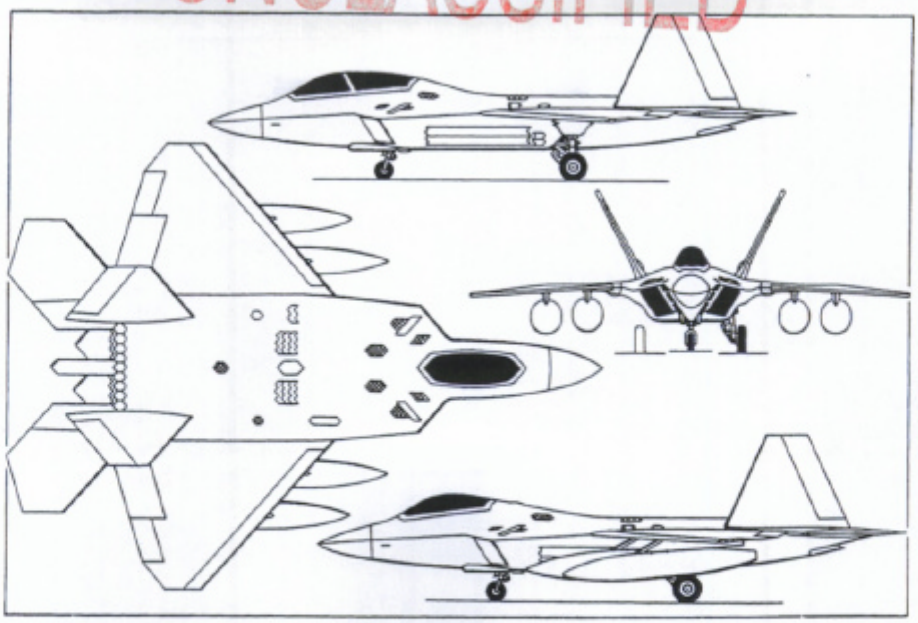


FIGURE 6: PRODUCTION CONFIGURATION OF LOCKHEED F-22A WITH ADDITIONAL SIDE VIEW (TOP) OF TWO-SEAT F-22B (JANES)

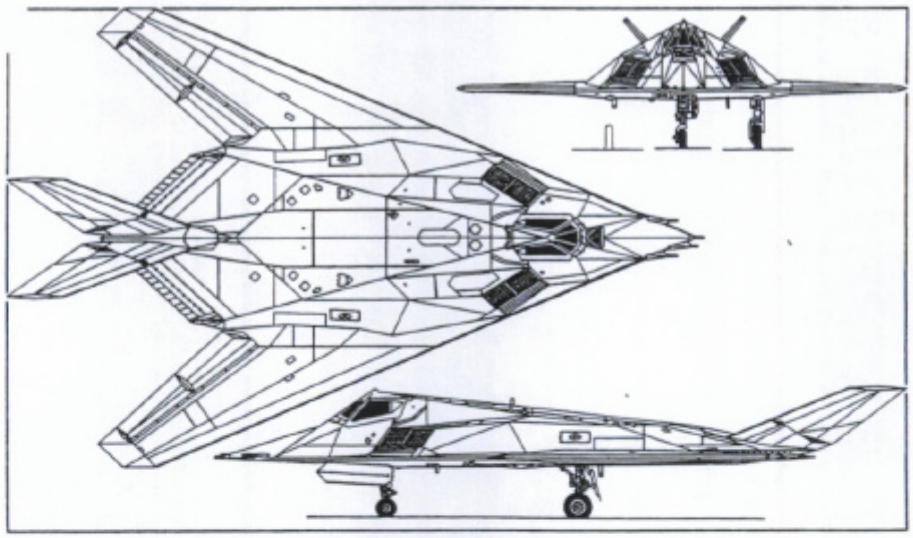


FIGURE 7: LOCKHEED F-117A STEALTH ATTACK AIRCRAFT (JANES)

UNCLASSIFIED

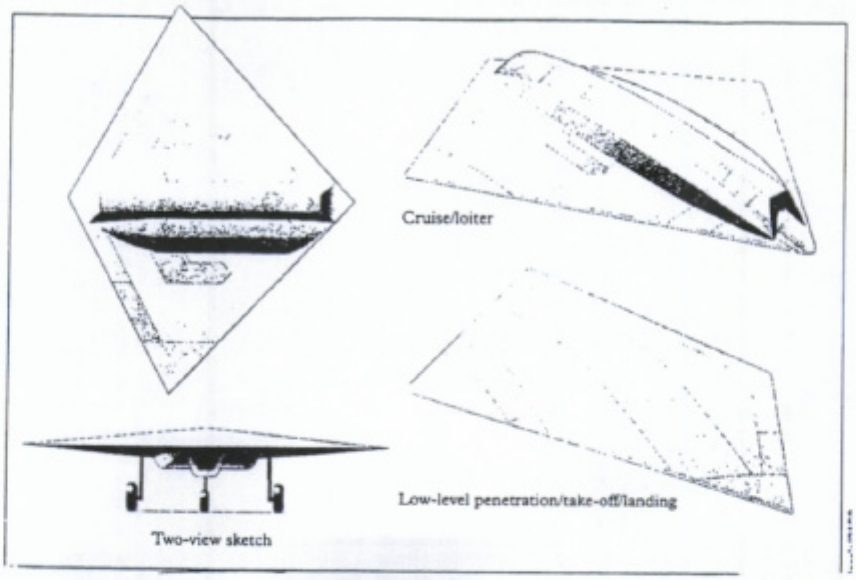


FIGURE 8: A STEALTHY UCAV CONCENT DEPICTING THE 'ROLL-OVER' TECHNIQUE FOR REDUCING RADAR CROSS SECTION (TOP RIGHT)

(JANES)

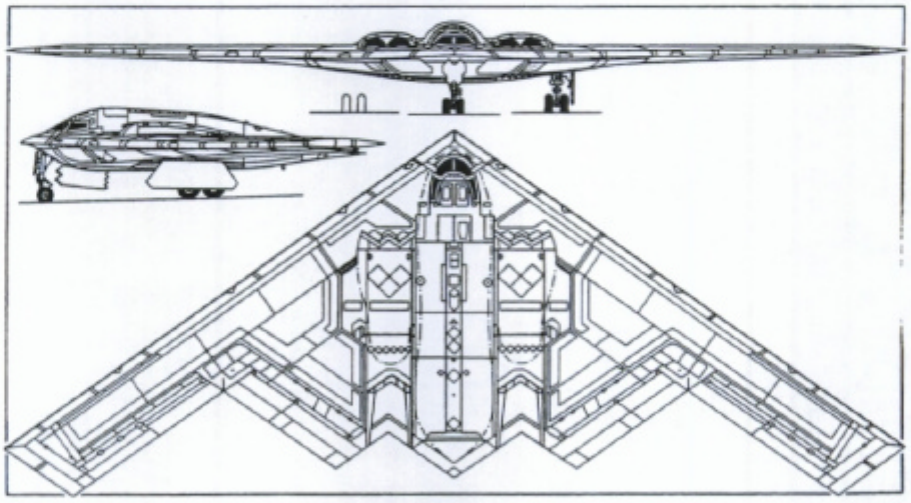


FIGURE 9: B-2 'SPIRIT' STEALTH BOMBER (USA)

(JANES)

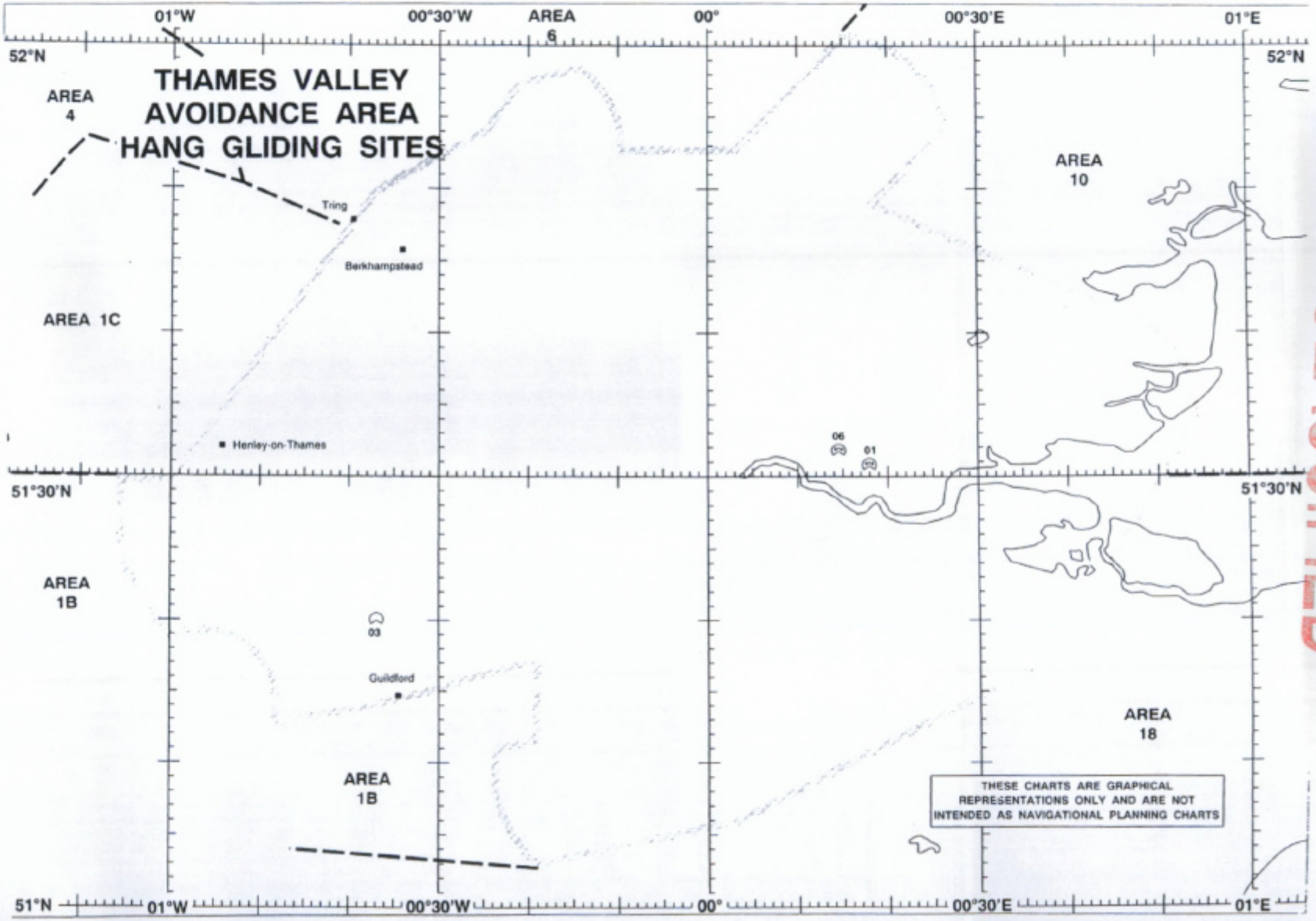


FIGURE 10

UNCLASSIFIED
SECRET
NATO RESTRICTED

UNCLASSIFIED
SECRET
NATO RESTRICTED

UNCLASSIFIED
NATO RESTRICTED

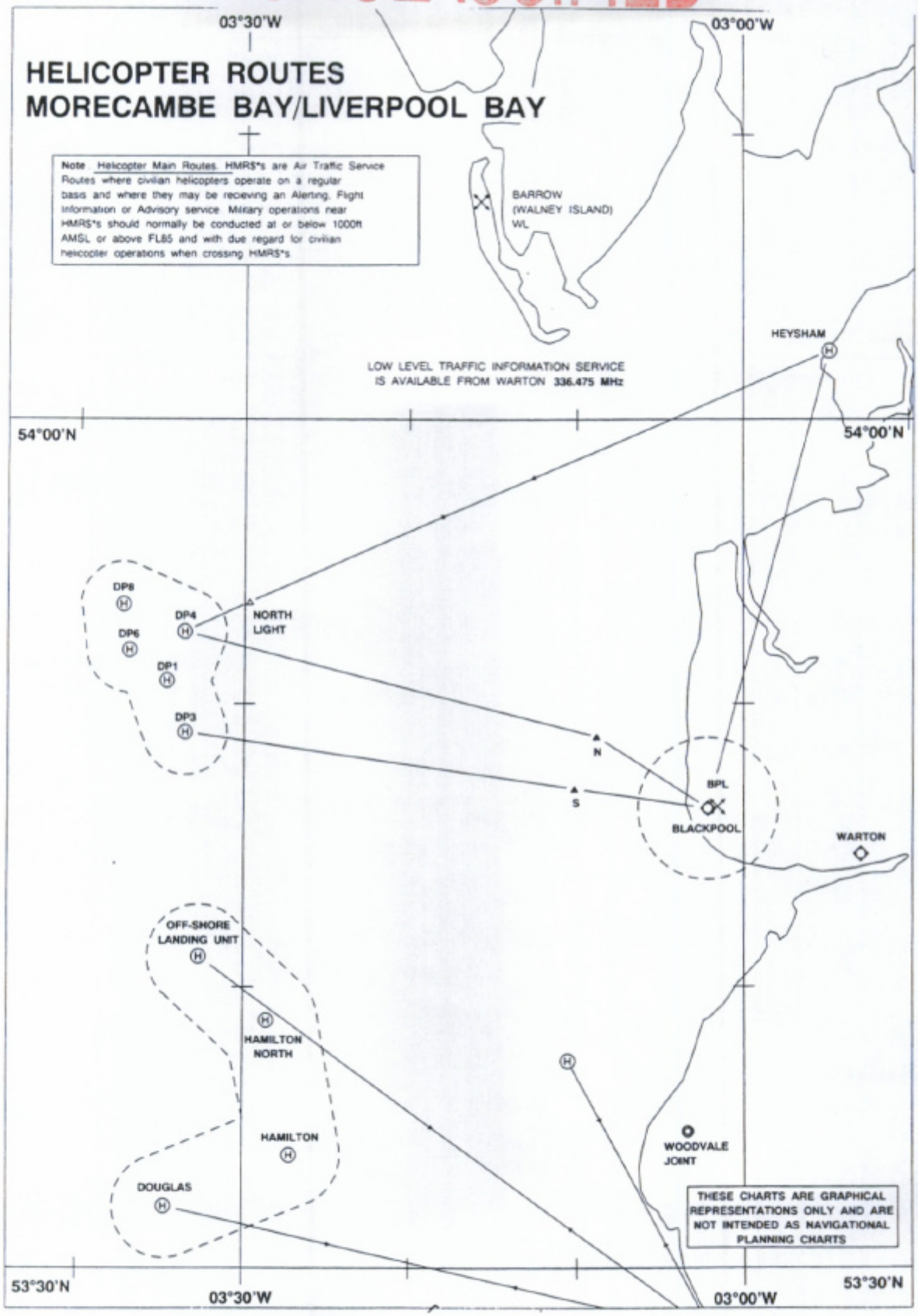


FIGURE 11

UNCLASSIFIED
NATO RESTRICTED

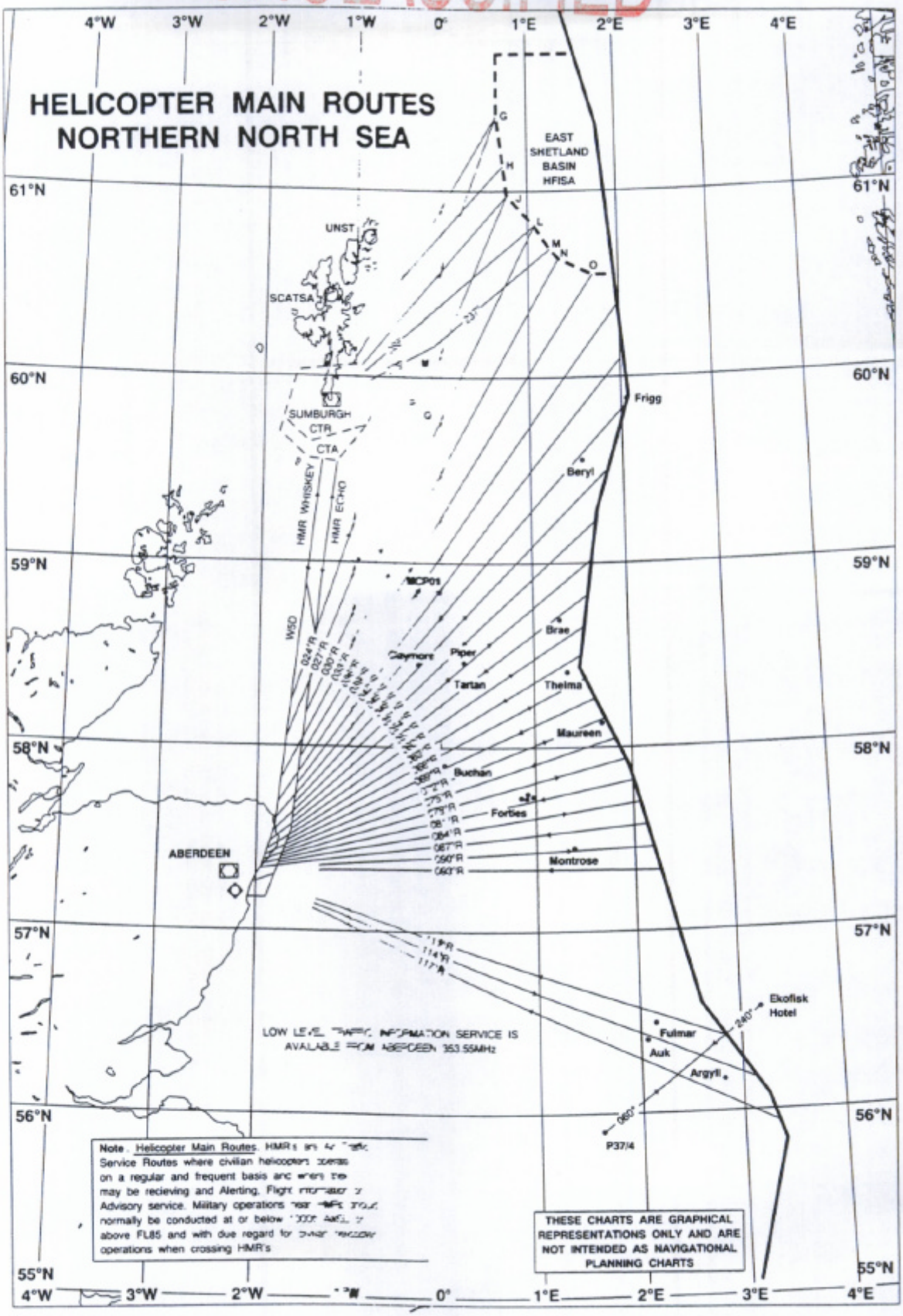

HELICOPTER MAIN ROUTES
NORTHERN NORTH SEA
EAST SHETLAND BASIN HFISA
UNST
SCATSA
SUMBURGH CTR
CTA
HMR WHISKEY
HMR ECHO
MCP01
W5D
Frigg
Beryl
Brae
Piper
Claymore
Tartan
Thelma
Maureen
Buchan
Forbies
Montrose
ABERDEEN
Ekofisk
Hotel
Fulmar
Auk
Argyll
P37/4
LOW LEVEL TRAFFIC INFORMATION SERVICE IS AVAILABLE FROM ABERDEEN 353.55MHz
Note. Helicopter Main Routes. HMR's are Air Traffic Service Routes where civilian helicopters operate on a regular and frequent basis and where they may be recieving and Alerting, Flight Information Service or Advisory service. Military operations near HMR's should normally be conducted at or below 1000 feet AGL or above FL85 and with due regard for civilian helicopter operations when crossing HMR's
THESE CHARTS ARE GRAPHICAL REPRESENTATIONS ONLY AND ARE NOT INTENDED AS NAVIGATIONAL PLANNING CHARTS
61°N
60°N
59°N
58°N
57°N
56°N
55°N
4°W
3°W
2°W
1°W
0°
1°E
2°E
3°E
4°E

FIGURE 12

UNCLASSIFIED
NATO RESTRICTED

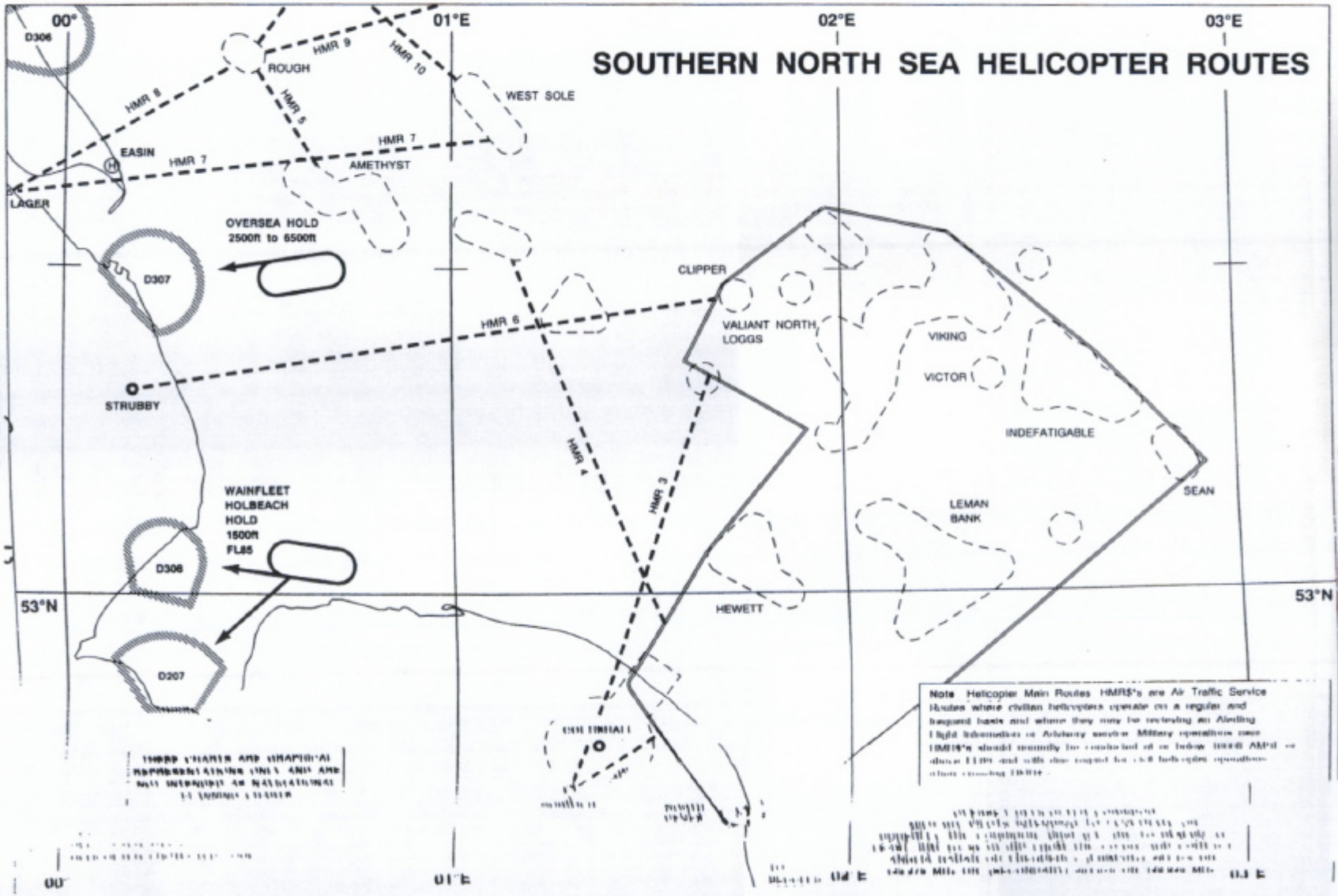


FIGURE 13

NATO RESTRICTED
UNCLASSIFIED

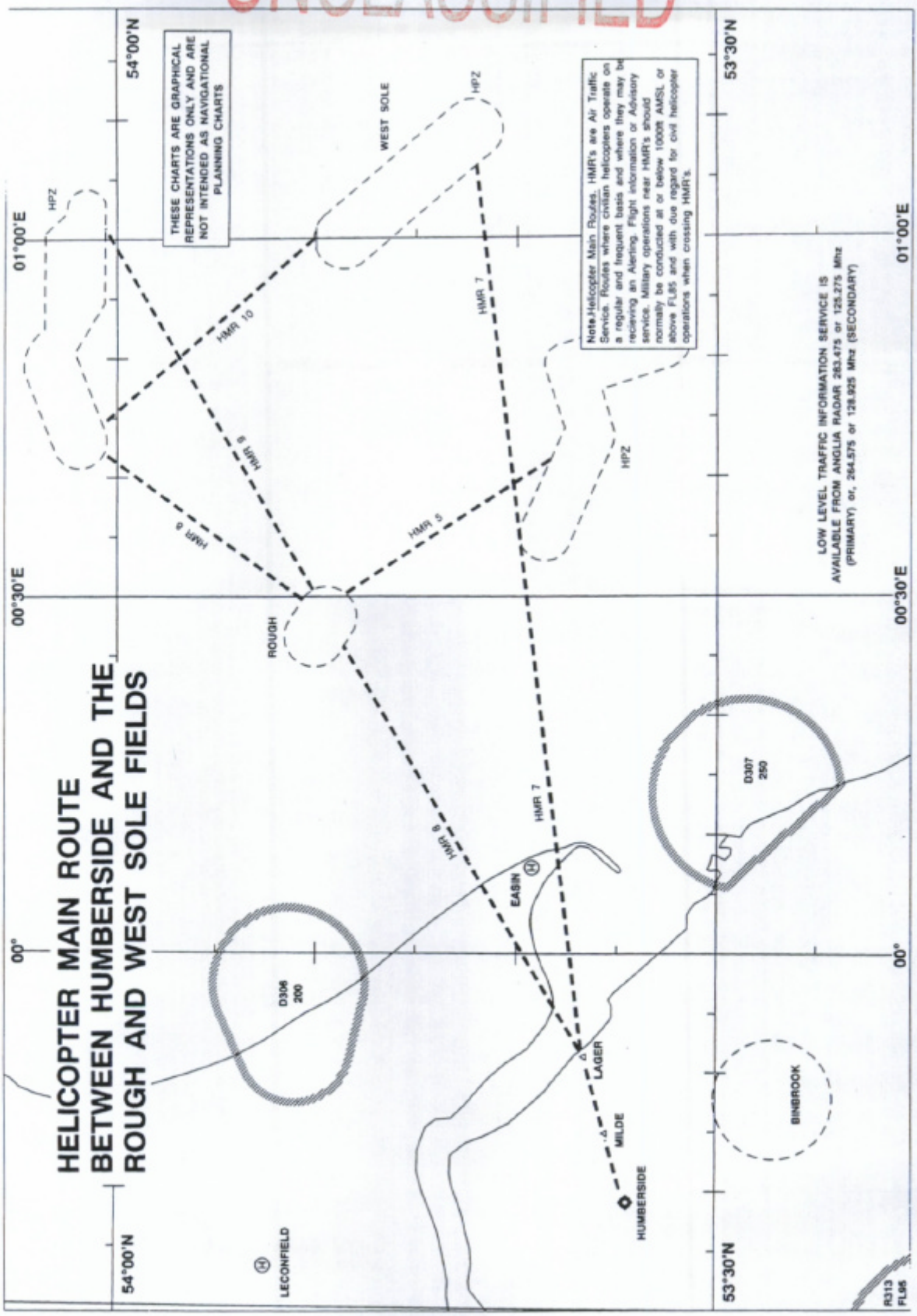

HELICOPTER MAIN ROUTE
BETWEEN HUMBERSIDE AND THE
ROUGH AND WEST SOLE FIELDS
THESE CHARTS ARE GRAPHICAL REPRESENTATIONS ONLY AND ARE NOT INTENDED AS NAVIGATIONAL PLANNING CHARTS
Note: Helicopter Main Routes. HMR's are Air Traffic Service. Routes where civilian helicopters operate on a regular and frequent basis and where they may be receiving an Alerting, Flight information or Advisory service. Military operations near HMR's should normally be conducted at or below 1000ft AMSL or above FL85 and with due regard for civil helicopter operations when crossing HMR's.
LOW LEVEL TRAFFIC INFORMATION SERVICE IS AVAILABLE FROM ANGLIA RADAR 263.475 or 125.275 Mhz (PRIMARY) or, 264.575 or 128.925 Mhz (SECONDARY)
54°00'N
53°30'N
01°00'E
00°30'E
00°
HPZ
WEST SOLE
ROUGH
HMR 10
HMR 9
HMR 8
HMR 7
HMR 5
D306
200
D307
250
EASIN
LAGER
MILDE
HUMBERSIDE
LECONFIELD
BINBROOK
R313
FL85

FIGURE 14

UNCLASSIFIED
SECRET

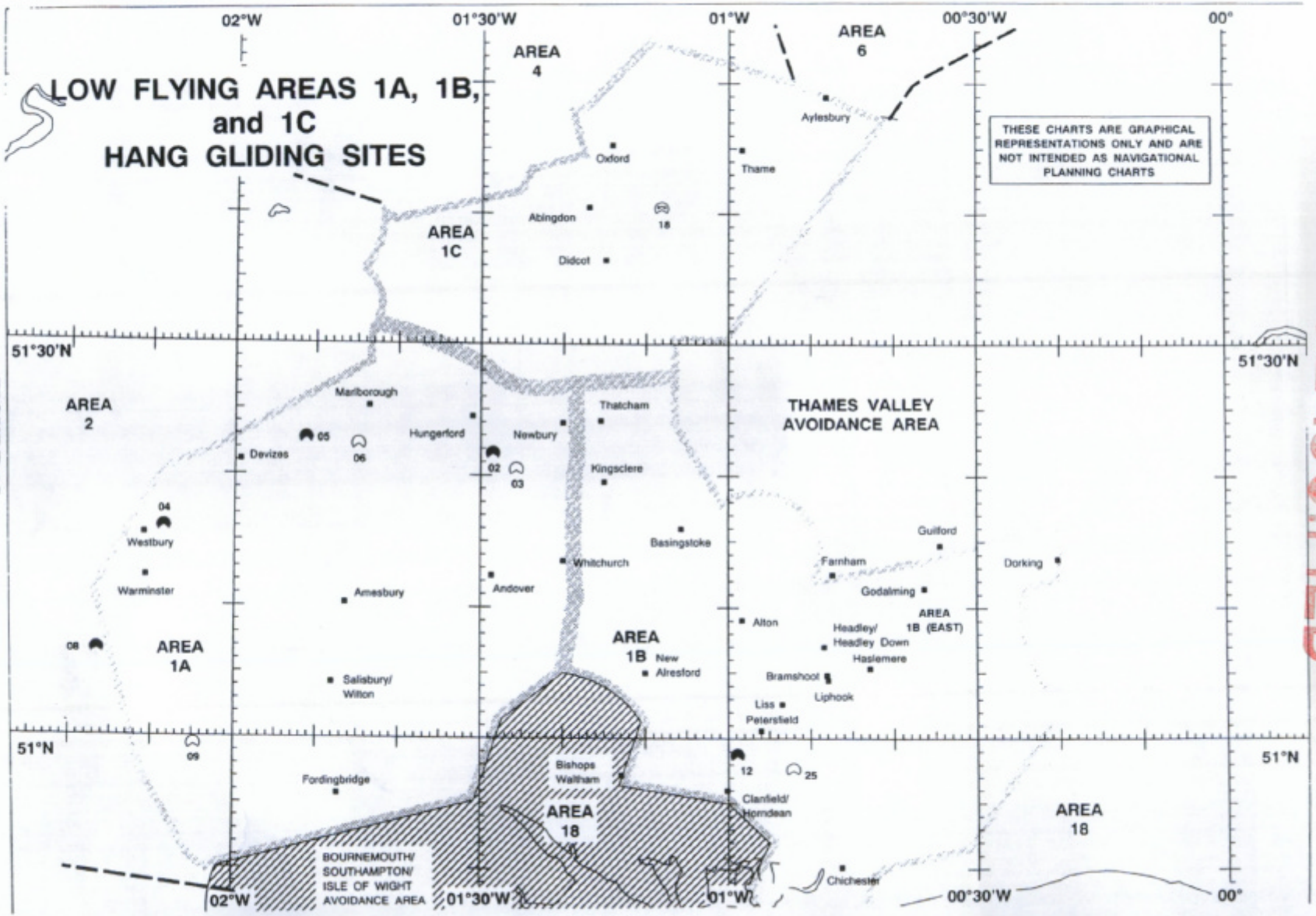


FIGURE 15

UNCLASSIFIED
SECRET

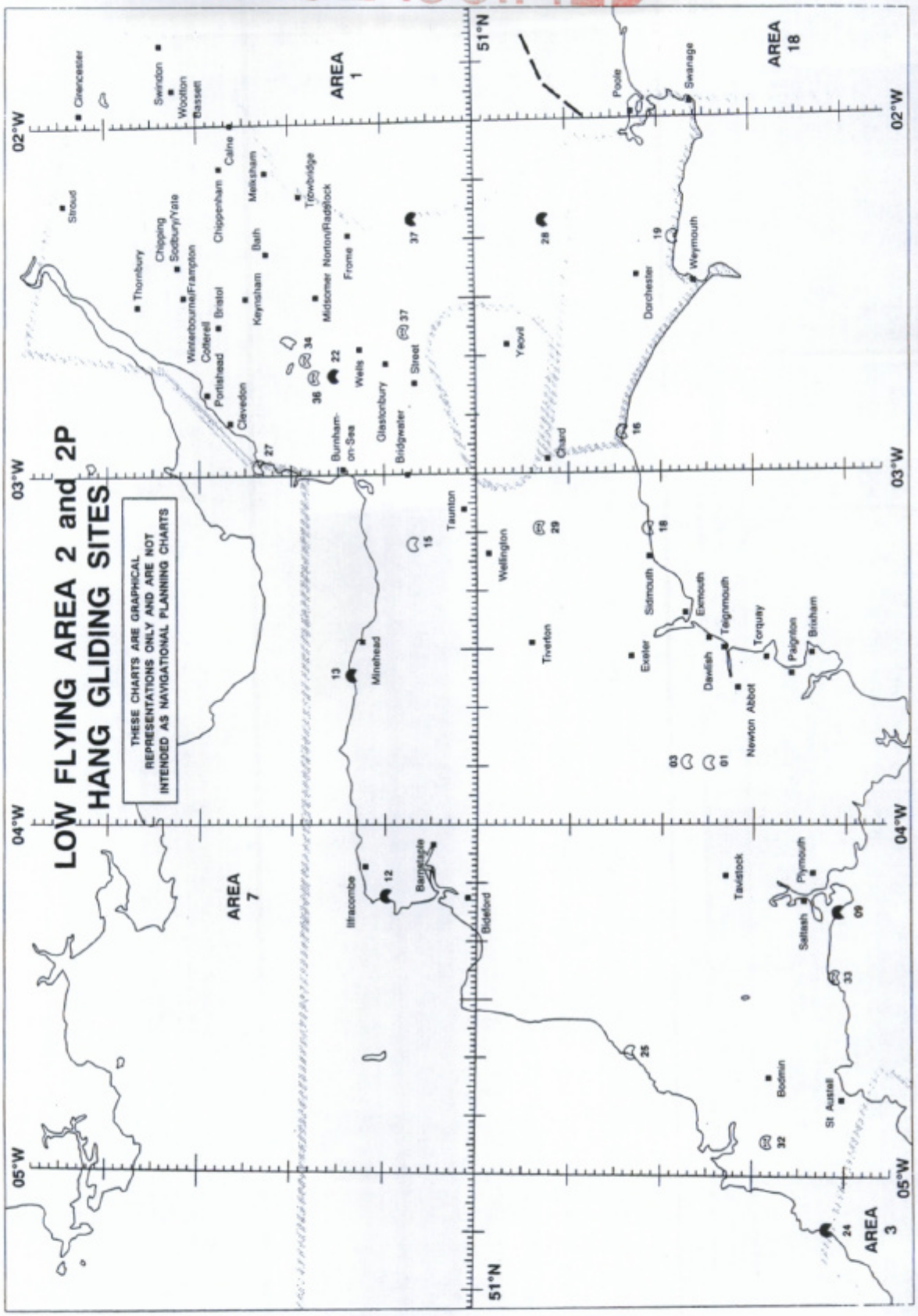

LOW FLYING AREA 2 and 2P
HANG GLIDING SITES
THESE CHARTS ARE GRAPHICAL REPRESENTATIONS ONLY AND ARE NOT INTENDED AS NAVIGATIONAL PLANNING CHARTS
AREA 1
AREA 7
AREA 18
AREA 3
02°W
03°W
04°W
05°W
51°N
Cirencester
Swindon
Wootton Bassett
Poole
Swanage
Stroud
Thornbury
Chipping Sodbury/Yate
Winterbourne/Frampton
Chippenham
Calne
Melksham
Trowbridge
Bath
Keynsham
Bristol
Midsomer Norton/Radstock
Frome
Weymouth
Dorchester
Portishead
Clevedon
Burnham-on-Sea
Wells
Glastonbury
Bridgwater
Street
Yeovil
Chard
Taunton
Wellington
Tiverton
Exeter
Sidmouth
Exmouth
Teignmouth
Torquay
Paignton
Brixham
Dawlish
Newton Abbot
Minehead
Ilfracombe
Barnstaple
Bideford
Tavistock
Plymouth
Saltash
Bodmin
St Austell

FIGURE 16

UNCLASSIFIED
SECRET
NATO RESTRICTED

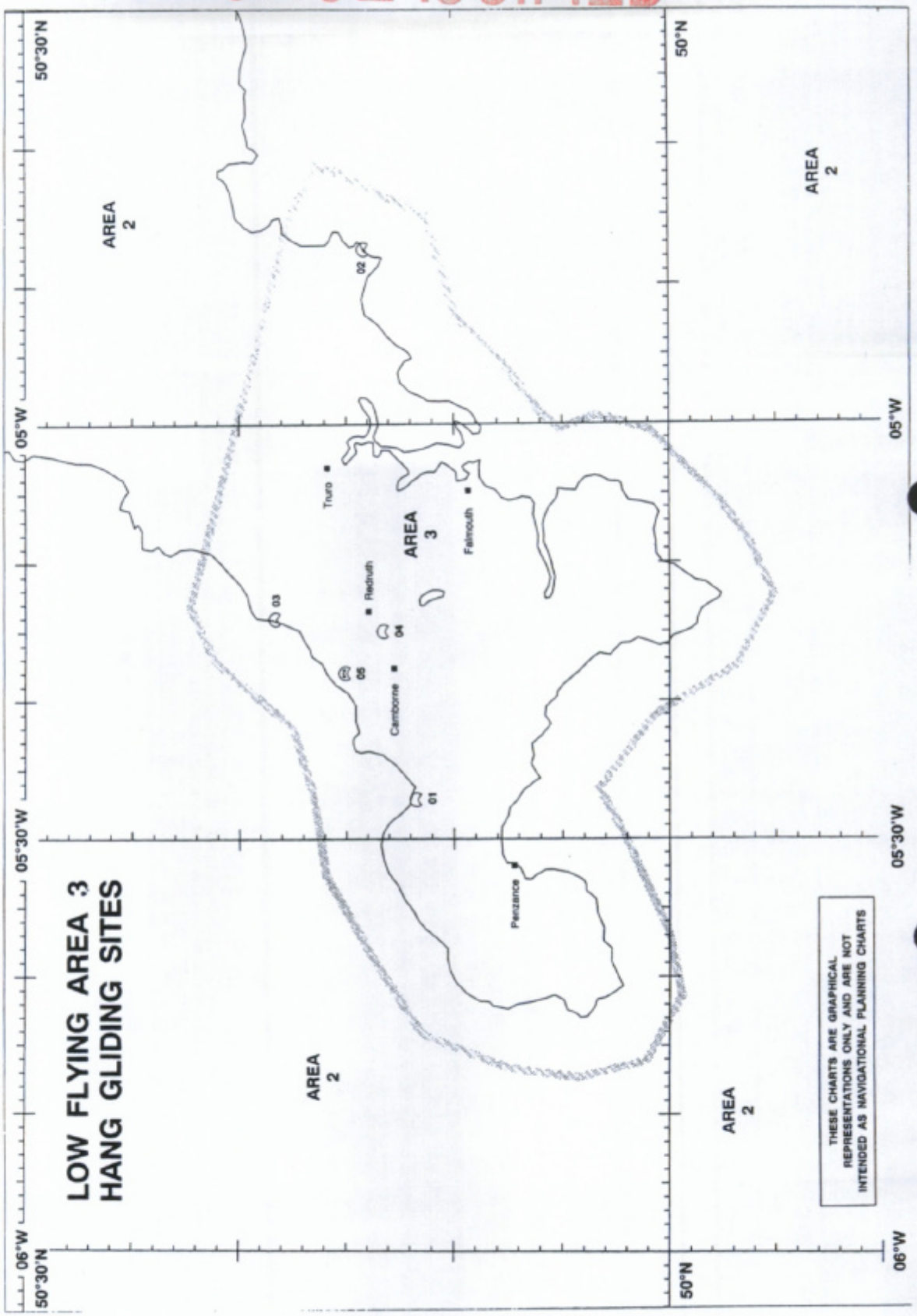


FIGURE 17

NATO RESTRICTED
UNCLASSIFIED

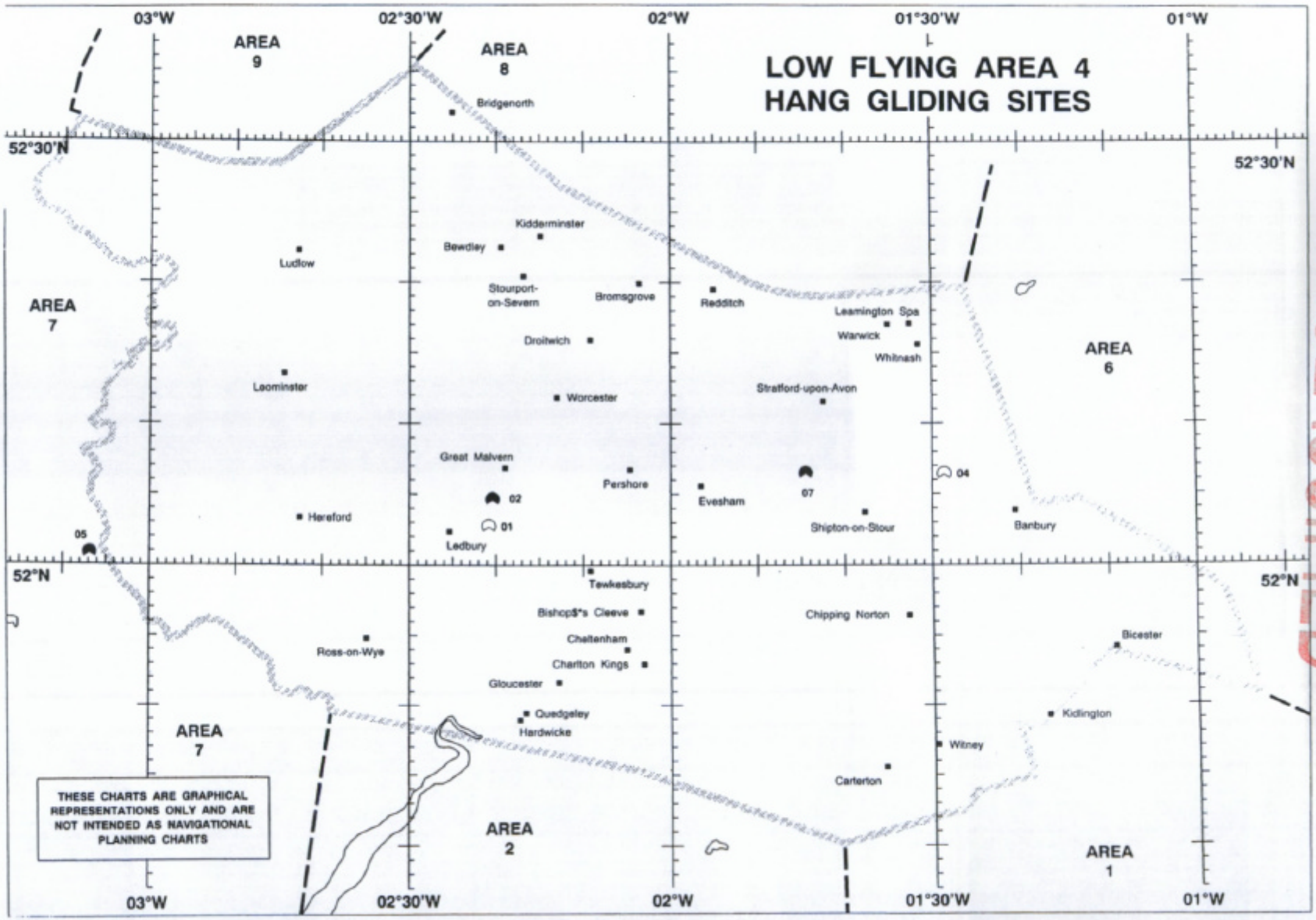


FIGURE 18

UNCLASSIFIED
SECRET
UNCLASSIFIED

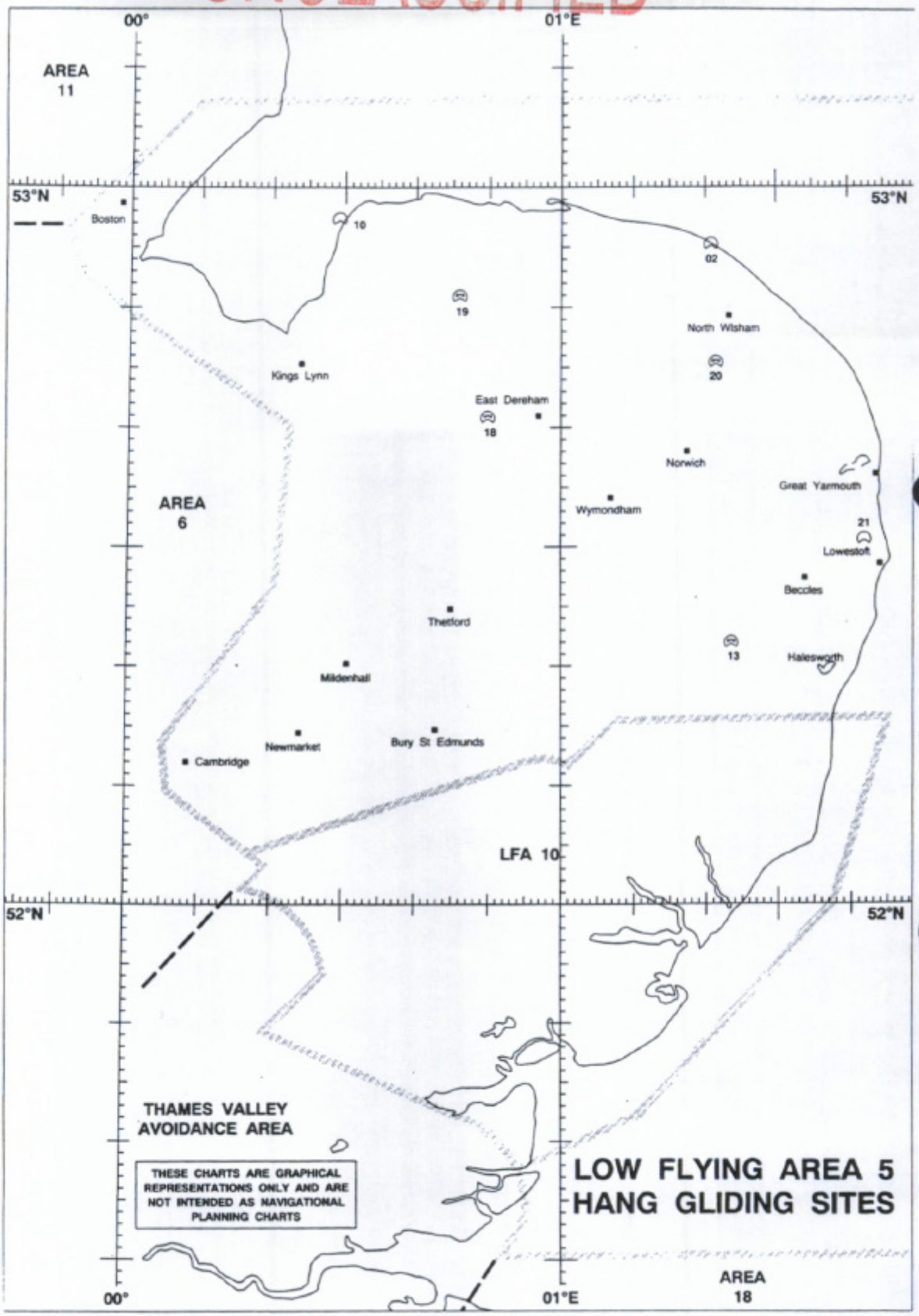

00°
01°E
AREA
11
53°N
53°N
Boston
10
02
19
North Wilsham
Kings Lynn
20
East Dereham
18
Norwich
Great Yarmouth
AREA
6
Wymondham
21
Lowestoft
Beccles
Thetford
13
Halesworth
Mildenhall
Newmarket
Bury St Edmunds
Cambridge
LFA 10
52°N
52°N
THAMES VALLEY
AVOIDANCE AREA
THESE CHARTS ARE GRAPHICAL REPRESENTATIONS ONLY AND ARE NOT INTENDED AS NAVIGATIONAL PLANNING CHARTS
LOW FLYING AREA 5
HANG GLIDING SITES
00°
01°E
AREA
18

FIGURE 19

UNCLASSIFIED
SECRET
NATO RESTRICTED

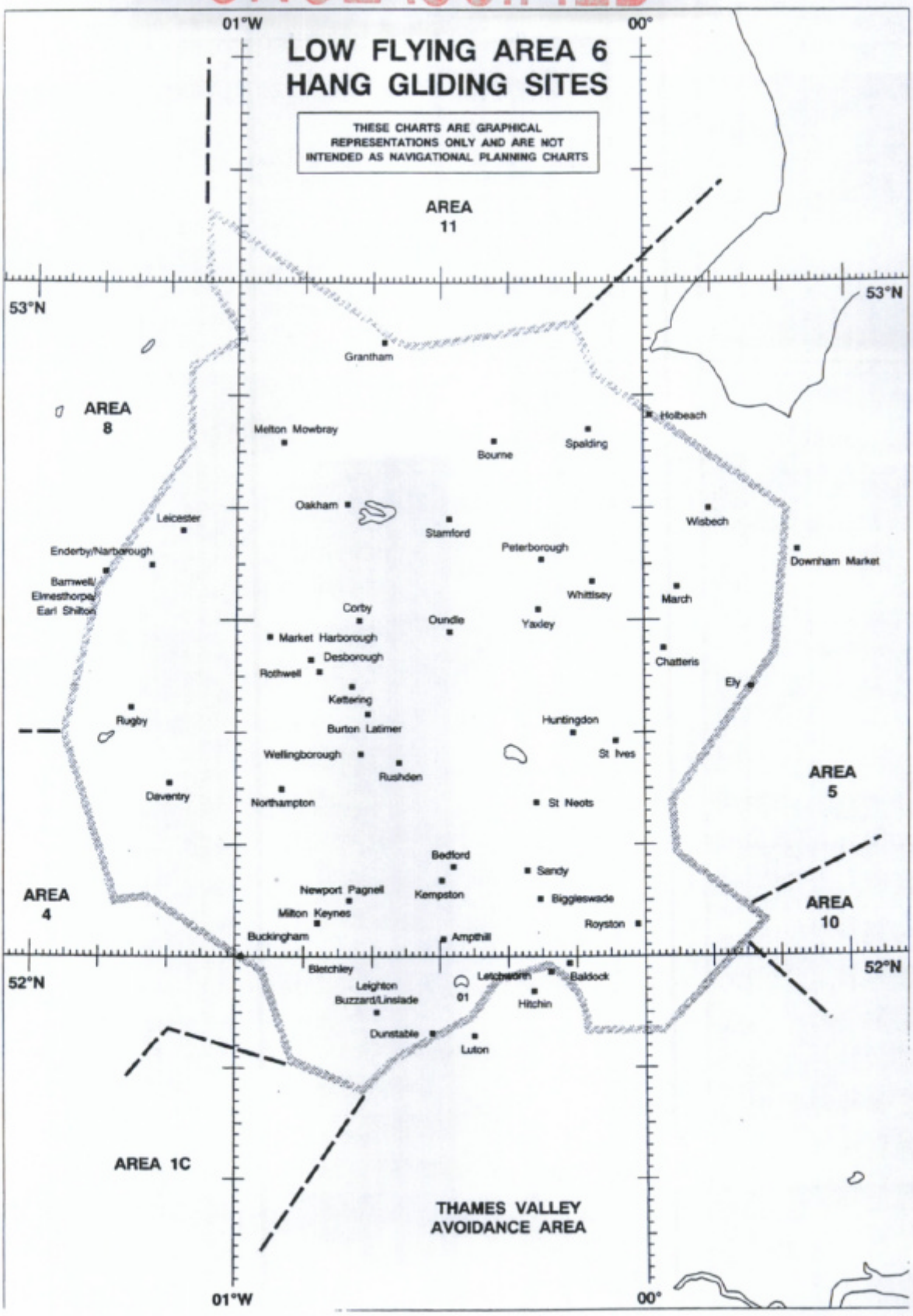


FIGURE 20

UNCLASSIFIED
NATO RESTRICTED
SECRET

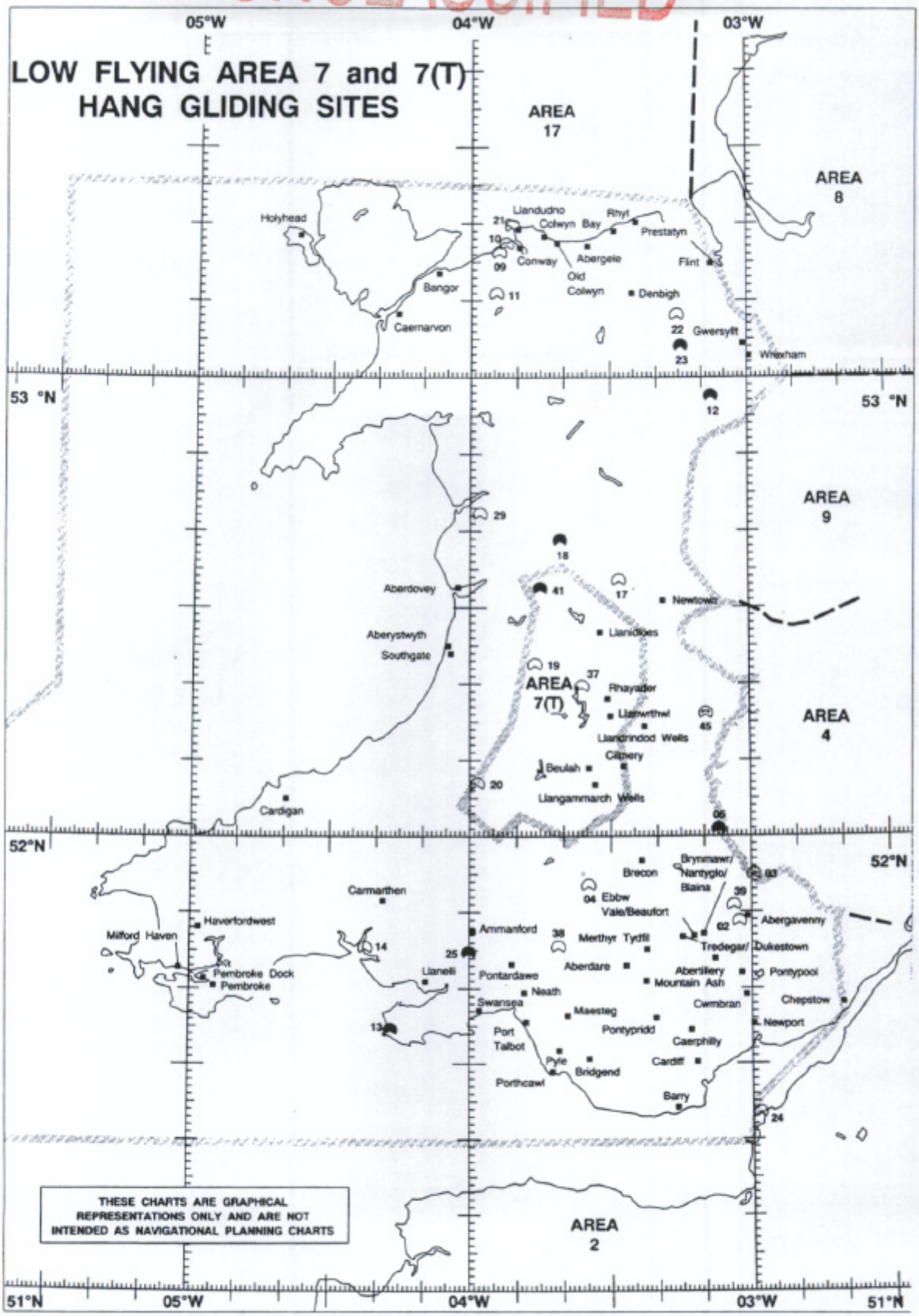

LOW FLYING AREA 7 and 7(T)
HANG GLIDING SITES
05°W
04°W
03°W
53 °N
52°N
51°N
AREA 17
AREA 8
AREA 9
AREA 4
AREA 2
AREA 7(T)
Holyhead
Llandudno
Colwyn Bay
Rhyl
Prestatyn
Conway
Abergele
Old Colwyn
Denbigh
Flint
Bangor
Caernarvon
Gwersyllt
Wrexham
Aberdovey
Aberystwyth
Southgate
Cardigan
Newtown
Llanidloes
Rhayader
Llanwrtwd
Llandrindod Wells
Builth Wells
Beulah
Llangammarch Wells
Carmarthen
Haverfordwest
Milford Haven
Pembroke Dock
Pembroke
Llanelli
Ammanford
Pontardawe
Swansea
Neath
Port Talbot
Maesteg
Merthyr Tydfil
Aberdare
Pontypridd
Pyle
Bridgend
Porthcawl
Barry
Cardiff
Caerphilly
Brecon
Brynmawr/ Nantyglo/ Blaina
Ebbw Vale/Beaufort
Tredegar/ Dukestown
Abergavenny
Abertillery
Mountain Ash
Pontypool
Cwmbran
Chepstow
Newport
THESE CHARTS ARE GRAPHICAL REPRESENTATIONS ONLY AND ARE NOT INTENDED AS NAVIGATIONAL PLANNING CHARTS

FIGURE 21

UNCLASSIFIED
SECRET
NATO RESTRICTED

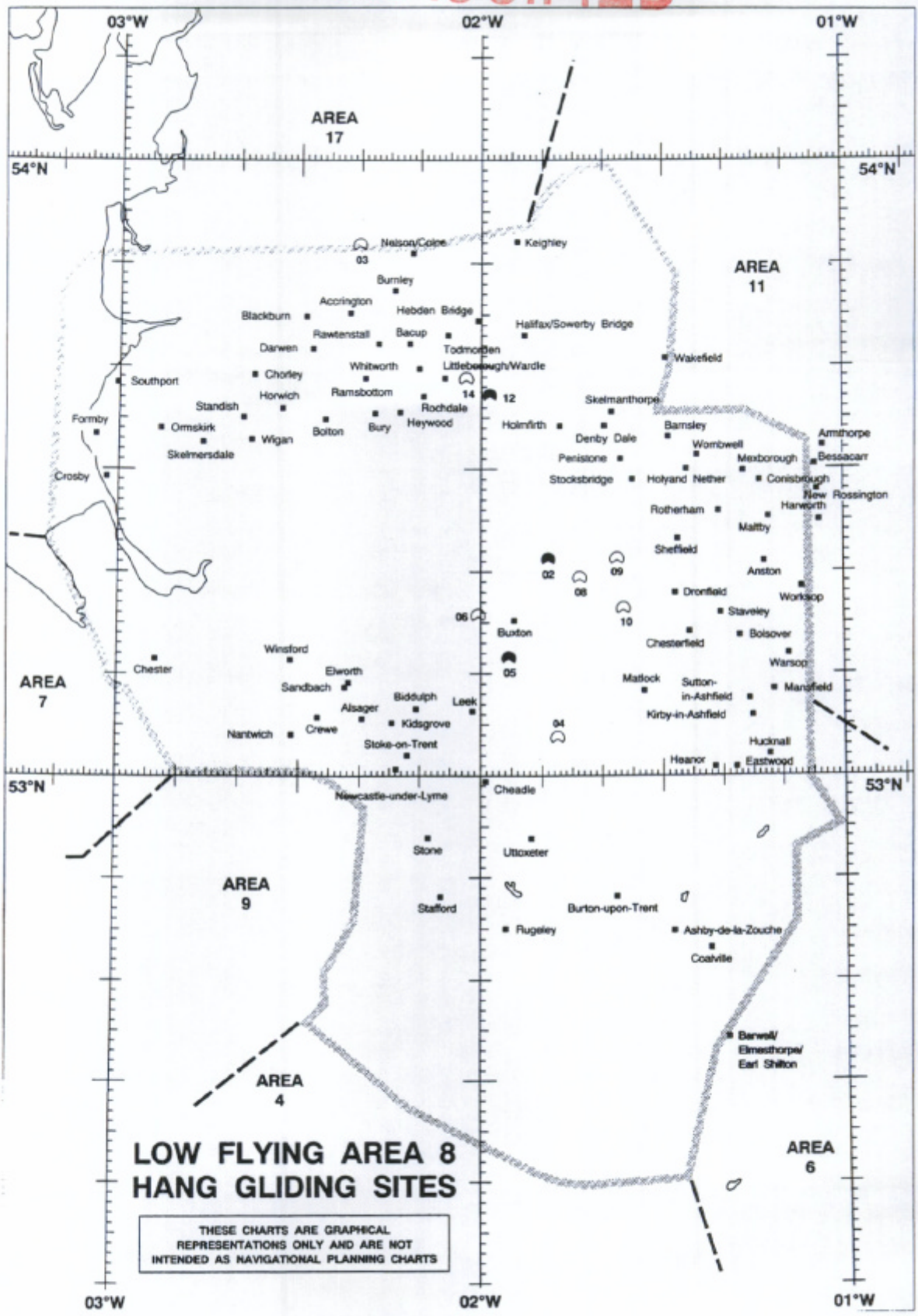


FIGURE 22

UNCLASSIFIED
NATO RESTRICTED
SECRET

UNCLASSIFIED
SECRET
NATO RESTRICTED

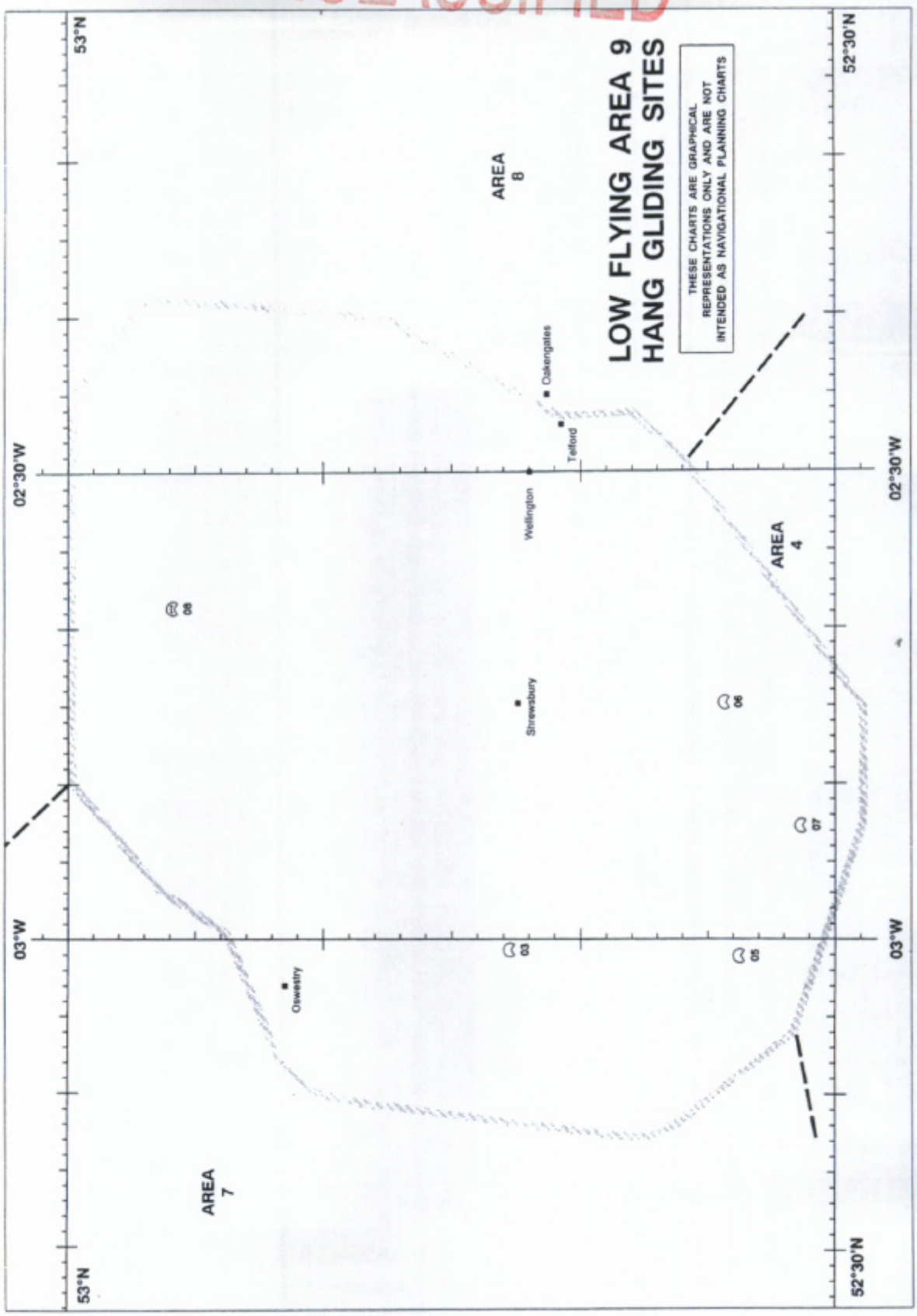


FIGURE 23

UNCLASSIFIED
SECRET
NATO RESTRICTED

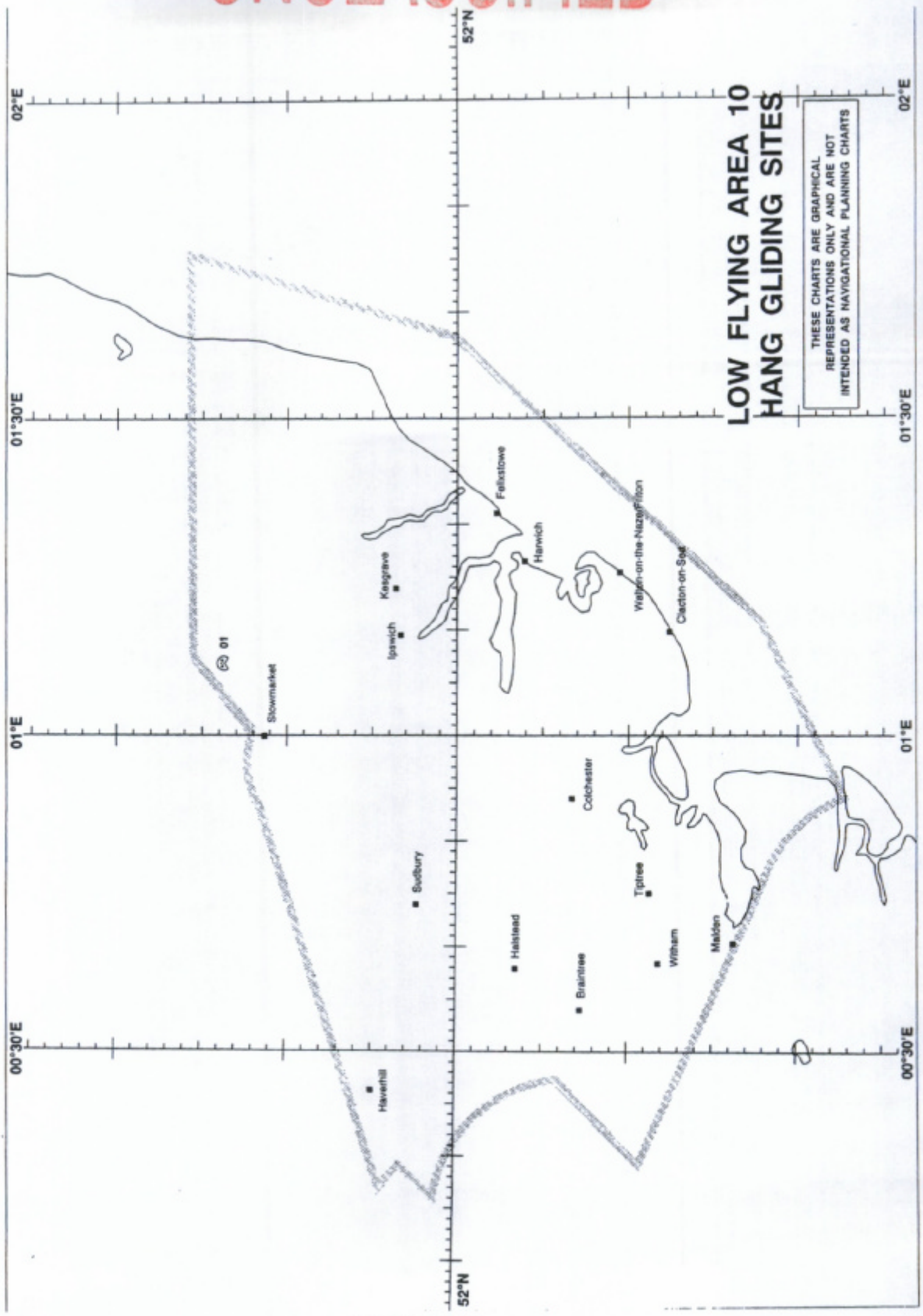

LOW FLYING AREA 10
HANG GLIDING SITES
THESE CHARTS ARE GRAPHICAL REPRESENTATIONS ONLY AND ARE NOT INTENDED AS NAVIGATIONAL PLANNING CHARTS
52°N
02°E
01°30'E
01°E
00°30'E
52°N
Felixstowe
Harwich
Walton-on-the-Naze
Clacton-on-Sea
Kesgrave
Ipswich
Stowmarket
01
Colchester
Tiptree
Witham
Maldon
Braintree
Halstead
Sudbury
Haverhill

FIGURE 24

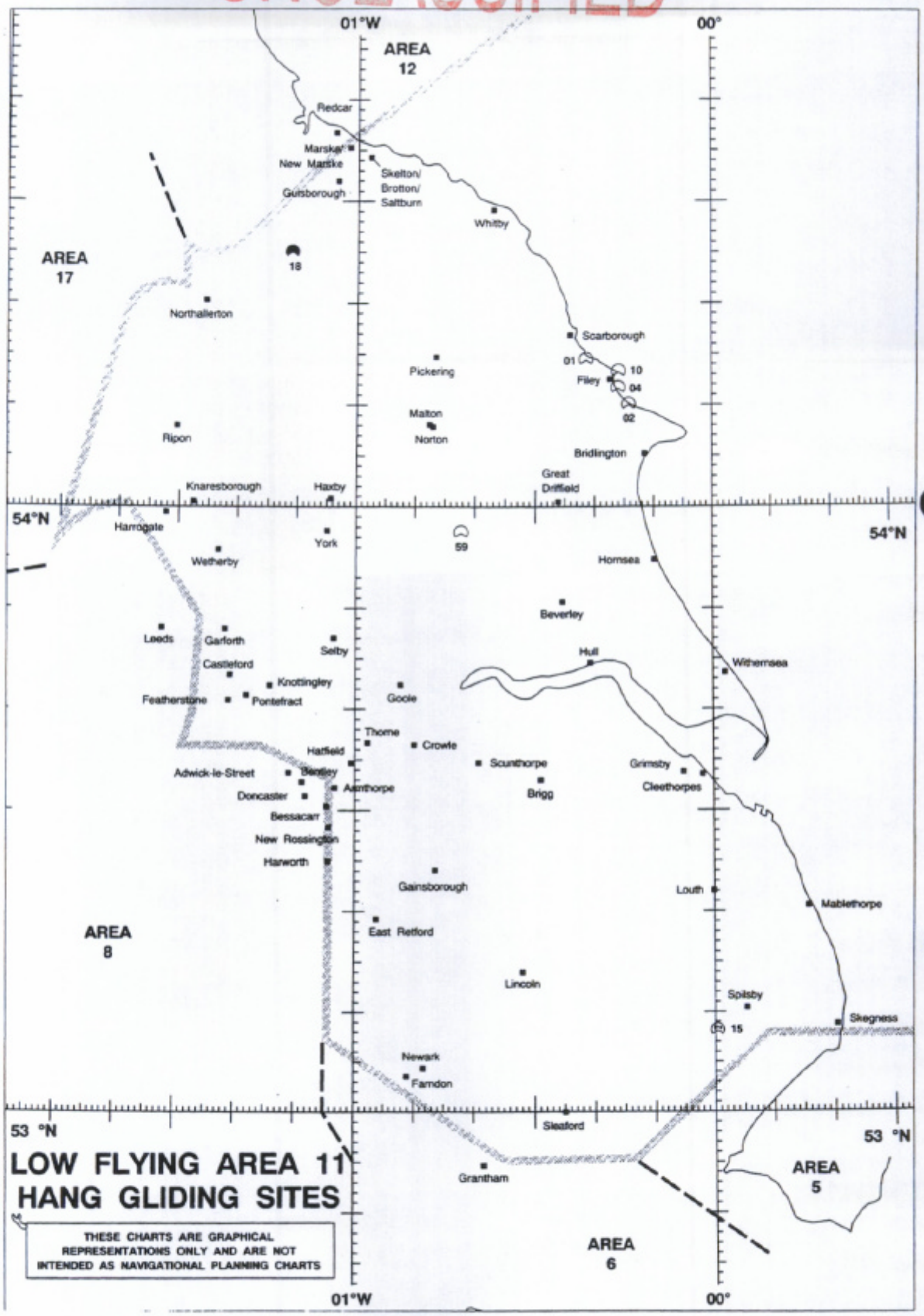

01°W
00°
AREA 12
Redcar
Marske
New Marske
Guisborough
Skelton/
Brotton/
Saltburn
Whitby
AREA 17
18
Northallerton
Scarborough
01
10
Filey
04
02
Pickering
Malton
Norton
Ripon
Bridlington
Great
Driffield
Knaresborough
Harrogate
Haxby
York
59
Hornsea
54°N
54°N
Wetherby
Beverley
Leeds
Garforth
Selby
Hull
Withernsea
Castleford
Knottingley
Featherstone
Pontefract
Goole
Thorne
Crowle
Hatfield
Scunthorpe
Grimsby
Adwick-le-Street
Bentley
Doncaster
Askthorpe
Brigg
Cleethorpes
Bessacarr
New Rossington
Harworth
Gainsborough
Louth
Mablethorpe
AREA 8
East Retford
Lincoln
Spilsby
Skegness
15
Newark
Farndon
Sleaford
53 °N
53 °N
LOW FLYING AREA 11
HANG GLIDING SITES
Grantham
AREA 5
THESE CHARTS ARE GRAPHICAL
REPRESENTATIONS ONLY AND ARE NOT
INTENDED AS NAVIGATIONAL PLANNING CHARTS
AREA 6
01°W
00°

FIGURE 25

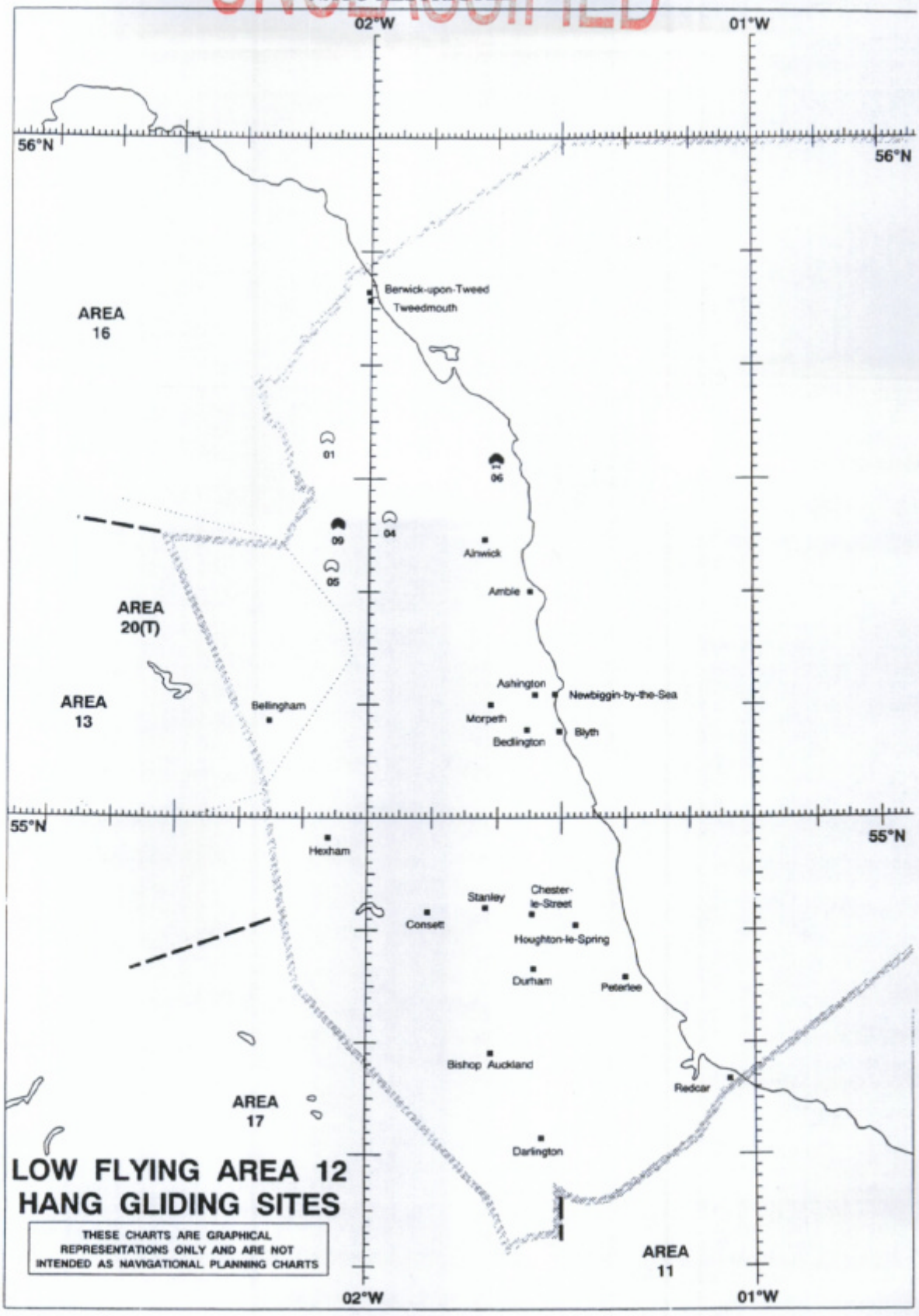

02°W
01°W
56°N
56°N
AREA
16
Berwick-upon-Tweed
Tweedmouth
01
06
09
04
05
Alnwick
Amble
AREA
20(T)
AREA
13
Bellingham
Ashington
Newbiggin-by-the-Sea
Morpeth
Blyth
Bedlington
55°N
55°N
Hexham
Stanley
Chester-
le-Street
Consett
Houghton-le-Spring
Durham
Peterlee
Bishop Auckland
Redcar
AREA
17
Darlington
LOW FLYING AREA 12
HANG GLIDING SITES
THESE CHARTS ARE GRAPHICAL
REPRESENTATIONS ONLY AND ARE NOT
INTENDED AS NAVIGATIONAL PLANNING CHARTS
AREA
11
02°W
01°W

FIGURE 26

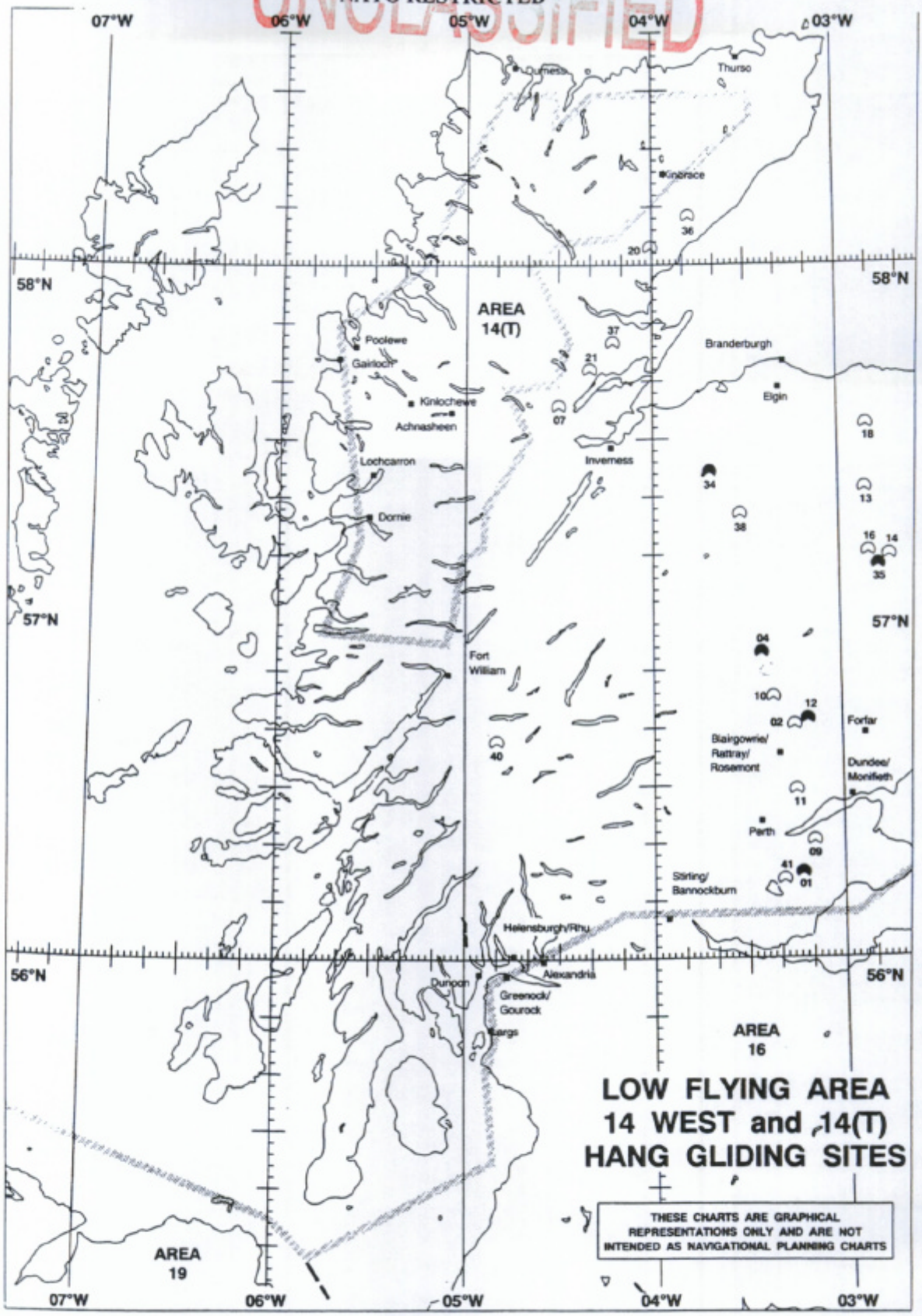

07°W
06°W
05°W
04°W
03°W
58°N
57°N
56°N
AREA
14(T)
AREA
16
AREA
19
Thurso
Wick
Kinbrace
Poolewe
Gairloch
Kinlochewe
Achnasheen
Lochcarron
Dornie
Inverness
Branderburgh
Elgin
Fort
William
Forfar
Blairgowrie/
Rattray/
Rosemont
Dundee/
Monifieth
Perth
Stirling/
Bannockburn
Helensburgh/Rhu
Alexandria
Dunoon
Greenock/
Gourock
Largs
LOW FLYING AREA
14 WEST and 14(T)
HANG GLIDING SITES
THESE CHARTS ARE GRAPHICAL
REPRESENTATIONS ONLY AND ARE NOT
INTENDED AS NAVIGATIONAL PLANNING CHARTS

FIGURE 27

UNCLASSIFIED
SECRET
NATO RESTRICTED

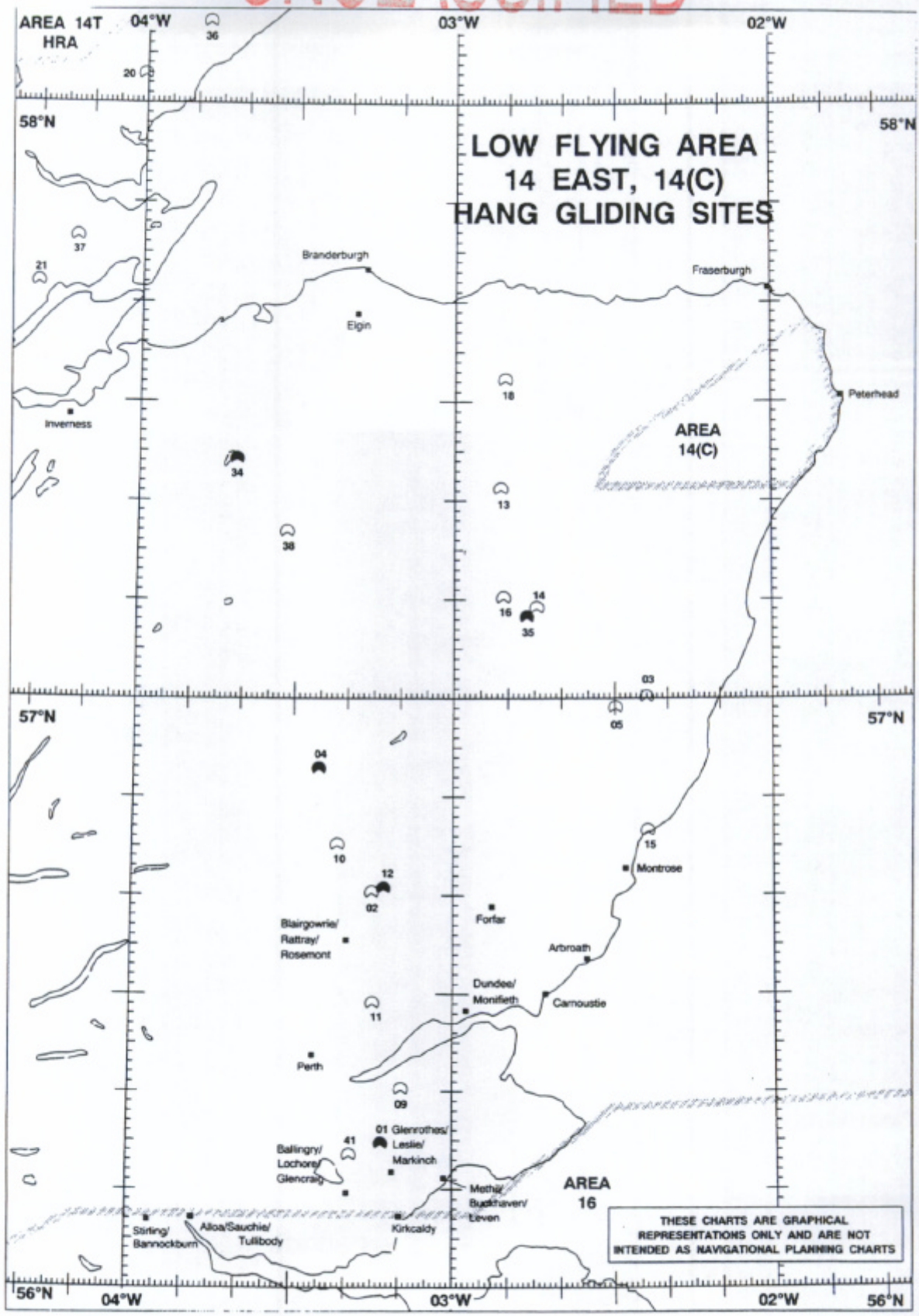


FIGURE 28

UNCLASSIFIED
NATO RESTRICTED
SECRET

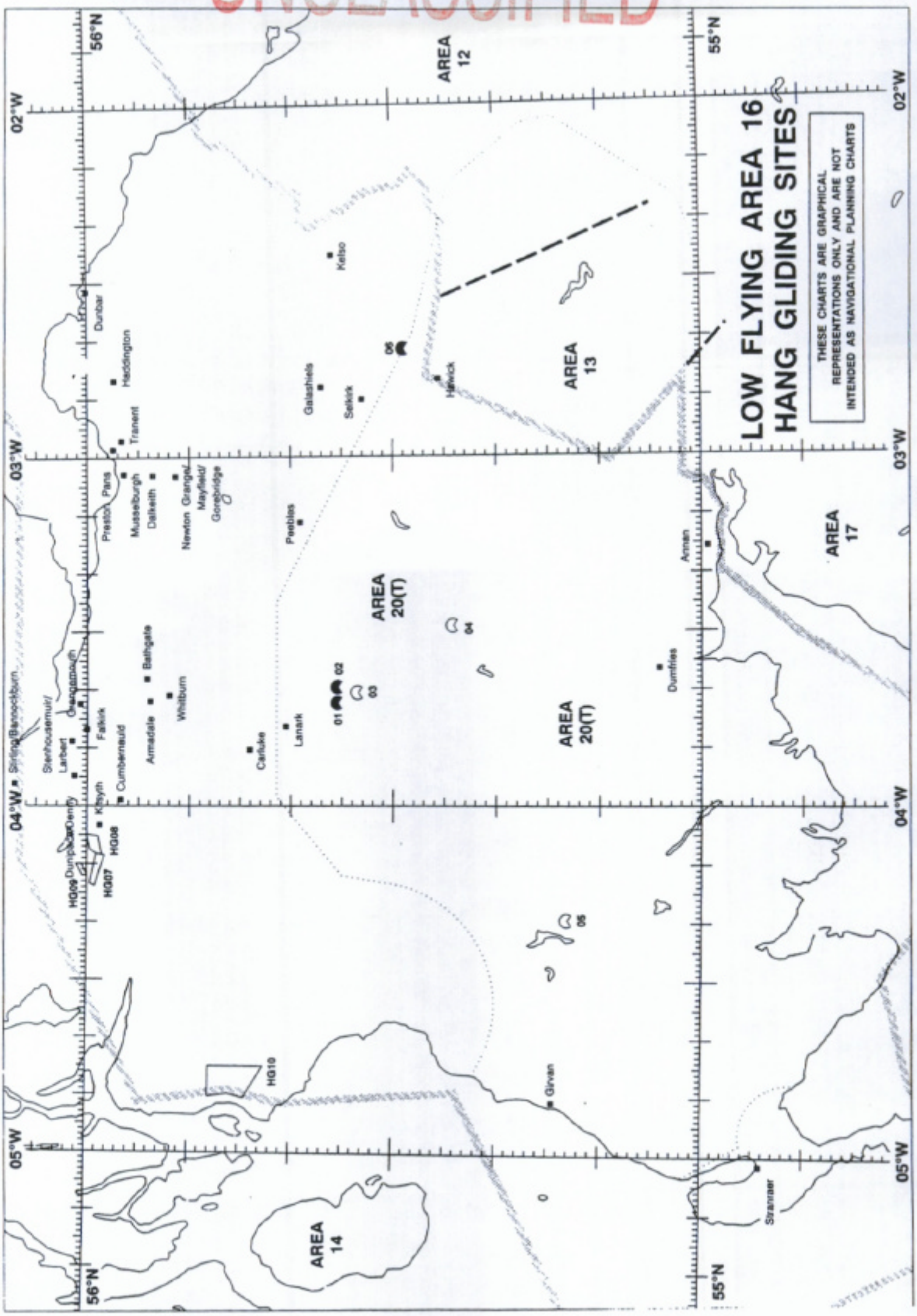

LOW FLYING AREA 16
HANG GLIDING SITES
THESE CHARTS ARE GRAPHICAL REPRESENTATIONS ONLY AND ARE NOT INTENDED AS NAVIGATIONAL PLANNING CHARTS
AREA 12
AREA 13
AREA 14
AREA 17
AREA 20(T)
AREA 20(T)
56°N
55°N
02°W
03°W
04°W
05°W
Dunbar
Haddington
Tranent
Kelso
Galashiels
Selkirk
Hawick
Preston
Pans
Musselburgh
Dalkeith
Newton Grange/ Mayfield/ Gorebridge
Peebles
Annan
Stenhousemuir/ Larbert
Bathgate
Armadale
Whitburn
Falkirk
Cumbernauld
Carluke
Lanark
Dumfries
Kirkyth
Dunfermline
HG08
HG07
HG09
HG10
Girvan
Stranraer
01
02
03
04
05
06

FIGURE 29

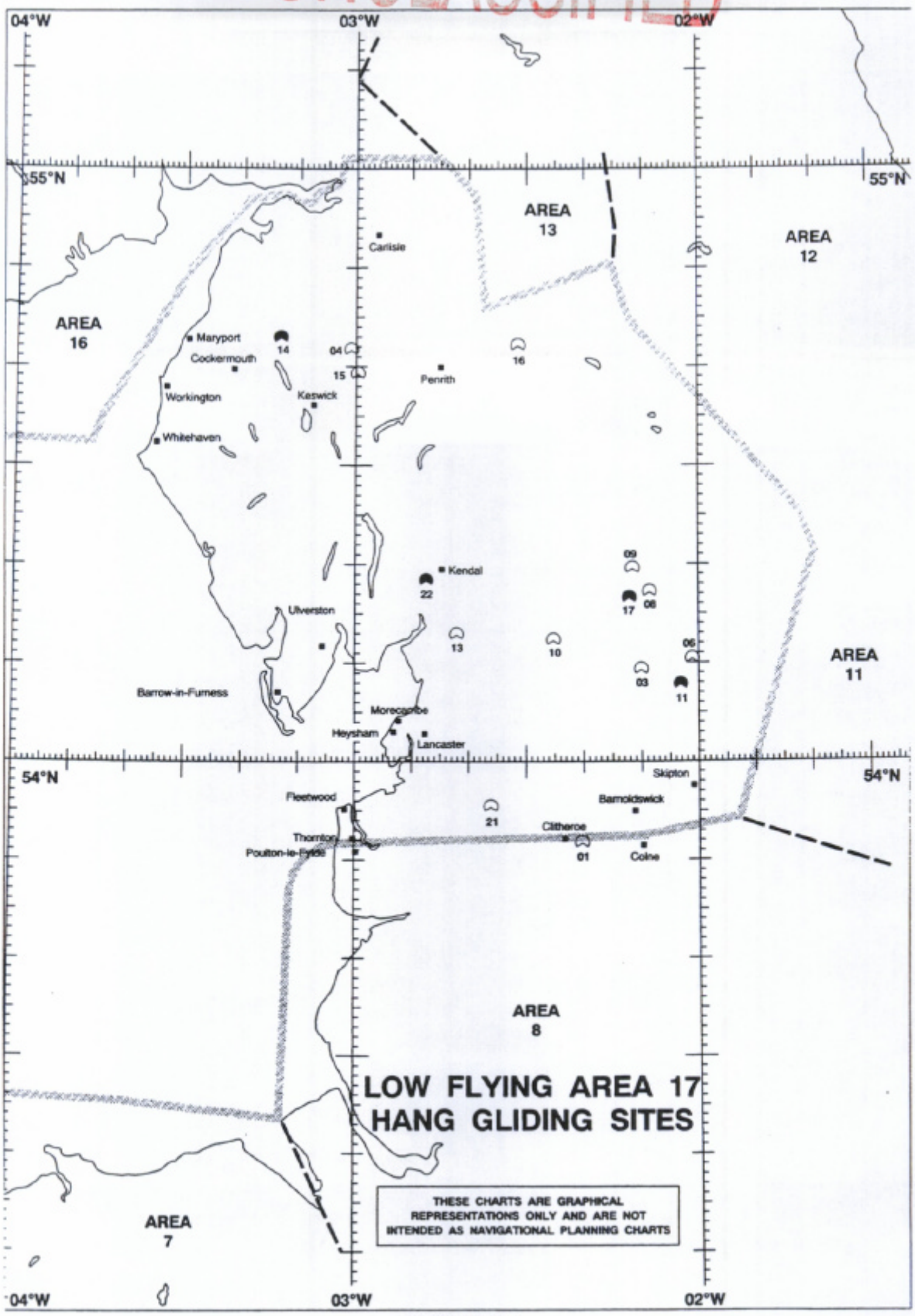

04°W
03°W
02°W
55°N
54°N
AREA 16
AREA 13
AREA 12
AREA 11
AREA 8
AREA 7
Carlisle
Maryport
Cockermouth
Workington
Whitehaven
Keswick
Penrith
Kendal
Ulverston
Barrow-in-Furness
Morecambe
Heysham
Lancaster
Skipton
Barnoldswick
Clitheroe
Colne
Fleetwood
Thornton
Poulton-le-Fylde
LOW FLYING AREA 17
HANG GLIDING SITES
THESE CHARTS ARE GRAPHICAL REPRESENTATIONS ONLY AND ARE NOT INTENDED AS NAVIGATIONAL PLANNING CHARTS

FIGURE 30

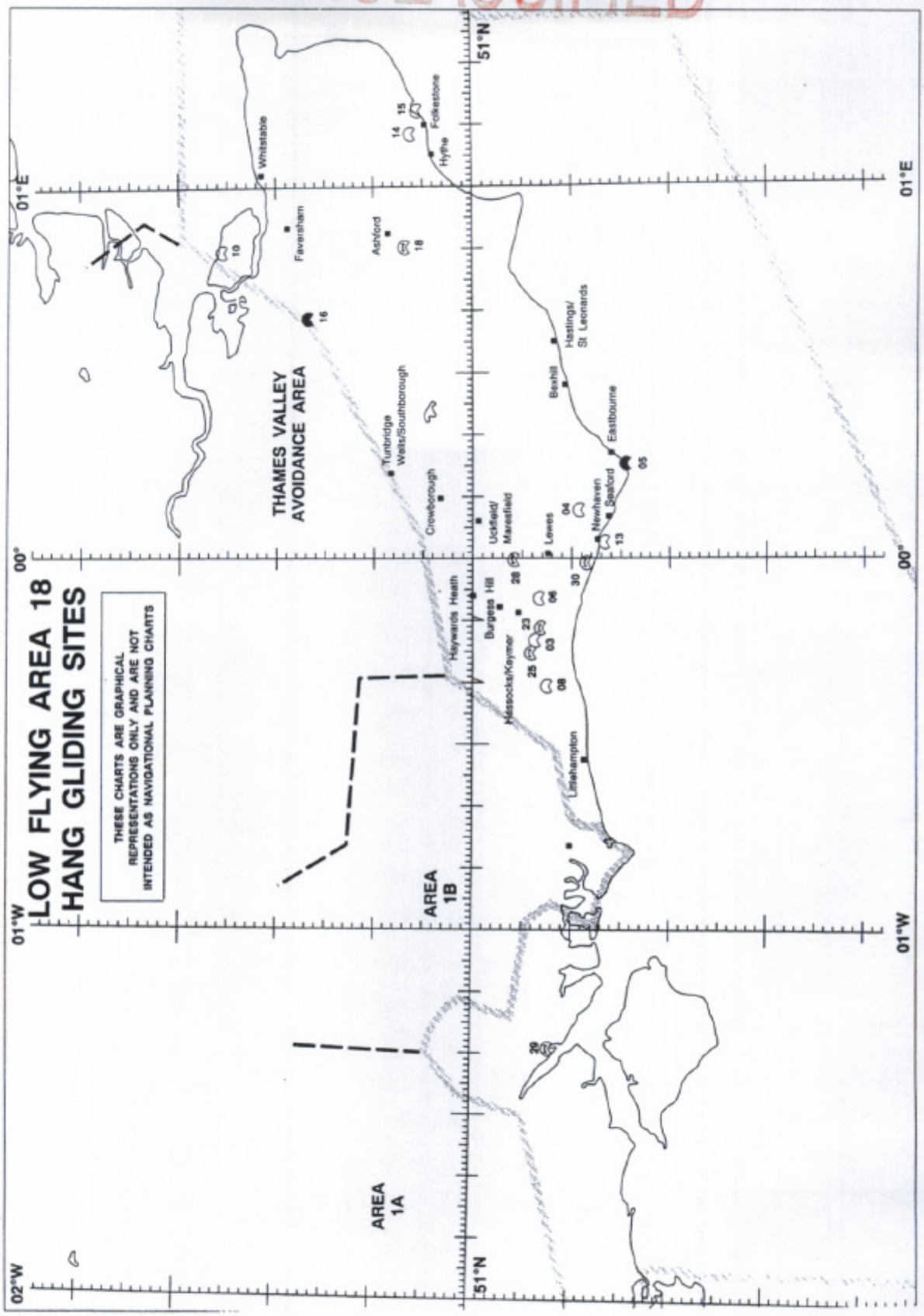

LOW FLYING AREA 18
HANG GLIDING SITES
THESE CHARTS ARE GRAPHICAL REPRESENTATIONS ONLY AND ARE NOT INTENDED AS NAVIGATIONAL PLANNING CHARTS
THAMES VALLEY AVOIDANCE AREA
AREA 1A
AREA 1B
51°N
01°E
00°
01°W
02°W
Whitstable
Folkestone
Hythe
Faversham
Ashford
Tunbridge Wells/Southborough
Crowborough
Uckfield/ Mayfield
Hastings/ St Leonards
Bexhill
Eastbourne
Seaford
Newhaven
Lewes
Haywards Heath
Burgess Hill
Hassocks/Keymer
Littlehampton

FIGURE 31

UNCLASSIFIED
SECRET

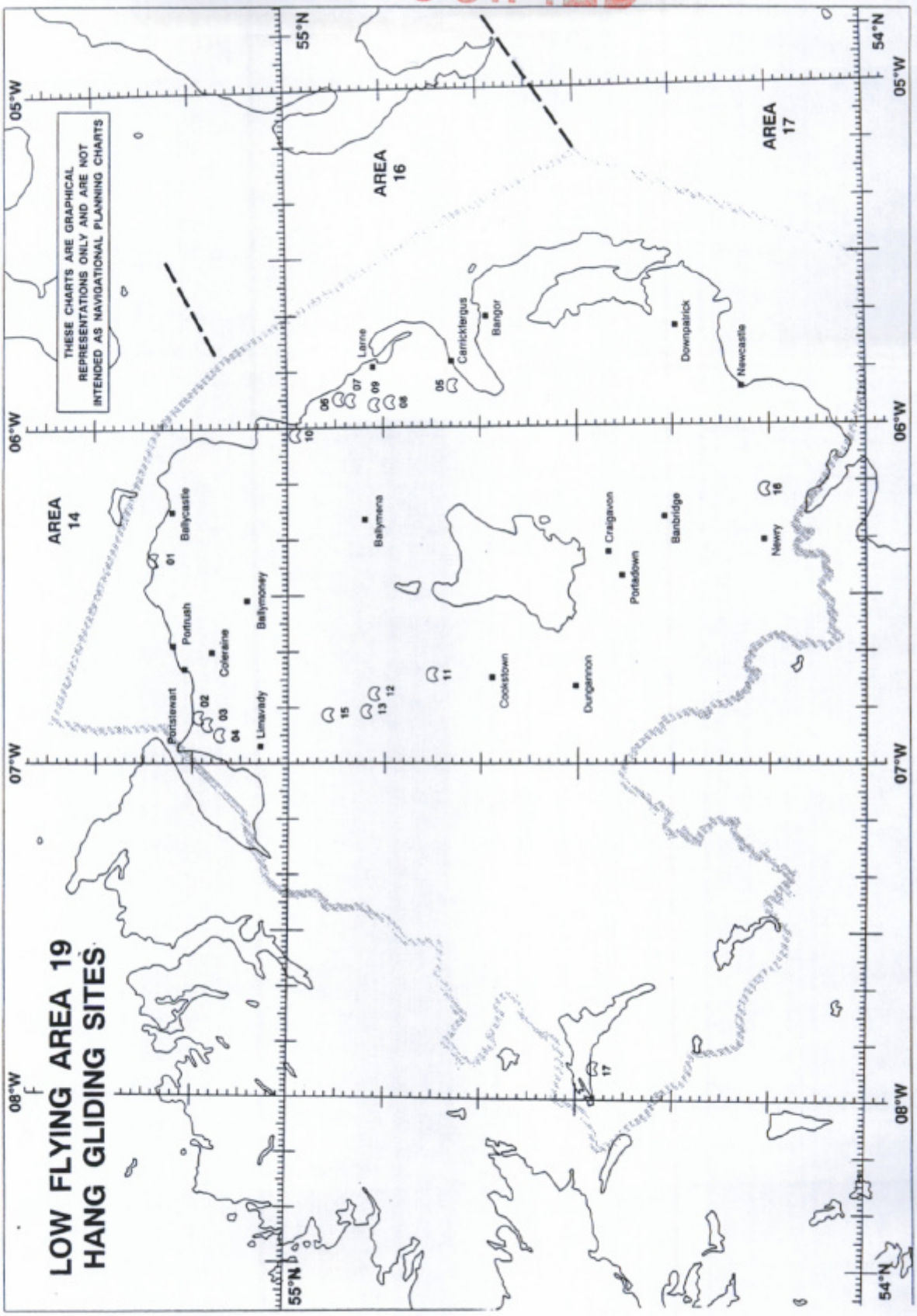
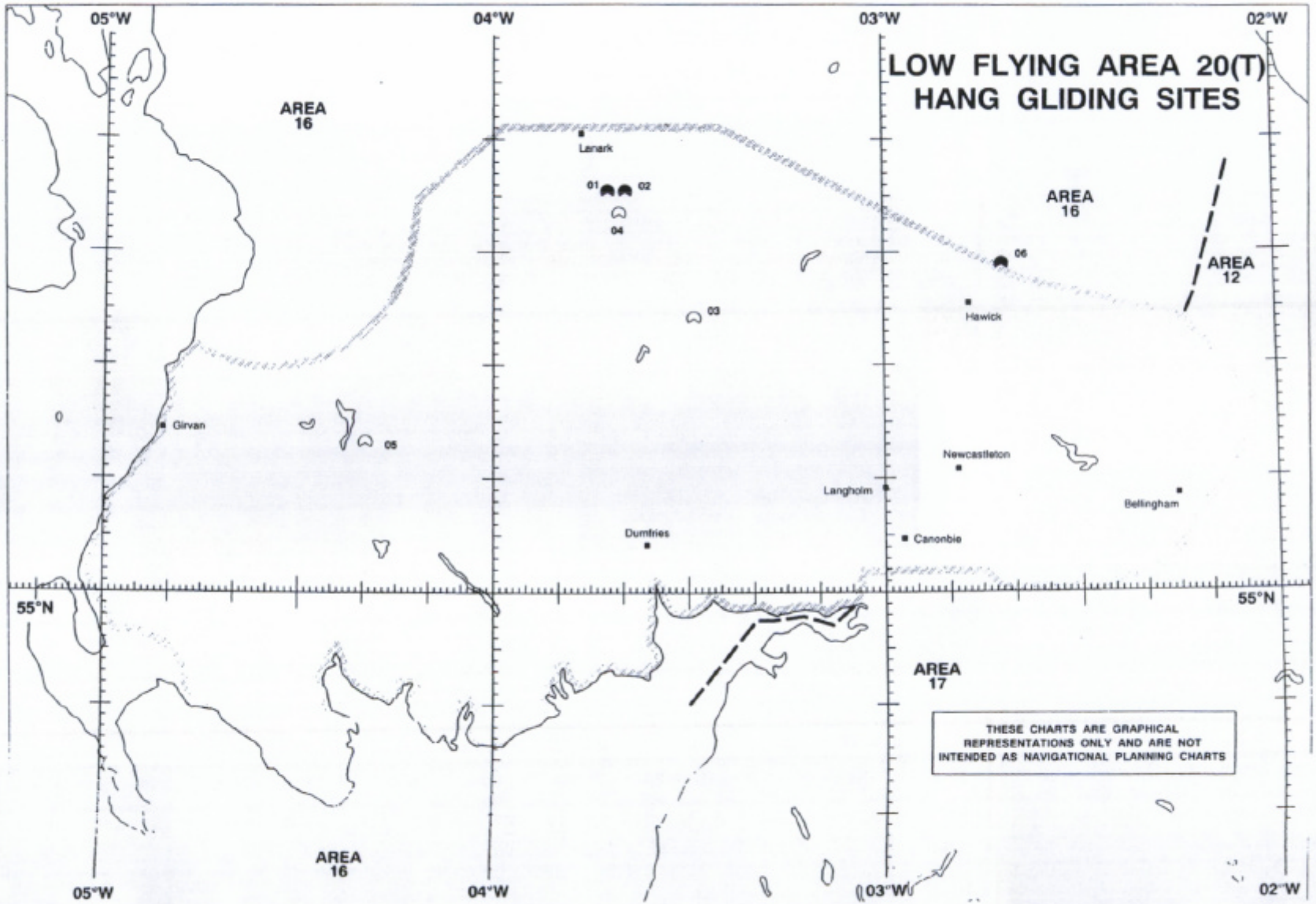


FIGURE 32

UNCLASSIFIED
SECRET



UNCLASSIFIED
UNCLASSIFIED
UNCLASSIFIED
UNCLASSIFIED

UNCLASSIFIED

WORKING PAPER NO. 10

LEY LINES, EARTHLIGHTS AND UK EARTH FAULT LINES

	Para	Page
LEY LINES	1	10-1
Study Objective	7	10-2
ELECTRO, THERMO AND TRIBOLUMINESCENCE	10	10-3
EARTHLIGHTS	13	10-3
Summary	14	10-5
EARTHLIGHT REACTION	15	10-6
HISTORICAL	16	10-6
GEOLOGICAL	17	10-6

UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED

LEY LINES, EARTHLIGHTS AND UK EARTH FAULT LINES

LEY LINES

1. This aspect is briefly investigated because of the suggestion that the location of 'LEY LINES' and UAP sightings may be linked in some way and even in coincidence. The name 'LEY LINES' was coined in 1921 from the old terminology the 'lay' or 'lie' of the land.

2. The suggestion of a UAP connection seems to have originated from a French investigator who postulated that there was a 'tendency for UFO sightings to appear in straight lines'[1]These were then called 'orthotenies'.

3. Further investigators ([2] and [3]) respectively linked archaeological and astronomical interests to the theory.

4. A Ley Line is stated to be a straight (or nearly straight) line which some have connected with ancient sites. These comprise hill forts, stone circles, earthworks (e.g. long burrows, mounds), stone markers, ancient abbeys and churches built on old pagan locations. The postulation is that these are found to be in alignment or near-alignment. There is other evidence that they often occur over water-bearing underground fissures. They are also supposedly associated with 'magnetic currents (or some type of unknown 'current' or 'force') which allow, for example, water to be located by some, while seeming to have physical effects on others. On occasions a plan of several ley line groups has (reportedly) shown replica astronomical patterns (e.g. BEAR). Numerous plots of these 'ley lines' can be made by simple reference to ancient sites and markers etc. found on Ordnance Survey Maps.

5. The work was further followed-up by researchers who conducted considerable investigation into the geometry and alignment of ancient sites, such as stone circles, the results of which have suggested that these were accurately constructed (and that ancient civilisations must have had knowledge beyond expectation). In the UK much of this is based on 'accurate' measurements of standing artefacts (which often turn out to be spaced at multiples of ~2.72 feet - the so called 'megalithic yard' - a human pace!)

6. In the research briefly explored the alignment of three such sites is statistically invalid. Four-point ley lines are also rejected as inadmissible on the grounds of probability. However, 'ley lines' of many objects spread over many kilometres in length can be found.

7. **Rationale** The only significance in including LEY LINES in this UAP study was to note that (should clusters of sightings or lines of sightings appear) in the analysis, ley lines may be a factor, since some of the locations which form ley lines involve rocky formations. Hence, there may be a tenuous connection with tribo-or chemi-luminescence, where certain archaeological formations are said to produce visual effects when they fracture. There may also turn out to be some sort of connection with the earth's geomagnetic field. The action of rocks fracturing to produce light has been proven in laboratory experiments. One particular Norweigian location where this has occurred consistently, with similar rock formations to parts of the UK.

UK RESTRICTED
SECRET
UNCLASSIFIED

UNCLASSIFIED
SECRET

8. Hessdalen is a small valley in the middle part of Norway, South East of Trondheim. In that valley strange unknown lights first showed up hundreds of times between 1981 and 1985. It was given the name "The Hessdalen Phenomenon"and the project was linked with the Norwegian Defence Research Establishment.

9. In June 1983 "Project Hessdalen" started, the main purpose of which was to collect as much scientific data as possible. During the autumn a research programme was established, and the work in the field started 21 January 1984 and ended 26 February 1984. A research station was set up in Hessdalen, with eight different kinds of instruments:

- **Camera with grating**
  Three pictures showed a continuous spectrum but no spectral-lines were seen.

- **IR-viewer**
  This instrument was used too little to draw any conclusions.

- **Spectrum-analyser**
  Sometimes there were electro-magnetic signals with harmonics of about 80MHz.

- **Seismograph**
  No local seismographic activity was detected. [This, of course is contrary to the expectation of the effect being initiated by normally detectable seismic activity].

- **Magnetograph**
  The magnetic field did sometimes change when the lights showed up. There also seemed to be a correlation with the magnetic pulsation.

- **Radar**
  The lights could be seen on the radar. The speed varied all the way from 0 to 30,000 km/hour. Sometimes the radar saw something moving at a low speed, but no lights were seen by eye. Clearly, something was there, but only the radar could detect it.

- **Laser**
  A laser-beam was directed toward the light and the behaviour of the light reportedly changed. Out of nine occasions the light changed on eight attempts, and reportedly reverted to the original state when the laser was switched off. There could, of course be several interpretations placed on this phenomena [the most bizarre of which is that known as a 'Close Encounter of the 5th kind' - see Volume 1 of this report]. A more realistic explanation may be that the laser light, being coherent, interacted with the light/energy supplied by the 'earthlight' to produce a different colour for the human observer - which would then clearly revert to its original colour unless some other more permanent or ongoing change was taking place anyway - for example a decay in the energy of the airborne mass.

- **Geiger-counter**

No radioactivity was detected. But the source was 1km away when this instrument was used. Sometimes the lights at Hessdalen lasted for more than two hours in one place before they moved. Literally hundreds of instances have

UNCLASSIFIED
SECRET

been reported, six to seven times a week and two to three times a day.

Despite all the blanks drawn during the investigation some 20 scientists researched the phenomenon during 1994 and their reports were either not completed or not available at the time this MoD study was made.

ELECTRO THERMO AND TRIBO-LUMINESCENCE FROM ROCK FORMATIONS/EARTH FAULTS

10. Statistical studies have shown [1] that geology and UAP events seem to be linked. Research [2] in 1977 confirmed that (French) events reported over 25 years correlated with locations of rock formations and a similar study in Leicestershire (1972-1977) gave almost the same statistical results. In 1981 t he US Bureau of Mines carried out experiments in which **granite** core was crushed under darkened test conditions in which recordings were made and a line was established between anomalous aerial lights and geological sites.

11. Although these luminous effects were earlier attributed to piezo-electric action several other scientific explanations have been proposed, including natural radioactivity, cosmic rays and light from thermo or tribo-luminescence. The latter would involve reactive electrons moving between conduction and valence bands in three-dimensional lattices and which contain defects. Some connection with tribo-luminescence is also reported - a simple example of which would be the electrical charging of materials by friction - which can be manifested as static discharge. Tribo-luminescence is the emission of visible radiation due to frictional forces - in effect 'cold light emission'.

12. Example fault lines where 'Earthlights' have been seen are shown at Figure .5. It is clear from other sources [3] that sightings are often directional rather (as might be expected) omni-directional, that the observer must normally be within a few hundred metres of the phenomena and that the lights appear within a few hundred metres of the local earth fault-line. Overseas, particularly in the USA, there is evidence of increased UAP sightings in areas of tectonic volatility - for example in the Cascade Mountain Range in Washington State. The description of these correlates with light seen in Leicestershire, first prior to the 1957 UK earthquake.

EARTHLIGHTS

13. The phenomenon of 'earthlights' is based on the fact that physical and electrical forces accumulate in areas of seismic activity, possibly over weeks or months, and the resultant stresses in rock formations finally result in rock fractures. At the moment of fracture (and proved by laboratory experiments) these produce electrically charged particles before bursting, which is manifested as light when the fracture occurs. Whereas an earthquake releases energy in a major form, pre- and post-earthquake stresses are the likeliest time for earthlights to be reported. It is claimed that this anomalous light phenomenon occurs:

(a) Along the earth's faultlines.

(b) At ± 2km from the faultline (although usually within 30m and exceptionally 20km from an epicentre).

(c) At land or sea (underwater faultlines, for example, Loch Ness, Loch Tay) overwater the lights have sometimes been described as green and globe shapes have been said to change to triangles.

(d) When exceptional meteorological conditions are present.

(e) When increased man-made pollution (air particles capable of holding a charge) are present.

(f) When there is a gaseous presence or chemiluminescent (i.e. rock to rock friction) also occurs.

The key characteristics are:

(a) Balls, streaks, sparkles or phosphorescent arcs, v-shaped formations or 'boomerangs'.

(b) Lights that change shape, fly, occur near the surface or at height and are often described as 'danced', 'chased' or 'merged'.

(c) Mostly reports are likely at night, even though the phenomena occur in daylight.

(d) An (apparently) ionised shape is formed.

(e) Sounds are sometimes heard.

(f) An emission of EM waves (or other unknown energy fields) are present.

(g) Shapes appear and disappear and normally take the form of:

- Triangles 'with rounded corners'
- Discoids
- Spheres (Globes, Boloids and Orbs) (see also (c) above)
- Tadpoles (square front with tail).

These can all flash,'flutter', 'flicker' or 'flip' in motion. Occasionally they are described as 'basketball' size, but diameters of 8 to 100m have been reported.

(h) More than one light can move together, leading to the supposition:

- That they are on each extremity of a solid object.
- That they have some sort of field present which regulates their spacing.

(i) Lights can merge or split, giving, according to some reports, the impression that they are 'intelligent' (see also para 15 below).

(j) Between lights in a cluster there is the appearance of blackness in outline. Three lights, for example, give the appearance of a solid triangle and four a rectangle. The outline of the shape can be clearly seen as 'blacker' than the background (i.e. absolute absence of light).

(k) Lights may move towards a witness when approached.

UNCLASSIFIED
TOP SECRET
UK RESTRICTED

(l) Lights seem to be attracted (frequency of occurrence is apparently higher) near to:

- Mountain peaks, quarries, rock ridges, caves and mines. (20 years of sightings in the 1920's era in Chipping Norton area of Oxfordshire and in Ironstone quarries of Banbury e.g. 1923).
- Power lines, transmitter towers.
- Water.
- Areas of mineral deposits.

(m) In daylight they appear as 'metallised' discs, hazy glows or haloes or 'cloudy cigar shapes', but colours have been reported, mainly as amber-yellow and white; with rapid colour changes. When red is reported the core is often described as red. A well reported example appeared on the Fakenham-Norwich road in 1908, lasted 20 minutes, had a red core and was 50-60ft high.

(n) Low-level seismic activity is apparently necessary.

(o) The phenomenon appears to be 'weightless'.

(p) Some can be seen on radar - others not. (see Working Paper 5 & Volume 3)

SUMMARY

14. Some comments can be made about the long list of earthlight attributes above.

(a) Electroluminescence is understood to be the release of luminous energy from rock when electrons move from higher to lower energy levels due to friction.

(b) Fault lines and 'ley lines' often coincide, as do the ancient buildings (stone circles, religious sites (often Christian churches, built over former Satanic worship sites, etc.).

EARTHLIGHT REACTION

15. It is noted (at para 8-Hessdalen) that the earthlights reacted when remotely irradiated with a laser. (No further information is available, as the Hessdalen report is still in the process of being published. It is of interest, however, that a Ship's Captain (in the Baltic Sea) claimed (in 1951) that earthlights were triggered 'on' by his ship's radar. The lights "took the form of phosphorescent arcs which gyrated clockwise and anti-clockwise". Working paper No. 24 on 'SPRITES' considers this phenomenon further.

HISTORICAL

16. It is of interest that the phenomena of earthlights has been observed for, perhaps, thousands of years. In medieval and Victorian times these were variously described as 'Spook Lights', 'Luminous Vapours', 'Fairy Lights' (Ireland), 'Fireball Spirits', 'Kitty Candlestick', 'Ignius Fatuus', 'Jack-o-Lantern', 'Boggarts', 'Dragons', 'Will-o-the-Wisp', 'Corpse Candles' and 'Orbs' (Windsor Castle early 1990s). It seems likely that what is seen becomes matched to the understanding of the day. What was once a simple type of

UK RESTRICTED
SECRET
UNCLASSIFIED

misunderstood apparition, becomes a space-craft or similar 20th Century-related technology entity. They were frequently connected with swampy or marshy conditions on the one hand and described as having a yellow core, violet edge and sometimes red. More recently some have been attributed as being methane-based (CH_4) with a trigger of $P_2 H_2$ (hydrogen phosphide).

17. As a sample of the pedigree of what is reported today, much further back (AD 584) brilliant rays of light which seemed to collide were reported and (in AD 585) 'rays' or 'domes' were observed in France. On 3 August, AD 989, three brilliant round objects were seen to join together. A fire breathing dragon came out of the sea. In Japan a 'spinning ball of fire like a red wheel hovered' - with many witnesses. While from the terrace of Windsor Castle on 18 August 1783 four eminent scientists (including Fellows of the Royal Society) observed and reported (Philosophical Trans. Royal Soc. 1784) an object which hovered, moved, changed luminosity and changed shape, brightened and finally, exploded. [This, in fact was probably ball lightning rather than an earthlight]. Other historical earthlight areas (which will be relevant when a database analysis is done for the present day) are:

- Llambedt, Barmouth and Harlech (see Ley Line/Fault Line map) and Llangolan. (40 mile wide strip).
- Haverfordwest, St. Brides Bay, Milford Haven, 'Stack Rocks'.
- Colwyn Bay to Shotton (24km wide extension inland).
- Denbigh (e.g. 1979 and 1984).

18. During the Second World War what were (now understood) clearly earthlights were reported by Commander-in-Chief Devonport. In 1915 Naval Intelligence investigated phenomena (feared to be of German origin) both in the Warminster and Dartmoor areas and further displays are recorded in 1981 at the Standing Stones of Drizzlecombe. Similar phenomena are reported in the USA. These are often reported for several days, weeks, or months in a particular area - after which they are not seen again, perhaps for years.

19. It appears that there may be more than one type earthlight since medieval miners were well aware that their interest in the phenomena was the proximity of earthlights to copper and iron ore.

GEOLOGICAL

20. As an aid to the statistical analysis of locations of UAP reports, Figure 8 shows the geological structure of the UK. This may be required if it becomes necessary to:

- Isolate what are believed to be earthlights to specific geographic and geological locations and types of rock formation.
- Further correlate (and thus eliminate those UAPs) with rock types known to produce earthlights when under seismic stress, (as it is suggested that low magnitude seismic disturbance may be sufficient to provide the conditions for light phenomena).

21. **Fault Systems** There are several Earth Fault-Systems which cross the United Kingdom. The location of these is shown for the whole country (known as the DENT Fault System) at Figure 9.

SECRET
UNCLASSIFIED

BIBLIOGRAPHY

[1] "Flying Saucers & the Straight Line Mystery Criterion" Michel Aime 1958.

[2] Ley Lines in Question" Williamson & Bellamy ISBN 0437-19205-9.

[3] The View over Atlantis" J. Mitchell SAGO Press 1969.

UNCLASSIFIED
SECRET

TOP SECRET UNCLASSIFIED

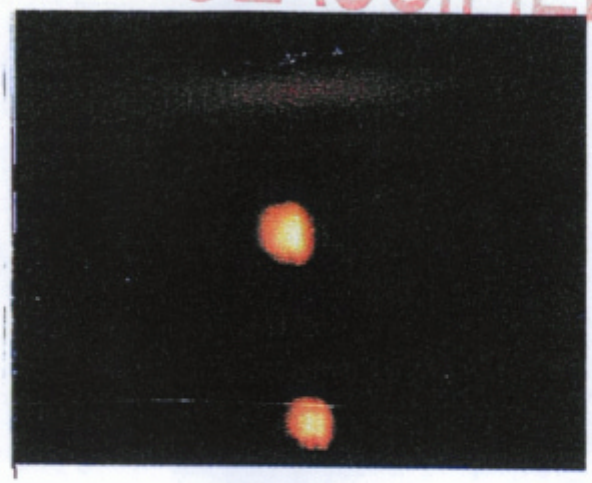


FIGURE 1: UK EARTHLIGHTS (OR POSSIBLY BALL LIGHTNING)

NOTE: Location Carleton Moor, Skipton, Yorks, police photograph (copyright Sgt. Anthony Dodd)

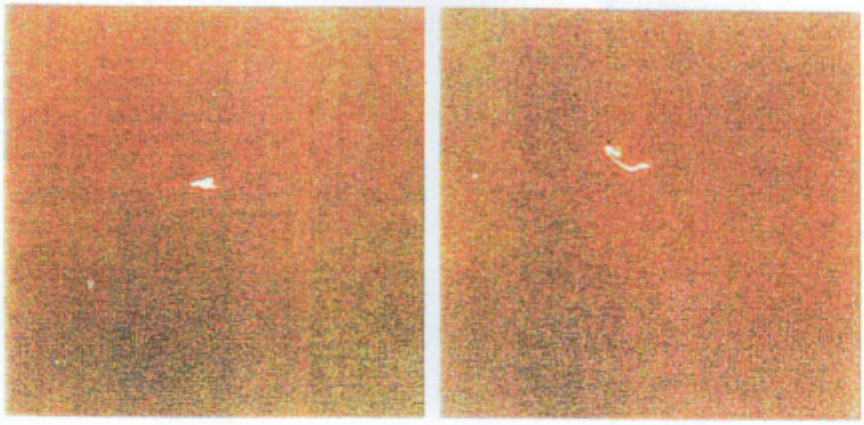


FIGURE 2: PROBABLE UK EARTHLIGHT (OR PLASMA/AEROSOL OR CHARGED PARTICLE VORTICE)

NOTE: location Rossendale, Lancs. (copyright David Milner)

UNCLASSIFIED TOP SECRET

UNCLASSIFIED
SECRET

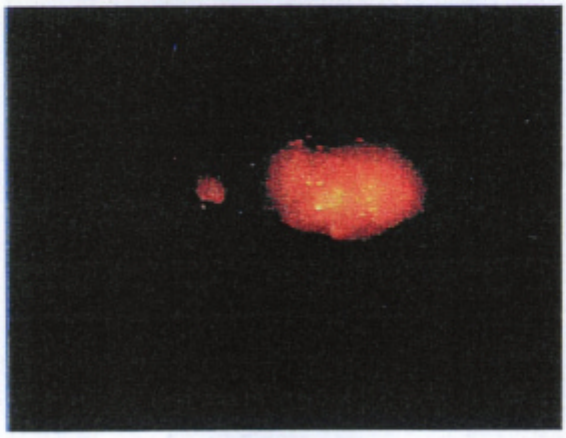


FIGURE 3: TRIBOLUMINESCENCE

NOTE: Laboratory-produce as a result of rock crystal fracture (copyright P. Devereux)

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET

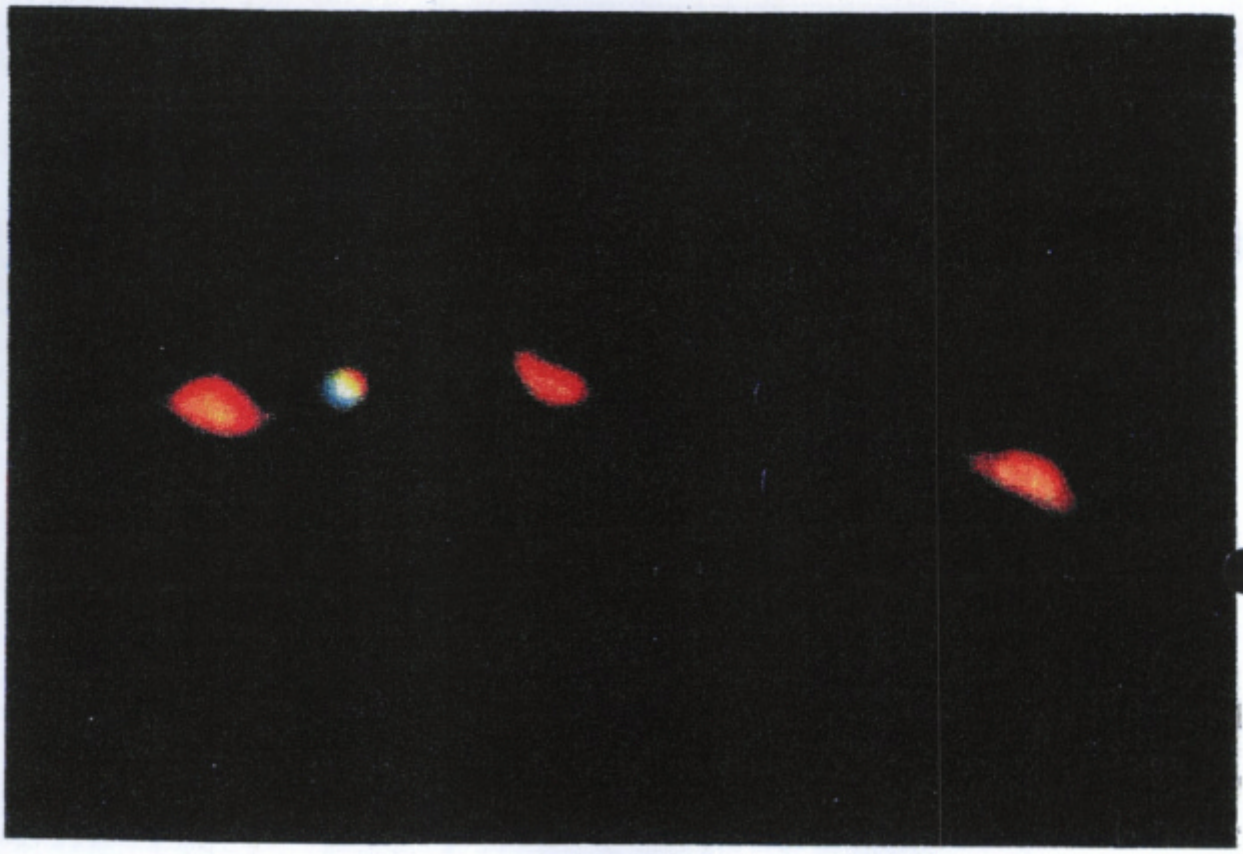


FIGURE 4: EARTHLIGHTS

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

FIGURE 5: UK EARTHLIGHTS LOCATIONS (P. DEVEREUX)

NOTE: Frequent earthlight reporting areas shown as stars. Larger stars indicates greater frequency of sightings.

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET

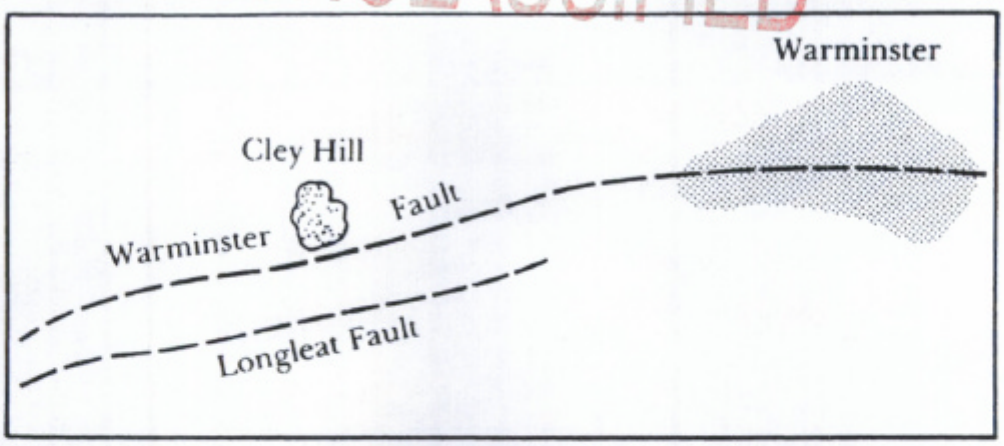


FIGURE 6(a): CLEY HILL FAULT-LINE (NEAR WARMINSTER) (P. DEVEREUX)

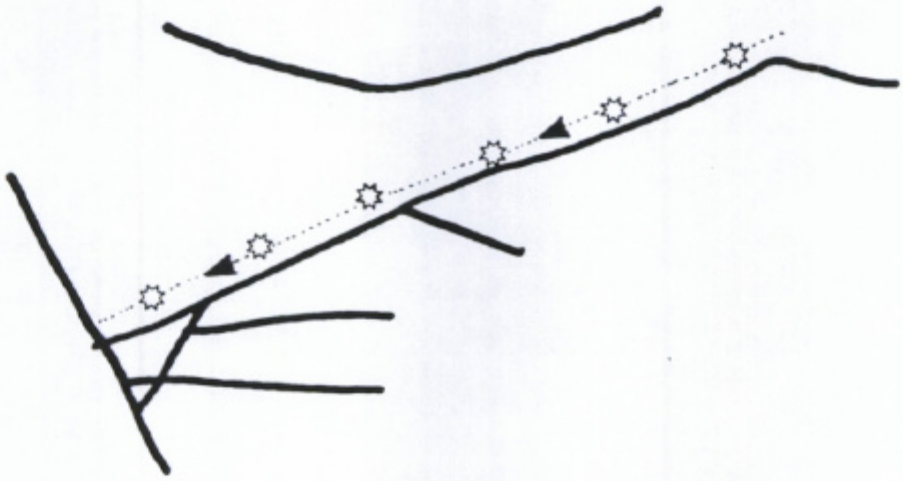


FIGURE 6(b): EARTHLIGHT 'BALL'/BALL LIGHTING COURSE (P. DEVEREUX)

NOTE: 1984 Wrose to Thackley (near Shipley). faultines solid, phenomena track dotted.

UNCLASSIFIED
SECRET

SECRET
UNCLASSIFIED

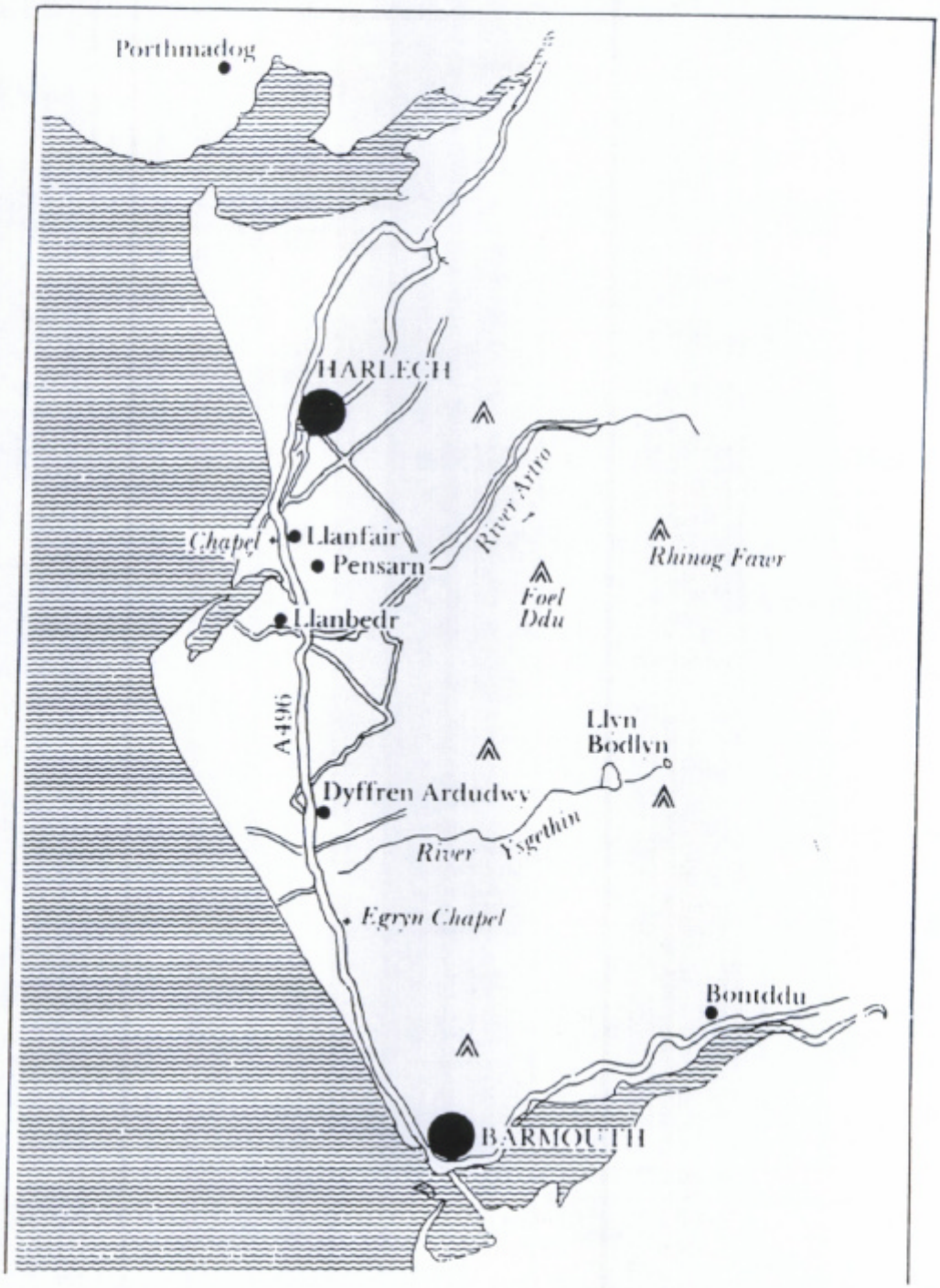


FIGURE 6(c): FAULTLINE BARMOUTH-HARLECH, WALES

NOTE: Particular earthlight activity 1904-5 and since.

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

FIGURE 7: 'PROJECT PENNINE' EARTHLIGHT LOCATIONS

NOTE: A simplified sketch map of the area of the Pennines found by Project Pennine to harbour zones of repeated earthlight activity.

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

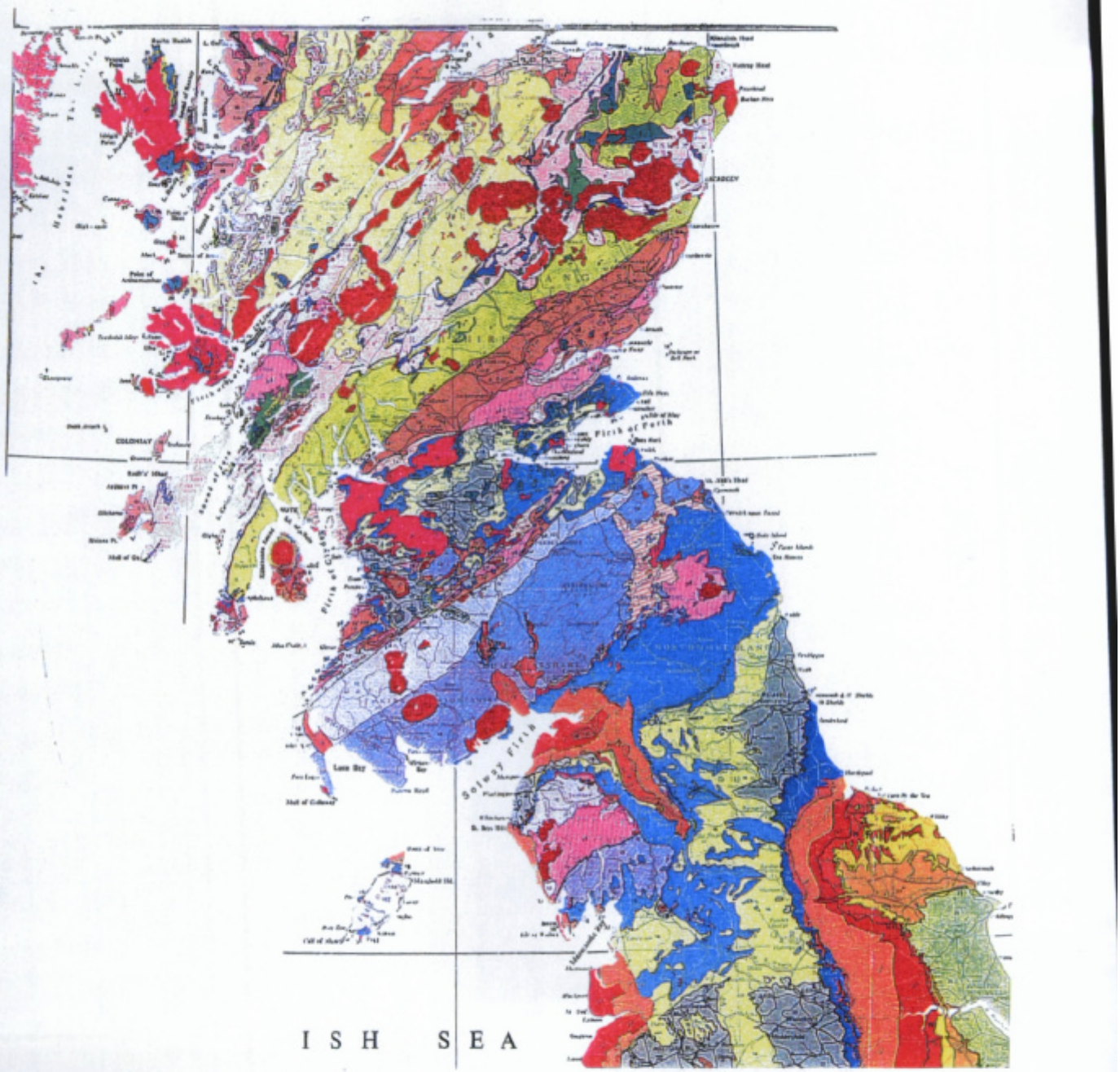
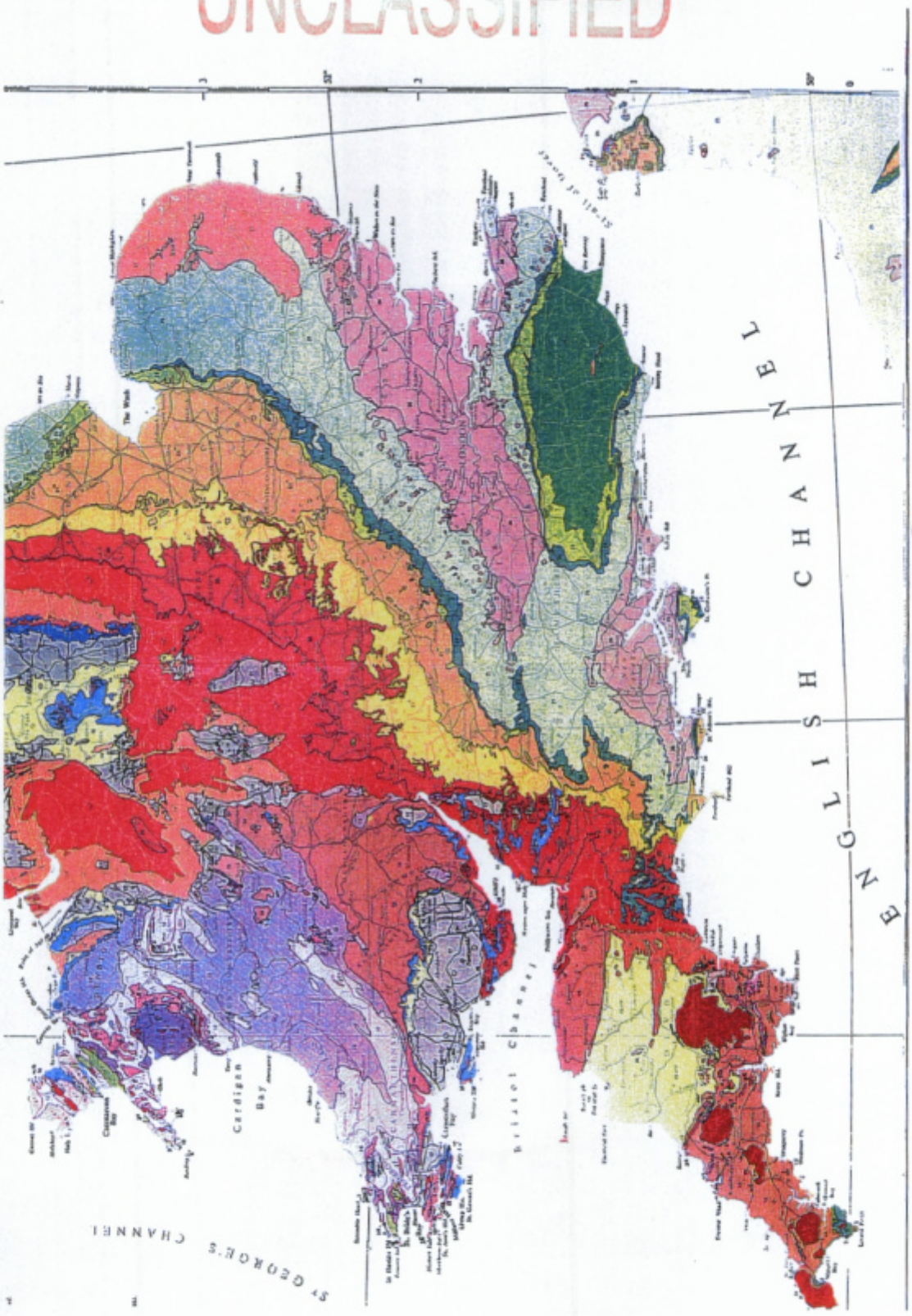


FIGURE 8: Geological Structure of UK

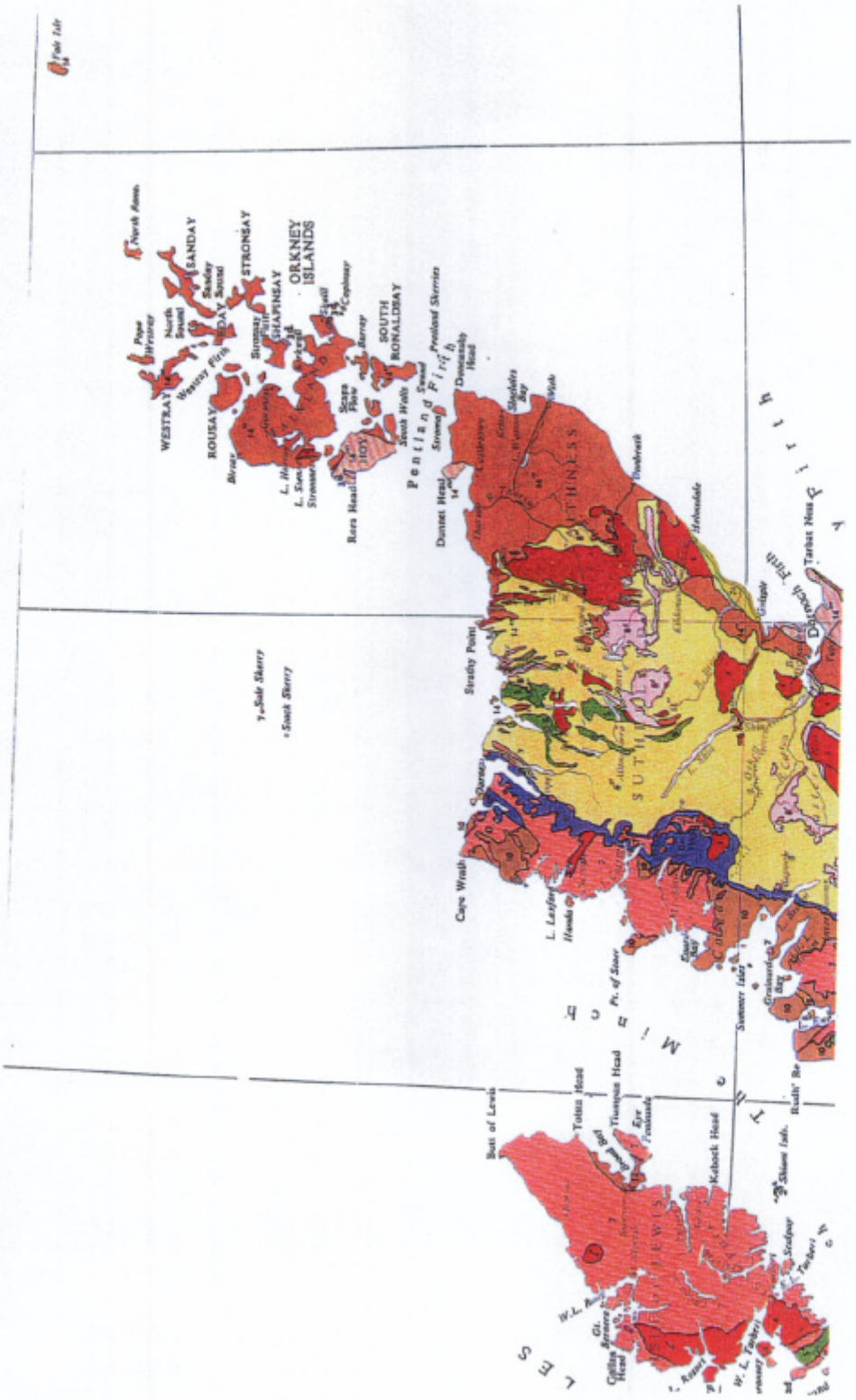
UK RESTRICTED
SECRET
UNCLASSIFIED

UNCLASSIFIED



UNCLASSIFIED

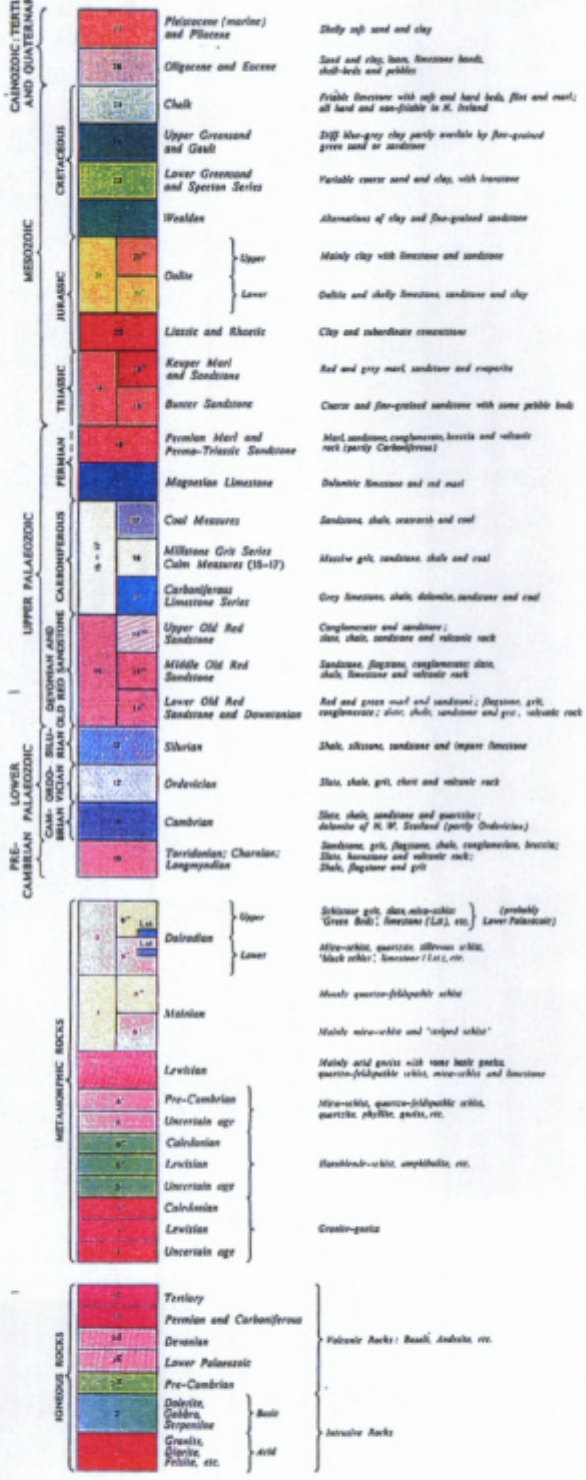
UNCLASSIFIED
SECRET
UK RESTRICTED



UNCLASSIFIED
SECRET
UK RESTRICTED

UNCLASSIFIED
SECRET
UK RESTRICTED

INDEX



Boulder clay and other superficial deposits are omitted. *Some major faults are shown.*

UNCLASSIFIED
SECRET
UK RESTRICTED

UNCLASSIFIED

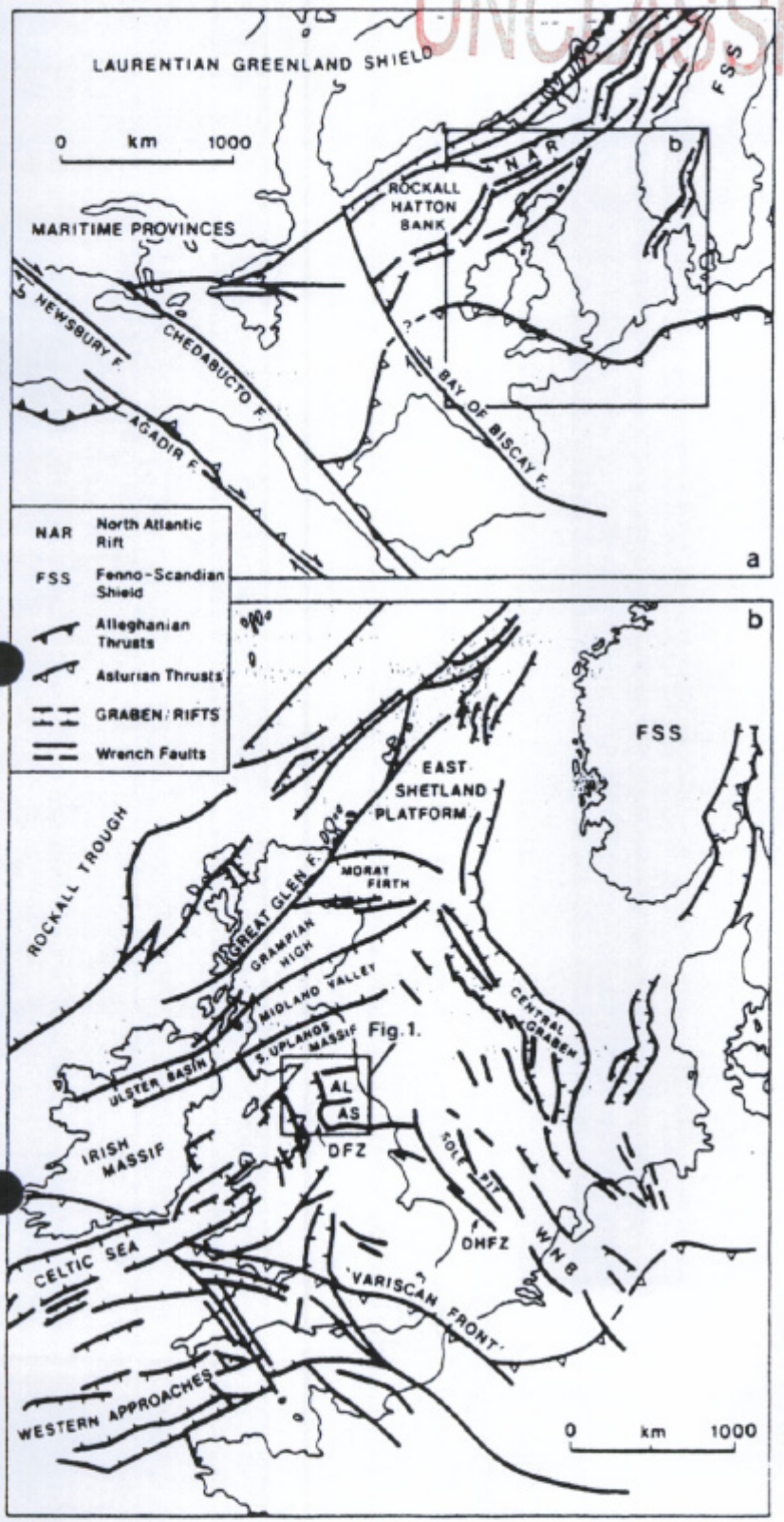


FIGURE 9

KEY

AL- ALSTON BLOCK

AS -ASTRIGG BLOCK

DFZ- DENT FAULT ZONE

DHFZ - DOWSING HEWITT FAULT ZONE

WNB -WEST NETHERLANDS BASIN

FRACTURES

ILIGHTS

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 11

COLLECTED IMAGERY AND CLASSIFICATION OF UAP SHAPES

 xxxxxxxxxx S.40

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED SECRET

COLLECTED IMAGERY AND CLASSIFICATION OF UAP SHAPES

CONTENTS

1. The material in this section has been collected from a number of sources - news reports, photography and video records. The sources are not limited to UK reports, as the intention is to use the material as a reference/correlation catalogue and to hopefully use the material as a filter to separate the explainable from the inexplicable, if possible. In some cases - particularly since the advent of personal video cameras - the original material is in colour. Shape and lights (colours) are invariably the trigger which attracts the eye and results in incident reports. Shapes have been generically categorised as follows:

- SPHERES	(Includes 'BOLS' and multiple spherical lights)	Figures 1 - 7
- DISCS	(Only circular in plan - and thus, on frequent occasions from different aspects, the same events are described by other witnesses as 'balls' or spheres)	Figures 8 to 28.
- CIGAR	These have a larger mid-chord than discs and tend towards 'long airship' shapes, with much less 'sharp' ends than discs	Figure 29
- STAR/POINT	Seen as balls of light, with the star effect due to atmospheric optics	-
- OVAL	Described as a variant of 'discs', but with a wider mid-chord and without the elongation of 'cigars'	
- TRIANGLE/PYRAMID/CONE/ RECTANGLE/CYLINDER	The outline shape is formed, not by a solid object, although at times it appears so - see Working Papers) but by three or more coloured lights at the extremities, forming the 'corners'. A cylinder is often described which is, in fact, formed by a row of lights (balls). A vertically oriented cylinder is sometimes seen - see Working Papers No 23 and 24	Figures30 to 35

UNCLASSIFIED SECRET

UNCLASSIFIED
SECRET

- RECTANGLE/DIAMOND	As for Figures 30 - 35, but where the viewing angle changes the spacing to form diamond/rhomboid patterns	As for Figures 30-35
- BOOMERANG/ARC		Figure 36

As can be seen (Vol. 1 Tables 1 and 2) certain combinations of shapes and lights can be attributed to definite causes. Shapes and lights are the **initial** key to filtering the known from the inexplicable. Little is gained in analysis of purely descriptive unknown shapes and lights reports unless further information, such as imagery, correlation from multiple witnesses, or data from which to obtain angles, sizes, sounds, smells, or velocities is available.

For the purposes of the database it was necessary to identify the whole range of shapes frequently reported. It is of course inevitable that these are due to a whole range of different underlying phenomena, described in the other working papers in this Volume.

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET

SPHERES

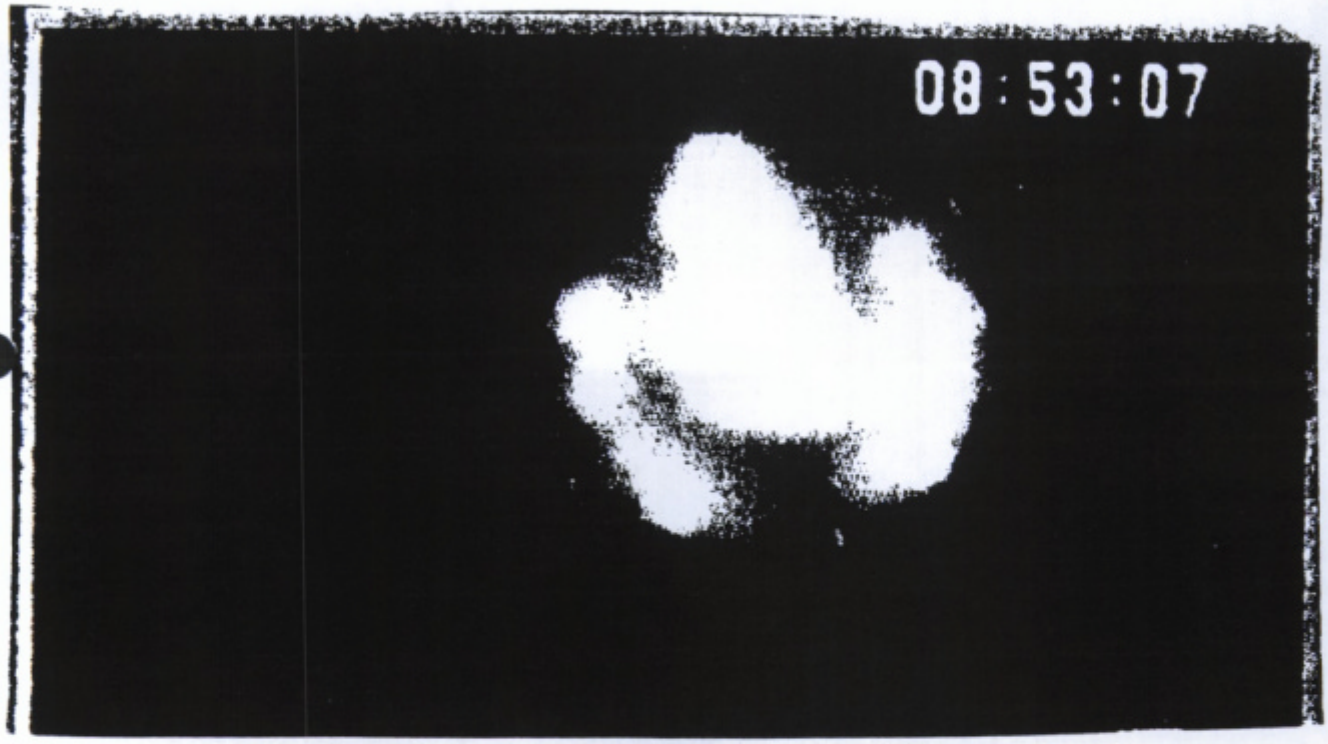


FIGURE 1: SPHERES

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET

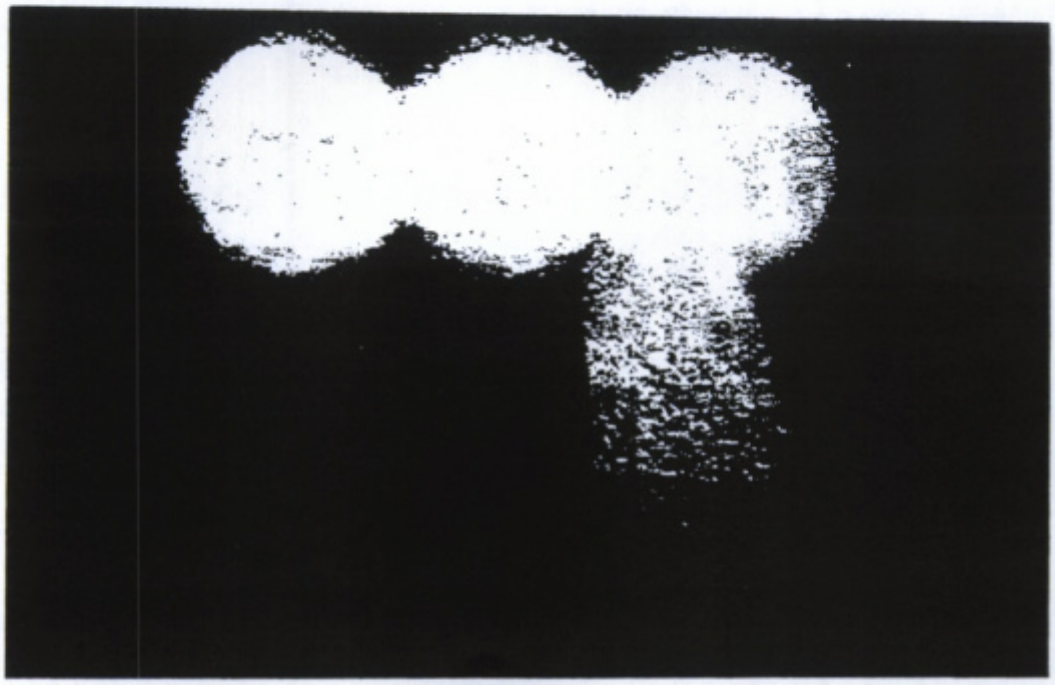


FIGURE 2: KENT UK, SEPTEMBER 17-20 1993

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET

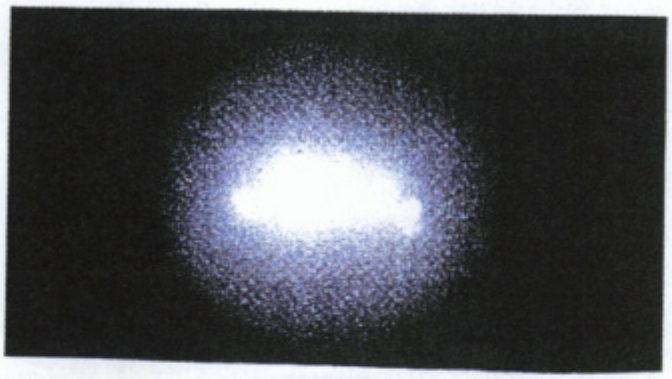


FIGURE 3: MEXICO POLICE PHOTOGRAPH [1] (JULY 1991)

Note [1] Four police officers at range ~50 yards. Some lens distortion.

SECRET
UNCLASSIFIED

SECRET
UNCLASSIFIED

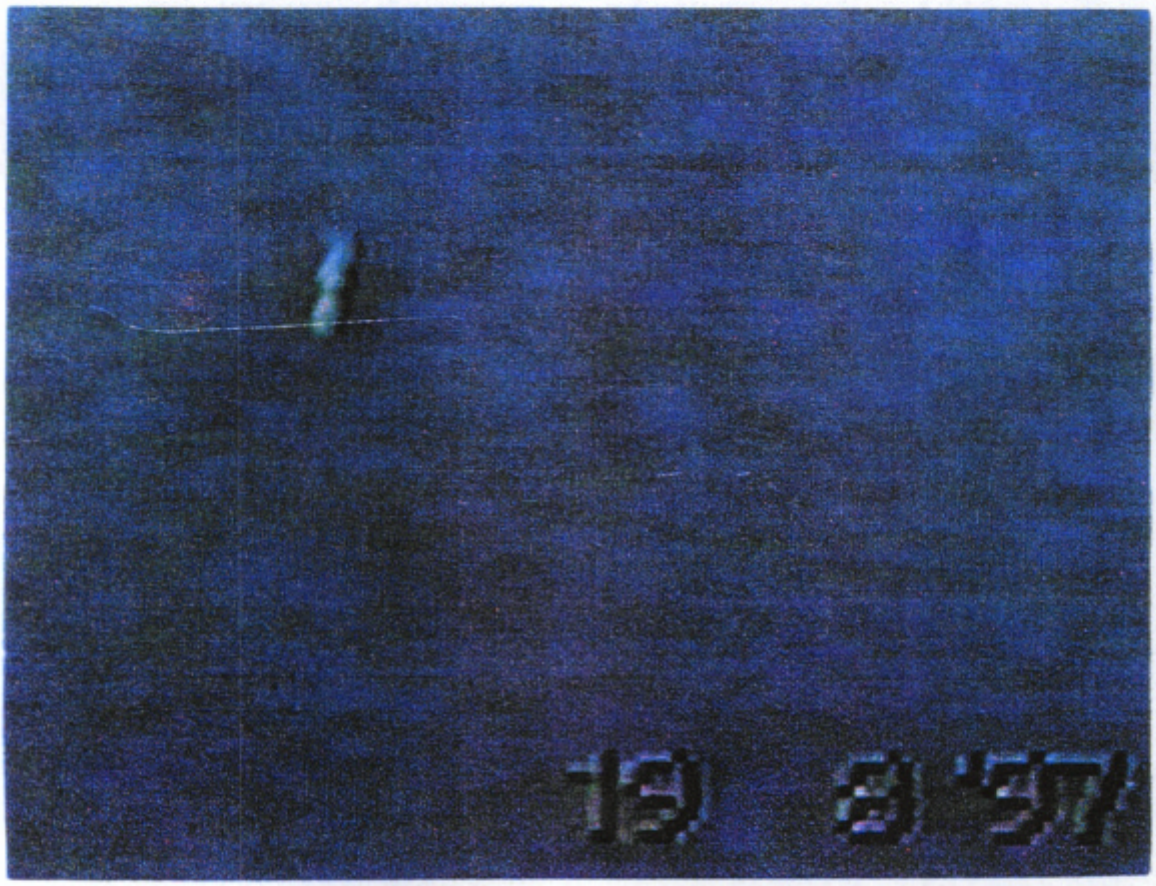


FIGURE 4: LOWESTOFT 1997

UNCLASSIFIED
SECRET

SECRET
UNCLASSIFIED

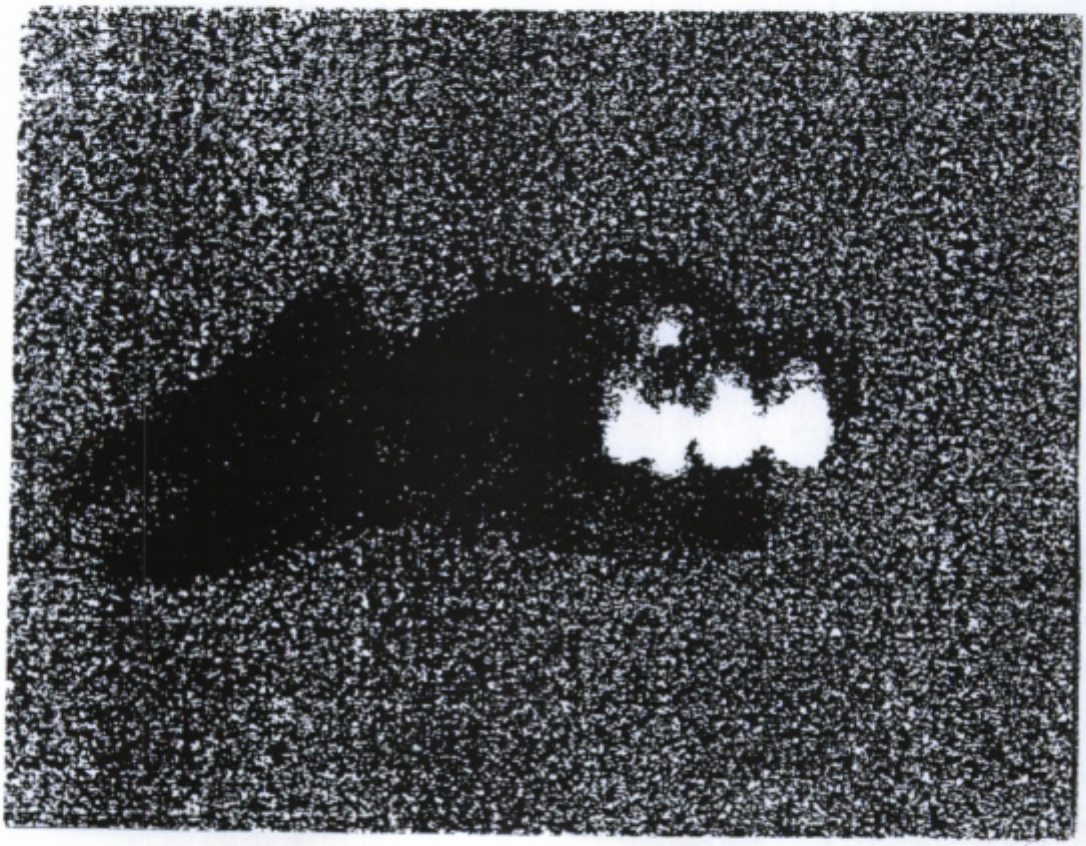


FIGURE 5: GULF OF MEXICO (DARK SHAPE IS THE ACCOMPANYING F15 AIRCRAFT)

UNCLASSIFIED
SECRET

UNCLASSIFIED

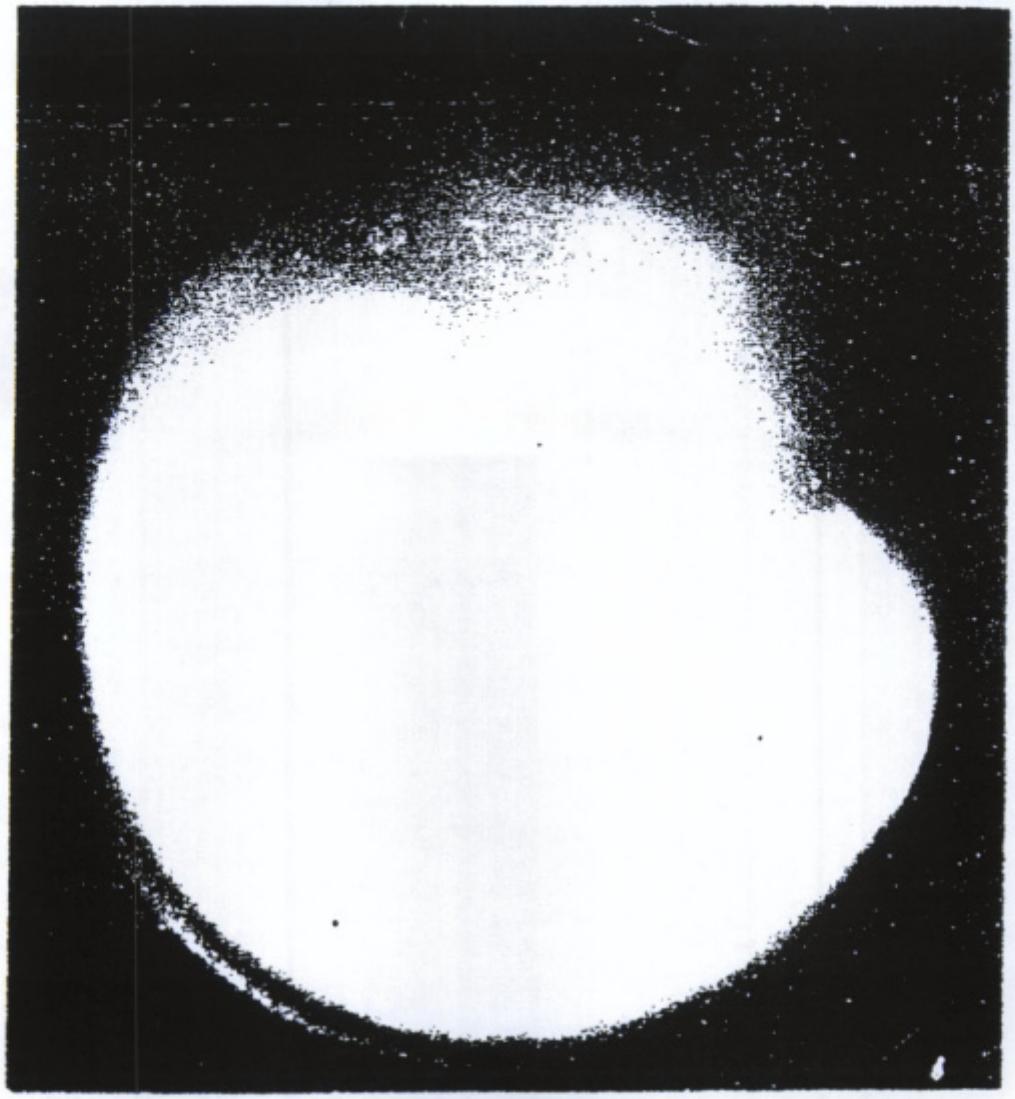


FIGURE 6: FRANCE 1974

UNCLASSIFIED

UNCLASSIFIED
SECRET

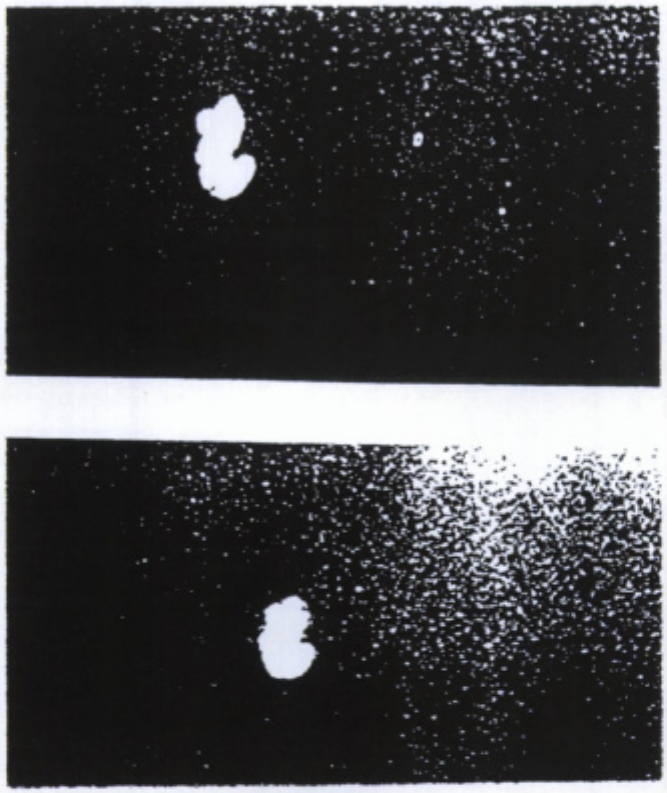


FIGURE 7: AIR-TO-AIR UAP

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET

DISCS

FIGURE 8: LAKE CONISTON ENGLAND 1954

FIGURE 9: JAPAN 1958

UNCLASSIFIED
SECRET

UNCLASSIFIED

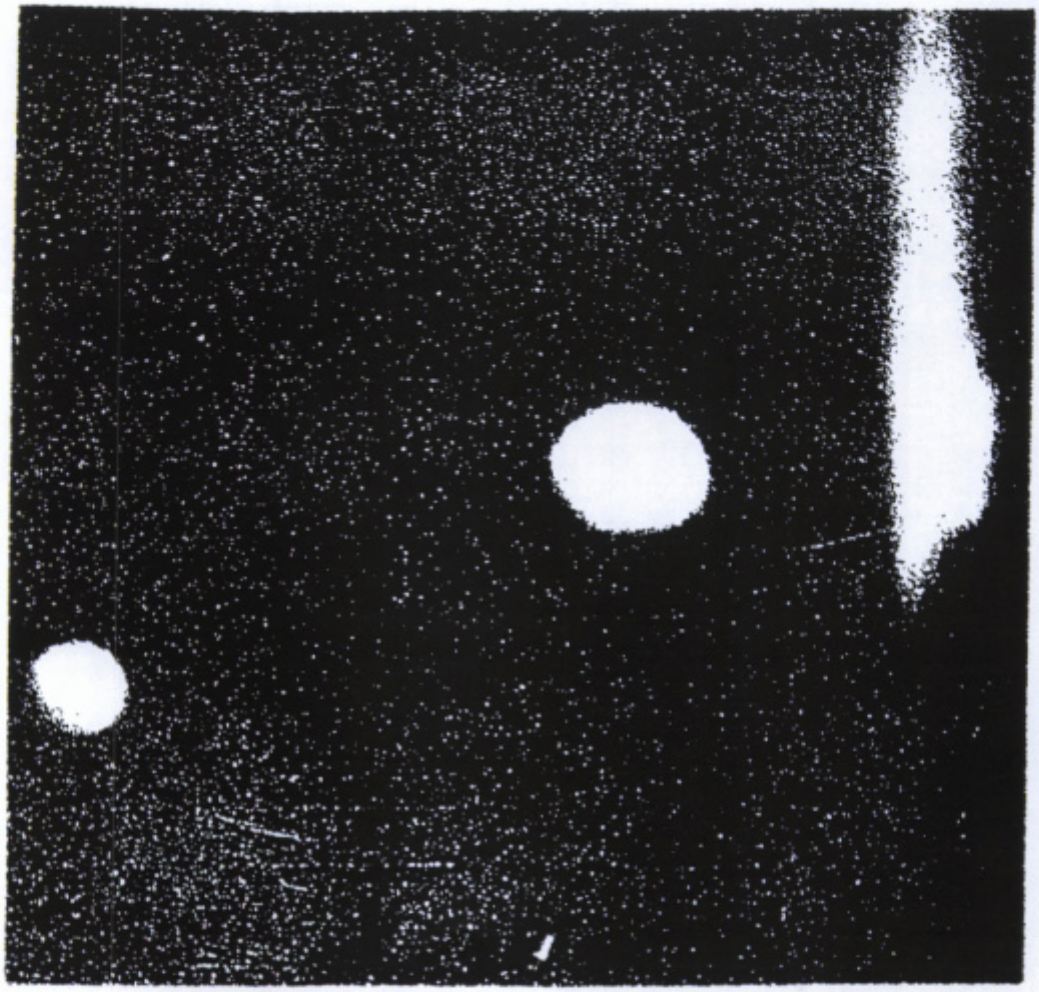


FIGURE 9: AUSTRALIA 1972

UNCLASSIFIED

UNCLASSIFIED

FIGURE 10: AUSTRIA 1971

FIGURE 11: OREGON USA 1950

UNCLASSIFIED

UNCLASSIFIED
UK RESTRICTED

FIGURE 12: 1958 SOUTH ATLANTIC (BRAZILIAN NAVY)

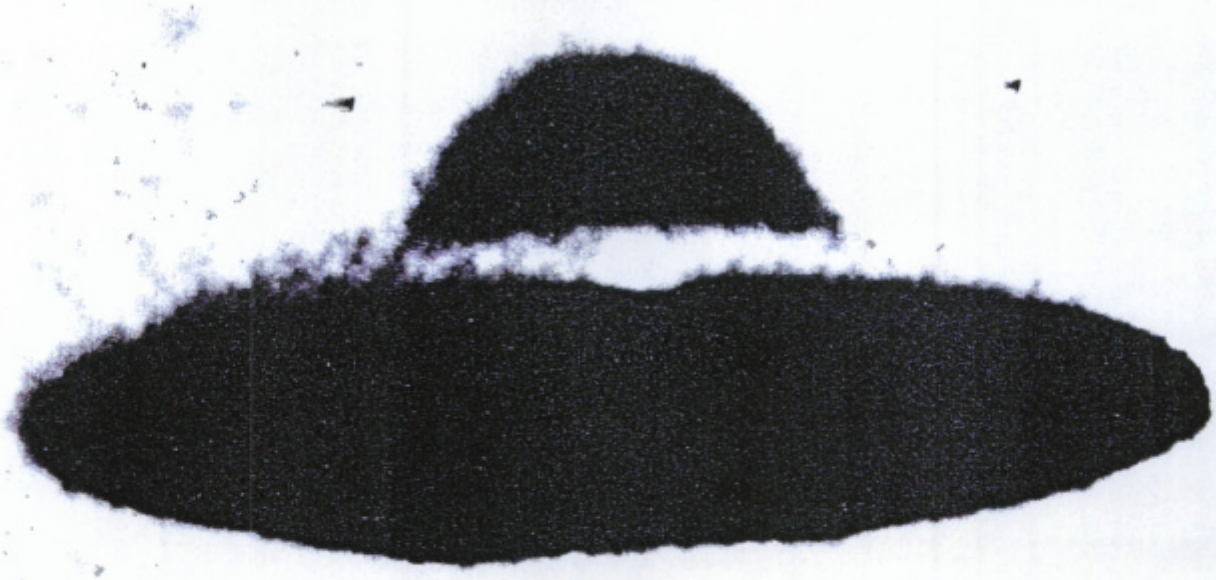


FIGURE 13: USA 1952

UNCLASSIFIED
UK RESTRICTED

UNCLASSIFIED
SECRET

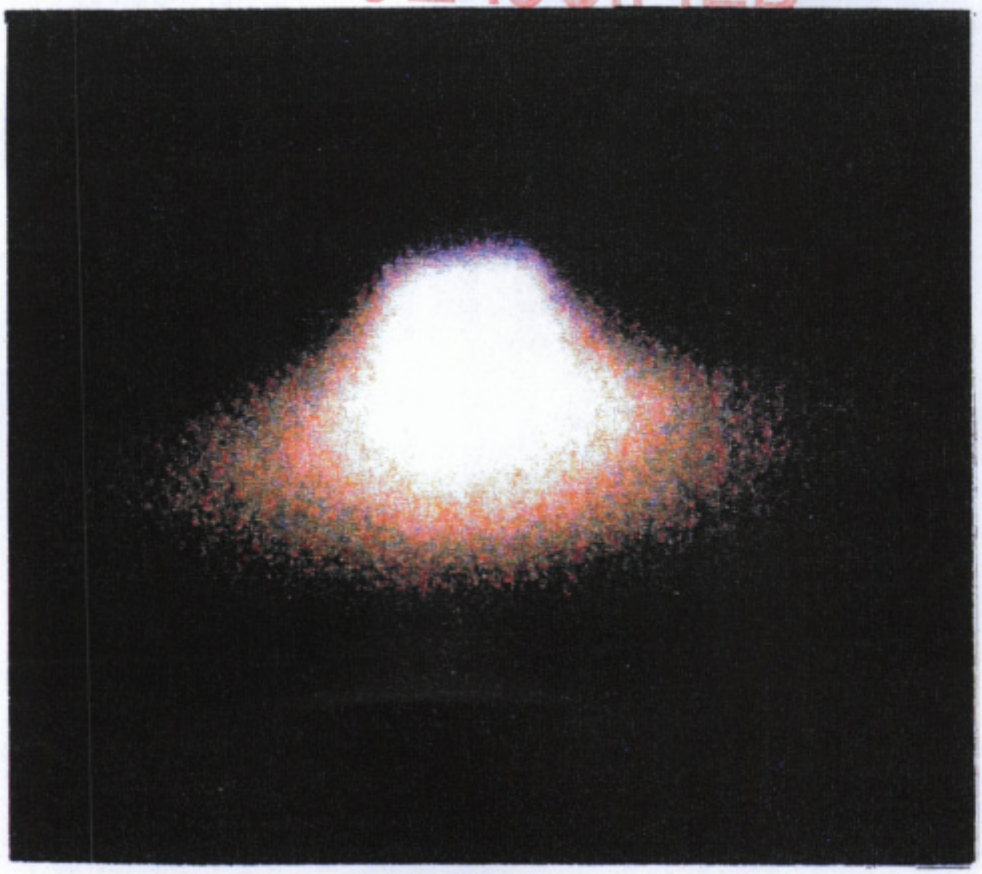


FIGURE 14:

FIGURE 15:

UNCLASSIFIED
SECRET

SECRET UNCLASSIFIED

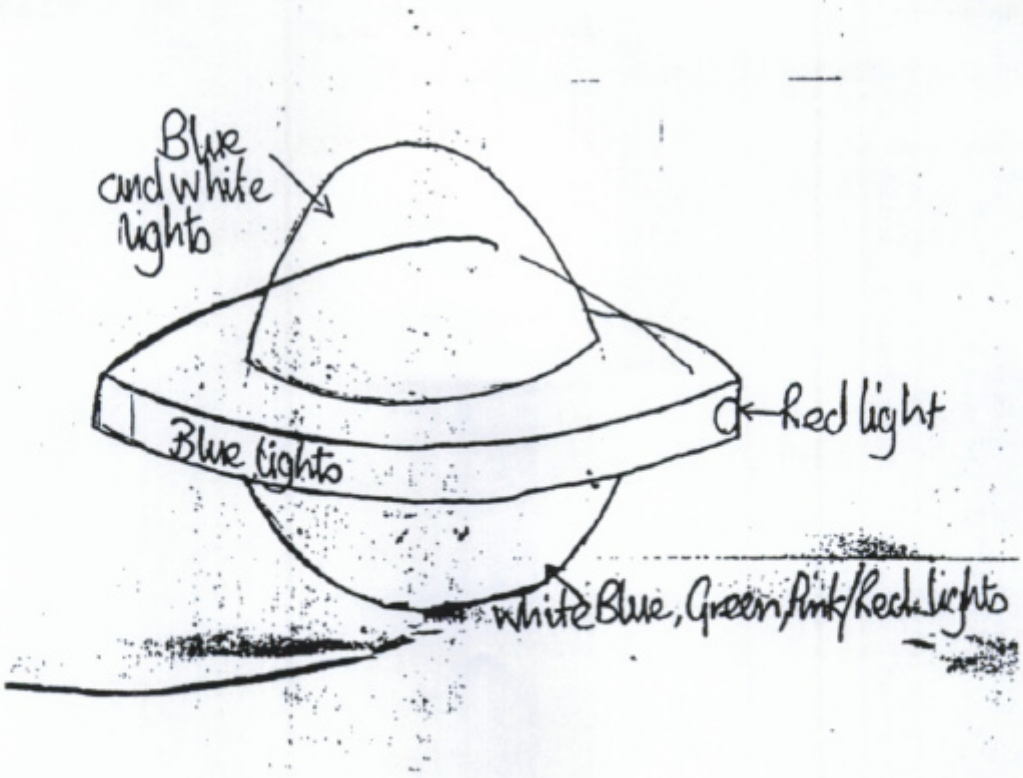


FIGURE 16: POLICE SKETCH 26 APRIL 1984 UK

UNCLASSIFIED SECRET

UNCLASSIFIED
SECRET

FIGURE 17: SILVER DISC (20-30 FEET DIAMETER) 1993

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

FIGURE 18: PERU

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
UK RESTRICTED

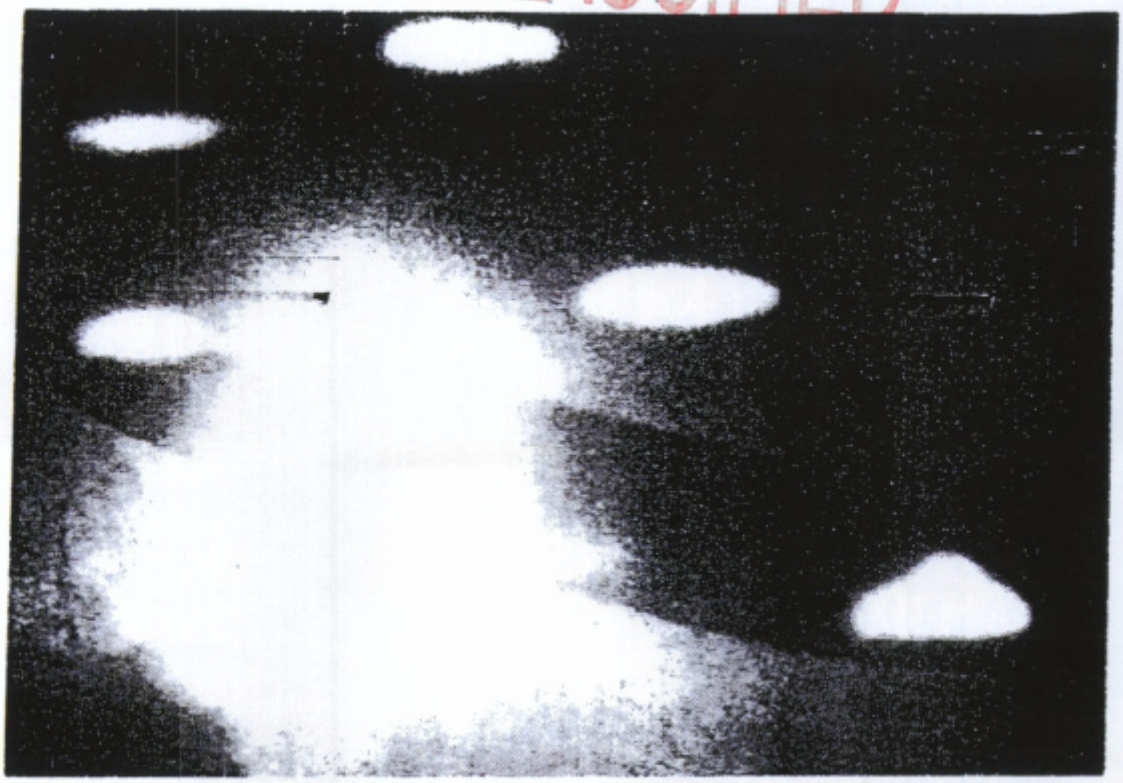


FIGURE 19(a): OPEN SKIES - CLOSED MINDS [N. POPE]

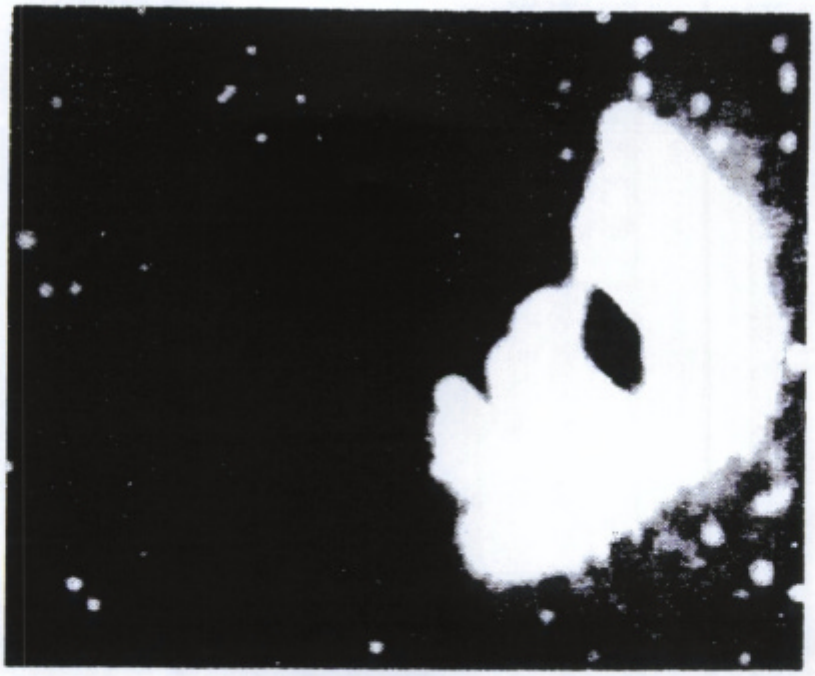


FIGURE 19(b): OPEN SKIES - CLOSED MINDS [N. POPE]

UK RESTRICTED
UNCLASSIFIED

UNCLASSIFIED
SECRET

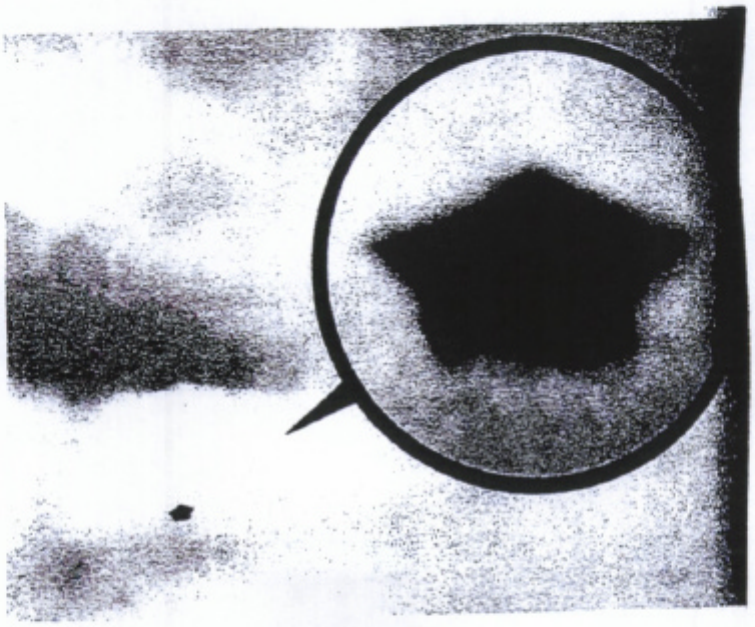


FIGURE 20: JAPAN (TOKYO) SEPTEMBER 1986[1]

Note [1] Sixteen witness event for 25 minutes 180 miles North of Tokyo. Appeared to rotate.

UNCLASSIFIED
SECRET

SECRET
UNCLASSIFIED

FIGURE 21: ARGENTINA - LAKE BARILOCHE (~1978)

UNCLASSIFIED
SECRET

UNCLASSIFIED SECRET

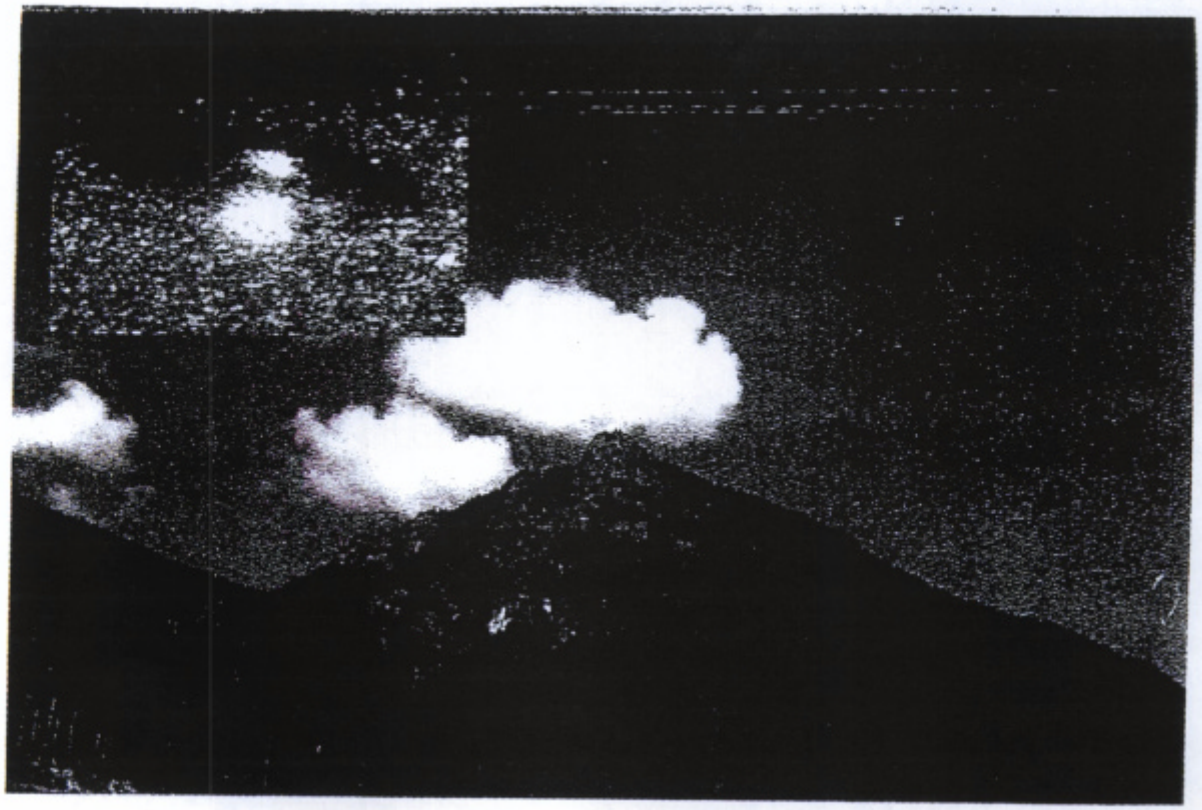


FIGURE 22: CANADA - VANCOUVER ISLAND 1981

UNCLASSIFIED SECRET

UNCLASSIFIED
TOP SECRET

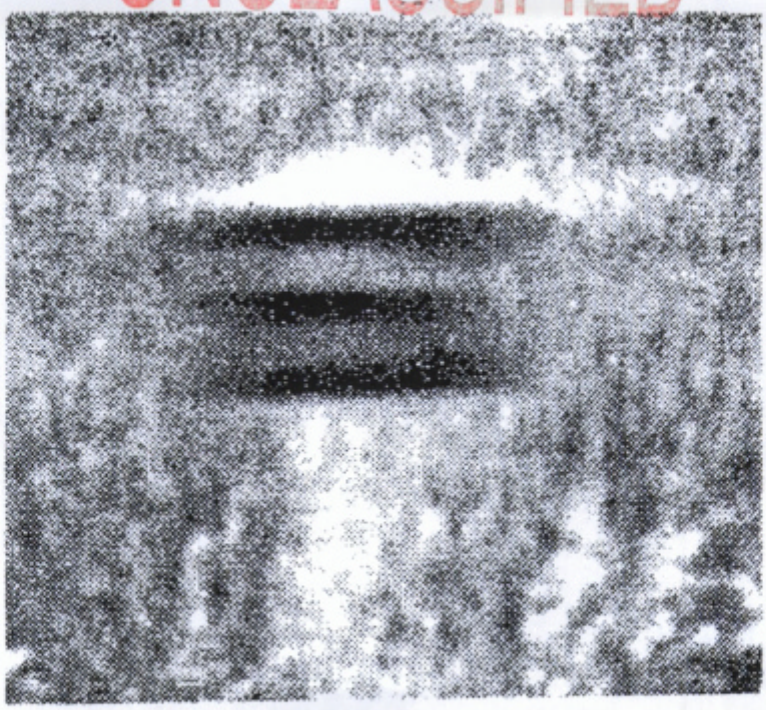


FIGURE 23: OREGON 1966

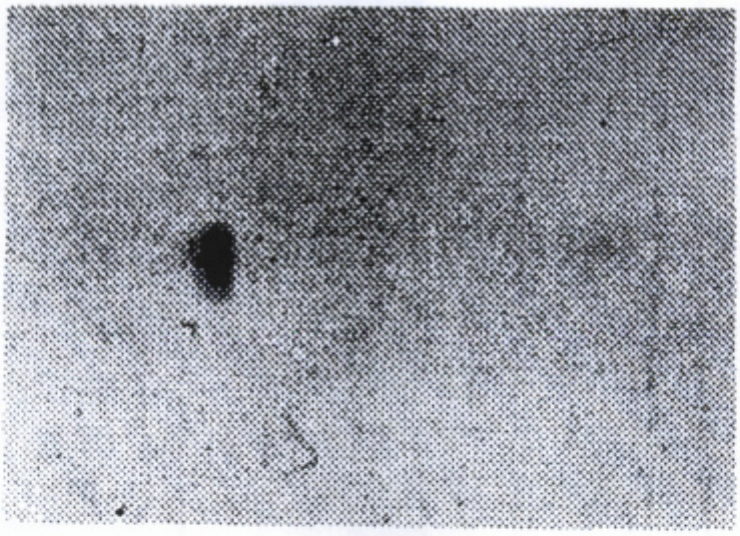


FIGURE 24: MALAYSIA 1966

UNCLASSIFIED
TOP SECRET

SECRET
UNCLASSIFIED

FIGURE 25: SPANISH AIR FORCE 1976

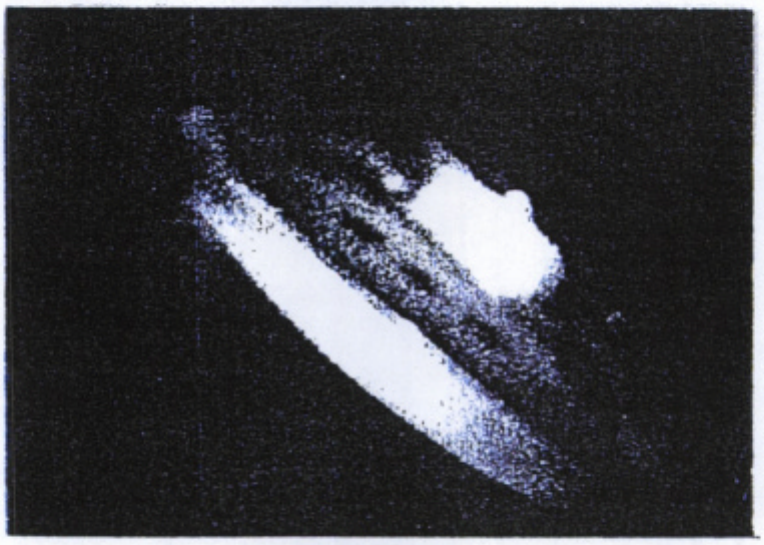


FIGURE 26: DENMARK 1974

UNCLASSIFIED
SECRET

SECRET
UNCLASSIFIED

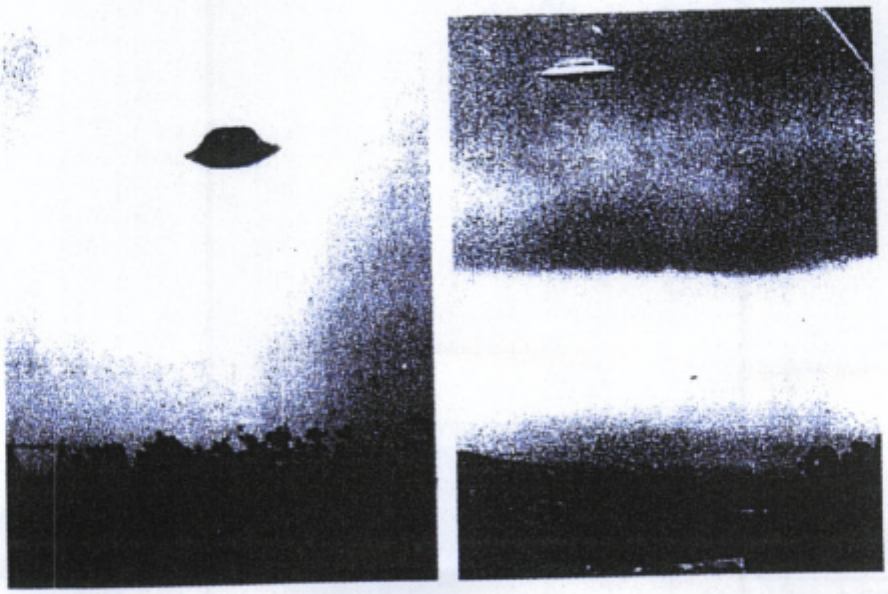


FIGURE 27: MEXICO (RESPECTIVELY MARCH AND JUNE 1992)

UNCLASSIFIED

SECRET

SECRET
UNCLASSIFIED

FIGURE 28: ROCHDALE LANCS., 1975

UNCLASSIFIED
SECRET

TOP SECRET
UNCLASSIFIED

'CIGAR' TYPES

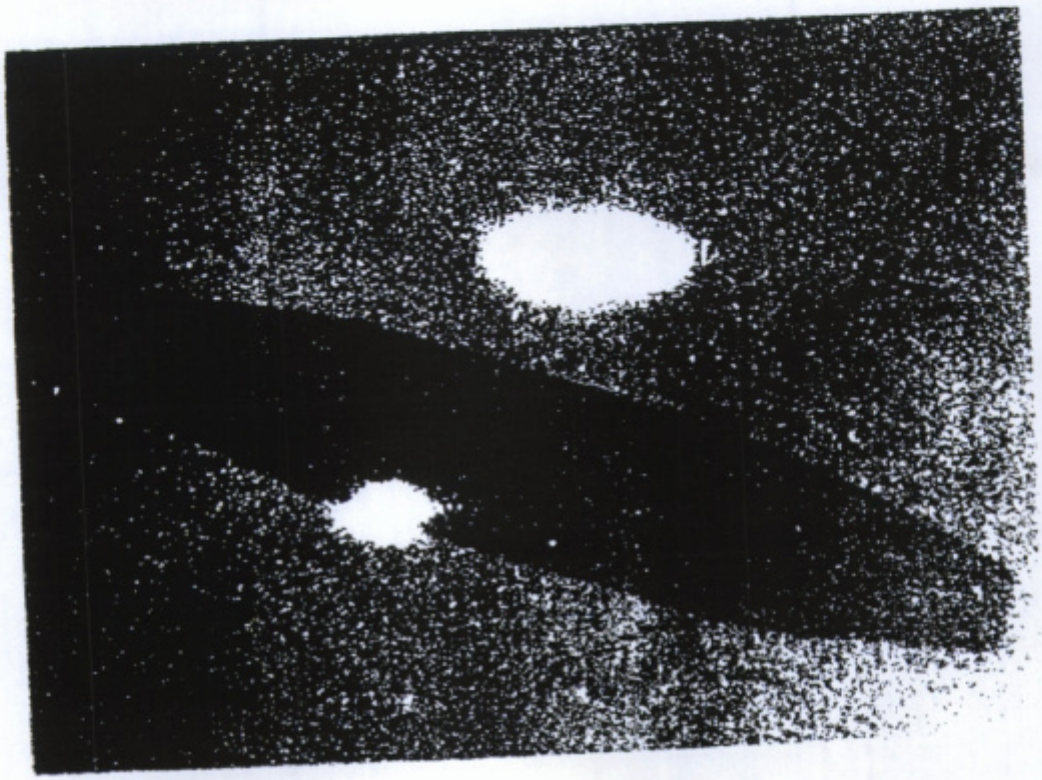


FIGURE 29: 'CIGAR' TYPE

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET

TRIANGLES

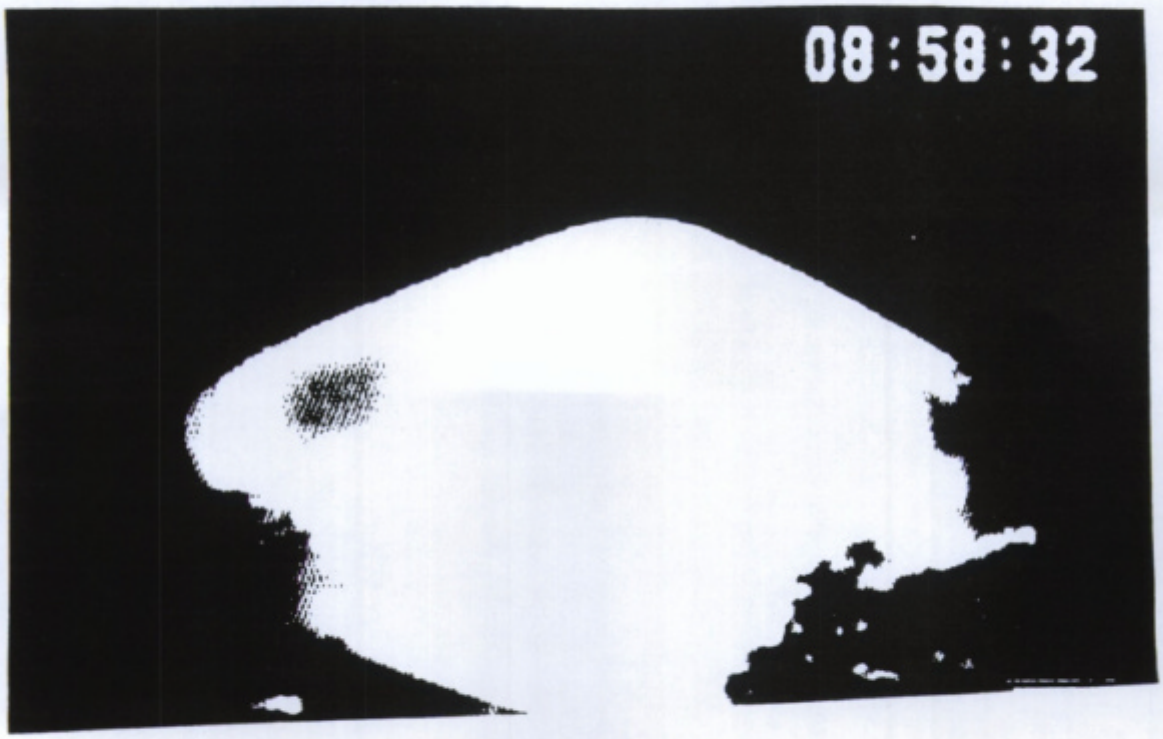


FIGURE 30: TRIANGLES/PYRAMID/CONES

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET

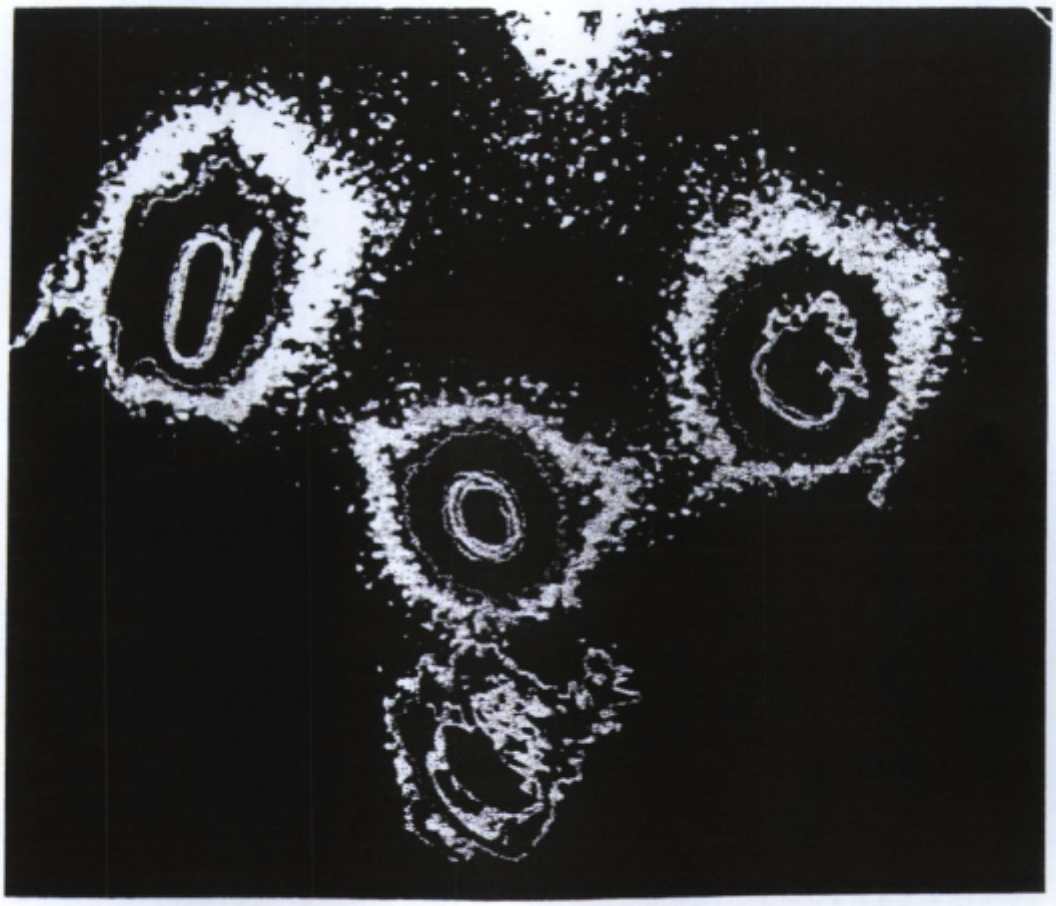


FIGURE 31: BELGIUM LOCATION EUPEN (2 SECOND AT ZOOM SETTING 100-150MM AT F4) 30-31 MARCH 1970

UNCLASSIFIED
SECRET

UNCLASSIFIED
NATO SECRET

FIGURE 32: BELGIUM (AS FIGURE.. ABOVE. BLUE FILTER ENHANCEMENT REVEALED UNDERLYING TRIANGULAR SHAPE (ALL OF WHICH IS VISIBLE ON ORIGINAL)

UNCLASSIFIED
NATO SECRET

UNCLASSIFIED
SECRET

FIGURE 33: SOVIET UNION - LOCATION ZAGRESK MARCH 1990 (NOTE UNDERLYING EQUILATERAL TRIANGLE)

UNCLASSIFIED
SECRET

SECRET
UNCLASSIFIED

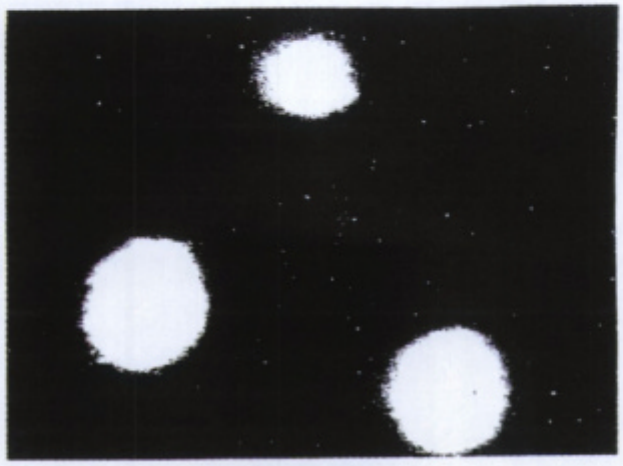


FIGURE 34: VIDEO FRAME - BELGIUM 31 MARCH 1990

UNCLASSIFIED

SECRET

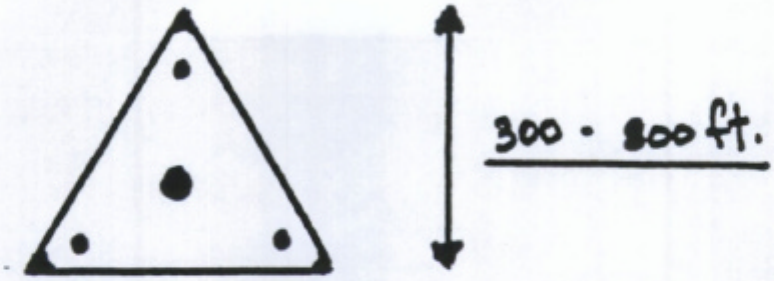


FIGURE 35: SHAPE UK, RUSSIA, BELGIUM

UNCLASSIFIED
SECRET

BOOMERANG/ARC

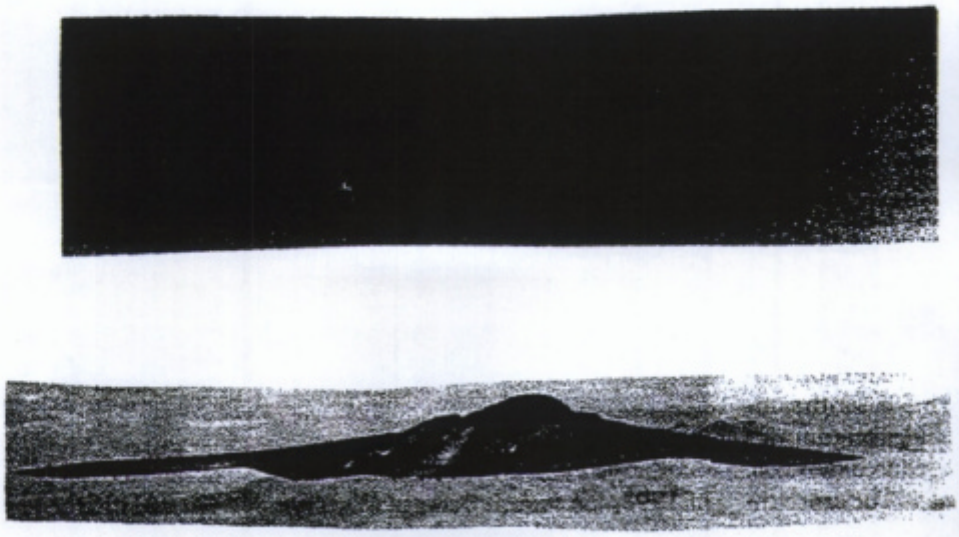


FIGURE 36:

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 12

EARTH'S MAGNETIC FIELD IN THE UKADR

	Para	Page
INTRODUCTION	1	12-1
FIELD MEASUREMENTS	2	12-1
Field Intensity	3	12-1
Field Angles	4	12-1
Local Variations	6	12-1
UNITED KINGDOM MAGNETIC SURVEY	7	12-1
COMPARISON WITH MEDICAL EXPERIMENTS	8	12-2

xxxxxxxxxx S.40

UNCLASSIFIED
UK RESTRICTED
SECRET

EARTH'S MAGNETIC FIELD IN THE UKADR

INTRODUCTION

1. Earth's magnetic field has been briefly researched because of:

- The possible connection of field strength with UAP events.
- As a comparison with the magnetic field strengths used during the magnetic field experiments reported at Working Paper No 25.

FIELD MEASUREMENTS

2. Over the period 1987-95 eight international stations, comprising a Sub-Auroral Magnetometer Network (SAMNET) monitored the changes every five seconds. Earth's internal magnetic field changes only slowly in direction and magnitude, but there are also magnetic effects due to the flow of charged particles in the upper reaches of the atmosphere (the ionosphere) and in space. Day plots have been taken every 1 second, since 1995. Each station records the magnetic field in three orthogonal directions. The stations cover the UK, Sweden, Norway, Finland and the Faroe Islands.

3. **Field Intensity** The magnetic field is calculated (in Nano Teslas) from the International Geomagnetic Reference Field (IGRF). The total intensity in the UK is 49,000 to 50,000 nT (1nT ≡ 1δ). Changes in intensity are ~30nT per year. The horizontal component of the field is about 20,000 nT in Southern UK and 15,000 nT in Northern UK.

4. **Field Angles** The field inclination angle is ~70° with typical changes of one to two minutes (of angle) per year. For epoch 1970 the declination angle is between -6 and -12 degrees, with changes of ~6 minutes of angle per year.

5. The North magnetic pole is migrating NW by 9km per year (79.1°N 28.9°E). For the chart shown at Figure 1, $1\delta = 10^{-5}$ Gauss. = 10^{-9}T = 1nT. The plotted readings show no sudden or unexplained variations but rather a steady decline in magnetic intensity level over the 50 to 60°N lines of latitude straddling most of the UKADR.

6. **Local Variations** No information is available on small variations which may occur in specific locations. Particularly, no field peculiarities are present in the main plots to indicate the possibility of influencing geographical clustering of UAP reports.

UNITED KINGDOM MAGNETIC SURVEY

7. Data gathered nationally by a network of 51 stations (survey points), established between 1985 and 1988, allow local (crustal) magnetic variations to be monitored[1]. Global models accurately represent the main part of the geo-magnetic field, originating in the earth's core. At the surface there are perturbations caused by magnetised rocks and electric currents in the ionosphere and

UNCLASSIFIED

atmosphere. While there are errors which are superimposed on the global model, in the UAP context it is just possible that the high density measurements of field strengths in certain areas may contribute either singly or in combination with other factors to produce UAP. The associated solar phenomena (solar flux and sun-spots) are considered at Working Paper No 16.

[1] British Geological Survey, Edinburgh

[2] Persinger is Referenced at Working Paper No 25, together with the results of his experiments on the human response to modulated magnetic fields, which are of prime importance to the overall findings of this study.

COMPARISON WITH MEDICAL EXPERIMENTS

8. A comparison of the national UK earth magnetic values at Working Paper No. 25 with those used by Persniger and others, in their medical experiments, has shown that the key difference between the experimental field which produces human responses and descriptions of experiences surprisingly like those of close encounter UFO/UAP reports; are those of modulation. It is noted that the modulated experimental amplitude values used by Persinger, and which cause the surprising effects on humans, are only approx. 1/500 of the steady field level experienced daily in the UK.

UNCLASSIFIED

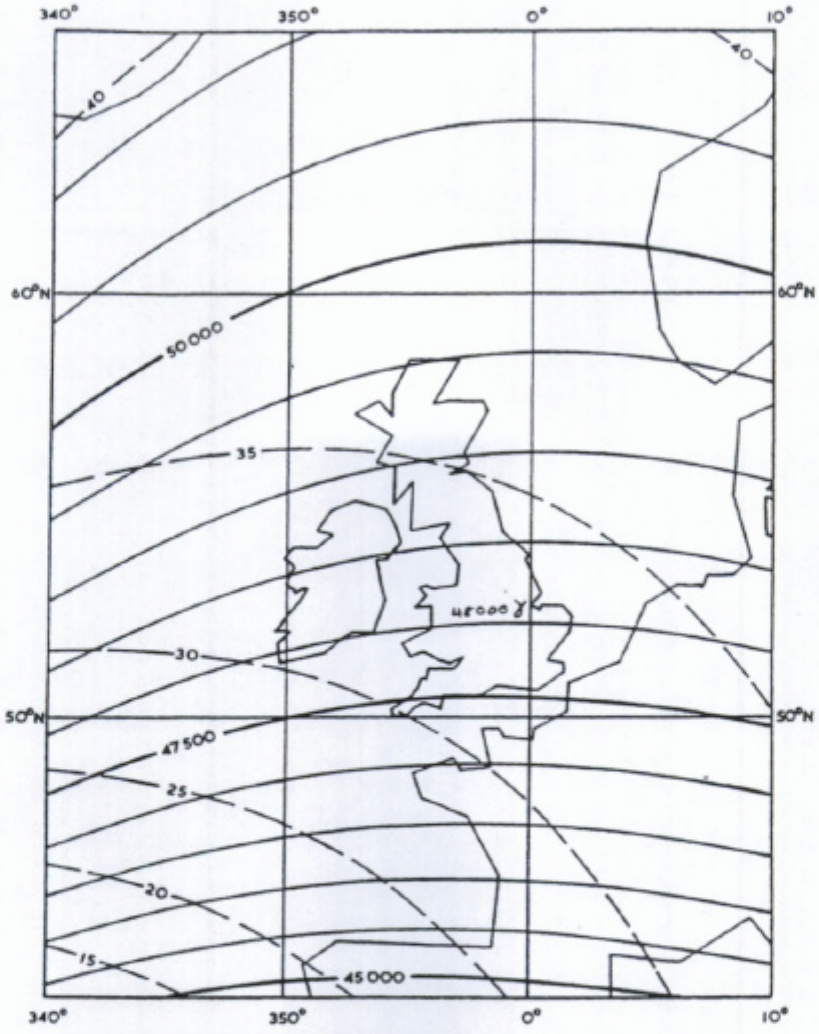


FIGURE 1: INTERNATIONAL GEOMAGNETIC REFERENCE FIELD FOR UKADR

Notes:
- Solid lines are total intensity (in Gammas, where 1δ = 1nT))
- Dashed lines are secular changes (gammas per year).

UNCLASSIFIED

WORKING PAPER NO. 13

VISUAL METEOROLOGICAL AND OTHER NATURAL ATMOSPHERIC PHENOMENA

	Para	Page
LENTICULAR CLOUDS	2	13-1
MAMMA	6	13-1
NOCTILUCENT CLOUDS	7	13-1
MOTHER OF PEARL CLOUDS	8	13-2
DUST DEVILS, TORNADOES & WATER SPOUTS	9	13-2
CONDENSATION AND DISSIPATION TRAILS	10	13-3
GLORY/CORONAS	11	13-3
HALOS & ARCS	12	13-3
SUN DOGS	13	13-4
ST. ELMO'S FIRE	14	13-4
BIRDS	15	13-4
MOTHS	16	13-5
SOLAR RADIATION	17	13-5
SUN PILLARS & LIGHT PILLARS	20	13-5

UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED

VISUAL METEOROLOGICAL AND OTHER NATURAL ATMOSPHERIC PHENOMENA

1. This paper briefly investigates a number of additional atmospheric visual phenomena, mainly meteorological, which can give rise to UAP reports because they are unfamiliar to most witnesses:

- Lenticular clouds
- Dust Devils
- Moon and Sun 'Dogs'
- Aurora
- Twisters
- Ice Clouds
- Glory/Corona
- Condensation Trails and Distrails
- Halos
- Mother of Pearl Clouds
- Mamma
- Noctilucent clouds

LENTICULAR CLOUDS

2. Examples of laminated, disc-like (Lenticularis) clouds are shown at Figures 1 to 9. These are clouds which are oval or lens-shaped. No further explanation is required to see that these can easily be visually mistaken - and, with a little embellishment - be turned into convincing 'UFOs'. Key factors in the filtering process must be:

- They are usually visible using reflected light (e.g. ambient daylight/sunlight or moonlight), but on some occasions they may be seen in silhouette as disc shapes.
- Lenticular clouds have no inherent glow (other than natural external illumination).
- They will either appear to be stationary (dependent on geometry) or move slowly (at wind rate).
- They will not manoeuvre.
- Conditions to climb are rare unless 'forced ascent' (i.e. external agency) conditions are present.

4. Lenticular clouds often form:

- Over hills.

UNCLASSIFIED
UK RESTRICTED
SECRET

- At the top of cumulus clouds to form a 'cap-cloud' (pileous cloud).

- With a 'metallic grey' colour.

4. If cumulus cloud below a cap-cloud evaporates or disperses the lenticular cap can descend (sink). They can remain poised or slowly wavering above hills. Lenticular effects can form with several basic cloud types, e.g. Altocumulus Lenticularis, Cumulus Pileus, Strato-Cumulus Lenticularis etc.

5. Some photographs (for example, at Figure 2) show that lenticularis clouds (or 'wave clouds') can appear as billows (i.e. ovals/lens-shaped discs with a hole in the centre) and also with laminated appearance. Pileous laminations occur when humid layers are sandwiched between dry air layers. At Figure 5 little imagination is required to describe 'a dome on top'. When the top of a wave-cloud is 'bow-shaped' and smooth, this usually indicates that the air above is stable and dry. The size of lenticularis clouds may extend for kilometres. However, small ones seen edge-on may give the impression of much smaller discs. These formations often appear to the leeward side of high ground. The typical reported altitude might be 3000-6500 metres.

MAMMA

6. These protuberances occur when small-scale convection changes cause portions of cloud to sink in clear air below a cloud formation. The sinking elements mix with the clear air and usually evaporate. However, if they contain rain or snow crystals, the shapes shown at Figure 6 can occur. These particularly occur beneath the thick clouds associated with thunderstorms. Mamma can also occur at the lower ends of cirrus cloud formations.

NOCTILUCENT CLOUDS

7. Noctilucent clouds have the appearance of decayed cirrus but are typically at 80Km altitude in the stratosphere. They can shine for an hour or so after sunset but they are not seen if the sun is above the horizon. If the sun is more than ~16° below the horizon noctilucent effects cannot be seen. Normally noctilucent clouds appear between May and August at latitudes 50°-70°N. (This includes UKADR latitudes). It is reported that these may be caused by dust particles which catch the lower stratosphere during volcanic eruptions, or due to dust produced in the solar system by collisions among minor planets. Noctilucent effects can also be caused by terrestrial-based light sources shining on the underside of disc-shaped or laminar clouds. Noctilucent clouds are the highest clouds in the atmosphere.

MOTHER OF PEARL CLOUDS

8. 'Mother of Pearl' formations (Figure 9) are rare but can be seen in Scotland occasionally between November and March. They have iridescent bands of colour, lit by sunlight in a twilight sky (limiting the time of occurrence). They occur only at altitudes of the order 22-30Km and probably comprise super-cooled droplets with ice crystals.

DUST DEVILS, TORNADOES & WATER SPOUTS

9. These occur in unstable layers of dry air over hot ground. They are visible because of the dust (which may rotate in

either direction) and often have a hollow centre. Water spouts occur similarly at sea. Tornadoes are predominantly cyclonic in rotation. All three phenomena move at prevailing wind-speed.

CONDENSATION & DISSIPATION TRAILS

10. 'Contrails' and 'Distrails' are well known visual effects in the sky. Drawn into aerodynamic vortices (i.e. wing-tip vortices), these can fragment to provide unusual visual phenomena. Distrails are formed when an aircraft flies in relatively dry air just above a thin layer of cloud such that the down-wash penetrates the layer. This can produce a series of 'holes'. Pendulous blobs (with the probable appearance of spheres) can occur.

GLORY & CORONAS

11. Coronas are colourful concentric rings centred on bright light sources. They are caused by water droplets or ice crystals of relatively uniform size. However, observers in both Texas and Finland have reported coronas caused by pollen particles. Coronas can be distinguished from halos in that they commonly have a radius angle of 22 degrees, although the extremes reported for halos have boundaries of 4 to 46 degrees. The key filter to use in UAP identification is that coronas are always centred on a bright object. Figure 7(a) shows the shadow of a crucial peak thrown onto mist. The observer (on the peak) is surrounded by a multicoloured 'Glory' of corona rings. In fact until the advent of aircraft only mountaineers could observe the effect. This is due to the refraction and diffraction of light by the mist droplets. This effect can also be seen from aircraft when their shadow falls on droplet clouds. On the ground it is especially noticeable in hilly country, when air close to the ground cools and flows into valleys overnight. Some of the ice particles in cirrus wave clouds at temperatures of -40 to -50 degrees C, apparently form faceted uni-axial polyhedral crystals, while others resemble spheres. It is well known that 'Glory' results from the interference of light rays back-scattered from internally reflected and circumferential ray paths (the latter is unique to spheres).

12. As seen at Figure 7(b), the incident ray couples to a sphere as a surface wave, is critically refracted into the sphere, reflects, and is critically refracted back to the surface, spends a short period as a surface wave and is directed back towards the original source. A curved wavefront is formed by exciting the rays to the right and left of the glory ray. Rotating this curved wavefront (Figure 7(c)), through an angle (Π), as directed by spherical geometry, reveals that a wavefront shape associated with the Glory is a toroid. Propagation of this wavefront to a far field gives rise to a strong axial focusing, because the infinite number of rays from the ring around the flat part of the wavefront all go in the same direction. As soon as the observer moves off the exact back-scattered axis, only two rays contribute to the scattering and it is the interference between the left and right rays of the toroidal wavefront that produces the 'Glory'.

HALOS & ARCS

13. A halo is observed when looking at the sun through high altitude cirro-stratus (which is several thousand feet deep and composed of non-spherical ice crystals - which have also recently been suspected of producing 'Glories'. It is a cloud type which readily forms aircraft condensation trails). The halo angular radius (i.e. half

angle) is said to be 22°. Halos from the sun can be either above or below the horizon. Halo activity is persistent and is known to many of the public, however it results in some UAP reports. Over a 40 year period (Netherlands) it was noted that average halo conditions existed for 227 days of the year, peaking in 1972, when 300 days were recorded.

13. On other days conditions existed for other parhelian and circumzenithal events. Halo Arcs occur at low solar elevations and are caused by pyramidal crystals and occur when they fall through the air with certain axes vertically orientated. Halo rings of unusual radii can be produced when their faces are not in random orientation. From those in random orientation six concentric odd-radii halos should result at 9, 18.3, 19.9, 22.9, and 23.8 degrees. Each of these six halo types has been imaged this century, but most of the 12 (yet undiscovered) forms are, at most solar elevations, completely below the horizon and thus only visible from airborne platforms in cool climates. The 12 halos divide into 32 individual arcs in the sky, of which only ten, so far, have been photographed. Halos still escape a complete understanding. In particular, ice particles with pyramidal ends are suspected of producing bright arcs of dimension of odd radius halos. It should be noted that some effects can be related to the polarisation of observers' sun-glasses!

Although the photograph at Figure 13 is artificially produced by light passing through a single vertically orientated hexagonal ice crystal (the parhelic spots shown are the actual projection on a wall), it is noted that these shapes are markedly similar to some UAP reports where 'multiple balls' are described.

SUN DOGS

14. A 'sun dog' (parhelian) is a mock sun, a parhalion. (See also para.20 and Figure 14)

St. ELMO's FIRE

15. This is commonly mis-identified as ball (or bead) lighting. It has been reported for thousands of years and is a corona discharge from a 'grounded' point in a strong electric field, hence, it is usually observed as a glowing object hovering over an earthed object before or during a thunderstorm. It is commonly blue or blue-white in appearance and about the size of a large orange. However, much larger diameters - up to 30cm - have been seen. It decays silently, sometimes slowly and sometimes suddenly, with a lifetime of (usually) many seconds, which may extend to minutes. A characteristic distinction between St. Elmo's Fire and Ball/Bead lighting is that the latter has motion. The exception is when St. Elmo's Fire moves along a conductor.

BIRDS

15. Small flocks of birds (e.g. gulls) can be reported at night as UAPs. Their reflective under-bellies can be seen in triangular formation. Because no sound may be heard this increases the likelihood of an unwary observer, who may only see the birds for a few seconds as they wheel; producing a brief visual reflection. In bright sunlight seagulls have high reflectivity. The specular reflection from the body reported as 'bluish white' observes the fact that it is a bird as the bright flash obscures the wings. Clusters of sightings tend to occur in areas of 'greatest watchfulness' - for example near airfields and population centres. The radar echoing area (i.e. RCS) of birds is

briefly considered at Volume 3 as a source of radar false alarms in the UAP context. Certain areas of the UKADR[1] (e.g. breeding areas) are prone to the presence of birds concentrations, shown at Figures 10 to 13, and are therefore more likely to be areas where UAP are mis-reported.

MOTHS

16. Clouds of large moths, usually in some country areas, can briefly reflect light and appear as a 'vehicle'. Swarms of spruce budworm moths are said to be luminous.

SOLAR RADIATION

17. LAZAREV, [2] writing in the Journal of Optical Technology, explains the 'outbreak in Flying Saucers' (in Brazil and S. Africa) by "atmospheric optical phenomena which manifest themselves especially distinctively at twilight, near the visible horizon of the earth".

18. It is claimed that this is associated with the increase of optically active air mass, coincident with sharp reduction of the brightness of the atmosphere combined with the enhanced contrast of the phenomenon against the twilight background. In particular (in the locations mentioned above) these formations were observed over volcanic areas and faded after a time. This is attributed to Fresnel reflection from clouds of heated gases (air, CO_2, water vapour, volcanic sulphurous gases, aerosols etc.). Sometimes these ring-like formations were observed for several minutes.

19. Lazarev has also reported the entry of a snowball core (of a minicomet) into the atmosphere (26 September, 1990) and possibly again on 20 June, 1992 (at the MIR orbital complex). The frequency of occurrence of cores of minicomets into the earth's atmosphere (observed from space-station MIR) is assessed at ~20 per minute.

SUN PILLARS & LIGHT PILLARS

20. A vertical column of light can sometimes be seen either below or above the sun, usually when the sun is at low elevation angles. Sun pillars are produced when correctly orientated ice crystals reflect sunlight or when hexagonal columnar ice crystals fall through the air with their long axes orientated horizontally. Example Sun Pillars and Sun Dogs are shown at Figures 14 to 16. Light Pillars are similarly formed from strong light sources other than the sun. It is possible to observe Light Pillars which do not reach to the ground - another source of UAP activity with 'searchlights' beaming downwards.

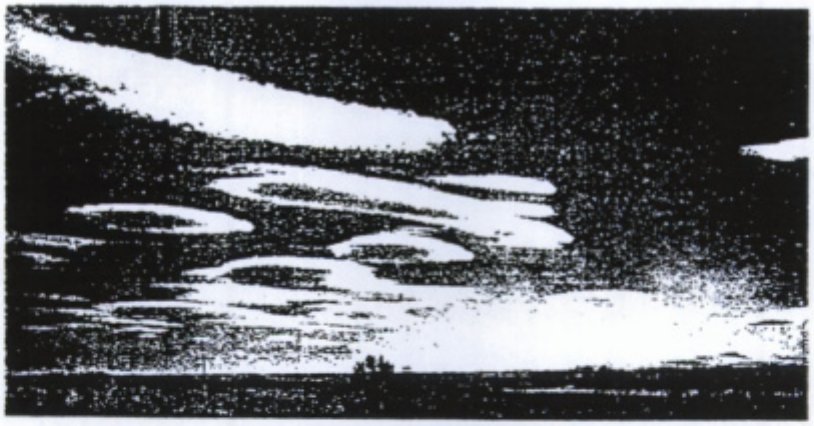
[1] UK Military Low Flying Handbook (NATO Restricted) Edition 82 Dec, 1997.

[2] A I Lazarev, State Optical Institute, All Russia Scientific Centre, St Petersburgh. 1997.

SECRET
UNCLASSIFIED
UK RESTRICTED
CONDIGN

Australian National Antarctic Research Expedition

FIGURE 1: LAMINATED CLOUD [1]



L. Larsson

FIGURE 2: LENTICULAR CLOUD [1]

[1] "Cloud Study". Ludlam and Scorer, Muray 1960

CONDIGN
UK RESTRICTED
UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET

FIGURE 3: LENTICULAR CLOUD

FIGURE 4: LENTICULAR CLOUD

UNCLASSIFIED
SECRET

UNCLASSIFIED

FIGURE 5: PILEOUS LAMINATED CLOUD [1]

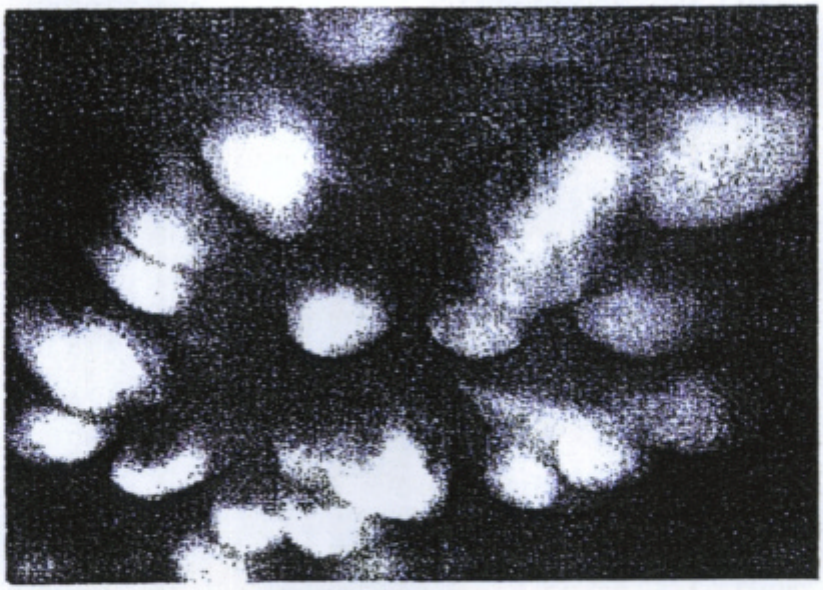
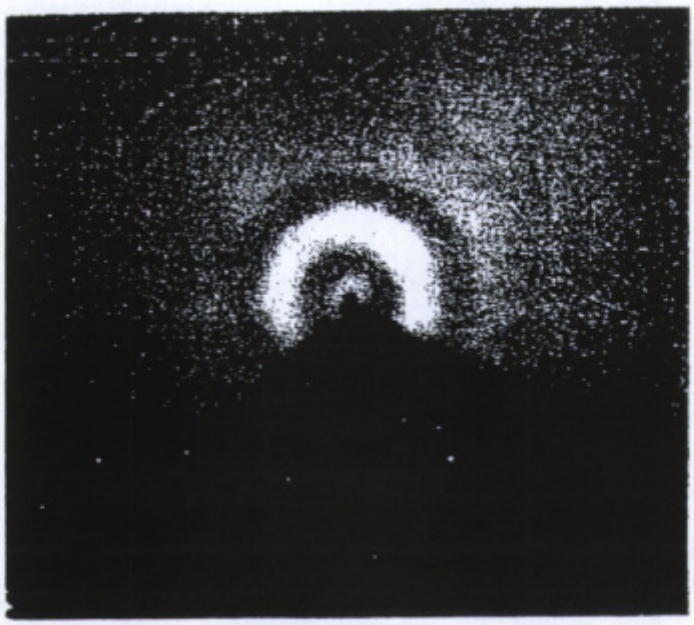


FIGURE 6: MAMMA [1]

R. S. Scorer

UNCLASSIFIED

SECRET
UNCLASSIFIED
UK RESTRICTED



J. E. Tinkler

FIGURE 7(a): GLORY [1]

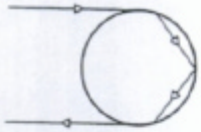


FIGURE 7 (b): LIGHT PATH

FIGURE 7(c): TOROID

UNCLASSIFIED
UK RESTRICTED
SECRET

SECRET
UNCLASSIFIED

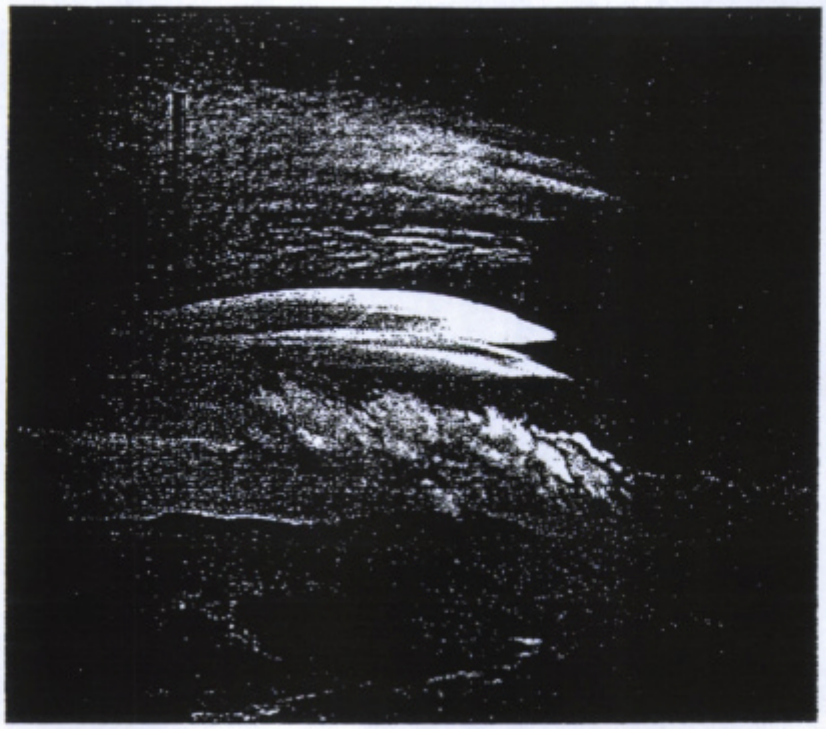


FIGURE 8: ROTOR CLOUD UK [1]

Carl Störmer

FIGURE 9: 'MOTHER OF PEARL'

UNCLASSIFIED
SECRET

SECRET
UNCLASSIFIED

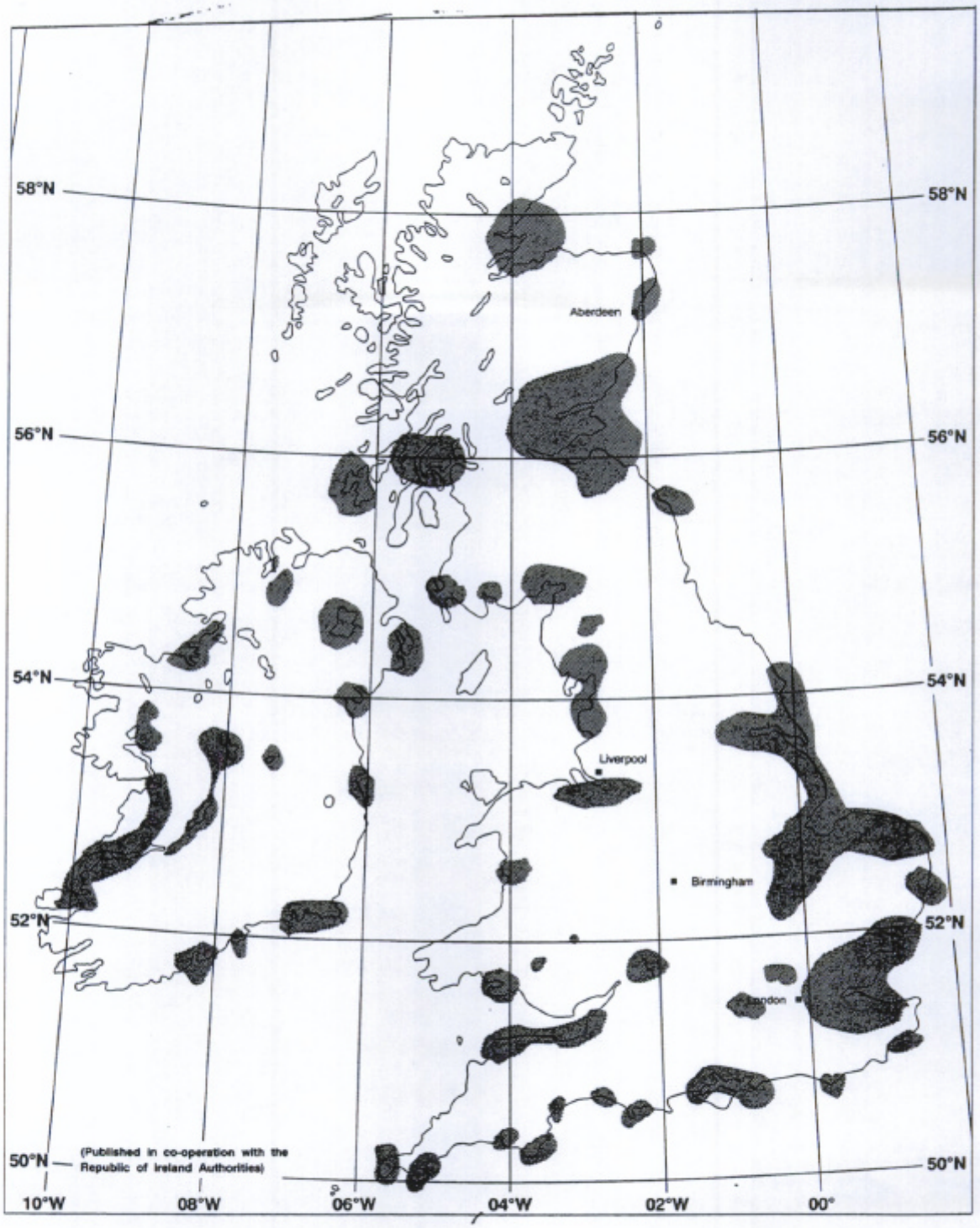


FIGURE 10: BIRD CONCENTRATION AREAS(Aug-Feb)

UNCLASSIFIED
SECRET

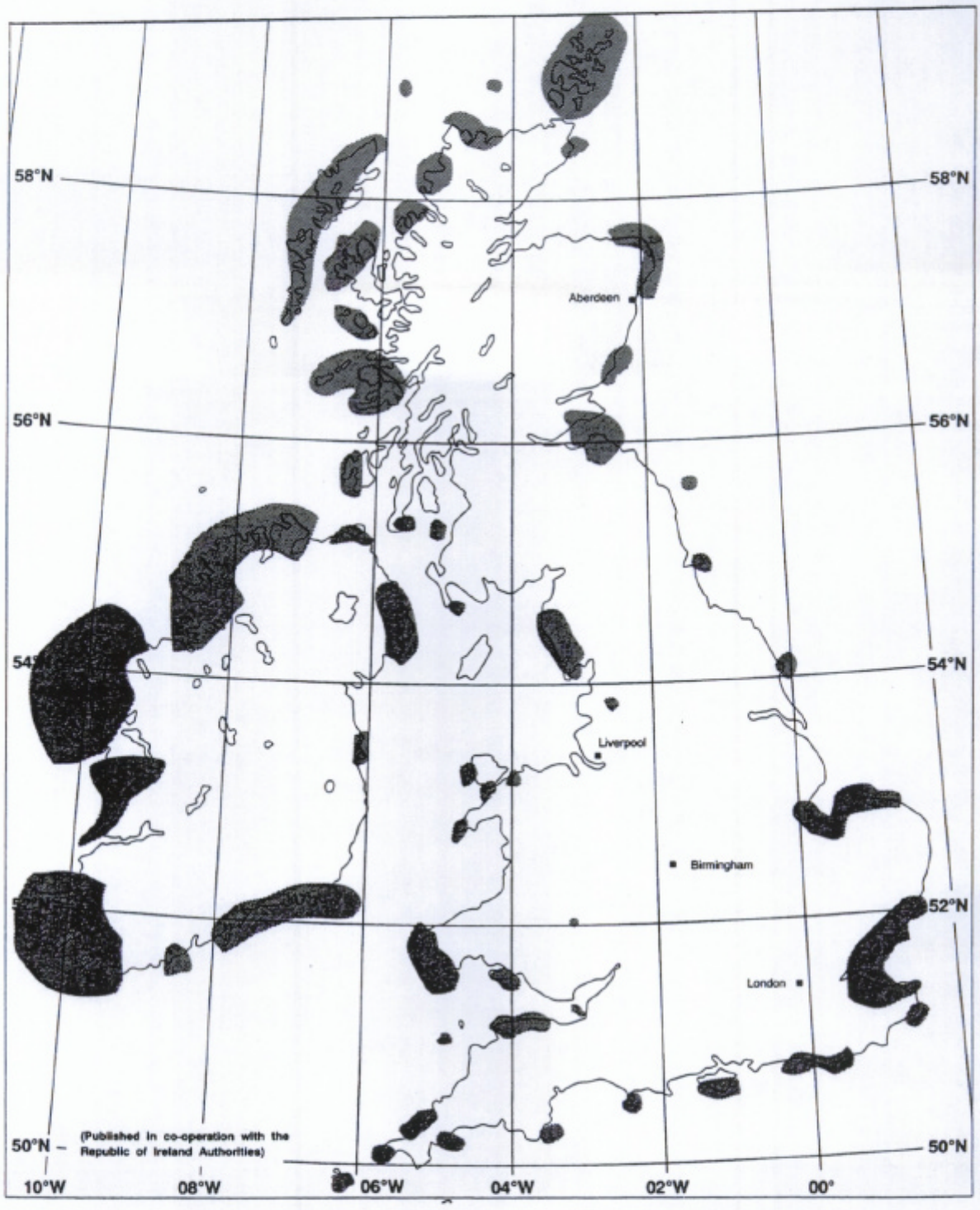


FIGURE 11: BIRD CONCENTRATION AREAS (Mar-Jul)

FIGURE 12: MAJOR SEABIRD AREAS -SCOTLAND

UNCLASSIFIED

FIGURE 13: SEVEN SOLAR IMAGES FROM ICE CRYSTAL

FIGURE 14: SUN PILLAR & SUN DOG (R GREENLER)

UNCLASSIFIED

UNCLASSIFIED
SECRET

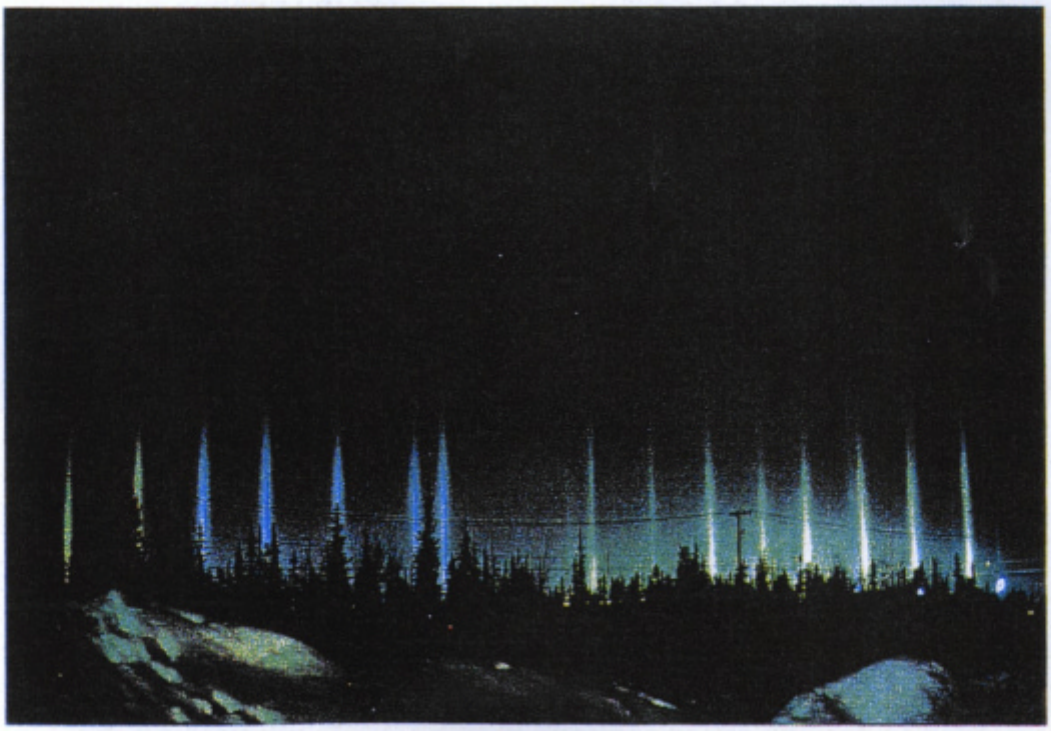


FIGURE 15: MULTIPLE LIGHT PILLAR DISPLAY (W TAPE)

FIGURE 16: LIGHT PILLAR (P PARVIAINEN)

UNCLASSIFIED
SECRET

SECRET
UK RESTRICTED

WORKING PAPER NO. 14

METEOROLOGICAL BALLOONS

	Para	Page
Radiosonde Launch Sites	2	14.1
Size and Shape	3	14.1
Location	4	14.1

UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET

METEOROLOGICAL BALLOONS

1. A probable cause of UAP reports which must be considered is that of radiosondes and their lifting balloons.

2. **Radiosonde Launch Sites** There are eight operational upper air stations in the United Kingdom, just part of a world wide network of some 900. The stations in the UK release helium- or hydrogen-filled balloons four times a day at midnight, midday, six o'clock in the morning and evening. The transmitter, (the proper name is a radiosonde), sends back information about the temperature, pressure and the water content of the upper atmosphere. Wind speed and direction may also determine, either by using a NAVAID system or in some cases, the balloon and radiosonde are followed by radar. The distance the balloons travel away from the launch site is dependent on the wind strength, but they will quite readily reach a height of up to 15 miles (about 80,000ft) above the ground before they burst. The equipment descends on a small parachute.

3. **Size and Shape** The Meteorological Office currently useS balloons which are spherical and 1.5 to 2m in diameter at launch.. The actual radiosonde is suspended some 30m beneath the balloon and, for visual purposes, can be ignored.

4. **Location** The location of radiosondes, on their lifting balloons, is known from LORAN C; and could be used to eliminate suspected UAP mis-reporting.

5. The location of the release points in the United Kingdom are shown at Figure 1. The incidence of mis-reported radiosondes as 'UAPs' is likely to be higher in the vicinity of these launch sites.

UNCLASSIFIED
SECRET

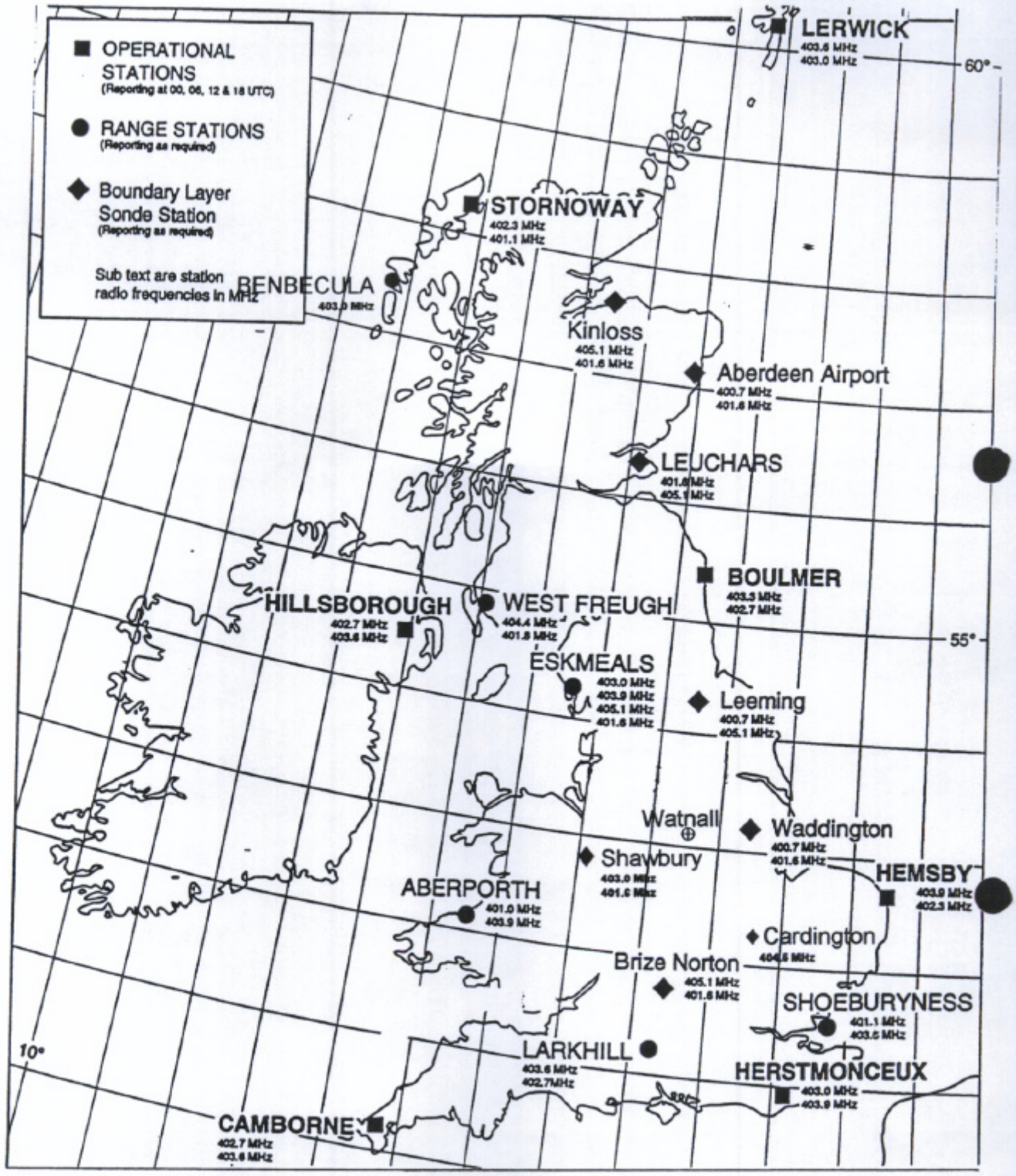


FIGURE 14-1 RADIOSONDE LAUNCH SITES

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 15

AIRSHIPS , HOT AIR & TETHERED BALLOONS

	Page	Para
Object Sizes	15-1	1
Report Incidence	15-1	2
Meteorological Balloons	15-1	3
Tethered Balloons	15-1	4

UK RESTRICTED
SECRET
UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED

AIRSHIPS AND HOT AIR BALLOONS

1. **Object Sizes** Airships and hot air balloons are frequently mis-reported as UAPs, probably because their appearance in the UKADR is still relatively rare in some parts of the country, and the fact that they are at low altitude. However, ballooning is a growing sport and an increase in false alarms from this source can be expected. Both UK-produced and imported balloons can be expected in UK airspace, including balloons of novel shapes (e.g. cylindrical). The situation is enhanced by the fact that balloons are often silent for long periods, and airship engines are relatively quiet. Table 1 shows a selection of typical parameters for airships. Balloon diameters are typically 22m with a height of 26m. The use of gas burners at night is a particular source of reports of 'glowing spheres', particularly in Southern England.

2. **Report Incidence** If a number of design proposals proceed, the incidence of both cargo and passenger airships can be expected to increase; however, their appearance will still be relatively rare to most observers, compared with other familiar air-objects such as aircraft and gliders.

3. **Meteorological Balloons** These are described at Working Paper No 14.

4. **Tethered Ballloons** While tethered balloons are less likely to be mis-identified as a UAP, by stationary observers, an observer in a moving vehicle may catch a glimpse of a tethered balloon in the appropriate weather and lighting conditons and submit an event report. In the UK, tethered balloons of up to 20ft in diameter may fly up to 200ft AGL, without tether streamers (the presence of streamers would almost certainly have eliminated many false reports).

5. It should, however, be noted that the presence of a tethered balloon may, in fact, attract an atmospheric UAP which is seeking an attracting electrical potential, since a charged mass of air may be attracted to the balloon or it's tether.

6. Tethered balloons may remain in one position for up to 10 days.

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET

	Length (m)	Diameter (m)	Height (m) [1]
Skyship P600	59	16	20
USA	17	5.5	6.77
USA	39	10	-
USA	25	8	-
USA	67.5	16.7	20.2
COLT	34	12.5	-
UK	30	11	-
GERMANY	68	14	-

TABLE 1 EXAMPLE BALLOON DIMENSIONS

Note [1] Including Gondola

SECRET
UNCLASSIFIED

SECRET
UNCLASSIFIED

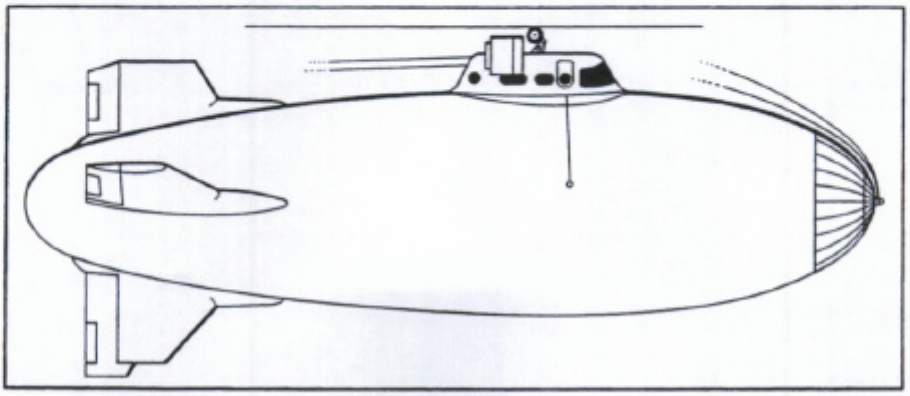


Figure 1 Design Drawing for the DKBA-800 Passenger/Cargo Airship

UNCLASSIFIED
SECRET

UNCLASSIFIED

WORKING PAPER NO. 16

SUNSPOT, AURORA AND SEISMIC CORRELATION

	Para	Page
SUNSPOT, AURORA AND SEISMIC CORRELATION		
Solar Cycle	**1**	**16-1**
Auroral Phenomena	**5**	**16-1**
CORRELATION OF UAP EVENTS WITH SEISMIC ACTIVITY	**6**	**16-2**
TECTONIC ELEMENTS OF THE UK	**8**	**16-2**

UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED

SUNSPOT, AURORA AND SEISMIC CORRELATION

1. **Solar Cycle** At the commencement of the UAP study it was recognised that the UAP enigma, which has apparently been present in some form for recorded history, might be due to a simple natural explanation. However, it is only in the last 50 years that an increasingly large number of UAP sightings have been recorded. While it was recognised that the phenomenon may eventually be shown to be due to a combination of natural events, rather than a single cause, the solar cycle is one of the more obvious candidates for investigation. The frequency of occurrence of UAP reports against known earth phenomena, such as solar activity, has been checked. However, as this transient solar phenomenon repeats in an eleven (~11.4) year cycle, long-term statistical comparison will not be possible unless a very large spread of UAP events are entered into the database and, clearly, it would not be viable, purely in the interests of Defence Intelligence, to do so. Investigations, reported in Volume 1 of the Study, were necessarily limited to monthly comparisons taken over a year. No direct correlation was found for solar flux or sunspot number. This does not mean that, in the future, there will not be shown to be some weak correlation, connection or contribution, when taken together with other natural effects

2. One of the reasons for considering sunspot correlation is because the cycle seems to derive from a more fundamental 23 year magnetic periodicity on the sun and, it has been suggested, in some quarters, that UAP and magnetic activity are connected in some way on the earth. The solar magnetic cycle has a period approximately twice that of sunspot (flare) activity. The electromagnetic emissions from the sun vary in power, penetrating power, degree of fluctuation and intensity distribution over the earth. The direct effects of electromagnetic radiation are confined to the sun-lit hemisphere of the earth. During each new 11 year cycle the polarity of the pattern of magnetic activity reverses.

3. Within the 11/23 year cycle,solar surges appear (solar flares) which produce complex magnetic fields. Therefore, even to make correlations between the frequency of UAP reports and spurious magnetic activity will require at least several years of reports in the UAP database - or ideally, a filter to remove identifiable distractors, such as aircraft. Figures 2 to 4[1] show portion of the solar cycles 21-23. Cycle 21 started in June 1976, Cycle 22 in September 1986 and Cycle 23 (the current Cycle) in May 1996. It is clear that to carry out any meaningful statistical analysis a the dat for a lengthy period of UAP sighting reports is required. As an initial sample the daily measurements were obtained for the period 1986-1996 and used for correlation studies reported at Volume 1.

4. Proof of the postulated UAP-solar connection may be difficult to confirm even if all the statistics were available because it must be remembered that UAP statistics will have been significantly skewed in the more recent decades by the addition of airships, aircraft, satellites, etc. to the reasons for sightings (i.e. man-made events).

5. **Auroral Phenomena** Magnetic and auroral phenomena (M-Region disturbance) occur at 27 day intervals over months or even years (Figure 1). These recurrent effects are most prevalent during the last three to four years of the 11 year cycle - unexpectedly when normal sunspot activity is low. The terrestrial effects are much less vigorous than the effects caused by flares, but they can last several days, reaching a peak when the earth is at its greatest distance above or below the plane of the sun's equator.

UK RESTRICTED
SECRET
UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED

CORRELATION OF UAP EVENTS WITH SEISMIC ACTIVITY

6. On the assumption that major luminous events are also connected with seismic activity, it should be possible to correlate this coincidence if enough UAP event evidence is available to compare with seismic records. The rationale for supposing that seismic (structural) strain causes luminescences is described (Working Paper No. 10). If this were a reliable guide then the onset of a set of UAP events could possibly be predicted! There are, however, several problem areas:

- The number of UAP events which are clearly luminous/earthlight-related, must first be separated from all other UAP sightings.

- The UK land-mass suffers serious seismic activity only at a low rate but hundreds of low-magnitude events occur which must influence rock-stress conditions from day to day.

- The UK distribution of probable 'earthlights' cannot be expected to be evenly spread because of the variability of the geological structure and sporadic reporting; as many of the rocky areas of the UK are in sparsely populated areas.

7. Persinger[3] has analysed luminosity events across Europe (Six nations) using reports taken over a 100 year period (1820-1920), where it is shown that the years of peak earthquake activity were also the same years of maximum UFO reporting. While this type of analysis could be made for the period for which the Department hold UAP reports (1967-1997), some of the early reports are limited in number and sparse in detail, and a more realistic approach is to take a ten year sample (1987-1997), where the statistical value will be higher. Distinct UAP-Earthquake to Fault-line links were found with UAP, in a French investigation as long ago as 1960. It has already been established elsewhere in this study that UAP events may be due to many different effects, no possible cause must be ignored.

TECTONIC ELEMENTS OF THE UK

8. As an aid to possible future analysis of UAP events, the UK earth-fault system has been briefly investigated. The most useful reference for this purpose is at [4]. A full database should enable UAP location correlations to be made with this fault map if seismic activity is the cause. It is assumed that if earthlights are formed at or near fault positions they may travel some distance (e.g. 10km or more) before dissipating. Under some circumstances (e.g. attachment to a charged body such as an aircraft), they may travel much further, depending on air target velocity.

9. The total annual release of energy in the world's earthquakes corresponds to up to 10^6kW and although the largest earthquakes account for most of the seismic release it is assessed that ~20,000 small quakes occur. A moderate earthquake generates ~10^5 watts per square metre and a fault rupture ~10^{14} watts. No trigger mechanism has been discovered to predict earthquakes reliably (in which case this might also act as a warning for expected UAP reports due to earthlights (see Working Paper No. 10)) Many events exhibit the property of 'dilantancy', for example, (i.e. an increase in volume during deformation). This, in turn, causes an increase in frictional forces and a change in resistivity/electrical conductivity, which, in turn, must affect the production of early, but small, seismic movements (said to be detected by animals in advance of human detection systems/instruments and a precursor to earthlights).

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET

10. Commercial data is available (at a small cost) to support further investigations, if required.

[1] SIDC Brussels at www.dxlc.com/spolar. J Alvested. 1988

[2] British Geological Survey, Edinburgh

[3] Persinger M.A. "Geographical Variables and Behaviour" Laurentian University Canada (1983)

[4] Underhill J. R. et al " The Dent Fault System....." Journal of the Geographical Society, London Vol 145,(1988)

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

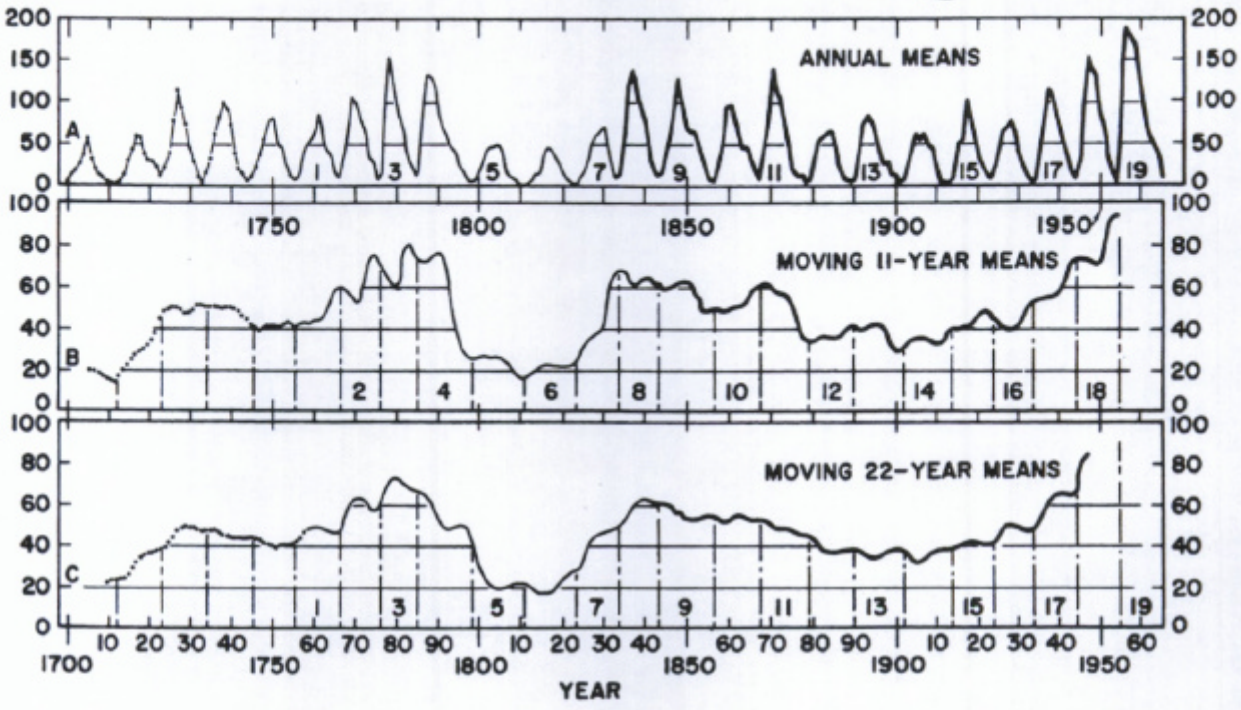


FIGURE 1: MEANS OF RELATIVE SUNSPOT NUMBERS, 1700 TO 1960[1]

[1] HANDBOOK of Geophysics and Space Environments Air Force Cambridge Research Laboratories.

UK RESTRICTED
SECRET
UNCLASSIFIED

UNCLASSIFIED
SECRET

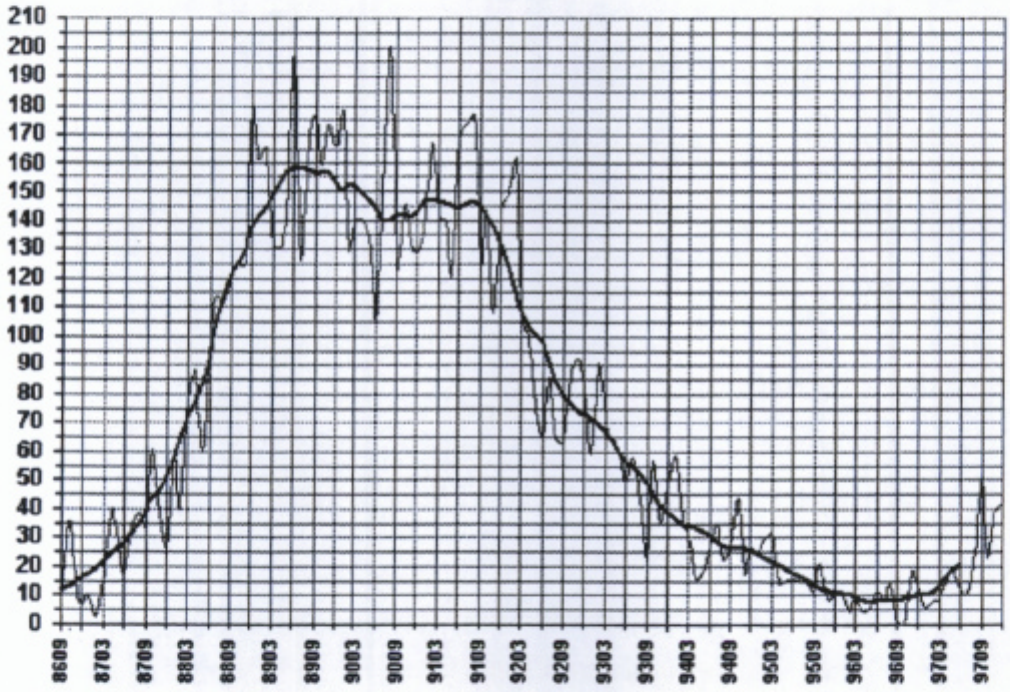


FIGURE 2: SOLAR CYCLE SUNSPOT NUMBERS (CYCLES 21-23)

Note: The heavy curve is a smoothed approximation. In the UAP context finer grain required (Figure 3)

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET

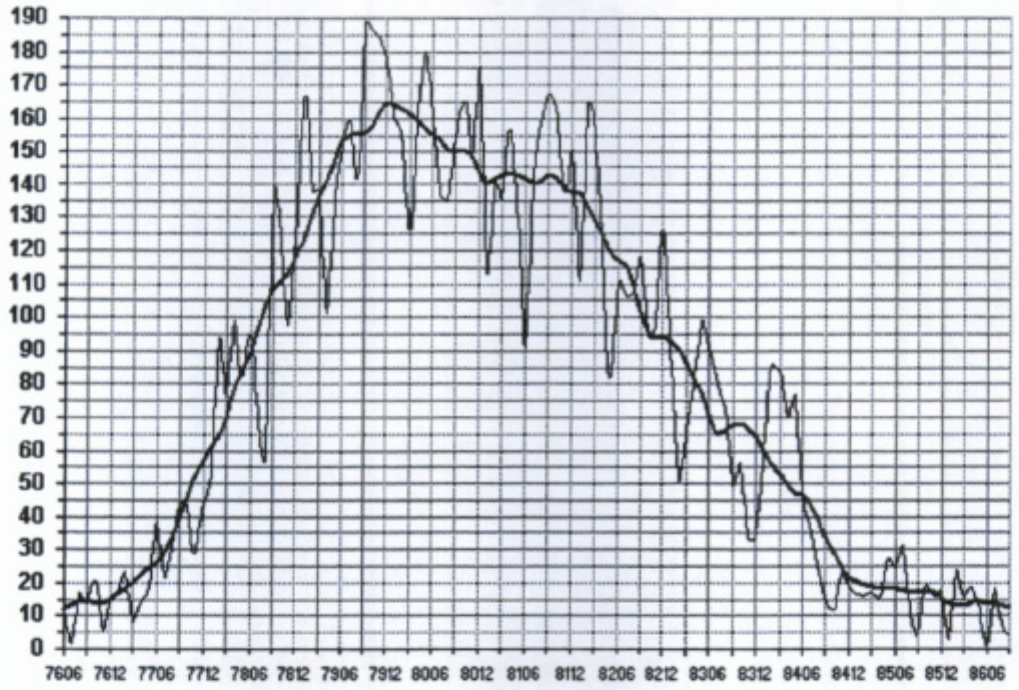


FIGURE 3: SOLAR CYCLE No 21(1976-1986)

UNCLASSIFIED
SECRET

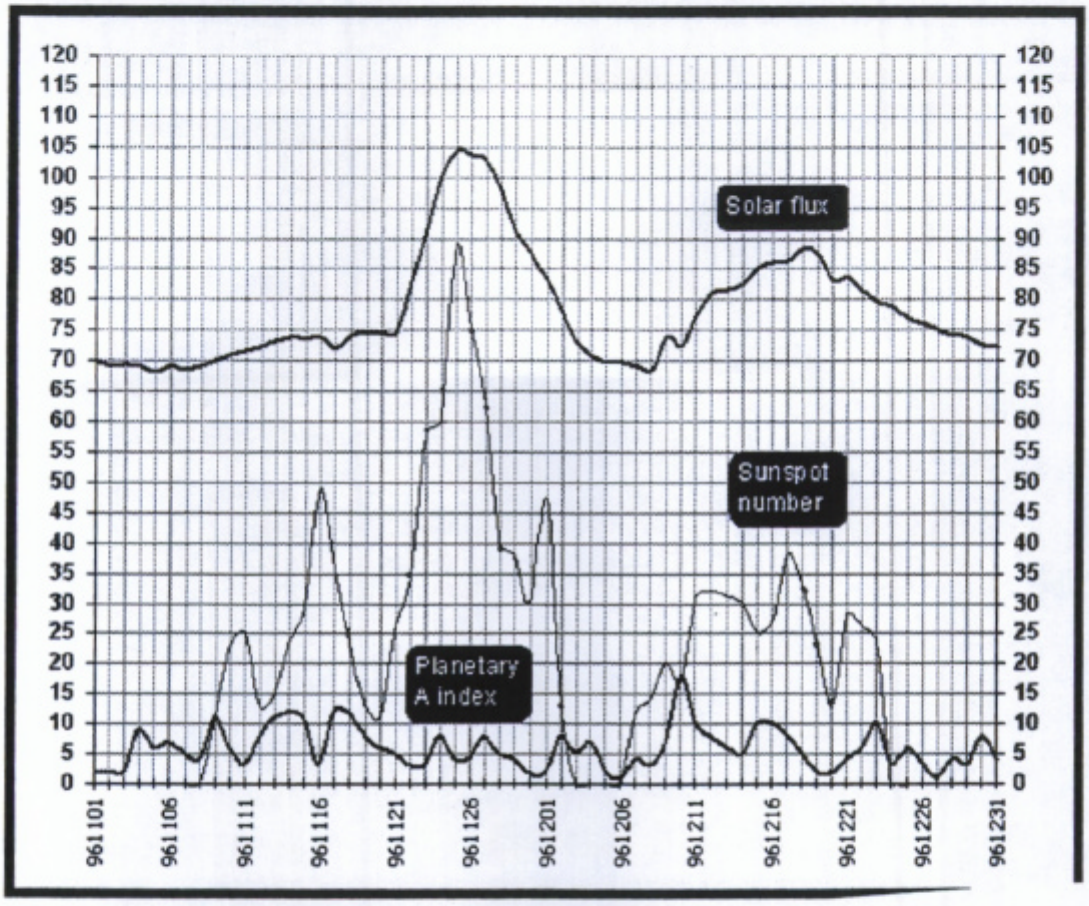


FIGURE 4: EXAMPLE DETAILED SOLAR FLUX/SUNSPOT NUMBERS FOR JAN/FEB 1996 (U)

SECRET
UNCLASSIFIED
UK RESTRICTED

WORKING PAPER NO. 17

VISUAL OBSERVATION OF SATELLITES

	Para	Page
Orbital Period	1	17-1
Inclination	2	17-1
Re-entry	3	17-1
Satellite Brightness	4	17-1
Comparison of Brightness with Stars	5	17-1
Cylindrical and Balloon Satellites	6	17-1
CONDITIONS FOR VIEWING SATELLITES	7	17-1
Earth's Shadow	9	17-2
Repeat Observations	12	17-3
Spells of Visibility	14	17-3
Angles of Elevation	16	17-3
Flash Periods	17	17-3
Sightline Rates	18	17-3

UK RESTRICTED
UNCLASSIFIED
SECRET

SECRET
UNCLASSIFIED

VISUAL OBSERVATION OF SATELLITES

1. **Orbital Period** This could be relevant to UAP studies, as an event (i.e. satellite mistaken for a UAP) could be reported once or more on the same pass or on successive passes. The orbital period (i.e. in this UAP context the time of appearance or reappearance) is shown at Figure 1. Thus if the orbit altitude is changed from 200km to 1500km the orbit time changes from 88 to 116 minutes. Hence, UAP sightings with similar characteristics and at these approximate time intervals could be satellite sightings.[1]

2. **Inclination** This is the angle at which the plane of an orbit cuts the equator. It determines the maximum latitude reached by the satellite and hence its potential to be observed in the UKADR.

3. **Re-entry** The effect of air drag (even with much reduced density) causes LEO satellites especially to re-enter the atmosphere. This occurs even with elliptic orbits, which suffer higher drag at each perigee. The lifetime of the satellite is a function of its mass and drag and is thus directly proportional to its mass/area ratio. Because the upper air density is variable, precise re-entry timing is difficult to predict. A visual example of re-entry (Skylab 1) is shown at Figure 2. It is important to note that the colours produced can be white, whitish-yellow, with touches of orange, red, green and blue, all colours often reported as UAP events. Re-entry velocity can be close to 8km sec^{-1} and the pyrotechnic display ceases when it has descended to ~30km altitude, having commenced its glow at 90km altitude. After 30km the remaining fragments fall at a steeper angle. A single calculation shows that a 60km downward path (at 8km per second) lasts only about 7.5 seconds.

4. **Satellite Brightness** Brightness depends on size, shape, surface finish and 'phase angle' relative to the sun. A spherical satellite (e.g. 40+m in diameter (Echo 2 balloon) or 0.3m dia, at the other extreme, may have all its surface illuminated facing the sun. This occurs if a spherical satellite is in the east with the sun just below the horizon in the West. If the sun is in the west when the satellite is in the West, only a crescent is illuminated. The texture of satellite surface (i.e. its surface finish) varies. A white or shiny surface is brighter than a black satellite. It may be partially illuminated and hence seen as an inclined disc, rather than a sphere.

5. **Comparison of Brightness with Stars** It is possible that some UAP reports (from those with knowledge of astronomy) may rate the UAP in terms of the 'magnitude' scale defined by reference to standard stars/planets and even compare a UAP brightness with that of a familiar star (e.g. Pole Star). The level 'magnitude 1' is the brightest with 'magnitude 6' roughly the faintest. the Pole Star has a magnitude of 2.1 Sirius; (a regular UAP report), Mars and Salyut-type systems have a magnitude of -1 (i.e. 2.5 times brighter than a star of magnitude 0 such as Vega, itself 2 times brighter than a star of magnitude 1. Figure 3 relates magnitude against satellite diameter, velocity and range from observer. Although this is short-range it can be roughly approximated to orbit height when a satellite is viewed approximately overhead.

6. **Cylindrical and Balloon Satellites** Brightness is estimated by converting to the brightness of an equivalent sphere from the side-on area of the cylinder (i.e. length x diameter) and then taking the square root to give the equivalent sphere. (e.g. 8 x 2 = $16m^2$ (cylinder side area) = 4m diaspherical equivalent). Clearly the area would be less when viewed end-on. Cylinder area viewed may fluctuate, if they are tumbling, giving the appearance of flashing lights. Balloon satellites are very sensitive to air drag. They may break up in space, producing several reflecting objects.

CONDITIONS FOR VIEWING SATELLITES

7. This is a key topic for UAP filtering. A satellite can only be seen:

- If illuminated by the sun
- If the observer is well in shadow
- If the satellite is against a dark background.

[1] "Observing Earth Satellites" Desmond King - Hele. MacMillan 1983.

UNCLASSIFIED
SECRET

UNCLASSIFIED SECRET

8. Certain conditions apply for viewing to occur, and which set the conditions (or eliminate!) the possibility of a satellite being mistaken for a UAV.

- The sun must be at least 10° below the horizon (giving a shadow height of at least 100Km).

- The satellite must be higher than the shadow.

- Faint satellites can only be seen when the shadow height is >100Km but less than the satellite's height, (which may be as low as 200Km).

9. **Earth's Shadow** Evening observations of low satellites are usually possible only during the hour or two while the shadow is climbing from 100Km to the satellite's height. The sequence is reversed in the morning. Because of earth's shadow, a low satellite can only be normally observed from 2 narrow bands of latitude (one in each hemisphere). Figure 4 illustrates the limitations **during northern summer for a satellite in near-polar orbit with the sun in near orbital plane**. The earth's shadow is shown with a sharp edge, but in practice this is fuzzy. The height of earth's shadow is absolutely fundamental for satellite observation, for example, in the Figure (at point P) the shadow height PS is approximately equal to earth's radius (~6000Km), so the only satellites visible overhead at point P would be more than 6000Km high and probably faint and difficult to see. In UAP evaluation most events which catch the eye and might be reported are likely to be bright.

10. Earth's shadow height varies with time of year. Figure 5 shows the variation at 50°N, local time. For viewers near London, Time = GMT. For every degree of longitude west of Greenwich four minutes must be subtracted. This chart can be used two ways; it shows the height of the evening shadow:

- Working from date (e.g. 2 March) at latitude 50°N sunset is ~17.45hrs, twilight lasts nearly one hour - hence the sky will not be dark enough to view satellites until ~18.40hrs, when the shadow height is100Km. By 19.10hrs the shadow has reached 200Km altitude. After that no satellite lower than 200Km height can be seen overhead, though they could still be observed in the West where the shadow height is still lower. By 21.00 hrs the shadow height exceeds 1000Km and many brighter satellites at these altitudes can be seen.

- Alternatively, if the satellite height is known the chart can be used in reverse. This is a less likely scenario in trying to eliminate mis-reported UAV reports.

11. It is observed that (using the 100 and 400 curves at Figure 5) at 50°N on 1 January, the period available for satellite viewing is only from 17.12-18.18hrs. By April this has lengthened to about 1 hour and from approximately 20 May to 20 July a satellite could be seen at any time of the night. In June any satellite higher than 300Km is always above the earth's shadow at latitudes greater than 50°N. These are all important factors in correlation with potential UAP windows of observation. The observing period is actually slightly more than Figure 5 might suggest (since this is plotted for a satellite overhead). Clearly the satellite might be at some other elevation angle. In the dark eastern sky it is sometimes possible to observe before the end of twilight. For a satellite at 400Km altitude at longitudes up to 10° to the west of the observer it is possible to observe up to 40 minutes longer than the figure indicates.

12. A rule of thumb (for 50°N) is that over the greater part of the year (excluding May, June, July) the possible observation time for a faint satellite (~200Km altitude) is one hour and two hours if its height is doubled. As an example (with reference to Figure 5) the observer sees a satellite at 21.30hrs on 29 August the shadow height on the diagram is 500Km. Hence the satellite will be in shadow and visible unless its height exceeds 500Km.

12. **Repeat Observations** Observation of a satellite on successive evenings is subject to longitude changes at which it crosses the latitude of the observer. A satellite appears to be ~1° (0.986°) further west on successive nights due to the 360.986° rotation in 24 hours because the earth spins through 360° 23hrs 56 minutes and spends

SECRET UNCLASSIFIED

UNCLASSIFIED SECRET

the remaining four minutes 'catching up' on the small angle needed to bring it to the same direction relative to the sun. The same satellite will also have a time-shift in arrival at the observer's latitude, by several minutes. Clearly this varies with orbit type. The daily shift to the West is shown at Figure 6 for near circular orbits. Hence, from the UAP aspect reports could be received, shifted in time and elevation angle on successive days/nights with an observer in the same position - or by an observer in a different position.

13. Figure 7 shows two successive ground tracks of a 90 minute period satellite at an inclination of 65°. This shows that the 22.5° shift in track longitude is such that it is unlikely that the same observer will see two successive transits. The spell of visibility of a particular satellite varies as the orbital plane swings westward. For example, a 500Km altitude satellite will reach a point where the shadow height is less than 500Km. The satellite will be visible in the evening for some weeks, but as it swings further west will be invisible because of the glare of the setting sun. Next, it will pass over in daylight for many weeks, then into morning twilight and after a spell of potential morning visibility will once again enter eclipse before repeating the cycle.

14. **Spells of Visibility** Satellites (in circular orbit) can pass over on either a north or southbound track. It is important to note the concept of 'spells of visibility' because these are likely to generate successive spurious UAP reports. It can be shown that evening visibility lasts for $v/4(1-\times)$ days, where v is the length of one evening's visibility time and the value × (the daily westward shift) is given from Figure 6. For example, for a satellite at 400km altitude, visibility is ~2 hours per evening/night, the value of × is zero (polar orbit), the visibility is 30 days. With an inclination of 70°, period 92 minutes, then × is 2.8 (Figure 6), hence the spell of visibility is reduced to $30/3.8 \approx 8$ days. If satellite height is increased the spell of visibility increases. This rule of thumb becomes inaccurate after ~ 1 month - but is of no concern for UAP elimination purposes. The important fact is that a given satellite is observable (given atmospheric clarity) for a number of successive days and this can result in mistaken reporting as a UAP on one or more of these days.

15. After a spell of visibility a circular orbit satellite becomes visible again (from the same location) after $1440/4\ (1+\times)$ days or $12/(1+\times)$ months. Slightly different rules apply to eccentric orbits.

16. **Angle of Elevation** This is one parameter which often occurs in UAP reports. Figure 8(a) and 8(b) show the angle/range/altitude relationship.

17. **Flash Periods** It is possible to time the satellite flash period. This feature may appear in UAP reports. Flashes (seen with the naked eye) from MOLNIYA satellites have been reported at once per minute (even from 40,000km range). These flashes tend to come from flat panels and have magnitudes which can exceed those of VENUS at its brightest.

18. **Sightline Rates** UAP reports occasionally include times and angles. Some examples are:

(a) Satellite at 200km altitude. The minimun orbital speed is $7900 m.s^{-1}$ (e.g. SKYLAB altitude 235km).

(b) Satellite at moon distance travels at $975 m.s^{-1}$.

(c) An equatorial orbit (circular) at 10,200km passes once every eight hours.

(d) A 100-300 nautical mile high orbit passes, typically, once every 90 minutes.

SECRET UNCLASSIFIED

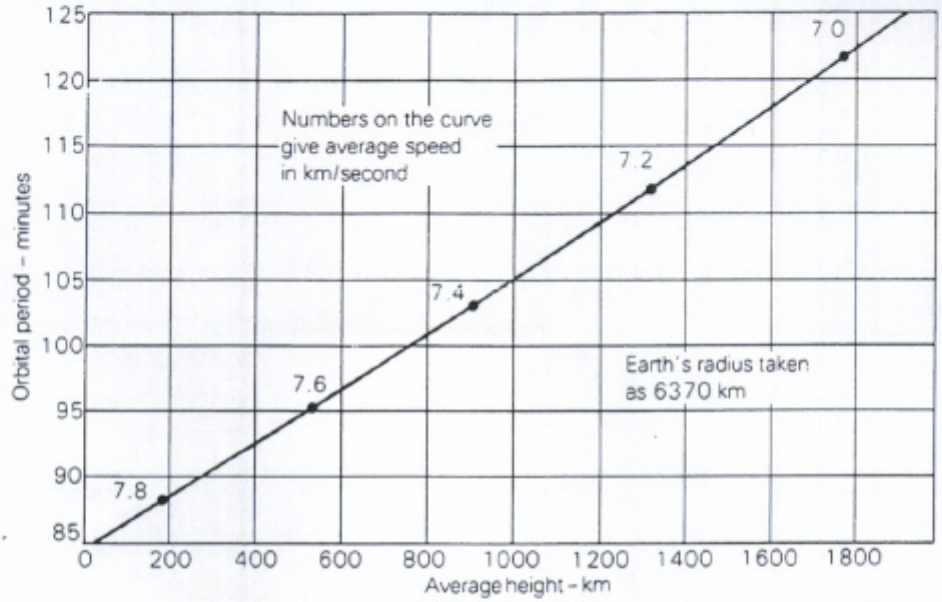


Figure 1: Orbital period of a satellite versus its average height above the Earth (U)

Figure 2: Photograph of the descent of Skylab 1 over Australia on 11 July 1979 (U)

UNCLASSIFIED SECRET

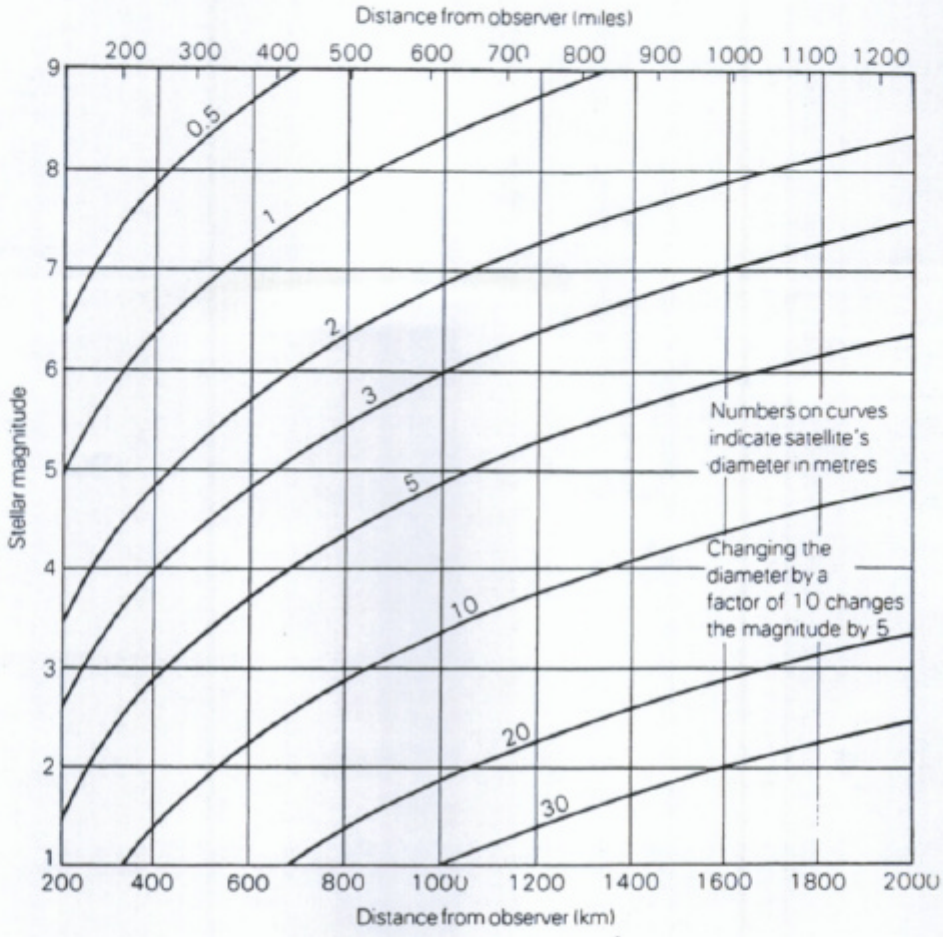


Figure 3: Spherical Satellite - Visual Brightness for given Range and Diameter (U)

UNCLASSIFIED SECRET

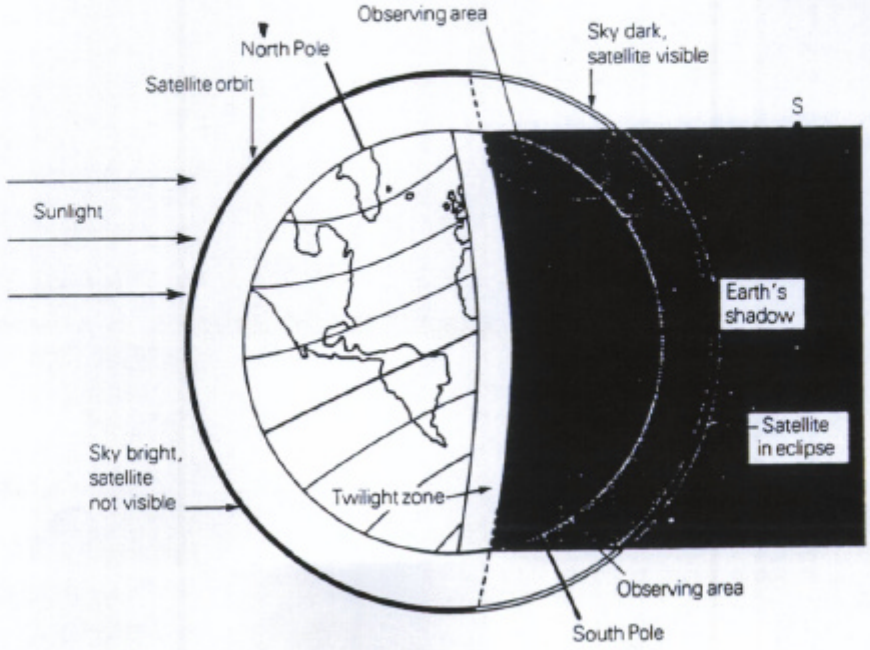


Figure 4: Example - Satellite Visibility Sectors (U)

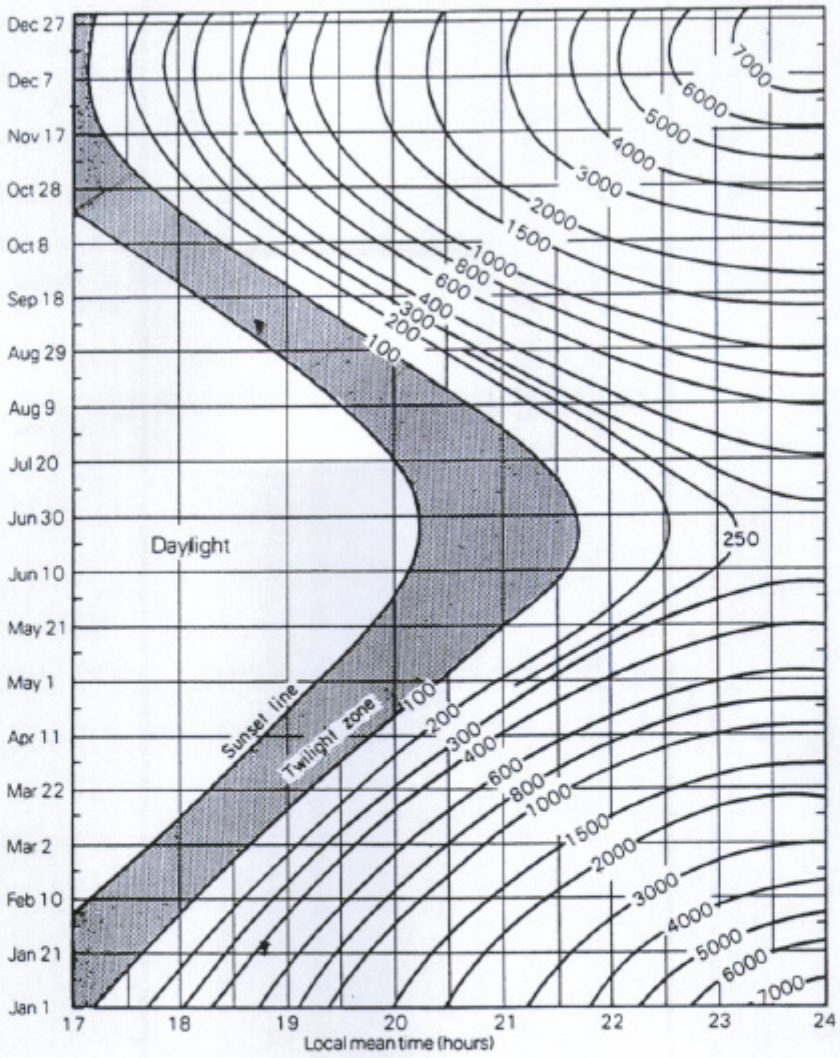


Figure 5: Satellite Viewing Windows (for Latitude 50°N) for Earth's Shadow Altitudes up to 7000Km (U)

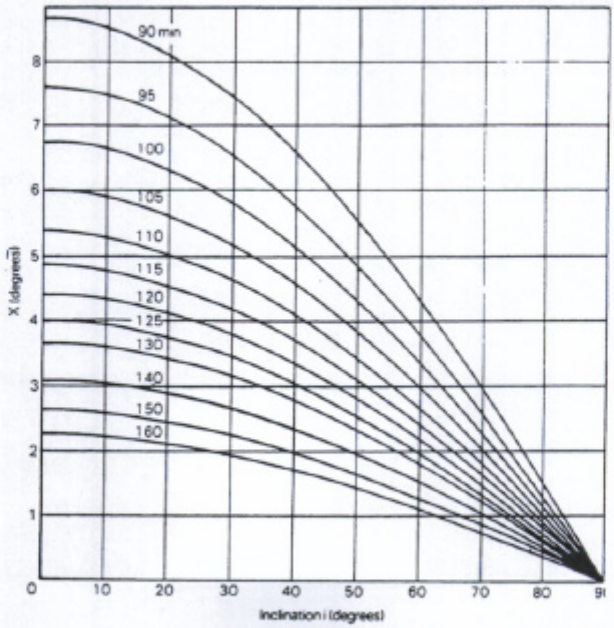


Figure 6: Daily Shift of Observed Position to the West for given Orbital Period (U)

Note: X (Degrees) is Nodal Regression.

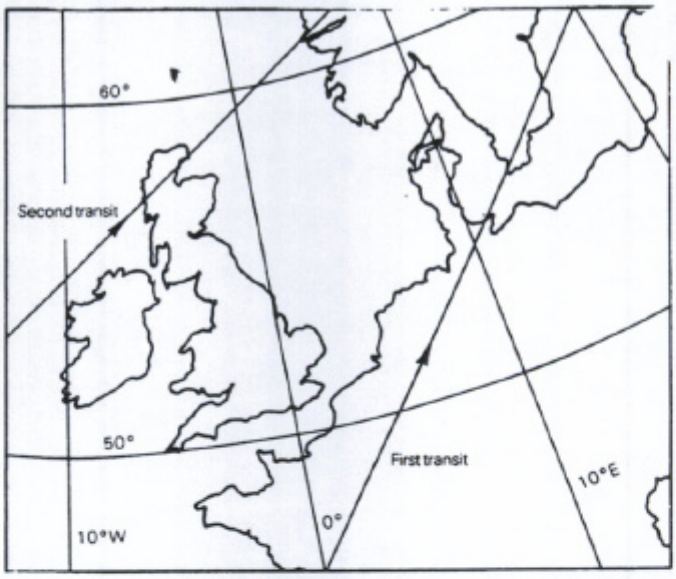


Figure 7: 90 Minute Orbit Tracks at 65° Inclination (U)

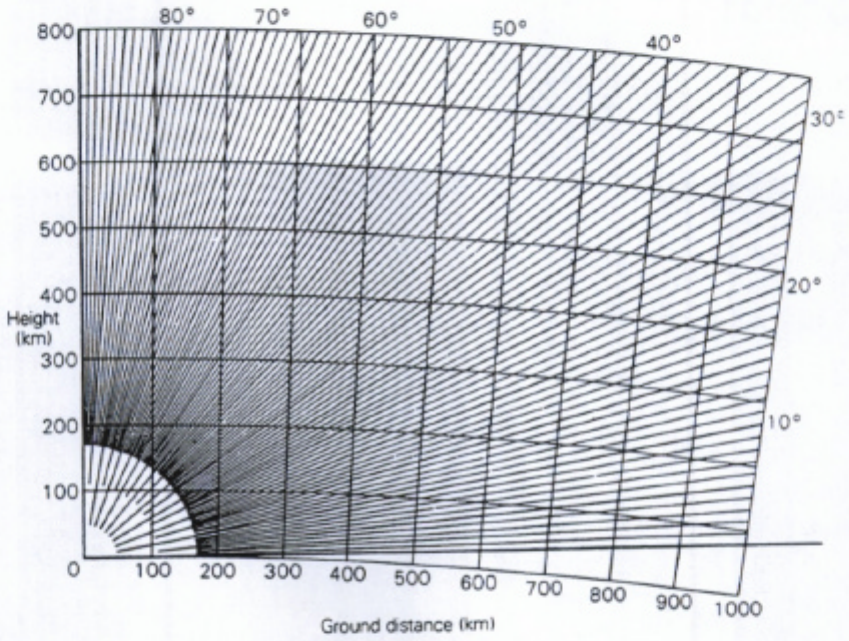


Figure 8(a): Satellite Elevation to 800Km Altitude (U)

UNCLASSIFIED
SECRET

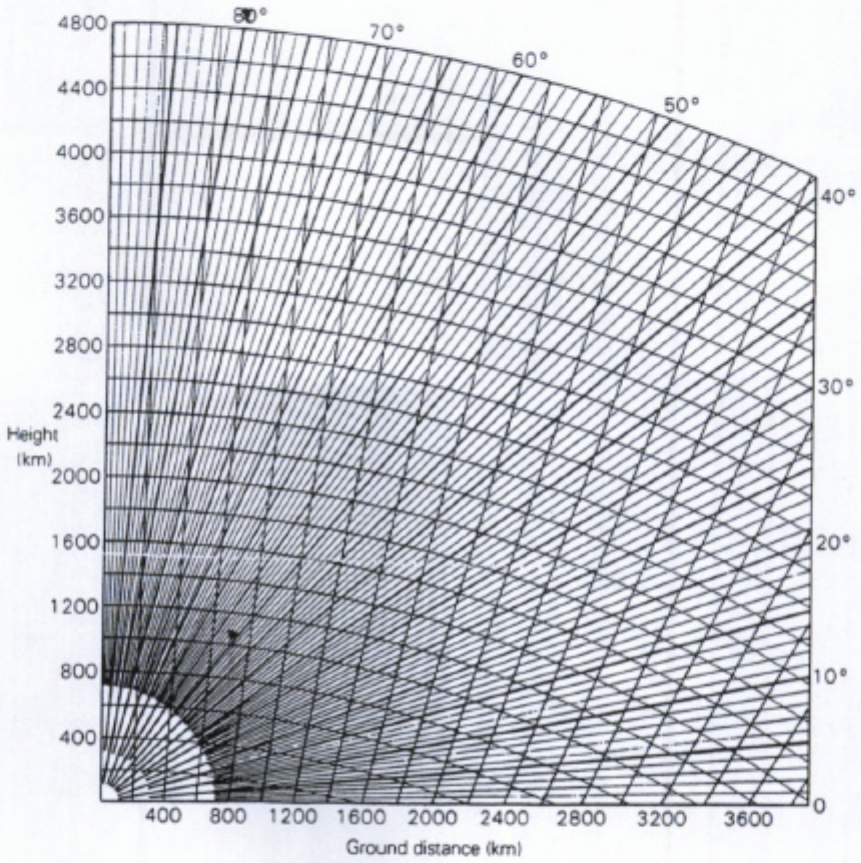


Figure 8(b): Satellite Elevation to 3000Km Altitude (U)

UNCLASSIFIED
SECRET

UNCLASSIFIED

WORKING PAPER NO. 18

PROJECTED SHAPES/SHADOWS, FLUORESCENCE, LUMINESCENCE & SONOLUMINESCENCE

	Para	Page
PROJECTED SHAPES AND SHADOWS	1	18-1
FLUORESCENCE AND LUMINESCENCE	3	18-1
ABSORPTION AND SCATTERING	4	18-1
Gas Absorption	6	18-2
Aerosol Fluorescence	7	18-2
Scattering Intensity	8	18-2
Pollution	9	18-2
SONOLUMINESCENCE	10	18-2

UNCLASSIFIED

UNCLASSIFIED SECRET

PROJECTED SHAPES AND SHADOWS

1. Frequently UAP reports suggest shadow shapes (i.e. objects apparently seen in silhouette). It is believed that a proportion of these are projected shadows from any object which is opaque, or near opaque at the wavelength of the surrounding light. Thus a shadow with a fairly sharp edge is reported, although much closer examination would show that the shadow is not absolutely sharp.

2. The shadows of aircraft and helicopters are frequently seen on the ground, often in film or video taken from the same platform. Less well known (to terrestrial observers) is the projection of aircraft shapes on to cloud layers and the consequent moving shadows seen from beneath the clouds. Further, it is possible for rainbow-like arrays to be produced through sunshine via aircraft windows, which can be projected on to clouds some kilometres distant. These can be reported as UAPs with colours.

FLUORESCENCE AND LUMINESCENCE

3. Earthlights are seen in the dark but they are not observed by reflected light They actually provide the light energy which the eye receives and be classed as 'fluorescent'', whereas, luminescence is visible light, generated by the conversion of energy invisible to the eye. Luminescence is a general term classified according to the means of excitation; examples are:

- Photo-luminescence is that generated by radiant energy.
- Bioluminescence is generated by bio-chemical reaction.
- Cathodo-luminescence is generated by electron bombardment.

Luminescence is called fluorescence or phosphorescence, depending on the rate of decay; phosphorescence persists for some time. Fluorescence ceases when electron bombardment stops (i.e. within ~10^{-8} sec.). Therefore to obtain continued fluorescence, continuous electron bombardment is needed. (See also para 6 below).

ABSORPTION AND SCATTERING

4. When ambient light impinges on a gas its intensity is affected by the absorption and, as a result its velocity will be less in the medium than in free space. The meduim may not reduce the intensity by equal amounts for all wavelengths. No substance is known which absorbs all wavelengths equally, although some can approach this condition over a wide range of wavelengths. Normally one would expect selective absorption to occur.

5. Bodies can cause different effects for transmitted and reflected light. Hence, an observer on one side of the body, receiving energy which has passed through a gas may observe one colour, whereas an observer of the same object using reflected (i.e. back-scattered) light can see a different colour. True absorption represents the actual disappearance of light, the energy of which is converted to heat motion of the molecules. In the UAP context there appears to be complete absorption when a totally 'black' shape

UNCLASSIFIED SECRET

UNCLASSIFIED
UK RESTRICTED

appears between what are taken to be highly charged 'balls' seen as sources of coloured or white light, usually at the extremities, forming a triangle, cone or rectangle.

6. **Gas Absorption** The absorption spectra of gases at ordinary pressures show narrow dark lines, although it is possible to find regions of continuous absorption. After an atom or molecule has taken up energy from light it may collide with another particle and an average increase in the velocity of particles may occur. Each atom energised can only exist for 10^{-7} to 10^{-8} sec. and unless a collision occurs the energy will be emitted as radiation. At low pressures the time between collisions is long, hence the gas becomes a source of radiation and there is not true absorption. The re-emitted light often has the same wavelength (resonance radiation). Under some circumstances the re-emitted light may have a longer wavelength than the incident light. This is known as fluorescence. In either resonance or fluorescence some of the light will be removed and dark lines would be seen in an examination of the spectral response.

7. **Aerosol Fluorescence** If it is postulated that some UAP comprise clouds of aerosol particles, then it is necessary, briefly, to examine fluorescence from solids. According to Stoke's Law the wavelength of the fluorescent light is always longer than that of the absorbed light. In the UAP context it seems unlikely that (if fluorescence is indeed the mechanism of making an aerosol cloud appear as a visible mass) this could be caused by radiation of the particles by any radar system. The source radiation must be shorter in wavelength than visible light, leading to the postulation that the cause may be IR or UV bursts from a natural source.

8. **Scattering Intensity** The scattered intensity is proportional to the incident intensity and to the square of the volume of the scattering particle and on wavelength. Hence, if an aerosol cloud exists (say at high altitude) and is radiated with a light source, the reflected light seen by an observer will be critically dependent on particle size. Long waves would be expected to be less effectively scattered than short ones because the particles themselves present obstructions to the waves, which are smaller (compared with the wavelength) for long waves than for short ones. The intensity viewed is proportional to $1/\lambda^4$. As red light (λ = 7200) has a wavelength 1.8 times as great as violet light (λ = 4000) the law predicts $(1.8)^4$ or ten times greater scattering for the violet light from particles much smaller than the wavelength of either colour. Hence, if white light is scattered from sufficiently fine particles the scattered light always has a bluish colour. If the size of the particles is larger, then the scattered light becomes whiter.

9. **Pollution** In passing it is suggested that the reported increase in atmospheric pollution (particularly over large cities) may have a bearing on the charged aerosol phenomena (reported at Working Paper No. 19) and thereby the increasing incidence of UAP reports. That there is a clear connection with the particles in suspension in earthquake and volcanic zones is reported elsewhere in the report.

SONOLUMINESCENCE

10. Sonoluminescence is the production of wide-spectrum light, visible by the human eye, due to the compression of gas

UNCLASSIFIED
UK RESTRICTED

UNCLASSIFIED
SECRET

bubbles by sonic (i.e. sound air pressure) shock waves. While this can be easily reproduced under laboratory conditions under water, and the light emitted extends from IR to UV, covering the entire human eye spectrum, it is not clear whether the conditions could (perhaps exceptionally) exist in the atmosphere. If this is so, then sonoluminescence could be a candidate source for the very short UAP events (e.g. <1 second), which are frequently found when examining the UAP reports. Although it is some 60 years since the discovery of the effect little serious work on understanding and quantifying the phenomenon has been done - mainly because of lack of measurement technology.

11. The science behind the sonoluminescence effect can be summarized as:

- A very small volume must be present (appearing, for example, as a gas bubble (cavity) in water) which must contain a gas other than pure oxygen or nitrogen. However, even a 1% impurity is sufficient to invoke sonoluminescence.

- Successive rarefactions and compressions must be present for the gas to pulsate rapidly.

- The radius of the gas bubble will expand when the pressure goes negative (e.g. for a bubble in water the radius can typically change from 4 to 40 microns).

- The sudden collapse (Rayleigh 1917) reaches supersonic velocities (1.4 kilometres per second quoted), stopping only when the gas in the bubble reaches a 'hard core' minimum radius (when the molecules can get no closer together).

- Photons of several eV energy level are emitted, at which time the temperature is estimated as being in the tens of thousands of degrees K. At this point the bubble surface is reported to 'bounce', with a surface acceleration which exceeds millions of g, causing a non-linear amplification effect (focussing) of the energy

- Several alternative theories are currently proposed for the micro-detail of the effect. However it is clear that flash duration depends upon, among other factors, the intensity of the emission and the gas/water mixture. The **longest** flashes occur with the **brightest** emissions. The effect is also pressure dependent.

- There are close analogies with cavitation bubbles in sonar.

12. The fact that this effect can be seen by the unaided eye was perhaps first reported in the original version of EXODUS (20:18); where "and all the people **saw** the sounds". This was removed in later translations (presumably as being impossible!) If the sonoluminescence effect can be produced, even under exceptional conditions in the atmosphere, it may account for some UAP reports.

UNCLASSIFIED
SECRET

UNCLASSIFIED

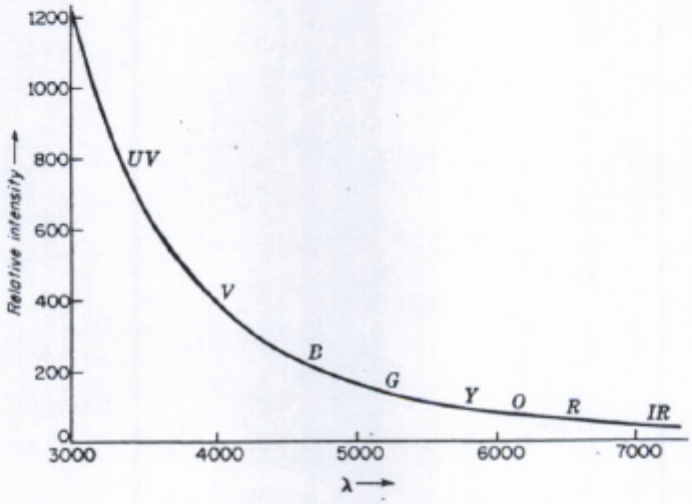


FIGURE 1: INTENSITY OF SCATTERING VS WAVELENGTH (RAYLEIGH'S LAW)

UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 19

CHARGED DUST AEROSOLS - DUSTY PLASMAS

&

ATMOSPHERIC PLASMAS AS REFLECTORS AND ABSORBERS

	Para	Page
Introduction	1	19-1
Streamlined Shaping	4	19-1
UAP Model	6	19-2
Motion	8	19-2
Particle Characteristics	9	19-2
Speed of Cloud	10	19-2
Lights	13	19-3
Colours	14	19-3
Electrical Attraction	15	19-3
Radar Reflections	17	19-4
SUMMARY- Dusty Plasmas	18	19-4
ATMOSPHERIC PLASMAS AS ABSORBERS & REFLECTORS	21	19-4
Plasma Lifetime	22	19-5
Reflection	23	19-5
Absorption	24	19-5
INTERACTIONS		
Plasma Interaction with Objects & Aircraft	26	19-5

XXXXXXXXX S.40

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED SECRET
UK RESTRICTED

CHARGED DUST AEROSOLS - DUSTY PLASMAS

1. **Introduction** There are numerous reports of unidentified flying objects of cigar, toroidal, spherical and a host of other regular shapes moving in earth's atmosphere due to the action of forces of an unknown nature. Depending on the witness's perception at the time, the object can have 'navigation lights', 'searchlights', be of various single colours or even multiple colours. The objects reportedly can change flight direction suddenly, stop, accelerate or decelerate. Reports by aircrew have included "buzzed by shining glass balls or cones" or "like soccer balls made of glass". Mukharev (Russia) [1] takes all these factors into account in his hypothesis that aerosol aggregation can accumulate electrical charges due to the action of the same process (charge mechanisms) as in thunderclouds. There are several types of 'dusty plasma'. For example, 'Dusty Dense' plasmas and 'Dust in a Plasma' are different. In the former the particles remain electrostatically trapped in the plasma volume. A strong electric field is needed in the gas in order to increase ionisation rate and maintain the structure against electron loss. An equilibrium is achieved by the balance between ionisations in the plasma volume and the charged particles lost at the extremities. Within the core of the effect the particles take up an ordered structure (rather like a crystal lattice). Russia has taken a particular interest in combustion plasmas since 1994, and the science of dusty plasmas has recently achieved several milestones. Several researchers have used microspheres as the experimental medium [An area of potential military interest is in the possible use of microspheres as chaff to produce false targets].

[1] Mukharev L.A. " Hypothesis on the Nature of Atmospheric UFO" Radiotekhrika Elektronika No. 8 1991 pp1437-1443

2. When dust particles are between separated charges (e.g. visualise as in a volume between capacitor plates) the dust will suspend in a matrix and a balancing of the charges causes the dust to suspend in flat layers. By using a laser beam it has been shown that the dust can be moved, or the crystal lattice 'fractured'. The radiation intensity of a low power laser can also accelerate the particles and the momentum given to them depends on their size, distribution, surface area and mass. If the sustaining source is removed the dust falls under gravity. Since the particles can be made to form specified alignments, there are specific industrial applications being researched for this technology, but the UAP context is potentially a special case - since clearly if the charge suddenly leaked away, the plasma would vanish. The overall equilibrium of the charged particles in the medium is thus defined by external conditions. It is suggested that Dusty Plasmas may well be closely related to at least some of the UAP reports; which frequently describe what appears to be a plasma (often with several 'centres' of turmoil), which are either attracted towards each other, held by some type of mutual repulsion field at a set distance from each other for long periods, or merge or collapse.

3. Just as in thunderclouds, spark discharges can occur, leading to the formation of an electromagnetic field, it is postulated that because the EM field will vary through the volume (because of the renewal of particles as the cloud moves) this will give rise to a reactive force which will maintain its motion.

4. **Streamlined Shaping** For a high cloud velocity, it is suggested, that those particles which are retained are so held by the amount that the EM field exceeds the surface aerodynamic drag forces. Therefore, once motion commences the 'object' assumes a shape due to aerodynamic drag and naturally becomes 'streamlined' - for example aircraft

UK RESTRICTED
UNCLASSIFIED SECRET

UNCLASSIFIED
UK RESTRICTED

fuselage shaped, (e.g. cigar), flattening sphere (i.e. disc or fat cigar), or even triangular, with curved edges. As air drag will operate in all planes, then all extremities of the original aerosol charged body (whatever its original format) will tend to be 'smoothed'. Eventually the EM field within the charged envelope will dampen and dissipate and the more sharpened contours will disperse and either be no longer recognised as a shape (i.e. as a UAP), or will vanish completely.

5. If high intensity EM field values occur, a gas discharge is possible at its maxima, giving rise to 'bright lights' on the surface of the UAP. (see paragraph 13 below)

6. **UAP Model** Mukharev, commencing with a postulated spherical aerosol, considers the natural equations for the electrical and magnetic oscillation modes, and derives a model. It is postulated that the most probable initial excitation is by streak lightning [Comment: Note that this can be present in either a 'wet' or 'dry' electrical storm condition]. The model estimates the dielectric constant of the medium from which the sphere comprises and Mukharev points out that this is similar to the dielectric constant of a plasma. It is determined by the character of the time-dependence of the field in which the aerosol is located. The ratio of the internal and external dielectric constants sets the conditions. This will depend upon whether the aerosol is one which dampens out with time - in which case a negative dielectric constant is obtained; or one where the field is sinusoidal. Mukharev shows that the amount of energy of the EM field within, say, a $1m^3$ volume of the aerosol cloud is only ~8 Joules. Therefore, it is claimed that the field of the UAP could be excited by a spark discharge.

7. The postulation shows that the aerosol cloud can remain within boundary conditions which do not result in immediate breakdown, but have a finite lifetime. For the purposes of the model it is shown that the Lorentz Force (Earth's Magnetic Field) is negligibly small compared with the aerodynamic drag force. The outcome is a postulated UAP which has motion.

8. **Motion** As the cloud moves in the atmosphere the aerosol particles located at its surface are removed by the air stream. (The energy of the EM fields associated with these particles being transformed into EM momentum). As a consequence of the momentum conservation law, the EM momentum arising within the closed system of the cloud must be compensated by the mechanical momentum. Hence, a force arises at the leading edge of the cloud which causes the cloud to accelerate until the force becomes equal to aerodynamic drag. After some time the cloud gradually decelerates because of the dampening field.

9. **Particle Characteristics** The particles may be variable in diameter and the entire mass of material in the aerosol cloud may amount to only a fraction of a gram. It has been suggested that this low mass, resulting in absence of inertia, may be the reason for the exceptional 'manoeuvrability' suggested by UAP reports; and also a tendency towards rapid acceleration.

10. **Speed of Cloud** It is possible to relate particle size to the drag-force by using the Reynolds number for the particles moving in a laminar stream, at velocity v:

$$Re = \gamma r_a v/\eta$$

/where:

UNCLASSIFIED
UK RESTRICTED

UNCLASSIFIED
UK RESTRICTED

where: γ is the density of the atmospheric medium, r_a the particle radius for 1.5μm. The velocity of laminar noiseless motion is shown below

For this situation Re must be ≤10 (since the radius of the particles, their velocity for $\gamma = 1.29 kg.m^{-3}$ must be inter-related by the conditions $r_a < 1.4 \times 10^{-4}.v^{-1}$. Thus the higher the observed velocity of the UAP the smaller the dimensions of the particles forming it. Examples are:

Particle Radius	1.5μm	0.05mm
Velocity(metres per.second).	280[1]	3
	2340[2]	

Notes: [1] Up to an altitude of ~3Km

[2] At an altitude of 15Km, where the density of the atmosphere has decreased.

11. It is therefore noted that, at 15Km altitude, the aerosol cloud can move at up to about seven times the speed of sound. Hence, this correlates with reports of fast-moving UAPs, much faster than aircraft. An aqueous aerosol moves at high velocity and evaporates quickly. Hence, life time can be short. A long-lived aerosol cloud forming a UAP can only consist of solid dust particles of very small size.

12. The energy of the EM field in the cloud and the aerodynamic (i.e. atmospheric) drag force are proportional to the cloud volume. Therefore the velocity and path taken should not depend on cloud dimensions. For example, if a charged aerosol cloud has moved distance L (e.g. 40km) with a velocity v (e.g. $30ms^{-1}$) a volume density can be calculated (in this case $4 \times 10^3 m^3$).

13. **Lights** For a high field potential (e.g. $>10^5 V_m^{-1}$) an electrodeless corona discharge should occur in the zones of maximum E field intensity; giving rise to light emission from the aerosol cloud. If the field intensity varies throughout the aerosol, localised luminous zones can occur - due to alternate regions of maxima and minima. Hence, it is postulated that 'navigation lights' are reported. In the E_{11} mode, for example two 'lights' or a luminous strip can be formed. If the number of discharge zones increases, the number of 'lights' will increase which will be equally distributed around the cloud as luminous zones or 'portholes'.

14. **Colours** It is suggested that different colours might be produced by the presence of particles in the discharge zones.

15. **Electrical Attraction** If the discharge connects with some conducting object (Earth's surface or aircraft), the 'beam' causes the aerosol cloud to re-orientate and even move along with a moving object such as an aircraft.

16. It is postulated that when 'searchlight beams' are reported from UAPs that most of the energy is concentrated in a discharge cone and can cause damage by the high voltage but very small intensity current. This can lead to involuntary closure of electronic and electrical circuits (switches) and have adverse health effects on humans (see Working Paper No. 25). On the ground the discharge can leave marks, bend grass etc.

UK RESTRICTED
UNCLASSIFIED

UNCLASSIFIED

17. **Radar Reflections** No information has been found on the possible radar reflectivity from charged dust aerosols, but some data is available on radar scatter from 'Dusty Plasmas'. There may well be some overlap in the terminology and applicability. The latter topic is covered at Working Paper No.5, on radar reflectivity.

SUMMARY

18. **Dusty Plasmas** The work reviewed above shows that it is theoretically possible for a charged cloud of particles to exhibit characteristics of visibility and motion similar to many UAP reports received. Further, the implication that atmosphere-borne particles must be present strengthens the proven circumstances where UAPs are reported more frequently in dust-laden scenarios, e.g. near volcanoes and earthquakes. For the uninitiated it would not take too much imagination to observe such a cloud, especially one with bright spots and turn this into a UAP, with portholes!

19. As the formation of clouds (of the charged aerosol type) would clearly depend on the presence of atmospherically-carried particles, it may well be worth making correlation studies of sightings of UAPs with geographical locations where dust is produced, e.g. quarries, or where other pollution particles are emitted (e.g. from power stations or factories). It may also be useful to compare the incidence of sightings in areas taken both during and after cessation of work where dust or other particles are produced. For example, where factories have closed or applied dust/smoke control regimes, or where dusty quarries operated but no longer do so. However, a considerable amount of effort would be required to properly investigate this suggestion. The critical information is not available on the database created for this study.

20. The topics of 'dust in plasmas' and 'dusty plasmas' have become of particular importance in the last two to three years. These plasmas can easily be produced under laboratory conditions, but much more research is required to understand all the mechanisms involved. This may well point towards an understanding of such plasmas in the atmosphere.

ATMOSPHERIC PLASMAS AS REFLECTORS & ABSORBERS

21. The electromagnetic properties of a plasma at atmospheric pressure is an inter-disciplinary topic, combining plasma physics, radio wave propagation, and air chemistry. Plasmas in the atmosphere can either reflect or absorb electromagnetic waves, depending on plasma characteristics. A high reflection co-efficient requires a grazing angle of incidence. A high absorption requires a high collision rate, a low plasma density and a plasma transition of about one wavelength. The power to sustain a plasma in air is high because of the short plasma lifetime unless continuously replenished. The bandwidth, as an absorber, can extend from Metric to I Band. However, absorption peaks at VHF/UHF. In an atmospheric plasma, electrons undergo numerous collisions with atoms and molecules in the background gas(es) and the collisions convert the electromagnetic energy which may be feeding the plasma to heat and damp the essential electron motion. The collision rate varies with pressure and temperature. Also water vapour has an effect - so that, for example, 50% relative humidity approximately doubles the sea-level dry air collision rate.

22. **Plasma Lifetime** The plasma lifetime depends on the electron density and the pressure (altitude). The presence of gases other than those normally in air can change lifetime significantly. For example by a factor of ~10,000 for helium.

UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED

23. **Reflection** If a rapid transition occurs, from free space to plasma (caused, for example, by the presence of large electrical/electromagnetic forces), the plasma will reflect. If the transition is diffuse, the plasma will reflect at a grazing angle. If the plasma transition gradient is too long, then the plasma patch will transmit (i.e. allow through) more energy than it reflects.

24. **Absorption** The absorption bandwidth depends on the collision rate and the plasma gradient. It is possible to generate a plasma absorber which is lightweight, has high attenuation per wavelength and can be switched on and off. Quite apart from any UAP-related properties, it is seen that there are potential military applications in the control of EM scattering and Low Observables.

25. The power requirements to sustain a plasma are dependent on the volume, the electron density required, the energy to generate electron-ion pairs and the lifetime required; and, of course the altitude (pressure) and the medium.

INTERACTIONS

26. **Plasma Interactions with Objects and Aircraft** The interaction of plasmas alone, or when surrounding other objects are complex, since plasmas can act both as absorbers and reflectors. In addition, for transmitters, it has been shown in practice that the presence of a plasma can introduce an inductive reactance into an antenna mounted on a body, thus modifying its performance, causing an increase, for example, in radiated power. The change in radiated power is a function of the ratio of plasma frequency to signal frequency. In the UAP context it seems likely that the response of an impinging EM wave-front on reaching a plasma might be affected. If the radiation from a plasma is capable of modifying an antenna on transmit, then presumably it will do so on receive - hence it seems possible that the presence of a plasma in proximity to a radio receiver (especially at VHF/UHF) may modify the receiver front-end characteristics and even off tune or dampen normal reception. This may well be the cause of reports that receivers, in what could be termed the 'near field' of a UAP, suffer loss of function (receive and transmit) until the UAP and receiver are separated. Usually the UAP moves away or if the vehicle ignition is working, it is hurriedly driven off. In the context of radio transmission, the frequency dependence of this phenomenon also depends upon the inductive reactance introduced by the plasma layer improving the antenna towards resonance and reducing the resistive losses, such that the efficiency is maximised. [Apart from the UAP-related aspects, a factor of military importance may be that the antenna can be made smaller].

27. **Interaction with Aircraft** Because it is usually unclear as to what the entity comprises, coupled with the surprise factor, most encounters with what are clearly charged masses have been assumed to have been with ball lightning (Working Paper No 2). Whether this is the case - and whether charged aerosols are a variation of the same physical realisation - is not currently clear. The laws of motion of a plasma ball and the effects when in close proximity to an aircraft in flight are of special interest to MOD. It is assumed that the charge on the ball diminishes with time, due to the leakage, where the air layer is adjacent to the ball's surface. In effect it is likely to behave as a non-deformable solid sphere, in aerodynamic terms, in a flow of non-compressible fluid. The charged mass is likely to be 'captured' by the exhaust of aircraft engines and to follow the aircraft, maintaining both its shape and keeping a constant distance from the tail assembly. It is further assumed that the force required (which, if it were a solid ball would be required to overcome drag and stay behind the aircraft.

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED

This force would be several tons!) is much less in practice. It seems probable that the air-stream would lose some of its viscous properties over the surface of the sphere (i.e. the presence of the plasma, it is suggested, would reduce drag). This has been shown to be the case in experimental observations. Frequent reports in Russia suggest that plasmas/charged bodies start to respond to the presence of an aircraft at a range of about 10km. N. I. Gaidukov and others have published papers on this phenomenon. Frequently, large aircraft crews have found (and indeed the Russian Aviation authorities now advise them) that if the plasma appears ahead of the aircraft, while it is impossible to lose the attracted entity by acceleration, it is nevertheless possible to carry out manoeuvres to make the mass fall astern, where it will remain until it dissipates, with no further danger to the aircraft. The Russians have reportedly lost aircraft to ball lightning (it is not clear whether these are the same claims as the four fatalities they have had chasing "'UFOs"), hence their particular interest in the phenomenon, and the large number of published papers.

UNCLASSIFIED

UNCLASSIFIED

WORKING PAPER NO. 20

OPTICAL MIRAGES

	Para	Page
OPTICAL MIRAGES		
Optical Conditions	1	20-1
Object Position	2	20-1
UAP CONTEXT	3	20-2

XXXXXXXXX S.40

UNCLASSIFIED

SECRET
UNCLASSIFIED
UK RESTRICTED

OPTICAL MIRAGES

1. **Optical Conditions** An optical mirage is a phenomenon associated with the refraction of light in a cloud-free atmosphere, resulting in the apparent displacement of a distant object. The refraction is caused by abnormal air densities, which cause the light to travel in a curvilinear path. Object shapes can be distorted and scintillation can cause rapid changes in the observed colour, shape and position of the object. For a stationary observer the effect can last for hours; for a moving observer only seconds or minutes. Mirages have the following characteristics:-

- Mirage images are seen at low grazing angles near the horizontal plane.
- Mirages can only be seen if there is a long uninterrupted sightline.
- Mirages are associated with atmospheric gradients which give anomalous propagation
- Focusing and interference of the wavefronts can give rapid movement and enhanced brightening.
- Distortions and colour changes can be accompanied by multiple images.
- Objects on the surface (e.g. ships) can appear as if they are elevated.

2. **Object Position** The amount the object is apparently (visually) displaced from its true position (angle) depends on the variability of the density of the medium (hence its value of refraction index). The effect is well understood in physical optics, and is pressure (P), temperature (T) and wavelength (λ) dependent. The spatial variations can be expressed in terms of P, T and λ and the resulting practical values of refraction (minutes of arc per km) for the ratio of temperature to altitude is significant. In the simplest terms this means that:

- One degree of arc represents the largest angular change between the true and false (mirage) position of an object.
- When the image appears **above** the true position this is know as a **superior** mirage. When below the true position, the term used is an **inferior** mirage.
- There must be the coincident conditions of a temperature inversion **and** the presence of light to illuminate the object at grazing angle.
- Vertical stretching can lead an observer to **under estimate** the true distance to the luminous object.

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED

UAP CONTEXT

3. The key factor in eliminating or including the mirage phenomena as a potential UAP event is that of low grazing angles and long distances, since it is unlikely (from the type of UAP details usually received) that the other detailed meteorological conditions will be known. In the UKADR the combination of long path lengths and low grazing angles is more likely to occur at sea.

UNCLASSIFIED

SECRET
UNCLASSIFIED
UK RESTRICTED

WORKING PAPER NO. 21

IONOSPHERIC PLASMA

	Para	Page
Formation of Plasma	1	21-1
Extent	3	21-1
Motion	4	21-1
Power	5	21-2
Radar Echoes	6	21-2

XXXXXXXXX S.40

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED SECRET

IONOSPHERIC PLASMA

1. **Formation Of Plasma** Within the troposphere operate powerful processes which orientate the separation of electric charges; for example, thunder conditions give rise to huge vertical separation of charges. Meanwhile it is understood, that wind is responsible for horizontal charge distribution. When charges are displaced it is possible for the creation of image charges which make the ionospheric plasma unstable, with the result that a downward electron stream is ejected from the bottom of the ionosphere which may produce 'airglow' in a narrow high altitude band. Because these visible manifestations can be seen at night, they are often described as 'nocturnal lights'. They appear to have a close connection with one class of UAP sighting.

Figure 1[1] Shows the mechanism, which is explained in the following sequence:

- Due to wind over the earth's surface in a hilly region a positive charge is deposited on the hills.
- A negative charge becomes attracted to the moving air mass (shown moving to the right on the figure).
- Corresponding 'mirror' charge images are formed with an upward E field (E_U) above the hills and a balancing downward field (E_D) restores equilibrium.
- At the ionosphere E_U causes instability and an electron stream from the ionosphere is downward-accelerated by the electric force.
- 'Airglows' (UAPs) are formed when electrons are stopped in the lower atmosphere.
- The glows or 'nocturnal lights' occur in a relatively thin altitude layer and visually appear as bright spots of appreciable angular size moving across the night sky.

2. The supporting theory is explained in some detail at [1]. It seems likely that the reports of 'silvery discs' at very high altitude are the same phenomenon. Below ionospheric altitudes researchers agree that air conductivity cannot prevent the onset of electric fields of considerable strength. In effect the middle atmosphere can become electrically de-coupled from the ionosphere. The ground and the ionosphere can be considered, in effect, two plates of an enormous capacitor. The conductivity of the ionosphere is of solar origin (hence, the investigations elswhere in this report on possible solar flux/solar flare coonections with the rate of UAP reports).

3. **Extent** The size of 'nocturnal lights', which is believed to be produced by an electron stream which penetrates to the lower atmosphere, is considerable, in order to be seen at long visual distances (slant ranges) of ~100km, where, it is calculated, the diameter can be several hundred metres. [As an example, an object of 905m diameter at 100km range has the same **angular** extent as that of the moon].

[1] BROVETTO P AND MAXIA V. "On the Instability of the Ionospheric Plasma...." ILNUOVO CIMENTO Italy 1995.

UNCLASSIFIED SECRET

UNCLASSIFIED

4. **Motion** A high angular velocity is produced because the phenomenon is light (i.e. nothing (no mass) actually moves physically). It is analogous to the movement of a CRT beam when the spot (i.e. UAP) moves. The very high angular velocity can give the impression that the light is at much lower altitude than is the case. The actual altitude of the nocturnal lights is ~50km.

5. **Power** Light emission occurs when ionized molecules or ionized atoms re-combine with electrons, with a sharp increase when the electrons are stopped. At the path end, when the electrons are stopped, a disc-shaped light is always originated, with its axis always parallel to the earth's geomagnetic field. The power of reflected light which is required for an observer on Earth (by comparison with that from other air-objects, including satellites) is estimated as between 0.3 and 3kW. A calculation of power (with its emission as visible energy) available from the postulated electric field phenomena, is 10 to 100kW, well exceeding that required.

6. **Radar Echoes** Radar echoes can be obtained due to the conductivity of the ionised air. The light emitting layer, caused by the electrons, is probably an effective radar target although, in some instances, this would be well above the elevation-slant range capability of typical terrestrial search radars, and beyond the slant range of air intercept radars. Radar detection of UAP is considered in Volume 2, Working Paper No 5 and at Volume 3.

UNCLASSIFIED

SECRET
UNCLASSIFIED
UK RESTRICTED

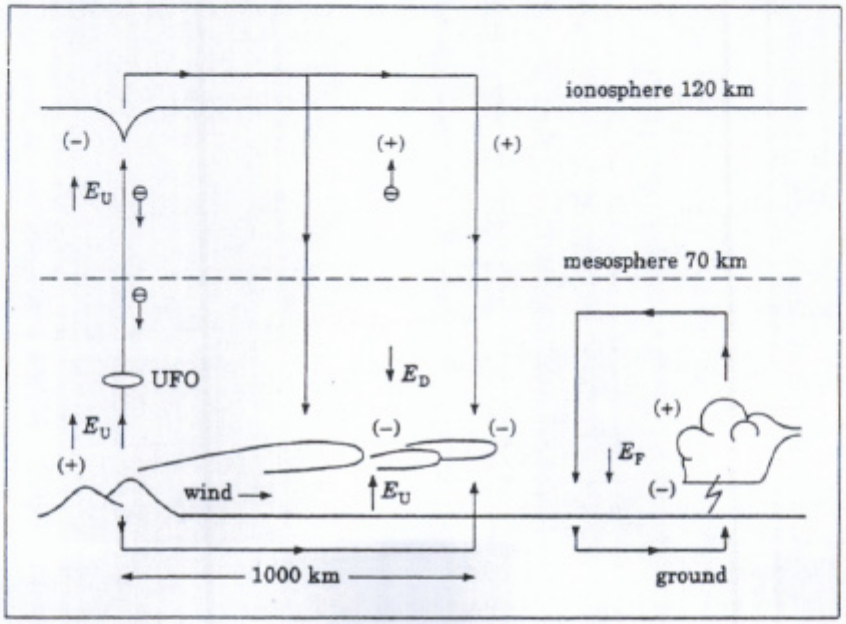


FIGURE 1: CONDITIONS FOR IONOSPHERIC PLASMA FORMATION

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 22

ARTEFACTS

	Para	Page
'Angel Hair'	1	22-1
Metallic Artefacts	2	22-1
Summary	3	22-1

XXXXXXXXX S.40

UNCLASSIFIED
UK RESTRICTED
SECRET

SECRET
UNCLASSIFIED

'ANGEL HAIR'

1. It is believed that this fibrous material resembling filaments, spider webs or candy-floss-like streamers is formed by reciprocal attraction between polarised dust particles. Sometimes the material is sticky. It can be carried large distances before being deposited and has been likened to long chaff and has even been named 'spacegrass'. It can leave a smoky or misty deposit. The thin filaments appear to be an electrostatic precipitation of atmospheric dust, which is unstable, and which eventually disintegrates and vanishes. On at least one occasion a UK witness has collected what was probably 'angel hair' in a jar, believing it to have come from a 'UFO' which "hovered at the bottom of his garden". The author of this report personally observed this material drifting in a light breeze in Norfolk on a hot but breezy summer's day in 1997.

METALLIC ARTEFACTS

2. Although no such artefacts have been found in the UKADR, it is claimed in Russia and Ukraine that items have been scientifically analysed. The results are not known. The Russians, like the USA, have never produced the artefacts which are claimed by some media reports to have been found. This seems to be quite extraordinary in view of the fact that it would be resonable to expect that this might solve the extra-terrestrial hypothesis of 'UFO' origins once and for all. The Brazilian claim of 'extra-pure aluminium' artefacts was not sustainable after analysis.

SUMMARY

3. No proven tangible artefacts have been obtained by the public for display, or shown by governments to exist. The metallic materials analysed scientifically have not been shown to be of unknown elements. **It is a fact that that some materials have entered the earth's atmosphere as a result of meteor activity and have survived to impact. Analysis has shown nothing to connect these with any type of flying vehicle or threat. MOD does not hold any such material**

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 23

LINKED VORTEX RINGS

	Para	Page
LINKED VORTEX RINGS	**1**	**23-1**
Experimental Vortices	**2**	**23-1**
Challenger Spacecraft Video Recording	**4**	**23-1**

XXXXXXXXXX S.40

UK RESTRICTED
SECRET
UNCLASSIFIED

SECRET
UNCLASSIFIED

LINKED VORTEX RINGS

1. Quite apart from the possibility of water spouts, dust eddies, whirlwinds and similar atmospheric vortex phenomena, which can be reported as UAPs, there is the possibility of linked vortex rings, such as those filmed from the US spacecraft Challenger on its post-launch ascent. It is suggested that aerial formations of this kind may be related to the UK sightings of the type shown at Working Paper No. 11, Figures 2 to 7 .

2. **Experimental Vortices**
Experimental work has been done[1] on linked vortex rings and this phenomenon has been modelled. Initially the vortex rings are formed separately. Under certain conditions, when collisions occur, linking is possible of distinctively separate rings. Some results shown at Figures 1(a) and (b). The appearance of linked vortices to an observer clearly depends:

- The viewing aspect.
- The relative position of the viewing light source.

3. If the ring assembly is rotating slowly then the component strands might be visible. The Challenger example cited shows the complex component strands (which, overall, could be described as being contained in a cylindrical volume) rotating (rolling) about its radius at an estimated rate of about 50-60 times a minute. However, if the structure was not rotating and viewed, for example, end-on, it would appear as either a solid ball, reflecting light according to the scattering of its component particles or as a dark spherical silhouette if between the sun (or light source, such as light cloud background) and the observer.

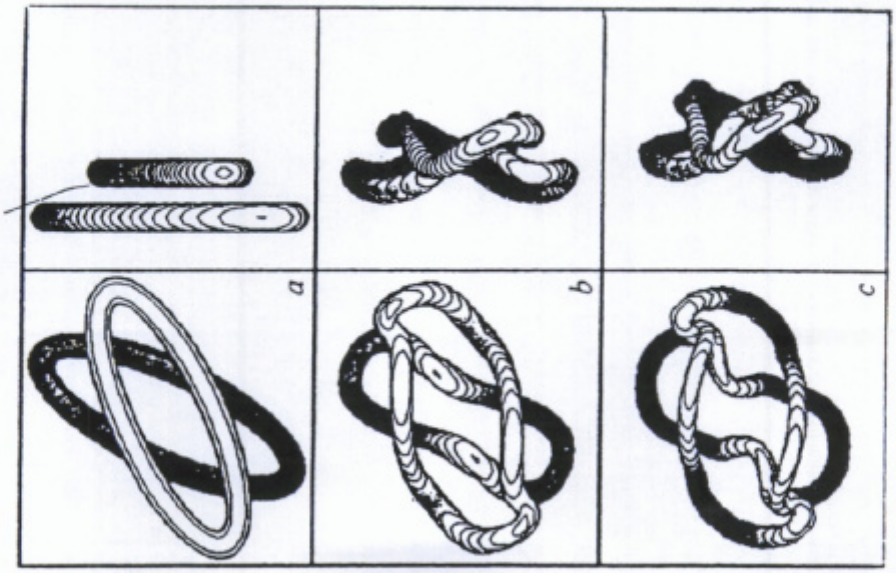
4. **Challenger Spacecraft Video Recording** The few extant reports on this topic (which were fortuitously connected with the Challenger incident only because the Department had collected open-source material on this space-launch) are not connected with UAPs, since the unusual effects are studied purely from the interest of fluid physics. However, the brief footage taken by the Challenger crew seems to be very similar indeed to a number of UAP reports received by the Department. Some examples are at Figure 2. Unfortunately the imagery taken from the video does not do justice to the original, which can clearly be seen 'rolling', or 'tumbling', as described above.

5. No attempt has been made in this brief investigation to correlate the 'linked vortex' postulation with the conditions for their formation in the atmosphere or of a possible combination of this effect with an electrical/charged particle or EM field effect.

[1] "Linking of Vortex Rings" Aref and Zawadzki. Nature Vol. 354 Nov 1991.

UNCLASSIFIED
SECRET

UNCLASSIFIED
UK RESTRICTED



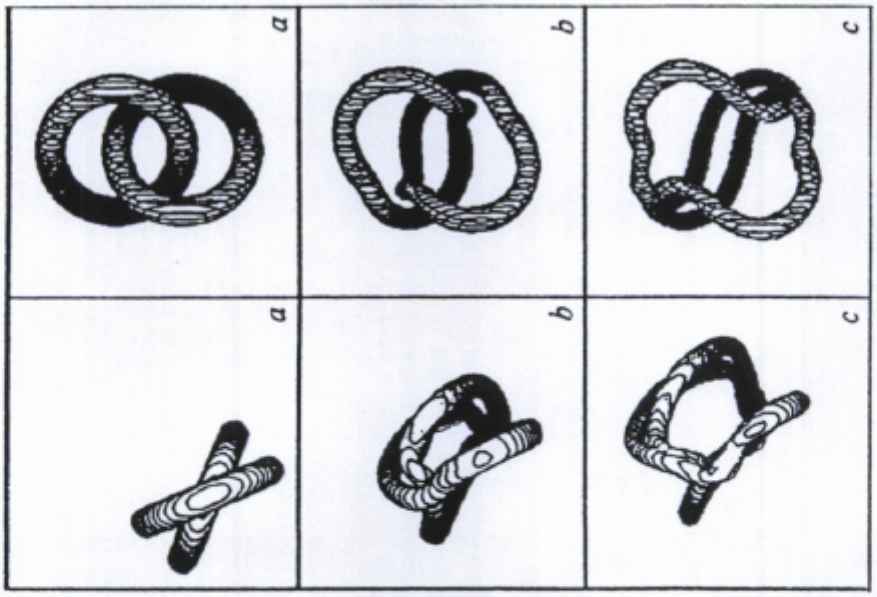


FIGURE 1(a): LINKED VORTEX RINGS

UK RESTRICTED
UNCLASSIFIED

SECRET
UNCLASSIFIED

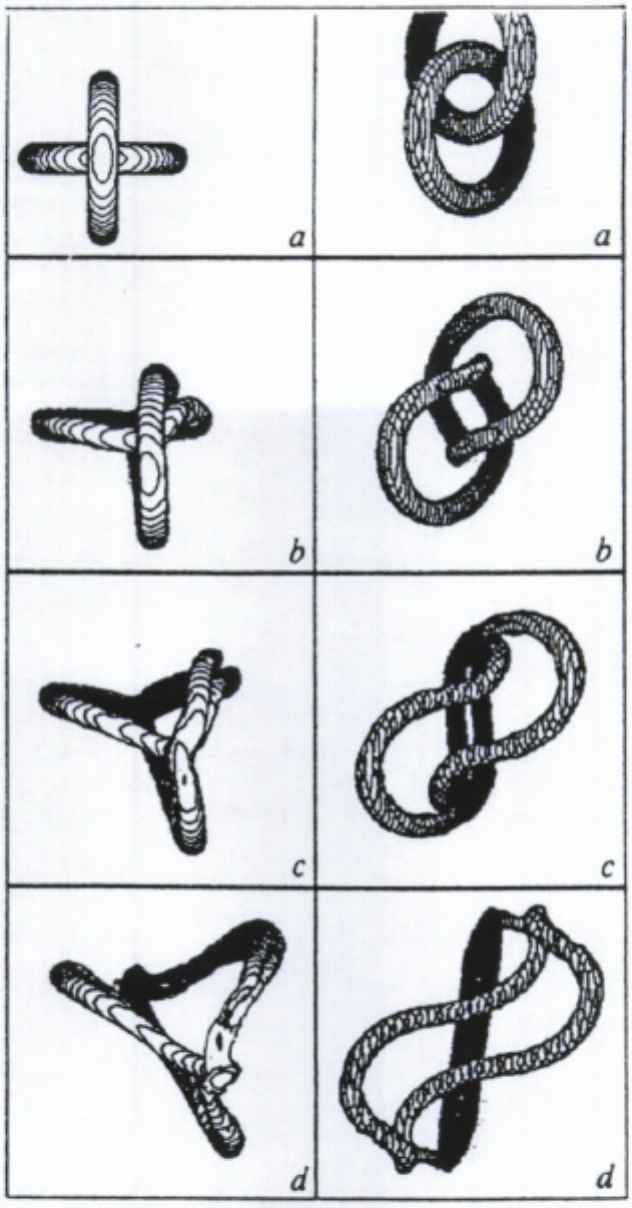


FIGURE 1(b): LINKED VORTEX RINGS

UNCLASSIFIED
SECRET

UNCLASSIFIED

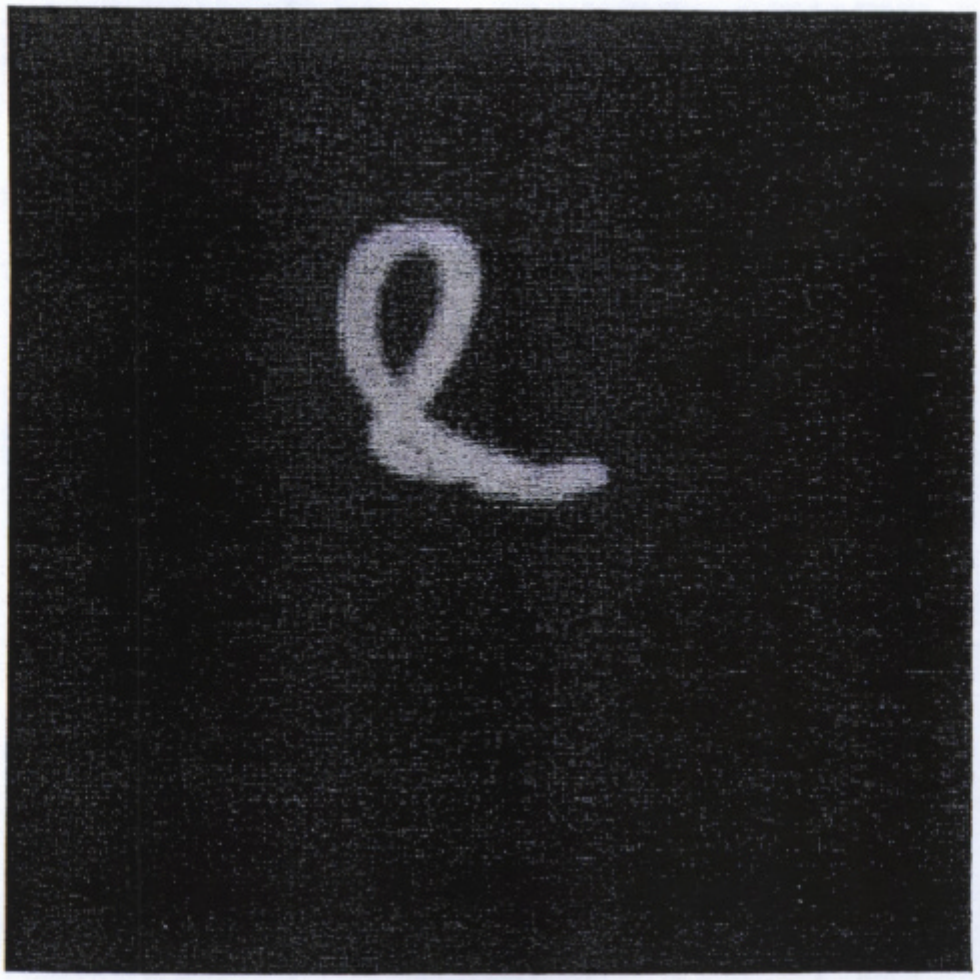


FIGURE 2: ROTATING/TUMBLING OBJECT (CHALLENGER SPACECRAFT)

UNCLASSIFIED

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 24

'SPRITES', 'ELVES' AND 'BLUE JETS'

(ATMOSPHERIC AND IONOSPHERIC PHENOMENA)

	Para	Page
INTRODUCTION	1	24-1
SPRITES	2	24-1
Measurements	4	24-1
Effect on RF Propagation	7	24-2
TERRESTRIAL GAMMA FLASHES	8	24-2
BLUE JETS	9	24-2
POSSIBLE UAP LINKS	10	24-2
EXTERNAL ENERGISATION	11	24-2
OBSERVATION OF SPRITES	12	24-3

 XXXXXXXXX S.40

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
UK RESTRICTED

SPRITES, ELVES AND BLUE JETS

INTRODUCTION

1. Three types of transient optical luminous vertically-orientated phenomena have been observed at high altitudes above thunderstorms: 'Elves' at roughly 90km, which is an enhanced airglow, 'Sprites', a reddish glow from 50-90km and an upward-moving bluish beam emission from cloud tops, known as 'Jets', below 40km. Large area multi-cell thunderstorms lead to the formation of vertically-orientated cylindrical structures of gravity waves closely resembling those observed in optical emissions associated with transient luminous glows. These are believed to occur as a result of transfer of large amounts of charge (from clouds at altitudes of 5-10km) to the ground. Apart from the visual effects, these charge transfers are known to generate upper ELF Band signals (>300kHz). The Sprite path can also be located at high altitudes between the ionosphere and cloud tops. The luminous emission at low altitude is red. The likely explanation is gas breakdown by the additional electromagnetic fields of lighting discharges. Some Sprite 'bluish tendrils' were observed to extend down to 20-30km altitude. Horizontal magnetic field variations have also been observed in the frequency range of the earth-ionosphere cavity resonance. These phenomena have been studied recently in the USA, Germany and in the Antarctic.

SPRITES

2. Sprites are the older known phenomenon, first being reported 100 years ago. They last tens of milliseconds and can thus be sensed by the human eye. They are sometimes described as 'fan shaped' or 'carrot-like' in shape. They can extend laterally for several kilometres. Other observers have reported 'upward forks', due to divergence of the striations.

3. Electric field discontinuities can occur over stratiform clouds at 10-16km altitude and this is believed to be due to the positive cloud-to-ground discharges. Satellite-based instruments have also detected gamma-ray flashes (see para. 7, below). Current theories suggest that Sprites, Gamma-ray Flashes and Blue Jets are all types of discharge produced by a run-away air breakdown.

4. **Measurements** A TV slit spectrograph recently recorded 25 events and measured optical wavelengths in a band from 540 to 840μm, although other measures have spanned from 450-800 nanometer. The fleeting columns of luminosity have also been imaged by CCD cameras. Sprites are found to have a bright core less than 2km in horizontal dimension, they followed the associated lighting (below the (cumulonimbus) cloud) within a few milliseconds, and rose to peak intensity in 0 to 3 ms, fading a few tens of milliseconds later. Sprites can easily be observed from aircraft and from the ground, and have been seen from spacecraft.

5. More than 150 discharges measured (in the USA) in August 1993 extended, exceptionally, down to cloud tops below 20km altitude. In 1994, 56 Blue Jets were recorded at one location in just 22 minutes. They can extend from anvil cloud tops either partially or fully up to the ionosphere.

UNCLASSIFIED
UK RESTRICTED

SECRET
UNCLASSIFIED

6. The peak intensity of the optical emissions is determined primarily by the removal of the thundercloud charge and its altitude. A vertically striated fine structure of sprites often repeatedly occur in the same place in the sky.

7. **Effect on RF Propagation** At least one researcher has considered red sprites to comprise an infinite vertical slab of plasmas with the ability to backscatter in the VHF/MF RF Bands. The sprite plasma conducting columns are known to produce wide-angle scattering of VLF signals. Further, rapid onset and rapid decay perturbations of sub-ionisphere propagation occurs. The sprite luminosity decays at a much faster rate than the perturbations. Propagation ducting is probably a by-product. Ground-based radar has been used to observe the effect of sprites on propagation in the vicinity of chaff, using both monostatic and bi-static configurations. Hence, sprite effects may be seen on radar.

TERRESTRIAL GAMMA FLASHES (TGFs)

8. A new phenomenon (discovered in the 1990s), known as TGFs, are probably also related to atmospheric lightning. However, the time-duration of TGF (estimated at up to 250μsec) is too short for human observation, which possibly limits at 280μsec and is not, therefore, pursued further in the UAP context (the reader is referred to the Working Paper on After-Images).

BLUE JETS

9. Blue Jet vertical velocities are ~100km.sec^{-1} at about 40-50km altitude. Another, competitive, phenomenon ('Blue Starters') may also occur.

POSSIBLE UAP LINKS

10. Although the field 'trigger' levels and current flows involved in finally ionising the atmosphere to produce sprites and blue jets in visible form are large (assuming all other field conditions and particle conditions are ready), it is postulated that a situation could exist where the charged atmospheric conditions are at the point of transition in which an **added potential** might cause a trigger to occur. This has been briefly investigated because a ship's Master reported a visual UAP event when his radar was first switched-on (in the Baltic Sea). It is assumed, since this occurred on a merchant ship, that the RF was I Band (standard 9375MHz maritime search).

EXTERNAL ENERGISATION

11. The phenomenon is a gas ionisation process for which, when the right threshold conditions exist an additional field is required to trigger the event. It is believed that, for example, a remote, rather than close-by lightning charge could reach the pre-charged volume and cause the glow to be triggered. A short bibliography is at the end of this paper. Since the initial quantification of the effect is quite recent, the following key attributes are taken from the best available (and most relevant to this study) published papers. Further work would be needed to confirm the postulation that a radar (or laser in some cases) could cause the ionisation to occur, thus making a pre-charged but hitherto invisible mass become visible to the human eye. Although the possibility might be linked with sprites/blue jets it is recognised that the 'added' energy available from terrestrial (or airborne) sources will be low in comparison with the huge energy levels in electrical storms. However, the principle is established that any highly charged gas could finally reach ionisation point by the

UNCLASSIFIED

UNCLASSIFIED
SECRET

addition of extra energy. Hence, it does not seem unreasonable that if swamp-gases, (if they are a component of earthlights), or even incompletely formed ball-lightning, might react to the addition of external energy. This, it is suggested, might account for the so-named 'close encounters of the fifth kind', where, it is claimed by ufologists that an airborne visual object appears to respond to, or be modified, by probing it with a terrestrial beam of energy. Since the shipping incident described at para. 11 above, was at I Band, the implications are that this is **at least** possible with I Band military radars (e.g. Air Intercept Radars) if the critical atmospheric conditions exist.

OBSERVATION OF SPRITES

12. It is clear that a visible and measurable phenomenon of red (Sprites), possible with blue offshoots ('tendrils') or blue (Blue Jet) columns exist; and that they can be seen:

- From aircraft, in particular, because they appear where high-flying aircraft are likely to be.
- Above severe thunderstorms.
- On occasions from ground-level when the cloud-breaks allow a sight-line.

The phenomena appear for a few milliseconds and could be reported as UAPs. Working Paper No. 4 confirms that the human eye will detect and possibly retain an after-image on the retina. Finally, they might be 'triggered' by a radar in the vicinity.

BIBLIOGRAPHY:

[1] Cummer S.A. & Inan U.S. "Measurement of Charge Transfer in Sprite-Producing Lightning.....". Geo. Phys. Res. Letters Vol. 24 p.1731-4 15 July 1997.

[2] Nemiroff et al. "Full Wave Calculation of 30 VLF/ LF Wave Fields Radiated from a Lightning Discharge". ISAP 1996 Proc. 1996 Int. Symp. Ant & Prop.

[3] Milikh et al. "Model of Red Sprite Optical Spectra". Geo Pages Res. Letters. Vol. 24 15 Apr. 97.

UNCLASSIFIED
SECRET

UNCLASSIFIED
SECRET
UK RESTRICTED

WORKING PAPER NO. 25

OVERVIEW OF MAGNETIC FIELD EFFECTS ON HUMANS

	Para	Page
INTRODUCTION	1	25-1
NEUROLOGICAL RESPONSE TO MAGNETIC FIELDS	4	25-2
Temporal Lobe Activity	5	25-2
Magnetic Flux Levels	10	25-3
KEY FINDINGS	14	25-4
COMPARISON WITH EARTH'S NATURAL MAGNETIC FIELD	19	25-5

 XXXXXXXXXX S.40

UNCLASSIFIED
UK RESTRICTED
SECRET

SECRET
UNCLASSIFIED

OVERVIEW OF MAGNETIC FIELD EFFECTS ON HUMANS

INTRODUCTION

1. As a result of research (and ignoring man-made air-objects which are frequently mis-reported as UAP and other natural though exceptional meteorological phenomena, such as cloud formations), there appears to be four types of electrical charge-related formations that can occur in the atmosphere, covered in the Working Papers Nos. 1,2,10,19 & 21:

- Ball Lightning
- Ionospheric Plasmas
- Earthlights
- Electrically-charged Aerosols.

It is known that visible and invisible fields can be sensed when close to a UAP. In the absence of any other postulations it is assumed that the fields are electromagnetic or magnetic (or both) in nature. Further away from the object only the emissions in the visible part of the electromagnetic spectrum are sensed; as is frequently the case by human observers, photographic film and video camera detectors. The results summarised are those of medical experiments in which the intention was to study the human brain response to external fields, particularly in the area of epilepsy. There is no UAP connection given in the scientific papers. The connection is made here, because of the apparent relevance to this study.

2. The fields investigated for medical purposes in Canada have some common characteristics, and the scenario which, in 'close encounters', reportedly produces 'alien' and similar descriptions, may be the result of the close proximity of one or more of these field types. The difficulty is that little, if any, instrumentation is available when these phenomena occur - hence suppositions rely on theory with few actual measurements on which to base firm evidence. It is clear that, while some screening from field effects can occur when a witness is in a vehicle, this may not be completely effective. Further, electrical/electronic equipment failure or poor performance or partial failure is often reported at the time, both in vehicle equipment, such as radios - including Police radios - and even ignition failure. For the radios, one theory is that a strong (magnetic) field off-tunes resonant circuits in radios which use ferrite-rod type antennas. Since radio components are normally in a metal box, the implication is that the field couples with the antenna, causing a larger than normal current to flow in the antenna and into the front-end receiver coils, mounted on the ferrite rod.

3. Using the near-field ranges, calculated at Working Paper No. 2, and the example magnetic field levels used to cause temporal lobe effects, it is possible to calculate the minimum energy level which must be at the source. Further, those reports where electrical equipment has been reported as unstable (noisy) or even unworkable until the UAP moved away, have always been scenarios where the UAP has been very close - even overhead. Assuming a free-space magnetic field attenuation, proportional to $1/R^2$ and a signal level (at the observer's position) of 1mG, then, for the ranges shown, the source power is calculated , below:

UNCLASSIFIED
SECRET

UNCLASSIFIED
UK RESTRICTED

Range (m)	Power at Observer (m. Gauss)	Power at Source (m.Gauss)
1	1	1
5	1	25
10	1	100
20	1	400
25	1	625

NEUROLOGICAL RESPONSE TO MAGNETIC FIELDS

4. On several occasions Persinger, et al [1], carried out measurements on volunteers to assess the (medical/neurological) response to bio-frequency magnetic fields; while making concurrent EEG pattern readings on the subjects. In 1990 18 male and 18 female volunteers (University Students) with ages ranging from 18 to 25 years were exposed to 9Hz, 4Hz, and 16Hz fields, plus a sham (control) field. The field strength was varied 0.3mG to 1.0mG (100nT) and pulsed at both polarisations. The fields were generated by solenoids fed, via a filter circuit, with square waves. The resulting imaging effect was caused by the successive rising and falling edge of the square wave and the components 0.1μF, 5.19mH and 5.2Ω resulted in an impulse, with rise-time <0.1msec. The experimental decrease returned to zero polarity within 0.3msec, proceeded through a maximum reversed polarity at 0.6msec and then returned to the zero condition at 1.0msec. Thus, the amplitude of the maximum reversed polarity was 1/6 of the initial rise peak; with a positive and negative mirror at the beginning of each wave. Hence (in the first test case) a 4Hz square wave passed through the circuit, generated 4 initially positive and 4 negative pulses per second. The test chamber was opaque to any other radio interference.

5. **Temporal Lobe Activity** A significant temporal lobe activity was registered. These areas are the most electrically labile of the human brain. It was demonstrated that people who already possess high levels of activity in this area are likely to experience:

- Mystical or paranormal activities
- Fear
- 'Out of body' activities
- Tingling or vibration.

6. The psychological profile of such people is that they are naturally disposed towards inordinate interests in poetry, mystical or the paranormal, philosophical (religious) and a sense of special purpose, whereby infrequent or unusual events (such as transient social or astronomical events) acquire a special, personal, meaning. There are strong connections between temporal lobe response activity and epilepsy.

7. Major factors of interest are that the experiments were made in an acoustically screened (as well as Faraday) chamber to exclude sounds which could be detected and responded to by the temporal lobes. Hence, all responses were caused by

UNCLASSIFIED
UK RESTRICTED

UNCLASSIFIED
SECRET
UK RESTRICTED

the only influence present - the magnetic fields.

8. Two further important factors are noted:

- No artefacts were present in the test area to visually suggest themes (for example a space theme is known to evoke 'alien' presence, a religious artifact is known to evoke reflections on death etc.).

- Elaborations and attributions are known to depend on the personality of the subject. People who display frequent temporal lobe signs generate more frequent and intense experiences.

The former was circumvented by placing the subjects in a plain chamber with low intensity red lighting. The second was, to an extent, reduced by taking an adequate population sample.

9. Instrumentation placed on the subject's head measured the temporal lobe bipolar electroencephalegraphic activity. Test results (which overlap with separate experiments with 85 volunteers, described at paper[1], below) are combined at Table 1. There was a general increase in all classes of experience when the fields were at 4Hz and 9Hz, compared with the 16Hz (and sham) values. It was noted that people who display more intuition (than sensing), perceiving (than judging) and feeling (than thinking), tend to display enhanced temporal lobe signs. The intensity of the spinning and tingling were less than the other 'symptoms' reported.

10. In 1991 Persinger et al continued their neurological experiment, with human subjects. This time they were exposed to spatially-rotated complex magnetic fields applied across the temporal lobes of the brain. It was discovered that the fields markedly increased the interaction with the neuro-electrical ensembles. Several field frequencies and pulse patterns were used. The results indicate that a person's temporal lobe profile affects the types and intensities of experience reported when exposed for short periods to fields of this type. The full list of 'symptoms' produced is shown at the matrix at Table 1. They appear to be amazingly similar to those reported by people who have had close encounters with a UAP. The words used in the Table are those reported by the 85 male and female volunteers (20 to 37 years).

11. **Magnetic Flux Levels** The magnetic field strength was 1mG (100nT). A 16Hz pulsed wave generated more experiences of thought intrusion than a 4Hz wave. A **positive** feedback ringing (also at 4Hz) evoked more visual memories and image than the mirror image of the same wave. The effects included vivid visual sensations, memory fragments, a sense of intense meaning, intrusion of ideas or images, mystical experiences and alterations of boundaries defining 'self'.

12. It was deduced that an applied magnetic sine wave would be minimally effective (compared with the filtered square wave used) **unless** the

UNCLASSIFIED
UK RESTRICTED
SECRET

UNCLASSIFIED
UK RESTRICTED

current densities are sufficient to produce potentially dangerous disruptions in neuronal assemblies.

13. During the experiments the 1Hz to 1kHz magnetic ambient background level was 0.025mG (2.5nT) and hence was negligible. The **rotating** magnetic field was either applied in a ringing or in a pulse burst format (see Fig. 1). The field spatial rotation, presented with four solenoids, comprised patterns of four 4 per second rotated once every two seconds. The research showed, once again, that the phenomenological profile of a person within the experimental setting is a function of his (or her) temporal lobe sensitivity, the demand characteristics of the setting and the magnetic field patterns.

14. The conclusions of the experiments showed that:

- Magnetic fields, rotated bilaterally once every two seconds (over the subject's temporal region) evoked stronger and more frequency experiences than when the field was static.
- Moving yellowish-green and purplish lights were only reported when the field was 'ON'.
- The only 'frequency-specific' effect (within the 4-16Hz region used) was in the enhanced number of thought intrusions when at 16Hz, rather than at 4Hz.
- Smells were reported (when clearly there were none in the test-chamber in reality).
- Normal people, placed in exotic introspective-oriented settings, report experiences that suggest temporal lobe signs and symptoms.
- There is some suggestion that effects might be cumulative.
- The sensitivity of time response as well as what is 'seen or felt' is likely to be conditioned by the subject's personality.

15. In 1996 another experiment was made[3] when another 33 subjects were exposed to four test conditions, a control (sham), left lobes, right lobes and both left and right together. The field level was 10mG (1 microT) and with 1mG (or 0.1 microT) applied on the other side. Exposure periods lasted 15 minutes (Three segments of five mins on, five mins off). The objective was to investigate long term memory effects. The group whose **left hemispheres** had been exposed exhibited approximately **twice** the number of accurate ideas relative to other test conditions. The results show that the complexity of the 'signature', or the 'information' within a magnetic field may be more important than its intensity.

KEY FINDINGS

16. The key question is what does this all mean in the UAP context? The

UK RESTRICTED
UNCLASSIFIED

UNCLASSIFIED

following observations are considered important.

(a) As seen at Table 1 the effects on a human of weak magnetic fields, used for the neurological experiments described, are uncannily similar to these reported by witnesses who have had 'close encounters' with a UAP. The effects experienced depend upon the phenomenological profile of the person.

(b) If a human brain is affected in this particular way it seems logical that a UAP might be emitting similar levels of magnetic energy, since it produces the same effect on an observer.

(c) In the wider context the 'alien', 'time lost', 'spaceship' and other descriptions only ever occur when the observer is very close to the UAP - implying that the human is probably within the UAP near-field and that magnetic (or electro magnetic) emissions are given off in which at least some fall within the energy levels given, at the point where they reach the observer. Clearly, if the observer is some distance away, to achieve an adequate level the signal source must be greater and attenuated by the time it magnetically couples with the subject.

(d) A magnetic field is not the only emission from a UAP, as visible colour emissions are seen by observers at all distances and, on occasions heat is also reported. A spectrum of emissions is, reportedly, present during the medical experiments carried out.

The magnetic field strengths used on the human volunteers, although low, had a dramatic effect. It seems likely that very much stronger source fields must emanate from UAPs if:

- The memory effects last longer.

- The magnetic energy is, reportedly, sufficient to disrupt electronic and electrical equipment, some metres from the UAP.

17. The magnetic field from a UAP could be directional (even highly so) - hence relative aspect of an observer or equipment nearby, to peaks and nulls of magnetic field, might also determine the local effects. The orientation (left or right temporal lobes or both) of the humans to the received direction might be critical.

18. With reference to Table 1 it should be noted that these responses were obtained in a test chamber with zero visual stimulation. If the subject **was** confronted with a visual stimulation in the form of a nearby UAP it can easily be appreciated how the 25 responses listed could, however unwillingly, fit into an 'extra-terrestrial' scenario in the mind of the subject. It is clear that the effect could

UNCLASSIFIED

be sufficiently vivid as to be so real to the witness(es) concerned to warrant a UAP report to the authorities. In 20 out of 25 instances the reports due to the magnetic fields in the test chamber tally with effects felt and reported during close proximity to a UAP. Close encounters are infrequent; witnesses at greater distances do not report these effects. It seems logical to conclude that they are at a range where the field energy is negligible. If the effect is caused purely by a magnetic field, then it seems likely that the field exists between the UAP and earth, with the flux lines 'leaking' to earth sensibly mostly beneath the object, with some fringing effects.

COMPARISON WITH THE EARTH'S NATURAL MAGNETIC FIELD

19. Working Paper No. 12 briefly reports on the natural magnetic field to which every citizen is exposed. It is noted that this amounts (average at mid latitude for the UKADR) to a gamma field value of about 48,850. [Also expressed as 0.485 Gauss or 48,500n Tesla]. Hence, as noted at para 4 above, the bio-magnetic field was only 100nT (i.e. nearly 500 times less than the natural field). **The key observation is that although very weak in comparison, unlike the earth's field, the experimental field was pulsed/rotated.** It therefore seems possible that fields produced by one or more plasma types listed at paragraph 1, above and for example, a plasma conceptually produced by a meteor may radiate. It may also 'pulse' (though, of course, not necessarily at the same rate observed visually; where witnesses very close to UAP events often report 'pulsating lights' and even 'pulsating sounds').

[1] L.A.Ruttan, M.A. Persinger, S Koran. "Enhancement of Temporal Lobe-related Experiences during Brief Exposures to Milligauss Intensity Extremely Low Frequency Magnetic Fields" J of Bio-Electricity 9(1)

[2] M.A Persinger et al. "Differential Effects of Waveforms and the Subjects Possible Temporal Lobe Signs.....Magnetic Fields". J of Bio-Electricity. 10 141-184 1991

[3] P.M.Richards, M.A Persinger, S A Koran. "Modifications of Semantic Memory in Normal Subjects.....Magnetic Field". J of Electro and Magnetobiology 15(2) 141-148 (1996)

UNCLASSIFIED
SECRET
UK RESTRICTED

Experience Number	Magnetic Field Experiments	% of Occasions	Reported UAP Effect Correlates
1	'Felt Dizzy or Odd'[2]	80	❄
2	'Felt presence of someone or something[4]	36	❄
3	'Felt Tingling Sensations'	76	❄
4	'Saw Vivid Images'[3]	65	❄
5	'There were pleasant vibrations'	67	-
6	'I felt as if I had left my own body (detached from)'	46	❄
7	'I experienced anger'	20	[7]
8	'Experienced sadness'	37	[7]
9	I heard a ticking sound'	50	❄
10	'There were odd smells'	9	❄
11	'There were odd tastes in my mouth'	13	❄
12	'I felt as though I was somewhere else'	69	❄
13	'Experienced childhood thoughts'	42	[7]
14	'Same idea kept recurring'	77	❄
15	'Felt as though spinning[1]	36	❄

UNCLASSIFIED
SECRET
UK RESTRICTED

UNCLASSIFIED

Experience Number	Magnetic Field Experiments	% of Occasions	Reported UAP Effect Correlates
16	'Dream-like images'	32	✓
17	'Lights varied in intensity'	16	✓
18	'Experienced fear or terror'	40	✓
19	'I felt the experiences did not come from my own mind'	20	✓
20	'I cannot move'	[6]	✓
21	'Colours blue-purple'[5]	[6]	✓
22	'Colours yellow-golden'[5]	[6]	✓
23	'red-yellow'[5]	[6]	✓
24	'I am moving forward through a closed space on all sides'	[6]	✓
25	'Floating'	[6]	✓

Notes:
[1] "I see something mechanical turning round and round"
[2] "I am flying in the sky"
[3] "I see bats and birds flying"
[4] "There is something in here with me"
[5] "Colours are seen in order, first No. 21, then 22, then 23".
[6] No percentages were given in the results published
[7] The experiences 7, 8, 13 are not observed in any UK UAP reports. It is, of course, possible that these responses are suppressed by the fact that (unlike the medical experiments) UAP witnesses are additionally confronted with the strong visual stimulus of a steady or fluctuating bright white or coloured object in close proximity.

TABLE 1: CORRELATION OF MAGNETIC EXPERIMENTS AND UAP REPORTS

UNCLASSIFIED

UNCLASSIFIED
SECRET

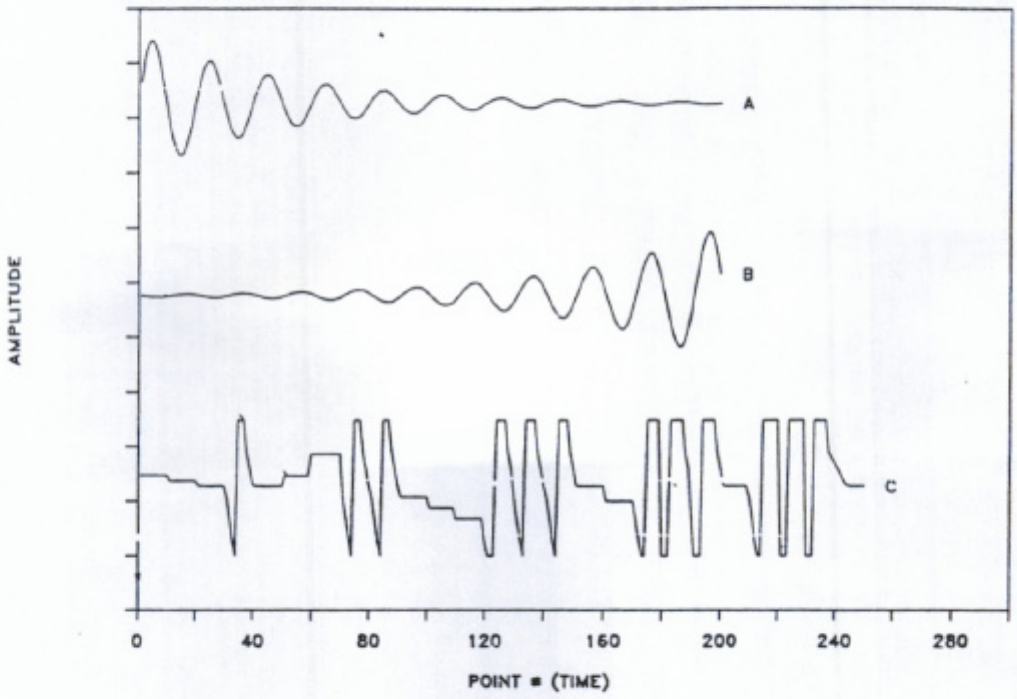


FIGURE 1: RINGING & BURST MODE MAGNETIC MODULATIONS

NOTE: HORIZONTAL SCALE IN MILLISECS

UNCLASSIFIED
SECRET

DIST
D154a2
cd(rw)sp

UNCLASSIFIED
UK SECRET
UK EYES ONLY

Copy No 7 of copies

Unidentified Aerial Phenomena in the UK Air Defence Region: Volume 3

Miscellaneous Related Studies

SCIENTIFIC & TECHNICAL MEMORANDUM - No. 55/2/00

MINISTRY OF DEFENCE
RECEIVED
7 DEC 2000
A31 - 3854
D154 REGISTRY

DEFENCE INTELLIGENCE STAFF

December 2000 Defence Intelligence Analysis Staff

DIS

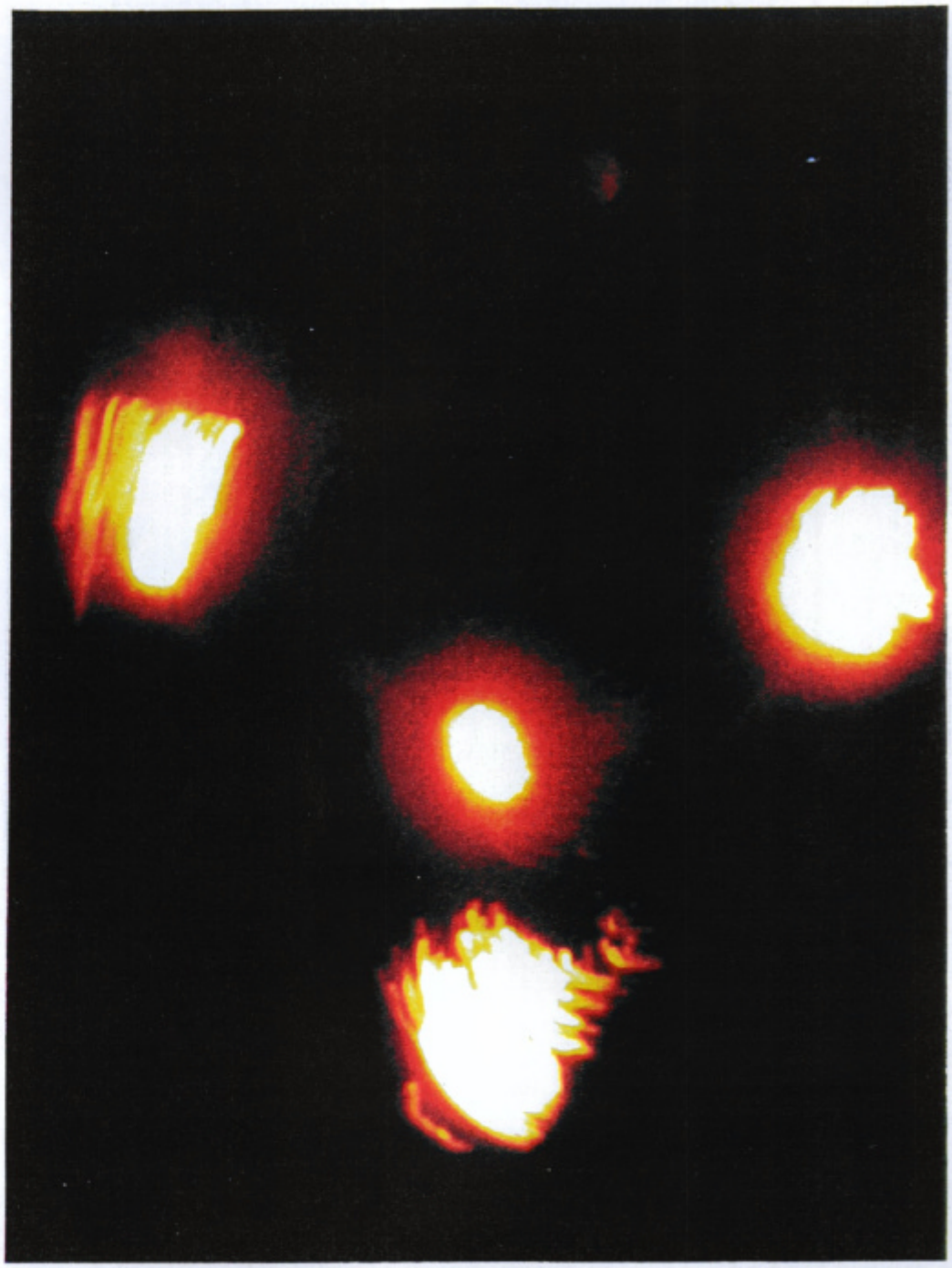
UNCLASSIFIED
UK EYES ONLY
UK SECRET

UNCLASSIFIED

THIS DOCUMENT IS THE PROPERTY OF HER BRITANNIC MAJESTY'S GOVERNMENT, and is issued for the information of such persons only as need to know its contents in the course of official duties. Any person finding this document should hand it to a Service Unit or Police Station for its safe return to the **MINISTRY OF DEFENCE, DEFENCE INTELLIGENCE STAFF, LONDON, SW1,** with particulars of how and where found.

THE UNAUTHORISED RETENTION OF THIS DOCUMENT, OR ITS DESTRUCTION, IS AN OFFENCE UNDER THE OFFICIAL SECRETS ACT 1911-1989. (When released to persons outside Government Service, this document is issued on a personal basis and the recipient to whom it is entrusted in confidence, within the provisions of the Official Secrets Acts 1911-1989, is personally responsible for its safe custody and for seeing that its contents are disclosed only to authorised persons).

UNCLASSIFIED



AN EXAMPLE UAP FORMATION OF THE TRIANGULAR TYPE

UNCLASSIFIED

SCIENTIFIC & TECHNICAL MEMORANDUM 55/2/00

PREFACE

This is the third volume of a three-part report on the information held in DI55 on the subject of UAP. The material researched in this Volume is classified overall SECRET, only because it contains performance values of the UKADR radars Radar performance is directly relevant to whether unidentified aerial objects can enter and leave UK airspace and whether they constitute a threat. ××××××

UNCLASSIFIED

UNIDENTIFIED AERIAL PHENOMENA IN THE UK AIR DEFENCE REGION

VOLUME 3

MISCELLANEOUS RELATED STUDIES

	Para.	Page
PREFACE		ii
EXECUTIVE SUMMARY		iii
CHAPTER 1 – RADAR DETECTION OF UAPs IN THE UKADR		
RATIONALE	1	1
Anomalous Propagation	2	1
Natural Conditions	4	2
RADAR PERFORMANCE	7	2
Plasma Cylinders & Vortex Rings	12	3
Aircraft as a Charged Body	16	3
UKADGE RADAR PERFORMANCE AGAINST UAPs	22	6
Target Characteristics	23	6
Radar Characteristics	24	6
Operator Procedures & Thresholds	26	8
SUMMARY	28	9
CHAPTER 2 – POTENTIAL HAZARDS TO AIRCRAFT		
RATIONALE	1	1
Unexplained Accidents	8	2
AIRMISSES	11	4
UAP Event Correlation	13	5
HAZARD SUMMARY	17	5
CONCLUSION	20	6
CHAPTER 3 – POTENTIAL FOR EXPLOITATION OF UAP-ASSOCIATED EFFECTS		
Exotic Vehicles	2	1
Propulsion	5	2
POTENTIAL APPLICATIONS	8	3
Earthlight Replication	9	3
CHAPTER 4 – UAP WORK IN OTHER COUNTRIES		
FORMER SOVIET UNION	1	1
Plasma Research	3	1
Former Soviet Union Ufology Institute	4	1

UNCLASSIFIED

Near Field Effects	5	1
Former Soviet Union Aircraft Incidents	8	2
FSU/Russian Experimental Vehicle	9	2
OTHER NATIONAL ACTIVITY		
CHINA	10	3
SPAIN	11	3
USA & CANADA	12	3

ANNEX A – GENERATION OF PLASMA FORMATIONS

UNCLASSIFIED

EXECUTIVE SUMMARY

1. This volume primarily deals with sensitive matters associated with the UAP study which could not be placed in the RESTRICTED Executive Summary. Much of the work reported in this third volume is an inevitable by-product of the main TORs. The main topics here are:

- The potential `collision' threat, posed by UAP events to aircraft flying in the UKADR

- XXXX

UNCLASSIFIED

XXXXXXXXX XXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

S.26

5. XXXXXXXXXXXXXXXXXXX It is believed that the majority of UAP targets are inherently variable in size, in radar terms. An analysis of the facts (reported at Volume 1) suggest that the majority, if not all, of the hitherto unexplained reports may well be due to atmospheric gaseous electrically charged buoyant plasmas.(S)

S.26

6. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

S.26

7. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

S.26

8. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

S.26

Foreign Military Interest

9. Although the Study TOR's specify a UK focus, based on the reports held, UAPs are by no means confined to UK airspace. Other NATO nations, China, Russia and elsewhere frequently report the most extreme and puzzling incidents in the open press. DI55 does not have access to any other Government's classified reports, as there is no formal intelligence exchange on this topic. However, XXXXXXXXXXXXXXXXXXXXXX are known to have at least one member of staff active in this area. Similarly, at least two scientists are active in XXXXXXXXXXXXXXXXXX. Many other XXXX scientists have published papers on closely related subjects and the conclusions from studying these are of importance to the UK findings.(S)

S.27

S.27

10. Many other XXXX scientists have published papers on closely related subjects and the conclusions from studying these are of importance to the UK findings. Several governments have also been sufficiently concerned to set up Commissions and Institutes to examine the phenomena. A brief examination of some of the open-press information and

S.27

UNCLASSIFIED

UNCLASSIFIED

scientific papers of topics (such as plasmas) when associated with reported UAP characteristics has shown that:

- Russian, Former Soviet Republics and Chinese authorities have made a co-ordinated effort to understand the UAP topic. Several aircraft have been destroyed and at least four pilots have been killed 'chasing UFOs'. The importance of the topic has resulted in appointment of astronauts and senior pilots, as well as senior scientists to carry out investigations.

- Russian investigators have measured (or at least detected) 'fields', which are reported to have caused human effects when they are located close to the phenomena. **(U)**

11. [redacted] S.27

12. [redacted] S.26

Strategic Threats

13. Although postulated in some quarters that the frequency and location of UAP events might be higher in the vicinity of important national assets and strategic military establishments, **there is no evidence that this is the case for any reason other than a combination of the propensity of charged buoyant bodies to be atracted to mainly isolated assets, coupled with the presence of alert personnel at these sites . However, there appear to be good scientific reasons why higher numbers of UAP events occur (see also report Volumes 1 & 2). For example, they often occur where there are isolated electrically charged objects present, such as certain industrial and military buildings, power lines or cars in open countryside, or aircraft. (R)**

[redacted] S.26

UNCLASSIFIED

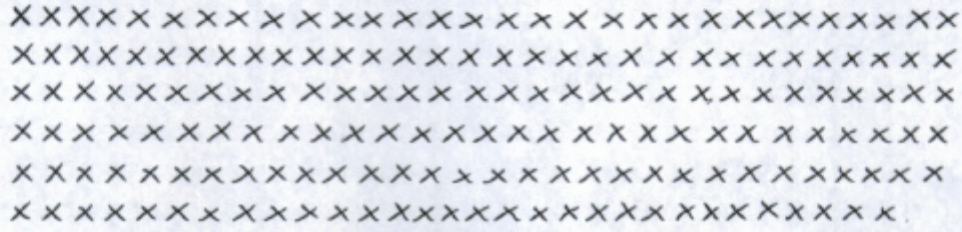
UNCLASSIFIED

VOLUME 3 - MISCELLANEOUS RELATED STUDIES

CHAPTER 1 - RADAR DETECTION OF UAPs IN THE UKADR

RATIONALE

1. An understanding of the capabilities and limitations of modern radars indicates that apart from the well-known radar interference from, for example, precipitation and wind-blown chaff (both RF dependent) and unwanted surface returns (clutter) the following interfering signals may also be received and displayed:

- 

S.26

- **RFI/EMC** - Local electromagnetic effects can produce spurious returns. Some radars have filters to reject non-synchronous signals. The persistent types, which may, for example, affect fixed radar installations are usually identified and eliminated. Moving radars may encounter unexpected sources, while fixed stations may be affected by a moving interference source, only lasting a short period - hence, the possibility of producing what can appear to be a genuine target for a while. Moving plasma reflectors can produce realistic targets which can cross the detection threshold. The case of the spurious reflector located between the real target and the radar is particularly noted. The 'ghost' detection false velocities can be very high (compared with expected target speeds).

- **'Angels'** - although usually rejected, it is possible to receive and display far-distant surface returns due to the wave being partially reflected and partially refracted by atmospheric conditions. Temperature inversions cause thermal refractivity gradients (see also Working Paper at Volume 2, on optical 'mirages'). Similarly to the optical situation, the maximum confusion effect at radar frequencies is at very low elevation angles.

- **Birds** The radar echoing area (RCS) of birds and insects is of passing interest. It is only a few square centimetres and would normally fall well below the detection threshold of all but specialist radars; generic values are at Table 1-3.

(U)

2. **Anomalous Propagation** Radar signal propagation is normal in the UKADR for the majority of the time. It is possible, however to have atmospheric temperature lapse-rates where upward bending of the radar beam results in a reduction of the distance to the normal radar horizon. Dependent on the pressure-temperature gradient and partial pressure of water vapour, the extreme case is that of trapping the curved wavefronts to produce surface ducting. The mechanism of

UNCLASSIFIED

UNCLASSIFIED

ducting is somewhat different in tropical conditions than in temperate climates. For the purpose of evaluation of possible anomalous specular signals (which may be mistaken as UAPs), in the UKADR, inversion duct theory is used[1] . The effect can occur both in the radar's main beam and its vertical side-lobes. It is important to note that anomalous radar returns caused by the super-refraction form of this phenomena can take place in thunderstorm conditions - often also the scenario for 'ball' and 'bead' lightning and its consequent mis-identification as a UAP.(U)

3. XXXX

UNCLASSIFIED

XXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXX XXXXXXXX XXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX S.26
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXX

8. The reflected power measured by a radar system is the average integrated power reflected from a finite illuminated area. If the reflecting area is smooth, with no irregularities, then the reflection will be entirely coherent and specular and a one-dimensional model can be adequate. However, if there are large spatial irregularities then the signal will be completely incoherent and diffuse. In between these extremes the reflected signal will contain both coherent and incoherent components, depending on the physical structure of the irregularities. In the context of the 'multi-cored' UAPs this seems likely to be the case. In the near field, from these diverse reflectors, there will be interference patterns and, potentially, considerable variability of reflected signal strength. The far-field value will be the residual signal resulting from the incoherent combinations.(R)

9. Since the plasma (or 'linked-plasmas' in a multi-core type UAP) will be, (according to witness reports of motion and colour change in the lights), in almost constant motion, it is reasonable to suggest that either regular or irregular field modulations could be present - not only in the self-radiation of the body, but in its radar-reflective properties. In basic terms, its RCS is likely to be fluctuating, probably for most of the time. This may not be the case where single-coloured ball lighting is reported which seems to be more stable than the multiple colour, multiple 'core' system that frequently form 'triangular', 'rectangular' or 'stacked' assemblies, often with an apparent shaped black coloured void between the bounding 'hot spots'. It may well be the case that quite apart from variable scatter from a large proportion of the total apparent reflecting area, that the variation of the reflectivity of the core itself may be below a particular radar's minimum detection capability.(R)

10. The scattering of EM waves from a variable surface has been long studied for more conventional radar targets. For a fluctuating plasma a number of variations will be evident dependent, for example, on the RMS coherent scattering coefficient, the RF in use, the ripple and curvature on the plasma surface, the electron density, correlation length, etc. Refraction effects, additionally, could cause smearing of the beam profile and absorption further weaken the radar returns, even if the electron density is theoretically adequate for the incident RF to be reflected under ideal conditions.(U)

11. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX S.26
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXX

12. **Plasma Cylinders & Vortex Rings** Occasionally UAP reports describe a circular, cylindrical or 'boomerang' shape. These are sometimes oriented horizontally and sometimes vertically and various models are proposed. Entities are sometimes described as "a row of balls touching each other" or "a stack of discs one above the other"; the radius differs at various points along the 'cylinder' length. In some ways the resultant RCS can be expected to

UNCLASSIFIED

UNCLASSIFIED

be similar in format to a rocket plume. The distribution of the electrical properties (e.g. the electron density) are inhomogeneous both radially and axially.(U)

13. The modelling results [3] can only be an approximation, since the actual structure of the plasma UAP has never been measured. In the absence of any other information, it is assumed that a UAP (of the plasma type) comprises a plasma which obeys Maxwell's Equations. The important factors of a tubular-shaped plasma appear to be:

(a) In similarity to other radar targets the target response will vary with plasma 'cylinder' orientation and radar polarisation.

(b) The RCS varies with the incident radar's Radio Frequency.

(c) The RCS per unit length increases with the aspect angle, with the maximum RCS being reached near the cylinder centre.

(d) ××××××

be moving at some velocity, whereas the 'UAP' can either be stationary or moving. Hence, there appear to be conditions occurring where the charges do not come together but reportedly parallel the aircraft course or follow it. When (conducting) flying vehicles enter a non-uniform field (E) a current dependent on $\partial E/\partial t$ arises in the vehicle. The balance of the charge with the UAP charge dictates the UAP subsequent motion. It is further reasonable to assume that the charged (phenomena) body may be either gaining or loosing energy hence it may dissipate and disappear.(U)

17. XXXX

SUMMARY OF UKADGE RADAR PERFORMANCE AGAINST UAPs

22. If, as seems quite likely, UAP phenomena is mainly caused by atmospheric plasmas (mis-reporting of man-made objects excepted), this phenomenon can be created by various natural causes for which examples are detailed in the Working Papers at Volume 2. The nature of plasmas has been studied in relation to their detectability by radar. S.26

23. **Target Characteristics** Plasma characteristics are widely explored in Vol. 2. In relation to radar response:

- The nature of plasma as a radar target is that of an amorphous electrically charged mass, which can appear as a sphere or other shape, a collection of spheres usually up to five in close formation, often forming a 'tube' or 'cylinder', either horizontally or vertically stacked; or (in plan) forming a pattern (triangle is the most prevalent, but oblongs, diamonds and star shapes can be seen). All would (according to witnesses' assessment of size) fall within a single radar resolution cell of most EW radars . They could possibly occupy adjacent range cells of Airborne Interception (AI) radar.

- Some plasmas can reflect radar energy, others cannot, dependent on the incident RF angle and the plasma electron density.

- Plasma life is limited. Weakening internal fields, temperatures, change in pressure, etc., internal electrical forces, rotation of the body, make the plasma an ever-changing target.

- According to russian research the maximum broadside RCS, i.e. at 90 degrees orientation, (Figure 1-4(a) to (f)), even with optimum polarisation, is only of the order of 0dB ($1m^2$) and changes in aspect-angle can quickly reduce to as low in value as - 40dB ($0.0001m^2$). As seen at Figure 1-4 (e), as the RF increased, the RCS decreased for most aspect angles. (U)

24. **Radar Characteristics** S.26

There are, however, several other key factors:

- [redacted] S.26

- **Radar Signature** Even though the RF conditions and plasma density conditions may be correct, the RCS of any given plasma may nevertheless be much too small to be detectable (see minimum detectable signal at Table 1-1) [redacted] S.26

  Further, it is not clear whether a UAP plasma has the same characteristic as a contained plasma in a laboratory. The radar response (including lack of response) could be quite different if the multi coloured plasmas rep[orted have more than one density core. For example the RCS may be dependent on a major reflector and several smaller ones or have the effect of a larger but unstable reflector fluctuation with random or predictable minor orientations. [redacted] S.26 Hence, it can be seen that together with the other factors below a plasma (which is inevitably gradually decaying towards extinction) may only produce a radar reflection for a limited period, if at all.

- [redacted] S.26

UNCLASSIFIED

S.26

25. The search beam (with, say, an azimuth beam-width of 1.5 Deg.) takes ~40m.seconds to pass through the UAP target. However, the velocity of the target may be 10km per second, travelling some 400 metres in this scan time. If UAP travel is across the beam and the radar detection range, due to the small target size, is only, say, 20km, (at which range the beam is only ~525m wide), the actual beam velocity is also travelling (at that range) at over 13km per second. Hence, depending which way the target is moving, either the radar beam is chasing the target and just overtakes it or, if the target is moving in the opposite direction to the beam, the dwell time on the target is seriously curtailed, as the time-on-target could easily be halved. Either way a relatively small number of pulses hit the target. With a PRF of, say 265pps about 11 pulses are designed to hit the target in normal operation against aircraft. Against a UAP, not only is it a small target in all probability, it may only receive half the number of pulses which, integrated-up, may not reach a detection level.

S.26

Of course, this is taking a fast target as an example, with an assumed small RCS. Slower targets might be detected if their RCS and aspects were favourable.(R)

26. **Operator Procedures & Thresholds**

S.26

27. Several other factors are important:

-

S.26

- **Correlation**

S.26

Frequently, when a UAP is spotted from an aircraft (often civil air-traffic) it cannot be seen on the controlling CAA radar. There is only one UK event on the DIS record where 3 radar's (2 RAF and one CAA) had simultaneous contact with a UAP, which eventually faded and disappeared.

(C)

UNCLASSIFIED

UNCLASSIFIED

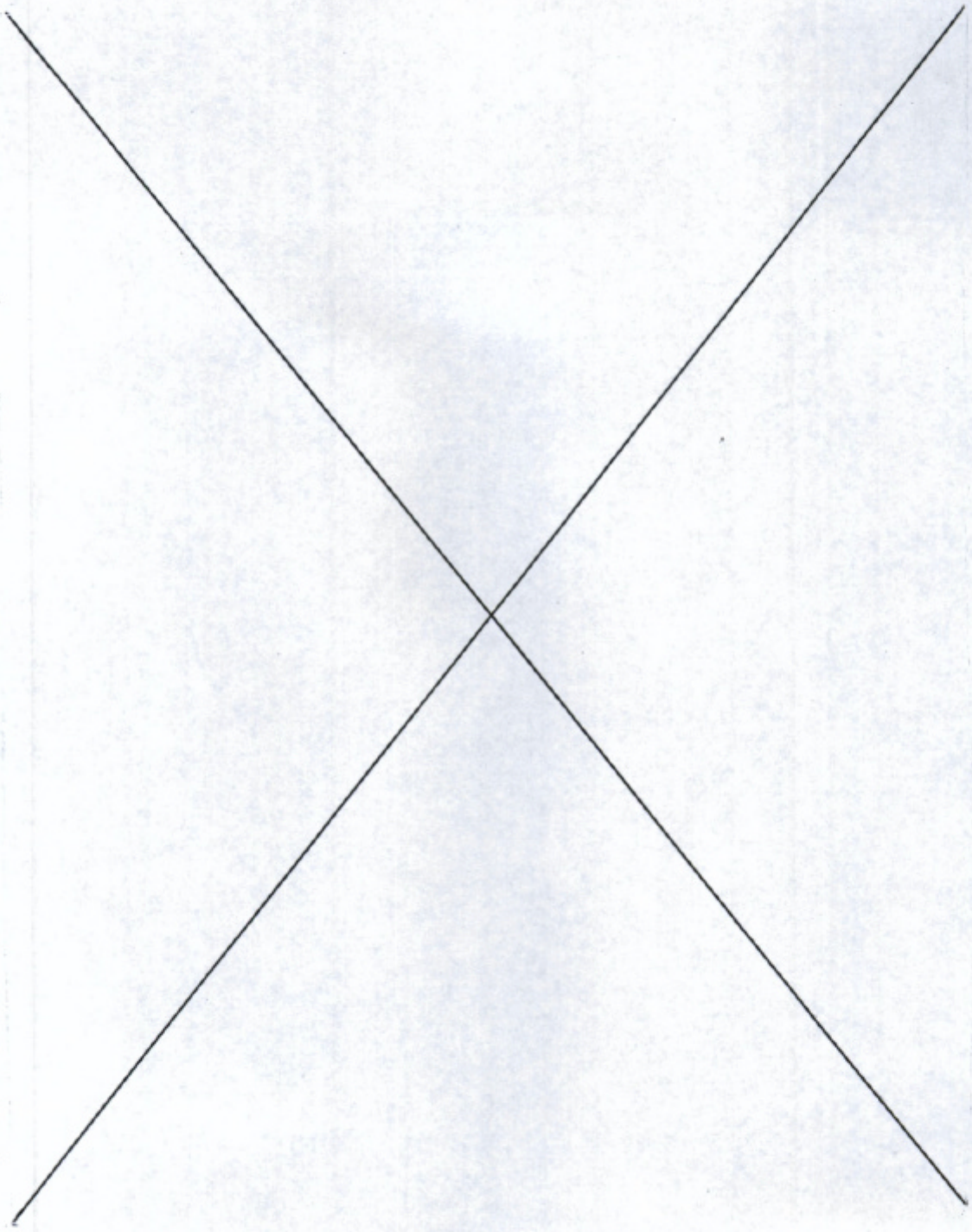
SUMMARY

28. [redacted] S.26

[redacted] [The findings of this brief investigation into the reasons for the clear lack of radar reports on UAP activity - bearing in mind that hundreds of visual reports are currently received annually, can be compared with a Spanish Air Force UFO investigation, in which it is openly reported that between 1962 and 1990 only 20 cases were detected by radar, and only 7 of those lasted long enough to vector AD Fighters to the location. Spain had UAP peaks in the periods 1968-71, 1974-75 and 1979-81].(U)

UNCLASSIFIED

UNCLASSIFIED

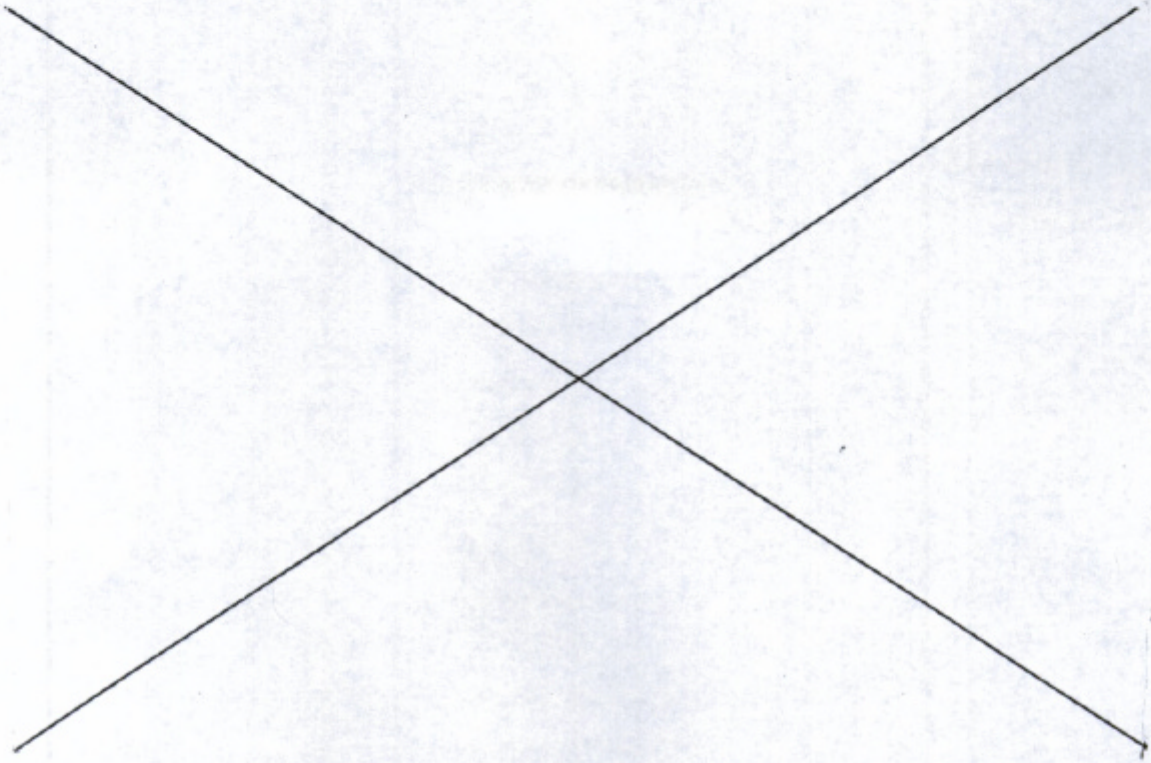


S.26

UNCLASSIFIED

UNCLASSIFIED

S.26



UNCLASSIFIED

UNCLASSIFIED

Target Velocity (metres per second)	Scan Rate (Seconds)	Distance Travelled Between Scans (km)[1]	Dwell Time in 1.5 Degree Beam(Counter Direction)[2](sec)	Dwell Time in 1.5 Degree Beam(Same Direction)[3](sec)
250	10	2.5	0.04[4]	0.04[4]
1000	10	10.0	0.043	0.037
3000	10	30.0	0.052	0.033
6000	10	60.0	0.074	0.027
10,000	10	100.0	0.173	0.023
15,000	10	150.0	0.035*	0.018

TABLE 1-2: RADAR DISTANCE , TIME & DWELL (U)

Notes:

[1] Using the 10 second inspection rate of the UKADR radars.

[2] The number of pulses a radar receives is a function of the antenna beam-width, the PRF and the antenna scan rate. Hence, the scan rate is effectively reduced if the target speed causes it to stay in the beam for a longer period. In the limit both the target and the beam move at the same rate and the reflected pulses from a continuous dwell on-target are theoretically available. For example, at a target range of 20km., when scanning at an angular rate of 36 Degrees per second, equivalent to a linear beam movement rate of ~525m(subtended at 20km range) in millisec, this is equal to a linear beam velocity of ~13,000 metres per second. In this case the radar beam speed is only exceeded by the target speed by the final item* in the list above. Ignoring, the radar sampling algorithms which may be in use and any system limits on the maximum resultant tracking velocities of the system, the UAP detection probability could increase. Before the point of dwell is reached, assuming that the pulses are available for use, for example, when the UAP (moving at 7000 metres per second) is overtaken by the radar beam as it scans, the increased time-on-target would produce about 20 pulses for integration, instead of the designed 11 pulses which would be received (from an aircraft sized target) if the target was only moving at 250 metres per second. However, because of the huge UAP velocities which are possible, by the next inspection time, subject to the geometry, the object could easily move into the overhead dead-space, out of coverage range, have faded to a lower electron density or even disappeared (discharged) completely. Although the opportunities for detection might **apparently** be present (i.e. as would reasonably be expected if an object is within coverage) this alone is not sufficient as detection depends on a combination of factors which do not apply to normal targets.

[3] At a target range of 20km but with the target flying across the azimuth beam in the opposite direction to it's rotation the effective scanning time is reduced. In this instance the beam-crossing target is spending progressively less time in the radar beam with increasing UAP velocity. As an example, at a UAP speed of 7000 metres per second the UAP passes through the beam at 20km range at an effective velocity of 20,000 metres per second. The time taken to cross a distance of 525m at this speed is ~0.026sec. and the number of pulses received by the radar would be reduced to 7. In turn, this will reduce the probability of detection, possibly to the point of not crossing the detection threshold. By the time the target velocity reaches 15,000 metres per second, there is only time for 5 pulses to be reflected.

[4] At a target velocity of 250 metres per second the dwell time does not vary significantly whether the target is going the same way as the beam is scanning. This is the normal situation for the speed range of typical manned aircraft.

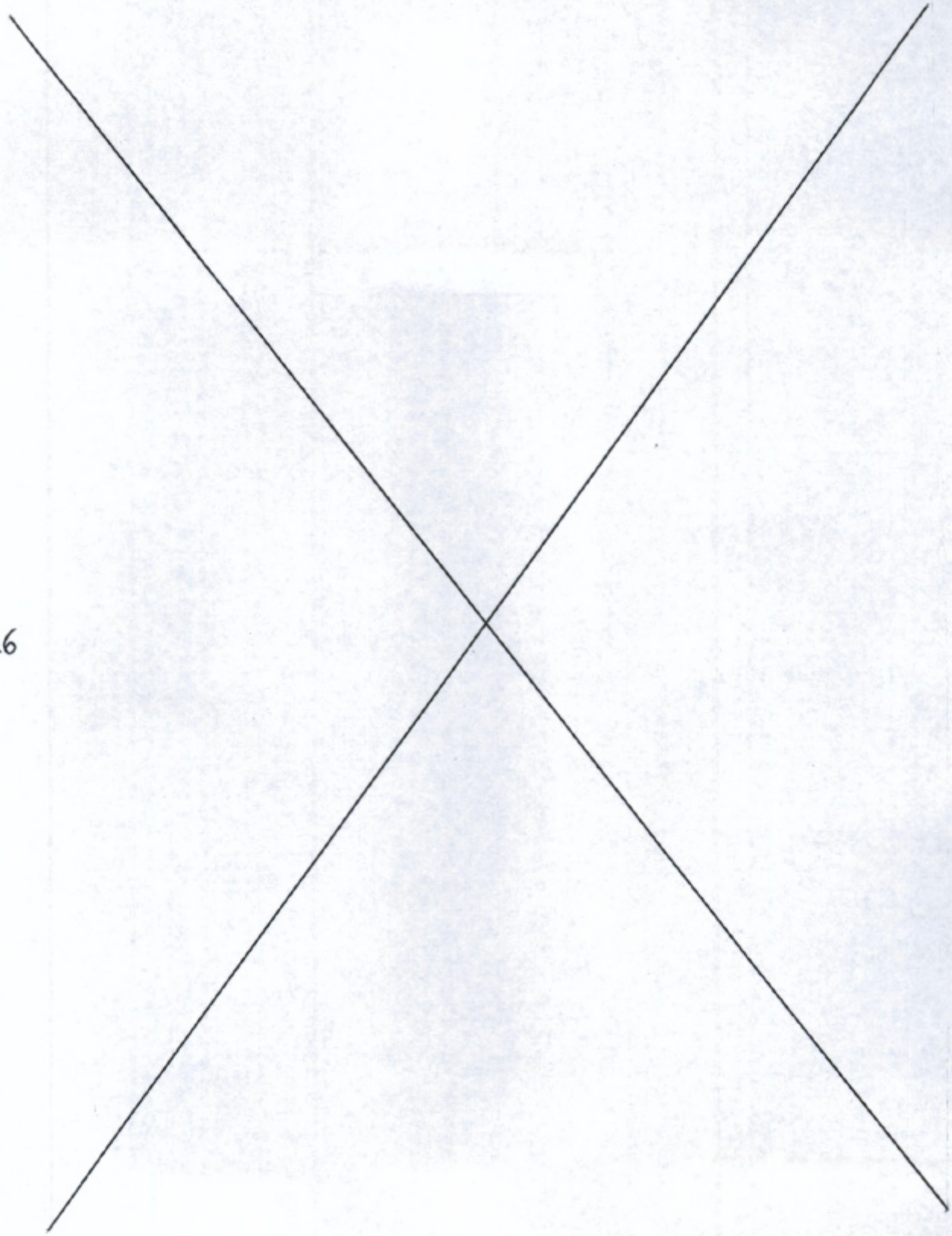
Moths	1	Wavelengths	10cm	(E/F Band)
Sparrow	15	Wavelengths	10cm	(E/F Band)
Sparrow	1.9	Wavelengths	3cm	(I Band)
Pigeon	80.0	Wavelengths	10cm	(E/F Band)
Pigeon	15	Wavelengths	3cm	(I Band)
Pigeon	11	Wavelengths	0.7m	(A/B Band)

TABLE 1-3: BIRD & INSECT RCS (U)

UNCLASSIFIED

UNCLASSIFIED

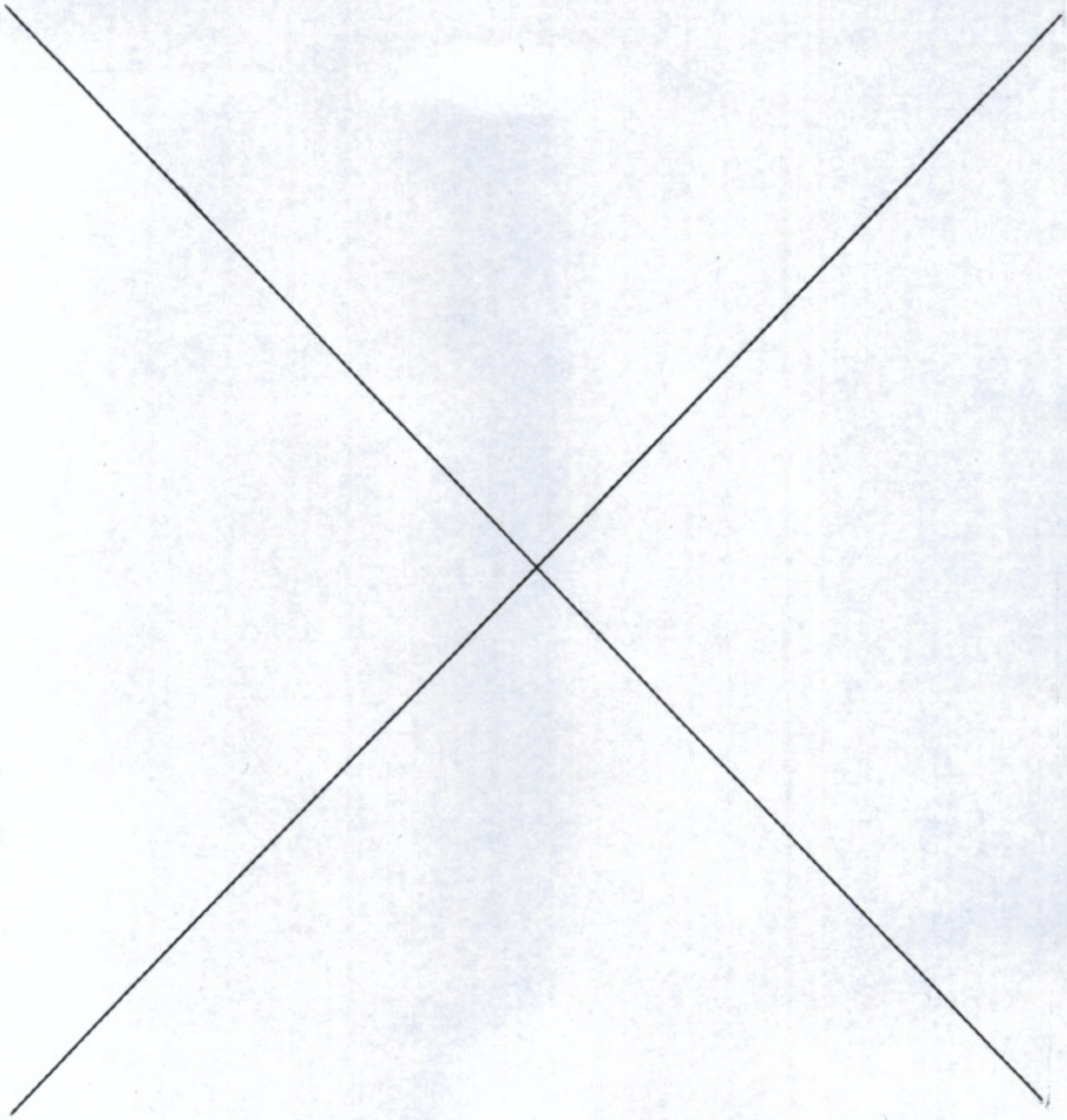
S.26



UNCLASSIFIED

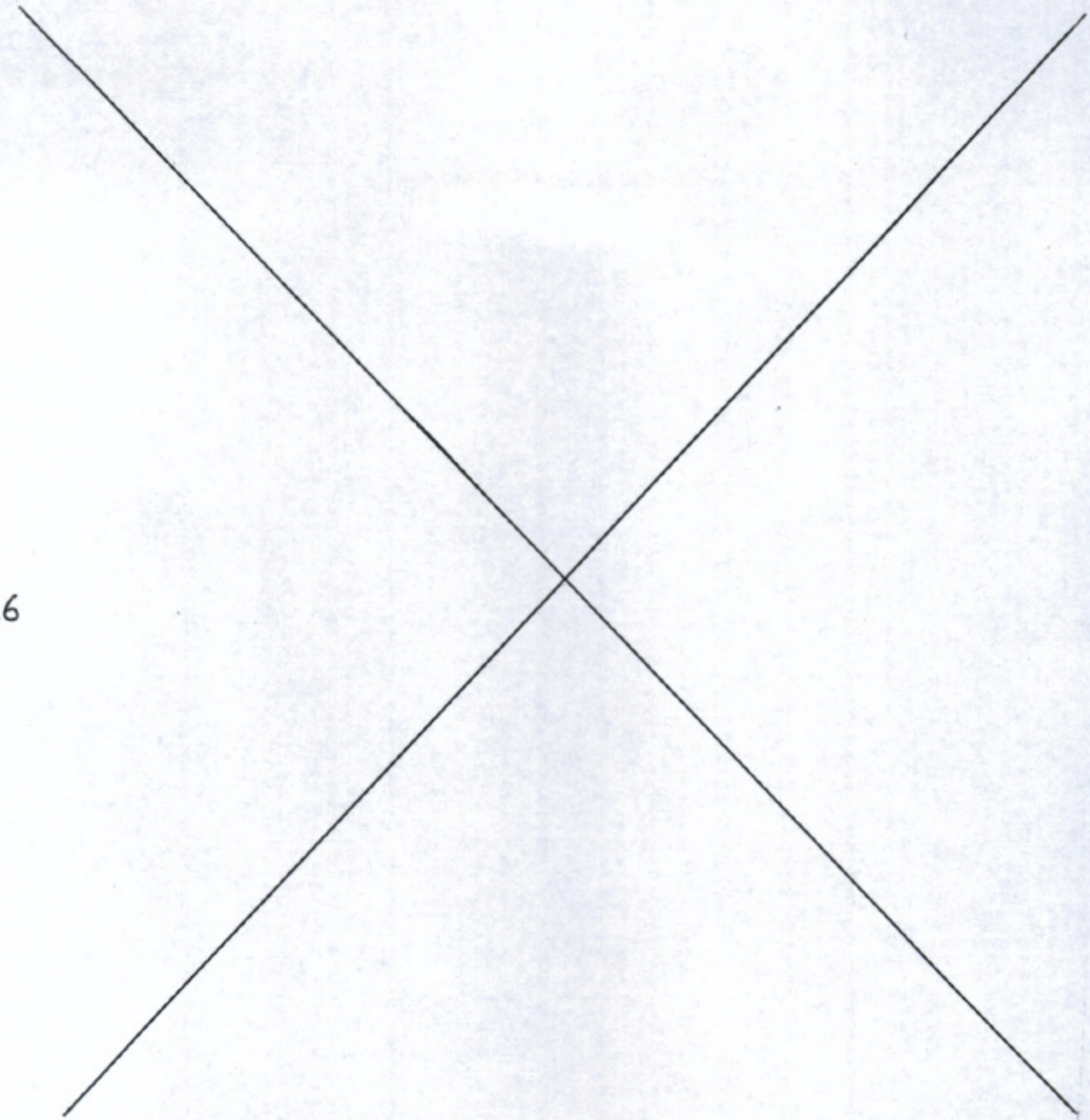
UNCLASSIFIED

S.26



UNCLASSIFIED

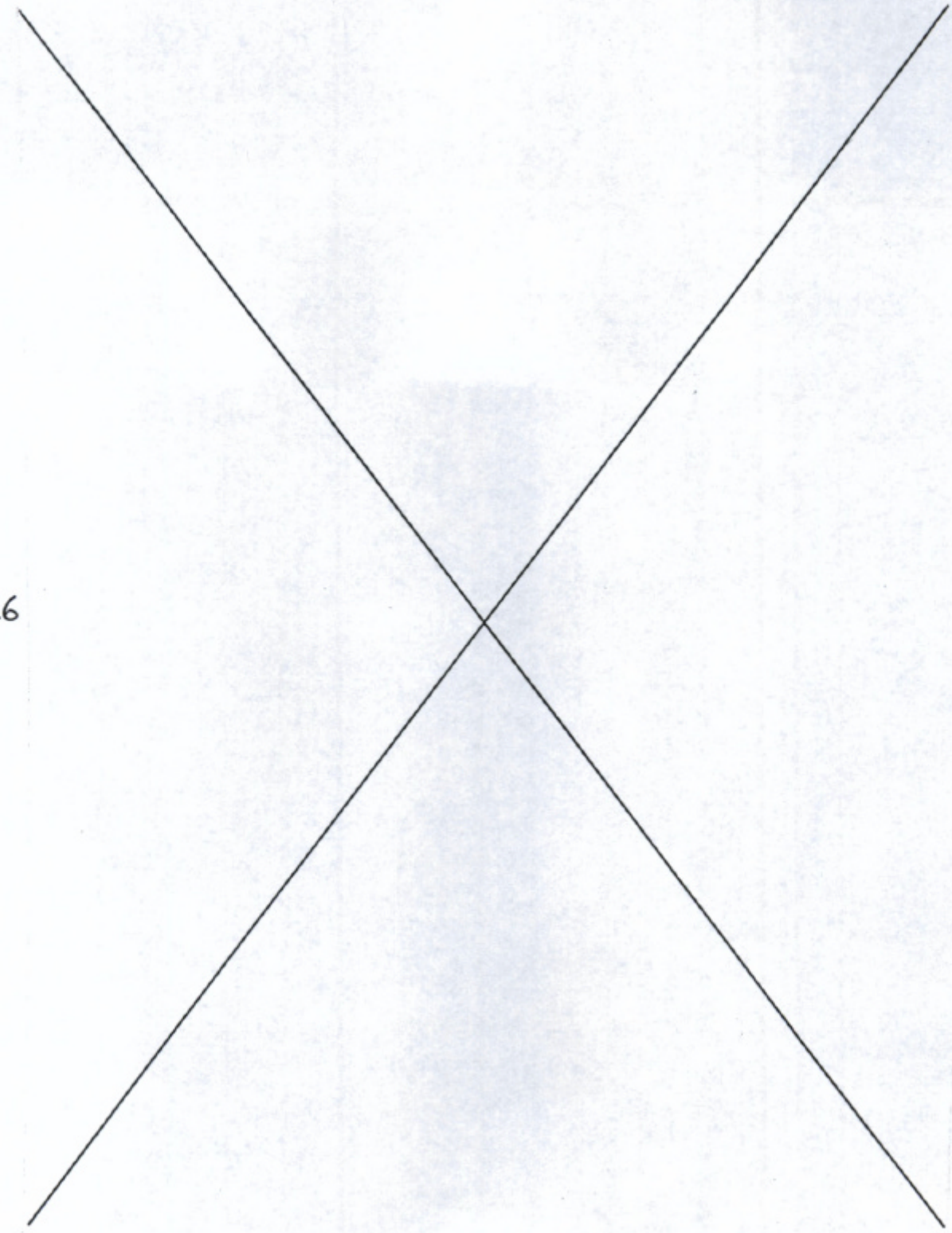
UNCLASSIFIED



S.26

UNCLASSIFIED

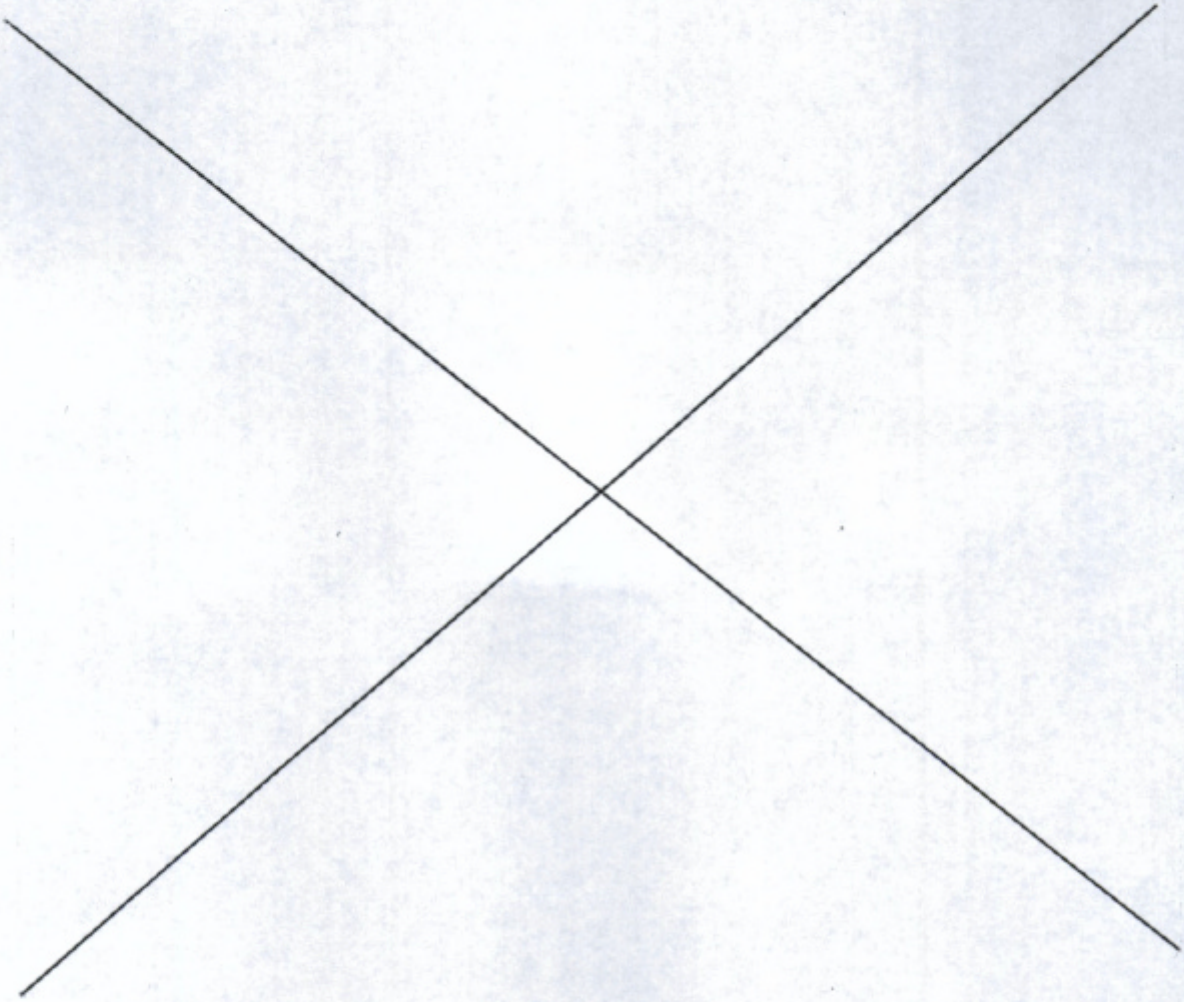
UNCLASSIFIED



S.26

UNCLASSIFIED

UNCLASSIFIED



S.26

UNCLASSIFIED

UNCLASSIFIED

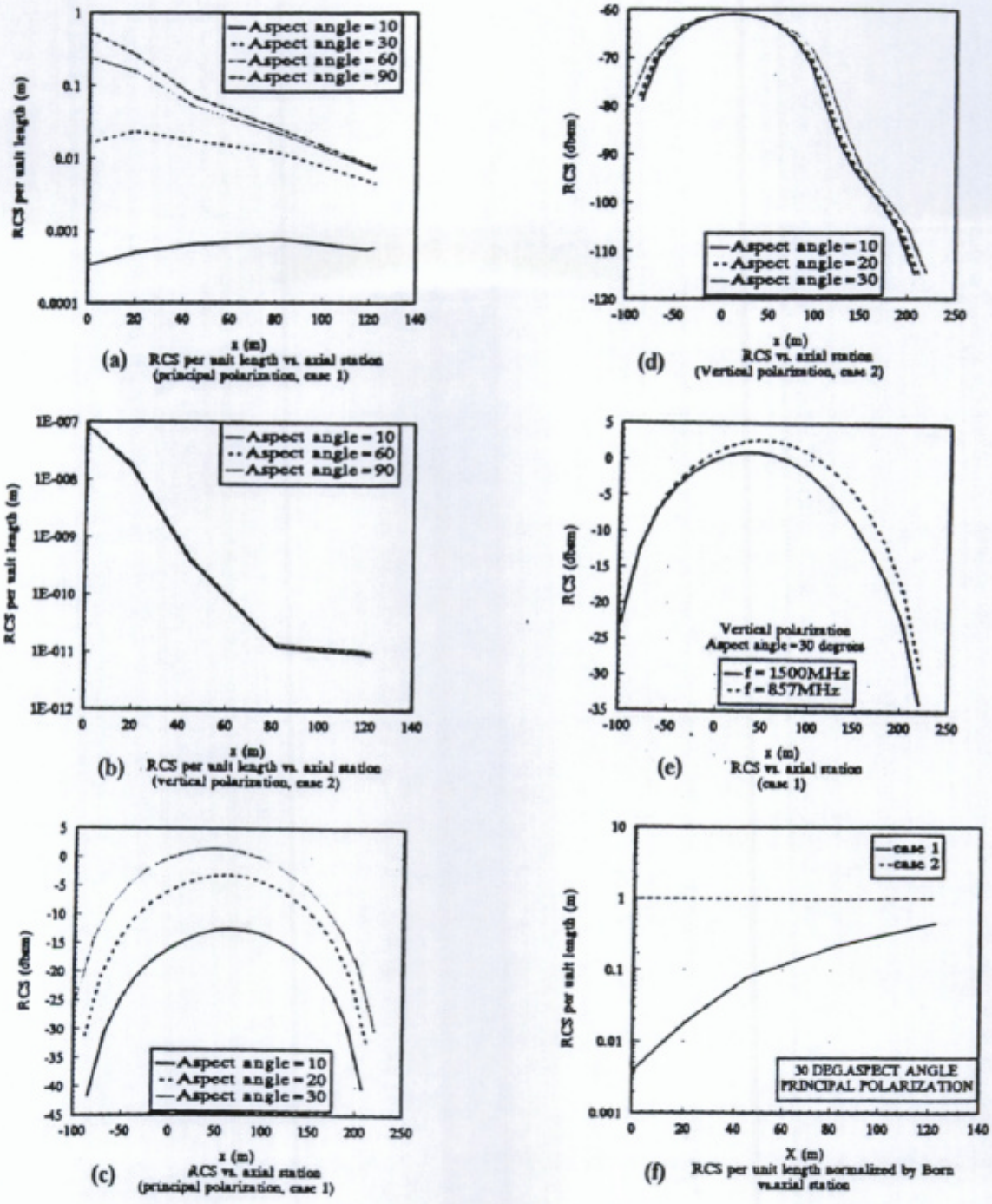


FIGURE 1-4 RADAR CROSS SECTION OF CYLINDRICAL PLASMAS(U)

UNCLASSIFIED

UNCLASSIFIED

CHAPTER 2 - POTENTIAL UAP HAZARDS TO AIRCRAFT

RATIONALE

1. A brief investigation has been made into the potential of UAP events as possible hazards. With assistance from the Inspectorate of Flight Safety (RAF Bentley Prior), all unexplained aircraft accidents on the RAF accident database were identified and then further filtered to isolate those which had apparently impacted the surface, due to what appeared to be sudden and inappropriate control inputs by the crew. Apart from isolated reported encounters (with what is apparently ball lightning) with both civil and some military aircraft, the investigation concentrated on the following scenarios:

- The possibility of aircrew suddenly being confronted with the phenomenon immediately ahead of the aircraft, especially when flying in Instrument Meteorological Conditions (IMC).

- The likely reaction of the pilot and the possibilities of distraction or disorientation.

- The possibility of this occurring at very low altitudes - leaving little margin for manoeuvre in proximity to the ground (or sea).

(R)

2. An examination of hundreds of UAP reports suggests that many occur (are reported) by witnesses at low altitudes and often in relatively low visibility. The UAP, in arriving near the surface, has undoubtedly descended from a higher altitude, whatever its origins. Although it is assumed that UAP may be encountered at any altitude, as shown by the infrequent reports from civil and military flight crews, there are no indications that any aircraft at high altitude has suffered an accident in UK airspace due to the presence of a UAP.(R)

3. In the absence of any reports of surviving aircraft crews having to take violent avoiding action, the investigation followed the logic that if violent manoeuvre has been carried out at low level by RAF aircraft, this could, potentially have caused fatal accidents. If these cases exist then there would be no crew report as to the cause of their sudden departure from the planned flight profile. However, none of the reports on file indicate a similar scenario for slow light aircraft or helicopters which one might assume could have time to recover after a sudden event. There is a dearth of sudden event reports from slow and low aircraft. However, many factors can be shown to possibly influence the behaviour of UAP, including, it is believed, the electrical charge on the aircraft. As charge is proportional to velocity and vehicle size, it may be the case that UAP are not generally seen in close proximity to small craft. This may explain the lack of reports. It should also be noted that many UAP events may be present of which crews are unaware because:

- They may not be visible in daylight.

- They may not occur in the Field of View (FOV) of the cockpit.

- They occur fleetingly and are not seen on a subsequent scan of the same spot.

UNCLASSIFIED

UNCLASSIFIED

- In IMC they may not be visible unless they are immediately ahead.

(U)

4. In sudden evasion at low altitude it is assumed that in mountain or hilly terrain the pilot would preferably try and fly over or under any object appearing suddenly ahead, rather than possibly turn into terrain. Hence, the possibilities of over-stress, out of envelope attitudes on pull-ups, and the possibility of wings level impact, if attempting to under-fly a UAP, all exist.(R)

5. Although it is fairly certain that at least some types of UAP emit either magnetic or electric fields, or both, it is assumed, in the absence of evidence to the contrary that aircraft systems are probably not adversely affected. Either they are adequately screened from the fields that a UAP may produce or will not remain within the field for sufficient time to have an effect. (see Working Paper No 25 Vol. 2).(R)

6. The rationale for the investigation was that a sudden appearance of fast - closing lights especially with, white green or red colours, or all three at once would almost certainly result in a sudden control input. In such a scenario it is easy to see that a collision with a solid object might be assumed imminent and evasive action would precede any radio call. It is often the case with UAP reports that red, green and white lights are reported, To an aircraft crew this would indicate the unexpected close presence of another aircraft. In undulating or rough terrain, when at very low altitude and high speed this involuntary response could be disastrous, especially if the turn was tightened as the object appeared to move in the same direction - which it could do if it was an electrically charged body (plasma), attracted by the aircraft's electrical charge.(R)

7. **Unexplained Accidents** Over the past 30 years, some 128 RAF aircraft accidents have not been completely explained. Those not occurring in the UKADR have been ignored. A careful examination has shown that many can be rejected from the UAP hypothesis because:

-There was adequate evidence to show that some form of mechanical event was the cause which was, nevertheless, not finally resolved.

- Some accidents occurred in close proximity to airfields where other observers should have noticed a UAP, if one was present.

- Some accidents happened away from base but when within visual range of other co-operating aircraft (e.g. on CAP or low altitude Fighter Affiliation exercises or near ships).

(C)

8. X X X

UNCLASSIFIED

9. After the initial filtering twenty one unexplained accidents remained. For these dates the available UAP data-base was examined for any reports which occurred on the same dates and in the same approximate locations where the accidents occurred. However, on ten of these occasions (between 1970 and 1978) no UAP records are available [as many of these earlier reports were destroyed before the current department assumed responsibility for UAP matters].(R)

10. On four occasions there were no UAP reports at all in the UKADR on the days of the air accidents. Two of these accidents occurred in 1987 Wales, which is one of the most fruitful areas for UAP reports. It must be noted, however, that UAP might have been present and gone unreported on these dates. The other 2 events occurred in the N. Sea and Cumbria, respectively in July and December 1982, where there were no other witnesses to the accidents.(C)

11. There were finally seven unexplained accidents:

Phantom 1400hrs 17 Dec. 1975 (ID 757231) Solway Firth, Cumbria. 1500ft Nearest (reported) UAP events were at Seven Trent 1840Z and South York's at 0905Z. [Accident Report: Loss of control but technical possibility]

Harrier 1215hrs 12 Feb. 1982 (ID 820629) 12nm NW Oswestry 8nm S Corwen. [Accident Report: probable distraction leading to disorientation] UAP reported at 0130Z with erratic motion at Redditch - not far in UAP terms from Oswestry.

Tornado 1204hrs 12 Dec. 1985 (ID 854334) Flamborough Head. Low flying. [Accident Report: No definite cause suggested] Reports of UAP activity were received from Andover. Increased UAP activity was noted in Northumberland on previous days up to 12 Dec.

Jaguar 1405hrs 27 Nov. 1986 (ID 863936) 11nm SW Hawick (5519N 00304W) 1500 ft. [Accident Report: Disorientation, inappropriate decision, Wings level, NIL weather, nose down into forest] No UAP activity reported on this day but reports from Reading on the previous day.

Tornado 1116hrs 1 Sep. 1994 (ID 942069) Glen Ogle, Killin Scotland 500 ft 480 Kt. [Accident Report: Inappropriate response to startling event]. Only one UAP report was received - from Northamptonshire at 2245 hrs.

Phantom 1445hrs 20 Apr. 1988 (ID 881174) 25nm 080° Leuchars. Low level CAP. [Accident Report: Probably sensory illusion in deceptive weather conditions]. Two UAP reports in England at Huddersfield, York, and Stockbury (M2 motorway).

Hercules 1530hrs 27 May 1993 (ID 931653) 8nm NW Blair Killecrankie, Scotland, Low flying. [Accident Report. Flew into ground]. No UKADR UAP reports anywhere on this date.

(UKR)

UNCLASSIFIED

12. On the days of the above fatal accidents no major clusters of UAP reports occurred on any day but single reports were filed elsewhere in the UKADR indicating that the conditions over the UK allowed phenomena to occur. The possibility that a UAP event was present, although low, cannot be ruled out. Such crashes occur on the sparsely populated low flying routes. It is noted from the statistics of duration and motion that it is unlikely that a UAP would still be present after a crash, by the time any witnesses arrived.(R)

13. It is of interest that **all** seven accidents which were finally considered occurred in day light. Although this might be seen initially as mitigating **against** the causes being due to sudden aircrew reaction to UAP appearance:

- There is much less likelihood of seeing a UAP in daylight unless it is very close. [The overall incidence of all UAP reports in daylight is only 19% and many of these are momentary. It is believed that UAP's are probably equally present in both darkness and daylight when the conditions exist for their creation].

- Very few UAP are reported as the solid' variety, hence if an accident is due to a UAP, the probability of encountering a UAP with a 'solid' appearance 'head-on', would be very low indeed, and if this ever were to occur over land, there would surely be physical evidence in the form of easily seen artefacts, and unfamiliar collision debris.[It is shown elsewhere in the report that, almost certainly, the phenomena has a plasma basis, which on occasions can appear to be visually (optically) 'solid'] (R)

AIRMISSES

14. All aircraft near-miss reports, filed with the Joint (CAA & MoD) Airprox Section (JAS), at Uxbridge are rigorously investigated. On a small number of occasions the identity of one of the conflicting objects is never explained, despite exhaustive enquiries by a Working Group, with full access to all AIS(Mil) and CAA resources. These include careful track analysis, weather, other flight plans, radar contacts and cockpit/ATC voice recordings. Seven such events have occurred in the past 10 years. Table 2-1, based on inquiry reports, lists examples, from which the following observations are made:

- If an object is visually small, or not fully opaque, (e.g. in an indistinct form - even gaseous), it will not be seen in daylight until it is very close.

- The nature of close proximity misses at high closing speeds is that encounters are fleeting - a few seconds at the most.

- By the time the presence of an object is noted visually and a possible collision conflict is realised, indeed apparently imminent, it is too late for evasive manoeuvre.

- If an object is a plasma-type it may not be seen on civil aircraft radar.

- A non-transponding target, if detected, may be taken to be due to weather - and disregarded.

(R)

15. The descriptions of the unexplained objects at Table 2.1 by the civil aircrews are very similar to those typically received as UAP reports, both from the ground and from other airborne sightings which are not airmisses. In particular it should be noted that a coloured object is (naturally to aircrew in the absence of other information) reported as a 'navigation light' - on the assumption that all flying objects are manned aircraft. It is of interest to note that all are below 20,000ft and that despite good visibility, in all but one case, the sightings were always extremely close and closing fast. In all cases they were corroborated by at least two crew - and on occasions by other aircraft (i.e. a multi-independent witness scenario. Only on one occasion was a co-incident radar contact made, although for two of the scenarios, stationary radar contacts were observed. All of the colours seen are typical of UAP reports. If a two-colour object streaks past it is not unreasonable to describe it as having 'stripes'. If an object (for example, black) has a white part, it is not unreasonable to describe this as a white 'navigation light' (e.g. often reported as on the 'nose' or 'tail', even if the object is in fact spherical. The black 'lozenge' (Serial 4) and the 'wrinkled cylinder'(Serial 5), are again typical UAP shapes, described elsewhere in this report, at Volume 1, and in the supporting Working Papers at Volume 2.(U)

16. **UAP Event Correlation** The DI55 records were searched for correlation with the civil aircraft airmiss events listed at Table 2.1. No public or other reports were found for Serials 4, 5 or 6. Serial 2 was the only actual near miss report which had also been reported at the time as a UAP event and is held in the Departmental records. None of the other near-misses had resulted in a UAP report, which re-enforces the believe that many civil pilots have sightings but sdo not report them. However, June 7th was a busy UAP day, with 4 reports - from St Ives(Cornwall at 0010hrs), Sleaford (0013hrs), Manchester(1248hrs), and Hove(2350hrs). The Hove, St Ives and Sleaford reports all speak of multiple lights. The Royal Meteorological Society log reports extensive thunderstorms with hail and ball lightning reports on this date. (U)

17. On 14 January 1994 (Serial 3 at, Table 5), two separate reports were filed, respectively, from Glenrothes and Alness (Inverness), however, these were some eight hours after the airmiss report.(U)

18. Only one UAP report was received on the day of the remaining airmiss report (19 Jun. 1988). This was at 1740 hrs in the London area.(U)

19. It is impossible to correlate the airmiss and UAP reports because there is inadequate data. However, it should be noted that the weather reports at Table 2-1 are those at the scene of the respective sightings. Bearing in mind that on five of the seven occasions it is logged that dry hot and thundery weather was present (25-32 degrees C) in many areas of the UK on the days in question. It seems likely that the entities which were reported in good faith, on the assumption that they were 'solid' objects - were almost certainly various manifestations of atmospheric plasmas of one sort or another - including the optical phenomenon where the non-reflection of light can apparently give the appearance of black opaqueness. (U)

HAZARD SUMMARY

20. There are no Service unexplained fatal air accidents where a collision has occurred with a solid object, leaving behind some sort of tangible artefact. Only those unexplained accidents which are known or thought to be due to sudden inexplicable control inputs where the aircraft,

and the occupant(s) did not survive were investigated on the remote possibility that here might have been a potential UAP explanation. The key findings are as follows:

- About half the unexplained RAF accidents could not be correlated in location with UAP sightings, because many of the UAP records (1970-78 period) have been destroyed.

- The probability of the remaining accidents being caused by sudden aircrew reaction to avoid what they may have believed to be an apparently imminent collision is a possibility, although of the 11 events, four occurred on days on which atmospheric and electrical conditions may not have been conducive to UAP formation or UAP formed but were not reported.

- The frequency of UAP reports (not withstanding the likelihood that many UAP events are never reported) is such that the probability of an RAF (or Civil) aircraft encounter with a UAP, at any altitude must be very low. (C)

21. Because there are no reports of RAF aircraft intercepting UAPs, there is no first-hand experience of the difficulty which reportedly occurs. The Department has no access to official reports from other nations. However, all indications are that a UAP can reposition itself faster than any aircraft can manoeuvre. The reader is referred to Chapter 4, where it is clear that any attempted manoeuvre may result in over-stressing the aircraft. (R)

CONCLUSION

22. In conclusion, the possibility exists that a fatal accident[1] might have occurred in the past due to aircrew taking UAP avoiding action, when flying fast and low. However, the probability of an encounter is extremely low, even if this was the case for any of the seven unexplained occasions where this **potentially** might have occurred in the last 30 years.(C)

23. It is of interest that no RAF incidents of **subsequently unexplained** air misses have apparently been reported to the Joint Airprox Section at Uxbridge[2].(R)

24. Data was provided for seven incidents reported by civil aircrews where the cause of the events could **not** be explained by the subsequent official inquiry. It is clear that unexplained air misses are discussed among crews and there is likely to be much more to be learned by interview. However, they are understood to be unwilling to speak to anyone who might be sceptical or repeat the conversations elsewhere. It is believed that many more civil events due to UAP remain unreported. This is because, firstly, the airline crews have most probably decided that the UAP are benign, secondly they are concerned about their individual reputations as professionals and finally the effect any publicity this might have on airline business. The airline crews are concerned when airmiss reports remain unresolved. It is further noted that since Pope's book has been published airline crews are unlikely to wish to take the matter further with SEC(AS2), or with the civilian UFO organisations.(C)

[1] For the purpose of this study one RAF Squadron Leader was made aware that aircraft accident data was required as part of a UAP investigation.
[2] The precise purpose of the study was not made known to the Airprox Section, which understood the data to be needed as part of a radar investigation.

UNCLASSIFIED
UK EYES ONLY
UK SECRET

	Date	Time	FL	Visibility (km)	Weather	Colours/Shapes	Radar Contact	Aircraft Type	Location
1	7 Jun. 96	1800	90	10+ (VMC)	CuNb	Red/blue/white[6]	None	146[5]	STEVENAGE
2	6 Jan 95	1848	40	10+ (VMC)	Cu	Black/White[2][6]	None[1]	737[5]	MANCHESTER
3	14 Jan94	0834	30	10+ (VMC)	-	Sparks/Flames[3]	None	Helo[4]	ABERDEEN
4	15 Jul. 91	1745	140	40+ (VMC)	-	Black(Lozenge)	Yes	737[5]	CRAWLEY
5	6 Jun. 91	1438	80	50+ (VMC)	Inversion /Unstable	Yellow/Orange (Cylinder)	None	737[5]	BRACKNELL
6	17Oct. 88	2316	190	IMC	-	Green	None	VC9[7]	~DOVER
7	19Jun. 88	1953	80	5 (VMC)	Haze	Grey/White	None	BAC-111[5]	GATWICK

TABLE 5 REPORTED UNRESOLVED NEAR-MISS DATA.(R)

Notes: [1] But stationary intermittent radar contact seen before or after.
[2] 'Like a Christmas Tree'.
[3] Possible Meteorite/SOYUZ re-entry debris.
[4] Seen by 2 pilots of 2 other aircraft in vicinity..
[5] Seen by both pilots.
[6] 'Hawk' aircraft size.
[7] Seen by three flight deck crew of the VC9.

UNCLASSIFIED
UK SECRET
UK EYES ONLY

UNCLASSIFIED

CHAPTER 3 - POTENTIAL FOR EXPLOITATION OF UAP-ASSOCIATED EFFECTS

1. One of the reasons for making an analysis of UAP reports was that of identifying any phenomena which could be robustly generated and provide a military advantage. [redacted] S.26

2. **Exotic Vehicles** In order to take an unbiased scientific approach the possibility of some sort of exotic vehicle, either terrestrial or from space could not be ruled out iuntil all available evidence had been examined. While it was clear that there are no artefacts on which any hands-on technical assessment can be made the possibility of technologies beyond the scope of human engineering and conception could not initially be ruled out. Even if it was discovered that such craft actually exist and were the product of other intelligence beings, any attempt to reproduce the exceptional performance achievements attributed to UAP could only be attempted using existing technology. Secondly, it seemed possible that other military applications might be found if the effects could be replicated in a controlled way. The problem then became one of identifying the precise physical effects and making a judgement as to whether there are credible roles in which they might be employed. The effects observed visually, on radar or through the apparent radiating field from UAP might be advantageous, for example as a countermeasure or decoy. Exceptionally, it was postulated that if the existence of some form of extra terrestrial technology was in fact proven, then (possibly) recommendations could be made as to the way ahead. For example, it would be necessary to focus on these capabilities in order to deduce and possibly, what sort of technologies might be necessary to achieve the reported almost instant accelerations, decelerations, manoeuvres and high velocities. At the level of human understanding this level of performance appears to imply the negation of inertia. Even if this was possible to achieve at some stage in the future in technological terms it would have to take place in an unmanned vehicle. Humans could not withstand (at least with our current our current knowledge of aviation medicine), the significant acceleration and deceleration forces which would be involved.(U)

3. Any attempt at the description of possible or probable technologies to construct a vehicle would be at the limits of current human understanding and involve technologies which may appear (one day) to be possible. They might include such ideas a propulsion by the use of anti-matter, gravitational or torsion fields or of particle phenomena and fields or waves which are not currently known in science or technology. One would have to concede that if extra terrestrial activity is involved, (the statistical analysis reported at Volume 1 makes this unlikely) not only would the originators of such vehicles have technologies developed over thousands of (earth) years – in any case they would have to travel very large distances to reach earth or other planets.(U)

UNCLASSIFIED

4. The conventional scientific expectation, when searching for extra terrestrial life, is that this might be revealed by searching for oxygen, nitrogen or other specific spectral lines. Of course, this supposition is based possibly/probably erroneously on the assumption that there could only be biological life elsewhere in the form which we conventionally understand it. So far unsuccessfully, the USA have spent millions of dollars (in the SETI programme) in this search. Lateral thinking soon shows that any other 'inhabited' part of the universe may conceivably contain entities which bear no resemblance to ourselves whatsoever. Clearly, if they exist, they may not 'breathe' as humans or have any of the usual attributes - hence, one could argue, they could, perhaps naturally, withstand the enormous gravity forces involved in the manoeuvres described. The logic soon changes again when it is suggested that, in the limit, these entities may have no mass! Several UAP (UFO) researchers have concluded, for example, based on what they have taken to be reliable incident reports, that these entities must also have the ability to materialise and de-materialise. Further, the reported aerodynamic gymnastics implies that their technology of using, apparently, near drag-less, noise-less flight, can be achieved most of the time. All of these exceptional characteristics can be explained if te objects are gaseous buoyant charged plasmas (U)

5. **Propulsion** UAP noise is only usually reported as a 'whine', 'hum', crackle or 'buzz' at 'take-off'. The method of propulsion of the objects does not, reportedly, produce the familiar noise which is made by air thrust, turbulence or motion by an aerofoil through the air, as we know it - despite the fact that the 'craft' size reports imply the presence of a significant mass given the enormous dimensions often described. If, however, as is believed, there are many reports which are of plasma/charged mass in characteristic, then they would be virtually inertia-less, and would therefore not push masses of air aside in order to move; while others are purely manifestations of visible light moving about. Further, allowing for variations in human descriptions, these sounds are those usually associated with electrical discharge and oscillation. If fields are present which cam cause neurological disturbance, as reported at Volume 2 Working Paper No 25, it is quite likely that other sounds will be sensed rather than heard acoustically. (U)

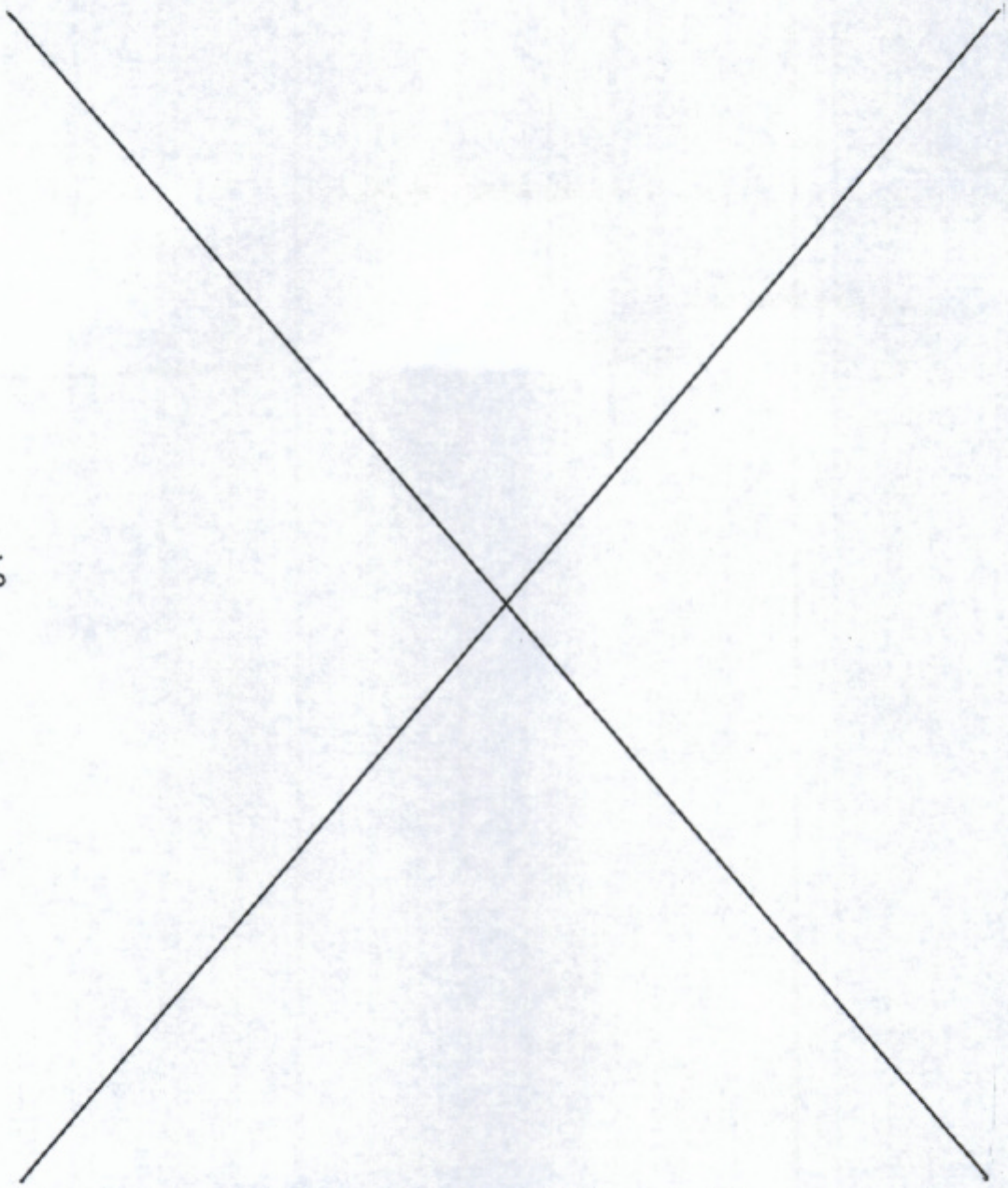
6. There is the question of the frequently reported merging and demerging of smaller craft with larger ones. These are usually triangular and sometimes 'oblong' or 'diamond'. In air operations we currently have at least some caution in linking up flying platforms for the comparatively simple task of air to air refuelling - and yet these smaller triangular UAPs seem to have little trouble in merging or seperating rapidly into or from their so called 'mother ship'. Finally, as these entities can also reportedly appear and disappear at will and have intelligence, one could surmise that they could also decide when and whether to be visible to humans or not. The classic reporting dilemma exists as to whether the witnesses are reporting what they are **actually** seeing or, alternatively reporting what they **think** they should be seeing. Finally, one must consider whther they are being affected in some way so as to distort their reporting.

7. In conclusion, from all the evidence examined in the UAP reports held in DI55, there is no indication that craft of extra-terrestrial origin exist. Any exploitation of technologies, resulting from this study, will clearly have to be based on those phenomena exposed and discussed at Volume 2. Those worth a brief examination are shown at Table 3.1. There are, as shown in the working papers, tens of natural and man made phenomena that can lead witnesses to believe that they have observed something quite extraordinary. The majority of the causes of known UAP sightings cannot be replicated and used for military purposes.(U)

UNCLASSIFIED

POTENTIAL APPLICATIONS

8. As a result of the UAP studies, the radar detection aspects have shown that there are three possible related potential applications:

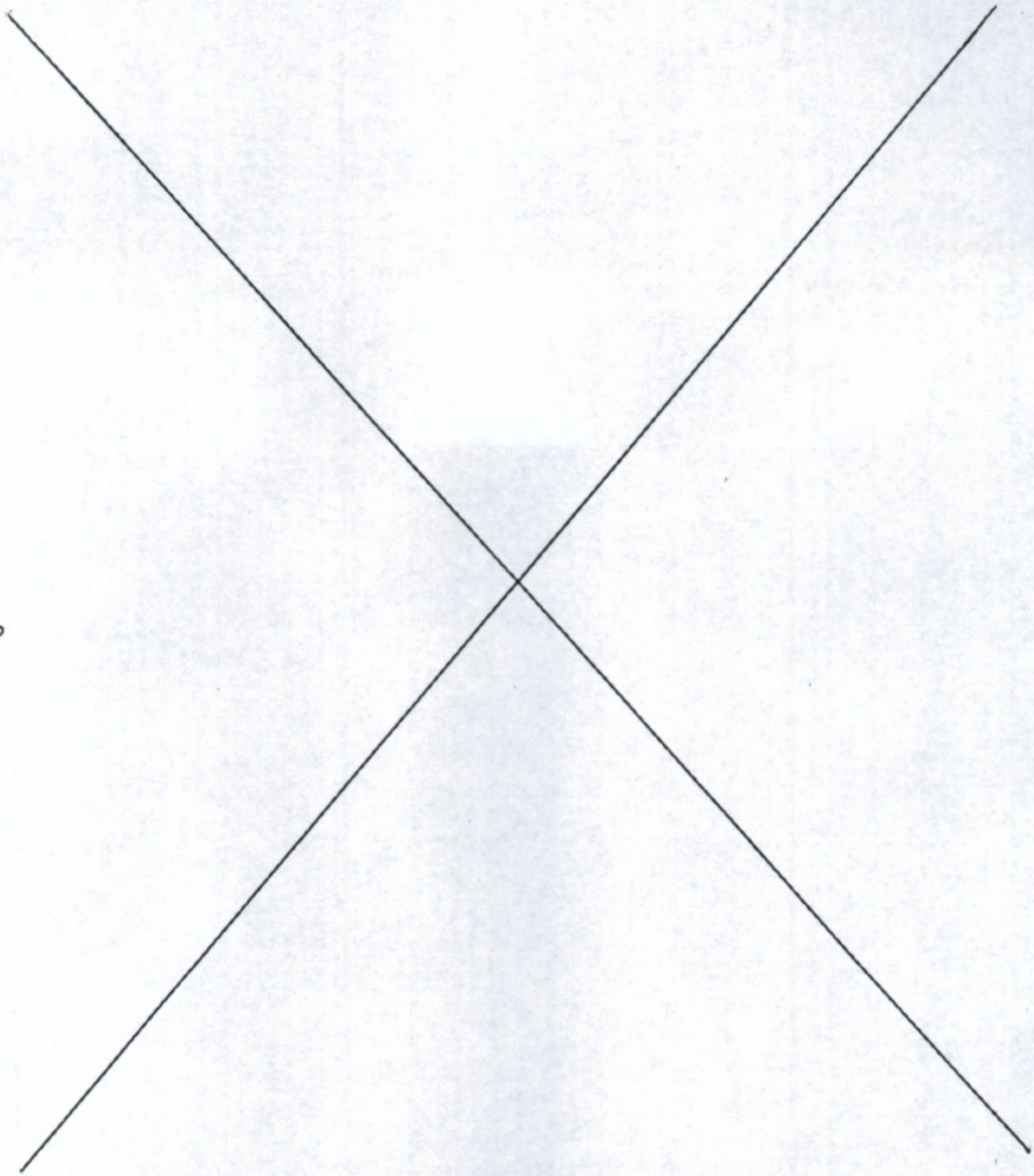


5.26

9. **Earthlight Replication** While the production of light by fractured rocks is an interesting natural phenomena, no military applications can be seen, lightning itself does not, of course, reflect radar energy, and there is no other known effect discovered as a result of studying the UAP data available, that could be used advantageously.

UNCLASSIFIED

UNCLASSIFIED



S.26

UNCLASSIFIED

UNCLASSIFIED

CHAPER - 4 UAP WORK IN OTHER COUNTRIES

FORMER SOVIET UNION

1. It is clear that the Former Soviet Union has taken the study of UAPs seriously and that this may well be related to a programme of understanding and exploiting certain UAP-related natural phenomena, such as plasmas. A 'UFO' Commission was created under the USSR Union of Scientific and Engineering Societies in 1989; together in 1990 with an Inter-Industry Ufology Research Centre (SOYUZUFOSENTR) to co-ordinate records. This Centre had the rights of an Institute under the USSR Academy of Sciences, and was headed by V.G. AZAHAZHA (or AZHAZHA) an eminent researcher and former naval submariner. A school was set up with the Terms of Reference to study "ufology as a science of unidentified flying objects and their inter-relations with the universe and, in particular, with the biotechnosphere of the earth". The ten week course, reportedly studied, observation, characteristics, astronomy and psychophysical aspects of the problem. The russians use the acronym UFO in all their references, course names etc., and this is used here rather than UAP, while discussing their work(U)

2. V.V. ALEXANDROV and Y.N. GLAZOV, respectively Senior Project Engineer and Astronaut (Hero of Soviet Union) both of the Test Centre (Tsenatr Podgotovki Kosmonatov) at the Scientific Production Association (Geophysics), have been involved in research into UFO activity in 'abnormal zones' and landing places(!). A laboratory to support this work is reportedly located at AKHTUBISK (on the Volga). Glazov was Deputy Head of the Cosmonaut Training Centre in charge of science and testing.(U)

3. **Plasma Research.** Annex A summarises two russian scientific papers where, it appears, 20-30 scientists have pursued research for the prevention of air target detection. [redacted] S.26

4. **Former Soviet Union Ufology Commission** The Commission Head, Azhazha, was also a member of the USSR Union of Scientific and Engineering Societies Ufology Commission. The geographical features of zones in which UAP reports have been particularly frequent have been studied. Russian open reports attribute UFO activity as being 'purely terrestrial in origin', according to some theories. The Institute have reportedly developed light filters, instrumentation, IR and UV photography to pursue the topic. Unexplained imagery has reportedly been obtained including "peculiar spheres, humanoid figures (perceived as cylinders, circular objects and man-like beings in visible light). If the imagery exists, it has never been published. It seems more likely that images may have been **seen but not recorded.** Some theories, Azhazha reported, attribute these to "manifestations of some substance whose nature is little known at present. This substance may be capable of forming organic matter and temporarily becoming visible to the unaided eye". [COMMENT: The reader is referred to the unusual effects on humans apparently caused when in proximity to some aerial phenomena, reported at Volume 2 Working paper No 25.] [redacted] S.27

5. **Near Field Effects** In 1991 a group of Russian Researchers, having collected soil samples from an alleged UFO landing place noted an unusual field (NFI). V. KHZOPOV (a member of an Applied Biolocation Group), reported that other samples were obtained from other reported landing sites. In all cases a local field developed over a period of three hours. Impairment of human senses were reportedly observed in every person studied who had been **'in the field'**. The main effect was that the thought processes were degraded in some way, but that 'energy was also added'. The report published in 1991 states that the energetics of the upper human

UNCLASSIFIED

UNCLASSIFIED

energy centres increased. [Comment: In the absence of further information It can only be assumed that this may apply to brain or nerve centre activity. There is no indication as to the type of field involved. It is possible, and confirmed from some other data that russian scientists may have discovered some new field types. If this is the case the reports suggest that they have also developed a means of both detecting and measuring the field. See also Volume 2 Working Papers No. 1 and, again, paper No. 25, in particular]. The implication here is that the Russians are stating that UAP emanate some type of field - presumably of a nature known to man since apparently they were able to sense that a 'field' was present.(U)

6. In an interview with 'Pravda Ukrainy (24 April 1990), the Deputy Flight Director of the Centre for Control of Space Complexes, stated that UFO sightings in nuclear test and disaster areas were to be studied. One pilot possibly involved is (or was) Boris KOLOTOV. [Comment: It is of interest that both former nuclear test areas and disaster areas (presumably natural events, for example, earthquake, hurricane/tornado, etc.) are locations where an additional level of atmospherically-borne dust is likely to occur - see the Working Paper at Volume 2 on Charged Aerosols]. In 1990 the All Union Ufology Association was formed and headed by Major General of Aviation P. POPOVICH (Pilot Cosmonaut) at the Air Force Academy.(R)

7. Also in 1990 General of Aviation Igor MALTSEV, Chief of the Main Staff of Defence Forces, submitted documents and photographs for public release. These reports were from pilot and other expert observers. [Report held by DI55(R)]. Another Russian personality involved in the studies is Vsevolod TROITSKY (Russian Academy of Sciences) who chaired the Commission for the Study of Anomalous Propagation and Phenomena.(U)

8. **Former Soviet Union Aircraft Incidents** Sokolov reported. "We had 40 cases where pilots encountered UFOs. Initially they were commanded to chase, then shoot. When our pilots would engage the UFO it would speed- up, our aircraft would give chase, loose control and crash. That happened 3 times and twice the pilots died. After that the pilots we told to observe and change course and get out". "The pilots viewed UFOs as a definite threat". Sokolov says "the military were interested in UFOs including the belief that if the secrets of the UFO could be described they would be able to win the competition against prospective enemies by incorporating the technology". The incidence of 'Foo Fighters' or 'BOLS' (i.e. BOLIDES) is perhaps higher than reported. In Russia, airline crews, it has been suggested, are reluctant to call passenger's attention to these as it is bad for business! (U)

9. **FSU/Russian Experimental Vehicle** In 1980 Candidate of Technical Sciences (N. Abacharayev) submitted an invention 'of UFO-like shape' which was based on a super conducting storage rings, one vertically and one horizontally orientated. Electrodes, assembled into several sections, terminate outside the craft and create electrical discharges in the flying medium. The discharge current between the electrodes is controlled in some way by a current flows from a superconducting winding and thrust is produced. The vertical section of the electrodes is switched off for take-off and the horizontal sections are used for manoeuvring. Further USSR reports speak of seeing unknown aerial experimental vehicles UAPs (devices) which rotate around an axis and claim that the rotation of a plasma sheath create an additional magnetic field. Pulsating lights were obtained from the plasmas discharges. As the pulsating increased the velocity of the object increased - the higher the plasma discharges the higher the accelerations and speeds. XXXXXX
XXXXX

UNCLASSIFIED

OTHER NATIONAL ACTIVITY

10. **CHINA** In the early 1990s China announced an interest in Unexplained Aerial Phenomena, and in May 1993 set up a 'Scientific Institute for the Study of UFOs. This Institute numbers more than 300 co-operating specialist members over 24 Industrial and Municipal Departments centred on Peking/Beijing and other large cities. The TORs are to determine whether UFOs represent unusual or unconventional astronomical phenomenon. Some articles have appeared in the Chinese News Media (in UKHAMI), together with UFO photography. The Chinese had contact with Russian officials on the topic of UAP in the setting-up of the organisation described briefly above, specifically Academicians Frolov, Kasmacheev and Pitrovich.[1][(U)

11. **SPAIN** The Spanish MoD have taken the 'UFO' phenomenon seriously. Sixty six files have reportedly been released to the public. DI 55 Staff have not seen these files.(U)

12. **USA & CANADA** The USA's widely-publicised activities were described and contrasted with the UK effort at the beginning of Volume 1 of this report. There is no intelligence exchange or access or collaboration of any sort on the topic of 'UFOs'. XXXXXXXXX XXXXXXXXXXX XXXXXXXXXX

UNCLASSIFIED

ANNEX A

CONTENTS

	Para	Page
INTRODUCTION		
Target Signature Control	1	A-2
SPHERICAL FORMATIONS IN THE ATMOSPHERE	7	A-3
Proposed Theory	12	A-5
Corona Discharge	13	A-6
Shells	14	A-6
SUMMARY	16	A-6

UNCLASSIFIED

UNCLASSIFIED

ANNEX A

GENERATION OF PLASMA FORMATIONS

INTRODUCTION

1. Avramenko [1] was working on plasma formations during the Cold War as a source of high power radiation, especially to produce 'long-lived' plasma formations. The properties developed were high density, low optical emission and retention of shape in an airflow up to 200ms^{-1}. These were supposedly analogues of ball lightning - but were clearly part of the Soviet Union HP microwave weapon programme. The colour of the plasma was light blue in air. In a water acrosol a **near spherical shape** was formed. Avramenko also showed, under laboratory conditions, that Energetic Plasma Formations (EPF) could pass through obstacles with holes in them. For example holes in rods, spheres, disks or plates. The EPF can pass through a much smaller hole than its dimensions, reforming on the other side without dividing into parts. This suggests that the plasma contains forces similar to surface tension or mutual attraction of the particles forming the medium. Experiments proved that pressures were possible up to ~25 torr before break-up. Strangely, the time taken for completion of the motion through the aperture apparently depends not only on the hole diameter and length (e.g. when passing through a tube), but also on the material. For example when the length of a glass tube was lengthened by a factor of ten, the transmit time was reduced by 40%. In diamagnetic material the time was reduced by ~25%. (U)

2. In the UAP context the implications are that (as often reported in practice by many witness) a UAP can 'enter' a room or even an aircraft though a small aperture relative to its size. It can achieve this either by puncturing a hole through a material or (frighteningly to a witness) entering through a door, chimney, keyhole, etc. ××Ẍ××××××

the plasma mass is capable of autonomous existence for an anomalously long time; when compared with an ideal plasma. The charged particle density for 100^{0} EPF may be of the order 5×10^{16} cm^{-3}. The references indicate that at least 20-30 Russian scientists have been pursuing plasma research, its relevance to military activities, including ball lightning, and plasma research relative to air vehicles.(R)

6. In summary, the plasma density is such that, if formed (by whatever means) in the atmosphere, it is likely to:

- 'Float' or 'bob' (because of its close relative density to the surrounding air).
- Climb or descend slowly, unless acted upon by very strong external, potential differences seen in the 'darting' towards objects of different potential - often electrical or other earthed pylons, or their insulated or isolated conductors; or towards vehicles in open ground, especially on exposed high moorland or, for example, on mountain roads.
- Exhibit erratic motion caused by an interaction of total body charge with other surrounding magnetic and electrical fields.
- Be attracted towards areas where the electrical activity in the form of electrostatic charges may be modified by the presence of intense air-vehicle activity.

(U)

SPHERICAL FORMATIONS IN THE ATMOSPHERE

7. A 1995 Russian review states that spherical formations in the atmosphere originate mostly as a result of human activities. Examples of activities which can produce spherical shapes are:

- Launches of missiles, spacecraft and satellites.
- The burning up of used missile stages and defunct satellites in dense layers of the atmosphere.
- Atmospheric pollution (see also Working Paper 1 & 2 on Dusty Plasmas).
- The launching of stratostats and balloons (see Working Papers No.14 & 15)

8. Other spherical formations may be related to meteors, planets, the Aurora Borealis or other optical and natural weather phenoma, also covered in Volume 2. Many drifting luminous formations maintain their shape over long periods. Explanations have been sought, which include, chemical, optical and vortice models - which often do not explain the reported electrical properties of the formations. In contrast, the plasma models appear not to explain their stability and lifetime. At least one option[3] contends that such formations, including ball lightning, consist of electrostatically bi-polar charged shells comprising orderly orientated water molecules.(U)

9. While ball lightning diameters (see Working Paper No.2) are predominantly small, by comparison with many others reported, the common factors between all these are that they exhibit:

- Sudden appearance/emergence.
- Sudden disappearance.
- Erratic and other motion which enables them to be clearly distinguished from familiar objects.
- Forms of energy detectable - electrical field(s) present, magnetic field(s) present, heat, light, colours and sound.
- Similar shapes or shapes and, in general, those formed by rotations or distortions of a sphere.
- Shapes described as patterns by that bounded by several `marker lights' (or colours) - (e.g. rings of lights, triangles, oblongs).
- Shapes described as solid objects but often with lights (colours) at their sharp extremities, (is at their `corners').
- A propensity for spherical formations to form near sources of Methane, Iron and copper .

(U)

10. About 60% of ball lightning phenomena have a diameter of ~5m, with a probability of occurrence of 10^{-9} to 10^{-8} km^{-2} min^{-1}. In basic terms this is approximately 100 to 1000 incidents on earth every hour, many of which go unseen and therefore unreported. Apart from any visual sightings, the implication must be that these do not constantly present false alarms to radars. While the **theoretical** radar cross-section of the ideal reflective sphere, (given by $2\pi a/\lambda$, where 'a' is the radius), can be 50 square metres for a 5m diameter ball and ten for a 1m diameter ball, at D(L) Band; clearly this is not the case in practice. Plasma researchers quote diameters from centimetres to 10-15metres and RCS values from -60dB to 8 metres at the same RF. (U)

11. During the period of observation the phenomena may exhibit one or more of the following:

- Gradual growth.
- Splitting into two or more separate parts (but rarely more than five), accompanied sometimes by a change of pattern, spacing and shape.
- Dissolution/dissipation to invisibility (often instability reported as accelerating away rapidly; when in fact the diameter reduces and intensity fades).
- Merging of disparate `bright lights' (or colours) into larger formation (often reported as small craft joining the `mother ship' and thereafter forming a row of portholes!).

- Disappearance, accompanied by smell.

- Rotation, non linear motion.

- Weak thermal radiation.

- Translucence, haloes, blackness.

- Beamed light emissions, especially when near a conductive object (usually described by witnesses as beams, which, if they move or rotate become `scanning searchlights', or `beams searching for a landing site', especially if the formation is stationary at the time. It is, of course, inevitable that conductive objects will be found - depending on the location. A vehicle, for example, crossing moorland, may be the only conductive object for miles apart from a few telephone or power wires). They are, most likely, the discharge or leakage paths by which the plasma entity gradually loses its structure and weakens to a point of disappearance unless it is either attracted away or its buoancy state changes, allowing it to 'float off ' and seek another destination.

- Under some conditions invisibility to the human eye, while being visible to some forms of photography and contrarily, visible to the eye, but not seen on photographs taken at the time.

or White ball lightning (generally smaller in diameter) is usually spherical, hence the name; larger formations with other shapes are often reported as discoids, and have often three or four different colours, especially at the top or bottom.

(U)

12 **Proposed Theory** It is noted that the Russian perception is much the same as in The West. That there is a UAP connection is evident by the `beamed light emissions' and `landing site' mentioned above. In a strong electric (E) field, a stable structure can be formed of water molecules, where their dipole moment vectors are aligned with the force lines. This is possible because they possess polarity and hydrogen bands are capable of forming dense structures like ice or loose ones like snow. Among all known substances, water possesses the largest number of crystalline phases; which can be formed under various temperatures, pressures and water vapour condensation conditions. Certain types of ice, which originate at high pressure, can exist at temperatures exceeding 70°C. Only common ice is lighter than water. Due to ordered structures and high electric striction pressure, spherical formation balls can exist at high temperatures. Using the theory suggested [at Ref. 3], the shell stability and shell strength is determined by the local field, which keeps the shell of the spheroid in tension. The shell theory suggests that for such spherical formations, for example for a radius of ~10km, the delay period could be ~200s. When such shells disintegrate, molecules change state and stored energy is suddenly released, for example as a small explosion. The attractive force between a sphere and a conductive surface at distance ℓ, when the axis of the sphere is normal to the surface is given by:

$$F = 3p^2/32\pi\ell^4 \text{ at } p = 4\pi ER^3$$

At $R_2 = 10m$ (where R_2 is the sphere outer radius)

$E_1 = 3MV.m^{-1}$
$\ell = 42m$
$F = 123N$
or at $\ell = 10m$
$F = 40kN$

The magnitude of this attraction force, plus their low aerodynamic drag could explain how plasma balls have been seen to move against the wind. (U)

13. **Corona Discharge** The corona discharge from the surface of objects can ensure the stability of low density objects in the air. When the charged formation approaches a conducting object, the discharge of a bi-polarly charged shell would increase. This is normally accompanied by an electric wind which, in laboratory conditions can be shown to exceed $2m.s^{-1}$. The reactive effect produced by the electric wind is capable of balancing the mirror reflection and gravitation forces. (U)

14. **Shells** Spherical formations are shells that may be perceived differently by the eye, cameras, or radar. These shells cause an interference of light and radio waves. Ambient light falling on a thin shell will be partly reflected by the inner and partly by the outer surface. If the shell thickness happens to displace a light source by half a wavelength the waves would interfere, thus making the shell appear as a black (or solid) object or silhouette. (U)

15. Supercooled water vapour in the discharge space can enhance the amount of glow by up to 1000 times. In the UAP context, eyewitnesses frequently report convergent radiating star-shaped beams. (U)

SUMMARY

16. The foregoing theory cannot be entirely proved to be an exact model of a UAP, but the characteristics are strikingly similar, if not identical to many of the reports on the UK database. Undoubtedly, the postulated shells can be stable, can travel, have persistence and other UAP-like characteristics. S.27

[1] "Study of Plasma Formations in an Erosion Discharge"
Avramenko R. F., Bakhtin B.I. et al Sov. Tech Phys 35 (12) Dec 1990

[2] Kang W.I., Radar M & Alexoff. I "A Conceptual Study of Stealth Plasma Antenna" Plasma Science Laboratory, University of Tennessee

[3] A.I Mesenyashin "Spherical Formations in the Atmosphere as a Physical Phenomenon" Journal of Electrostatics No. 36,1995. Russian interest in UAPs is often evident in this short review, where 'shapes as solid objects' and triangles etc are mentioned. The similarlity of UAP characteristics are not normally connected in Western scientific papers on ball or bead lightning.

SECRET
UK EYES ONLY
UNCLASSIFIED

UNCLASSIFIED
UK EYES ONLY
SECRET