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TECHNICAL REPORT

No 102-AC 49/15-100

AF 180273

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UNIDENTIFIED FLYING OBJECTS

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Project "GRUDGE"

Unidentified Objects

Incl File

Release Date
August 194

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AIR MATERIEL COMMAND

WRIGHT-PATTERSON AIR FORCE BASE

DAYTON, OHIO

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Technical Report No. 102-AC 49/15-100

UNIDENTIFIED FLYING OBJECTS
PROJECT "GRUDGE"

Lt H. W. Smith
Mr. G. W. Towles

Project No. XS-304

Approved by:

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ABSTRACT

A Technical Intelligence Report covering the method of investigation of unidentified flying objects and results obtained to date is presented.

The report discusses in full the history of the project, the problems encountered, and the procedures followed in the investigation and evaluation of reports of unidentified flying objects. Since the project is continuous in nature, this report comprehensively treats reports of sightings only up to January 1949. Work is continuing on later reports.

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FOREWORD

The following individuals and agencies served as consultants in the investigation and evaluation of unidentified flying objects:

1. Dr. J. A. Hynek, Ohio State University -- was under contract from 16 December 1948 to 30 April 1949, Contract No. AF 33 (038)-1118
2. Hq, Air Weather Service, Washington 25, D. C.
3. Dr. G. E. Valley, Scientific Advisory Committee
4. Rand Corporation, 1500 Fourth Street, Santa Monica, Calif.
5. 3160th Electronics Laboratory, Cambridge Field Station, Mass.
6. Dr. P. M. Fitts, Air Materiel Command Aero-Medical Laboratory
7. Weather Bureau, U. S. Department of Commerce

In addition, technical sections of the Analysis and Engineering Divisions, Air Materiel Command, were available for consultation when needed.

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INTRODUCTION

This report may be considered as final for the period reported upon. It also indicates the probable future trends of reports of unidentified flying objects.

In gathering and evaluating material for the report, it was found, and will be seen, that the conclusions evolve without effort. No attempt has been made to force evidence into a pattern that was not clearly indicated.

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SUMMARY

While there are approximately 375 incidents on record, only incidents Nos. 1 thru 244 are encompassed in this report. Of the later incidents, many have not yet been investigated, few have been completely tabulated, and none have been submitted to the consulting agencies. It is certain that better over-all results will be obtained in the analysis of the later reports, as these incidents generally have been more completely investigated.

Since 5 December 1948, a series of recurring phenomena described as "green fireballs" have been reported in the general vicinity of Albuquerque, New Mexico. Dr. Lincoln La Paz, noted meteoritic expert, has been directly, though unofficially, associated with the investigation of these sightings and has himself observed the phenomena. Dr. La Paz states he is convinced the green fireballs are not ordinary meteors. This group of incidents has little or nothing in common with other incidents on file with Project "Grudge", therefore, these incidents are not considered in this report. The Scientific Advisory Committee was asked to investigate this matter and had advised that an independent investigation be conducted in the field of atmospheric research.

Upon eliminating several additional incidents due to vagueness and duplication, there remain 226 incidents which are considered in this report. Thirty of these could not be explained, because there was found to be insufficient evidence on which to base a conclusion.

Consulting agencies provided plausible solutions for 164 incidents, along with the following comments and findings:

Rand Inc. — (172 Incidents considered) "We have found nothing which would seriously controvert simple rational explanations of the various phenomena in terms of balloons, conventional aircraft, planets, meteors, bits of paper, optical illusions, practical jokers, psychopathological reporters, and the like."

Ohio State University (Dr. Hynek - 244 Incidents considered) Assuming evidences of observers and investigators to be correct, Dr. Hynek concluded that 32% could be explained astronomically, 35% could be attributed to balloons, aircraft, rockets, birds, etc., and 33% either lacked necessary evidence or a suitable explanation was not apparent. When due allowance was made for inaccuracies in observing and reporting, 53% might be explained astronomically.

Air Weather Service (233 Incidents considered)

12.0% apparently were weather balloons.

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Air Materiel Command Aero-Medical Laboratory (Dr. Paul M. Fitts - 212 Incidents considered)

There are sufficient psychological explanations for the reports of unidentified flying objects to provide plausible explanations for reports not otherwise explainable. These errors in identifying real stimuli result chiefly from inability to estimate speed, distance, and size.

All of the remaining 34 incidents are treated in detail in this report. These incidents form no pattern in regard to area of sighting, type of object, or manner of performance. There are indications, however, that some sightings were influenced by earlier reports, and probably would not have been considered unusual or reported had there been no publicity.

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CONCLUSIONS

1. Evaluation of reports of unidentified flying objects to date demonstrate that these flying objects constitute no direct threat to the national security of the United States.

2. Reports of unidentified flying objects are the result of:

a. Misinterpretation of various conventional objects.

b. A mild form of mass hysteria or "war nerves".

c. Individuals who fabricate such reports to perpetrate a hoax or to seek publicity.

d. Psychopathological persons.

3. Planned release of unusual aerial objects coupled with the release of related psychological propaganda could cause mass hysteria.

a. Employment of these methods by or against an enemy would yield similar results.

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RECOMMENDATIONS

1. That the investigation and study of reports of unidentified flying objects be reduced in scope.

a. That current collection directives relative to unidentified flying objects be revised to provide for the submission of only those reports clearly indicating realistic technical applications.

2. That Conclusions 1 and 2 of this report, with sufficient supporting data, be declassified and made public in the form of an official press release.

3. That psychological Warfare Division and other governmental agencies interested in psychological warfare be informed of the results of this study.

a. That such agencies coordinate in and provide further recommendations for public release of material as recommended in Para. 2 above.

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FACTUAL DATA

I. Foreign Reports

During the summer of 1946, there were reported to have been seen in Sweden a number of mysterious aerial objects. There were as many different descriptions for the "ghost rockets", as the newspapers tagged them, as there were observers. It soon became quite common for newspapers in Sweden and in the U. S. to refer authoritatively to these objects as guided missiles with the inference that they were test flights from Russia or Russian-dominated areas. The "ghost rockets" were usually seen in hours of darkness, almost always traveling at extremely high speed; shaped like a ball or projectile; bright or incandescent blue, white, red, green, or yellow; sometimes had an associated noise; and were always seen at too great a distance to observe details. By the end of the summer, 1946, an occasional report came out of Denmark, Norway, Spain, Greece, Fr. Morocco, Portugal, and Turkey. Throughout 1947 and 1948, "ghost rocket" reports totalled less than a dozen. None have been received within the past 6 months. These reports reached the public through the press and the radio, they reached the government of the U. S. through Military Attache reports. Attaches had obtained virtually all of their information from European press and radio items.

The Swedish Defense Staff conducted a comprehensive study of the early incidents. Several thousand reports were thoroughly investigated and plotted, with resultant conclusions that all evidence obtained of sightings were explicable in terms of astronomical phenomena. Since that time, although the Swedes themselves show little concern, they attempt to play up their incidents to the United States, obviously to emphasize their request for radar (see Appendix "A").

II. Early American Reports

The first American report of unidentified objects to receive wide publicity and to cause some national concern was that of Kenneth Arnold of Boise, Idaho. Arnold described the objects as "saucer-like discs" and this is evidently the origination of the much-used terms "flying saucers" and "flying discs". This incident is Number 17 in the project files. The date of sighting is given as 24 June 1947. Arnold's story appeared in many newspapers throughout the country. He even wrote a series of articles about this sighting for "Fate" magazine. This periodical styles itself a "cosmic reporter" and delves into the supernatural and fantastic.

Within the month following Arnold's report, the number of incidents reached a peak that remained unsurpassed for any like period covered by this report. (This peak was, however, surpassed in May 1949, following an Air Force press release and a series of articles in the Saturday Evening Post concerning flying objects. A few individuals later reported having seen objects prior to the Arnold incident.

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Since August 1947 until the present, except May 1949 as noted above, the number of reports maintained a monthly average of approximately twelve, with occasional up-surges often directly attributable to an unusual or overly publicized report.

III. Air Force Cognizance of Unidentified Aerial Objects

In September 1947, the Air Force was forced to take official cognizance of the "flying discs" because of increasing demand from the public for an explanation, and as a result of certain publications persisting in using a sensational approach in reporting such items, and often implying that something subversive, dangerous, and fearful was upon us.

Hq. AMC in a letter dated 23 September 1947, requested the Commanding General, Army Air Forces, to issue a directive assigning a priority, security classification and code name for a detailed study of flying disc reports. Hq. AMC explained that their action was based on the opinion that the phenomena reported appeared to be real. Awaiting a specific directive, Hq. AMC collected information on flying disc incidents in order to more clearly define the nature of the phenomena. On the 22nd of December 1947, in a memorandum, "Analysis of Flying Disc Reports", the Director of Intelligence, Hq. USAF, concurred with AMC recommendations and forwarded them to the Director of Research and Development, DCS/M, Hq. USAF, for reply to the Commanding General, AMC. In a letter dated 30 December 1947, the Director of Research and Development, DCS/M, advised the Commanding General, AMC, that Air Force policy was not to ignore reports of sightings and phenomena in the atmosphere. To implement this policy, AMC was directed by Hq. USAF, to set up a project with the purpose of collecting, collating, evaluating, and distributing to interested government agencies and contractors, all information concerning sightings and phenomena in the atmosphere which might be construed to be of concern to the national security. This directive assigned a priority of 2A to the project, a RESTRICTED classification and a code name of "Sign". (The code name of "Sign" for the project was changed to "Grudge" by a 16 December 1948 request of the Director of Research and Development, DCS/M. "Grudge" under the U.S. Joint Services code word index refers to the title "Detailed Study of Flying Discs".) As a result of the directive from Hq. USAF for establishment of the special project, Hq. AMC Technical Instruction No. 2185, dated 11 February 1948, was published and assigned responsibility for the project activities to the Technical Intelligence Division, Intelligence Department, Hq. AMC.

Department of Air Force and Department of Army letters directed all respective subordinate units to report directly to Air Materiel Command all information concerning unidentified flying objects. Air Intelligence Requirements Memorandum No. 4 was published 15 February 1949 at the request of Air Materiel Command in an effort to obtain more comprehensive and accurate information.

IV. Project Administration

At the outset, project personnel proceeded by air to the scene of a reported sighting to personally interrogate witnesses. This was not

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entirely satisfactory, due to the fact that the number of personnel available was not sufficient to cover each report adequately and have time for recording and analyzing material collected. Furthermore, it was learned that project personnel could not be well enough versed in all the technological and scientific fields involved in this study to efficiently execute all phases of this work. Therefore, in September 1948 the method of operation of the project was revised. Enough experience had been gained to make it evident that a large proportion of disc reports arose from sightings of unfamiliar objects and failure to recognize known objects for what they were. The course then became apparent. It has since been the endeavor to have adequate investigations of all reports, systematic tabulation of all information, and analysis of information by competent technical personnel in all branches of science and engineering into which the reported object may conceivably fall. In this way misrepresented and generally unfamiliar objects, hoax makers, and psychopathological reporters may be identified, and these reports eliminated from the study. With these out of the way, the succeeding steps would develop.

In implementing the above plan, the following general procedure was established and followed:

A. Receipt of Initial Reports

1. Personal letter and personal contact.

2. Newspaper clippings and radio news broadcasts.

3. Reports from military and naval installations, (as a result of official directives; these make up the largest bulk of reports).

B. Investigation of Reports

1. A few reports are investigated by Headquarters, Air Materiel Command personnel, ATI field teams or project personnel.

2. When a sighting involves only military personnel, especially in out-of-the-way locations, local base intelligence officers are requested to investigate.

3. The largest number of reports are investigated by the appropriate CSI District, by request through 5th District CSI.

4. All investigators are instructed to use AMC form titled, "Guide to Investigation Unidentified Flying Objects" to assure collection of all available, pertinent information. The Guide to Investigation is frequently revised to incorporate recommendations of technical consultants to the project.

C. Recording of Information After Receipt of Report of Investigation

1. Upon completion of investigation, the reported sighting is then treated as an incident and assigned a consecutive number.

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Its location and configuration is then plotted. Statistical graphs are brought up to date.

2. Information for locating and comparing is recorded on card files by witness, and on a tabular sheet for convenient study.

3. Pertinent information is extracted, condensed, and compiled on an Incident Summary Sheet, which is similar to the first two pages of the Guide to Investigation.

4. Entire incident files are microfilmed, in order that technical consultants will have access to all available information if desired.

5. Data is collated against monthly blimp flight reports, Airline schedules, information on ball lightning, and other known aerial objects.

D. Consultants

Since, as stated above, there were indications that some sightings could be attributed to natural phenomena, conventional aircraft and aerial vehicles, birds, lights, clouds, etc., effort was made to have all material analyzed by individuals in all technical fields that might conceivably be touched upon. These individuals and agencies include the following (only those agencies which provided usable results are considered):

1. Dr. J. A. Hynek, Astronomer, Ohio State University, was awarded a contract, effective 16 December 1948 to 30 April 1949, for the purpose of attempting to determine which reported objects might be attributed to natural celestial phenomena.

2. Headquarters Air Weather Service was requested to review each incident to determine those which may have been weather balloons by comparison of release and weather data with time of sighting, description of object, and its maneuvers.

3. Dr. C. E. Valley, Scientific Advisory Board. Since many reporters colored their reports with talk of ray, electronic beams, and magnetic support and propulsion, Dr. Valley was asked to analyze the incidents and decide whether this could possibly be the case in any instance, and to provide information on this matter.

4. Rand Corporation was requested to analyze each incident and provide any reasonable explanation that could be determined from the evidence given. Rand also provided a discussion of the possibility of visitations by beings from other planets.

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5. 3160th Electronics Laboratory, Cambridge Field Station, studied all incidents by comparing evidence with research balloon data, to determine which incidents may be attributed to various types of research balloons.

6. Dr. P. M. Fitts, Psychologist, AMC Aero-Medical Laboratory was requested to review all material relative to sightings and to provide psychological and illusory information and determine human capacity for observing and remembering minute details of range, speed, size, etc.

While these analyses were being conducted, the Swedish Defense Staff was contacted through our Air Attache to learn the official Swedish attitude toward the "ghost rockets". The results of these requests are contained in AA Reports, No. IR-115-48, 30 December 1948, and No. IR-47-49, 2 March 1949 (listed as Appendix "A").

V. Discussion of Reports of Consulting Agencies

A. Dr. J. A. Hynek, Final Report (see Appendix "B"). Dr. Hynek's report includes the results of a concentrated study of all files up to an including Incident No. 244. However, as mentioned above, Incidents 223 through 227 and 241 through 244, in the New Mexico area, will not be considered in this analysis. An additional seven incidents were excluded by Dr. Hynek as explained in his Summary on Page 4 of Appendix "B". Of the remaining 228 then treated, Dr. Hynek concluded that approximately 33% were astronomical with varying degrees of probability. He concluded that an additional 37% were not astronomical but suggestive of other explanations, such as birds, rockets, balloons, ordinary aircraft, etc. The remaining 30% as far as Dr. Hynek was concerned either lacked sufficient evidence or evidence offered suggested no explanation. In compiling these statistics, Dr. Hynek cautiously accepted each case at face value, without discounting evidence that sometimes "verged on the ludicrous" and without taking into consideration psychological factors. Dr. Hynek then stated that "53% might conceivably be considered (although the likelihood of their being so may be very small) as extra-terrestrial or astronomical in origin". These include "those which either are definitely astronomical or can by suitable manipulation of the evidence be construed as such".

B. Hq, Air Weather Service, one indorsement and one letter (see Appendix "C") Air Weather Service conducted an analysis simultaneously with Dr. Hynek using the same evidence. AWS attempted to determine whether a synoptic weather balloon could have been at the location where a sighting was reported.

In this investigation consideration was given to the wind direction and speed at the surface and aloft at the scheduled time of balloon release, and the location of the nearest weather station making balloon observations. AWS used files of the first 233 incidents.

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These include five of New Mexico fireballs and the seven incidents that duplicated others or had no information. Therefore, 221 incidents are considered here. Of these, AWS concluded that 31 incidents could have been synoptic balloons, four of these were incidents that Dr. Hynek could not explain. In addition, AWS determined that ten more incidents could be attributed to astronomical phenomena. A discrepancy is noted in that, of the 31 which AWS concluded were balloons, Dr. Hynek has listed six as possible meteors. In the remaining 25, AWS and Dr. Hynek were in close agreement.

NOTE: The project files contain listing of over 200 weather stations within the U.S.A. A conservative estimate of balloon releases by these stations alone would number well over 500 per day.

C. Dr. G. E. Valley, General Study (Appendix "D"). Dr. Valley was requested to review all reports (Incident No. 1 thru 172 incl.) and provide any possible explanation. At the same time, he considered the possibility of supporting and propelling a solid object by unusual means. (It will be noted that Dr. Valley's theories along these lines very closely parallel those of J. E. Lipp, Rand Corporation, Appendix "E".)

D. Rand Corporation, letter, 13 December 1948, and letter, 29 March 1949 (Appendix "E"). Rand provided a discussion of the special design and performance characteristics that are believed to distinguish space ships. Rand received files on Incidents No. 1 thru No. 233 for general analysis. Although the final report from Rand has not yet been received, Rand reported, in a letter (Appendix "E") based on study of the first 172 incidents, "to date, we have found nothing which would seriously controvert simple rational explanations of the various phenomena in terms of balloons, conventional aircraft, planets, meteors, bits of paper, optical illusions, practical jokers, psychopathological reporters, and the like."

E. 3160th Electronics Laboratory, Cambridge Field Station (Appendix "F"). The Electronics Laboratory reviewed Incidents No. 1 thru No. 172 to determine whether any may have been sightings of special research balloons. The Laboratory showed that 18 could possibly have been their balloons. Dr. Hynek's analysis did not conflict with any of these, and in some cases served as slight confirmation. However, of the 18, three were thought to have been synoptic balloons. It was learned while obtaining this information, that numerous universities and laboratories are engaged in various types of research requiring the use of balloons. Even when the balloons are recovered, there is no certain way of determining their exact path.

F. Dr. P. M. Fitts, Air Materiel Command Aero-Medical Laboratory (Appendix "G"). Dr. Fitts studied 212 incidents from a psychological point of view and concluded "that there are sufficient psychological explanations for the reports of unidentified objects to provide

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plausible explanations for reports not otherwise explainable." Review of Dr. Fitt's report reveals that this conclusion is warranted, despite its presumptuous sound. Dr. Fitts provided plausible explanations in six specific reports, one agreed with AWS, four agreed with Dr. Hynek, and one Dr. Hynek could not explain and AWS did not mention.

G. U. S. Department of Commerce Weather Bureau (Appendix "H").

The Weather Bureau provided much information on the phenomenon of ball lightning and lightning in general. These phenomena cannot be ruled out entirely. However, none of the recorded incidents appear to have been lightning.

VI. Summary of Results of Consultants

It can be stated with certainty that unidentified objects are many different types of objects and not multiple sightings of the same object or the same type object.

It is realized that none of the explanations given constitute positive scientific proof. Such proof might be possible were fragments recovered or were damage to property or injury to personnel sustained in any instance. On the other hand, almost every incident has less than legal proof that an object was seen, or that an object appeared or performed as described. Even in those cases where more than one witness reported, all witnesses seldom agreed on details.

In view of the foregoing, the explanations provided by consulting agencies are accepted as solutions to the respective incidents.

Of the 228 incidents under consideration in this report, 30 must be disregarded for lack of workable evidence. Eight were extracted from press and radio accounts and are hardly more than rumors. In the investigation of five others, the observers were found to have possessed too vivid imaginations, were of low intelligence, or were morally questionable. It is reasonable to assume that if these thirty incidents had contained sufficient information a proportionate number could be explained as were the 164 incidents that have been explained.

With 194 incidents thus eliminated, there remain thirty-four which contain some evidence but have no apparent ready explanation. This statement is true only under the assumption that the evidence is accepted as reliable and accurate. When psychological and physiological factors are taken into consideration, all of these incidents can be explained rationally, as pointed out by Rand Corporation and Dr. Fitts of Air Materiel Command Aero-Medical Laboratory (see Appendixes "E" and "G").

VII. Summary of AMC Evaluation of Remaining Reports

The remaining unexplained incidents (see Appendix "I") exhibited few common characteristics. Two of them, by statements of the reporters, would not have been made had the witnesses not read of the Mt. Ranier

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incident (Incident No. 17). Most were distributed without pattern throughout the United States. A few were outside the U. S. No two descriptions of appearance or performance were exactly alike. The reported sightings occurred at various times of day and year.

VIII. Relationship Between Publicity and Dates of Reports

The following graph (Fig. 1) illustrates an apparent relationship between reports which received wide publicity and the total number of reports. It is believed this has been carried to a sufficient degree to allow the conclusion that many reports are the direct result of such publicity.

This was further illustrated recently, when this Command received 64 reports of sightings and 51 possible solutions following a Saturday Evening Post article and an official press release on the subject of flying objects. Virtually all of the reporters and correspondents made reference to one of the above mentioned articles.

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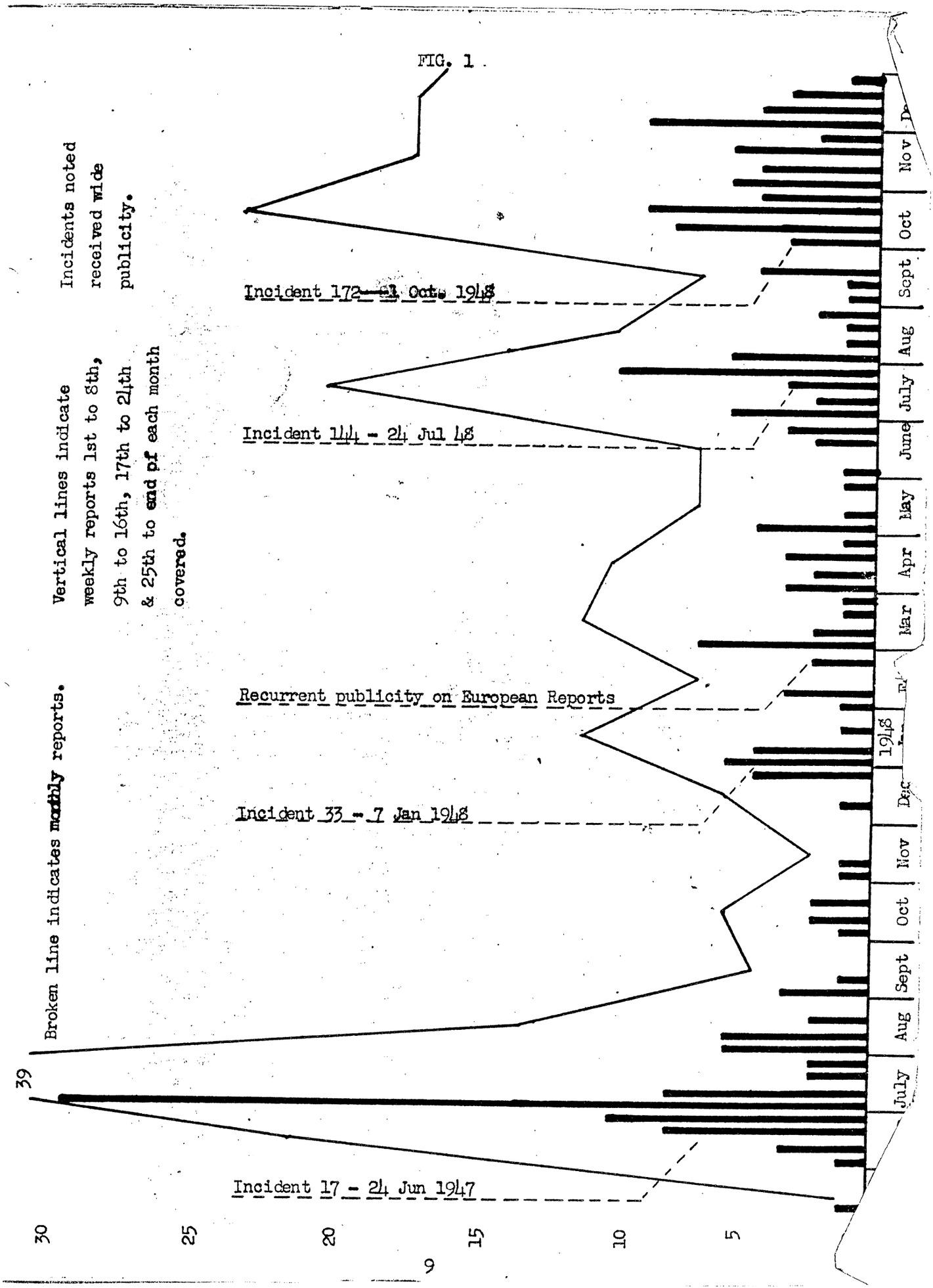
FIG. 1



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IX. Conclusions and Recommendations

A. There is no evidence that objects reported upon are the result of an advanced scientific foreign development; and, therefore, they constitute no direct threat to the national security. In view of this, it is recommended that the investigation and study of reports of unidentified flying objects be reduced in scope. Headquarters AMC will continue to investigate reports in which realistic technical applications are clearly indicated.

NOTE: It is apparent that further study along present lines would only confirm the findings presented herein.

1. It is further recommended that pertinent collection directives be revised to reflect the contemplated change in policy.

B. All evidence and analyses indicate that reports of unidentified flying objects are the result of:

1. Misinterpretation of various conventional objects.

2. A mild form of mass-hysteria and war nerves.

3. Individuals who fabricate such reports to perpetrate a hoax or to seek publicity.

4. Psychopathological persons.

It is, therefore, recommended that Conclusions 1 and 2 of this report, with sufficient supporting data, be declassified and made public in the form of an official press release. This action would aid in dispelling public apprehension, often directly attributable to the sensationalistic reporting of many of these incidents by the press and radio.

C. There are indications that the planned release of sufficient unusual aerial objects coupled with the release of related psychological propaganda would cause a form of mass-hysteria. Employment of these methods by or against an enemy would yield similar results.

In view of this, the Psychological Warfare Division and other governmental agencies interested in psychological warfare should be informed of the results of this study. These agencies should then coordinate in and provide further recommendations for public release of material relative to unidentified flying objects as recommended herein.

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APPENDIX A-1

Air Intelligence Information Report No. IR-115-48

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AF FORM 112—PART I
APPROVED 1 JUNE 1948

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COUNTRY	REPORT NO.	(LEAVE BLANK)
SWEDEN	IR 115-48	

AIR INTELLIGENCE INFORMATION REPORT

SUBJECT: Project "SIGN" AF-33165-1

AREA REPORTED ON	FROM (Agency)
Sweden	OAA-Sweden

DATE OF REPORT	DATE OF INFORMATION	EVALUATION
30 December 1948	29 December 1948	B-2

PREPARED BY (Officer)	SOURCE
Donald L. Hardy, Colonel, USAF	Swedish Defense Staff

REFERENCES (Control number, directive, previous report, etc., as applicable)
Source Control No. AMC-435

SUMMARY: (Enter concise summary of report. Give significance in final one-sentence paragraph. List inclosures at lower left. Begin text of report on AF Form 112—Part II.)

1. The Swedish Defense Staff has no proof that any unidentified flying objects, missiles or vehicles have passed over or near Sweden to date.

2. All reports of sightings in Sweden during the past year, irrespective of to whom they were submitted, have been funneled to a special section of the Defense Staff, where the sightings were plotted. In each case an exhaustive interrogation of the sighter followed, somewhat along the lines of the EEI for Project "SIGN". All evidence obtained of sightings was explicable in terms of astronomical phenomena.

3. In addition, 3 ground radar stations and 2 radar equipped destroyers cooperated in maintaining watch. The radar equipments were Swedish modified British sets of fairly short range and were not operated on a 24 hour basis; however, no unexplained sightings were made with this equipment.

4. Conclusion: Although the possibility exists that objects have traversed Sweden and its adjacent waters, no proof has been obtained to confirm such flight in any instance.

COMMENT: The cooperation of the Defense Staff in securing this information was undoubtedly given in an effort to emphasize their need for additional U.S. radar equipment. The Swedish Air Board had previously negotaited with the Bendis Corporation for 20 TPS-1a sets but had been refused an export license by our State Department. The members of the Defense Staff, to whom I talked, were eager to point out the good use to which such equipment could be put for both ourselves and the Swedes as instanced by our mutual interest in unidentifiable flying objects. However, I am convinced that our refusal to grant an export license for such equipment will do more good in implementing our national policy, as expressed in the National Security Council documents NSC 28/1, than would the information we might receive from the use of such equipment here.

/s/ Donald L. Hardy
DONALD L. HARDY
Colonel, USAF
Air Attache

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APPENDIX A-2

Air Intelligence Information Report No. IR-47-49

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AF FORM 112—PART I
APPROVED 1 JUNE 1948

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COUNTRY	REPORT NO.	(LEAVE BLANK)
SWEDEN	IR 47-49	

AIR INTELLIGENCE INFORMATION REPORT

SUBJECT: Guided Missile Activity Over Sweden

AREA REPORTED ON	FROM (Agency)
Sweden	OAA-Sweden

DATE OF REPORT	DATE OF INFORMATION	EVALUATION
2 March 1949	2 March 1949	B-2

PREPARED BY (Officer)	SOURCE
H. B. Walsh, Major, USAF	Personal Contact

REFERENCES (Control number, directive, previous report, etc., as applicable)
R 605-48, Control No. DA-244

SUMMARY: (Enter concise summary of report. Give significance in final one-sentence paragraph. List inclosures at lower left. Begin text of report on AF Form 112—Part II.)

1. With reference to request dated 18 January 1949, Control No. DA-244, and revised by our cable, the following information is submitted:

a. Withdrawn (AFOIN Cable 51648 dated 21 February 1949)

b. Do the Swedes feel that the reported and unconfirmed incidents of guided missile sightings in recent years have any similarity to any such reports that were received in the days when Germany was conducting experiments with missiles in the Baltic area.

Answer: The Swedes feel that the guided missile sightings over Sweden have been natural phenomena only and they have no proof to discount such a statement.

c. What was Swedish official opinion to unconfirmed guided missile incidents prior to the time that debris of a V-2 missile was actually recovered in Sweden during German experimentation activities in the early part of World War II.

Answer: Swedish official opinion prior to the landing of a V-2 in Sweden, was that a certain number of the "missile sightings" were natural phenomena and a certain number were German fighters at high altitude enroute across Sweden to Norway. This view in fact remained the official opinion even after the V-2 missile landed in Sweden.

Assistant Air Attache Comment: The Sweden actually do not think very much about these reported incidents but attempt to play it up as much as possible to the U. S. Attaches in an effort to show their great need for radar. Continued interest, therefore, on our part towards the last reported incidents, only causes extreme embarrassment when the Swedes emphasize their radar request.

S/ H. B. Walsh
Major, USAF
Assistant Air Attache

APPROVED:

S/ DONALD L. HARDY
Colonel, USAF
Air Attache

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APPENDIX B

Prof. J. A. Hynek - Final Report, Project 364

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MAPPING, CHARTING AND RECONNAISSANCE RESEARCH LABORATORY

FINAL REPORT
PROJECT 364

PREPARED BY DR. J. ALLEN HYNEK
ASSISTED BY HARRIET R. SUMMERSON

THE OHIO STATE UNIVERSITY RESEARCH FOUNDATION
PROJECT NO. 364

for

U. S. AIR FORCE AIR MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, DAYTON, OHIO
Contract No. W33-038-1118

Columbus, Ohio,
April 30, 1949

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REPORT ON UNIDENTIFIED AERIAL AND CELESTIAL OBJECTS

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INTRODUCTION

Perhaps the most bizarre post-war phenomenon was the sudden barrage of reports, in the summer of 1947, describing unidentified objects in the sky. The incident which evidently triggered the volley was the now-famous account by Kenneth Arnold, in which he claimed to have seen "nine peculiar-looking aircraft" without tails, which flew in a chain-like line and "swerved in and out of the high mountain peaks." The handling of this incident by the press led to the unfortunate but descriptive term "flying saucer," which caught the public imagination. From that time on, there has been a fairly steady stream of similar reports, including some of "flying saucers" seen prior to the Arnold incident, which presumably otherwise would have gone unreported. (It is pertinent, therefore, to speculate whether any of the incidents would have been reported if Mr. Arnold had not made his observation.) Possibly, of course, we deal here with an excellent example of mass hysteria. In the interests of the defense of the country, however, it would be highly inadvisable to ignore the accounts, even though the chance be remote that they contain anything inimical to the nation's welfare. To this end, the present investigator, as an astronomer, was asked to review the data, to eliminate the patently astronomical incidents and to indicate which others might have such an explanation.

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GENERAL PROCEDURE

The method of the investigation was to examine a number of individual reports of unidentified aerial and celestial objects, to determine which of them could be explained on purely astronomical lines — that is, how many cases give evidence corresponding to descriptions of meteors, fireballs or bolides, comets, the planets, or even the sun or moon. Analysis was based entirely upon these reports, furnished by Project GRUDGE offices, with no attempt to make independent interrogation of witnesses, since this was not authorized under the contract. Nor was any attempt made to deduce explanations for the non-astronomical incidents, although hypotheses which appeared possible from the evidence were noted.

The subject reports number 244 and cover, approximately, the period from January, 1947, to January, 1949. They do not, however, correspond exactly to the number of separate incidents: sometimes, two or more reports refer to the same object observed by different people (although in general such cases have been handled by affixing letters to the incident numbers, thus: 33, 33a, 33b); occasionally, subdivisions of one number patently refer to separate phenomena. To avoid confusion, one report is being submitted by this investigator for each numbered incident, with cross references for identical or similar incidents, and separate discussions for those including more than one phenomenon.

Inasmuch as the avowed object of the investigation was

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solely to indicate the possible astronomical content of the reports at hand, in the primary analysis all evidence was accepted at face value, with no attempt to evaluate psychological factors. Frequently, however, when fairly liberal limits of tolerance were allowed, the report made sense physically, whereas the literal statement did not. (Whenever allowance was made for possible errors arising from subjective reporting, the fact was noted.) Furthermore, while some of the reports verge on the ludicrous, the attitude deliberately adopted was to assume honesty and sincerity on the part of the reporter. Among the general public, two attitudes toward "flying saucers" seem to be prevalent: one, that all are obviously illusions, hallucinations, or hoaxes; the other, that "there must be something to it." From the outset, this investigator has attempted to regard each report, insofar as is logically possible, as an honest statement by the observer, and to adhere to neither of the two schools of thought.

One further comment should be made: almost all of the data dealt with in this investigation are extremely tenuous. Many of the observers' reports are incomplete and inexact, and some are distinctly contradictory. Therefore, it has obviously been impossible to reach definite, scientific conclusions. Most explanations are offered in terms of probability, the degree of which is discussed in the individual reports, but can be indicated only generally in the statistics which follow.

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SUMMARY OF RESULTS

What, in particular, was gathered from the evidence concerning the astronomical character of the objects observed?

Of the 244 incidents submitted, 7 are excluded from all statistical reckoning: 1 is identified (in the subject report) as a hoax, 3 are duplicates, and 3 contain no information. In summarizing the findings in the remaining 237, two systems of classification are possible:

First, all incidents can be placed in one of two classes: 1) those which under no stretch of the imagination can be regarded as astronomical or extra-terrestrial (extra-terrestrial throughout this investigation refers solely to natural objects not originating on earth; it does not include "space ships from other planets"), and 2) those which either are definitely astronomical or can by suitable manipulation of the evidence be construed as such. The object here is to segregate all cases in which any vestige of astronomical origin is indicated. When this division is made, 111, or 47%, fall into the definitely non-astronomical category; or, conversely stated, 126, or 53%, might conceivably be considered (although the likelihood of their being so may be very small) as extra-terrestrial or astronomical in origin. The exact percentage is not important. The significant thing is that over 50% of the incidents might possibly be explained astronomically, if wide enough tolerances were allowed.

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The primary purpose here, however, is to segregate incidents which have a reasonable degree of certainty of astronomical origin. Therefore, in a second, more detailed breakdown, incidents are placed in one of three classes, according to the most probable interpretation seen in the evidence offered (with a minimum of allowance for subjective observation). Class 1 includes the astronomical incidents (with degree of probability indicated). The non-astronomical incidents are divided into two classes, because it appeared as the work progressed that they fell naturally thus: in some, the evidence at hand suggested a simple explanation; in others, it did not. Listings under class 2 are not to be considered in any way decisive (with the exception of a few which, according to subject reports, have been definitely identified); they are offered as suggestions.

A summary of the results of this breakdown is shown in the table on the following page.

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Class	Number of incidents	Approximate percentage
1. Astronomical		
a. High probability	42	18
b. Fair or low probability	33	14
Total	75	32
2. Non-astronomical but suggestive of other explanations		
a. Balloons or ordinary aircraft	48	20
b. Rockets, flares, or falling bodies	23	10
c. Miscellaneous (reflections, auroral streamers, birds, etc.)	13	5
Total	84	35
3. Non-astronomical, with no evident explanation		
a. Lack of evidence precludes explanation	30	13
b. Evidence offered suggests no explanation	48	20
	78	33

According to these findings, 78, or almost one-third, of the 237 incidents yet remain without an appropriate hypothesis for explanation. It is likely, of course, that with additional evidence a number of those included in class 3a would be easily explained (some of them, probably, astronomically). There are, however, at least 48 incidents in which the evidence, if correct as given, does not fit any simple explanation, and a number of these were reported by presumably well-qualified observers.

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COLLATERAL STUDIES

In relation to the investigation, besides the individual analyses of separate incidents, two brief studies were conducted:

Certain breakdowns of the subject reports were made, for the purpose of determining whether they include any prevalent characteristics; for example, incidents were grouped according to the date of occurrence, the hour, the presence or lack of noise, presence or lack of trail or exhaust, number of observers, general qualifications of observers (whether with appropriate training for accurate observation of aerial phenomena -- aviators, weather observers, etc.; or laymen). Although these classifications were helpful in spotting identical or similar incidents, they revealed no pertinent trends.

As a matter of general interest, the highly dubious works of Charles Fort (which, as has been stated in a previous report, are entirely reprehensible in viewpoint, but which do contain accounts of unusual aerial sightings over a period of many years) were examined, to check whether any of the reasonably authenticated incidents are similar to these recent reports. It was found, however, that Mr. Fort's accounts do not include sufficient specific evidence to reveal positive similarities, and the most that can be said of the works is that they indicate that strange objects in the sky have been reported long before this post-World War II flurry.

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RECOMMENDATIONS

This investigator would like to offer three recommendations, one in the general interest of the nation's airmen, and two as aids toward more effective investigation of the problem of unidentified aerial objects, if such work is continued:

First and foremost, it is definitely recommended that Air Forces personnel be apprised of simple astronomical phenomena like the recurrent brilliance of Venus and the characteristics of a typical fireball, so that much confusion and alarm and even possible tragic consequences can be avoided. If, as seems possible, Lieutenant Mantell met his death while attempting to chase down Venus, certainly the need for such basic education is great.

Second, if Project GRUDGE is authorized to extend its investigations, it might be found profitable to interrogate personally varied trained personnel concerning any untoward aerial objects which they may have observed in the past. Many competent observers might hesitate to take the initiative in reporting such phenomena for fear of ridicule or criticism, yet it is only from such people that accurate and meaningful descriptions can be obtained; reliance on the general public for such observations is almost certain to prove of little value. It would be of considerable aid to know whether (aside from the few cases reported here) experienced pilots, weather observers, and other "watchers of the sky" have ever found unidentified objects there. Even negative results would prove valuable, for they would offer evidence for the belief held by many that the unexplained

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incidents do not really involve tangible physical objects.

Third, if this type of investigation is to be continued, men with proved scientific and technical ability should be assigned to carry out the interrogations and investigations; it would be preferable either that the interrogator and technical specialist be the same person or, at least, that they work together in close harmony. Such an arrangement would aid greatly in lessening the incompleteness and inexactness of evidence which has thus far hindered the explanation of many "flying saucer" incidents.

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INCIDENT INDEX

1. Astronomical

   a. High probability:
   #26, 27, 30, 31, 32, 33, 34, 48, 49, 59, 60, 66, 69, 70, 94, 95, 96, 97, 98, 101, 102, 103, 104, 116, 119, 132, 136, 140, 147, 148, 158, 174, 184, 185, 187, 197, 203, 204, 208, 216, 219, 238.

   b. Fair or low probability:
   #19, 20, 23, 24, 28, 35, 36, 46, 50, 63, 67, 80, 82, 93, 100, 112, 120, 121, 129, 130, 144, 153, 165, 166, 167, 175, 192, 199, 202, 205, 220, 230, 240.

2. Non-astronomical but suggestive of other explanations

   a. Balloons or ordinary aircraft:
   #3, 11, 22, 41, 42, 53, 54, 73, 81, 83, 91, 92, 113, 114, 115, 126, 131, 138, 141, 145, 155, 156, 157, 159, 160, 161, 163, 169, 171, 173, 178, 180, 182, 188, 190, 194, 195, 196, 198, 200, 201, 209, 210, 217, 222, 235, 237, 239.

   b. Rockets, flares or falling bodies:
   #4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 25, 56, 65, 78, 106, 107, 108, 109, 133, 170, 211, 218.

   c. Miscellaneous (reflections, auroral streamers, birds, etc.):
   #39, 89, 123, 124, 128, 146, 164, 181, 189, 214, 221, 231, 234.

3. Non-astronomical, with no explanation evident

   a. Lack of evidence precludes explanation:
   #38, 44, 45, 47, 55, 57, 72, 86, 87, 88, 90, 99, 110, 117, 118, 125, 127, 137, 139, 149, 150, 177, 179, 191, 206, 212, 213, 229, 232, 233.

   b. Evidence offered suggests no explanation:
   #1, 2, 10, 17, 21, 29, 37, 40, 51, 52, 58, 61, 62, 64, 68, 71, 75, 76, 77, 79, 84, 105, 111, 122, 135, 151, 152, 154, 162, 168, 172, 176, 183, 186, 193, 207, 215, 223, 224, 225, 226, 227, 236, 241, 242, 243, 244, 134.

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Incident #1, 1c, 1d, 1e -- Muroc, California -- 8 July 1947

No astronomical explanation for this incident is possible. It is tempting to explain the objects as ordinary aircraft observed under unusual light conditions, but the evidence of the "tight circle" maneuvers, if maintained, is strongly contradictory. This incident must be judged with reference to other similar incidents, which probably have a common explanation.

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Incident #2, 2a -- Muroc, California -- 8 July 1947

No astronomical explanation is possible for this incident.

The object's slow speed and apparent size suggest aircraft under unusual light conditions, but the tactics argue against this interpretation.

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Incident #3 -- Maroc, California -- 7 July 1947

There is no astronomical explanation of this incident. In this investigator's opinion, there is nothing in the evidence offered that is basically contradictory to the hypothesis of a weather balloon. Perhaps ascending currents of warm air over the desert could give the illusion that the object was oscillating.

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Incident #4 -- Rogers Dry Lake, California -- 8 July 1947

"There is no astronomical explanation for this incident.

Is there any definite reason why the object observed could not have been a bursted weather balloon?

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Incident #5 -- Portland, Oregon -- 4 July 1947

There is no astronomical explanation for this incident, nor for numerous others (#6, 7, 8, 9, 12, 13, 14, 15, 16) which occurred in and near Portland on the Fourth of July, 1947.

Besides being observed in the same vicinity and most of them at the same time, the objects seen have in common a round shape, "terrific" speed, abrupt tactics, and quick disappearance. Abrupt tactics certainly suggest that the objects were of a very light weight.

This investigator can offer no definite hypothesis, but in passing would like to note that these incidents occurred on the Fourth of July, and that if relatively small pieces of aluminum foil had been dropped from a plane over that area, then any one object would become visible at a relatively short distance. Even moderate wind velocities could give the illusion that fluttering, gyrating discs had gone by at great velocities. Various observers would not, of course, in this case have seen the same objects.

The above is not to be regarded as a very likely explanation but only as a possibility: the occurrence of these incidents on July 4 may have been more than a coincidence. Some prankster might have tossed such objects out of an airplane as part of an Independence Day celebration.

If these were aircraft of either known or unknown type,

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it would be difficult to explain their appearance over only one locality and at only one time, their apparent random motion, the lack of any sound or obvious propulsion method, and the lack of aerodynamic construction.

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Incident #6 -- Milwaukee, Oregon -- 4 July 1947

There is no astronomical explanation for this incident.

See report on incident #5.

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Incident #7 -- Portland, Oregon -- 4 July 1947

There is no astronomical explanation for this incident.

See report on incident #5.

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Incident #9 -- Portland, Oregon -- 4 July 1947

There is no astronomical explanation for this incident.

See report on incident #5.

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Incident #10 -- Boise, Idaho, 4 July 1947

There appears to be no astronomical explanation for this incident.

One minor lead is suggested: observation was made at the time of sunset, when light conditions are changing rapidly. Disappearance of the object might have occurred simply because of the changing visibility. It is the time of day when illusory effects are most likely to occur, and it might not be out of the question that the objects actually were other aircraft.

Despite these conjectures, no logical explanation for the incident seems possible at this time.

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Incident #11 -- Seattle, Washington -- 4 July 1947

There is no astronomical explanation for this incident.

The description answers that of a "hot air balloon," such as those launched at Fourth of July celebrations. There is nothing in the evidence given which is contradictory to this hypothesis.

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Incident #12 -- Vancouver, Washington -- 4 July 1947

There is no astronomical explanation for this incident.

See report on incident #5.

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Incident #13 -- Portland, Oregon -- 4 July 1947

There is no astronomical explanation for this incident.

See report on incident #5.

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Incident #14 -- Portland, Oregon -- 4 July 1947

There is no astronomical explanation for this incident.

See report on incident #5.

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Incident #15 -- Portland, Oregon -- 4 July 1947

There is no astronomical explanation for this incident.

See report on incident #5.

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Incident #16 -- Mt. Jefferson, Oregon -- 4 July 1947

There is no astronomical explanation for this incident.

See report on incident #5.

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Incident #17 -- Mt. Ranier, Washington -- 24 June 1947.

There appears to be no astronomical explanation for this classic incident, which is the prototype of many of the later flying saucer stories.

It is impossible to explain this incident away as sheer nonsense, if any credence at all is given to Mr. Arnold's integrity. However, certain inconsistencies can be pointed out in the facts as reported:

Arnold's attention was first drawn to the objects by a bright flash on his plane, which was followed by numerous other similar flashes. If these were something like the flash one gets from a distant mirror, it means that the reflection was specular, or direct. For a direct reflection, the angle between the observer, sun, and object must be "just right," and at such distances as 20 or 25 miles, the chance of a series of direct reflections is extremely small. If the object was a diffuse reflector -- that is, scattering the sunlight falling on it, much as the moon or a balloon does -- then at such a distance it seems quite unlikely that Mr. Arnold would have been startled, or that our attention would have been called to it, unless the objects reflecting were extremely large.

The supersonic speeds called for if the estimated distance is correct also throw suspicion on the original calculations; by computation (see below) it can be seen that, considering the detail which Arnold observed in the objects, at least one of his estimates

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must have been erroneous:

Arnold states that the objects seemed about 20 times as long as wide. Let us assume that the thickness was just discernible, which means that the object was just at the limit of resolution of the eye. Now, the eye cannot resolve objects that subtend an angle of appreciably less than 3 minutes of arc, and, in general, for any detail to be seen at all, the angle subtended must be much greater. Even if we assume the limiting resolution of 3 minutes, then, if the distance was 25 miles, elementary calculations show that each object must have been at least 100 feet thick, and if, as Arnold's drawings indicate, the object was some 20 times longer than wide, it must have been about 2000 feet long.

Looking at the matter in another way and assuming that Arnold's estimate of distance as 20 to 25 miles (125,000 feet) and his estimate of length as 45 to 50 feet are both correct, then it can be shown that the object will subtend an angle of only about 80 seconds of arc, which is definitely below the limit of resolution of the eye.

If Arnold actually saw the objects, and if his estimate of distance is correct, that of size cannot be, and vice versa. It seems most logical to assume that his estimate of distance is far too great. In fact, assuming a reasonable limiting size to the objects of 400 feet, in order to show the detail that Arnold's drawings indicate, the distance must have been not over roughly six miles. At this distance the objects would have travelled 11 miles (rather than 47 miles) in 102 seconds, or at a rate of approximately 400 MPH. (Arnold's

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original estimate is also incorrect; if the objects had travelled 47 miles in 102 seconds, they would have been travelling at a rate of approximately 1700 MPH, not 1200.)

In view of the above, it appears probable that whatever objects were observed were travelling at subsonic speeds and may, therefore have been some sort of known aircraft.

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Incident #18 -- Toronto, Canada -- 20 September 1947

It is stated in the information given here that this incident has been determined to be a hoax.

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Incident #19 -- Dayton, Ohio -- 20 October 1947

Information given here is insufficient to exclude positively the possibility that the objects observed were a close pair of fireballs, but this seems extremely unlikely. Since the length of time in sight is not stated nor the speed estimated, it is impossible to draw any definite conclusions. Assuming these to be appropriate, if one were to stretch the description to its very limits and make allowances for the remarks of an untrained observer, he could say that the "cigar-like shape" might have been an illusion caused by rapid motion and that the bright sunlight might have made both the objects and the trails nearly invisible.

This investigator does not prefer that interpretation, and it should be resorted to only if all other possible explanations fail. In short, while it is not out of the realm of possibility that the objects seen were an unusual double fireball, it is most unlikely.

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Incident #20 -- Xenia, Ohio -- 20 October 1947

The information given here is insufficient to determine any possible astronomical origin of the object observed.

As in incident #19, while it is impossible to rule out the meteoric explanation (e.g., straight course, fast speed), the lack of information about trail, length of time in sight, manner of disappearance, and distance from observer, make any attempt at a definite interpretation rather futile.

Again, in short, it is not impossible that the object seen was a daylight, slow-moving bolide, but it is highly improbable, judging from the limited information offered.

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Incident #21 -- Des Moines, Iowa -- 29 June 1947

There is no obvious astronomical explanation for this incident.

If the estimate of size can be given any credence at all, the objects could not have been farther than five miles away; this is an absolute upper limit, and objects probably were very much closer.

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Incident #22 -- Spokane, Washington -- 21 June 1947

This incident does not have any obvious astronomical explanation.

The information given is too limited to suggest any definite interpretation. It would seem, however, that the objects might possibly have been a series of balloons.

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Incident #23 -- Boise, Idaho -- 30 June 1947

It seems exceedingly probable that the object observed in this incident was a combination sun-cloud effect. The altitude of the sun was 30°, azimuth 280°. At that time of the afternoon, the sun's position was such that it could easily have illuminated a background cloud which was perhaps almost entirely covered by a foreground cloud. (Boise weather reports indicate an entirely clear sky, but the report of the incident itself states that the object "seemed to be clinging to a huge cloud.") This investigator himself has observed such effects.

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Incident #24 -- Weiser, Idaho -- 12 June 1947

There is nothing in the description of this incident that is fatal to the hypothesis that the objects observed were parts of a "double fireball," but any such identification must remain uncertain.

The most convincing element favoring the meteoric hypothesis is the persistent train. Fireballs occasionally leave trains that persist for over an hour.

As far as trajectory is concerned, this is in agreement with that to be expected from a meteor on its way out from the sun (it having gone toward the sun several weeks previously and now being on its return journey toward outer space). Such a fireball would be travelling relatively slowly, and could appear to "shoot out from the sun" and to travel in a southeasterly direction.

The absence of bright flame and of noise is not unusual, since reported daylight meteors are frequently not luminous (but do leave a trail), and often no noise is heard.

Nor is the fact that there were two such objects fatal to the hypothesis. The object could easily have been single and have broken in two, either in its journey around the sun or upon entering the earth's atmosphere. There have been several cases of comets that were single on their trip toward the sun and double on the way out. Since comets and meteors are closely related as far as structure is concerned, the double feature is entirely possible.

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The shooting up and down might be dismissed as subjective and illusory, although small bits shooting off from the main meteor could also give this effect.

In spite of all this, this investigator would prefer a terrestrial explanation for the incident.

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Incident #25 -- West Trenton, New Jersey -- 4 July 1947

The object sighted here could easily have been a bright meteor, but in view of the date of the observation, it seems even more likely that the young lady saw part of a late Fourth of July celebration -- a rocket from some amusement park, perhaps.

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Incident #26 -- Harmon Field, Newfoundland -- 10 July 1947

The evidence presented here, and in incident #27, 27a, which refers to the same object, favors the hypothesis that the trail of a fireball was seen. The photographs submitted show a typical fireball trail. The "feathered edges" left on a cloud which the object broke through could easily have been caused by a fireball.

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Incident #27, 27a -- Harmon Field, Newfoundland -- 10 July 1947

Evidence presented here favors the hypothesis that the trail of a fireball was seen by observers. For details see report on incident #26.

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Incident #28 -- Idaho -- 24 June 1947

Any probable astronomical explanation for this incident is dependent upon the hour of observation, which is not stated in the information given with the summary.

An unconfirmed statement (by Mr. Larkham, quoted in material submitted relative to incident #101) that the observation was made at 5:30 P. M. allows for no possible astronomical explanation other than that a persistent meteor train may have been observed. Such a phenomenon might have given the general impression suggested by the limited description of the incident.

If, however, the observation occurred during the early evening hours, shortly after sunset, which occurred that day at about 8:00 P. M. local time, then it is extremely likely that Lt. Gov. Whitehead saw either the planet Saturn or Mercury. Mercury set almost exactly an hour after the sun and was of stellar magnitude +1. Saturn, of magnitude +0.6 and hence about once again as bright as Mercury, set two hours after the sun. A bright planet shining through thin cirrus clouds could give the impression of a "comet-like object."

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Incident #29 -- Portland, Oregon -- 14 June 1947

There is nothing whatever in this incident to suggest that the objects observed were of astronomical origin. Their maneuvers and the relatively long time they were in sight definitely preclude any possible astronomical interpretation.

It is of interest to note that in this locality and at this season other possibly-similar, non-astronomical incidents were reported -- e.g., #17 and #68.

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Incident #30, a-c -- Lockbourne AAB, Columbus, Ohio -- 7 January 1948

Considering this incident with #32, 33, and 48, one is forced to conclude that the object observed from Lockbourne Army Air Base on the evening of 7 January 1948 was the planet Venus.

One report of the incident gives the location of the object as ESE-120°, or approximately opposite from that stated by other observers and that of Venus. Obviously, since the time of observation was the same, this means that one witness either was looking at a different object or had his directions mixed. Since the description otherwise agrees generally with the rest, and since it is assumed throughout the reports that all observers were viewing the same object, the latter interpretation seems preferable.

Witnesses state that the object "couldn't have been a star" (of course, it wasn't), because the sky was completely overcast. However, reports from the Columbus weather bureau indicate that, although the afternoon was cloudy, the sky was clear by 1900 hours. (This does not mean, of course, that there were no clouds near the western horizon.)

For possible explanations of the "tactics" reported by observers of this object, and further discussion of the incident, see report on #33.

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Incident #31 -- northern Arizona -- mid-December 1946

The trail seen here was almost certainly that of a slow-moving fireball. In daylight quite frequently the primary thing observed in such cases is a white smoke trail.

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Incident #32 -- over Columbus, Ohio -- 7 January 1948

The evidence given in this incident fits the hypothesis that the object observed was the planet Venus, and, considered with incidents #30, 33, and 48, it is incredible that it could have been anything else.

See report on #33 for detailed discussion of sightings of 7 January 1948.

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Incident #33, a-g -- Godman Field, Fort Knox, Kentucky -- 7 January 1948
& discussion of all incidents reported for this date

Incidents #33, 32, 33, and 48 all occurred on 7 January 1948, with #33 involving the death of Lieutenant Mantell. Detailed attention has therefore been given to any possible astronomical body or phenomenon which might serve to identify the object or objects concerned. The four incidents are considered together here.

Although the several reports differ considerably in regard to the bearing and motion of the object (assuming for the moment that the afternoon and evening sightings refer to the same phenomenon), they are generally consistent concerning the time, manner, and place of its disappearance over the horizon. Hour and azimuth are given as 1906 CST, about 250°, by observers at Godman Field; 1955 EST, west southwest, by those at Lockbourne Air Base; and 1955-2000 EST, about 210°, by those at Clinton County Air Base; (there are, as is to be expected, slight differences in individual reports). Using this for the focal point of attack, one notes immediately that all these times and bearings agree closely with the time and place of the setting of Venus. Furthermore, all accounts except one agree that the object was low in the southwest before the time of disappearance. Reports vary as to details of its motion, but the overall motion was southwest and then over the horizon. These facts taken together preclude any question of coincidence. Furthermore, simultaneous observation from scattered locations proves that the object had negligible parallax, or, in short, that it was a very great distance away. All other statements concerning the object must,

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it seems to this investigator, be weighed in terms of the overwhelming evidence of the manner of disappearance over the horizon.

The stellar magnitude of Venus on January 7 was -3.4, which makes it 29 times brighter than the bright star Arcturus. Venus, when as bright as this and shining through interstices in a host of clouds, could very easily give the effect of a flaming object with a tail. Concerning the erratic motion reported by some witnesses, this can be said: motion of clouds past the object could give the illusion of rapid movement, as when clouds scud by the moon; or the effect could have been a psychological illusion; a third possibility, remote but based on a rarely-observed phenomenon, is that, owing to thermo-inversions in the atmosphere, stars near the horizon have been known to jump about erratically through arcs of two or three times the moon's apparent diameter. Venus, when very close to the horizon, has been known to twinkle brilliantly with rapidly changing colors.

It appears to the present investigator, in summing up the evidence presented, that we are forced to the conclusion that the object observed in the early evening hours of January 7, 1948, at these widely separated localities, was the planet Venus. To assume that a terrestrial object could be located so high as to be visible simultaneously over a wide area, could be of such intrinsic brightness (of incredible brightness, far surpassing any known man-made light), and would be placed essentially at the very position of Venus in the sky over an

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interval of more than half an hour, would be incredible.

Incident #33 is the only one of the four that includes the daytime observation of presumably this same object. The importance of the incident is, however, paramount, for it was in tracking down the mysterious object that Lieutenant Mantell lost his life. Again it is possible that the object observed was the planet Venus, although the evidence is by no means as definitive as that for the sightings made later that day. First, the bearings of the object as reported by various witnesses differ considerably; where one says southwest, another says south, for the same instant. However, integrating all the evidence, one is again struck with the coincidence of the object's position with that of Venus. The following short table of sightings vs the positon of Venus shows the general agreement of the two in azimuth:

CST	Object	Venus
1330 (PFC Oliver)	SW of field	Almost due S: 174°
1345 (Sgt. Blackwell)	South of field	178°
(PFC Oliver)	SW	
after 1400 (Lt. Orner)	SW	from due S (180°) at 1400, moving westward
1445 (Capt. Mantell)	210°	198°
(Col. Hix)	215°	

A more pertinent question is that of whether it would have been possible to see Venus in the daytime on that day. All that can be said here is that it was not impossible to see the planet under those conditions. It is well known that when Venus is at its greatest brilliancy, it is possible to see it during the daytime when one knows exactly where to look, but on January 7, 1948, Venus was less than half

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as bright as it is when most brilliant. However, under exceptionally good atmospheric conditions and with the eye shielded from the direct rays of the sun, Venus might be seen as an exceedingly tiny bright point of light. It can be shown that it was definitely brighter than the surrounding sky, for on the date in question Venus had a semi-diameter of 6 seconds of arc, or a total apparent surface area of approximately 125 square seconds. Assuming that a square second of sky would be a trifle brighter than the fourth magnitude, a portion of the sky of the same area presented by Venus would be about -1.4 magnitude. Since the planet, however, was -3.4, it was 6 times brighter than an equivalent area of sky. While it is thus physically possible to see Venus at such times, usually its pinpoint character and the large expanse of sky makes its casual detection very unlikely. If, however, a person happens to look toward a point on the sky that is just a few minutes of arc from the position of Venus, he is apt to be startled by this apparition and to wonder why he didn't see it before. The chances, of course, of looking at just the right spot are very few. Once done, however, it is usually fairly easy to relocate the object and to call the attention of others to it. However, atmospheric conditions must be exceptionally good. It is improbable, for example, that Venus would be seen under these circumstances in a large city.

It can be said, therefore, that a possible explanation for the object sighted in the daytime in incident #33, a-g, is that it

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too was the planet Venus. In the absence of exact measures, however, it is impossible to establish that it was or was not. (It is unfortunate that theodolite measures of the afternoon observations were evidently not made.)

It has been unofficially reported that the object was a Navy cosmic ray balloon. If this can be established, it is to be preferred as an explanation. However, if one accepts the assumption that reports from various other locations in the state refer to the same object, any such device must have been a good many miles high -- 25 to 50 -- in order to have been seen clearly, almost simultaneously, from places 175 miles apart.

It is entirely possible, of course, that the first sightings were of some sort of balloon or aircraft, but that when these reports came to Godman Field, a careful scrutiny of the sky revealed Venus, and it could be that Lieutenant Mantell did actually give chase to the planet, even though whatever object had been the source of the excitement elsewhere had disappeared. At the altitudes that the pilot reached, Venus would have been very much more easily observed than from the ground, and it might even be that he did not actually pick it up until he was at a considerable altitude. The one piece of evidence that leads this investigator to believe that at the time of Lieutenant Mantell's death he was actually trying to reach Venus is

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that the object appeared essentially stationary (or moving steadily away from him) and that he could not seem to gain on it.

In summing up, this can be said: the evening sightings reported in incidents #30, 32, 33, and 48 were undoubtedly of the planet Venus. Regarding the daylight sightings from Godman Field and other places in Kentucky, there seems so far to be no single explanation that does not rely greatly on coincidence. If all reports were of a single object, in the knowledge of this investigator no man-made object could have been large enough and far enough away for the approximately simultaneous sightings. It is most unlikely, however, that so many separate persons should at that time have chanced on Venus in the daylight sky. It seems, therefore, much more probable that more than one object was involved: the sightings might have included two or more balloons (or aircraft); or they might have included both Venus (in the fatal chase) and balloons. For reasons given above, the latter explanation seems more likely. Such a hypothesis does, however, still necessitate the inclusion of at least two objects other than Venus, and it certainly is coincidental that so many people would have chosen this one day to be confused (to the extent of reporting the matter) by normal airborne objects. There remains one possible, very plausible explanation for this fact, however: was the original report by any chance broadcast by local radio stations? If so, with the general public on the alert, even

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the commonest aircraft might suddenly have appeared to be strange celestial objects.

In any event, since it seems possible that at the time of Lieutenant Mantell's death, he was actually giving chase to Venus (and since, certainly, during the evening sightings, persons assumedly well acquainted with objects of the sky were alarmed by the appearance of the planet), it might be wise to give information about this incident wide circulation among air force personnel, so that tragic mistakes will not occur in the future.

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Incident #34, 34a-f -- Manitoba, Canada -- 13 October 1947

The reports of this incident answer to the description of a typical large meteor, or fireball. The trajectory, speed, color, and explosion are particularly convincing evidence.

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Incident #35 -- off coast of Oregon -- 12 November 1947

The information given here is too meager for a definite conclusion to be drawn concerning the identity of the objects observed. It is probable, however, that they were two parts of a meteor that had broken upon entrance into the earth's atmosphere. The length of time in sight is unduly great, but one wonders whether this might not have been grossly overestimated for psychological reasons. Otherwise, the scanty description favors the meteoric hypothesis.

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Incident #38 -- Boise, Idaho -- date unknown (probably November 1947)

Very little can be said of this incident, inasmuch as the date and exact time of observation, speed, altitude and size of object, and length of time in sight are not stated. The speed and time in sight are particularly important in forming a judgment. In the absence of this information, the most that can be said is that the object might have been a fireball.

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Incident #8,8a -- Portland, Oregon -- 4 July 1947

There is no astronomical explanation for this incident.

See report on incident #5.

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Incident #37 -- Phoenix, Arizona -- 14 October 1947

There is clearly nothing astronomical about this incident, and the information given here does not suggest any other explanation.

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Incident #38 -- Hungary -- around 10 June 1947

It is extremely unlikely that the objects observed in Hungary were meteorites, unless the meager description given here is quite inaccurate. Without knowledge of the speed and trajectory of the objects, nothing definite can be said.

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Incident #39 -- Grand Falls, Newfoundland -- 9 July 1947

It is extremely unlikely that these objects were meteors, although their speed would argue for such interpretation. Had they been, however, one would expect much more brilliant light, a trail, and perhaps even detonation. Furthermore, their flight in formation argues against their being meteoric.

The meager description suggests a light phenomenon rather than material objects. Was any auroral activity reported in the region at the time? The description answers more closely to a detached auroral streamer than to anything else, but this explanation is perhaps also far fetched.

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Incident #40 — Phoenix, Arizona — 7 July 1947

No astronomical explanation seems possible for the unusual object cited in this incident.

This case is especially important because of the photographic evidence and because of the similarity of these photographs to the drawings by Kenneth Arnold (incident #17). The two incidents are separated by slightly more than two weeks, and, of course, they occurred in different localities. It is, however, perhaps more than coincidence that these two best-attested, entirely independent cases should agree so closely concerning the shape of the object and its maneuverability.

The present investigator would like to suggest that this incident, #40, being one of the most crucial in the history of these objects, be reopened for investigation. The actual camera used by Mr. Rhodes should be examined, and the original negatives preserved. Since, from the size of the image on the photograph, we can have an accurate estimate of the angle subtended by the object, this, in connection with what appears to be a fairly reliable estimate of the distance, can give us an estimate of the forces and accelerations involved in the trajectory described by Mr. Rhodes. (It is unfortunate that a competent investigator was not dispatched at once to "reenact the crime" with Mr. Rhodes and to obtain sketches of the trajectory, etc., before details faded from his memory.) It would be important to know at what

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altitude and azimuth Mr. Rhodes' camera was pointed at the time of his two exposures and the approximate time interval between exposures. Physical data like these are absolutely essential if we are to get anywhere in any basic physical explanation of these incidents.

There remains the strong possibility that the entire incident is spurious, and the invention of an excitable mind. This strengthens the need for reinvestigation; if spurious, this fact should be highlighted and even publicized, to quench enthusiasm for the irresponsible reporting of "saucers" and like objects.

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Incident #41 -- Anchorage, Alaska -- 11 July 1947

No astronomical explanation can be given for this incident.

The object apparently was a balloon, although the meager data given does not allow a definite conclusion.

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Incident #42 -- Anchorage, Alaska -- 12 July 1947

As in incident #41, no astronomical explanation can be given here.

In this incident also, the temptation is to assume that the object seen was a balloon.

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Incident #43 -- Clarion, Iowa -- 29 June 1947

This incident refers to the same sighting by the same observer as that summarized in incident #21. See that report for conclusions.

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Incident #44 -- near Milwaukee, Wisconsin -- 28 June 1947

Information given here is insufficient to indicate what was seen. If this were a totally independent observation and not one that was presumably incited by current radio reports of flying saucers, more weight could be given to it. As it is, with flying saucer talk rampant, almost anything from meteors to balloons or aircraft would be reported as saucers by an uncritical observer. It is unlikely, however, that there was anything astronomical about this incident.

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Incident #45 -- Illinois -- 28 June 1947

See statement concerning incident #44.

Information is entirely insufficent to determine whether anything of an astronomical nature was observed.

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Incident #46 -- Greenfield, Massachusetts -- 22 June 1947

This incident does not admit of a ready astronomical explanation. The absence of a trail does not favor the meteoric hypothesis, although the speed and brilliance of the object might.

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Incident #47 — Fairfield-Suisun Air Base, California — 6 July 1947

This incident cannot be readily explained astronomically. The object was in sight too long to be a meteor, and the variable "reflection" and absence of any statement about trail also argue against that interpretation. It is difficult, however, to rule out the hypothesis completely, because of the lack of pertinent information and the ever-present possibility that the reporting was more subjective than objective.

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Incident #48 -- Clinton County Air Field, Ohio -- 7 January 1948

This incident must be considered with #30, 32, and 33. Comoined evidence shows that the object observed from Clinton County Air Field on the evening of 7 January 1948 was undoubtedly the planet Venus.

For discussion of erratic motion related by the observers of the object, and other details, see report on incident #33.

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Incident #49 -- Danville, Kentucky -- 9 January 1948

Although the distance, time in sight, speed, sound, size, color, and construction of the object reported here are not stated, the fact that it showed a long trail and exploded makes it entirely probable that it was a fireball.

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Incident #50, 50a -- Wildwood, New Jersey -- 10 January 1948

In view of the unbalanced character of at least one of the observers (as indicated by the report of the interview), this investigator wonders how much credence can be given to the reports of the object or objects cited. For instance, the summary states that the first object was in sight 5-8 seconds, while the interview indicates 15-20 minutes. Assuming that this first incident was authentic and the shorter time correct (it evidently being the estimate given by the second observer), there is nothing in the evidence that is contradictory to the notion that the object observed was nothing more than a slow-moving fireball. The color, splitting into two pieces, and manner of disappearance all support this view.

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Incident #51 -- Oswego, Oregon -- 3 September 1947

The limited information given here does not suggest anything astronomical.

It is surprising that there was only one witness to this incident, since it occurred in a city, at a time when there was a plane in the sky.

If these objects were not ordinary aircraft at a great distance, or a cluster of balloons, then the incident must be considered together with others reporting groups of unidentified round or discoid objects, several of which occurred in this locality (e.g., incidents #5-9, 12-16).

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Incident #52, a -- Hamilton Field, California -- 29 July 1947

The objects observed here were almost certainly not astronomical, although their speed, shape, and manner of disappearance might tend to the fireball hypothesis. The lack of trail and the "tactics" pursued by the second object make the likelihood of that interpretation very slight; however, the possibility cannot be entirely ruled out if considerable allowance is made for looseness in reporting.

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Incident #53 -- near Lake Meade, Nevada -- 28 June 1947

There appears to be nothing astronomical about this incident.

According to the observer, the objects had a speed of 285 MPH and were moving on a course of 120°. Now, since the plane was moving at 285 MPH on a course of 300°, it is possible that the observed motion of the objects was only apparent (since 180° plus 120° equal 300°), and we can conjecture that a cluster of balloons (cosmic ray apparatus perhaps) was observed, the motion of which was merely a reflection of the motion of the plane.

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Incident #54 -- between Dutch coast & Norfolk, England -- 16 Jan. 1947

The object observed here was obviously not astronomical. From the information given, it appears that this was definitely an aircraft.

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Incident #55 -- Harmon Field, Newfoundland -- 23 July 1947

If proper allowance is made for the reporting of untrained observers, it is possible that the objects observed in this incident were a minor meteor shower. The "reddish flashes of light" and "abrupt darts" would tend to this interpretation. The hypothesis hinges, however, on the statement that "a number of intermittent flashes were observed for three minutes." If this means independent flashes, it lends support to the meteoric interpretation. If it means that the same objects flashed intermittently for three minutes, that theory is ruled out. It seems more probable in view of the statement about "abrupt darts of light" that the former meaning is correct.

There is somewhat more evidence in this incident than in #57 (which is similar, and occurred just three days earlier) favoring meteors, but probably the events of these two incidents are related, and it is very unlikely that meteors could explain both of them.

According to the report of the U. S. Weather Bureau on ball lightning, it would appear that this phenomenon sometimes takes the form of luminous darts and can be red. Perhaps this could offer an alternate explanation for the incident.

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Incident #56 -- Birmingham, Alabama -- 6 July 1947

This incident has no obvious astronomical explanation.

The photograph purported to be a part of the report of the incident is not documented. There is no proof in the evidence at hand that it shows the objects described. From the word description alone, which is quite limited, the objects could be explained simply as rockets: "vertical ascent," "travelled in arc." Data is too meager for a definite conclusion, however.

If the photograph is authentic, it would be extremely valuable to know the shutter speed at which it was taken, since from this the angular velocity could be determined.

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Incident #57 -- between Nova Scotia and Newfoundland -- 20 July 1947

This incident and #55, which occurred in the same vicinity just three days apart, do not fit into the usual description pattern. In both cases, information given is meager, and in both cases the meteoric hypothesis cannot be completely ruled out, but the objects could have been rockets or even freak auroral streamers or brush discharge from ionized dust clouds. In any event, it seems unlikely, although it is not impossible, that the objects seen in this incident were meteors. The even spacing of the flashes argues strongly against the meteoric hypothesis.

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Incident #68 -- NW of Bethel, Alaska -- 4 August 1947

There is no astronomical explanation for this incident. The time in sight (four minutes) and rate of speed (520 MPH) seem to preclude any such possibilities.

The similarity of this incident to #10, in which several objects were seen silhouetted against a sunset, is striking.

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Incident #59 -- beyond Necker Island -- 12 September 1947

From the evidence at hand, it appears quite likely that the object observed was a fireball. Fireballs have been known to change course abruptly when splitting. The reported change to reddish hue from the previous color of incandescent light, the length of time in sight, and the manner of disappearance all lend support to this hypothesis. At sunset one can expect relatively slow-moving, nearly horizontal fireballs.

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Incident #60, a, b -- Cordroy, Newfoundland -- 10 July 1947

The descriptions given by the three observers of this object answer quite closely to that of a typical bright, "slow-moving" bolide. It is extremely likely that the object sighted here was nothing more than a fireball.

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Incident #61, 61a -- Logan, Utah -- 8 September 1947

This incident, and incident #62, which clearly refer to the same objects (witnesses were together at the time of observation) do not have an astronomical explanation.

Since it was dark, any judgment of distance can be greatly misleading, and extremely fast motion might be ascribed to closeness rather than to true linear distance.

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Incident #62 -- Logan, Utah -- 8 September 1947

This incident does not have an astronomical explanation.

See report on incident #61.

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Incident #63 -- NE of Helena, Montana -- 29 July 1947

With the exception of the color ("like polished nickel") and the lack of statement concerning a trail, the object reported in this incident might very well have been a daylight meteor. Bright meteors have been observed to move in wavy paths. The manner of disappearance ("melted into thin air") further supports this view. Time in sight and speed also check. In short, it is more likely that this object was a bright meteor than that it was anything else.

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Incident #64 -- Twin Falls, Idaho -- 19 August 1947

There is nothing astronomical in this incident.

The reported overcast sky could have made it possible for signal or search lights to be reflected from the cloud background.

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Incident #65 -- Rehoboth Beach, Delaware -- September 1946
October 1946
2 June 1947

This incident contains nothing astronomical.

It is entirely possible that the objects observed on these three separate dates were "Bumble Bees," ram-jet missiles, as fired from Fort Miles by the Applied Physics Laboratory of Johns Hopkins University. Since the hour of observation of the various sightings (and the exact day of the first two) is not given in material submitted to this investigator, positive identification cannot be made; but if these facts are known, inquiry at the above-mentioned laboratory (address: 8621 South Georgia Avenue, Silver Spring, Maryland) might bring forth definite identification.

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Incident #66 -- Silver Springs, Ohio -- 7 August 1947

From all evidence, it appears that the object seen here was a bright meteor. Slow-moving meteors occur before midnight, and, while their paths are almost never "absolutely horizontal," it is quite possible that the observer could have gained this impression, since the object was in sight for only three or four seconds. Furthermore, an observer, surprised by an unusual occurrence, often tends to overestimate the actual duration of time; thus, "three or four seconds" might mean not much more than a second.

There is nothing at all in the evidence that cannot be explained under the assumption that the object was a meteor.

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Incident #67 -- near Placerville, California -- 14 August 1947

If details of the observers' statement are accurate, it would be difficult to assign an astronomical origin to the object seen in this incident. There are a few statements which, taken alone, strongly suggest that a meteor was observed: high rate of speed, "seemed to be in a shallow dive," white smoke trail, "disappeared in a puff of dark gray smoke." However, unless the description of the object (4-6 feet long and 10-14 inches wide) and the estimated distance (less than 1000 feet) are illusory, the meteoric explanation will not hold.

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Incident #68 -- Portland, Oregon -- 24 June 1947

There is no astronomical explanation for this incident, which should be considered together with the Kenneth Arnold case (#17), which occurred on the same day, and in which similar discoid objects were observed. (The present objects appeared to have tails, however; another major difference between this and the Arnold incident is the inferred size of the objects, as determined from the estimated distance.)

It is difficult to take seriously the peculiar action of the compass, for this would imply fantastically large magnetic fields.

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Incident #69, 69a -- Philadelphia, Pennsylvania -- 6 August 1947

The reports of this incident and those of #70 refer to the same object and are typical of descriptions of relatively slow moving meteors. The speed, trail, hissing sound (after passage -- although this could easily have been a subjective reaction) and color all check with the object's having been a fireball, bolide, or large meteor.

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Incident #70, 70a -- Philadelphia, Pennsylvania -- 6 August 1947

The descriptions given of this object are typical of those of relatively slow moving meteors. See report on incident #69 for details.

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Incident #71 -- Las Vegas, Nevada -- 8 or 9 October 1947
(Supercedes interim report of 2/15/49)

In everything except the course flown, the description given here answers to that of a fireball. The course indicated in this incident, however, appears almost fatal to such a hypothesis. No fireball on record, to this investigator's knowledge, has been known to turn back on itself. Daytime fireballs have been observed, however, that were invisible save for a marked white cloudlike trail.

Most fireballs pursue essentially straight courses, and, in fact, apparent deviations are often caused by illusions of perspective and of a spherical sky. Real deviations are caused by effects of the meteor's encounter with the atmosphere. To execute a curved trajectory would require highly extraordinary circumstances indeed, and a meteoric explanation for this incident must be regarded as most improbable.

It is more likely that some sort of aircraft was under observation.

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Incident #72 -- Alaska -- 1947 (exact date not known)

From the scanty information available, it appears improbable that this object was astronomical, unless the report represents a highly garbled and subjective account of a daylight meteor. (The time of the sighting is not given, but it is assumed from the description of the incident that it occurred during daylight hours.)

It should be noted as a matter of general record that some of the reports received at observatories of recognized fireball falls are so highly colored and garbled that if the astronomer did not have independent evidence of the identity of the object, it would be impossible to determine from these reports.

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Incident #73 — Boston, Massachusetts -- 4 August 1947

There is nothing in the evidence given here to suggest that the object sighted was astronomical.

The description suggests rather that the object may have been a highly distorted reflection image of the sun on a balloon or aircraft. The "deep gold" color ascribed to the object tends to indicate this interpretation.

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Incident #74 -- cancelled -- see #68

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Incident #75 -- near Twin Falls, Idaho -- 13 August 1947

There is clearly nothing astronomical in this incident. Apparently it must be classed with the other bona fide disc sightings.

Two points stand out, however: the "sky blue" color, and the fact that the trees "spun around on top as if they were in a vacuum." Could this, then, have been a rapidly travelling atmospheric eddy?

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Incident #76 -- Salmon Dam, Idaho -- 13 August 1947

There does not appear to be anything astronomical about this incident.

Although sighted on the same day as the sky-blue canyon saucer (incident #75), the objects described here seem to have little or no similarity to the former.

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Incident #77 -- South Brooksville, Maine -- 3 July 1947

There is nothing to suggest an astronomical origin of the objects cited in this unusually well-reported incident. Inasmuch as the sightings were made by an "astronomer" (although this investigator has never heard of him), one can presume that any astronomical implications would have been noted. The observer's question "Have any meteorites been reported?" is puzzling, because he should have been able to rule out that possibility himself. The estimated speed is all that would suggest meteors, and the absence of smoke trails and the general tenor of the description seems to rule out the objects' having been daylight meteors.

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Incident #78 -- Grand Canyon, Arizona -- 30 June 1947

While it seems more probable that the objects sighted in this incident were freely-falling, man-made instruments, perhaps from bursted instrument balloons, the possibility of their being freely-falling meteorites is not completely ruled out. When the mass of an in-coming meteorite is of the proper order of magnitude, the meteor can come in on a non-vertical path, become a bright bolide, or fireball, and have its horizontal speed component reduced essentially to zero. It then falls to earth as a non-luminous, freely-falling body.

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Incident #79 -- Richmond, Virginia -- April 1947

There is no astronomical explanation for this incident, which, however, deserves considerable attention, because of the experience of the observers and the fact that the observation was made through a theodolite and that comparison could be made with a pibal balloon. The observers had, therefore, a good estimate of altitude, of relative size, and of speed -- much more reliable than those given in most reports.

This investigator would like to recommend that these and other pibal observers be quizzed as to other possible, unreported sightings.

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Incident #80 -- Arlington, Virginia -- 7 July 1947

There is nothing in the description of this incident that contradicts an explanation of the object as a slow-moving, bright meteor. Slow-moving meteors are generally observed before midnight.

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Incident #81 -- Hickam Field -- 7 July 1947

Clearly there is nothing astronomical in this incident.

It would appear that the object sighted was an instrument-carrying balloon.

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Incident #82 -- Oklahoma City, Oklahoma -- between 17-21 May 1947

At first glance it does not appear that this incident has an astronomical explanation, but there are several portions of the description that can fit into such a picture, particularly if allowance is made for subjective reporting. The speed and manner of flight tally with that to be expected from an early-evening bolide. The observer states that the object was "round but disolike" and then again says that it was ten times longer than thick. It appears to this investigator that this sort of impression could be given by a bolide, the persistence of vision accounting for the reported elongated appearance.

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Incident #83 -- between Boise & Meridian, Idaho -- 9 July 1947

There appears to be a time discrepancy in this incident: the summary report states that the object was in view 10 to 30 seconds, yet indicates that the observer had time to call a weather station to inquire about balloon releases, and also to expose 10 seconds of 8 mm. film.

In any event, however, besides the fact that no smoke trail was indicated, tactics of the object precludes the possibility of its having been astronomical; meteors do not execute "slow rolls" or climb upward.

A better estimate of speed is needed. The possibility remains that the object may have been an unsymmetrically-painted balloon.

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Incident #84 - near Lakeland, Florida -- 7 July 1947

There appears to be no astronomical explanation for this incident. Upward trajectory and "plastic appearance," if accurately reported, do not lend themselves to such an explanation. No trail is mentioned.

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C Incident #85 — cancelled -- see #29

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Incident #86 — Hollywood, California -- 6 July 1947

From the limited data available, there appears to be no astronomical explanation for this incident.

Rolling motion and saucer shape relate the incident to many others, which, however, did not exhibit the ray phenomenon..

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Incident #87 -- Germany -- date not given

As this incident is reported, it is very unlikely that any astronomical interpretation can be offered. The description is probably of a low order of reliability, however, and it is not beyond reason that a spiral smoke trail ("first thought it was a cloud") from a meteor was observed. Unfortunately, no definite conclusion can be drawn.

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Incident #88 -- Hackensack, New Jersey -- 3 August 1947

It seems clear that no astronomical interpretation can be given to this incident.

Information is so meager that little else can be said. If the object observed was only 200 yards away, it would seem that witnesses could have furnished much more detailed information.

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Incident #89 — 100 mi. N of Kansas City, Missouri -- 6 July 1947

There is no direct astronomical explanation for this incident.

The striking feature of the incident is that the "very bright" object travelled in the same direction and at the same speed as the observer did, and that it appeared at 11 o'clock position at his left, or approximately opposite to the position of the sun at the time.

It cannot be proved, of course, but it is probable that the witness saw a direct reflection of the sun on some continuous object — thin clouds, ice crystals, or the like. (Had the object appeared on his right, then this explanation would be untenable.) Its disappearance can be explained logically also, for turning altered the observer's angular relationship to the reflector.

It is further noted that an apparent inconsistency exists in the report. The observer first stated that the object appeared to be the top of a water tank "low and to his left"; after checking his position he stated that the object was at 11,000 feet. The inconsistency in altitude throws some suspicion on the observation. If the object was low, then a running reflection along a river or railroad track would be a promising explanation.

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Incident #90 -- between Las Cruces, New Mexico & White Sands V-2 firing grounds -- 29 June 1947

The information given here is insufficient for any definite conclusion to be drawn, but it is not impossible that the object observed was meteoric. The estimated time in sight is quite long, however, and, if a meteor, the object should have had a pronounced vapor trail. The "solar specular reflection which seemed to change in intensity" could, of course, have been light from the meteor itself, blended with daylight.

Once again, it is unfortunate that more detailed observations were not made.

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Incident #91 -- Montgomery, Alabama -- 28 June 1947

No astronomical object could possibly behave in the manner described in this incident.

A small lighted balloon at the mercy of changeable winds aloft might offer a possible explanation.

(The stated position of the moon at the time has been checked and found to be correct.)

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Incident #92 -- Manitou Springs, Colorado -- 19 May 1947

There is no astronomical explanation for this incident; the reversal of direction of flight and the manouvers executed by the object preclude this.

The speed is not stated with any exactness, but if it was not too great, the object might have been a balloon, or aircraft seen under unusual conditions. Otherwise, there appears to be no plausible explanation.

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Incident #93 -- Hartford, Connecticut -- 11 January 1948

Despite the absence of a trail and of sound, identification of this object as a fireball at the very end of its trajectory seems possible. It is described as "shooting toward earth at 45°," as resembling a "shooting star," and as having a very high velocity.

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Incident #94 -- 42° 9.3' N, 114° 22.2' W -- 30 December 1947

This incident and incidents #95, 96, and 97, which describe the same object, clearly refer to a thoroughly authenticated fireball. These sightings can be dismissed with finality by the following quotation from Popular Astronomy, October, 1948:

> Fireball of 1947 -- Dec. 30
> Nancy E. Weber
>
> On this date at 7:30 P. M. PST a brilliant fireball appeared travelling westward over southern Oregon. ... Prof. J. Hugh Pruett gathered numerous reports from observers in Oregon, California, and Nevada, and from these made an appropriate solution for the path. He sent both his solution and all the 47 reports to the Flower Observatory where another solution was independently made. Ours agreed closely in all respects with that of Pruett except for the heights.
>
> . . .
>
> The meteor was most generally reported to be bluish-green in color. It appeared to explode twice, lighting up the countryside to close observers.
>
> The sound phenomena were limited to 6 out of the 47 observers.
>
> . . .
>
> From the height at which the meteor exploded it is doubtful whether any fragments reached the ground.

It is clear from the general agreement with this of evidence given in incidents #94-97 inclusive that this fireball was the object being described.

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Incident #95 -- Rosedale, California -- 30 December 1947

The description given here refers to an authenticated fireball. See report on incident #94 for details.

It is likely that the fire observed on the ground by viewers of this incident had no connection with the fireball, but it is not out of the question that a fragment of the bolide did land and cause a brush fire.

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Incident #96 -- near Lovelock, Nevada -- 30 December 1947

The explosion seen in this incident was undoubtedly that of the fireball discussed in detail in the report on incident #94.

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Incident #93 -- between Medford, Ore., and Mt. Shasta, Calif. -- 30 Dec. 1947

The flash or explosion referred to here agrees also in time and location (no other details are given) with that of the fireball described in detail in the report on incident #94.

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Incident #98 -- Houston, Texas -- 2 November 1947

The information given here indicates strongly that the object observed was a fireball. There is nothing to suggest that it was not. As far as "falling into a nearby field" is concerned, that is perhaps the best-attested illusion with respect to these phenomena. Very frequently a fireball is reported to have fallen in a "nearby field" all along its track across two or three states.

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Incident #99 -- Finland -- 3 January 1948

Information given here is insufficient to establish even vague identification.

The object seen could have been a fireball, although the length of time of observation seems unduly long. Perhaps this is subject to considerable error?

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Incident #100 -- Finland -- 5 January 1948

Information given here is insufficient to establish any sort of identification. There is nothing in the scanty report of the incident, however, that could not be explained as a meteoric phenomenon.

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Incident #101 -- Norcatur, Kansas -- 18 February 1948

This now-celebrated case of an unusual fireball has been adequately reported in astronomical literature; (for details, see Sky and Telescope, April, 1948, page 164, and October, 1948, page 293). Positive identification has been made by the recovery of fragments. The origin of this object is, therefore, definitely astronomical, and the incident need not be considered further.

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Incident No. 236 -- 4 Jan. 1949, 1400 Hours, Hickam Field, Territory of Hawaii.
An Air Force pilot saw an object which appeared to be a large round piece of flat cardboard the size of a T-6. It was white underneath and dark on top. It approached from 25 mile distance at 3000 ft and circled the area at 85. The object seemed to "blink" a "whitish reflection" regularly. It departed climbing at 25° angle.

AMC Opinion: The evidence does not lead to an explanation. It should be noted, however, that if the object were actually the size of a T-6 at 3000 feet a greater amount of detail should have been observed.

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Incident #102 -- air near Green River, Utah -- 18 February 1948

It seems entirely probable that the object observed in this incident and in #103 was the Moracatur meteorite seen at an earlier part of its trajectory.

The direction of flight is stated as "southeast of Limon, Colorado." If this means that the object was heading southeast from Limon, it could not have been the Moractur fireball, since the direction of flight of that object was northeast; but if the statement merely means that the object was seen in the vicinity southeast of Limon, the location is consistent with the trajectory of that famous meteorite.

The time stated is approximate, and need not be given too much concern. Actually, of course, the sightings here would have had to be made almost simultaneously with those in Kansas. If the time had been reported as 1600 MST instead of 1500 (a typographical error, by any possibility?), then, allowing for the difference of one hour in time zones, the sightings would have been appropriately simultaneous.

In any event, whether this was the same or another object is not important. The description given -- particularly the statement "huge, multicolored ball of fire and dense cloud of smoke" -- answers closely to that of a fireball.

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Incident #103 -- air near Green River, Utah -- 18 February 1948

It seems probable that the object observed here was the Noractur meteorite seen at an earlier part of its trajectory. See report on incident #102 for discussion.

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Incident #104 -- Smyrna, Tennessee -- 7 March 1948

The object sighted here was undoubtedly the planet Venus. The stated position checks exactly (within allowable observational error) with the computed position of Venus. Description of color, speed, and setting time also all check closely.

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Incident #105 -- Belmont, North Carolina -- 8 March 1948

The speed of 600 MPH, the lack of an exhaust trail, and the reported "exactly horizontal course" make it extremely improbable that the object seen in this incident was a meteor. The "steady reflection which did not flicker" also argues against that possibility. Since the observer was a technical man, it does not seem likely that his observations can be considered subjective enough to fit them into an astronomical hypothesis.

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Incident #106-- Bakersfield, California -- 5 March 1948

While this report taken alone, with allowances made for subjective reporting, could be considered as applying to a disintegrating meteorite, the occurrence of at least three very similar incidents (see #107, 108, 109) at the same location, over a time interval of a few days, is sufficient to make this hypothesis completely untenable.

The description applies more closely to the "star shell" (a projectile which after disintegration emits a parachute to bring instruments safely to the ground), with which this investigator was familiar during the war, than to anything else.

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Incident #107 -- Bakersfield, California -- 8 March 1948

It is very unlikely that the objects observed here were of astronomical origin. See report on incident #106.

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Incident #108-- Bakersfield, California -- 8 March 1948

It is extremely unlikely that this object was of astronomical origin. See report on incident #106.

Although the hour of observation is not stated in the witness's report of incident #107, it is possible, judging by the information which is given, that #107 and #108 refer to the same object or objects.

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Incident #109 -- Bakersfield, California -- 9 March 1948

It is extremely unlikely that the object cited in this incident was of astronomical origin. See report on incident #106.

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Incident #110 -- Baltimore, Maryland -- 23 March 1948

There appears to be nothing whatever astronomical about this incident, and, in view of the limited nature of the information given, nothing further can be said.

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Incident #111 -- Philippine Islands -- 1 April 1948

There appears to be nothing astronomical in this incident.

At a distance of 3 miles an object 20 feet long would subtend an angle of slightly more than 4 minutes of arc, and hence would be very near to the limit of the resolution of the eye. The object must have been very much larger, if the distance is correct, for the observer to discern its shape and its turtle back.

Since the object was seen by only one person, and since the description is contradictory, it seems to this investigator that not much weight can be given to the incident.

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Incident #113 -- Montgomery, Alabama -- 9 April 1948

The object cited in this incident answers to the description of an instrument-carrying balloon. In any case, there is nothing whatever in the report which would allow for an astronomical interpretation.

Attention can be called to the similarity of the description given here to that of incident #81.

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Incident #114 -- Fairbanks, Alaska -- 18 April 1948

There is nothing astronomical in this incident.

The description answers that of a maneuvering plane reflecting sunlight. One inconsistency is noted: report states, "Weather clear and visibility unrestricted," whereas weather sequence shows partial cloud coverage. This would not, of course, necessarily have prevented sun reflection from aircraft.

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Incident #115 -- Greenville, South Carolina -- 19 April 1948

There is nothing astronomical in this incident.

The description suggests that the objects observed were balloons or aircraft reflecting sunlight.

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Incident #116 -- Moose Factory, Canada -- 11 March 1948

This incident can certainly be ascribed to the fall of a bright meteor, or fireball.

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Incident #117 -- Memphis, Tennessee -- 7 May 1948

It is unlikely that the objects viewed in this incident were meteors, but the possibility is not excluded.

It is unfortunate that some estimate of distance and of time in sight was not made. Objects might have been quite close, in which case large angular velocity would not imply great speed.

This investigator would like to emphasize again the need for better reporting of such incidents.

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Incident #118 -- Berlin, Germany -- 28 March 1948

The information given here is insufficient for a definite conclusion to be reached, the only possible astronomical explanation, which would be a slow-moving meteor, is very unlikely.

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Incident #119, 119a-b -- Asuncion, Paraguay -- 20 February 1948

While some of the reports of this incident are contradictory, the major portion support the hypothesis that the object observed was a slow-moving meteor or fireball. The speed and color concur in this. The fact that the object was seen over so wide an area implies that the observer who stated that it was only 1000 feet away was in error in his estimate.

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Incident #120 -- Vejle, Denmark -- c. 7 February 1948

Nothing is said here that militates against the object's having been a meteor. Information is very scanty.

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Incident #121 -- Cartersville, Georgia -- 9 January 1948

While the possibility of this object's being a meteor is not ruled out, it seems unlikely. Meteors are not known to be "light sky blue," nor to travel so slowly as indicated. However, report also states that color was an "intense blue," and, if speed were underestimated (or if object had a large radial velocity component -- coming largely "head-on"), it might possibly be interpreted as a fireball.

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Incident #122, a, b -- Holloman Air Force Base -- 5 April 1948

At the moment there appears to be no logical explanation for this incident.

There is nothing to indicate an astronomical origin of the object observed.

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Incident #123 -- Alton, Illinois -- 11 April 1948

There is nothing of astronomical character in this incident. If one considers Colonel Siegmund's statements apart from the considerably less reliable ones of other observers, it would seem that the object may really have been a bird.

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Incident #124 -- North Atlantic -- 18 April 1948

On the basis of the information given about this radar sighting, no astronomical explanation of the incident is at all likely. Could the sighting possibly refer to a flock of migrating birds?

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Incident #125 -- St. Louis, Missouri -- 2 May 1948

Information given here is inadequate to establish any category. The object observed was apparently nothing of an astronomical character.

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Incident #126 -- Anacostia, Naval Air Station -- 30 April 1948

There is nothing in the description of this incident to indicate astronomical origin of the object observed. It appears to have been a balloon.

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Incident #127 -- Yugoslav-Greek frontier -- 7 May 1948

Information given here is entirely too limited for any conclusions to be drawn. Possibly the object observed was a meteor.

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Incident #128 -- Hobson, Ohio -- 8 May 1948

Once again, the report given is entirely inadequate for a conclusion. However, astronomical origin of the object or objects observed seems very improbable.

The phenomenon described resembles the observation of an airplane beacon or search light reflecting against an overcast. This would certainly be periodic, appear phosphorescent, travel at great speed, and be oval in shape. Such interpretation would dismiss the occasional bursting and disintegrating as a subjective impression. -- However, weather conditions are not stated.

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Incident #129 -- Wilmington, North Carolina -- 31 May 1948

Evidence in this incident is contradictory, especially concerning tactics, but from the meager description and the fact that the object emitted smoke and travelled at a high speed, the possibility of its having been a meteor is not ruled out. Apparent oblong shape might have arisen from persistence of vision of a rapidly travelling bright object.

Is there a government testing field for guided missiles near by?

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Incident #130 -- Plevna, Montana -- 17 May 1948

If the report is to be taken at face value, then no astronomical explanation of this incident is possible.

However, in seeking even a remote logical explanation for the incident, the present investigator is impressed with the fact that on this very night, May 17, Venus was at its greatest brilliancy, with a magnitude of -4.2, or about 100 times brighter than a first magnitude star. It would have appeared that night as an intensely bright light in the northwest.

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Incident #131 -- Belleville, Illinois -- 20 June 1948

It appears improbable that this incident has an astronomical explanation. If the evidence is correct as given, the object could not have been a fireball. The zig zag course and the relatively slow speed do not fit in with the description of a large meteor. Lack of flare and train also tend to rule out this hypothesis.

The description answers that of a lighted balloon relatively close by.

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Incident #132 -- Oslo, Norway -- 12 December 1947

The object observed here answers the description of a fireball, and the probability that it actually was one is very great.

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Incident #133 -- Norway, Denmark, Sweden -- 20-26 February 1948

Information given here is too limited for any conclusions to be drawn. The stated heights, the occurrence at the same time each night, and their specific direction makes explanation of the objects as meteors unlikely. The green tails are also not characteristic of typical meteors, but would fit into a description of rockets or flares.

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Incident #134, 134a -- Monroe, Michigan -- 28 May 1948

There is no direct astronomical explanation for this incident.

This investigator wishes to call attention to the fact that the objects observed were seen at essentially the same level as the lower cloud stratum and that there was a high overcast. Could it be that these officers saw successive shafts of sunlight, through breaks in the high overcast, illuminating small portions of the lower cloud stratum? Apparent speed of the objects could then have been a combination of the relative velocity of the C-47 and the projected motion of the break in the overcast.

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Incident #135 -- Weaver, South Dakota -- between 15-20 August 1947

For the description of this incident as given, there is no astronomical explanation.

The statements of an apparently well-trained observer can scarcely be doubted, but no interpretation, either astronomical or otherwise, other than possible detached auroral streamers, suggests itself. The moon at the time was new and the night apparently very dark, the most favorable conditions for the observation of auroral phenomena.

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Incident #136, 136a -- S. Knoxville, Tennessee -- 30 June 1948

This incident answers well to the description of a typical fireball: color -- orange; apparent construction -- fire; exhaust -- "streamer of bluish color trailing"; manner of disappearance -- "over horizon"; and (in remarks) "streamer emitted sparks."

All of the above fit the typical phenomena associated with a night-time fireball.

One witness states that the object was in sight for three minutes and the other states for three seconds. The lower time estimate is clearly more in keeping with meteoric phenomena. It is also probably far more nearly accurate, since one is much more likely to grossly overestimate than underestimate intervals of time.

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Incident #137, 137a -- Chapel Hill, North Carolina -- 7 July 1948

This report refers solely to a sound phenomenon. Statements of the witnesses indicate specifically that no object was seen. The summary sheet given here seems to confuse the description of this incident with that of incident #138.

Fireballs and bright meteors are often known to emit sounds similar to the rolling of thunder. The information given in this report is so meager, however, that, while the sound referred to could have been meteoric, no decision can be made.

It seems more probable that actual aircraft were heard.

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Incident #138 -- Columbus, Ohio -- 8 July 1948

There is clearly nothing of astronomical character in this incident.

It is the present investigator's opinion that the objects were aircraft. The "bobbing up and down" can be explained as a "seeing" effect -- that is, distortion of the image by air currents.

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Incident #139 -- Osborn, Ohio -- 9 July 1948

There is no obvious astronomical explanation for this incident.

The present investigator was struck first by the fact that the description of the incident states, "... with about a quarter moon rising in the east-southeast." The quarter moon can never be seen in that position at 2147 hours (local time), for the quarter moon sets at approximately midnight. The moon at that date was not yet at the first quarter, and it set at Osborn at about 2300. The correct statement would be, "... with about a quarter moon setting in the west-northwest." This, oddly enough, is the quadrant of the sky in which the object was reported to be seen. In what direction, then, was the observer really looking?

Although the sky was reported as clear, could it possibly be that rapidly scudding clouds periodically obscured the setting moon -- a moon which, incidentally, does have a pale yellowish-white light?

Other possibilities that suggest themselves are detached auroral streamers or floodlights or searchlights playing on the sky.

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Incident #140, a -- Gahanna, Ohio -- 1 July 1948

The object sighted here was probably a bright, slow-moving meteor. It is described as a "bright yellow-white light," moving at a "terrific" rate of speed, and was in sight for two or three seconds.

This investigator is again struck by the reference to the ubiquitous moon. "Bright moonlight" was reported; at the stated hour of observation, the moon had not yet risen.

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Incident #141 -- Hecla, South Dakota -- 30 June 1948

The description given here obviously does not answer to that of a star, or of any other astronomical body.

In all probability the object was a cluster of balloons, carrying, perhaps, cosmic ray apparatus. This would account for the starlike appearance and the eventual breaking up into parts.

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Incident #142 -- Boise, Idaho

No details are given concerning this incident. Letter from investigator indicates that observer was not sufficiently reliable to warrant consideration of his report.

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Incident #143 -- Columbia, South Carolina

No details concerning this incident have been obtained.

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Incident #144 -- near Montgomery, Alabama -- 24 July 1948
144a, b -- near Blackstone, Virginia -- 24 July 1948

The famous "space ship" sighting reported in incident #144 should be compared with #108 and 208, and also with #144a and b, which together constitute a separate incident if facts are correct as given.

For #144, there is no astronomical explanation if we accept the report at face value. The sheer improbability of the facts as stated, particularly in the absence of any known aircraft in the vicinity, makes it necessary to see whether any other explanation, even though far fetched, can be considered. The two reliable pilots obviously saw something. If one extracts from their reports parts of the description -- "tremendous bursts of flame," "cigar-shaped," "disappeared into a cloud," "orange-red flame," "time in sight five to ten seconds" -- one sees that this much, at least, could be satisfied by a brilliant, slow-moving meteor. The orange-red flame is particularly suggestive. It is pertinent also, that the only passenger awake at the time the two pilots sighted the object gave a description that does not tally with that of a "space ship" but does agree with that of a meteor.

It will have to be left to the psychologists to tell us whether the immediate trail of a bright meteor could produce the subjective impression of a ship with lighted windows. Considering only the Chiles-Whitted sighting, the hypothesis seems very improbable. However, not included in the summary but mentioned in the

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voluminous collateral material is the report of a qualified Robins Air Base observer, who stated that he saw a cylindrical object trailing a red flash of fire, but did not discern any windows or a double deck; (admittedly, from the ground he would have had less opportunity to do so). The time of his observation is exactly one hour earlier, if both times are given in EST (as is stated). It is interesting to note, however, that Macon, Georgia, and Montgomery, Alabama, are both on the line of flight as described by the Montgomery observers.

If these two sightings refer to the same object, there are two possible interpretations: One is that the object was some type of aircraft, regardless of its bizarre nature. The distance between Macon and Montgomery is approximately 200 miles. From all reports the object was travelling definitely faster than 200 MPH, so would have covered the distance between the two points in much less time than that noted. (The schedule is, of course, correct for an ordinary aircraft.)

The other possible explanation is that the object was a fireball, in which case it would have covered the distance from Macon to Montgomery in a matter of a minute or two. If the Montgomery observers had been using daylight savings time (do regular

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commercial airlines connecting cities using daylight savings time operate on it?), then there would be no discrepancy in the time.

The conclusion seems to be this: If the difference in time is real, the object was some form of aircraft travelling at 200 MPH. If there is no time difference, the object must have been an extraordinary meteor. The observation from two such widely separated points is the focal point of the investigation -- if one assumes that the same object was observed in the two cases. That there were two separate objects can most likely be ruled out by the sheer improbability of more than one such extraordinary object being seen on the same night, travelling over the same course, exactly one hour apart.

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The object reported in incident #144a and 144b was very probably a meteor.

It should be noted that this object was travelling in the same direction as the one reported in #144, although separated by some 400 miles. It is not unusual for a fireball to be seen along a path several hundred miles long. There is a time discrepancy of 15 minutes between the observations, however; any connection between #144 and 144a-b (in considering the meteoric hypothesis) necessarily hinges on whether this time difference was real, or not.

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Incident #145 -- Fielding Lake -- 9 July 1948

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The lack of any exhaust trail and/luminosity elimtnates an astronomical explanation for the objects reported here.

It seems more probable that they were distant aircraft flying in formation, or migrating birds.

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Incident #146 -- San Acacia Dam, New Mexico -- 17 July 1948

Lack of exhaust trails eliminates any possible astronomical explanation for this incident.

It seems more probable that the objects observed were a) balloons at a much lesser distance than that estimated, b) aircraft in formation, or c) birds.

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Incident #147 -- Springfield, Ohio -- 27 July 1948

The description of this incident, although meagor, is in agreement with the hypothesis that the object observed was a fireball. Thus, "bright red tail of fire," "travelled in straight line," "great height," and the short time in sight all increase the probability that it was a bright meteor. The fact that it was travelling north, at this time of night, implies that the meteor was crossing the orbit of the earth on its way toward the sun when the collision occurred.

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Incident #148 -- Springfield, Ohio -- 28 July 1948

The planet Venus seems to be the culprit in this incident. Venus attained its greatest brilliancy in the morning sky on July 31, and at approximately 0400 in the morning on July 28, it was a very brilliant object slightly to the north of east. The magnitude was -4.2, which makes it about 100 times brighter than a first magnitude star. Intermittent cloud coverage could easily explain the appearance and disappearance of the object, and as to the stated size, this can be dismissed as a purely subjective estimate. The evidence appears convincing to this investigator that the object observed was Venus.

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Incident #149 -- North Jutland -- 19 January 1948

There is nothing in the meager description of this incident that precludes the possibility of the objects' being meteors. The description would also allow for their being rockets. However, the explosion of the objects favors the meteoric hypothesis.

It might be well to note the similarity of this and other Scandanavian reports to the "green flash" objects reported from New Mexico.

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Incident #150 -- Swedish coast -- 1 March 1948

The description given here is entirely too fragmentary for any conclusions to be drawn. The object sighted could have been a meteor, a rocket, or a guided missile. The fact that it left no trail in the sky argues against its having been a meteor.

Note the similarity of this incident to #149 and #133.

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Incident #151 -- Indianapolis, Indiana -- 29 July 1948

This incident and #152 are being considered together by this investigator, because they both occurred in Indianapolis, were separated by just two days, were observed at approximately the same time of day, and include certain similarities of description.

Both incidents are clearly non-astronomical.

Drawings are available for both objects observed, and, although they are considerably different, they might conceivably represent the same object viewed on edge and in plan. Both have approximately the same shape, although the scale given by one observer is about three times that given by the other. Both have 3:1 ratios of length to width. If these objects were real, it seems to be straining coincidence too far to assume that they were entirely independent of each other.

Were there by any chance some special glider experiments going on in the vicinity of Indianapolis at that time?

Barring hallucinations, these two incidents and incidents #17, 40, 75, and 84 seem to be the most tangible, from the standpoint of description, of all those reported, and the most difficult to explain away as sheer nonsense.

It should be noted that both incidents #151 and 152 had two observers.

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Incident #152 -- Indianapolis, Indiana -- 31 July 1948

There is no astronomical explanation for the object observed in this incident.

See report on incident #151 for discussion.

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Incident #153 -- Georgia -- 5 August 1948

The limited description which is offered here is consistent with that of a disintegrating fireball, in spite of the observer's statement that the object was not a meteor or falling star. Actually, fireballs bear little resemblance to the ordinary, frequently-seen meteors. The trail of sparks at the end is sometimes associated with a fireball.

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Incident #154, 154a -- Columbus, Ohio -- 2 August 1948

This incident is in two respects unique among all those investigated: 1) it is the only object that is defined solely by an outline, appearing vacant inside, so that the sky was visible through it; and 2) it is similar to an object that this investigator viewed as a boy.

The writer's recollection has remained vivid throughout these many years. The object he saw could best be described as a floating ellipse, like a wire hoop travelling slowly across the sky. The motion was uniform, and the form of the object changed slowly, as though the hoop were being distorted. The object was observed for at least ten minutes, with several witnesses, until it finally disappeared in the distance. The writer had dismissed the object as some sort of unusual atmospheric phenomenon, perhaps a travelling air pocket.

Because of the similarity between this observation and that reported in incident #154, the latter has a special interest to this investigator. In the recent incident, however, the tail of smoke is an added feature.

There is obviously no astronomical explanation for these incidents -- the most plausible explanation probably lies in the field of meteorology.

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Incident #155 -- Columbus, Ohio -- 31 July 1948

There is no astronomical explanation for this incident.

If the information offered is to be given any weight at all, the most likely explanation is that a cluster of balloons, or a balloon with several fire-pots hanging below it, was observed. Corroboration for this interpretation is probably furnished by incidents #156 and 157, which occurred a few hours later near this location. The object reported in #157 proved to be a "county-fair" type balloon.

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Incident #156 -- Columbus, Ohio -- 31 July 1948.

This incident and incident #157, which obviously refer to the same object, must be considered together. The object fell to earth and was retrieved; it proved to be a "county fair balloon," once quite common in this part of the country. Usually they are lighted in mid-afternoon, having one or more fire-pots to provide the hot air. They then rise and stay aloft for several hours before finally falling to earth.

It is highly probable that the object described in incident #155, which was observed a few hours earlier on the same day and near the same location, was this object, seen while it was still high in the sky.

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Incident #157 -- Columbus, Ohio -- 31 July 1948

The object described in this incident can be easily identified as a "county fair balloon."

See report on incident #156 for discussion.

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Incident #158 -- Groveport, Ohio -- 1 August 1948

With two essential items missing (speed with which the trail was formed and length of time involved in the formation), it is difficult to come to a definite conclusion concerning the origin of the object observed, but it is entirely possible that it was parts of the smoke trail of a fireball. Fireball trails have been known to act in the manner described. The witness states that the streak was not like an anti-aircraft shell burst or a vapor trail from a plane. He implies that the motion of the object forming the trail was very rapid, and that the distance was considerable. At least, nothing is said which is contrary to the meteoric hypothesis.

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Incident #159 -- Worthington, Ohio -- 30 July 1948

No astronomical explanation is suggested by the description of this incident.

This investigator wonders whether an advertising "blimp" might not have been in the neighborhood. The time of observation was just after sunset, and a blimp would probably have given the appearance described.

It should be noted that the size of the object and distance are not stated.

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Incident #160 -- Dravosburg, Pennsylvania -- 4 July 1948

There is no astronomical explanation for this incident.

The date of occurrence, July 4, suggests that the object seen might have been a part of some celebration -- for instance, a lighted balloon, or even a "county fair" type of balloon.

Or there may be a much simpler explanation for the incident: the observer was very close to the Allegheny County airport. Does the airport have record of either pilot balloon or small aircraft in the air at the time of the sighting? Since when the object seemed to stop it also changed direction, the stopping may have been merely the effect of perspective.

This incident does not appear to have any relation to incident #161.

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Incident #161 -- McKeesport, Pennsylvania -- c. 8 July 1948

Information offered by these two untrained, uncritical, and excitable observers can be given little weight. There does not appear to be anything astronomical about this incident; chances are that the two women saw ordinary aircraft with sunlight reflected from fuselage but not from wings.

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Balloon recovered

Incident #162 -- Hamel, Minnesota -- 11 August 1948

No astronomical explanation is possible for this incident. A meteorite would not have descended so gently, nor would it have risen again.

It seems incredible that this could have been an actual physical occurrence, but if it was, it is doubly unfortunate that no mature observers were at hand. If the object did land just a few feet away, one would think that even children would have given a more detailed description. Is it known whether the children have normal vision? To one with myopic vision, even a buzzard or hawk gliding to a landing might appear as a strange object.

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Incident #163 -- VanNuys, California -- 21 July 1948

Since a complete description of this incident is given in numerous reports from Mt. Wilson Observatory and Griffith Planetarium, since the observations there were made with telescopes by experienced observers, and since their descriptions agree that the object was in all respects balloon-like, there is nothing that this investigator can add. The object was evidently an unidentified balloon.

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Incident #164, a, b -- Uniontown, Pennsylvania -- 29 June 1948

There is no astronomical explanation for this incident.

Its occurrence at the time of a thunderstorm suggests that the report might be referred to an expert on ball lightning to see whether this might be a possible explanation.

Another possibility is that the observers saw a beacon searchlight projected against clouds, although if this were the case, it should have continued visible at regular intervals.

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Incident #165, a -- Chamblee, Georgia -- 28 July 1948

The object reported in incident #165 and 165a (which presumably refer to the same thing) can be easily explained as having been a very bright meteor. The majority of observers agree that the object did not maneuver, was on a steady course, and lost altitude slowly.

Numerous other reports (included with incident #144), from the vicinity of Augusta, which are widely divergent as to time, direction of motion, and color of the object, all appear to refer to a bright meteor. It may be that these scattered reports all describe the object of incident #165, a. It could be, of course, that the state of Georgia was treated to several fireballs in one evening, but it seems more likely that we have here an example of serious dispersion in the description of one object.

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Incident #166 -- Los Angeles, California -- 30 August 1948

The observer of this incident states that the object looked like a rocket and was larger than a B-29. He does not give the distance, but estimates the altitude as well over 20,000 feet. At this implied distance, it appears to this investigator that resemblance to a rocket must have been largely subjective.

Although a rocket cannot be ruled out, it is also possible that the object seen was a bright meteor. If the hour of observation given is correct, it was late twilight. It seems that a bright meteor appearing at this time could give the general impression of a rocket leaving a trail.

The report states that the object was observed through field glasses taken from a German 88 mm. artillery piece and that each lens was 8" in diameter. (This is an improbably large size for a field glass.) If the object completely filled the lens at that given altitude, either it was of a truly tremendous size or the glass was out of focus. Furthermore, the telegram and summary state that the object was travelling from west to east (another report says from north to south); if it had been a rocket heading east, the landing would probably have been reported.

All in all, the evidence supports the conclusion that the object was more likely a bright meteor than a huge rocket.

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Incident #167 -- Pacific Ocean: 19° 08' N, 164° 05' E -- 8 May 1948

The object observed here was probably an exploding fireball seen head-on and seen only at the time of actual explosion. This, with partial cloud coverage, could easily explain the absence of a trail.

It is not likely that lights sighted on the water surface or aircraft sighted later had any relation to the original object.

If the object had been a shell fired from the USS Boxer, it appears improbable that only one shell would have been observed.

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Incident #168 -- The Hague -- 20 July 1948

The information given here is too limited even for guesswork. It is extremely difficult to take at face value the report of an aircraft with two decks and no wings travelling with supersonic speed, even if "seen four times through clouds" by the chief of the Court of Damage and his daughter. It seems much more probable that the observers had a subjective impression of ordinary aircraft or a fireball. Even though these two items are at opposite ends of the scale, there is nothing in the evidence to favor one or the other.

In passing, it is interesting to note that this incident occurred just four days before the famous "Alabama space ship." Maybe our visitors from Mars were cruising around!

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Incident #169 -- Maplewood, Ohio -- 29 August 1948

There does not appear to be any astronomical explanation for this incident.

There is some chance that the object could have been a weather balloon in the process of disintegration.

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Incident #170 -- Adapazari, Turkey -- c. 5 May 1948

It is extremely unlikely that there is any astronomical explanation for this incident. The information given is very limited, but it points definitely to the probability that the object or objects sighted were rockets. The report indicates that one rocket-like object was recovered.

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Incident #171 -- Moscow, Russia -- 3 August 1948

There is no astronomical explanation for this incident. Perhaps the Russians were experimenting with their own or a captured German dirigible.

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Incident #172, a, b, c -- Fargo, North Dakota -- 1 October 1948

There is no conceivable astronomical explanation for this much-examined and much-discussed incident.

Analyses by a psychologist and a meteorological expert would be of importance here.

It seems significant to this investigator that other witnesses of the incident did not observe the complex tactics reported by Lieutenant Gorman, although they were presumably seeing the same thing. Is it possible, then, that the pilot "took on" a lighted weather balloon? (See report on incident #207 for further discussion.)

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Incident #173 -- Shreveport, Iowa -- 13 September 1948

There is no astronomical explanation for this incident.

It appears probable that a balloon was under observation.

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Incident #174 -- near New Orleans, Louisiana -- 1 October 1948

There is a strong possibility that the object sighted here was nothing other than a fireball. The description of the object itself particularly suggests this: white hot, with red flames trailing. The course and size also fit in with the fireball hypothesis. It is an unusual time of day to see a slow-moving meteor, since in the early morning they strike nearly head-on; however, this one could have been seen after the earth's atmosphere had slowed it down very appreciably.

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Incident #175A-- Santa Fe, New Mexico -- 23 September 1948

The evidence here is so contradictory that it is very difficult even to attempt any identification. For example, one observer states that the object was stationary; the other that it was moving at a speed of 700-800 MPH. One says the elevation was 45°; the other says 70°. It is hard to believe that they were looking at the same object, even though it is so stated.

Considering #175 (Mr. Angier's statement) alone, it is possible that the object observed was the planet Venus. The location is is given as southwest and the elevation as 70°, which correspond approximately with the position of Venus at the time. The magnitude of the planet was -3.8; it could have been visible in the daylight sky. It would have appeared, however, more like a pinpoint of bright light than like a "dime in the sky." It seems unlikely that it would have been noticed at all, but since the observer was looking closely at the sky ("watching a government plane come in"), he might have chanced upon it.

Considering the vast discrepancies in the two reports, it may not be amiss to suggest another, far fetched, interpretation for one or both. The moon at the time was in gibbous phase, and was a little off the horizon north of west. Most people are so unused to thinking of the moon in that position in the daytime that they fail

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to identify it. This is particularly true if one's eyesight is not of the best. While this hypothesis has little correspondence to either report, as the evidence is stated, it is worth mentioning, especially since it may be met in future citings of incidents.

It seems far more probable that some type of balloon was the object in this case.

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Incident #176, a -- Castro's Ranch, California -- 23 September 1948

The two observers of this incident make, in several respects, directly contradictory statements: diffuse object versus definite box-shaped object, easterly line of flight versus northwesterly, etc. They agree on speed (very fast).

It does not seem likely that the incident can be explained astronomically. The only possible astronomical hypothesis would be that the object observed was the smoke mass from an exploded fireball, which would probably have an amoeba-like shape, agreeing with the description of one witness. At noon a meteor outward-bound from the region of the sun could approach the earth head-on, explode, and not leave any long trail.

However, in view of the conflicting descriptions, very little weight can be given to the whole incident. Perhaps the observers were looking at different things. There was a west-bound United Airlines plane in the vicinity at approximately that time; one observer may have seen that. The description of one observer suggests a box kite, such as those once used by weather observers.

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Incident #177 -- Kentwood, Louisiana -- 5 September 1948

Contradictory opinions concerning the existence of the alleged unusual noise and the dubious personality of the reporter of this incident make serious attention to the incident impossible.

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Incident #178 -- Honolulu, T. H. -- 18 October 1948

There does not appear to be any astronomical explanation for this incident. The moon had not yet risen at the time the object was sighted, although it was about to rise in the northeast.

The object may have been a balloon reflecting the light of the setting sun.

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Incident #179 -- San Francisco, California -- October 1947

There is no astronomical explanation for this incident. The extremely incoherent and unreliable nature of the report of the incident makes serious consideration futile.

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Incident #180a, b -- South Bend, Indiana -- 13 October 1948

There is no astronomical explanation for this incident. Reflection of the sun from a balloon or aircraft appearing in foreshortened position might possibly account for the description given here.

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Incident #181 -- near Dayton, Ohio -- 14 October 1948

There is no astronomical explanation for this incident.

Since the speed of the plane was 160 MPH, if it had passed through a cluster of small balloons, a flock of migrating birds, or any other group of relatively stationary objects, they would undoubtedly have appeared to observers within as objects whizzing by, much as telephone poles appear from a window of a speeding train. Little credence can be given to the pilot's statement that the objects could not have been migrating birds; there would have been no time for identification.

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Incident #182 -- At sea: 74° 40' W, 36° 42' N -- 15 October 1948

The bearings and motion given in this report by the Master of the SS Gulfport do not correspond to those of any celestial object.

From the reported size and shape and the statement that the object had a bright center, one can surmise that it was spherical -- probably a balloon.

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Incident #183 -- Japan -- 15 October 1948

There does not appear to be anything astronomical about this incident.

Radar experts should determine the reliability of the data, particularly concerning acceleration rates.

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Incident #184 -- Winona, Minnesota -- 20 October 1948

This incident and #185 appear to be a clear-cut case of a fireball. Strongest evidence is the fact that the object was seen in several communities at the same time. While the reports given in the Minneapolis Morning Tribune article conflict in minor details, the general sense of the description of all observers fits that of a fireball.

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Incident #185, a, b -- Minneapolis, Minnesota -- 20 October 1948

The object reported in this incident is the same as that in #184, seen from a different locality. The description of the incident leaves no question but that the object observed was a fireball.

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Incident #186 -- near Sterling, Utah -- 16 October 1948

There is nothing astronomical in this incident.

It should be pointed out that, since the object was in sight just a few seconds, even a conventional aircraft under peculiar lighting conditions might have given the reported appearance. The estimated distance of 500 feet, if correct, should have allowed much more detailed observation. Probably the distance is grossly underestimated.

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Incident #187 -- Godman Air Force Base, Kentucky -- 19 August 1948

There can be no question but that the object sighted in this incident was Venus. It was just three weeks past its period of greatest brilliancy, and was separating from the sun. The close agreement between the observed position of the object and the actual position of Venus, determined by others concerned with the incident and rechecked by this investigator, is convincing.

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Incident #138 -- Goose Bay, Labrador -- 29 October 1948

There appears to be nothing astronomical in this incident.

Judging from the speed and apparent size of the object, it seems that a balloon may have been picked up by the radar.

Radar experts should evaluate these sightings.

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Incident #189 -- Albany, Georgia -- 22 September 1948

There is nothing astronomical in this incident.

Since the object looked like a drone, perhaps it was one.

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Incident #190, a, b — Neubiberg AF Base, Germany -- 11 October 1948

The position of this object in the sky (northeast at an altitude of 70°) rules out any possible astronomical explanation. The moon had not yet risen at the time.

The description appears to fit that of a high-altitude balloon.

Question: If there had been "no release of airborne weather equipment prior to or during sighting," where did the information concerning winds aloft come from?

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Incident #191 -- near Junction City, Kansas -- 24 October 1948

There is no astronomical explanation for this incident. The description given is sketchy and would be entitled to no weight whatever if it had not been reported by a responsible USAF officer. With size, shape, time in sight, tactics, and sound not stated, it is impossible to say anything further than that this seems to be a typical example of the "garden variety" of flying saucer.

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Incident #192 -- near Moorhead, Minnesota -- 24 October 1948

Despite the observer's statement that the object seen could not have been a meteor, the possibility is not ruled out. Early evening is the most propitious time for the observation of slow, bright meteors. This is the time of day when a meteor inbound to the sun and caught by the earth's gravitational field would appear to travel from east to west, and could appear to rise slightly. Most people identify meteors with sharp, fast flashes of light, which are not at all characteristic of slow fireballs. The observed turn is difficult but not impossible to explain; this investigator would prefer, however, to think that it was an illusion caused by perspective.

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Incident #193 -- near Neuoiberg, Germany -- 24 October 1948

It is very unlikely that this incident has any astronomical explanation. No trail nor luminescence was observed, and the object flew a straight and level course. Time in sight (two minutes) also effectively rules out any possible astronomical hypothesis.

Could the object reported here have been a conventional airoraft viewed in foreshortened aspect?

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Incident #194 -- near Andrews Field -- 3 November 1948

No astronomical explanation is possible for this incident.

The object reported has been independently identified as an MIT cosmic ray balloon cluster.

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Incident #195 -- Goose Bay, Labrador -- 31 October 1948

The object reported in this incident has no astronomical explanation: speed was too slow and time in sight too long.

The object, observed on a radarscope, was probably a balloon or unidentified aircraft.

Question: Is the speed indicated the radial velocity of the object or true space velocity? If the latter, it is obviously too slow for conventional aircraft.

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Incident #196 -- Goose Bay, Labrador -- 1 November 1948

There is no astronomical explanation for this incident.

The object could have been balloon radiosonde.

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Incident #197 -- Richmond, Indiana -- 5 November 1948

This incident very likely has an astronomical explanation; the object sighted was probably Venus. Venus rose on November 5 at about 5:30 A. M. and an hour later would have been a little south of east at an altitude of about 15°. Its magnitude was -3.4, or about six times brighter than the brightest star in the sky. The photograph taken of the object sighted does not contradict this hypothesis.

It is unlikely that the object observed was the bright comet (1948L) discovered one day earlier in the southern hemisphere, for this comet at that time was very far to the south and east, almost on the horizon, and was very much fainter than Venus. If the object seen here had been the comet, the persons observing it could lay claim to the first discovery. It was discovered one day later in Australia because of much more favorable location.

Venus, of course was visible all during the autumn of 1948 in approximately the same position as that in which it was seen on the morning of November 5.

It is also of interest to note that Mercury had its greatest western elongation on November 5, but it rose just at the beginning of the morning twilight and would therefore have been just rising at the time of this incident. Furthermore, Mercury was much less brilliant than Venus.

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Incident #198 -- Wakkanai, Japan -- 6 November 1948

This incident has no astronomical explanation.

The object has been independently identified from radar information as a Soviet aircraft.

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Incident #199 -- near Grays Harbor, Washington -- 30 October 1948

From the meager information given by Lieutenant Kunzman, presumably a responsible and well-trained observer, positive identification of the object is impossible, but it appears likely that it was a bursting fireball.

The bits of evidence that tend toward this interpretation are the following: one object bursting into ten or twenty pieces, color white and yellow, and the short time in sight. Manner of disappearance, simply fading from view "like fumes from an airplane," is also similar to that of a disintegrating fireball; in bright daylight the otherwise bright, flare-like quality is sometimes not observed.

Against this interpretation are the following: no lights or outstanding reflection, and no trail. The former might be the result of bright daylight. Obviously the objects were observed, and if they were yellow and white, they must have had some luminosity. Lack of trail is, however, unusual.

Unfortunately, without more detailed information, little more can be said.

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Incident #220 -- San Francisco, California -- 29 November 1948

There is good reason to believe that the object observed in this incident was a bolide. The fact that the observer, although a science teacher, confused the term comet with meteor is strong evidence that he is unacquainted with these phenomena: a comet appears stationary in the sky over a relatively long period of time. While the evidence is insufficient to establish with any certainty that the object was a bolide, it appears to this investigator, none the less, to be the most probable explanation.

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Incident #221 -- Midland, Michigan -- 9 July 1947

From the chemical analysis (as reported in this incident) of the material turned in to the laboratory, it is evident that there is no astronomical explanation for the object. Meteorites do not include in their contents silver pellets or magnesium hydroxide.

This incident was evidently a prank or a private experiment. (Observer may or may not have been the instigator.) Since the event occurred on July 9, it is possible that chemicals left over from a Fourth of July celebration were used; the magnesium content might imply this.

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Incident #222 -- Furstenfeldbruck, Germany -- 23 November 1948

The tactics described by this object, if correct, and the implied time in sight (long enough to call others to see it) argue strongly against an astronomical interpretation for the incident.

The object might have been a balloon with a light on it.

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Incident #223, a-e -- New Mexico -- 5 December 1948

Since several separate sightings are encompassed by incident #223 to 223e, it must be regarded as a composite incident, occurring during one night but referring to several distinct phenomena. The reports in #223 appear in turn to be a part of a larger series of incidents, all concerned with the "green meteors" or "green flashes" which have appeared in and near New Mexico, and the present statement applies to some degree to all of them.

In his letter of December 29, 1948, to Lieutenant Colonel Rees of the OSI, my colleague Dr. Lincoln LaPaz has summarized thoroughly the nature of these incidents and, particularly, has noted the reasons why the objects concerned cannot be dismissed as ordinary meteoric phenomena. Dr. LaPaz is an extremely able man in the field of meteoritics and an enthusiastic, almost to the point of extravagance, investigator and worker. On the basis of the description at hand, I concur in his conclusions. Dr. LaPaz, who is "on location" and has observed at least one of these objects at first hand, should be fully supported in a continued investigation. Apart from the unusual appearance of the objects, the pattern of incidents is particularly striking. It would be exceedingly unlikely that so many meteors would appear in that small sector of the Southwest and nowhere else; if they did, they would not have consistently horizontal paths and

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head in a consistent direction. These points alone are sufficient to dismiss the meteoric hypothesis. It is entirely possible that, among the many incidents reported, one or two of the objects may have been fireballs, thus serving to confuse the issue, but a blanket explanation of that sort is improbable.

I would suggest that Dr. Jack Workman, Director of the New Mexico School of Mines, be contacted. He is conducting highly classified experiments in very high velocity projectiles and may be in a position to offer a worthwhile opinion. High velocity experiments, probably in connection with preliminary trials in the production of artificial meteors or artificial satellites, may prove to be the explanation of these incidents. Such experiments would not be conducted at any of the recognized air bases so far contacted.

Note: It has come to my attention since the writing of the above that Dr. LaPaz, in the March issue of Popular Astronomy (LVII, 3, p. 136) refers to "the spectacular meteoric display of 1948 December 5" in northeastern New Mexico. It would seem an unusual coincidence that the sightings reported in this incident occurred on the same evening and yet were entirely apart from it. The apparent contradiction is puzzling.

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Incident #224 -- near Las Vegas, New Mexico -- 8 December 1948

See report on incident #223 for detailed statement.

The present incident, if it were an isolated one, would be suggestive of a fireball, but, in view of significant differences and the general pattern of other related incidents, that explanation is improbable.

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Incident #225 -- near Vaughn, New Mexico -- latter part of 1947
3 or 4 November 1948
23 November 1948

It is difficult to ascertain whether the objects described in this incident belong to the general group of "New Mexico green flashes," or not. The description here is sufficiently different from the majority to indicate that they do not: the characteristic green color is not mentioned.

It is improbable, however, that the three separate sightings, all occurring at approximately 2200 hours and in the same locality, can be explained as astronomical phenomena. Furthermore, the stated altitude and distance are entirely out of keeping; this fact might be discounted as an illusion, common in the observation of fireballs, if the instance were isolated. The weight of the evidence, however, inclines to the conclusion that the objects were man-made devices and part of some scientific experiments, so common in that section of the country.

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Incident #223 -- Sandia Base, New Mexico -- 8 December 1948

See report on incident #223 for detailed statement.

Again, it is more probable that the object seen is related to the "New Mexico green flashes" than that it was a fireball.

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Incident #227 -- near Bernal, New Mexico -- 12 December 1948

There is nothing that the present investigator can add to the detailed analysis given by the observer of this incident, Dr. Lincoln LaPaz.

See report on incident #223 for discussion.

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Incident #228, 228a

No information (other than the names of observers) concerning this incident has been received by the present investigator.

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Incident #229 -- South Bay, Florida -- 13 December 1948
229a -- Riviera Beach, Florida -- 14 December 1948

There seem to be two separate occurrences reported in this incident, and the information given for each is entirely insufficient for adequate analysis.

In #229, the location of the object in the sky is not given, nor is the hour of observation. The moon and Jupiter were visible in the early evening, the moon quite high, and Jupiter setting in the west. One might hazard a guess that Jupiter seen through a variable mist or high, thin cloud coverage appeared to blaze up and die out. The larger planets often become momentarily spectacular when they are very near the horizon and the weather conditions are right.

#229a occurred at dusk, with the observers looking out over the ocean. The nearly-full moon was fairly high in the southeastern sky at that time; there might possibly be some connection between it and the object observed, if weather conditions were unusual.

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Incident #230 -- near North Powder, Oregon -- 4 August 1948

If it were not for the intense green color of this object, it would answer the description of a fireball. In view, however, of many similar occurrences in the New Mexico area, this interpretation is open to question. It should be noted that this incident occurred very much farther north than did the majority of the "green flashes," but that the observer was facing south. Nevertheless, considering the geographical difference, and the difference in season and in time of night of the observation, this object could very well have been a fireball. Insufficient evidence is offered to decide whether it belongs among the New Mexico objects or among the fireballs.

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Incident #231 -- Abilene, Texas -- 1 January 1948

This incident has no astronomical explanation.

The fan-shaped glow that extended momentarily from the horizon to the zenith suggests a man-made disturbance -- electrical or explosive. The green color is the only characteristic that might connect this incident with the "New Mexico green flashes"; the rest of the description does not.

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Incident #232 -- Demarest, New Jersey -- 16 November 1948

The information available concerning this incident is entirely insufficient to serve as a basis for analysis.

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Incident #233 -- near Jackson, Mississippi -- 1 January 1949

There is nothing in this incident that can be said to have an astronomical origin.

The object sighted is described as resembling a tow target, but with no towing plane seen. No one else reported seeing the object after this one sighting by several persons.

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Incident #234 -- Oak Ridge, Tennessee -- July 1947

Inasmuch as independent analysis has determined the object on the photographs to be a flaw, there is no need for further investigation. Object was never seen visually.

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Incident #235. -- Indiana County, Pennsylvania -- probably early December 1948

There appears to be no astronomical explanation for this incident.

The object seen was most likely a balloon.

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Incident #236 -- near Hickam Field, Hawaii -- 4 January 1949

There is clearly no astronomical explanation for this incident.

The account given seems trustworthy, even though only one person saw the circular disc. This report differs from many others in that the description of maneuvers executed by the object is definite, rather than hazy.

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Incident #237 -- Bourbon County, Kentucky -- 16 January 1949

There is some confusion as to whether the object or the smoke trail reported in this incident was visible for fifteen minutes. If the object itself was, it could not have been a meteor, but the gist of the report seems to indicate that only the trail was visible for any length of time. In that case, it could have been either the trail from a meteor or the vapor trail from an aircraft: the description is not sufficient to distinguish the two. Other observers (not those reporting the incident) indicated that the object was a high flying plane with a vapor trail, but this does not necessarily exclude the meteoric hypothesis, because of the general unfamiliarity of the public with such phenomena.

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Incident #239 — Phoenix, Arizona -- 24 October 1948

This incident as described is not amenable to any astronomical explanation. The object took 75 minutes to cross the sky.

The witness apparently is not a very critical observer (e.g., there could be no possible physical connection between the object's brightness and its apparent distance from a star).

The object could have been a lighted balloon; speed and maneuvers check.

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Incident #240 -- near Hood River, Oregon -- 11 December 1948

The gist of this incident is that a flash of light was seen and a continuing sound of explosion heard at about 7:30 on a rainy evening. Clearly this description could apply to any large explosion, such as that of an ammunition dump or factory; however, it is true that when a bolide explodes a blinding flash of light is seen, and thundrous sounds are sometimes heard for many seconds. Since the sky was overcast at the time of this incident, and a light rain was falling, the earlier part of the trail of the fireball (if that is what it was) was, of course, not visible; only the flash from the final explosion, which would have appeared essentially stationary, was seen.

In the absence of positive evidence of any other type of explosion occurring in that vicinity at the time, it is the opinion of this investigator that a bolide explosion was observed.

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Incident #241, a, b -- Los Alamos, New Mexico -- 20 December 1948

Dr. LaPaz, who has interviewed the various observers of this incident, has stated that the object seen was not a falling meteorite. He had access to more detailed information than is contained in the typed reports offered here, and he is an expert in these matters.

It should be noted, however, that the reports available to this investigator show many contradictions concerning the color and trajectory of the object: One observer gives the angle of fall as 45°; another states that the trajectory was horizontal. Most observers indicate a bluish-white light; only one mentions the color green, which is so predominant in the New Mexico "green flashes."

It is not at all certain that the object observed here belongs to the "green flash" family of incidents.

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Incident #242 -- Los Alamos, New Mexico -- 6 January 1949

The information offered concerning this incident is meager, and there was only one observer. According to the description, a brilliant green incandescent light was seen low on the horizon for about two seconds; speed was "high" but slower than that of a meteor. In view of this scanty evidence, no definite conclusion can be drawn.

If it were not for the fact that the incident appears to belong in the family of New Mexico "green flashes," the object could be considered to have been a slow meteor, even though the time of night of the sighting does not favor that hypothesis. It is much more probable, however, that this incident falls into the pattern of those dealt with in detail in the report on incident #223. See that report for further discussion.

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Incident #243 -- Los Alamos, New Mexico -- 28 December 1948

The object described here seems to belong to the mysterious family of "New Mexico green flashes." See report on incident #223 for detailed discussion.

It can be said, however, that, if this is regarded as an isolated incident, the description is not very different from that of a fireball. It is the occurrence of these incidents in a seemingly definite pattern that argues very strongly against the meteoric hypothesis.

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Incident #244 -- Kirkland Field, Albuquerque, New Mexico -- 12 November 1948

The evidence given concerning this incident does not hang together physically: If the object was a bright white light, diamond-shaped and two feet long, and only a third of a mile away, then it seems incredible that it should have been observed over only a 500' trajectory. And a bright light, that close, in a populated spot, surely would have attracted the attention of more than one person.

The whole report suggests a physiological optical illusion rather than a real object in the sky. The evidence is incomplete: time in sight is not stated, nor is the elevation or bearing of the object even implied. The manner of disappearance is not told: did the light simply go out abruptly, or did it fade out gradually, or what?

There is a remote possibility that the observer saw a daylight meteor over a very short part of its trajectory, but if this had been the case, there should have been some sort of a trail.

The method of reporting and interrogation in this incident is very poor. It would seem that if the observer was aware enough to note a length of 2' and a trajectory of 500', he would also have known the bearing and elevation of the object and its manner of disappearance.

The whole incident lacks a sense of physical reality.

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The preceding pages complete the analyses required to fulfill the terms of Contract No. W33-038-1118 (Ohio State University Research Foundation Project No. 364)

Note: In submitting this report it is understood that all provisions of the contract between The Foundation and the Cooperator and pertaining to publicity of subject matter will be rigidly observed.

Investigator J. Allen Hynek Date May 1, 1949

Laboratory Supervisor George W. Harding Date May 1-1949

For the Ohio State University Research Foundation

Executive Director James L. Owens Date 5/9/49
W.X.H.

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APPENDIX C-1

Headquarters Air Weather Service

Analysis of Incidents Nos. 1-172

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By VH NARA Date 2/14/98
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B/Ltr from AMC
dtd 5 Jan 1949
Subj: Project
"SIGN"

AWS DSS 1st Ind 24 Jan 1949

HEADQUARTERS, AIR WEATHER SERVICE Andrews Air Force Base, Washington 25, D. C.

TO: Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio
ATTN: MCIAXO

Investigations by this headquarters reveal that a synoptic weather balloon could have been at the location where sightings were reported in the following incidents. In compiling this list consideration was given to the wind direction and speed at the surface and aloft at the scheduled time of balloon release, and the location of the nearest weather station making balloon observations.

2	52	91	126
3	72	93	148
4	73	94	155
25	78	105	166
28	81	113	169
36	87	115	172

FOR THE CHIEF AIR WEATHER SERVICE

/s/ W. A. West
W. A. WEST
Lt. Col., USAF
Adjutant General

2 Incls:
n/c

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HEADQUARTERS
AIR MATERIEL COMMAND
Wright-Patterson Air Force Base
Dayton, Ohio

MCIAXO-3/HWS/rm
Jan 5 1949

MCIAXO

SUBJECT: Project "SIGN"

TO: Chief, Air Weather Service,
Andrews Air Force Base,
Washington 25, D. C.
ATTN: DSS

1. Project "SIGN" is responsible for the collection, investigation and interpretation of data relative to sighting of unidentified flying objects. Attached Incident Summaries 1 thru 172 from the files of Project "SIGN" are forwarded for study and recommendations as to which of the incidents may be eliminated as balloons released on routine synoptic ascents by the Air Weather Service, the Navy Aerological Service or the United States Weather Bureau. The summaries attached may be retained in your headquarters for working and reference purposes.

2. The Air Weather Service is the only agency of its type that has been asked to assist in the accomplishment of Project "SIGN" except that the United States Weather Bureau has provided information on ball lightning. Research projects in which balloons are used and which are conducted or sponsored by the Army, Navy or United States Air Force are checked by the Intelligence Department of this Command. These checks areusually made direct from the Project "SIGN" Office, MCIAXO-3. These checks are distinct from the check of synoptic balloon flights made by weather service stations of the Air Force, the Navy and the Department of Commerce. (U. S. Weather Bureau) requested of Air Weather Service.

3. It is the opinion of this office that the below listed incidents are those having the greatest possibility of being balloons. This list does not eliminate the possibility that many of the remaining incidents are balloons.

2	24	50	91	113	155
3	25	52	92	115	156
4	28	72	96	126	157
11	30	73	104	141	159
14	31	81	105	148	163
16	32	87	107,8,9	151	167
22	33	89	112(See122)	154	169
23	48				

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Hq AMC, Chief, Air Weather Service, Washington 25, D. C.
Subj: Project "SIGN"

4. The form used in interrogating witnesses to sightings is inclosed as a matter of interest. Comment as to possible improvement of the "Essential Elements of Information" in regard to routine synoptic balloon flights is invited.

5. It is requested that correspondence be forwarded to the Commanding General, Headquarters, Air Materiel Command, attention MCIAXO-3.

FOR THE COMMANDING GENERAL:

/s/ W. R. Clingerman, Col, USAF
for H. L. McCOY
Colonel, USAF
Chief, Intelligence Dept

2 Incls:
Summaries 1-172 incl
"EEI"

Copies furnished:

AFOIR, Hq. USAF
Capt Trakowski, Geophysics Lab
Major Kodis, MCREEP
Colonel Neal, MCLAWS

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APPENDIX C-2

Headquarters Air Weather Service

Analysis of Incidents Nos. 172-233

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Incident #200, a, b, c -- Crescent City, California -- 17 October 1948

This incident has no astronomical explanation.

Although the four observers had no technical training, their reports are remarkably consistent. The object was in sight several minutes, too long to be a meteor; it made a banking turn of 45° and appeared to reflect sunlight very strongly. The speed was great but not excessive.

The object seen could have been an advertising blimp, a balloon, or an aircraft. The banking turn appears to rule out the balloon, unless this was a subjective impression caused by the turning of the balloon in the wind.

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Incident #201, a, b -- Army Air Base, Azores -- 31 October 1948

There appears to be no astronomical explanation for this incident.

The observers agree in the general description, but not in the speed of the object; speeds are given from 30 to 800 MPH.

The most likely explanation on the basis of the meager information offered is that the object was a balloon carrying a swinging light.

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Incident #202 -- Newark AF Base, New Jersey -- 8 November 1948

. In everything but the luminosity, the object reported here answers to the description of a slow-moving fireball. Since it was in sight "one second or less," the first quarter moon and, presumably, the lights of the city and the airport, providing background and foreground illumination, may have tended to diminish the brilliance of the object. The time of day was most propitious for a slow-moving meteor. Unless a more likely explanation is forthcoming, this incident can be tentatively ascribed to the flight of a fireball.

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Incident #203 -- Alberta Province, Canada -- 17 November 1948

The object reported in this incident was certainly a fireball. The description fits very closely.

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Incident #204 -- Panama -- 8 November 1948

It seems entirely probable that the object sighted in this incident was the comet 1948L, which had been discovered two days earlier in Australia. The comet was suitably placed for observation near the equator and in the southern hemisphere. The time of observation also checks closely with the time of visibility. There is no single statement in the limited report that contradicts the comet hypothesis. If the observer had given the actual bearings of the object, these would have clinched the matter.

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Incident #205 -- Carthage, Missouri -- 31 October (?) 1948

The vague nature of the information reported in this incident and the inferred unreliability of the observer makes it difficult to take the incident seriously, especially since the observer has obviously jumped to conclusions on the basis of insufficient evidence.

However, if credence is given to the observations, either they must be placed with the group of "aluminum-colored objects," or, if liberal allowance is made for subjective impressions, one could stretch a point to say that a slow-moving fireball was seen. This hypothesis is far fetched, but the speed of the object and the time of day favor it. The fact that the observer stated that the object was aluminum colored actually means little, since he immediately identified it as a flying saucer, which he knew from newspaper reports to be such a color.

It is very difficult to deal with reports of untrained and unreliable observers, because they invariably see in an incident what they wish to be there.

From a purely physical basis, this investigator would prefer the meteoric hypothesis, even though the evidence is entirely insufficient to establish it.

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Incident #206 -- Clark AF Base, Philippine Islands -- 12 November 1948

Two things enter heavily into any possible interpretation of this incident: the reported maneuverability of the object, and the character evaluation of the witness.

If the facts are as stated, then there is no astronomical explanation for the object observed. A few points favor its having been a daylight meteor: the snow-white color, speed faster than that of a jet plane, roaring noise, similarity to "sky writing," and the time of day of the observation. The tactics, however, if really performed, oppose it strenuously.

The question is, did this object actually maneuver in and out of a cloud bank -- i.e., did it make turns of 180° or more? It is possible that such impressions were merely illusions. The witness saw the object intermittently through clouds. It is not clear whether he ever saw it against a cloud background or only in the sky background between clouds, a fact which is highly important. If he saw it only in breaks between clouds, this fact, coupled with its great speed, makes it clear that only momentary impressions could be obtained. Such observations, by an untrained observer, may bring forth a description that is extremely unlike the facts.

The impression of a fuselage with windows could even more easily have been a figment of the imagination.

Unless more specific information concerning this incident becomes available, the present investigator cannot say whether an astronomical explanation is possible, or not.

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Incident #207, a, b, c -- Andrews AF Base, Camp Springs, Maryland---
18 November 1948

There is no astronomical explanation for the object observed in this incident.

The similarity of the incident to #172 is striking, and it suggests a common origin for the objects. The two incidents were separated by a month and a half and by half a continent. The hours of observation were about the same. It may be significant that ground observers in each incident did not report the evasive tactics described by air observers, and it is tempting to hazard the guess that such tactics were largely the result of relative motion. It should be investigated whether a lighted balloon caught in the prop wash could give the appearance of a rapidly-maneuvering aircraft. In fact, this investigator believes that it would be an interesting experiment to have a typical lighted balloon engaged by aircraft at night, with a competent observer along to record apparent relative tactics of the balloon.

(It is not clear whether the two observers in this incident who reported evasive tactics were in the same plane, or not, but it is presumed that they were.)

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Incident #208 -- Clark AF Base, Philippine Islands -- 17 November 1948

The limited information in the description of this incident can be explained as referring to the trail and explosion smoke left by a fireball. The white exhaust trail extending some one to ten miles, the "flak-like" terminal burst, the estimated altitude, and the color and time in sight all concur in ascribing this sighting to a fireball. The time of day of the observation is also in agreement.

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Incident #209 -- South Korea -- 4 November 1948

There is no astronomical explanation for this incident.

The object has been independently identified as a Soviet aircraft.

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Incident #210 — Boston, Massachusetts -- 10 November 1948

There is no astronomical explanation for this incident. The objects seen were apparently conventional aircraft. It is rather surprising that, in the dim light, the observer could identify them as single-engine planes, and yet could hear no sound from them.

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Incident #211 -- Bellefontaine, Ohio -- 4 December 1948

There is no astronomical explanation for this incident, in view of identification of recovered materials as man-made. Apparently there has been independent identification of the object as a pistol flare fired from the ground.

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Incident #212 -- Dayton, Ohio -- 3 December 1948

Little can be determined from the scanty evidence concerning this incident. Two half-second pulses of light are apparently all that was seen. It is unlikely that any astronomical origin can be found for the object or objects observed, and certainly on the basis of so little information not even a guess can be hazarded.

See report on incident #213, which apparently refers to the same phenomenon.

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Incident #213 -- Dayton, Ohio -- 3 December 1948

This incident may represent the same phenomenon indicated in #212. The description here is more detailed.

The object could not have been a meteor, since observers state that it was in view several minutes and that it was rapidly ascending, and disappeared overhead.

The moon was at crescent phase, and this investigator has often seen it at this phase appearing through small breaks in overcast, at which time it gave the appearance of a bright light flashing on and off. At the time of this incident, however, the moon was in the southwest, whereas the observers state that their object was in the northwest. The altitude given does agree approximately with that of the moon.

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Incident #214 -- West Rindge, New Hampshire -- 7 July 1948

Inasmuch as the metallic particles concerned in this incident have been independently identified at MIT as parts of a cast-iron cylinder, an astronomical explanation of the incident is precluded. However, as a matter of general interest, it should be noted that iron meteorites could have produced the same effect. It is assumed, of course, that the MIT examination excluded the possibility of these particular particles being meteoritic.

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Incident #215 -- Fairfield Suisun AFB, California -- 3 December 1948

If the observations were exactly as stated by witnesses, this "ball of light" could not have been a fireball. However, astronomers receive such outlandish reports about fireballs that they are prepared for almost any kind of a story.

Even trained observers are sometimes greatly fooled by the illusion of closeness; cases are on record of fireballs which were reported to have fallen in adjacent fields, but actually came to earth some 200 miles away.

A fireball would not come into view at 1000' and rise to 20,000'. If this observation is correct, an astronomical interpretation for the incident can be ruled out. Under unusual conditions a fireball might, however, appear to rise somewhat, as a result of perspective as it slants into the earth's atmosphere.

Absence of trail and sound definitely does not favor the meteoric hypothesis, but, as in many other cases, does not rule it out with finality.

It does not seem likely that any known meteorological or auroral phenomenon would have been as bright as this object was reported to be.

In the almost hopeless absence of any other natural explanation, one must consider the possibility of the object's having been a meteor, even though the description does not fit very well.

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Incident #216 -- Chanute AF Base, Illinois -- 8 December 1948

A fairly bright, slow-moving bolide offers a good explanation for the object reported in this incident. The apparent rise can be explained as an effect of perspective. There is nothing in the description given that is contradictory to the bolide hypothesis.

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Incident #217 -- near Pittsburgh, Pennsylvania -- 9 December 1948

There is no astronomical explanation for this incident. The object seen could easily have been a balloon, for apparent speed could have been a result of the observers' own motion. Even if an object were standing still, observers in an airplane would not see it for much longer than the time reported here (7 minutes).

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Incident #218 -- near Martinsburg, West Virginia -- 11 December 1948

As described, the object seen in this incident could have been a parachute flare. Under circumstances of a head-on approach, a meteor can appear stationary; however, the time in sight (one minute), if accurate, argues against the object's being a meteor. Therefore, while it is possible that the incident has an astronomical explanation, it is more probable that a flare was being observed.

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Incident #219 -- Newburgh, New York -- 29 November 1948

The object reported in this incident is clearly a slow-moving fireball. Time of day, length of time in sight, and all other data check with the bolide hypothesis.

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APPENDIX D

Dr. G. E. Valley

Some Considerations Affecting the Interpretation of Reports of Unidentified Flying Objects

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By VH NARA Date 2/14/98
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SOME CONSIDERATIONS AFFECTING THE INTERPRETATION OF REPORTS OF UNIDENTIFIED FLYING OBJECTS.

By
G. E. Valley, Member Scientific Advisory Board,
Office of the Chief of Staff, United States Air Force.

The writer has studied summary abstracts and comments pertaining to unidentified flying objects, which were forwarded by Air Force Intelligence. These remarks are divided into three main parts: The first part is a short summary of the reports; the second part consists of a general survey of various possibilities of accounting for the reports; the third part contains certain recommendations for future action.

PART 1 SHORT SUMMARY OF OBSERVATIONS.

The reports can be grouped as follows:

Group 1. The most numerous reports indicate the daytime observation of metallic disk-like objects, roughly in diameter ten times their thickness. There is some suggestion that the cross section is assymetrical and rather like a turtle shell. Reports agree that these objects are capable of high acceleration and velocity; they often are sighted in groups, sometimes in formation. Sometimes they flutter.

Group 2. The second group consists of reports of lights observed at night. These are also capable of high speed and acceleration. They are less commonly seen in groups. They usually appear to be sharply defined luminous objects.

Group 3. The third group consists of reports of various kinds of rockets, in general appearing somewhat like V-2 rockets.

Group 4. The fourth group contains reports of various devices which, in the writer's opinion, are sounding balloons of unusual shape such as are made by the General Mills Company to Navy Contract.

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Group 5. The fifth group includes reports of objects in which little credence can be placed.

General Remarks.

In general it is noted that few if any reports indicate that the observed objects make any noise or radio interference. Nor are there many indications of any material affects or physical damage attributable to the observed objects.

SUMMARY, PART 1.

This report will consider mainly the reports of Groups 1 and 2.

PART 2. ON POSSIBLE EXPLANATIONS OF THE REPORTS.

Section A. What can be deduced concerning the nature of an unknown aerial object from a single sighting.

Here there are two problems: first, how much can be deduced concerning the nature of the objects from geometrical calculations alone; second, how much more can be deduced if, in addition, it is assumed that the objects obey the laws of nature as we know them.

Concerning the first problem it can be stated that only ratios of lengths, and rates of change of such ratios can be accurately determined. Thus the range and size of such objects cannot be determined; and it is noticeable that reports of size of the observed objects are widely at variance. However, angles, such as the angle subtended by the object, can be observed. Likewise there is fair agreement among several observers that the diameter of the objects of Group 1 is about ten times their thickness. Although velocity cannot be determined, angular velocity can be, and in particular the flutter frequency could, in principle, be determined.

All that can be concluded about the range and size of the objects, from geometrical considerations alone, is: 1) from the fact that estimated

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sizes vary so widely, the objects were actually either of different sizes, or more likely, that they were far enough from the observers so that binocular vision produced no stereoscopic effect; this only means that they were farther off than about thirty feet; 2) since objects were seen to disappear behind trees, buildings, clouds etc, they are large enough to be visible at the ranges of those recognizable objects.

Now it is obviously of prime importance to estimate the size and mass of the observed objects. This may be possible to some extent if it is permissable to assume that they obey the laws of physics. Since the objects have not been observed to produce any physical effects, other than the one case in which a cloud was evaporated along the trajectory, it is not certain that the laws of mechanics, for instance, would be sufficient.

But suppose that mechanical laws alone are sufficient. Then the following example is sufficient proof that at least a length could, in principle, be determined: suppose a simple pendulum were observed suspended in the sky; then after observing its frequency of oscillation, we could deduce from the laws of mechanics its precise length.

This suggests that something could be deduced from the observed fluttering motion of some of the objects of Group 1. Assume that we know the angular frequency and angular amplitude of this fluttering motion (they can be measured in principle from a motion picture). Then for purposes of calculation assume the object to be thirty feet in diameter, to be as rigid as a normal aircraft wing of 30 foot span, to be constructed of material of the optimum weight-strength ratio and to be a structure of most efficient design. It is now possible to calculate how heavy the object must be merely to remain rigid under the observed angular motion. Let the caluclation be made for a plurality of assumed sizes 1, 2, 4, 8, 16, 32, 64 ----- up to say

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200 feet, and let calculated mass be plotted versus assumed size. The non-linear character of the curve should indicate an approximate upper limit to the size of the object.

If in addition, it is assumed that the flutter is due to aerodynamic forces, it is possible that more precise information could be obtained.

The required angular data can probably be extracted from witnesses most reliably by the use of a demonstration model which can be made to oscillate or flutter in a known way.

SUMMARY, PART 2, SECTION A.

Geometrical calculations alone cannot yield the size of objects observed from a single station; such observation, together with the assumption that the objects are essentially aircraft, can be used to set reasonable limits of size.

PART II, SECTION B. THE POSSIBILITY OF SUPPORTING AND PROPELLING A SOLID OBJECT BY UNUSUAL MEANS.

Since some observers have obviously colored their reports with talk of rays, jets, beams, space-ships, and the like, it is well to examine what possibilities exist along these lines. This is also important in view of the conclusions of Part II, Section A. of this report.

METHOD I. Propulsion and support by means of "rays" or "beams".

By "rays" or "beams" are meant either purely electromagnetic radiation or else radiation which is largely corpuscular like cathode-rays or cosmic-rays or cyclotron-beams.

Now it is obvious that any device propelled or supported by such means is fundamentally a reaction device. It is fundamental in the theory of such devices that a given amount of energy is most efficiently spent if the momentum thrown back or down is large. This means that a large mass should

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be given a small acceleration - a theorem well understood by helicopter designers.

The beams or rays mentioned do the contrary - a small mass is given a very high velocity - consequently enormous powers - greater than the total world's power capacity - would be needed to support even the smallest object by such means.

METHOD II. Direct use of Earth's Magnetic Field.

One observer (incident 68) noticed a violent motion of a hand-held compass. If we assume from this that the objects produced a magnetic field, comparable with the Earth's field, namely 0.1 gauss, and that the observer found that the object subtended an angle θ at his position, then the ampereturns of the required electromagnet is given by

$ni = \frac{30\ R}{\theta 2}$ where R is the range of the object.

For instance, if R is one kilometer and the object is ~10 meters in diameter, then ni = 1 billion ampere-turns.

Now if the object were actually only 10 meters away and were correspondingly smaller, namely 10 cm in diameter, it would still require 10 million ampere-turns.

These figures are a little in excess of what can be conveniently done on the ground. They make it seem unlikely that the effect was actually observed.

Now the Earth's magnetic field would react on such a magnet to produce not only a torque but also a force. This force depends not directly on the Earth's field intensity but on its irregularity or gradient. This force is obviously minute since the change in field over a distance of 10 meters (assumed diameter of the object) is scarcely measurable - moreover the gradient is not predictable but changes due to local ore deposits.

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Thus even if the effect were large enough to use it would still be unreliable and unpredictable.

METHOD III. Support of an Electrically Charged Object by Causing It to Move Transverse to the Earth's Magnetic Field.

A positively charged body moving from West to East, or a negatively charged body moving from East to West will experience an upward force due to the Earth's magnetic field.

A sphere 10 meters diameter moving at a speed of one kilometer/second would experience an upward force of one pound at the equator if charged to a potential of 5×10^{12} volts. This is obviously ridiculous.

SECTION D. THE ANTI GRAVITY SHIELD.

It has been proposed, by various writers, perhaps first by H. G. Wells, that it might be possible to construct a means of shielding a massive body from the influence of gravity. Such an object would then float. Recently there appeared in the press a notice that a prominent economist has offered to support research on such an enterprise.

Obviously, conservation of energy demands that considerable energy be given the supported object in order to place it on the shield. However this amount of energy is in no way prohibitive, and furthermore it can be gotten back when the object lands.

Aside from the fact that we have no suggestions as to how such a device is to be made, the various theories of general relativity all agree in assuming that gravitational force and force due to acceleration are indistinguishable, and from this assumption the theories predict certain effects which are in fact observed. The assumption therefore is probably correct, and a corollary of it is essentially that only by means of an acceleration can gravity be counteracted. This we can successfully do

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for instance by making an artificial satelite - but this presumably is not what has been observed.

SUMMARY, PART II, SECTION B.

Several unorthodox means of supporting or propelling a solid object have been considered - all are impracticable. This finding lends credence to the tentative proposed assumption of Part II, that the objects are supported and propelled by some normal means, or else that they are not solids. No discussion of the type of Part II, Section B can, in principle, of course, be complete.

PART II, SECTION C. POSSIBLE CAUSES FOR THE REPORTS.

CLASSIFICATION I. NATURAL TERRESTRIAL PHENOMENA.

1) The observations may be due to some effect such as ball lightning. The writer has no suggestions on this essentially meteorological subject.

2) The objects may be some kind of animal.

Even in the celebrated case of incident 172 where, the light was chased by a P51 for half an hour and which was reported by the pilot to be intelligently directed, we can make this remark. For consider that an intelligence capable of making so remarkable device would not be likely to play around in so idle a manner as described by the pilot.

In this connection it would be well to examine if some of the lights observed at night were not fire-flies.

3) The observed objects may be hallucinatory or psychological in origin.

It is of prime importance to study this possibility because we can learn from it something of the character of the population: its response under attack; and also something about the reliability of visual observation.

One would like to assume that the positions held by many of the re-

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ported observers guarantee their observations. Unfortunately there were many reports of curious phenomena by pilots during the war - the incident of the fire-ball fighters comes to mind. Further, mariners have been reporting sea-serpents for hundreds of years yet no one has yet produced a photograph.

It would be interesting to tabulate the responses to see how reliable were the reports on the Japanese balloons during the war. There we had a phenomenon proven to be real.

It is interesting that the reports swiftly reach a maximum frequency during the end of June 1947 and then slowly tapor off. We can assume that this is actually an indication of how many objects were actually about, or, quite differently, we can take this frequency curve as indicating something about mass psychology.

This point can be tested. Suppose the population is momentarily excited; how does the frequency of reports vary with time? A study of crank letters received after the recent publicity given to the satelite program should give the required frequency distribution.

It is probably necessary but certainly not sufficient that the unidentified object curve and the crank-letter curve should be similar in order for the flying disks to be classed as hallucinations.

A large scale experiment was made at the time of Orson Welles's "Martian" broadcast. Some records of this must persist in newspaper files.

CLASSIFICATION II. MAN-MADE TERRESTRIAL PHENOMENA.

1) The objects may be Russian aircraft. If this were so, then the considerations of Sections A and B indicate that we would have plenty to worry about. It is the author's opinion that only an accidental discovery

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of a degree of novelty never before achieved could suffice to explain such devices. It is doubtful whether a potential enemy would arouse our curiosity in so idle a fashion.

CLASSIFICATION III. EXTRA TERRESTRIAL OBJECTS.

1) Meteors: It is noteworthy that the British physicist Lovell writing in "Physics Today" mentions the radar discovery of a new daytime meteorite stream which reached its maximum during June 1947. The reported objects lose little of their interest however if they are of meteoritic origin.

2) Animals. Although the objects as described act more like animals than anything else, there are few reliable reports on extra-terrestrial animals.

3) Space Ships. The following considerations pertain:

a) If there is an extra terrestrial civilization which can make such objects as are reported then it is most probable that its development is far in advance of ours. This argument can be supported on probability arguments alone without recourse to astronomical hypotheses.

b) Such a civilization might observe that on Earth we now have atomic bombs and are fast developing rockets. In view of the past history of mankind they should be alarmed. We should therefore expect at this time above all to behold such visitations.

Since the acts of mankind most easily observed from a distance are A-bomb explosions we should expect some relation to obtain between the time of A-bomb explosions, the time at which the space ships are seen, and the time required for such ships to arrive from and return to home-base.

PART III. RECOMMENDATIONS.

1) The file should be continued.

2) A meteorologist should compute the approximate energy required to

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evaporate as much cloud as shown in the incident 26 photographs. Together with an aerodynamicist he should examine whether a meteorite of unusual shape could move as observed.

3) The calculations suggested in Part II, Section A, should be estimated by an aerodynamicist with such changes as his more detailed knowledge may suggest.

4) The mass-psychology studies outlined in Part II, Section C, Classification I 3 should be carried out by a competent staff of statisticians and mass-psychologists.

5) Interviewing agents should carry objects or moving pictures for comparison with reporter's memories. These devices should be properly designed by a psychologist experienced in problems pertaining to aircraft and design of aircraft control equipment so that he shall have some grasp of what it is that is to be found out. If the Air Force has reason to be seriously interested in these reports it should take immediate steps to interrogate the reporters more precisely.

6) A person skilled in the optics of the eye and of the atmosphere should investigate the particular point that several reports agree in describing the objects as being about ten times as wide as they are thick; the point being to see if there is a plurality of actual shapes which appear so under conditions approaching limiting resolution or detectable contrast.

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APPENDIX E-1

Rand Corporation

Letter, dated 29 March 1947

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By VH NARA Date 2/14/98
REPRODUCED AT THE NATIONAL ARCHIVES

The RAND Corporation

1500 Fourth St - Santa Monica - California

29 March 1949 L-2563

Lieutenant Colonel A. J. Hemstreet
Technical Intelligence Division
Air Material Command
Wright-Patterson Field
Dayton, Ohio

Dear Colonel Hemstreet;

In reply to your inquiry of March 24th, we had not planned to issue a formal report on Project Grudge until or unless our study leads to some unusual or unexpected finding which would throw new light on Grudge.

We are now working through the data in search of significant consistencies or other indirect bits of evidence. It is expected that we shall have explored all our various avenues of attack in about two months. To date we have found nothing which would seriously controvert simple rational explanations of the various phenomena in terms of balloons, conventional aircraft, planets, meteors, bits of paper, optical illusions, practical jokers, psychopathological reporters, and the like.

We should like to take this opportunity to raise a few questions: (1) The file on incident 50 contains a photograph which apparently belongs with incident 40. Is this surmise correct? (2) The file on incident 162 was omitted from the data. Why? (3) We have heard from a reliable source of an incident in which fishermen observed flying objects which dropped hot material which they collected and subsequently gave to official investigators. The investigators' plane crashed but there was a survivor. We do not seem to have a file on this incident - certainly not a complete file. May we have one?

Sincerely yours,

/s/ A. M. Mood
A. M. Mood

AMM:rb

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APPENDIX E-2

Rand Corporation (J. E. Lipp)

Space Ship Considerations

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By VH NARA Date 2/14/98
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13 December 1948 AI-1009

Brigadier General Putt
United States Air Force
Director of Research and Development
Office, Deputy Chief of Staff, Materiel
Washington 25, D. C.

Dear General Putt:

Please refer to your letter of 18 November 1948 relative to the "flying object" problem and to Mr. Collbohm's reply dated 24 November 1948. In paragraph (b) of the reply, Mr. Collbohm promised (among other things) to send a discussion of the "special design and performance characteristics that are believed to distinguish space ships."

This present letter gives, in very general terms, a description of the likelihood of a visit from other worlds as an engineering problem and some points regarding the use of space vehicles as compared with descriptions of the flying objects. Mr. Collbohm will deliver copies to Colonel McCoy at Wright-Patterson Air Base during the RAND briefing there within the next few days.

A good beginning is to discuss some possible places of origin of visiting space ships. Astronomers are largely in agreement that only one member of the Solar system (besides Earth) can support higher forms of life. It is the planet Mars. Even Mars appears quite desolate and inhospitable so that a race would be more occupied with survival than we are on Earth. Reference 1 gives adequate descriptions of conditions on the various planets and satellites. A quotation from Ref. 1 (p. 229) can well be included here.

> "Whether intelligent beings exist to appreciate these splendors of the Martian landscape is pure speculation. If we have correctly reconstructed the history of Mars, there is little reason to believe that the life processes may not have followed a course similar to terrestrial evolution. With this assumption, three general possibilities emerge. Intelligent beings may have protected themselves against the excessively slow loss of atmosphere, oxygen and water, by constructing homes and cities* with the physical conditions scientifically con-

*"Not too large or they might be visible. Perhaps underground, where the atmospheric pressure would be greater and where the temperature extremes would be reduced."

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trolled. As a second possibility, evolution may have developed a being who can withstand the rigors of the Martian climate. Or the race may have perished.

"These possibilities have been sufficiently expanded in the pseudo-scientific literature to make further amplification superfluous. However, there may exist some interesting restrictions to the anatomy and physiology of a Martian. Rarity of the atmosphere, for example, may require a completely altered respiratory system for warm-blooded creatures. If the atmospheric pressure is much below the vapor pressure of water at the body temperature of the individual, the process of breathing with our type of lungs becomes impossible. On Mars the critical pressure for a body temperature of 98.6°F. occurs when a column of the atmosphere contains one sixth the mass of a similar column on the Earth. For a body temperature of 77°F. the critical mass ratio is reduced to about one twelfth, and at 60°F. to about one twenty-fourth. These critical values are of the same order as the values estimated for the Martian atmosphere. Accordingly the anatomy and physiology of a Martian may be radically different from ours - but this is all conjecture.

"We do not know the origin of life, even on the Earth. We are unable to observe any signs of intelligent life on Mars. The reader may form his own opinion. If he believes that the life force is universal and that intelligent beings may have once developed on Mars, he has only to imagine that they persisted for countless generations in a rare atmosphere which is nearly devoid of oxygen and water, and on a planet where the nights are much colder than our arctic winters. The existence of intelligent life on Mars is not impossible but it is completely unproven."

It is not too unreasonable to go a step further and consider Venus as a possible home for intelligent life. The atmosphere, to be sure, apparently consists mostly of carbon dioxide with deep clouds of formaldehyde droplets, and there seems to be little or no water. Yet living organisms might develop in chemical environments that are strange to us: the vegetable kingdom, for example, operates on a fundamentally different energy cycle from Man. Bodies might be constructed and operated with different chemicals and other physical principles than any of the creatures we know. One thing is evident: fishes, insects, and mammals all manufacture within their own bodies complex chemical compounds that do not exist as minerals. To this extent, life is self-sufficient and might well adapt itself to any environment within certain limits of temperature (and size of creature).

Venus has two handicaps relative to Mars. Her mass, and gravity, are nearly as large as for the Earth (Mars is smaller) and her

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cloudy atmosphere would discourage astronomy, hence space travel. The remaining Solar planets are such poor prospects that they can be ignored.

In the next few paragraphs, we shall speak of Mars. It should be understood that most of the remarks apply equally well to Venus.

Various people have suggested that an advanced race may have been visiting Earth from Mars or Venus at intervals from decades to eons. Reports of objects in the sky seem to have been handed down through the generations. If this were true, a race of such knowledge and power would have established some form of direct contact. They could see that Earth's inhabitants would be helpless to do interplanetary harm. If afraid of carrying diseases home, they would at least try to communicate. It is hard to believe that any technically accomplished race would come here, flaunt its ability in mysterious ways and then simply go away. To this writer, long-time practice of space travel implies advanced engineering and science, weapons and ways of thinking. It is not plausible (as many fiction writers do) to mix space ships with broadswords. Furthermore, a race which had enough initiative to explore among the planets would hardly be too timid to follow through when the job was accomplished.

One other hypothesis needs to be discussed. It is that the Martians have kept a long-term routine watch on Earth and have been alarmed by the sight of our A-bomb shots as evidence that we are warlike and on the threshold of space travel. (Venus is eliminated here because her cloudy atmosphere would make such a survey impractical). The first flying objects were sighted in the Spring of 1947, after a total 5 atomic bomb explosions, i.e., Alamogordo, Hiroshima, Nagasaki, Crossroads A and Crossroads B. Of these, the first two were in positions to be seen from Mars, the third was very doubtful (at the edge of Earth's disc in daylight) and the last two were on the wrong side of Earth. It is likely that Martian astronomers, with their thin atmosphere, could build telescopes big enough to see A-bomb explosions on Earth, even though we were 165 and 153 million miles away, respectively, on the Alamogordo and Hiroshima dates. The weakest point in the hypothesis is that a continual, defensive watch of Earth for long periods of time (perhaps thousands of years) would be dull sport, and no race that even remotely resembled Man would undertake it. We haven't even considered the idea for Venus or Mars, for example.

The sum and substance of this discussion is that if Martians are now visiting us without contact, it can be assumed that they have just recently succeeded in space travel and that their civilization would be practically abreast of ours.

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The chance that Martians, under such widely divergent conditions, would have a civilization resembling our own is extremely remote. It is particularly unlikely that their civilization would be within a half century of our own state of advancement. Yet in the last 50 years we have just started to use aircraft and in the next 50 years we will almost certainly start exploring space.

Thus it appears that space travel from another point within the Solar system is possible but very unlikely. Odds are at least a thousand-to-one against it.

This leaves the totality of planets of other stars in the Galaxy as possible sources. Many modern astronomers believe that planets are fairly normal and logical affairs in the life history of a star (rather than cataclysmic oddities) so that many planets can be expected to exist in space.

To narrow the field a little, some loose specifications can be written for the star about which the home base planet would revolve. Let us say that the star should bear a family resemblance to the Sun, which is a member of the so-called "main-sequence" of stars, i.e., we eliminate white dwarfs, red giants and supergiants. For a description of these types, see reference 2, chapter 5. There is no specific reason for making this assumption except to simplify discussion: we are still considering the majority of stars.

Next, true variable stars can be eliminated, since conditions on a planet attached to a variable star would fluctuate too wildly to permit life. The number of stars deleted here is negligibly small. Reference 3, pages 76 and 85 indicate that the most common types are too bright to be in nearby space unnoticed. Lastly, we shall omit binary or multiple stars, since the conditions for stable planet orbits are obscure in such cases. About a third of the stars are eliminated by this restriction.

As our best known sample of space we can take a volume with the Sun at the center and a radius of 16 light years. A compilation of the 47 known stars, including the Sun, within this volume is given in reference 4, pages 52 to 57. Eliminating according to the above discussion: Three are white dwarfs, eight binaries account for 16 stars and two trinaries account for 6 more. The remainder, 22 stars, can be considered as eligible for habitable planets.

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Assuming the above volume to be typical, the contents of any other reasonable volume can be found by varying the number of stars proportionately with the volume, or with the radius cubed, $S_e = 22 \times (\frac{r}{16})^3$, where S_e is number of eligible stars and r is the radius of the volume in light years. (This formula should only be used for radii greater than 16 light years. For smaller samples we call for a recount. For example, only one known eligible star other than the Sun lies within eight light years).

Having an estimate of the number of useable stars, it is now necessary to make a guess as to the number of habitable planets. We have only one observed sample, the Solar System, and the guess must be made with low confidence, since intelligent life may not be randomly distributed at all.

The Sun has nine planets, arranged in a fairly regular progression of orbits (see reference 1, Appendix I) that lends credence to theories that many stars have planets. Of the nine planets, (one, the Earth) is completely suitable for life. Two more (in adjacent orbits) are near misses: Mars has extremely rigorous living conditions and Venus has an unsuitable atmosphere. Viewed very broadly indeed, this could mean that each star would have a series of planets so spaced that one, or possibly two, would have correct temperatures, correct moisture content and atmosphere to support civilized life. Let us assume that there is, on the average, one habitable planet per eligible star.

There is no line of reasoning or evidence which can indicate whether life will actually develop on a planet where the conditions are suitable. Here again, the Earth may be unique rather than a random sample. This writer can only inject some personal intuition into the discussion with the view that life is not unique on Earth, or even the random result of a low probability, but is practically inevitable in the right conditions. This is to say, the number of inhabited planets is equal to those that are suitable!

One more item needs to be considered. Knowing nothing at all about other races, we must assume that Man is average as to technical advancement, environmental difficulties, etc. That is, one half of the other planets are behind us and have no space travel and the other half are ahead and have various levels of space travel. We can thus imagine that in our sample volume there are 11 races of beings who have begun space explorations. The formula on page 3 above now becomes

$$R = 11 \times (\frac{r}{16})^3$$

where R is the number of races exploring space in a spherical volume of radius $r \geq 16$ light years.

Arguments like those applied to Martians on page 2 need not apply to races from other star systems. Instead of being a first port of call, Earth would possibly be reached only after many centuries of development and exploration with space ships, so that a visiting race would be expected to be far in advance of Man.

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To summarize the discussion thus far: the chance of space travelers existing at planets attached to neighboring stars is very much greater than the change of space-traveling Martians. The one can be viewed almost as a certainty (if the assumptions are accepted), whereas the other is very slight indeed.

In order to estimate the relative chances that visitors from Mars or star X could come to the Earth and act like "flying objects", some discussion of characteristics of space ships is necessary.

To handle the simple case first, a trip from Mars to Earth should be feasible using a rocket-powered vehicle. Once here, the rocket would probably use more fuel in slowing down for a landing, than it did in initial takeoff, due to Earth's higher gravitational force.

A rough estimate of one-way performance can be found by adding the so-called "escape velocity" of Mars to that of the Earth plus the total energy change (kinetic and potential) used in changing from one planetary orbit to the other. These are 3.1, 7.0, and 10.7 miles per second, respectively, giving a total required performance of 20.8 miles per second for a one-way flight. Barring a suicide mission, the vehicle would have to land and replenish or else carry a 100% reserve for the trip home.

Let us assume the Martians have developed a nuclear, hydrogen-propelled vehicle (the most efficient basic arrangement that has been conceived here on Earth) which uses half its stages to get here and the remaining stages to return to Mars, thus completing a round trip without refueling, but slowing down enough in our atmosphere to be easily visible (i.e., practically making a landing). Since it is nuclear powered, gas temperatures will be limited to the maximum operating temperatures that materials can withstand (heat must transfer from the pile to the gas, so cooling can't be used in the pile). The highest melting point compound of uranium which we can find is uranium carbide. It has a melting point of 4560°R. Assume the Martians are capable of realizing a gas temperature of 4500°R (= 2500°K), and that they also have alloys which make high motor pressures (3000 psi) economical. Then the specific impulse will be I = 1035 seconds and the exhaust velocity will be c = 33,400 ft/sec (reference 5). Calculation shows that using a single stage for each leg of the journey would require a fuel/gross weight ratio of 0.96 (for each stage) too high to be practical. Using two stages each way (four altogether) brings the required fuel ratio down to 0.81, a value that can be realized.

If, by the development of strong alloys, the basic weight could be kept to 10% of the total weight for each stage, a residue of 9% could be used for payload. A four stage vehicle would then have a gross weight $\frac{(100)^4}{9}$ = 15,000 times as great as the payload: thus, if the payload were 2,000 pounds, the gross weight would be 30 million pounds at initial takeoff (Earth pounds).

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Of course, if we allow the Martians to refuel, the vehicle could have only two stages* and the gross weight would be only $(\frac{100}{9})^2$ = 123 times the payload, i.e., 250,000 pounds. This would require bringing electrolytic and refrigerating equipment and sitting at the South Pole long enough to extract fuel for the journey home, since they have not asked us for supplies. Our oceans (electrolysis to make H_2) would be obvious to Martian telescopes and they might conceivably follow such a plan, particularly if they came here without foreknowledge that Earth has a civilization.

Requirements for a trip from a planet attached to some star other than the Sun can be calculated in a similar manner. Here the energy (or velocity) required has more parts: (a) escape from the planet (b) escape from the star (c) enough velocity to traverse a few light years of space in reasonable time (d) deceleration toward the Sun (e) deceleration toward the Earth. The nearest "eligible" star is an object called Wolf 359 (see reference 4, p 52), at a distance of 8.0 light years. It is small, having an absolute magnitude of 16.6 and is typical of "red dwarfs" which make up more than half of the eligible populations. By comparison with similar stars of known mass, this star is estimated to have a mass roughly 0.03 as great as the sun. Since the star has a low luminosity (being much cooler and smaller than the Sun) a habitable planet would need to be in a small orbit for warmth.

Of the changes of energy required as listed in the preceding paragraph, item (c), velocity to traverse intervening space, is so large as to make the others completely negligible. If the visitors were long lived and could "hibernate" for 80 years both coming and going, then 1/10 the speed of light would be required, i.e., the enormous velocity of 18,000 miles per second. This is completely beyond the reach of any predicted level of rocket propulsion.

If a race were far enough advanced to make really efficient use of nuclear energy, then a large part of the mass of the nuclear material might be converted into jet energy. We have no idea how to do this, in fact reference 6 indicates that the materials required to withstand the temperatures, etc., may be fundamentally unattainable. Let us start from a jet-propellant-to-gross-weight ratio of 0.75. If the total amount of expended material (nuclear plus propellent) can be 0.85 of the gross weight, then the nuclear material expended can be 0.10 of the gross. Using an efficiency of 0.5 for converting nuclear energy to jet energy and neglecting relativistic mass corrections, then a rocket velocity of half the velocity of light could be attained. This would mean a transit time of 16 years each way from the star Wolf 359, or longer times from other eligible stars. To try to go much faster would mean spending much energy on relativistic change in mass and therefore operating at lowered efficiency.

* Actually three stages. On the trip to Earth, the first stage would be filled with fuel, the second stage would contain partial fuel, the third would be empty. The first stage would be thrown away during flight. On the trip back to Mars, the second and third stages would be filled with fuel. The gross weight of the initial vehicle would be of the order of magnitude of a two-stage rocket.

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To summarize this section of the discussion, it can be said that a trip from Mars is a logical engineering advance over our own present technical status, but that a trip from another star system requires improvements of propulsion that we have not yet conceived.

Combining the efforts of all the science-fiction writers, we could conjure up a large number of hypothetical methods of transportation like gravity shields, space overdrives, teleports, simulators, energy beams and so on. Conceivably, among the myriads of stellar systems in the Galaxy, one or more races have discovered methods of travel that would be fantastic by our standards. Yet the larger the volume of space that must be included in order to strengthen this possibility, the lower will be the chance that the race involved would ever find the earth. The Galaxy has a diameter of roughly 100,000 light years and a total mass about two hundred billion times that of the Sun (reference 4). Other galaxies have been photographed and estimated in numbers of several hundred million (reference 2, p. 4) at distances up to billions of light years (reference 7, p 158). The number of stars in the known universe is enormous, yet so are the distances involved. A super-race (unless they occur frequently) would not be likely to stumble upon Planet III of Sol, a fifth-magnitude star in the rarefied outskirts of the Galaxy. — deck

A description of the probable operating characteristics of space ships must be based on the assumption that they will be rockets, since this is the only form of propulsion that we know will function in outer space. Below are listed a few of the significant factors of rocketry in relation to the "flying objects".

(a) Maneuverability. A special-purpose rocket can be made as maneuverable as we like, with very high accelerations either along or normal to the flight path. However, a high-performance space ship will certainly be large and unwieldy and could hardly be designed to maneuver frivolously around in the Earth's atmosphere. The only economical maneuver would be to come down and go up more or less vertically.

(b) Fuel reserves. It is hard to see how a single rocket ship could carry enough extra fuel to make repeated descents into the Earth's atmosphere. The large number of flying objects reported in quick succession could only mean a large number of visiting craft.

Two possibilities thus are presented. First, a number of space ships could have come as a group. This would only be done if full-dress contact were to be established. Second, numerous small craft might descend from a mother ship which coasts around the Earth in a satellite orbit. But this could mean that the smaller craft would have to be rockets of satellite performance, and to contain them the mother ship would have to be truly enormous.

(c) Appearance. A vertically descending rocket might well appear as a luminous disk to a person directly below. Observers at a distance, however, would surely identify the rocket for what it really is. There would probably be more reports of oblique views than of end-on views. Of course, the shape need not be typical of our rockets; yet the exhaust should be easy to see.

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One or two additional general remarks may be relevant to space ships as "flying objects". The distribution of flying objects is peculiar, to say the least. As far as this writer knows, all incidents have occurred within the United States, whereas visiting space-men could be expected to scatter their visits more or less uniformly over the globe. The small area covered indicates strongly that the flying objects are of Earthly origin, whether physical or psychological.

The lack of purpose apparent in the various episodes is also puzzling. Only one motive can be assigned; that the space-men are "feeling out" our defenses without wanting to be belligerent. If so, they must have been satisfied long ago that we can't catch them. It seems fruitless for them to keep repeating the same experiment.

Conclusions:

Although visits from outer space are believed to be possible, they are believed to be very improbable. In particular, the actions attributed to the "flying objects" reported during 1947 and 1948 seem inconsistent with the requirements for space travel.

Very truly yours,

J. E. Lipp
Missiles Division

JEL:sp

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APPENDIX F

3610th Electronics Station

Analysis of Project Grudge Reports

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AIR MATERIEL COMMAND
3160 Electronics Station
Cambridge Field Station
230 Albany Street
Cambridge 39, Mass.

ACT/Bs

000.92
In reply address both communication and envelope to the Commanding Officer and attention of following office symbol. ERH

April 18, 1949

SUBJECT: Analysis of Project "Grudge" Reported Incidents

TO: Commanding General
Air Materiel Command
Wright-Patterson Air Force Base
Dayton, Ohio
ATTN: MCIAXO

1. Reference is made to the letters from your Headquarters to this station of 22 November 1948, 6 December 1948, and 14 January 1949, Subjects: "Project 'Sign' ", requesting that reported incidents 1 through 172 be analyzed to determine whether or not these might have been caused by balloons launched by these laboratories.

2. A listing has been compiled of all balloons launched by these laboratories and its contractors for special atmospheric research purposes, from the first such launching to No. 101 on 17 November 1948. Each of these launchings has been compared with the reported incidents 1 through 172. Factors of comparison were date of launching and date of recovery with respect to date of reported incidents; place of launching and place of recovery with respect to the place of reported incidents, and possible deviations from the known flight path with respect to the place of reported incidents. So that your office may make an independent analysis, three copies of the launching list are inclosed.

a. Incidents No. 5 through No. 16 reported on 4 July 1947 throughout Oregon, Idaho and Washington gave, in general, descriptions of clusters or groups of objects. The 3 July 1947 balloon launching No. 8 at Alamogordo was a cluster of balloons and was not recovered, and so might be suspected of being the cause of these reports. However, although not recovered, this flight was terminated in the New Mexico Tularosa Valley only a few miles northwest of Alamogordo. That the balloons were downed was determined both by airplane spotting and by radio direction finding upon the balloon telemetering instruments. Recovery of the balloons and instruments was prevented by the impassability of the terrain.

b. Balloon release No. 11 of 7 July 1947 could compare with respect to date with incident No. 1 through No. 4, and again with incident No. 40. This balloon flight was again a cluster.

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The description of incident No. 40 is inconsistent with the appearance of balloon flight No. 11. Also, in consideration of the prevailing upper winds, it is very unlikely that the balloons would have gone more than a few miles westward of Alamogordo, although it must be admitted that a long flight west of the launching point could not be ruled out as impossible.

c. Incident No. 47 compares somewhat in time with balloon Launching No. 10 of 5 July 1947. However, balloon No. 10 although not recovered was known to have been downed northeast of Albuquerque, New Mexico. It was not recovered due to impassability of terrain. Incident No. 113 is a reasonable description of the 20 ft. plastic balloon and instruments used by these Laboratories. This incident was on the date of balloon release No. 46 of 9 April 1948 at Alamogordo. However, the time of the reported incident (1506 CST) is about 1/2 hour before the time of balloon release (1432 MST), thus the incident could not have been that balloon.

d. It is of interest to note that incident No. 122 was reported by an employee of these Laboratories who had considerable experience in the use of balloons of all kinds, and could have been depended upon to know the appearance and behavior of a balloon if it was this he saw.

e. Incident No. 163 bears a fair description of the appearance of a large plastic balloon in sunset light. The object's disappearance could be accounted for either by its movement into the earth's sunset shadow or by natural defocusing of the observer's eyes. This incident could possibly have been balloon release No. 75 or No. 76 or 20 and 21 July 48 from Alamogordo. Balloon No. 75 was recovered at Hollister, California, which is in the Monterey Bay area, on 22 July 1948 and could have easily had a trajectory which would have been within sight of the Los Angeles area. Balloon No. 76 was never recovered. It is possible that it had a trajectory similar to No. 75.

f. All other reported incidents from 1 to 172 do not seem to have reasonable comparison with balloons launched by these Laboratories.

3. The balloons used by these Laboratories are now somewhat standardized. They are 20 feet long, plastic, white in color, and hemisphere-on-cone in shape. Nearly all launchings are made at the Holloman AFB at Alamogordo, New Mexico. Two photograph prints are inclosed showing the appearance and size of these balloons. The larger photograph shows the typical flight appearance at any altitudes where it would be visible. It is hoped that this information may be of some use to you in identifying future reports of incidents.

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4. It is believed that certain of the items in the questionnaire "Checklist-Unidentified Flying Objects" produce insignificant and unreliable data from an observer. These are: 9. Distance of object from observer; 11. Altitude; 12. Speed; and 16. Size. For any unfamiliar object beyond the focal range of the human eyes (about 60 ft.), these four factors are mutually inter-dependent and therefore indeterminant unless at least one of them (and some observed angles) are known. Directly asking an observer about these indeterminants not only gets unreliable data but induces wild answers because the observer is led into making a statement about quantities for which he has no basis in fact. He will unconsciously assume knowledge of some one of these factors and so give incorrect information on all. That people (many of whom should know better) will arbitrarily give answers to two significant figures on these questions, which really cannot be answered at all, is proof of the unreliability of their information.

5. It is suggested that these four items on the questionnaire be replaced by questions which will yield answers possible of being independent facts in terms of the observer's best estimates of angles and time. From such data given by observers of the same object at two different places, a reliable calculated estimate could be made of the object's size, altitude, speed and path. These data should include:

a. An estimate of the angular size of the object. A quick but reasonable estimate can be made by comparing the angle subtended by the index finger held at arms length. The finger (7/8" wide) of an average man held at 26" to 30" (arms length) will subtend an angle of approximately two degrees. In this way angular size from about 1/2° to about 8° can be estimated.

b. The range of the object's flight in terms of the angle subtended by the observed path. If the object moves in a reasonably straight course it is important to observe the position at the beginning and the end of its course. After the flight has been completed a person can extend his arms toward the two points and also at 90° or 180° and by comparison estimate the angular extent of the flight. It is also important that information which will determine those directions relative to a compass point be given. If the angular course is associated with objects on the horizon, with roads, with the sun (if the time of day is also noted) or by the north star, the orientation can be rechecked at any later time.

c. The time required for the object to traverse the observed course. This is probably the most difficult estimate to make. Timing with a watch is the most satisfactory, but an observer is seldom prepared to do so. Seconds can be counted with good accuracy by saying,

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"one flying saucer; two flying saucers, three flying saucers" ---etc. At a normal speaking speed. On the other hand it is not easy to count , seconds and at the same time make all the other desirable observations. It must be remembered that when a person is excited his estimates of time are apt to be rather inaccurate.

d. Estimation of the elevation angle of the object. Almost all persons will overestimate elevation angles. This tendency can be reduced by the observer extending one arm vertically and the other horizontally to observe a 90° angle. The vertical arm can then be lowered to point to the observed object. In this way the observed angle can be compared with a 90° angle and a more accurate estimate obtained.

6. It is realized that it might not be possible for an observer to perform the opeations suggested in the preceding paragraph, during the period the object is sighted. If he would immediately reconsider what he saw and then estimate such measurements, he should be able to give quantitative answers accurate to at least 25%. In interrogating observers, they should also be asked to reconstruct their observations and then estimate these same factors. It is suggested that instructions for making such quick and estimated observations be given to weather observers, control tower operators, civil police, forest and fire rangers, and other such people who might have good chance of seeing unidentified flying objects. If any information concerning unidentified flying objects is given to the public, instructions for reliable observation should be included.

7. This organization will be pleased to be of any further assistance required in connection with this matter.

FOR THE COMMANDING OFFICER:

3 Incls
1. List of balloons launched (in trip)
2. 8" X 10" photo print of plastic balloon
3. 4" X 5" photo print of plastic balloon

/s/ A. C. Trakowski, Jr.
A. C. TRAKOWSKI, JR.
Captain, USAF
Director, Base Directorate for Geophysical Research

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APPENDIX G

Dr. Paul M. Fitts

Psychological Analysis of Reports of Unidentified Aerial Objects

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C O N F I D E N T I A L

U. S. AIR FORCE
HEADQUARTERS, AIR MATERIEL COMMAND
ENGINEERING DIVISION

No. of pages - 15

MCREXD9/PMF/maf

MEMORANDUM REPORT ON

28 April 1949

SUBJECT: Psychological Analysis of Reports of Unidentified Aerial Objects

SECTION: Aero Medical Laboratory

SERIAL NO.: MCREXD-694-18D

Expenditure Order No. 694-38

A. PURPOSE:

1. At the request of the Technical Intelligence Division, Intelligence Department, AMC, an analysis has been made, from a psychological point of view, of 212 investigations of persons reporting sightings of unidentified aerial objects.

B. FACTUAL DATA:

2. A report of this analysis is attached as Appendix A.

C. CONCLUSIONS:

3. It is concluded by the writer that there are sufficient psychological explanations for the reports of unidentified flying objects to provide plausible explanations for reports not otherwise explainable. These errors in identifying real stimuli result chiefly from inability to estimate speed, distance and size.

D. RECOMMENDATIONS:

4. Test the ability of pilots to estimate the course of a small lighted balloon while doing acrobatics with it at night. It is suggested that several pilots try to fly pursuit curves and collision courses on such targets at night and report accurately their sensations. It would be desirable, but probably impossible, to keep them from knowing the nature of the light source.

5. In all future reports of unidentified objects specify the location of object with reference to polar coordinates (direction and degrees above the horizon) rather than asking individuals to estimate distance. If possible, obtain an estimate of size in terms of the visual angle subtended by the object.

6. In all future investigations determine the angular position of the sun with respect to the unidentified object and the observer.

C O N F I D E N T I A L

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Engineering Division
Memorandum Report No. MCREXD-694-18D
28 April 1949

Also determine the approximate time during which the object was in sight (this information was not available for more than half the reports).

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PAUL M. FITTS, Ph.D.
Chief, Psychology Branch

Prepared by: Shirley C. Connell
SHIRLEY C. CONNELL
Psychology Branch

Approved by: A. P. Gagge
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Engineering Division
Memorandum Report No. MCREXD-694-18D
28 April 1949

APPENDIX A

PSYCHOLOGICAL ANALYSIS OF REPORTS OF UNIDENTIFIED AERIAL OBJECTS

The Inaccuracy of Human Observation

Psychologists have long know that human perception is fallible. In fact, part of the science of psychology is concerned with the measurement of errors of observation, and with the discovery of the conditions and laws that govern such phenomena.

Errors of observation may be classified as variable or constant. Variable errors are those in which a number of separate observations are found to differ from one another. The distribution of such errors often follows the normal probability curve. Constant errors are those in which observations are consistently biased in one or another direction. For example, individuals often are guilty of a constant error, in the direction of underestimation, in reporting their ages.

Errors of observation may be classified further as precision errors and identification errors. Inaccuracy in estimating the speed of an aircraft is an example of the former. Mistaking an aircraft for a "flying saucer" is an example of the latter.

It is the purpose of the present report to analyze 212 reports of observations of unidentified flying objects in order to see to what extent these reports can be explained in terms of known psychological facts and principles.

Scientific Method and a Posteriori Data

A word of caution must be injected at the outset of this report. Certain conditions are necessary for drawing valid scientific conclusions.

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These conditions are largely lacking in the case of the data available on unidentified flying objects. It is impossible to say with any assurance what any particular individual in this series of 212 reports was actually observing at any particular time. It is only possible to examine the accumulation of available evidence or the accumulation of all reports of a given class (e.g., all reports from supposedly competent observers) and to consider them in a statistical sense. If certain characteristics appear repeatedly in reports from different people it may be possible to infer causal factors.

It will never be possible, on the other hand, to say with certainty that any given observer could not have seen a space ship or an enemy missile, or some other object. It will only be possible to estimate the probability that he could have seen such things.

The principal hypothesis to be examined in the following discussion is that reports of unidentified flying objects have the characteristics that would be expected if they were cases of failure, on the part of typical normal individuals, to identify common or familiar phenomena.

Possible Sources of Inaccurate Reports of Flying Objects

There are three broad classes of mistakes in human observations. These are the following: 1. Misinterpreting the nature of real stimuli, 2. Mistaking unreal (imaginary) stimuli for real ones, and 3. Deliberate falsifications. Each of these are considered briefly below.

(1) Errors in Identifying Real Stimuli. All normal, intelligent people experience certain errors of observation. The moon appears much larger on the horizon than when it is high in the sky. A stick looks bent when one end is in water. Distant objects appear relatively close in clear, desert atmosphere. A small point-source of light, if viewed in a dark room, will appear to move about in strange gyrations, even though it is actually motionless. This is called

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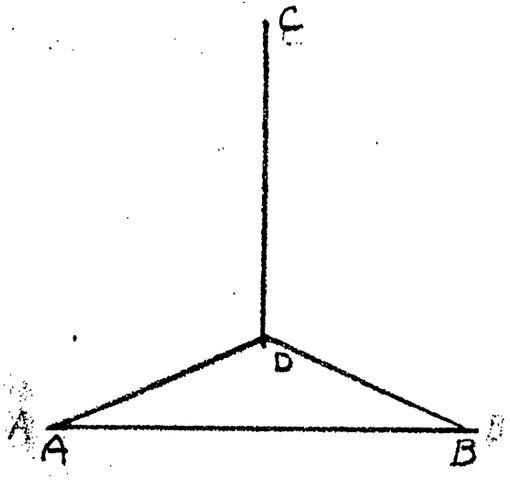
the autokinetic illusion (see Guilford, J. P., 1928). In the accompanying figure the line AB looks approximately as long as the line CD, but when you measure them the two will be found to be of quite different lengths.



Visual stimuli originating within the eye itself also give rise to mistaken observations. Muscae volitantes or "flying gnats" are small solid particles that float about in the fluids of the eye and cast shadows on the retina. They often can be seen when you look up at the clear sky, or when you are reading. They move as your eyes move. It is sometimes possible also to see corpuscles or other objects that are circulating within the fluids in the retina of the eye.

Then, of course, everyone from time to time mistakes some more or less familiar object for another object. A probable explanation for many reports of unidentified aerial phenomena is that the object is really something quite familiar, such as an aircraft, a light, or a bird. The observer simply fails to identify it correctly. These errors arise chiefly as a result of inability to estimate speed and distance.

(2) Mistaking Imaginary for Real Events. This error of observation is usually made ~~only~~ by children, by individuals of low intelligence (people who are very suggestible), by people who see visions, or by the mentally ill. It usually is not difficult for an

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expert to spot this type of person. Reports will be received from such persons especially at times when the radio and newspapers carry accounts of strange phenomena. Relatively few of the 212 investigations considered in this report are of this nature, probably because investigators interviewed only the more reliable type of witness.

(3) Deliberate Falsifications. It is always possible that some persons will give false reports. Circulation of false reports has been a standard psychological warfare technique from earliest times. This procedure might have some utility in wartime, but it hardly seems likely that it would be resorted to at this time. Probably, however, some individuals start false reports of "flying saucers" for the same reason that they turn in false fire alarms.

Some Consistent Points in the Reports of Unidentified Objects.

The following section summarizes some significant facts that come out of a tabulation of 212 reports of interrogations, by USAF Intelligence Officer, of some of the individuals who reported seeing unidentified flying objects. It is understood that these interrogations covered primarily persons that were judged to be reliable. Most of the 212 reports were made by pilots, non-flying officers, professional men, government employees, housewives and other supposedly dependable people.

1. Number of objects. About 75% of the people who reported on the number of objects seen said that they saw only one object.

2. Time the object remained in sight. About half of the persons specifying time in sight saw the object for 60 seconds or less.

3. Altitude and distance of the object. Of those who estimated the distance of the object, two-thirds judged it to be more than a mile away. Ninety percent also thought that it was more than 1,000 feet high.

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4. Speed. About half judged that the speed was less than 500 miles an hour. The other half of the judgments varied from 500 miles an hour all the way to "terrific", "tremendous", "inconceivable" and "blue blazes".

5. Background against which viewed. The great majority of observers saw the object against a clear day or night sky.

6. Time of day sighted. About two-thirds as many observations were reported at night as in the day. There are, of course, many more opportunities for observing things during the day. The most popular hours were from 12 noon to 5:00 P.M. and from 7:00 P.M. to 11:00 P.M. at night. Very few (6 only) observations were made from 5:00 to 7:00 P.M., the usual hours of sunset.

7. Color. Observers almost universally reported seeing a light-colored object. Thirty observers reported "white" and twenty-five said "silver". Over 70 percent described glittering, shiny, luminescent, mirror-like, flame-like or other very bright objects. Only six individuals said black or dark.

8. Shape. Over half described the object as either "round", "disc-shaped", "spherical" or "circular". Other descriptions were similar. Very few observers saw any distinctive shape.

9. Size. The majority of observers did not specify the objects' size. Of those who did over half said it was less than 10 feet in its largest dimension. Many compared it with a dime, a lamp, a dot, a weather ballon, a baseball, etc.

Interpretation of the Common Points of All Reports

The words used by observers to describe the appearances of the unidentified objects fall into a surprisingly uniform pattern. The objects were usually reported as being far away, small, bright and without a distinctive shape. They were usually seen against a clear sky

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and were frequently seen for less than a minute.

First of all, it is obvious that it would usually be impossible for observers to make reliable estimates of the speed, distance, or size of such stimulus objects. It is not possible to estimate accurately the distance of small bright objects viewed against a clear sky, unless the object is identified first. If you know beforehand that an object is a weather balloon, an F-80, or a dirigible you can estimate its speed and distance with some degree of accuracy. In such situations distance is judged on the basis of known size, and speed on the basis of an estimate of distance plus the angular change in position. It must be concluded, therefore, that most of the statements of speed, distance, altitude and size are entirely unreliable and should be disregarded. This is doubly true of observations made at night. The objects seen may actually have been at very great distances, or they may have been relatively close by. In the latter case, of course, they could also have been quite small.

Secondly, it is probable that individuals who saw objects in daylight were in many cases observing either the reflection of the sun on a shiny surface or else looking directly at a light source of high intensity. Aircraft themselves, when viewed against a clear sky, are seen as dark objects against a lighter background unless they are reflecting the sun's rays directly. This fact was recognized during the recent war by camouflage experts who placed bright lights on the leading edges of the wings of aircraft on anti-submarine patrol in order to conceal them from the eyes of submarine lookouts. If observers, during daylight hours, were actually seeing lights, or reflections of the sun, this would account in large measure for their inability to identify the objects. On the other hand, if they were actually seeing enemy missiles, for example, the majority of reports

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of daylight sightings should have been of dark objects. It is possible, of course, that they may have thought the objects were bright because they expected all aerial objects to be bright.

On the basis of the evidence thus far considered, the best guess as to the nature of a visual stimulus that would elicit reports of unidentified flying objects is that in the daytime it would be the reflection of the sun from an aircraft, a wind-blown object, etc., and at night some direct light source, such as an engine exhaust, the light on a weather balloon, a running light on an aircraft, a meteor, etc., or lights from the ground or the moon reflected back by birds or other objects in the air.

Discussion of Several Specific Reports

Discussion of a few specific reports will serve to illustrate some of the points brought up earlier, particularly some of the factors that make observations of aerial phenomena inaccurate.

Incidents No. 81 and 163.

In one case (Investigation No. 81) a civilian employee at Hickam Field at 0900 observed what looked like a balloon with a bright object suspended below it. It was estimated to be at about 6,000 ft. The bright object appeared to reflect the sun's rays at times. After a few minutes he looked away and then could not find the object again.

In another case (No. 163) a reserve officer at Van Nuys, California, about an hour before dark saw an object that looked somewhat like a weather balloon at about 2000 ft. He kept it in sight for about an hour. He later concluded that it was at a great height. At first it had the color of a fluorescent electric light but became orange as the sun went down and then rather suddenly became invisible.

Both of these objects could well have been just what they appeared to resemble most—balloons. The sun was low in the sky in both cases.

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Reflection of the sun's rays may have given an unusual appearance to the object. The second case illustrates the uncertainty of judgments of height or distance. The object looked near, but when it remained in view for an hour the observer decided that it must be very far away. Actually he probably had nothing on which to base an accurate estimate. f distance.

Incidents 61 and 61a.

Two couples saw approximately 12 objects flying in formation at what they judged to be 2000 or 3000 feet altitude over Logan, Utah at 22:30. They were judged to be about the size of pigeons and looked white. All four observers agreed that these objects looked and acted somewhat like birds but all thought they were not birds because they appeared to travel much faster than birds.

As we have seen, it is not possible to judge speed accurately under the conditions of these observations, i.e., when looking at objects of unknown size and distance against a night sky. The objects may actually have been a flock of white birds, flying at a relatively low altitude and reflecting the lights of the city.

Incidents 30, 30b, 30c, and 48, 48a, 48b, 48c, 48d.

During the same space of time (about half an hour) on the night of 7 January 1948 observers at Lockbourne Air Force Base, observers at Clinton County AFB and the pilot of an aircraft flying from Dayton to Washington reported an unidentified object in the sky. All reports agreed as to the color and general appearance of the object, and as to the fact that its light at times was visible through a light overcast. All agreed also that it was seen to the southwest. However, persons at all three locations judged the object to be only a few miles away. To all of them it looked motionless at times, then appeared to gain and lose elevation. A very similar object was seen by numerous

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persons at Fort Knox and other towns in Kentucky a few hours earlier. All saw it in the southwest and many thought it was only a few miles away. The Commanding Officer at Goodman Field observed it for 1 1/2 hours, (beginning at 1445). During this time it seemingly remained stationary. It was "chased" by four National Guard pilots, one of whom crashed after having been up to 20,000 feet. It was also reported by persons in Lexington, Madisonville, and Elizabethtown.

The significant fact that emerges from these reports again is the inability to estimate distance. It appears possible that persons over parts of Kentucky and Ohio may have been seeing the same astronomical phenomena which was a great many miles away. Nevertheless each believed it to be relatively near his own location.

Incident No. 172.

A National Guard Pilot returning to Fargo, North Dakota, in a F-51 at approximately 2100 hours saw a small light in the air below him. He was then in the traffic pattern. He dived on the light. The light gained altitude. The pilot "chased" it up to 14,000 feet, making various passes at it and attempts to ram it as he climbed. He finally stalled out.

Several inferences can be drawn from the several reports about this incident. In the first place, when it is night, and a pilot is turning so steeply, and going such violent acrobatics, that he sometimes blacks out, as was the case here, it would be very difficult if not impossible to judge at the same time what another object was doing. In the second place, if the pilot kept his eyes intently on the object, as also was the case here, he would have great difficulty in knowing and reporting later what he himself was doing. The situation is very conducive to loss of orientation. In other words, it is impossible to infer from the pilot's report whether the light pursued by him was

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maneuvering or not maneuvering. It is quite possible that it was simply climbing steeply on a relatively straight course, such as would be taken by a lighted weather balloon.

As a matter of fact, a lighted weather balloon was released by the Fargo Weather Station within 10 minutes of the time the light was first sighted by the F-51 pilot. It is the opinion of the writer that this lighted balloon easily could have accounted for all of the pilot's observations. (It should be noted that the standard 30 inch and 65 inch weather balloons have a vertical speed of about 600 and 1100 ft./min. respectively.)

General Discussion and Summary

In the preceding section the hypothesis has been advanced that most reports of unidentified flying objects have been the result of persons failing to identify familiar phenomena, such as reflections from bright surfaces in the day or lights in a night sky. It is believed that this explanation will account for many of the reports. However, some reports undoubtedly have other explanation.

Vertigo. The term vertigo covers a large group of miscellaneous phenomena including air sickness, disbelief in one's instruments, and partial loss of orientation. The conditions under which some of the observations of flying objects were made were such that they could have produced loss of orientation on the part of an observer. This is especially true for those experiences occurring at night and those in which attempts were made to "chase" the object. Movement is always relative. If the only outside reference is a point of light, and both the observer and the object observed are moving, it would be practically impossible under certain conditions to tell which was moving and which was not, or to separate out the two motions. It is hard enough

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to fly a good pursuit curve on another aircraft in good daylight, for example, much less to close on a solitary light at night. The difficulty is due chiefly to the inability to judge distance or speed of a point source of light.

Suggestion. Suggestion works in various ways. Sensational radio and newspaper reports lead a few people to imagine they are seeing things they are not seeing. The effect on most people is to dampen their critical judgment. Under such conditions we are more likely to overlook certain factors, and find it easier to accept the suggested explanation uncritically. The expected result would be to make the reports of most observers slightly less accurate than if they had never heard reports of others seeing "flying saucers". Particularly when the stimulus object is fuzzy or ill-defined, persons tend to see it as resembling whatever is suggested to them. Carmichael et. al., for example (1932) showed individuals simple designs and gave them the name of an object. When the individuals drew the design from memory, they drew it to resemble whatever the object was that had been suggested to them.

Precedent. An historical precedent can be found for most errors of human observation. Although the writer has not tried to make an historical survey of reports of earlier unidentified aerial objects, he feels sure that there have been many such reports in years past, particularly during and after World War I.

Small Wind-borne Objects. It is possible that some observers may have seen small objects carried aloft by strong winds, or objects dropped from aircraft. Bits of paper, small cartons, etc., may occationslly be carried to a considerable height by strong winds. Aircraft may sometimes jettison small articles. It would be impossible to

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estimate the distance, size or speed of such objects, and it would be easy to fail to recognize them.

Conclusions

It is concluded by the writer that there are sufficient psychological explanations for the reports of unidentified flying objects to provide plausible explanations for reports not otherwise explainable. These errors in identifying real stimuli result chiefly from inability to estimate speed, distance and size.

Recommendations

The following recommendations are offered:

1. Test the ability of pilots to estimate the course of a small lighted balloon while doing acrobatics with it at night. It is suggested that several pilots try to fly pursuit curves and collision courses on such targets at night and report accurately their sensations. It would be desirable, but probably impossible, to keep them from knowing the nature of the light source.

2. In all future reports of unidentified objects specify the location of the object with reference to polar coordinates (direction and degrees above the horizon) rather than asking individuals to estimate distance. If possible, obtain an estimate of size in terms of the visual angle subtended by the object.

3. In all future investigations determine the angular position of the sun with respect to the unidentified object and the observer. Also determine the approximate time during which the object was in sight (this information was not available for more than half the reports).

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HEADQUARTERS
AIR WEATHER SERVICE
Andrews Air Force Base
Washington 25, D. C.

In Reply
Refer To: AWS DSS 11 May 1949

SUBJECT: Unidentified Flying Objects

TO : Commanding General
Air Materiel Command
Wright-Patterson Air Force Base
Dayton, Ohio
ATTN: MCIAXO-3

1. Reference is made to letter from your headquarters, MCIAXS, dated 9 March 1949, subject "Unidentified Flying Objects," and first indorsement thereto by this headquarters, dated 31 March 1949.

2. The incident summaries 173 through 233 have been checked against routine weather-balloon ascents made by the Air Force, Navy and Weather Bureau. Comments based on this review are inclosed.

3. It is recommended that the "Guide To Investigation Of Unidentified Aerial Objects" be changed as follows: Item 13, "Direction of Flight of Object," should be clarified so that vertical and horizontal motions are distinguished if possible, and so that motion is specified as the direction towards which the object appears to move. "Relative to Radar Settings" should include a statement of the type of radar set used.

FOR THE CHIEF, AIR WEATHER SERVICE

/s/ W. A. West
W. A. WEST
Lt. Col., USAF
Adjutant General

2 Incls:
1 - Incident Summaries
2 - Comments 173 thru 233

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No. 173: Rawinsonde released from Barksdale AFB at 1500 CST. Shreveport under influence of very tight low of a local nature which extended through the 500 mb. level. In all probability, rawinsonde balloon path was circular following isobar curvature around Shreveport, hence balloon was seen approximately two hours later in the same area. Assuming a balloon leak, not altogether uncommon, the rawinsonde could have remained low enough to be seen. Winds reported as high as 70K account for speed. Conclusion: Rawinsonde balloon.

No. 174: Nearest pilot balloon sounding release was at Lake Charles at 0300 CST. Wind flow WNW in lower levels, changing to SSW with altitude. No winds of high enough velocity to carry pilot balloon sounding from Lake Charles to New Orleans in time interval were reported. Only other release in the area was at Biloxi, North of New Orleans. Winds aloft were WSW. Speed stated by observer of 300 M.P.H. is approximately 15 times greater than any wind reported for that area. Conclusion: Not a balloon.

No. 175: Pilot balloon sounding released from Albuquerque at same time as observation. Upper winds show WNW flow hence could not have been the AB balloon. Great differences of opinion exist as to speed and shape of the object. One observer states that the object was not a weather balloon. All evidence indicates that this is true. Conclusion: Not a balloon.

No. 176: Navy rawinsonde and Weather Bureau pilot balloon sounding were released approximately one hour prior to sighting. Wind flow, however, was WNW at all levels from the surface to 15,000 feet which would seem to preclude the possibility of either balloon drifting North to the San Pablo area. Both witnesses also agree that the object was travelling at high speed. Winds for that region did not exceed 25 K. Conclusion: No balloon.

No. 177: Crack-pot report; insufficient information to evaluate.

No. 178: No weather balloons were released in the vicinity on the date mentioned.

No. 179: Crack-pot report; insufficient information to evaluate.

No. 180: No date given hence no analysis possible.

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No. 181: This obviously inaccurate report says in effect that the object was seen about 30 minutes after pilot balloon sounding and rawinsonde release time. From the known releast points, wind direction and speed at the level mentioned, this object or objects could not possibly have been a weather balloon.

No. 182: No balloons released within 120 miles of this position, but if wind were from west it could have been a leaking balloon from Norfolk or Hatteras which was not rising as it should. However, the date of incident cannot be read from the questionnaire, hence no definite conclusion can be drawn.

No. 183: Purely a radar report. If this report is accurate, couldn't possibly be a balloon.

No. 184 - 185: Very controversial accounts of speed (0 - 3 times that of a Jet); description sounds like burning pilot balloon sounding with lantern. However, nearest release was two hours earlier at St. Cloud. Could have been this pilot balloon sounding assuming a leaky balloon to keep it at a low altitude. Not at all probable, but possibly a balloon.

No. 186: Object reported moving directly into headwind of 20K. Only possible weather balloon would have been moving SE from Salt Lake City. If speed is any criterion, this was dofinitely not a balloon.

No. 187: A heavenly body, Venus.

No. 188: No actual sighting; a radar report, if accurate, definitely no weather balloon.

No. 189: Rawinsondes released at Montgomery and Atlanta 1 1/2 hours earlier and would have been blown into sighted area by upper winds. Only a faulty balloon, however, could have descended to that low altitude. From description, balloon is most unlikely.

No. 190: Every indication seems to point to this object being a rawinsonde balloon. Rawinsonde scheduled to be released from Munich approximately one hour previous to sighting. Very light winds in Munich area. Definitely a balloon.

No. 191: Only balloon released in wind pattern that would carry it over Junction City was released at Dodge City approximately one hour before sighting time. If reported direction and speed of object were at all accurate, balloon not possible.

No. 192: Balloons released from St. Cloud and Duluth just prior to sighting. Wind perfect for carrying balloon ~~it~~ into observer's path. Wind

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reported at 30K at about 80° to 110°. Steadily rising is also indicative of weather balloon.

No. 193: No date given; very little information; cannot determine object.

No. 194: Definite identity established by M.I.T.

No. 195: Very little information, only radar pipe; cannot determine if weather balloon or not.

No. 196: Radar scope observation only; object travelling directly into wind. Cannot determine if balloon, but unlikely.

No. 197: Almost certainly the comet discovered by the Sydney astronomer. No balloon could have reached Richmond at the time the object was sighted inasmuch as the sighting time and release time were almost simultaneous.

No. 198: No visual observation; radar blip moving at high speed and constantly changing direction. If radar report is accurate, couldn't possibly be a balloon.

No. 199: Wind, time and number of objects sighted rule out possibility of weather balloons.

No. 200: Definitely not weather balloon. Course southerly, wind almost due North at all levels. Only station releasing balloon in this area is North of Crescent City.

No. 201: Pilot balloon sounding released from Azores station at 0300 Z. Time of sight "about" that time. Description sounds very much like lighted pilot balloon sounding. Only discrepancy is speed which is reported from 25 M.P.H. to 800 M.P.H. If the lower speed is correct, object may be almost certainly assumed to be a weather balloon.

No. 202: Time of sighting was five hours after last scheduled release time for any rawin or pilot balloon sounding, thus discounting a balloon leak, would put it far too high for easy sighting. Definitely not a weather balloon.

No. 203: Again last scheduled release was over five hours prior to sighting. Only possibility, and a definitely unlikely one, is a lighted balloon falling in flames from an extremely high altitude.

No. 204: Venus.

No. 205: No date given on this, therefore, impossible to check wind flow pattern. Time, two hours after scheduled release time for Kansas City, Columbia, and St. Louis, Mo. balloons.

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No. 206: If description is accurate, i.e., wings on fuselage, roar of engine, circling object, possibility of weather balloon is remote. Also, latest time of release for Clark Field was four hours prior to sighting. Also, note F.B.I. note on character of observer.

No. 207: Definitely not a weather balloon.

No. 208: Object sighted about four hours after last scheduled release time. Upper air flow pattern gives no indication of possibility of weather balloon drifting in from another station. Also balloon would have to have leaked to remain at 30,000 feet.

No. 209: Determined to have been twin-engined bomber.

No. 210: Summary sheet missing; no altitude given; time incompatible with scheduled balloon release times. If direction is correct, objects were flying into the wind. Cannot be determined conclusively. Inclined to believe objects were Jet aircraft.

No. 211: Very Pistol.

No. 212: Object sighted three hours after release time of Indianapolis and Ft. Wayne balloons. Defective balloon could have remained low enough to be seen and upper winds indicate that such a balloon would have been in the Dayton area at the time sighted. All other statements of observers seem to indicate that the object was a weather balloon.

No. 213: Evidently refers to the same object as in Incident No. 212, but with entirely different description which, if accurate, makes conclusion on No. 212 obviously incorrect. If not same object, certainly not a weather balloon, as definite pattern of motion, as described, not possible under existing wind flow conditions.

No. 214: No information whatsoever.

No. 215: Very high winds 60-70 M.P.H. from SW at all levels, definitely would have prohibited any balloon from making any southerly motion. Also, last scheduled released time was three hours prior to sighting at 1,000 feet. No time in sight given so cannot compute rate of climb to 20,000 feet. Fairly conclusive, not a balloon of any kind.

No. 216: Object reported moving directly into 70 M.P.H. head winds at an estimated 350 M.P.H. Observer is a professional weather observer and should know a weather balloon. Also, reported sighting was four hours after scheduled release time.

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No. 217: Object reported moving into winds of 20-30K velocity and going faster than C-47 doing 180 M.P.H. The speed and direction are apparently very accurate since the C-47 was paralleling the object's course and several readings were made of the compass and air speed indicator. If report is true, definitely no balloon.

No. 218: No date given, consequently no check could be made of surface or upper-air data. As stated by observer, a flare is probable answer.

No. 219: Time of sighting coincides within a few minutes of the release time of the USAF rawinsonde at Newburgh and a pilot balloon sounding at New York. Very little description given that can be interpreted as either being a burning balloon or a meteor. One negative remark was that the object moved from East to West, an impossible situation for a balloon since winds at all levels were westerly.

No. 220: Wind at all levels W. to WNW; object reported flying directly into these winds. Also made definite turn from flying due North to North Northwest. Sighting time 4 1/4 hours after scheduled release times at Alameda, Sacramento and McClellan AFB.

No. 221: No information.

No. 222: Winds aloft charts not available on this one. Object sighted 2 1/2 hours after scheduled release time at which time it was plotted by a radar DF station to be at 27,000. A short time later the same station reported the object circling at 40,000; speed estimated at between 200-500 M.P.H. Most likely not a balloon.

No. 223: Definitely not a scheduled release balloon since it was seen to rise from the ground one hour before release time at Albuquerque and was seen by various persons as late as four hours after its original sighting. Seventeen individuals saw and reported this object as definitely a green flare. All commercial and governmental airfields were questioned concerning balloon releases with no success.

No. 224: Described exactly as that in No. 223, only at an altitude of 13,500 feet Mean Sea Level, 7,000 feet above the earth. Seen 2 1/2 hours after scheduled balloon release time. Wind at levels from 10,000 to 15,000 was WNW while flare was reported as travelling at very high speed in a WSW direction. Very accurate observation made by two F.S.I. agents. Definitely not a weather balloon.

No. 225: No date given. Object sighted within 15 minutes of release time of pilot balloon soundings at Albuquerque at low altitude, 500 feet. Exploded in red spray at 200 feet. This exact phenomena occurred on three different occasions at the same time which would seem to eliminate possibility of burning weather balloon.

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No. 226: Sighted one hour after release at Albuquerque; same green flare appearance as in previous five or six cases, and moving into the wind from East to West. No balloon.

No. 227: Read report of incident; definitely not a weather balloon. Serves also as guide to interpreting Incidents 223, 224, 225, and 226.

No. 228: Case under investigation, no information.

No. 229: Case dropped.

No. 230: Exactly as described in 223, etc. Definitely no weather balloon.

No. 231: Another glowing green flare just as described above.

No. 232: Investigation dropped.

No. 233: Definitely no balloon; made turns, definite fuselage, accelerated from 200 M.P.H. to 400 M.P.H.

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APPENDIX H

U. S. Department of Commerce Weather Bureau

Information on Ball Lightning

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UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU
Washington 25

In Reply Please Address
CHIEF OF BUREAU
and Refer to
0-4.3

Dec. 16, 1948

Commanding General
Air Materiel Command
Attention: MCIAXO
Wright-Patterson Air Force Base
Dayton, Ohio

Dear Sir:

Your letter of October 20, 1948, addressed to the National Bureau of Standards and requesting information on the subject of "Ball Lightning" has been referred to this Bureau for reply.

Attached is a tabulation filling in as well as practicable the information called for by the outline presented in your letter. We shall be glad to be of further assistance in connection with this matter.

Very truly yours,

/s/ F. W. Reichelderfer
F. W. Reichelderfer
Chief of Bureau

Attachment

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UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU

Report

Information on "Ball Lightning"

I. Origin

Various theories and suggestions have been proposed to explain ball lightning, most of them being without well-established physical foundation. There is still doubt in scientific circles regarding the origin of a number of reported cases of ball lightning.

Briefly, the explanations of the origin of ball lightning may be broken down as follows:

(1) Brush discharge (St. Elmo's fire).

(May be stationary over sharp-pointed objects, or moving along or near the surface of wires, roofs, rocks, etc., especially on mountains. Conditions most favorable for brush discharge occur during thunderstorms, but the phenomenon may occur even during clear, dry, dusty weather. When a lightning stroke is approaching an object, the brush discharge becomes especially intense.)

(2) Intensely ionized, incandescent volume of air forming end of lightning stroke and lasting for short interval of time.
(This would occur mainly during thunderstorms following the passage of a lightning stroke. At the ground end, the terminal flash is intense, and vapors, smoke or molten material from objects fused at points struck may enhance and extend the duration of incandescence. After-image formed on the retinas of the eyes of a person looking at the brilliant flash at the point of discharge may give spurious effects.)

(3) Brush discharge in air containing high concentration of dust or other aerosols, during thunderstorms.
(If this occurs, it probably is associated with the path taken by a real lightning stroke, and presumably involves corona discharges from suspended particles and possibly combustion in some cases.)

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(4) Jumping of gap by lightning indoors.
(When lightning strikes a house, lightning streamers may jump gaps such as between pipes within the house, thus causing a bright flash of limited extent. After-image is generally formed on the retina and movements of eye produce apparent movements of the illuminated region.)

(5) A cloud-to-ground lightning stroke with an associate, horizontally-directed, moving potential wave may possibly produce a transient horizontal potential gradient sufficiently intense to initiate electrical discharges.
(Such discharges would involve luminous darts moving at high speed and may move over irregular trajectories, producing, in some cases at least, more-or-less horizontally directed, sinuous, ribbon-like or tubular paths. If there is a heavy concentration of electrical charges near the earth beneath the thunderstorm the triggering of a discharge by the transient potential gradient may yield horizontal lightning streamers having a relatively slow propagation rate and long duration.)

(6) A lightning discharge that strikes and runs along a conductor such as power or telephone lines and flashes-over or jumps the gaps at breaks produces a brilliant illumination at the gaps that may be mistaken for ball lightning.

(7) A piece of wire with attached light object that is carried aloft by the gusty winds and turbulence attending a thunderstorm or tornado may serve to facilitate conduction of lightning currents and yield streamers at its ends during discharges.

(8) Spurious cases.

(a) After-image (persistence of vision)

(b) Will-o'-the Wisp

(c) Meteorites

(d) Reflections of lightning observed on highly polished objects, such as door knobs.

(e) Falling molten metal

(f) Lightning channel seen on end.

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II. Appearance

(a) Forms

Spherical, roughly globular, egg-shaped, or pear-shaped; many times with projecting streamers; or flame-like irregular "masses of light." Appearance of outer boundary is generally hazy or ill-defined. Photographs of the phenomenon may show one or several sinuous, tubular propagation paths (trajectories taken by luminous darts), which may have associated with them broader luminous spaces of irregular configuration. (These latter spaces probably are regions where the sinuosities of path became involved and tortuous or are areas of major discharge where darts originated or terminated). Some paths show a beaded structure (alternate luminous and dark spaces).

(b) Color

Luminous in appearance, described in individual cases by different colors but mostly reported as deep red and often as glaring white. One scientist described the color in a certain case as similar to that he has noted in the laboratory on observing active nitrogen, or possibly slightly darker. Another observed one of yellow and still another of lavender or rose color. Others have reported some of blue appearance. The luminous mass is occasionally stated to be surrounded by a border, weakly but differently-colored than the main body.

(c) Degrees of Brilliance

Brilliance at most glaring white and incandescent. Minimum brilliance equal to that of feeble St. Elmo's Fire.

(d) Movement through Space

1. Possible directions.

Generally downward, inclined or horizontal, in straight, curved, or tortuous paths. Mostly observed near the surface, but may originate in thunderclouds, and so take a trajectory from cloud to earth.

2. Maneuverability

May appear stationary, or moving. Range of speed is zero to values of the order of 10^7 cm./sec. In the

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latter, extreme case, the luminous darts observed are probably of the same general nature as the lightning streamer, although the path taken may be very irregular and even show reversals in direction. In some cases, long sections of paths of such luminous darts may show slight curvature. Near the ground or in closed spaces a much smaller speed is often said to be observed, mostly about 1 - 2 meters/sec. The "ball of fire" may seem to move or float along in a room, or to roll along the floor. In a thunderstorm, as may be experienced on a mountain top, an observer has reported "seeing balls of fire roll along the rocks and drop from one to another." Intense St. Elmo's Fire on sharp objects beneath thunderstorms may fluctuate rapidly in size, intensity, and orientation, or show displacements from one point to another, hence the flame may appear to whirl and dance, or move. When a lightning flashover at a point produces an after-image on the observer's retina, movements of the eyes cause corresponding movements of the image which the untrained observer attributes to the movement of a luminous "ball of fire" or flame. Ball lightning observed by Jonsen[1] in the wake of a lightning flash through dust-laden air during a thunderstorm "appeared as a shapeless mass of lavender color which seemed to float slowly downward." Jonsen states: "The rose-colored mass seemed most brilliant near the ground and gave the impression of a gigantic pyrotechnic display. Two or three of the globular structures seemed to roll along a pair of 2300 volt power lines for 100 feet or more, then bounded down on the ground and disappeared with a loud report."

When a lightning streamer from a thundercloud terminates in the air, the leader stroke is sometimes so faintly luminous in portions that only a segment of the path is observed. This may conceivably give the impression of elongated "ball lightning," but is a natural cloud-air lightning stroke.

3. Nearby Air or other Craft

There have been numerous cases of aircraft struck by lightning. When the aircraft is all-metallic, it serves as a Faraday cage, and provides electrical protection

1. Jonsen, J. C. Physics, vol. 4, p. 372 (1933).

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to the crew and passengers. Just preceding the onset of a lightning stroke to an aircraft, pilots have reported observing a streamer of corona discharge build up on the nose, propellers or other extremity of the craft[1]. The movement of the streamer accompanies that of the aircraft and depends on the passage of a lightning stroke nearly or through the aircraft. Corona discharges on sharply convex surfaces of aircraft have also been observed during flight between masses of clouds strongly charged with electrical charges of opposite sign (positive and negative). Autogenous charging of the aircraft by tribo-electric and other effects during flight through snow or other precipitation particles intensifies the corona discharges. These are of the same nature as St. Elmo's Fire.

St. Elmo's Fire has been observed numerous times on the mastheads of ships and generally moves with them during passage beneath thunderclouds or other meteorological conditions where intense electrical potential gradients exist.

(e) Effect on Surrounding Atmosphere

1. Clouds

Lightning of any kind can occur in clouds only if the dielectric properties of the air are broken down when the sparking potential gradient is reached. In clear air this amounts to about 30,000 volts per cm. at sea level and about 21,000 volts per cm. at 10,000 ft. altitude. In clouds, or in the presence of precipitation particles the sparking potential gradient is less, depending on the size of the particles. For example, in the presence of raindrops 1/8 inch in diameter it is about 10,000 volts/cm.

As shown by Macky[2], droplets of water suspended in an electrical field sufficiently intense to induce breakdown will display sparking-over phenomena and will

1. Harrison, L. P., "Lightning Discharges to Aircraft and Associated Meteorological Conditions," N.A.C.A. Technical Note 1001, (1946).
2. Macky, W. A., Proc. Roy. Soc. London, Ser. A, vol. 133, pp. 565-587, (1931).

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become deformed. Under very strong fields, the droplets become drawn out into filaments and disrupt with attendant electrical discharges along their surfaces or through them.

It is probable that these phenomena occur along the channel of a lightning stroke through a cloud, and that some evaporation and disruptive breakdown of droplets occur in consequence of the intense heat and flow of electrical charges. These major effects on cloud or precipitation particles are believed to be confined to the lightning channel, although minor effects such as glow or brush discharges from particles in other portions of the cloud possibly occur in connection with the development of lightning strokes. These discharges from countless particles may yield a general illumination within the cloud under strong electrical field conditions, especially during propagation of lightning strokes.

Effects of "ball lightning" on clouds are unknown. Since "ball lightning," if real, is presumably less severe than an ordinary lightning stroke or at most is probably a dart streamer of such a stroke, we may assume that the effects of "ball lightning" on clouds are not more severe than those outlined above in connection with lightning.

2. Increased Ionization

The formation of corona discharge at any point leads to a considerable increase in ionization of the surrounding air. Any case of so-called "ball lightning" which is actually a corona discharge will have a similar effect.

Ordinary lightning strokes distribute heavy concentrations of electrons and ions or charged nuclei along and near their channels during the passage of the stepped leader or dart leader. These particles form a space charge surrounding the channel. After the leader reaches the earth, the return stroke occurs from earth to cloud. When this develops, the space charge tends to migrate rapidly to the channel, producing a rush of charges within it. The flow of these charges in the channel yields the brilliant, return lightning stroke. Within the channel ionization is exceeding heavy.

"Ball lightning" associated with a true lightning stroke will probably involve a flow of space charges to its

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channel and so leads to a diminution of space charge from the environment of the path but an immediate increase of ionization along its path. Following the passage of the phenomenon, ionization will decay by recombination.

3. Nearby Air or Other Craft

All metallic aircraft which are struck by true lightning generally have scorch marks, pits, or holes burned through the skin. The holes rarely exceed one inch in diameter. (See N.A.C.A. Technical Note 1001). Portions of non-metallic material in contact with the area struck may be burnt or explosively separated from the metal to which the material is attached. When radio antennae are struck or the lightning arrester does not function as desired, damage to radio equipment often occurs.

Temporary blinding of pilots looking directly at the flash due to the stroke to some exterior portion of the aircraft such as the nose of the fuselage may introduce some hazard. As a rule the temporary blinding is effective from about 10 seconds to a larger fraction of a minute, but in one extreme case a copilot was reported to have been temporarily blinded for about 8 minutes. Several cases of temporary blinding of about 3 minutes have been reported.

The Weather Bureau has not received any reports of accidents in which an airplane was said to have suffered contact with "ball lightning." Judging by the phenomenon called by that name and experienced at the surface, the aircraft damage to be expected by such contact would probably be less severe than that caused by a typical genuine lightning stroke. That type of so-called "ball lightning" which is actually an intense corona discharge would not cause any mechanical damage to non-inflammable exposed materials, but would hamper radio communications by producing static similar to the kind termed "precipitation static."

A real lightning stroke to a non-metallic object on the ground often causes an explosive disruptive effect on the object and will cause burning of inflammable materials.

Contact of so-called "ball lightning" may have physical effects on exposed persons varying from negligible to

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fatal. In the cases of fatalities resulting from this cause, it is believed that genuine lightning was involved. Physical effects of electrical origin on persons enclosed in all-metallic aircraft are negligible, owing to the Faraday cage protection afforded by the conducting skin. However, a slight electrical shock may be experienced by a crew member aboard an aircraft if he is making good contact at two well separated points during passage of the steep wavefront of potential through the area of contact at the time of a real lightning stroke.

(f) Accompanying Phenomena

1. Sound

The origination and dissipation of "ball lightning" at the surface are often attended by a sharp report, but not invariably. Very frequently the beginning or end, respectively, of "ball lightning" is accompanied by a positively identified stroke of streak lightning to or very nearly to the point of observation. The thunder produced by such a stroke will naturally be considered by many observers to have been associated with the "ball lightning." "Ball lightning" which is in the form of a corona discharge makes very little sound, since the current carried is very low and the explosive heating effects on the air negligible. Lightning of the continuing-current type, with low-wavefront, will not produce intense sounds, and this is to be more or less expected, also, of isolated luminous dart streamers traversing the channels of preceding or succeeding lightning strokes. Such streamers have been included in the category of "ball lightning."

2. Chemical Effects

The odor of ozone in connection with "ball lightning" has been reported by some observers. This is to be expected in cases where the phenomenon is a brush discharge which produces ozone in air. When actual streak lightning is involved, the formation of oxides of nitrogen and ozone is a normal occurrence.

3. Thermal Effects

Fires have been caused in combustible material, such as straw, by discharges reported to have been "ball lightning."

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4. Electrical Effects

"Ball lightning" will certainly be accompanied by radio static in some form. Electrical shock to persons is possible when the phenomenon stems from streak lightning. Disruptive mechanical effects on non-conductors especially if containing moisture, or crushing effects on hollow conducting tubes may occur in cases where actual steep wave-front, lightning currents pass through the objects.

5. Optical Appearances

Some of the cases of "ball lightning" observed have displayed excrescences of the appearance of little flames emanating from the main body of the luminous mass, or luminous streamers have developed from it and propagated slant-wise toward the ground. In rare instances, it has been reported that the luminous body may break up into a number of smaller balls which may appear to fall towards the earth like a rain of sparks. It has even been reported that the ball has suddenly ejected a whole bundle of many luminous, radiating streamers toward the earth, and then disappeared.

Jensen[1] has quoted the following report of electrical discharges appearing in a violent storm: "A tornado which occurred on the evening of July 9, 1932, near Rock Rapids, Iowa, gave evidence of a closely related type of luminous display according to the report of Mr. George Raveling, U. S. Weather Bureau observer. From the sides of the boiling, dust-laden cloud a fiery stream poured out like water through a sieve, breaking into spheres of irregular shape as they descended. No streak lightning of the usual type was observed and no noise attended the fire-balls other than the usual roar of the storm."

(c) Possible Objects to Which Attracted

Lightning strokes are more likely to hit at or near the top of high, pointed objects, than on the surfaces of low objects with flat or concave exteriors. If the tips of the high objects are grounded via conductors such as wires or metal pipes, they will tend to show a higher frequency to strokes than ungrounded objects. This is especially true if, in the former case, the

1. Jensen, J. C., Physics, vol. 4, p. 374 (1933).

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ground is well moistened or possesses an extensive network of conducting elements (water pipes, telephone and electric cables, etc.)

It follows that the lightning flash will be observed more frequently at these relatively high points than elsewhere, and hence probably that "ball lightning" will appear to develop quite commonly at such points.

Brush discharges tend to form at sharply convex extremities of objects, and align themselves in the direction of the potential gradient. Well-grounded and conducting objects would generally receive preference. These considerations apply to cases which were classified by the layman as "ball lightning" but actually were cases of St. Elmo's Fire (bright glow or brush discharges).

There have been reports by observers of "ball lightning" to the effect that the phenomenon appeared to float through a room or other space for a brief interval of time without making contact with or being attracted by objects. Holzer and Workman[1] have published a reproduction of moving film camera photographs of unusual discharges during thunderstorms. In the case of the phenomenon observed at Santa Fe, New Mexico (elevation 7000 feet) on the night of September 3, 1936, these authors state: "The cameras were mounted rigidly on a bench in a portable laboratory. The discharge was probably about 100 feet from the cameras, although the exact distance is not known since no thunder addociated with this flash could be distinguished from the general background of thunder. The discharge occurred within less than one-thousandth of a second after an intense cloud ground stroke not shown on this portion of the film. Analysis of the photographs indicates that the discharge consisted of at least four luminous darts moving with a projected velocity of the order of 10^7 cm/sec. The most notable features of this discharge are: (1) its irregularity of path and rapid reversals in direction, (2) its proximity to ground objects with no apparent contact with the ground, (3) the beaded nature of the path, and (4) the progress of the discharge in two directions from a single point."

Note should be made of the fact that the luminous darts did not appear to be attracted to available ground objects even though they were in the vicinity of the ground. On this basis it cannot be stated whether there are any definite objects to which all cases of "ball lightning" would be attracted. We should think that sharp-pointed, grounded objects are most likely to attract "ball lightning."

1. Holzer, R. E., and Workman, E. J., Jour. of Applied Physics, vol. 10, p. 659 (1939).

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(h) Methods of Terminal Dissipation

As a rule so-called "ball lightning" of the variety which we judge to be intense brush discharge dissipates when the potential gradient diminishes to a value below the critical one for maintenance of the discharge. This generally occurs following lightning strokes which largely discharge the heavy concentrations of electric charges of opposite sign in the overlying thundercloud.

"Ball lightning" which appears to form at sharp-pointed objects as a lightning stroke approaches disappears when (a) the main lightning currents cease flowing just after contact of the stroke or (b) the space charge around the lightning channel is largely collected into the channel and transported to earth or cloud.

"Ball lightning" which appears to be a luminous dart like a meteorite rapidly falling (or rising) along the path of an immediately preceding or succeeding lightning stroke disappears into the earth (or cloud).

"Ball lightning" in the form of a luminous ball apparently moving through a space or rolling along the ground dissipates eventually, perhaps on making contact with some object. Some observers have stated that the ball collapses with a noise resembling that of a big firecracker, leaving an odor of ozone. It seems probable that in these cases also the dissipation takes place when the potential gradient has diminished below the critical value for maintenance of the discharge, simultaneously with the occurrence of a genuine lightning stroke to the area involved.

As indicated previously, reports have also been given that the main body of the "ball lightning" has appeared to have broken up into a number of smaller "balls" which have fallen to earth, or to have emitted small streaks, like lightning, projected towards the earth, and thus dissipated.

A sound of thunder, of greater or lesser intensity, may accompany the dissipation. It is not possible to be certain that the sound is always intimately connected with the phenomenon, for it may have been the thunder associated with a nearby lightning stroke.

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III. Recommended Material for Questionnaire

1. Name and address of person who observed phenomenon

2. Age, education and employment of person
(Specify especially training, if any, in scientific fields such as physics, engineering, etc.)

3. Name, address and educational qualifications of person who prepared questionnaire

4. Date and time of occurrence

5. Geographic location

6. Elevation

7. Character of observation point and surroundings
(State whether inside or outside; kind of structure, if any; neighboring structures or ground objects; and terrain)

8. Illumination available (natural and artificial)

9. Weather conditions (as thunderstorm, rain, overcast)

10. State whether genuine streak lightning was observed (a) before, (b) after, the "ball lightning"; and indicate time interval between phenomena

11. Indicate direction and apparent distance of such streak lightning; also objects believed to have been struck by it

12. State whether glow or brush discharges were observed (a) before, (b) after, the "ball lightning"; and indicate time interval between phenomena

13. Indicate locations at which glow or brush discharges were observed, and objects on which they appeared

14. Indicate brightness of discharge at points of occurrence referred to in (11) and (13)

15. Shape of ball lightning observed

16. Transparency of "ball" and general appearance of its exterior and periphery

17. Changes in its form

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18. Indicate whether flames or streamers emerged from it, and describe them

19. Location, distance, and height of phenomenon when first observed

20. Apparent size of phenomenon

21. Rotation, if any, observed

22. Colors

23. Brightness

24. Smoke or vapors emitted (color, odor, form, etc.)

25. Odor (during and after occurrence of phenomenon)

26. Heating effects, if any

27. Physiological effects

28. Mechanical effects

29. Electrical or magnetic effects

30. Sounds accompanying original appearance and life-span of phenomenon

31. Path taken by "ball lightning," including height and location during its life span

32. Movements of observer during phenomenon (including movements of head and eyes, if possible)

33. Speed of motion of "ball lightning"

34. Duration of phenomenon and duration of period of observation

35. Indicate any special conditions observed to attend beginning of phenomenon

36. Indicate conditions observed at time of ending of phenomenon

37. Traces, if any, left after dissipation

38. Psychological effect on observers

39. Was sould like that of thunder heard at time of its disappearance? Describe its intensity and character

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APPENDIX I

Project Grudge

Summary of AMC Evaluation of Remaining Reports

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APPENDIX I

In the following section of this report, each remaining unexplained incident is considered separately. It is not the intent to generally discredit the character of observers, but each case has undesirable elements, and these cannot be disregarded. The numerical designation is merely the categorical order of the incident in the project files.

Incident No. 1 — 8 July 1947, 0930 hours local, Muroc Air Force Base. Four witnesses, all observed two silver disc like or spherical objects against a clear bright sky. All witnesses estimated the altitude at about 8000 feet, and the speed between 300 and 400 MPH. It is possible to estimate distance and speed of an object with a fair degree of accuracy if the size is known. The distance is judged on the known size and speed on an estimate of distance, plus angular change in position (see page 8, app. G). In this incident the size could not be known, owing to the fact that the object was not identified. The time in sight and angular distance traveled were not given. However, the first witness stated he sighted the objects at 0930, and the last witness said he was called to view the objects at 1000. Time in sight is therefore assumed to be at least one-half hour. The objects reportedly traveled in a straight line. Taking the mean reported speed (350 MPH), the objects must then have traveled 175 MPH while in sight. If the objects were of such proportions as to be seen at that distance, it is believed that more details could have been observed at the first sighting. Two additional remarkable aspects of this case are:

1. A few moments previous to the sighting, the first witness was engaged in conversation. Quoting the witness, "My part in this conversation was as follows: 'Someone will have to show me one of those discs before I will believe it.'"

2. The statements of the three other witnesses were made to the first witness. All three agree almost identically with the first. It is probable, therefore, that their evidence was influenced by suggestion.

AMC Opinion: This report is a result of misinterpretation of the nature of real stimuli, probably research balloons.

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Incident No. 10 — 4 July 1947, 2004 hours, Boise, Idaho. An airline pilot and crew watched from the air two groups, (5 and 4 in number) of objects described as thin and smooth on the bottom and rough on top, silhouetted against sunset and flying "loose formation." They followed them for forty-five miles; therefore, had them in sight for approximately ten minutes. No further information was submitted.

AMC Opinion: Since the sighting occurred at sunset, when light conditions change rapidly and illusory effects are most likely, the objects could have been ordinary aircraft, balloons, birds, or pure illusion. Insufficient information.

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Incident No. 17 — 24 June 1947, afternoon, Mt. Rainier, Washington. One witness viewed nine "saucer-like discs" from the air calculated to be 20 to 25 miles distant, and 45-50 feet in length, (about 20 times as long as wide) which traveled 47 miles in 102 seconds (1700 MPH). Dr. Hynek calculated mathematically (see Appendix B) that assuming the estimate of distance to be accurate, in order to see such detail, the objects would need to have been at least 100 feet thick, therefore, 2000 feet long. If the estimated size is more nearly correct, then to have been seen as described, the objects would have been roughly six miles distant. At this distance they would have traveled only 11 miles in 102 seconds, or approximately 400 MPH. The entire report of this incident is replete with inconsistencies. It is to be noted that the observer has profited from this story by selling it to Fate magazine.

AMC Opinion: The report cannot bear even superficial examination, therefore, must be disregarded. There are strong indications that this report and its attendant publicity is largely responsible for subsequent reports.

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Incident No. 21 -- 29 June 1947, 1645, Des Moines, Iowa.
The observer, a bus driver, reported observing thirteen objects at 1200 ft altitude, traveling in a straight line in file at 300 MPH. The objects were elliptical in form "inverted saucer", 12 ft thick, 175-250 ft in diameter, dirty white, and made a sound like an electric motor or dynamo. There was no further information supplied except that the observer stated they looked like dots in the sky.

AMC Opinion: These objects were seen just outside Des Moines, and were flying toward Des Moines. If they were not ordinary objects mistaken for something else by the observer, but were really unusual aircraft, it seems almost certain that someone else would have also reported them. There is insufficient information for a proper analysis.

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Incident No. 29 — 14 June 1947, 1200 and 1415, Bakersfield, Calif. The observer, an experienced pilot, reported sighting ten and later seven objects at 8900 ft altitude, traveling 350 MPH in a loose "V" formation. Although the objects were apparently at a considerable distance, the reporter described them as being similar to the XF5U-1 "Flying Flapjack." He stated that he attached no particular importance to this sighting until he read of the Cascade Mountain sighting,(Incident No. 17). He then recalled this incident.

AMC Opinion: There is no information contained in this report to refute the assumption that these objects were ordinary aircraft beyond the range of identification. The fact that no one else in Bakersfield reported observing anything unusual, tends to substantiate this conclusion.

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Incident No. 35 -- 14 October 1947, 1200 hours, eleven miles north, N.E. of Cave Creek, Arizona.

Two mine operators observed one object at 8000 to 10,000 ft altitude, traveling 350 MPH, S.E. in a straight line for a period of 45-60 seconds. The object was red against the sky, and black against a cloud. It appeared to be three feet in diameter from point of observation. The OSI report of investigation states that one observer thought it was a buzzard, but decided later that it was not; the other observer said it resembled a flying wing, but was not a flying wing. No reasons are given for these apparently superfluous and conflicting remarks. As in many other instances, these observers cite their flying experience as qualification for their ability to observe and report details.

AMC Opinion: From the limited data furnished in this report, it is difficult to arrive at any conclusion. If the object was actually 10,000 ft distant, and yet appeared three feet wide to the observer, it would of necessity been huge. This sole point of contention tends to discredit the report.

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Incident No. 37 -- 14 October 1947, 1200 hours, eleven miles North, N. E. of Cave Creek, Arizona.

Two mine operators observed one object at 8000 to 10,000 ft altitude, traveling 350 MPH S.E. in a straight line for a period of 45-60 seconds. The object was red against the sky, and black against a cloud. It appeared to be three feet in diameter from point of observation. The OSI report of investigation states that one observer thought it was a buzzard, but decided later that it was not; the other observer said it resembled a flying wing, but was not a flying wing. No reasons are given for these apparently superfluous and conflicting remarks. As in many other instances, these observers cite their flying experience as qualification for their ability to observe and report details.

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Incident No. 40 — 7 July 1947, 1600 hours, Phoenix, Airzona. One observer witnessed an elliptical, flat, gray object, measuring 20-30 ft across, flying 400-600 MPH, spiraling downward to 2000 ft from 5000 ft, then ascending at a 45° angle into an overcast. Observer ran into a garage where he obtained a Kodak Brownie 120 box camera, and snapped two pictures; one negative, and a print of the other, are contained in project files. The negative displays a small apparently flat object rounded on one end, and pointed on the other. The object appears to have a hole in the center. The image is in stark contrast with the background of clouds. From the print, the object appears to be jet black with sharp outlines. Four expert photographers concur in the opinion that the image is of true photographic nature. However, they disagree with each other as to the possibility of filming such an occurrence under the conditions described. Considering the object was grey as described, and at a distance of 2000 feet, it seems unlikely that it would appear pure black on the print. In subsequent correspondence to the reporter of this incident, the observer refers to himself as Chief of Staff of Panoramic Research Laboratory, the letterhead of which lists photography among one of its specialities. Yet, the negative was carelessly cut and faultily developed. It is covered with streaks and over a period of six months, has faded very noticeably. An OSI agent discovered that a letter by this observer was published by Amazing Stories magazine early this year. In this letter he stated that he had been interviewed by two Federal agents, had given them pictures of "flying discs" and that the pictures had not been returned. He requested the advice of the magazine as to how to proceed to sue the Government. This individual is aware of the whereabouts of these pictures, but has never requested their return. There are other undesirable aspects to this case. The observer's character and business affiliations are presently under investigation, the results of which are not yet known. Dr. Irving Langmuir studied subject photographs, and after learning of the prior passage of a thunderstorm, discounted the photographed object as being merely paper swept up by the winds.

AMC Opinion: In view of the apparent character of the witness, the conclusion by Dr. Langmuir, seems entirely probable.

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By VH NARA Date 2/14/98

REPRODUCED AT THE NATIONAL ARCHIVES

Incident No. 51 -- 3 September 1947, 1215 hours, Oswego, Oregon. A housewife observed twelve to fifteen round, silver-colored objects at a high altitude. No further information was submitted, therefore, no conclusion can be reached.

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By VH NARA Date 2/14/98

REPRODUCED AT THE NATIONAL ARCHIVES

Incident No. 58 — 4 August 1947, Sunset, near Bethel, Alaska. A pilot and his co-pilot observed a black object of the design and approximate dimensions of a C-54 fuselage, flying at 500-1000 ft altitude N.W. The object crossed their path at right angle, and they pulled up to 1200 ft to avoid a collision, then chased it at 170, but lost sight of it in four minutes. They estimated the speed of the object to be three times their own, or 510 MPH. Assuming the estimate of speed to be correct, elementary computations determine the distances object traveled as 34 miles in four minutes while the observer's airplane moved eleven miles in the same period. Therefore, the object was more than twenty miles distant when last seen. To be capable of being seen at this distance under the conditions given, the object would have to be about 50 feet in its smallest or end-on dimension. If this were true, and the object was proportionate with a C-54 fuselage, its length would be about 500 ft. Assuming the estimate of speed to be incorrect, but time in sight to be correct, the problem is figured in reverse, using as a reasonable width 15 feet. In this event the object would have been less than ten miles away when lost to sight, therefore, it would have traveled about eighteen miles in four minutes, giving a speed of less than 300 MPH.

AMC Opinion: It is believed that the pilots were suddenly startled by a conventional aircraft crossing their path, and that as they gave chase to the aircraft which was "silhouetted against a brilliant evening sky", they were partially blinded, and were therefore unable to discern wings or engines.

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Incident No. 62 -- 8 September 1947, 2230-2300 hours, Logan, Utah. A man and his wife, together with five other unidentified people, observed five groups each of 35-60 small objects, yellowish-white in color, flying several thousand feet in the air at a high rate of speed. The weather was cloudy.

AMC Opinion: From the limited evidence submitted, it is practically impossible to formulate a conclusion. Fast motion could be attributed to closeness rather than to true linear distance. In an atmosphere of darkness, any impression may be erroneous. Ground lights reflected from moving, low-hanging clouds, themselves not visible, could readily account for this report. Light colored birds are another possibility.

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Incident No. 64 — 19 August 1947, 2130 hours, Twin Falls, Idaho. Several people were reported as sighting numerous groups of objects in the night sky. These objects were described as a glow in the air with a color similar to regular electric lights. The objects were said to have traveled at "terrific" speed. Some flew in triangular formation. Three objects peeled off of one group of ten, and proceeded on another course. The sky was overcast. Two observers stated that the objects could not have been birds since the lights were not a reflection of city lights.

AMC Opinion: Many familiar objects visible because of the fact that they reflect light, appear to be incandescent; for example, the moon and certain planets. The evidence is, therefore, contradictory since in one instance the objects are described as merely a glow, and later on as not being reflectory. The submitted evidence is readily explained as in incident 62; ground lights reflected from clouds, or birds in flight.

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Incident No. 68 — 24 June 1947, Daytime, Cascade Mountains, Washington. A prospector reported sighting five or six round objects with tails, 1000 ft overhead, heading S.E., and banking in the sun. The objects were in sight 45-60 seconds, and alleged to be thirty feet in diameter. They made no noise. While the objects were within sight, the observers compass fluctuated wildly. He states that he read of a former sighting (incident No. 17) also occurring on 24 June 1947, and submitted this report solely to add credence to the person who provided that story. While there appears to be an attempt on the part of the observer to infer that these objects were possibly the same as those reported in (incident No. 17), there are several major differences, notably as Dr. Hynek points out (app.B), that these objects had tails, and that the inferred size, as determined from the estimated distance, is quite different. Dr. Valley (App D) has pointed out and Dr. Hynek concurred that it is difficult to take seriously the peculiar action of the compass for this would imply fantastically large magnetic fields.

AMC Opinion: From the limited evidence submitted, it is impossible to reach a definite conclusion. However, two possible psychological factors are readily apparent; one, the observer stated he submitted this report solely because he had read several days following his observation of another sighting. Therefore, he very likely either consciously or inadvertently may have attempted to conform his report to that recounted in the newspaper; and two, he colored his report with inference of huge magnetic fields, as to the implications of which he was obviously uninformed.

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Incident No. 71 — 8 or 9 October 1947, daytime, Las Vegas, Nevada. An Air Force Reserve pilot reported observing a trail appearing high in the sky at an estimated speed of 400-1000 MPH. The object producing the trail was not visible. The trail was white as a cloud, and dissipated in fifteen to twenty minutes. The object proceeded in a straight line, then it made an approximately 180° turn of radius five to fifteen miles, and proceeded away toward the direction of first appearance. The weather was described as "almost cloudless."

AMC Opinion: It is difficult to understand why this individual attached any importance to this sighting, and why he did not conclude that the trail was caused by exactly what it appears to have been; that is, an ordinary aircraft flying normally at an altitude too high for itself to be visible, but in the best altitude range to form vapor trails 20,000 - 45,000 feet.

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Incident No. 75 -- 13 August 1947, 1300 hours, Smoke River Canyon, Idaho. A farmer together with his two sons, ten and eight years of age, witnessed an object move down a canyon. It was in view only momentarily at a distance of 300 feet, and approximately 75 feet above the ground. The object made a swishing sound, and was sky-blue in color. The farmer doubted the possibility of its visibility if viewed against the sky. The children told of smokeless turbine or exhaust flames shooting from the device through which could be seen daylight. The object passed over some trees, which in the words of the farmer, "spun around on top as if they were in a vacuum."

AMC Opinion: It seems logical to concur with Dr. Hynek's deduction, that this object was simply a rapidly moving atmospheric eddy.

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Incident No. 76 -- 13 August 1947, Salmon Dam, Idaho.

Two men reported simultaneously hearing a roar, and looking up observed two objects of undertermined size, several miles distant at a great height which they thought might have been 4000-6000 feet. The objects were "circular", "reflected light", and were traveling at "great speed". Although occurring on the same day as Incident No. 75, the descriptions vary widely.

AMC Opinion: There is no information contained in this report to refute the assumption that these men saw two ordinary aircraft at too great a distance to discern details.

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REPRODUCED AT THE NATIONAL ARCHIVES

Incident No. 77 -- 3 July 1947, 1430 Hours, South Brooksville, Maine.
This observer, an "astronomer", heard a loud roar and with difficulty observed at 50° elevation approximately ten very light-colored objects traveling N. W. The group is reported to have covered 1 1/2° angular diameter in the sky, bunched together with no regular formation. He calculated that at a distance of 10 miles the objects would have a speed of 1200 MPH; that their width must be 100 feet across and due to their color would be barely visible. He also estimated the object would have a width of fifty feet at five miles with a speed of 600 MPH. He believed they were aircraft of some type, owing to the loud roar. In his letter he asked, "have any meteorites been reported?"

AMC Opinion: It is believed that the observer should have been able to rule out the possibility of meteorites. Reducing the estimate of distance, and correspondingly reducing the required size to that of objects such as birds or insects, then the speeds become very modest. If the objects were actually five to ten miles distant, and responsible for the "unusually loud roar", it is expected that numerous other reports would have been received from this section of Maine, which is thickly populated.

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Incident No. 79 -- April 1947, Richmond, Virginia
A weather bureau observer at the Richmond Station observed on three different occasions, during the six-month period prior to April 1947, a disc-like metal chrome object. All sightings were made through a theodolite while making pibal observations. On the last reported sighting, the balloon was at 15,000 feet altitude, the disc followed for fifteen seconds. It was shaped like an ellipse with a flat level bottom and a dome-like top. The altitude and speed were not estimated, but the object, allegedly through the instrument, appeared larger than the balloon. Another observer at the same station saw a similar object under corresponding circumstances, with the exception that her balloon was at an altitude of 27,000 feet and possessed a dull metallic luster. There was good visibility on days of observation. Report of this sighting was not submitted until 22 July 1947.

*AMC Opinion: There is no readily apparent explanation. If there were only one such object, it seems amazingly coincidental that it would be seen four times near the pibal of this station only. On the other hand, there would have to have been a great number of these objects to rule out coincidence, and as the number of objects increases so do the chances of sightings by other witnesses.

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Incident No. 84 -- 7 July 1947, 1300-1400 Hours, Lakeland, Fla. One observer reported hearing a swishing noise and then seeing, five shiny objects climbing from 5000 ft to 7500 ft in fifteen to thirty seconds. He estimated the objects were one mile from him. The lead object was of plastic appearance and appeared to be towing the other four. The reporter made a model and submitted it as an exhibit. The model is roughlytwo feet in diameter, domed top and bottom and with an opening in the rear on either side of a vertical fin. Police records list the man as having been AWOL from the Navy on two occasions. A neighborhood and employment check disclosed he is an excitable person, very talkative, possessing an exaggerated imagination, and inclined to impress people with his continuous verbal chatter.

AMC Opinion: This incident has all the aspects of a psychopathological report.

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Incident No. 111 — 1 April 1947, 0955 Hours, Central Phillipines. An F-47 pilot leading three other aircraft at 1500 ft saw an object approximately three miles away at 1000 ft. Object appeared to be a flying wing thirty by twenty feet, silver in color. The pilot turned to intercept the object and the object turned on nearly the same course and disappeared from sight in five seconds. Object appeared to have a dorsal fin but distance was too great to note any other features. The report does not reveal whether any of the other pilots saw the object.

AMC Opinion: No definite explanation. However, every pilot has experienced the sensation of seeing an aircraft obliquely at nearly the limit of vision and then losing sight at the same range when the aircraft presented, in stern view, a smaller surface.

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Incident No. 122 -- 5 April 1948, Holloman Air Force Base, New Mexico.
Three balloon observers saw ar object very high in the sky, moving faster than any known aircraft and possessing a rounded indistinct form, which disappeared suddenly. It was seen less than thirty seconds and was apparently not manned, judging by its violent maneuvers. For analogous size they stated if the moon were the size of an orange the object would approximate the size of a disc.

AMC Opinion: No explanation. However, the above comparison of size is to be noted. A dime held at arms length would shield the moon from the eye even if the moon appeared several times larger than it does. To reduce the proportion then, this object must have appeared as an infinitesimal point. From trained observers, this is certainly a major discrepancy.

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Incident No. 134 -- 28 May 1948, 1500 Hours, Monroe, Michigan. One passenger in a C-47 at 8000 ft observed three disc-like objects and later two more (another observer saw only the two). The objects appeared to descend from above, level off at altitude of C-47 and travel in the opposite direction at great speed. They left no trail, were disc shaped and were "silvery-gold" or "shiny brass" in color. One observer said they were 300-400 feet across with well rounded contours, the other said they were four feet in size. The first observer later said all had a hazy or fuzzy outline. There was an overcast at 15,000 feet and a thin, broken stratus layer at 8000 feet, the level of the aircraft.

AMC Opinion: Dr. Hynek suggests these individuals could have seen successive shafts of sunlight through breaks in the high overcast illuminating portions of the lower cloud stratum. Apparent speed could be a combination of projected motion of the break in the overcast and the velocity of the C-47. This explanation partially fits the contradictory evidence.

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Incident No. 135 -- Between 15 and 20 August 1947, 2130 Hours, Weaver, South Dakota.

An Air Force Officer saw twelve "flying discs" four miles away over the Rapid City Air Force Base in a tight diamond formation at 8000 to 10,000 feet descending to 6000 feet at 500 MPH. Objects made a formation turn and climbed at 30° to 40° accelerating. Objects were very maneuverable, remaining equally spaced in all maneuvers. Each object was 100 feet in length, oval-shaped and brilliant yellowish-white. No sound nor exhaust trail were heard or seen.

AMC Opinion: This reporter should be a reliable observer. However, it has been shown that distance cannot be estimated without prior knowledge of the size of an object. If distance is not known, speed cannot be estimated. More notable perhaps is that such minute detail could be remembered in a report made one year after the observation and yet the date was not remembered. Dr. Hynek suggested the possibility of detached auroral streamers.

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Incident No. 151 -- 29 July 1948, 0955 Hours, Indianapolis, Indiana.
The observers driving a truck saw an object shaped like a broad short propeller traveling 25-30 MPH in a bank just above the trees at thirty feet altitude. It was eight feet long, two feet wide and one foot thick, with "cups" on the upper sides of the blades. The object glided with no spinning action, and there was no sound or trail. The object was thought to have fallen, but a search revealed nothing.

AMC Opinion: No satisfactory conclusion can be drawn.

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REPRODUCED AT THE NATIONAL ARCHIVES

Incident No. 152 -- 31 July 1948, 0825 Hours, Indianapolis, Indiana.
A man and his wife saw an object shaped like a cymbal, lusterless white in color, at an altitude of 2000 ft. The object moved across the sky to the east at approximately 1800 MPH, on a level course and shimmering in the sun, giving the appearance of spinning. It was twenty feet in diameter and six to eight feet high in the center. There was no sound or exhaust.

AMC Opinion: This object could conceivably be the same at different angles as that seen in Incident 151, although all the remaining evidence is widely divergent. No satisfactory conclusion can be drawn.

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By VH NARA Date 2/14/98
REPRODUCED AT THE NATIONAL ARCHIVES

Incident No. 154 -- 2 August 1945, 1945 Hours, Columbus, Ohio
An attorney and his wife observed an object moving south over the center of Columbus at 1500-2000 ft altitude. During the ten to fifteen minutes the object remained in sight, it changed shape from that of a parellogram to a circle and back again, direction of travel remained constant. Once it seemed to hesitate and a thin trail of smoke appeared from the rear. The smoke disappeared soon. The outline of the object was dark gray or black, but the center seemed to be transparent. Object was judged to be 20 to 30 feet in diameter.

AMC Opinion: There is no reason to believe other than that this object was a research balloon, of which there are many types, and that the "trail of smoke" appeared so from a momentary glimpse of trailing apparati.

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Incident No. 162 -- 11 August 1948, 1200 Hours, Hamel, Minnesota. Two children, ages ten and eight, described a dull gray object two feet in diameter and one foot thick, shaped like two plates together which settled gently to the ground. It clanked when it touched down. On the ground it emitted a whistling noise and "shot" up to twenty feet where it hesitated, whistled once more, "shot" up to thirty feet, then "shot" off in a northeast direction.

AMC Opinion: This apparent bit of fantasy is hardly worth further consideration.

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Incident No. 168 -- 20 July 1948, 1330 Hours, Arnheim, The Hague.
One observer saw an object intermittently through clouds four times. The object had two decks and no wings, was said to be very high, with speed comparable to V-2.

AMC Opinion: Insufficient information. It may be well to point out that the V-2 is not visible in flight, therefore, it follows that this object would not have been visible as described if traveling at that speed.

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Incident No. 176 -- 23 Sept. 1948, 1200 Hours, San Pablo, Calif. On a dull hazy day, two men saw a large translucent object over a mile overhead. It was the size of a four-engine bomber, buff-gray in color, and appeared to be made of canvas. According to the first observer, the center portion was spherical and undulated, having appendages fore and aft, like an amoeba. The second observer said the object looked like a "vegetable crate" covered with translucent material. The investigator states one observer's description was in direct contradiction to the other. One observer was far-sighted but wore no glasses, the other was over seventy, needed glasses to read but wore none at time of sighting.

AMC Opinion: The only fact that might be accepted is that an object was seen. Two observers, side by side, could not agree on its appearance. The evidence is useless. A balloon or cluster of balloons, an aircraft, or a cloud could have been the stimulus.

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Incident No. 183 -- 15 Oct. 1948, 2305 Hours, Fusnoka Area, Japan.
Airborne radar observer in F-61 attempted six times to intercept an object between 5000 and 6000 ft. The object traveled 200 MPH until approached to within 12,000 ft., then quickly accelerated from scope at estimated 1200 ft. Object appeared to be 20-30 ft long. Pilot saw silhouette on undercast of object with rounded nose, general projectile shape, cut off sharply at rear.

AMC Opinion: There is no apparent explanation. One discrepancy seems to be that the target was never seen by ground radar, which was operating and had the F-61 in sight throughout period of sighting.

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Incident No. 186 -- 16 Oct. 1948, 1145 Hours, eight miles east of Sterling, Utah.
One observer on mountain at 9000 ft heard a throbbing noise, then saw one object 9 inches long, three inches thick, and six inches wide traveling horizontally at 300 MPH, 500 ft overhead. It was black with a wide silver stripe on underside center. Investigator states observer's ability to estimate distances is poor. In sight approximately four seconds.

AMC Opinion: Information indicates no explanation.

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Incident No. 193 -- 24 Oct. 1948, between 1100 and 1330 GMT, Neubiberg, Germany.
An Air Force Officer heard a sound like an F-47 at high altitude, looked up and saw a dark object shaped like a coin at undetermined altitude, 60° elevation flying southwest at fast undetermined speed in level flight.

AMC Opinion: There is nothing to controvert the conclusion that this object was a conventional aircraft at a range outside the limit of visual resolution.

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REPRODUCED AT THE NATIONAL ARCHIVES

Incident No. 207 -- 18 Nov. 1948, 2200 Hours, Andrews Air Force Base, Maryland.
The pilot of a T-6 reported seeing an object over the base at 1700 feet. Object was an oblong ball with one light, no wings, no exhaust, in landing light of T-6. It had a dull gray glow and was thought to be smaller than the T-6. Pilot made passes and object evaded by going above aircraft. T-6 tried to close in very tight climbing turns, but object turned inside the aircraft. Object was lost after ten minutes at 7500 feet. Its speed seemed to vary between 80 MPH and 60 MPH.

AMC Opinion: That the object described was a synoptic balloon. Dr. Fitt's report shows that it is very difficult for the observer to separate target motion and his own motion even in daylight, and practically impossible to do so at night. This fact has been substantiated by the writer, who in controlled experiments attacked ordinary balloons with a T-6. In daylight, and with knowledge of what the object was and what it did, all the above described maneuvers were duplicated in appearance.

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Incident No. 215 -- 3 Dec. 1948, 2015 Hours, Fairfield-Luisan Air Force Base, California.
The base control tower operator saw for 25 seconds a bright white light in the air. It came into view two miles away at 500 to 1000 ft, climbing slowly at 400 MPH; at 1500 ft it slowed for a few seconds to 200 MPH; at this time, it undulated or bounced; rose vertically to 3000 ft and immediately afterwards climbed quickly to 20,000 ft and was lost to sight.

AMC Opinion: There is no logical explanation for this incident that fits the available evidence.