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SCIENTIFIC STUDY OF UNIDENTIFIED FLYING OBJECTS

Conducted by the
University of Colorado
under contract No. F44620-67-C-0035
with the
United States Air Force

Dr. Edward U. Condon
Scientific Director

Volume I

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JAN 28 1969
A

Final Report of the
Scientific Study of Unidentified Flying Objects
conducted by the University of Colorado
under contract to the United States Air Force

Dr. Edward U. Condon
Scientific Director

Daniel S. Gillmor
Editor

This research was supported by the Air Force
Office of Scientific Research, Office of Aerospace
Research, USAF, under contract F44620-67-C-0035.

1968

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With the exception of correction of grammatical
and typographical errors made in this edition, it
is a reproduction of the report submitted to the
National Academy of Sciences on November 15, 1968,
for its scientific review.

UNIVERSITY OF COLORADO

PRESIDENT'S OFFICE

BOULDER, COLORADO 80502

October 31, 1968

The Honorable Harold Brown
Secretary of the Air Force
The Pentagon
Washington, D. C.

Dear Dr. Brown:

Pursuant to Contract No.F44620-67-C-0035 between the United States Air Force and the University of Colorado, I transmit herewith the final report of the Scientific Study of Unidentified Flying Objects.

As you know, the University undertook this study at the urging of the Air Force, not only for its purely scientific aspects, but in order that there might be no question that any of the matters reported herein reflect anything other than strict attention to the discovery and disclosure of the facts. I want to take this occasion to assure you that, under the direction of Dr. Edward U. Condon, the study has been made and the report prepared with this thought constantly in mind. The Air Force has been most cooperative, both in respect to furnishing the project with all information in its possession bearing upon the subject matter of the investigation and, equally important, in pursuing most scrupulously a policy of complete non-interference with the work of Dr. Condon and his staff. There has never been the slightest suggestion of any effort on the part of the Air Force to influence either the conduct of the investigation or the content of this report.

The Honorable Harold Brown
Page 2.

October 31, 1968

As a consequence of this cooperation and of a diligent effort on the part of scientists at this University, at the Environmental Science Services Administration, at the National Center for Atmospheric Research, and at other universities and scientific institutions, the report transmitted to you herewith is, I believe, as thorough as the time and funds allotted for the purpose could possibly permit.

We hope and believe that it will have the effect of placing the controversy as to the nature of unidentified flying objects in a proper scientific perspective. We also trust that it will stimulate scientific research along lines that may yield important new knowledge.

Sincerely yours,



J. A. Smiley
President

Preface

On 31 August 1966, Colonel Ivan C. Atkinson, Deputy Executive Director of the Air Force Office of Scientific Research, addressed a letter to the University of Colorado. In it he outlined the belief of AFOSR that a scientific investigation of unidentified flying objects conducted wholly outside the jurisdiction of the Air Force would be of unusual significance from the standpoint of both scientific interest in and public concern with the subject. Colonel Atkinson requested "that the University of Colorado participate in this investigation as the grantee institution." The University was asked to undertake this scientific study with the unconditional guarantee that "the scientists involved will have complete freedom to design and develop techniques for the investigation of the varied physical and psychological questions raised in conjunction with this phenomenon according to their best scientific judgment."

The request of AFOSR was pursuant to the recommendation made in March, 1966, of an *ad hoc* panel of the United States Air Force Scientific Advisory Board, chaired by Dr. Brian O'Brien. Subsequently, as chairman of the Advisory Committee to the Air Force Systems Command of the National Academy Sciences-National Research Council, Dr. O'Brien had advised AFOSR on the suitability of the University of Colorado as the grantee institution.

Following receipt of Colonel Atkinson's request in behalf of AFOSR, the University administration and interested members of the faculty discussed the proposed study project. The subject was recognized as being both elusive and controversial in its scientific aspects. For this reason alone, there was an understandable reluctance on the part of many scientists to undertake such a study. Scientists hesitate to commit their time to research that does not appear to offer reasonably

clear avenues by which definite progress may be made. In addition, the subject had achieved considerable notoriety over the years. Many popular books and magazine articles had criticized the Air Force for not devoting more attention to the subject; others criticized the Air Force for paying any attention whatever to UFOs.

Bearing these facts in mind, the University administration concluded that it had an obligation to the country to do what it could to clarify a tangled and confused issue while making entirely certain that the highest academic and scientific standards would be maintained. Fortunately, Dr. Edward U. Condon, Professor of Physics and Fellow of the Joint Institute for Laboratory Astrophysics, shared this concern and was willing to accept appointment as scientific director of the project. Designated as principal investigators with Dr. Condon were Dr. Stuart Cook, Professor and Chairman of the Department of Psychology, and Dr. Franklin E. Roach, physicist specializing in atmospheric physics at the Environmental Science Services Administration. Assistant Dean Robert J. Low of the Graduate School was appointed project coordinator.

The University undertook the study only on condition that it would be conducted as a normal scientific research project, subject only to the professional scientific judgment of the director and his aides. Freedom from control by the granting agency was guaranteed not only by the assertions of Colonel Atkinson, but also by the provision that the complete report of the findings of the study would be made available to the public.

In addition the University recognized that this study, as the first undertaken on a broad scale in this field, would have seminal effect. It therefore desired the cooperation of the scientific community at large. Assurances of support and counsel were forthcoming from such institutions as the National Center for Atmospheric Research (NCAR) and the Environmental Science Services Administration (ESSA), and from

many scientists and scientific institutions in other parts of the country.

The University also welcomed an arrangement whereby the methods and results of the study would be critically examined at the conclusion of the project. This cooperation was extended by the National Academy of Sciences, which announced in its October 1966 *News Report* that the Academy had agreed to review the University of Colorado study upon its completion in 1968. Unhesitatingly agreeing to this independent examination of the study, the ASOFR announced that it would consider the NAS review a "further independent check on the scientific validity of the method of investigation."

In October, 1966, the scientific director assembled a modest staff centered at the University campus in Boulder and work began. In addition, agreements were entered into between the University and such institutions as NCAR, the Institutes of ESSA, the Stanford Research Institute and the University of Arizona for the scientific and technical services of persons in specialized fields of knowledge bearing upon the subject under investigation. Thus it became possible to study specific topics both at Boulder and elsewhere and to bring to bear upon the data gathered by the project's field investigation teams whatever expertise might be required for full analysis of the information.

The report of the study that was conducted over the ensuing 18 months is presented on the following pages. It is lengthy and diverse in the subjects it treats, which range from history to critical examination of eye-witness reports; from laboratory analysis to presentation of general scientific principles. No claim of perfection is made for this study or for its results, since like any scientific endeavor, it could have been improved upon -- especially from the vantage-point of hindsight. The reader should thus bear in mind that this study represents the first attempt by a group of highly qualified scientists and specialists to examine coldly and dispassionately a subject that has

aroused the imagination and emotions of some persons and has intrigued many others. No one study can answer all questions; but it can point out new lines for research, it can cross off some ideas as not fruitful for further inquiry, and it can lay to rest at least some rumors, exaggerations, and imaginings.

Thurston E. Manning
Vice President for Academic Affairs

Boulder, Colorado
October 31, 1968

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Section I

Conclusions and Recommendations

Edward U. Condon

We believe that the existing record and the results of the Scientific Study of Unidentified Flying Objects of the University of Colorado, which are presented in detail in subsequent sections of this report, support the conclusions and recommendations which follow.

As indicated by its title, the emphasis of this study has been on attempting to learn from UFO reports anything that could be considered as adding to scientific knowledge. Our general conclusion is that nothing has come from the study of UFOs in the past 21 years that has added to scientific knowledge. Careful consideration of the record as it is available to us leads us to conclude that further extensive study of UFOs probably cannot be justified in the expectation that science will be advanced thereby.

It has been argued that this lack of contribution to science is due to the fact that very little scientific effort has been put on the subject. We do not agree. We feel that the reason that there has been very little scientific study of the subject is that those scientists who are most directly concerned, astronomers, atmospheric physicists, chemists, and psychologists, having had ample opportunity to look into the matter, have individually decided that UFO phenomena do not offer a fruitful field in which to look for major scientific discoveries.

This conclusion is so important, and the public seems in general to have so little understanding of how scientists work, that some more comment on it seems desirable. Each person who sets out to make a career of scientific research, chooses a general field of broad specialization in which to acquire proficiency. Within that field he looks for specific fields in which to work. To do this he keeps abreast of the published scientific literature, attends scientific meetings, where reports on current progress are given, and energetically discusses his interests and those of his colleagues both face-to-face and by

correspondence with them. He is motivated by an active curiosity about nature and by a personal desire to make a contribution to science. He is constantly probing for error and incompleteness in the efforts that have been made in his fields of interest, and looking for new ideas about new ways to attack new problems. From this effort he arrives at personal decisions as to where his own effort can be most fruitful. These decisions are personal in the sense that he must estimate his own intellectual limitations, and the limitations inherent in the working situation in which he finds himself, including limits on the support of his work, or his involvement with other pre-existing scientific commitments. While individual errors of judgment may arise, it is generally not true that all of the scientists who are actively cultivating a given field of science are wrong for very long.

Even conceding that the entire body of "official" science might be in error for a time, we believe that there is no better way to correct error than to give free reign to the ideas of individual scientists to make decisions as to the directions in which scientific progress is most likely to be made. For legal work sensible people seek an attorney, and for medical treatment sensible people seek a qualified physician. The nation's surest guarantee of scientific excellence is to leave the decision-making process to the individual and collective judgment of its scientists.

Scientists are no resisters of authority. Our conclusion that study of UFO reports is not likely to advance science will not be uncritically accepted by them. Nor should it be, nor do we wish it to be. For scientists, it is our hope that the detailed analytical presentation of what we were able to do, and of what we were unable to do, will assist them in deciding whether or not they agree with our conclusions. Our hope is that the details of this report will help other scientists in seeing what the problems are and the difficulties of coping with them.

If they agree with our conclusions, they will turn their valuable attention and talents elsewhere. If they disagree it will be because

our report has helped them reach a clear picture of wherein existing studies are faulty or incomplete and thereby will have stimulated ideas for more accurate studies. If they do get such ideas and can formulate them clearly, we have no doubt that support will be forthcoming to carry on with such clearly-defined, specific studies. We think that such ideas for work should be supported.

Some readers may think that we have now wandered into a contradiction. Earlier we said that we do not think study of UFO reports is likely to be a fruitful direction of scientific advance; now we have just said that persons with good ideas for specific studies in this field should be supported. This is no contradiction. Although we conclude after nearly two years of intensive study, that we do not see any fruitful lines of advance from the study of UFO reports, we believe that any scientist with adequate training and credentials who does come up with a clearly defined, specific proposal for study should be supported.

What we are saying here was said in a more general context nearly a century ago by William Kingdon Clifford, a great English mathematical physicist. In his "Aims and Instruments of Scientific Thought" he expressed himself this way:

Remember, then, that [scientific thought] is the guide of action; that the truth which it arrives at is not that which we can ideally contemplate without error, but that which we may act upon without fear; and you cannot fail to see that scientific thought is not an accompaniment or condition of human progress, but human progress itself.

Just as individual scientists may make errors of judgment about fruitful directions for scientific effort, so also any individual administrator or committee which is charged with deciding on financial support for research proposals may also make an error of judgment. This possibility is minimized by the existence of parallel channels, for consideration by more than one group, of proposals for research

projects. In the period since 1945, the federal government has evolved flexible and effective machinery for giving careful consideration to proposals from properly qualified scientists. What to some may seem like duplicated machinery actually acts as a safeguard against errors being made by some single official body. Even so, some errors could be made but the hazard is reduced nearly to zero.

Therefore we think that all of the agencies of the federal government, and the private foundations as well, ought to be willing to consider UFO research proposals along with the others submitted to them on an open-minded, unprejudiced basis. While we do not think at present that anything worthwhile is likely to come of such research each individual case ought to be carefully considered on its own merits.

This formulation carries with it the corollary that we do not think that at this time the federal government ought to set up a major new agency, as some have suggested, for the scientific study of UFOs. This conclusion may not be true for all time. If, by the progress of research based on new ideas in this field, it then appears worthwhile to create such an agency, the decision to do so may be taken at that time.

We find that there are important areas of atmospheric optics, including radio wave propagation, and of atmospheric electricity in which present knowledge is quite incomplete. These topics came to our attention in connection with the interpretation of some UFO reports, but they are also of fundamental scientific interest, and they are relevant to practical problems related to the improvement of safety of military and civilian flying.

Research efforts are being carried out in these areas by the Department of Defense, the Environmental Science Services Administration, the National Aeronautics and Space Administration, and by universities and nonprofit research organizations such as the National Center for Atmospheric Research, whose work is sponsored by the National Science Foundation. We commend these efforts. By no means should our lack of

enthusiasm for study of UFO reports as such be misconstrued as a recommendation that these important related fields of scientific work not be adequately supported in the future. In an era of major development of air travel, of space exploration, and of military aerospace activities, everything possible should be done to improve our basic understanding of all atmospheric phenomena, and to improve the training of astronauts and aircraft pilots in the recognition and understanding of such phenomena.

As the reader of this report will readily judge, we have focussed attention almost entirely on the physical sciences. This was in part a matter of determining priorities and in part because we found rather less than some persons may have expected in the way of psychiatric problems related to belief in the reality of UFOs as craft from remote galactic or intergalactic civilizations. We believe that the rigorous study of the beliefs--unsupported by valid evidence--held by individuals and even by some groups might prove of scientific value to the social and behavioral sciences. There is no implication here that individual or group psychopathology is a principal area of study. Reports of UFOs offer interesting challenges to the student of cognitive processes as they are affected by individual and social variables. By this connection, we conclude that a content-analysis of press and television coverage of UFO reports might yield data of value both to the social scientist and the communications specialist. The lack of such a study in the present report is due to a judgment on our part that other areas of investigation were of much higher priority. We do not suggest, however, that the UFO phenomenon is, by its nature, more amenable to study in these disciplines than in the physical sciences. On the contrary, we conclude that the same specificity in proposed research in these areas is as desirable as it is in the physical sciences.

The question remains as to what, if anything, the federal government should do about the UFO reports it receives from the general public. We are inclined to think that nothing should be done with them in the expectation that they are going to contribute to the advance of science.

This question is inseparable from the question of the national defense interest of these reports. The history of the past 21 years has repeatedly led Air Force officers to the conclusion that none of the things seen, or thought to have been seen, which pass by the name of UFO reports, constituted any hazard or threat to national security.

We felt that it was out of our province to attempt an independent evaluation of this conclusion. We adopted the attitude that, without attempting to assume the defense responsibility which is that of the Air Force, if we came across any evidence whatever that seemed to us to indicate a defense hazard we would call it to the attention of the Air Force at once. We did not find any such evidence. We know of no reason to question the finding of the Air Force that the whole class of UFO reports so far considered does not pose a defense problem.

At the same time, however, the basis for reaching an opinion of this kind is that such reports have been given attention, one by one, as they are received. Had no attention whatever been given to any of them, we would not be in a position to feel confident of this conclusion. Therefore it seems that only so much attention to the subject should be given as the Department of Defense deems to be necessary strictly from a defense point of view. The level of effort should not be raised because of arguments that the subject has scientific importance, so far as present indications go.

It is our impression that the defense function could be performed within the framework established for intelligence and surveillance operations without the continuance of a special unit such as Project Blue Book, but this is a question for defense specialists rather than research scientists.

It has been contended that the subject has been shrouded in official secrecy. We conclude otherwise. We have no evidence of secrecy concerning UFO reports. What has been miscalled secrecy has been no more than an intelligent policy of delay in releasing data so that the public does not become confused by premature publication of incomplete studies of reports.

The subject of UFOs has been widely misrepresented to the public by a small number of individuals who have given sensationalized presentations in writings and public lectures. So far as we can judge, not many people have been misled by such irresponsible behavior, but whatever effect there has been has been bad.

A related problem to which we wish to direct public attention is the miseducation in our schools which arises from the fact that many children are being allowed, if not actively encouraged, to devote their science study time to the reading of UFO books and magazine articles of the type referred to in the preceding paragraph. We feel that children are educationally harmed by absorbing unsound and erroneous material as if it were scientifically well founded. Such study is harmful not merely because of the erroneous nature of the material itself, but also because such study retards the development of a critical faculty with regard to scientific evidence, which to some degree ought to be part of the education of every American.

Therefore we strongly recommend that teachers refrain from giving students credit for school work based on their reading of the presently available UFO books and magazine articles. Teachers who find their students strongly motivated in this direction should attempt to channel their interests in the direction of serious study of astronomy and meteorology, and in the direction of critical analysis of arguments for fantastic propositions that are being supported by appeals to fallacious reasoning or false data.

We hope that the results of our study will prove useful to scientists and those responsible for the formation of public policy generally in dealing with this problem which has now been with us for 21 years.

Section II

Summary of the Study

Edward U. Condon

1. Origin of the Colorado Project

The decision to establish this project for the Scientific Study of Unidentified Flying Objects stems from recommendations in a report dated March 1966 of an Ad Hoc Committee of the Air Force Scientific Advisory Board set up under the chairmanship of Dr. Brian O'Brien to review the work of Project Blue Book. Details of the history of work on UFOs are set forth in Section V, Chapter 2. (See also Appendix A.)

The recommendation was:

It is the opinion of the Committee that the present Air Force program dealing with UFO sightings has been well organized, although the resources assigned to it (only one officer, a sergeant, and a secretary) have been quite limited. In 19 years and more than 10,000 sightings recorded and classified, there appears to be no verified and fully satisfactory evidence of any case that is clearly outside the framework of presently known science and technology. Nevertheless, there is always the possibility that analysis of new sightings may provide some additions to scientific knowledge of value to the Air Force. Moreover, some of the case records at which the Committee looked that were listed as 'identified' were sightings where the evidence collected was too meager or too indefinite to permit positive listing in the identified category. Because of this the Committee recommends that the present program be strengthened to provide opportunity for scientific investigation of selected sightings in more detail than has been possible to date.

To accomplish this it is recommended that:

A. Contracts be negotiated with a few selected universities to provide scientific teams to investigate promptly and in depth certain selected sightings of UFO's. Each team should include at least one psychologist, preferably one interested in clinical psychology, and at least one physical

scientist, preferably an astronomer or geophysicist familiar with atmospheric physics. The universities should be chosen to provide good geographical distribution, and should be within convenient distance of a base of the Air Force Systems Command (AFSC).

B. At each AFSC base an officer skilled in investigation (but not necessarily with scientific training) should be designated to work with the corresponding university team for that geographical section. The local representative of the Air Force Office of Special Investigations (OSI) might be a logical choice for this.

C. One university or one not-for-profit organization should be selected to coordinate the work of the teams mentioned under A above, and also to make certain of very close communication and coordination with the office of Project Blue Book.

It is thought that perhaps 100 sightings a year might be subjected to this close study, and that possibly an average of 10 man days might be required per sighting so studied. The information provided by such a program might bring to light new facts of scientific value, and would almost certainly provide a far better basis than we have today for decision on a long term UFO program.

These recommendations were referred by the Secretary of the Air Force to the Air Force Office of Scientific Research for implementation, which, after study, decided to combine recommendations A and C so as to have a single contracting university with authority to subcontract with other research groups as needed. Recommendation B was implemented by the issuance of Air Force Regulation 80-17 (Appendix B) which establishes procedures for handling UFO reports at the Air Force bases.

In setting up the Colorado project, as already stated in Section I, the emphasis was on whether deeper study of unidentified flying objects

might provide some "additions to scientific knowledge."

After considering various possibilities, the AFOSR staff decided to ask the University of Colorado to undertake the project (see Preface). Dr. J. Thomas Ratchford visited Boulder in late July 1966 to learn whether the University would be willing to undertake the task. A second meeting was held on 10 August 1966 in which the scope of the proposed study was outlined to an interested group of the administrative staff and faculty of the University by Dr. Ratchford and Dr. William Price, executive director of AFOSR. After due deliberation, University officials decided to undertake the project.

The contract provided that the planning, direction and conclusions of the Colorado project were to be conducted wholly independently of the Air Force. To avoid duplication of effort, the Air Force was ordered to furnish the project with the records of its own earlier work and to provide the support of personnel at AF bases when requested by our field teams.

We were assured that the federal government would withhold no information on the subject, and that all essential information about UFOs could be included in this report. Where UFO sightings involve classified missile launchings or involve the use of classified radar systems, this fact is merely stated as to do more would involve violation of security on these military subjects. In our actual experience these reservations have affected a negligible fraction of the total material and have not affected the conclusions (Section I) which we draw from our work.

The first research contract with AFOSR provided \$313,000 for the first 15 months from 1 November 1966 to 31 January 1968. The contract was publicly announced on 7 October 1966. It then became our task to investigate those curious entities distinguished by lack of knowledge of what they are, rather than in terms of what they are known to be, namely, unidentified flying objects.

2. Definition of an UFO

An unidentified flying object (UFO, pronounced OOF0) is here defined as the stimulus for a report made by one or more individuals of something seen in the sky (or an object thought to be capable of flight but seen when landed on the earth) which the observer could not identify as having an ordinary natural origin, and which seemed to him sufficiently puzzling that he undertook to make a report of it to police, to government officials, to the press, or perhaps to a representative of a private organization devoted to the study of such objects.

Defined in this way, there is no question as to the existence of UFOs, because UFO reports exist in fairly large numbers, and the stimulus for each report is, by this definition, an UFO. The problem then becomes that of learning to recognize the various kinds of stimuli that give rise to UFO reports.

The UFO is "the stimulus for a report . . ." This language refrains from saying whether the reported object was a real, physical, material thing, or a visual impression of an ordinary physical thing distorted by atmospheric conditions or by faulty vision so as to be unrecognizable, or whether it was a purely mental delusion existing in the mind of the observer without an accompanying visual stimulus.

The definition includes insincere reports in which the alleged sighter undertakes for whatever reason to deceive. In the case of a delusion, the reporter is not aware of the lack of a visual stimulus. In the case of a deception, the reporter knows that he is not telling the truth about his alleged experience.

The words "which he could not identify . . ." are of crucial importance. The stimulus gives rise to an UFO report precisely because the observer could not identify the thing seen. A woman and her husband reported a strange thing seen flying in the sky and reported quite correctly that she knew "it was unidentified because neither of us knew what it was."

The thing seen and reported may have been an object as commonplace

as the planet Venus, but it became an UFO because the observer did not know what it was. With this usage it is clear that less well informed individuals are more likely to see an UFO than those who are more knowledgeable because the latter are better able to make direct identification of what they see. A related complication is that less well informed persons are often inaccurate observers who are unable to give an accurate account of what they believe that they have seen.

If additional study of a report later provides an ordinary interpretation of what was seen, some have suggested that we should change its name to IFO, for identified flying object. But we have elected to go on calling it an UFO because some identifications are tentative or controversial, due to lack of sufficient data on which to base a definite identification. A wide variety of ordinary objects have through misinterpretation given rise to UFO reports. This topic is discussed in detail in Section VI, Chapter 2. (The Air Force has published a pamphlet entitled, "Aids to Identification of Flying Objects" (USAF, 1968) which is a useful aid in the interpretation of something seen which might otherwise be an UFO.)

The words "sufficiently puzzling that they undertook to make a report . . ." are essential. As a practical matter, we can not study something that is not reported, so a puzzling thing seen but not reported is not here classed as an UFO.

3. UFO Reports

In our experience, the persons making reports seem in nearly all cases to be normal, responsible individuals. In most cases they are quite calm, at least by the time they make a report. They are simply puzzled about what they saw and hope that they can be helped to a better understanding of it. Only a very few are obviously quite emotionally disturbed, their minds being filled with pseudo-scientific, pseudo-religious or other fantasies. Cases of this kind range from slight disturbance to those who are manifestly in need of psychiatric care. The latter form an extremely small minority of all the persons

encountered in this study. While the existence of a few mentally unbalanced persons among UFO observers is part of the total situation, it is completely incorrect and unfair to imply that all who report UFOs are "crazy kooks," just as it is equally incorrect to ignore the fact that there are mentally disturbed persons among them.

Individuals differ greatly as to their tendency to make reports. Among the reasons for not reporting UFOs are apathy, lack of awareness of public interest, fear of ridicule, lack of knowledge as to where to report and the time and cost of making a report.

We found that reports are not useful unless they are made promptly. Even so, because of the short duration of most UFO stimuli, the report usually can not be made until after the UFO has disappeared. A few people telephoned to us from great distances to describe something seen a year or two earlier. Such reports are of little value.

Early in the study we tried to estimate the fraction of all of the sightings that are reported. In social conversations many persons would tell us about some remarkable and puzzling thing that they had seen at some time in the past which would sound just as remarkable as many of the things that are to be found in UFO report files. Then we would ask whether they had made a report and in most cases would be told that they had not. As a rough guess based on this uncontrolled sample, we estimate that perhaps 10% of the sightings that people are willing to talk about later are all that get reported at the time. This point was later covered in a more formal public attitude survey (Section III, Chapter 7) made for this study in which only 7% of those who said they had seen an UFO had reported it previously. Thus if all people reported sightings that are like those that some people do report, the number of reports that would be received would be at least ten times greater than the number actually received.

At first we thought it would be desirable to undertake an extensive publicity campaign to try to get more complete reporting from the public. It was decided not to do this, because about 90% of all UFO reports

prove to be quite plausibly related to ordinary objects. A tenfold increase in the number of reports would have multiplied by ten the task of eliminating the ordinary cases which would have to be analyzed. Our available resources for field study enabled us to deal only with a small fraction of the reports coming in. No useful purpose would have been served under these circumstances by stimulating the receipt of an even greater number.

Study of records of some UFO reports from other parts of the world gave us the strong impression that these were made up of a mix of cases of similar kind to those being reported in the United States. For example, in August 1967 Prof. James McDonald of Arizona made a 20-day trip to Australia, Tasmania and New Zealand in the course of which he interviewed some 80 persons who had made UFO reports there at various times. On his return he gave us an account of these experiences that confirmed our impression that the reports from these other parts of the world were, as a class, similar to those being received in the United States. Therefore we decided to restrict our field studies to the United States and to one or two cases in Canada (See Section III, Chapter 1). This was done on the practical grounds of reducing travel expense and of avoiding diplomatic and language difficulties. The policy was decided on after preliminary study had indicated that in broad generality the spectrum of kinds of UFO reports being received in other countries was very similar to our own.

4. Prologue to the Project

Official interest in UFOs, or "flying saucers" as they were called, at first dates from June 1947. On 24 June, Kenneth Arnold, a business man of Boise, Idaho was flying a private airplane near Mt. Rainier, Washington. He reported seeing a group of objects flying along in a line which he said looked "like pie plates skipping over the water." The newspaper reports called the things seen "flying saucers" and they have been so termed ever since, although not all UFOs are described as being of this shape.

Soon reports of flying saucers were coming in from various parts of the country. Many received prominent press coverage (Bloecher, 1967). UFOs were also reported from other countries; in fact, more than a thousand such reports were made in Sweden in 1946.

The details of reports vary so greatly that it is impossible to relate them all to any single explanation. The broad range of things reported is much the same in different countries. This means that a general explanation peculiar to any one country has to be ruled out, since it is utterly improbable that the secret military aircraft of any one country would be undergoing test flights in different countries. Similarly it is most unlikely that military forces of different countries would be testing similar developments all over the world at the same time in secrecy from each other.

Defense authorities had to reckon with the possibility that UFOs might represent flights of a novel military aircraft of some foreign power. Private citizens speculated that the UFOs were test flights of secret American aircraft. Cognizance of the UFO problem was naturally assumed by the Department of the Air Force in the then newly established Department of Defense. Early investigations were carried on in secrecy by the Air Force, and also by the governments of other nations.

Such studies in the period 1947-52 convinced the responsible authorities of the Air Force that the UFOs, as observed up to that time, do not constitute a threat to national security. In consequence, ever since that time, a minimal amount of attention has been given to them.

The year 1952 brought an unusually large number of UFO reports, including many in the vicinity of the Washington National Airport, during a period of several days in July. Such a concentration of reports in a small region in a short time is called a "flap." The Washington flap of 1952 received a great deal of attention at the time (Section III, Chapter 5).

At times in 1952, UFO reports were coming in to the Air Force from the general public in such numbers as to produce some clogging of military communications channels. It was thought that an enemy planning a sneak attack might deliberately stimulate a great wave of UFO reports for the very purpose of clogging communication facilities. This consideration was in the forefront of a study that was made in January 1953 by a panel of scientists under the chairmanship of the late H. P. Robertson, professor of mathematical physics at the California Institute of Technology (Section V, Chapter 2). This panel recommended that efforts be made to remove the aura of mystery surrounding the subject and to conduct a campaign of public education designed to produce a better understanding of the situation. This group also concluded that there was no evidence in the available data of any real threat to national security.

Since 1953 the results of UFO study have been unclassified, except where tangential reasons exist for withholding details, as, for example, where sightings are related to launchings of classified missiles, or to the use of classified radar systems.

During the period from March 1952 to the present, the structure for handling UFO reports in the Air Force has been called Project Blue Book. As already mentioned the work of Project Blue Book was reviewed in early 1966 by the committee headed by Dr. Brian O'Brien. This review led to the reaffirmation that no security threat is posed by the existence of a few unexplained UFO reports, but the committee suggested a study of the possibility that something of scientific value might come from a more detailed study of some of the reports than was considered necessary from a strictly military viewpoint. This recommendation eventuated in the setting up of the Colorado project.

The story of Air Force interest, presented in Section V, Chapter 2, shows that from the beginning the possibility that some UFOs might be manned vehicles from outer space was considered, but naturally no publicity was given to this idea because of the total lack of evidence

for it.

Paralleling the official government interest, was a burgeoning of amateur interest stimulated by newspaper and magazine reports. By 1950 popular books on the subject began to appear on the newsstands. In January 1950 the idea that UFOs were extraterrestrial vehicles was put forward as a reality in an article entitled "Flying Saucers are Real" in *True* magazine written by Donald E. Keyhoe, a retired Marine Corps major. Thereafter a steady stream of sensational writing about UFOs has aroused a considerable amount of interest among laymen in studying the subject.

Many amateur organizations exist, some of them rather transiently, so that it would be difficult to compile an accurate listing of them. Two such organizations in the United States have a national structure. These are the Aerial Phenomena Research Organization (APRO), with headquarters in Tucson, Arizona, claiming about 8000 members; and the National Investigations Committee for Aerial Phenomena (NICAP) with headquarters in Washington, D. C. and claiming some 12,000 members. James and Coral Lorenzen head APRO, while Keyhoe is the director of NICAP, which, despite the name and Washington address is not a government agency. Many other smaller groups exist, among them Saucers and Unexplained Celestial Events Research Society (SAUCERS) operated by James Moseley.

Of these organizations, NICAP devotes a considerable amount of its attention to attacking the Air Force and to trying to influence members of Congress to hold hearings and in other ways to join in these attacks. It maintained a friendly relation to the Colorado project during about the first year, while warning its members to be on guard lest the project turn out to have been "hired to whitewash the Air Force." During this period NICAP made several efforts to influence the course of our study. When it became clear that these would fail, NICAP attacked the Colorado project as "biased" and therefore without merit.

The organizations mentioned espouse a scientific approach to the study of the subject. In addition there are a number of others that have a primarily religious orientation.

From 1947 to 1966 almost no attention was paid to the UFO problem by well qualified scientists. Some of the reasons for this lack of interest have been clearly stated by Prof. Gerard P. Kuiper of the University of Arizona (Appendix C). Concerning the difficulty of establishing that some UFOs may come from outer space, he makes the following cogent observation: "The problem is more difficult than finding a needle in a haystack; it is finding a piece of extra-terrestrial hay in a terrestrial haystack, often on the basis of reports of believers in extra-terrestrial hay."

5. Initial Planning

A scientific approach to the UFO phenomenon must embrace a wide range of disciplines. It involves such physical sciences as physics, chemistry, aerodynamics, and meteorology. Since the primary material consists mostly of reports of individual observers, the psychology of perception, the physiology of defects of vision, and the study of mental states are also involved.

Social psychology and social psychiatry are likewise involved in seeking to understand group motivations which act to induce belief in extraordinary hypotheses on the basis of what most scientists and indeed most laymen would regard as little or no evidence. These problems of medical and social psychology deserve more attention than we were able to give them. They fell distinctly outside of the field of expertise of our staff, which concentrated more on the study of the UFOs themselves than on the personal and social problems generated by them.

Among those who write and speak on the subject, some strongly espouse the view that the federal government really knows a great deal more about UFOs than is made public. Some have gone so far as to assert that the government has actually captured extraterrestrial

flying saucers and has their crews in secret captivity, if not in the Pentagon, then at some secret military base. We believe that such teachings are fantastic nonsense, that it would be impossible to keep a secret of such enormity over two decades, and that no useful purpose would be served by engaging in such an alleged conspiracy of silence. One person with whom we have dealt actually maintains that the Air Force has nothing to do with UFOs, claiming that this super-secret matter is in the hands of the Central Intelligence Agency which, he says, installed one of its own agents as scientific director of the Colorado study. This story, if true, is indeed well kept secret. These allegations of a conspiracy on the part of our own government to conceal knowledge of the existence of "flying saucers" have, so far as any evidence that has come to our attention, no factual basis whatever.

The project's first attention was given to becoming familiar with past work in the subject. This was more difficult than in more orthodox fields because almost none of the many books and magazine articles dealing with UFOs could be regarded as scientifically reliable. There were the two books of Donald H. Menzel, director emeritus of the Harvard College Observatory and now a member of the staff of the Smithsonian Astrophysical Observatory (Menzel, 1952; Menzel and Boyd, 1963). Two other useful books were *The UFO Evidence* (1964), a compilation of UFO cases by Richard Hall, and *The Report on Unidentified Flying Objects* by E. J. Ruppelt (1956), the first head of Project Blue Book. In this initial stage we were also helped by "briefings" given by Lt. Col. Hector Quintanilla, the present head of Project Blue Book, Dr. J. Allen Hynek, astronomical consultant to Project Blue Book, and by Donald Keyhoe and Richard Hall of NICAP.

Out of this preliminary study came the recognition of a variety of topics that would require detailed attention. These included the effects of optical mirages, the analogous anomalies of radio wave propagation as they affect radar, critical analysis of alleged UFO photographs, problems of statistical analysis of UFO reports, chemical

analysis of alleged material from UFOs, and reports of disturbances to automobile ignition and to headlights from the presence of UFOs. Results of the project's study of these and other topics are presented in this section and in Sections III and VI of this report.

6. Field Investigations

Early attention was given to the question of investigation of individual cases, either by detailed critical study of old records or by field trip investigation of current cases. From this study we concluded that there was little to be gained from the study of old cases, except perhaps to get ideas on mistakes to be avoided in studies of new cases. We therefore decided not to make field trips to investigate cases that were more than a year old, although in a few cases we did do some work on such cases when their study could be combined with a field investigation of a new case.

At first we hoped that field teams could respond to early warning so quickly that they would be able to get to the site while the UFO was still there, and that our teams would not only get their own photographs, but even obtain spectrograms of the light of the UFO, and make radioactive, magnetic, and sound measurements while the UFO was still present.

Such expectations were found to be in vain. Nearly all UFO sightings are of very short duration, seldom lasting as long as an hour and usually lasting for a few minutes. The observers often become so excited that they do not report at all until the UFO has gone away. With communication and travel delays, the field team was unable to get to the scene until long after the UFO had vanished.

This was, of course, a highly unsatisfactory situation. We gave much thought to how it could be overcome and concluded that this could only be done by a great publicity campaign designed to get the public to report sightings much more promptly than it does, coupled with a nationwide scheme of having many trained field teams scattered at many points across the nation. These teams would have had to be ready to

respond at a moment's notice. Even so, in the vast majority of the cases, they would not have arrived in time for direct observation of the reported UFO. Moreover, the national publicity designed to insure more prompt reporting would have had the effect of arousing exaggerated public concern over the subject, and certainly would have vastly increased the number of nonsense reports to which response would have had to be made. In recruiting the large number of field teams, great care would have had to be exercised to make sure that they were staffed with people of adequate scientific training, rather than with persons emotionally committed to extreme *pro* or *con* views on the subject.

Clearly this was quite beyond the means of our study. Such a program to cover the entire United States would cost many millions of dollars a year, and even then there would have been little likelihood that anything of importance would have been uncovered.

In a few cases some physical evidence could be gathered by examination of a site where an UFO was reported to have landed. In such a case it did not matter that the field team arrived after the UFO had gone. But in no case did we obtain any convincing evidence of this kind although every effort was made to do so. (See below and in Section III, Chapters 3 and 4).

Thus most of the field investigation, as it turned out, consisted in the interviewing of persons who made the report. By all odds the most used piece of physical equipment was the tape recorder.

The question of a number of investigators on a field team was an important one. In most work done in the past by the Air Force, UFO observers were interviewed by a single Air Force officer, who usually had no special training and whose freedom to devote much time to the study was limited by the fact that he also had other responsibilities. When field studies are made by amateur organizations like APRO or NICAP, there are often several members present on a team, but usually they are persons without technical training, and often with a strong bias toward the sensational aspects of the subject.

Prof. Hynek strongly believes that the teams should have four or more members. He recommends giving each report what he calls the "FBI treatment," by which he means not only thorough interviewing of the persons who made the report, but in addition an active quest in the neighborhood where the sighting occurred to try to discover additional witnesses. Against such thoroughness must be balanced the consideration that the cost per case goes up proportionately to the number of persons in a team, so that the larger the team, the fewer the cases that can be studied.

The detailed discussions in Section III, Chapter 1 and in Section IV make it clear that the field work is associated with many frustrations. Many of the trips turn out to be wild goose chases and the team members often feel as if they are members of a fire department that mostly answers false alarms.

We found that it was always worthwhile to do a great deal of initial interviewing by long distance telephone. A great many reports that seem at first to be worthy of full field investigation could be disposed of in this way with comparatively little trouble and expense. Each case presented its own special problems. No hard-and-fast rule was found by which to decide in advance whether a particular report was worth the trouble of a field trip.

After careful consideration of these various factors, we decided to operate with two-man teams, composed whenever possible of one person with training in physical science and one with training in psychology. When the study became fully operational in 1967 we had three such teams. Dr. Roy Craig describes the work of these teams in Section III, Chapters 1, 3, and 4. Reports of field investigations are presented in Section IV.

7. Explaining UFO Reports

By definition UFOs exist because UFO reports exist. What makes the whole subject intriguing is the possibility that some of these reports cannot be reconciled with ordinary explanations, so that some

extraordinarily sensational explanation for them might have to be invoked. A fuller discussion of some misinterpretations of ordinary events by Dr. W. K. Hartmann is given in Section VI, Chapter 2.

A great many reports are readily identified with ordinary phenomena seen under unusual circumstances, or noted by someone who is an inexperienced, inept, or unduly excited observer. Because such reports are vague and inaccurate, it is often impossible to make an identification with certainty.

This gives rise to controversy. In some cases, an identification that the UFO was "probably" an aircraft is all that can be made from the available data. After the event no amount of further interviewing of one or more witnesses can usually change such a probable into a certain identification. Field workers who would like to identify as many as possible are naturally disposed to claim certainty when this is at all possible, but others who desire to have a residue of unexplained cases in order to add mystery and importance to the UFO problem incline to set impossibly high standards of certainty in the evidence before they are willing to accept a simple explanation for a report.

This dilemma is nicely illustrated by a question asked in the House of Commons of Prime Minister Harold Wilson, as reported in *Hansard* for 19 December 1967:

Unidentified Flying Objects. Question 14. Sir J. Langford-Holt asked the Prime Minister whether he is satisfied that all sightings of unidentified flying objects which are reported from service sources are explainable, what inquiries he has authorised into these objects outside the defence aspect, and whether he will now appoint one Minister to look into all aspects of reports.

The Prime Minister: The answers are 'Yes, except when the information given is insufficient', 'None' and 'No.'

Obviously there is a nice bit of semantics here in that the definition of "when the information is sufficient" is that it is sufficient when an explanation can be given.

Discussions of whether a marginal case should be regarded for statistical purposes as having been explained or not have proved to be futile. Some investigators take the position that, where a plausible interpretation in terms of commonplace events can be made, then the UFO is regarded as having been identified. Others take the opposite view that an UFO cannot be regarded as having been given an ordinary identification unless there is complete and binding evidence amounting to certainty about the proposed identification.

For example, in January 1968 near Castle Rock, Colo., some 30 persons reported UFOs, including spacecraft with flashing lights, fantastic maneuverability, and even with occupants presumed to be from outer space. Two days later it was more modestly reported that two high school boys had launched a polyethylene hot-air balloon.

Locally that was the end of the story. But there is a sequel. A man in Florida makes a practice of collecting newspaper stories about UFOs and sending them out in a mimeographed UFO news letter which he mails to various UFO journals and local clubs. He gave currency to the Castle Rock reports but not to the explanation that followed. When he was chided for not having done so, he declared that no one could be *absolutely* sure that *all* the Castle Rock reports arose from sightings of the balloon. There might also have been an UFO from outer space among the sightings. No one would dispute his logic, but one may with propriety wonder why he neglected to tell his readers that at least *some* of the reports were actually misidentifications of a hot-air balloon.

As a practical matter, we take the position that if an UFO report can be plausibly explained in ordinary terms, then we accept that explanation even though not enough evidence may be available to prove it beyond all doubt. This point is so important that perhaps an analogy is needed to make it clear. Several centuries ago, the most generally accepted theory of human disease was that it was caused by the patient's being possessed or inhabited by a devil or evil spirit. Different

diseases were supposed to be caused by different devils. The guiding principle for medical research was then the study and classification of different kinds of devils, and progress in therapy was sought in the search for and discovery of means for exorcising each kind of devil.

Gradually medical research discovered bacteria, toxins and viruses, and their causative relation to various diseases. More and more diseases came to be described by their causes.

Suppose now that instead, medicine had clung to the devil theory of disease. As long as there exists one human illness that is not yet fully understood in modern terms such a theory cannot be disproved. It is always possible, while granting that *some* diseases are caused by viruses, etc. to maintain that those that are not yet understood are the ones that are really caused by devils.

In some instances the same sort of UFO is observed night after night under similar circumstances. In our experience this has been a sure sign that the UFO could be correlated with some ordinary phenomenon.

For example, rather early in our work, a Colorado farmer reported seeing an UFO land west of his farm nearly every evening about 6:00 p.m. A field team went to see him and quickly and unambiguously identified the UFO as the planet Saturn. The nights on which he did not see it land were those in which the western sky was cloudy.

But the farmer did not easily accept our identification of his UFO as Saturn. He contended that, while his UFO had landed behind the mountains on the particular evening that we visited him, on most nights, he insisted, it landed in front of the mountains, and therefore could not be a planet. The identification with Saturn from the ephemeris was so precise that we did not visit his farm night after night in order to see for ourselves whether his UFO ever landed in front of the mountains. We did not regard it as part of our duty to persuade observers of the correctness of our interpretations. In most cases observers readily accepted our explanation, and some expressed relief at having

an everyday explanation available to them.

We sought to hold to a minimum delays in arriving at the site of an UFO report, even where it was clear that it was going to be impossible to get there in time actually to see the reported UFO. Once an observer made a report, the fact of his having done so usually becomes known to friends and neighbors, local newspapermen, and local UFO enthusiasts. The witness becomes the center of attention and will usually have told his story over and over again to such listeners, before the field team can arrive. With each telling of the story it is apt to be varied and embellished a little. This need not be from dishonest motives. We all like to tell an interesting story. We would rather not bore our listeners if we can help it, so embellishment is sometimes added to maximize the interest value of the narration.

It is not easy to detect how a story has grown under retelling in this way. Listeners usually will have asked leading questions and the story will have developed in response to such suggestions, so that it soon becomes impossible for the field team to hear the witness's story as he told it the first time. In some cases when the witness had been interviewed in this way by local UFO enthusiasts, his story was larded with vivid language about visitors from outer space that was probably not there in the first telling.

Another kind of difficulty arises in interviewing multiple associated witnesses, that is, witnesses who were together at the time that all of them saw the UFO. Whenever several individuals go through an exciting experience together, they are apt to spend a good deal of time discussing it afterward among themselves, telling and retelling it to each other, unconsciously ironing out discrepancies between their various recollections, and gradually converging on a single uniform account of the experience. Dominant personalities will have contributed more to the final version than the less dominant. Thus the story told by a group of associated witnesses who have had ample opportunity to "compare notes" will be more uniform than the accounts these individuals

would have given if interviewed separately before they had talked the matter over together.

One of the earliest of our field trips (December 1966) was made to Washington, D. C. to interview separately two air traffic control operators who had been involved in the great UFO flap there in the summer of 1952. Fourteen years later, these two men were still quite annoyed at the newspaper publicity they had received, because it had tended to ridicule their reports. Our conclusion from this trip was that these men were telling in 1966 stories that were thoroughly consistent with the main points of their stories as told in 1952. Possibly this was due to the fact that because of their strong emotional involvement they had recounted the incident to many persons at many times over the intervening years. Although it was true that the stories had not changed appreciably in 14 years, it was also true for this very reason that we acquired no new material by interviewing these men again. (See Section III, Chapter 5).

On the basis of this experience we decided that it was not profitable to devote much effort to re-interviewing persons who had already been interviewed rather thoroughly at a previous time. We do not say that nothing can be gained in this way, but merely that it did not seem to us that this would be a profitable way to spend our effort in this study.

In our experience those who report UFOs are often very articulate, but not necessarily reliable. One evening in 1967 a most articulate gentleman told us with calm good manners all of the circumstances of a number of UFOs he had seen that had come from outer space, and in particular went into some detail about how his wife's grandfather had immigrated to America from the Andromeda nebula, a galaxy located 2,000,000 light years from the earth.

In a few cases study of old reports may give the investigator a clue to a possible interpretation that had not occurred to the original investigator. In such a case, a later interview of the witness may

elicit new information that was not brought out in the earlier interview. But we found that such interviews need to be conducted with great care as it is easily possible that the "new" information may have been generated through the unconscious use of leading questions pointing toward the new interpretation, and so may not be reliable for that reason.

8. Sources of UFO Reports

Usually the first report of an UFO is made to a local police officer or to a local news reporter. In some cases, members of UFO study organizations are sufficiently well known in the community that reports are made directly to them. In spite of the very considerable publicity that has been given to this subject, a large part of the public still does not know of the official Air Force interest.

Even some policemen and newsmen do not know of it and so do not pass on the UFO report. In other cases, we found that the anti-Air Force publicity efforts of some UFO enthusiasts had persuaded observers, who would otherwise have done so, not to report to the Air Force. We have already commented on the fact that for a variety of reasons many persons who do have UFO experiences do not report promptly.

Ideally the entire public would have known that each Air Force base must, according to AFR 80-17, have an UFO officer and would have reported promptly any extraordinary thing seen in the sky. Or, if this were too much to expect, then all police and news agencies would ideally have known of Air Force interest and would have passed information along to the nearest Air Force base. But none of these ideal things were true, and as a result our collection of UFO reports is extremely haphazard and incomplete.

When a report is made to an Air Force base, it is handled by an UFO officer whose form of investigation and report is prescribed by AFR 80-17 (Appendix A). If the explanation of the report is immediately obvious and trivial -- some persons will telephone a base to report a contrail from a high-flying jet that is particularly bright in the light of the setting sun -- the UFO officer tells the person

what it was he saw, and there the matter ends. No permanent record of such calls is made. As a result there is no record of the total number of UFO reports made to AF bases. Only those that require more than cursory consideration are reported to Project Blue Book. Air Force officers are human, and therefore interpret their duty quite differently. Some went to great lengths not to submit a report. Others took special delight in reporting all of the "easy" ones out of a zealous loyalty to their service, because the more "identified" they turned in, the higher would be the over-all percentage of UFO reports explained. When in June 1967 Air Force UFO officers from the various bases convened in Boulder some of them quite vigorously debated the relative merits of these two different extreme views of their duty.

Many people have from time to time tried to learn something significant about UFOs by studying statistically the distribution of UFO reports geographically, in time, and both factors together. In our opinion these efforts have proved to be quite fruitless. The difficulties are discussed in Section VI, Chapter 10.

The geographical distribution of reports correlates roughly with population density of the non-urban population. Very few reports come from the densely-populated urban areas. Whether this is due to urban sophistication or to the scattering of city lights is not known, but it is more probably the latter.

There apparently exists no single complete collection of UFO reports. The largest file is that maintained by Project Blue Book at Wright-Patterson Air Force Base, Ohio. Other files are maintained by APRO in Tucson and NICAP in Washington. The files of Project Blue Book are arranged by date and place of occurrence of the report, so that one must know these data in order to find a particular case. Proposals have been made from time to time for a computer-indexing of these reports by various categories but this has not been carried out. Two publications are available which partially supply this lack: one is *The UFO Evidence* (Hall, 1964) and the other is a collection of reports called

The Reference for Outstanding UFO Reports (Olsen,).

We have already mentioned the existence of flaps, that is, the tendency of reports to come in clusters at certain times in certain areas. No quantitative study of this is available, but we believe that the clustering tendency is partly due to changing amounts of attention devoted to the subject by the news media. Publicity for some reports stimulates more reports, both because people pay more attention to the sky at such a time, and because they are more likely to make a report of something which attracts their attention.

In the summer of 1967 there was a large UFO flap in the neighborhood of Harrisburg, Pa. This may have been in part produced by the efforts of a local NICAP member working in close association with a reporter for the local afternoon newspaper who wrote an exciting UFO story for his paper almost daily. Curiously enough, the morning paper scarcely ever had an UFO story from which we conclude that one editor's news is another's filler. We stationed one of our investigators there during August with results that are described in Case 27.

Many UFO reports were made by the public to Olmsted Air Force Base a few miles south of Harrisburg, but when this base was deactivated during the summer UFO reports had to be made to McGuire Air Force Base near Trenton, N. J. This required a toll call, and the frequency of receipt of UFO reports from the Harrisburg area dropped abruptly.

For all of these various reasons, we feel that the fluctuations geographically and in time of UFO reports are so greatly influenced by sociological factors, that any variations due to changes in underlying physical phenomena are completely masked.

In sensational UFO journalism the statement is often made that UFOs show a marked tendency to be seen more often near military installations. There is no statistically significant evidence that this is true. For sensational writers, this alleged but unproven concentration of UFO sightings is taken as evidence that extra-terrestrial visitors are reconnoitering our military defenses, preparatory to launching a

military attack at some time in the future. Even if a slight effect of this kind were to be established by careful statistical studies, we feel that it could be easily accounted for by the fact that at every base men stand all night guard duty and so unusual things in the sky are more likely to be seen. Moreover civilians living near a military base are more likely to make a report to the base than those living at some distance from it.

AFR 80-17a directed UFO officers at each base to send to the Colorado project a duplicate of each report sent to Project Blue Book. This enabled us to keep track of the quality of the investigations and to be informed about puzzling uninterpreted cases. Such reporting was useful in cases whose study extended over a long period, but the slowness of receipt of such reports made this arrangement not completely satisfactory as a source of reports on the basis of which to direct the activity of our own field teams. A few reports that seemed quite interesting to Air Force personnel caused them to notify us by teletype or telephone. Some of our field studies arose from reports received in this way.

To supplement Air Force reporting, we set up our own Early Warning Network, a group of about 60 active volunteer field reporters, most of whom were connected with APRO or NICAP. They telephoned or telegraphed to us intelligence of UFO sightings in their own territory and conducted some preliminary investigation for us while our team was en route. Some of this cooperation was quite valuable. In the spring of 1968, Donald Keyhoe, director of NICAP, ordered discontinuation of this arrangement, but many NICAP field teams continued to cooperate.

All of these sources provided many more quickly reported, fresh cases than our field teams could study in detail. In consequence we had to develop criteria for quickly selecting which of the cases reported to us would be handled with a field trip (See Section III, Chapter 1).

9. Extra-terrestrial Hypothesis

The idea that some UFOs *may* be spacecraft sent to Earth from another civilization, residing on another planet of the solar system, or on a planet associated with a more distant star than the Sun, is called the Extra-terrestrial Hypothesis (ETH). Some few persons profess to hold a stronger level of belief in the *actuality* of UFOs being visitors from outer space, controlled by intelligent beings, rather than merely or the *possibility*, not yet fully established as an observational fact. We shall call this level of belief ETA, for extra-terrestrial actuality.

It is often difficult to be sure just what level of belief is held by various persons, because of the vagueness with which they state their ideas.

For example, addressing the American Society of Newspaper Editors in Washington on 22 April 1967, Dr. McDonald declared: "There is, in my present opinion, no sensible alternative to the utterly shocking hypothesis that the UFOs are extraterrestrial probes from somewhere else." Then in an Australian broadcast on 20 August 1967 McDonald said: ". . . you find yourself ending up with the seemingly absurd, seemingly improbable hypothesis that these things may come from somewhere else."

A number of other scientists have also expressed themselves as believers in ETH, if not ETA, but usually in more cautious terms.

The general idea of space travel by humans from Earth and visitors to Earth from other civilizations is an old one and has been the subject of many works of fiction. In the past 250 years the topic has been widely developed in science fiction. A fascinating account of the development of this literary form is given in *Pilgrims through Space and Time -- Trends and Patterns in Scientific and Utopian Fiction* (Bailey, 1947)

The first published suggestion that some UFOs are visitors from other civilizations is contained in an article in *True*, entitled "Flying Saucers are Real" by Donald E. Keyhoe (1950).

Direct, convincing and unequivocal evidence of the truth of ETA would be the greatest single scientific discovery in the history of mankind. Going beyond its interest for science, it would undoubtedly have consequences of surpassing significance for every phase of human life. Some persons who have written speculatively on this subject, profess to believe that the supposed extraterrestrial visitors come with beneficent motives, to help humanity clean up the terrible mess that it has made. Others say they believe that the visitors are hostile. Whether their coming would be favorable or unfavorable to mankind, it is almost certain that they would make great changes in the conditions of human existence.

It is characteristic of most reports of actual visitors from outer space that there is no corroborating witness to the alleged incident, so that the story must be accepted, if at all, solely on the basis of belief in the veracity of the one person who claims to have had the experience. In the cases which we studied, there was only one in which the observer claimed to have had contact with a visitor from outer space. On the basis of our experience with that one, and our own unwillingness to believe the literal truth of the Villas-Boas incident, or the one from Truckee, Calif. reported by Prof. James Harder (see Section V, Chapter 2), we found that no direct evidence whatever of a convincing nature now exists for the claim that any UFOs represent spacecraft visiting Earth from another civilization.

Some persons are temperamentally ready, even eager, to accept ETA without clear observational evidence. One lady remarked, "It would be so wonderfully exciting if it were true!" It certainly would be exciting, but that does not make it true. When confronted with a proposition of such great import, responsible scientists adopt a cautiously critical attitude toward whatever evidence is adduced to support it. Persons without scientific training, often confuse this with basic opposition to the idea, with a biased desire or hope, or even of willingness to distort the evidence in order to conclude that ETA is not

true.

The scientists' caution in such a situation does not represent opposition to the idea. It represents a determination not to accept the proposition as true in the absence of evidence that clearly, unambiguously and with certainty establishes its truth or falsity.

Scientifically it is not necessary -- it is not even desirable -- to adopt a position about the truth or falsity of ETA in order to investigate the question. There is a widespread misconception that scientific inquiry represents some kind of debate in which the truth is adjudged to be on the side of the team that has scored the most points. Scientists investigate an undecided proposition by seeking to find ways to get decisive observational material. Sometimes the ways to get such data are difficult to conceive, difficult to carry out, and so indirect that the rest of the scientific world remains uncertain of the probative value of the results for a long time. Progress in science can be painfully slow -- at other time it can be sudden and dramatic. The question of ETA would be settled in a few minutes if a flying saucer were to land on the lawn of a hotel where a convention of the American Physical Society was in progress, and its occupants were to emerge and present a special paper to the assembled physicists, revealing where they came from, and the technology of how their craft operates. Searching questions from the audience would follow.

In saying that thus far no convincing evidence exists for the truth of ETA, no prediction is made about the future. If evidence appears soon after this report is published, that will not alter the truth of the statement that we do not *now* have such evidence. If new evidence appears later, this report can be appropriately revised in a second printing.

10. Intelligent Life Elsewhere

Whether there is intelligent life elsewhere (ILE) in the Universe is a question that has received a great deal of serious speculative attention in recent years. A good popular review of thinking on the

subject is *We Are Not Alone* by Walter Sullivan (1964). More advanced discussions are *Interstellar Communication*, a collection of papers edited by A. G. W. Cameron (1963), and *Intelligent Life in the Universe* (Shklovskii and Sagan, 1966). Thus far we have no observational evidence whatever on the question, so therefore it remains open. An early unpublished discussion is a letter of 13 December 1948 of J. E. Lipp to Gen. Donald Putt (Appendix D). This letter is Appendix D of the Project Sign report dated February 1949 from Air Materiel Command Headquarters No. F-TR-2274-1A.

The ILE question has some relation to the ETH or ETA for UFOs as discussed in the preceding section. Clearly, if ETH is true, then ILE must also be true because some UFOs have then to come from some un-earthly civilization. Conversely, if we could know conclusively that ILE does not exist, then ETH could not be true. But even if ILE exists, it does not follow that the ETH is true.

For it could be that the ILE, though existent, might not have reached a stage of development in which the beings have the technical capacity or the desire to visit the Earth's surface. Much speculative writing assumes implicitly that intelligent life progresses steadily both in intellectual and in its technological development. Life began on Earth more than a billion years ago, whereas the known geological age of the Earth is some five billion years, so that life in any form has only existed for the most recent one-fifth of the Earth's life as a solid ball orbiting the Sun. Man as an intelligent being has only lived on Earth for some 5,000 years, or about one-millionth of the Earth's age. Technological development is even more recent. Moreover the greater part of what we think of as advanced technology has only been developed in the last 100 years. Even today we do not yet have a technology capable of putting men on other planets of the solar system. Travel of men over interstellar distances in the foreseeable future seems now to be quite out of the question. (Purcell, 1960; Markowitz, 1967).

The dimensions of the universe are hard for the mind of man to conceive. A light-year is the distance light travels in one year of 31.56 million seconds, at the rate of 186,000 miles per second, that is, a distance of 5.88 million million miles. The nearest known star is at a distance of 4.2 light-years.

Fifteen stars are known to be within 11.5 light-years of the Sun. Our own galaxy, the Milky Way, is a vast flattened distribution of some 10^{11} stars about 80,000 light-years in diameter, with the Sun located about 26,000 light-years from the center. To gain a little perspective on the meaning of such distances relative to human affairs, we may observe that the news of Christ's life on Earth could not yet have reached as much as a tenth of the distance from the Earth to the center of our galaxy.

Other galaxies are inconceivably remote. The faintest observable galaxies are at a distance of some two billion light-years. There are some 100 million such galaxies within that distance, the average distance between galaxies being some eight million light-years.

Authors of UFO fantasy literature casually set all of the laws of physics aside in order to try to evade this conclusion, but serious consideration of their ideas hardly belongs in a report on the scientific study of UFOs.

Even assuming that difficulties of this sort could be overcome, we have no right to assume that in life communities everywhere there is a steady evolution in the directions of both greater intelligence and greater technological competence. Human beings now know enough to destroy all life on Earth, and they may lack the intelligence to work out social controls to keep themselves from doing so. If other civilizations have the same limitation then it might be that they develop to the point where they destroy themselves utterly before they have developed the technology needed to enable them to make long space voyages.

Another possibility is that the growth of intelligence precedes

the growth of technology in such a way that by the time a society would be technically capable of interstellar space travel, it would have reached a level of intelligence at which it had not the slightest interest in interstellar travel. We must not assume that we are capable of imagining now the scope and extent of future technological development of our own or any other civilization, and so we must guard against assuming that we have any capacity to imagine what a more advanced society would regard as intelligent conduct.

In addition to the great distances involved, and the difficulties which they present to interstellar space travel, there is still another problem: If we assume that civilizations annihilate themselves in such a way that their effective intelligent life span is less than, say, 100,000 years, then such a short time span also works against the likelihood of successful interstellar communication. The different civilizations would probably reach the culmination of their development at different epochs in cosmic history. Moreover, according to present views, stars are being formed constantly by the condensation of interstellar dust and gases. They exist for perhaps 10 billion years, of which a civilization lasting 100,000 years is only 1/100,000 of the life span of the star. It follows that there is an extremely small likelihood that two nearby civilizations would be in a state of high development at the same epoch.

Astronomers now generally agree that a fairly large number of all main-sequence stars are probably accompanied by planets at the right distance from their Sun to provide for habitable conditions for life as we know it. That is, where stars are, there are probably habitable planets. This belief favors the possibility of interstellar communication, but it must be remembered that even this view is entirely speculation: we are quite unable directly to observe any planets associated with stars other than the Sun.

In view of the foregoing, we consider that it is safe to assume that no ILE outside of our solar system has any possibility of visiting

Earth in the next 10,000 years.

This conclusion does not rule out the possibility of the existence of ILE, as contrasted with the ability of such civilizations to visit Earth. It is estimated that 10^{21} stars can be seen using the 200-inch Hale telescope on Mount Palomar. Astronomers surmise that possibly as few as one in a million or as many as one in ten of these have a planet in which physical and chemical conditions are such as to make them habitable by life based on the same kind of biochemistry as the life we know on Earth. Even if the lower figure is taken, this would mean there are 10^{15} stars in the visible universe which have planets suitable for an abode of life. In our own galaxy there are 10^{11} stars, so perhaps as many as 10^8 have habitable planets in orbit around them.

Biologists feel confident that wherever physical and chemical conditions are right, life will actually emerge. In short, astronomers tell us that there are a vast number of stars in the universe accompanied by planets where the physical and chemical conditions are suitable, and biologists tell us that habitable places are sure to become inhabited. (Rush, 1957).

An important advance was made when Stanley L. Miller (1955) showed experimentally that electrical discharges such as those in natural lightning when passed through a mixture of methane and ammonia, such as may have been present in the Earth's primitive atmosphere, will initiate chemical reactions which yield various amino acids. These are the raw materials from which are constructed the proteins that are essential to life. Miller's work has been followed up and extended by many others, particularly P. H. Abelson of the Carnegie Institution of Washington.

The story is by no means fully worked out. The evidence in hand seems to convince biochemists that natural processes, such as lightning, or the absorption of solar ultraviolet light, could generate the necessary starting materials from which life could evolve. On this basis they generally hold the belief that where conditions make it possible

that life could appear, there life actually will appear.

It is regarded by scientists today as essentially certain that ILE exists, but with essentially no possibility of contact between the communities on planets associated with different stars. We therefore conclude that there is no relation between ILE at other solar systems and the UFO phenomenon as observed on Earth.

There remains the question of ILE within our solar system. Here only the planets Venus and Mars need be given consideration as possible abodes of life.

Mercury, the planet nearest the Sun, is certainly too hot to support life. The side of Mercury that is turned toward the Sun has an average temperature of 660⁰F. Since the orbit is rather eccentric this temperature becomes as high as 770⁰F, hot enough to melt lead, when Mercury is closest to the Sun. The opposite side is extremely cold, its temperature not being known.* Gravity on Mercury is about one-fourth that on Earth. This fact combined with the high temperature makes it certain that Mercury has no atmosphere, which is consistent with observational data on this point. It is quite impossible that life as found on Earth could exist on Mercury.

Jupiter, Saturn, Uranus, Neptune and Pluto are so far from the Sun that they are too cold for life to exist there.

Although it has long been thought that Venus might provide a suitable abode for life, it is now known that the surface of Venus is also too hot for advanced forms of life, although it is possible that some primitive forms may exist. Some uncertainty and controversy exists about the interpretation of observations of Venus because the planet is always enveloped in dense clouds so that the solid surface is never seen. The absorption spectrum of sunlight coming from Venus indicates that the principal constituent of the atmosphere is carbon dioxide. There is no evidence of oxygen or water vapor. With so little oxygen in the atmosphere there could not be animal life there resembling that on Earth.

* Mercury rotates in 59 days and the orbital period is 88 days, so there is a slow relative rotation.

Although it is safe to conclude that there is no intelligent life on Venus, the contrary idea is held quite tenaciously by certain groups in America. There are small religious groups who maintain that Jesus Christ now sojourns on Venus, and that some of their members have travelled there by flying saucers supplied by the Venusians and have been greatly refreshed spiritually by visiting Him. There is no observational evidence in support of this teaching.

In the fantasy literature of believers in ETH, some attention is given to a purely hypothetical planet named Clarion. Not only is there no direct evidence for its existence, but there is conclusive indirect evidence for its non-existence. Those UFO writers who try not to be totally inconsistent with scientific findings, recognizing that Venus and Mars are unsuitable as abodes of life, have invented Clarion to meet the need for a home for the visitors who they believe come on some UFOs.

They postulate that Clarion moves in an orbit exactly like that of the Earth around the Sun, but with the orbit rotated through half a revolution in its plane so that the two orbits have the same line of apsides, but with Clarion's perihelion in the same direction from the Sun as the Earth's aphelion. The two planets, Earth and Clarion, are postulated to move in their orbits in such a way that they are always opposite each other, so that the line Earth-Sun-Clarion is a straight line. Thus persons on Earth would never see Clarion because it is permanently eclipsed by the Sun.

If the two orbits were exactly circular, the two planets would move along their common orbit at the same speed and so would remain exactly opposite each other. But even if the orbits are elliptical, so that the speed in the orbit is variable, the two planets would vary in speed during the year in just such a way as always to remain opposite each other and thus continue to be permanently eclipsed.

However, this tidy arrangement would not occur in actuality because the motion of each of these two planets would be perturbed by the gravitational attractions between them and the other planets of the

solar system, principally Venus and Mars. It is a quite complicated and difficult problem to calculate the way in which these perturbations would affect the motion of Earth and Clarion.

At the request of the Colorado project, Dr. R. L. Duncombe, director of the Nautical Almanac office at U.S. Naval Observatory in Washington, D. C., kindly arranged to calculate the effect of the introduction of the hypothetical planet Clarion into the solar system. The exact result depends to some extent on the location of the Earth-Sun-Clarion line relative to the line of apsides and the computations were carried out merely for one case (see Appendix E).

These calculations show that the effect of the perturbations would be to make Clarion become visible from Earth beyond the Sun's limb after about thirty years. In other words, Clarion would long since have become visible from Earth if many years ago it were started out in such a special way as has been postulated.

The computations revealed further that if Clarion were there it would reveal its presence indirectly in a much shorter time. Its attraction on Venus would cause Venus to move in a different way than if Clarion were not there. Calculation shows that Venus would pull away from its otherwise correct motion by about 1" of arc in about three months time. Venus is routinely kept under observation to this accuracy, and therefore if Clarion were there it would reveal its presence by its effect on the motion of Venus. No such effect is observed, that is, the motion of Venus as actually observed is accurately in accord with the absence of Clarion, so therefore we may safely conclude that Clarion is nonexistent.*

In his letter of transmittal Dr. Duncombe comments "I feel this is definite proof that the presence of such a body could not remain undetected for long. However, I am afraid it will not change the minds of those people who believe in the existence of Clarion."

We first heard about Clarion from a lady who is prominent in American political life who was intrigued with the idea that this is

* These calculations assume Clarion's mass roughly equal to that of the Earth.

where UFOs come from. When the results of the Naval Observatory computations were told to her she exclaimed, "That's what I don't like about computers! They are always dealing death blows to our fondest notions!"

Mars has long been considered as a possible abode of life in the solar system. There is still no direct evidence that life exists there, but the question is being actively studied in the space research programs of both the United States and Soviet Russia, so it may well be clarified within the coming decade.

At present all indications are that Mars could not be the habitation of an advanced civilization capable of sending spacecraft to visit the Earth. Conditions for life there are so harsh that it is generally believed that at best Mars could only support the simpler forms of plant life.

An excellent recent survey of the rapidly increasing knowledge of Mars is *Handbook of the Physical Properties of the Planet Mars* compiled by C. M. Michaux (NASA publication SP-3030, 1967). A brief discussion of American research programs for study of life on Mars is given in *Biology and Exploration of Mars*, a 19-page pamphlet prepared by the Space Science Board of the National Academy of Sciences, published in April 1965.

The orbit of Mars is considerably more eccentric than that of the Earth. Consequently the distance of Mars from the Sun varies from 128 to 155 million miles during the year of 687 days. The synodic period, or mean time between successive oppositions, is 800 days.

The most favorable time for observation of Mars is at opposition, when Mars is opposite the Sun from Earth. These distances of closest approach of Mars and Earth vary from 35 to 60 million miles. The most recent favorable time of closest approach was the opposition of 10 September 1956, and the next favorable opposition will be that of 10 August 1971. At that time undoubtedly great efforts will be made to study Mars in the space programs of the U.S.S.R and the United States.

Some of the UFO literature has contended that a larger than usual number of UFO reports occur at the times of Martian oppositions. The contention is that this indicates that some UFOs come from Mars at these particularly favorable times. The claimed correlation is quite unfounded; the idea is not supported by observational data. (Vallee and Vallee, 1966, p. 138).

Mars is much smaller than Earth, having a diameter of 4,200 miles, in comparison with 8,000 miles. Mars' mass is about one-tenth the Earth's, and gravity at Mars' surface is about 0.38 that of Earth. The Martian escape velocity is 3.1 mile/sec.

At the favorable opposition of 1877, G. V. Schiaparelli, an Italian astronomer, observed and mapped some surface markings on Mars which he called "canali," meaning "channels" in Italian. The word was mistranslated as "canals" in English and the idea was put forward, particularly vigorously by Percival Lowell, founder of the Lowell Observatory of Flagstaff, Arizona, that the canals on Mars were evidence of a gigantic planetary irrigation scheme, developed by the supposed inhabitants of Mars (Lowell, 1908). These markings have been the subject of a great deal of study since their discovery. Astronomers generally now reject the idea that they afford any kind of indication that Mars is inhabited by intelligent beings.

Mars has two moons named Phobos and Deimos. These are exceedingly small, Phobos being estimated at ten miles in diameter and Deimos at five miles, based on their brightness, assuming the reflecting power of their material to be the same as that of the planet. The periods are $7^{\text{h}}39^{\text{m}}$ for Phobos and $30^{\text{h}}18^{\text{m}}$ for Deimos. They were discovered in August 1877 by Asaph Hall using the then new 26-inch refractor of the U.S. Naval Observatory in Washington. An unsuccessful search for moons of Mars was made with a 48-inch mirror during the opposition of 1862.

I. S. Shklovskii (1959) published a sensational suggestion in a Moscow newspaper that these moons were really artificial satellites which had been put up by supposed inhabitants of Mars as a place of

refuge when the supposed oceans of several million years ago began to dry up (Sullivan, 1966, p. 169). There is no observational evidence to support this idea. Continuing the same line of speculation Salisbury (1962), after pointing out that the satellites were looked for in 1862 but not found until 1877, then asks, "Should we attribute the failure of 1862 to imperfections in existing telescopes, or may we imagine that the satellites were launched between 1862 and 1877?" This is a slender reed indeed with which to prop up so sensational an inference, and we reject it.

11. Light Propagation and Visual Perception

Most UFO reports refer to things seen by an observer. Seeing is a complicated process. It involves the emission or scattering of light by the thing seen, the propagation of that light through the atmosphere to the eye of the observer, the formation of an image on the retina of the eye by the lens of the eye, the generation there of a stimulus in the optic nerve, and the perceptual process in the brain which enables the mind to make judgments about the nature of the thing seen.

Under ordinary circumstances all of these steps are in fairly good working order with the result that our eyes give reasonably accurate information about the objects in their field of view. However, each step in the process is capable of malfunctioning, often in unsuspected ways. It is therefore essential to understand these physical and psychological processes in order to be able to interpret all things seen, including those reported as UFOs.

The study of propagation of light through the atmosphere is included in atmospheric optics or meteorological optics. Although a great deal is known about the physical principles involved, in practice it is usually difficult to make specific statements about an UFO report because not enough has been observed and recorded about the condition of the atmosphere at the time and place named in the report.

Application of the knowledge of atmospheric optics to the interpretation of UFO reports has been especially stressed by Menzel (1952);

(Menzel and Boyd, 1963). A valuable treatise on atmospheric effects on seeing is Middleton's *Vision through the Atmosphere* (1952). A survey of the literature of atmospheric optics with emphasis on topics relevant to understanding UFO reports was prepared for the Colorado project by Dr. William Viezee of the Stanford Research Institute (Section VI, Chapter 4).

Coming to the observer himself, Menzel stressed in consulting visits to the Colorado project that more ought to be known about defects of vision of the observer. He urged careful interviews to determine the observer's defects of vision, how well they are corrected, and whether spectacles were being worn at the time the UFO sighting was made. Besides the defects of vision that can be corrected by spectacles, inquiry ought to be made where relevant into the degree of color blindness of the observer, since this visual defect is more common than is generally appreciated.

Problems connected with the psychology of perception were studied for the Colorado project by Prof. Michael Wertheimer of the Department of Psychology of the University of Colorado. He prepared an elementary presentation of the main points of interest for the use of the project staff (Section VI, Chapter 1).

Perhaps the commonest difficulty is the lack of appreciation of size-distance relations in the description of an unknown object. When we see an airplane in the sky, especially if it is one of a particular model with which we are familiar, we know from prior experience approximately what its size really is. Then from its apparent size as we see it, we have some basis for estimating its distance. Conversely, when we know something about the distance of an unknown object, we can say something about its size. Although not usually expressed this way, what is really "seen" is the size of the image on the retina of the eye, which may be produced by a smaller object that is nearer or a larger object that is farther away. Despite this elementary fact, many people persist in saying that the full moon looks the same size as

a quarter or as a washtub. The statement means nothing. Statements such as that an object looks to be of the same size as a coin *held at arm's length* do, however, convey some meaningful information.

Another limitation of normal vision that is often not appreciated is the color blindness of the dark-adapted eye. The human eye really has two different mechanisms in the retina for the conversion of light energy into nerve stimulus. Photopic vision is the kind that applies in the daytime or at moderate levels of artificial illumination. It involves the cones of the retina, and is involved in color vision. Scotopic vision is the kind that comes into play at low levels of illumination. It involves the rods of the retina which are unable to distinguish colors, hence the saying that in the dark all cats are gray. The transition from photopic to scotopic vision normally takes place at about the level of illumination that corresponds to the light of the full moon high in the sky. When one goes from a brightly lighted area into a dark room he is blind at first but gradually dark adaptation occurs and a transition is made from photopic to scotopic vision. The ability to see, but without color discrimination, then returns. Nyctalopia is the name of a deficiency of vision whereby dark adaptation does not occur and is often connected with a Vitamin A dietary deficiency.

If one stares directly at a bright light which is then turned off, an afterimage will be seen; that is, the image of the light, but less bright and usually out of focus, continues to be seen and gradually fades away. Positive afterimages are those in which the image looks bright like the original stimulus, but this may reverse to a negative afterimage which looks darker than the surrounding field of view. Afterimages have undoubtedly given rise to some UFO reports.

The afterimage is the result of a temporary change in the retina and so remains at a fixed point on the retina. When one then moves his eyes to look in a different direction, the afterimage seems to move relative to the surroundings. If it is believed by the observer to be

a real object it will seem to him to have moved at an enormous velocity. A light going out will seem to shrink and move away from the observer as it does so. If one light goes on while another is going off, it may appear as if the light that is going off is moving to the place where the other light is going on.

Autokinesis is another property of the eye which needs to be understood by persons who are interested in looking for UFOs. A bright light in a field of view which has no reference objects in it, such as a single star in a part of the sky which has very few other stars in it, will appear to move when stared at, even though it is in reality stationary. This effect has given rise to UFO reports in which observers were looking at a bright star and believed that it was rapidly moving, usually in an erratic way.

12. Study of UFO photographs

The popular UFO literature abounds with photographs of alleged strange objects in the sky, many of which are clearly in the form of flying saucers. Some of these have been published in magazines of wide circulation. The editors of *Look* in collaboration with the editors of United Press International and Cowles Communications, Inc. published a *Look* "Special" in 1967 that is entirely devoted to "Flying Saucers," which contains many examples of UFO pictures.

Photographic evidence has a particularly strong appeal to many people. The Colorado study therefore undertook to look into the available photographs with great care. Chapter 2 of Section III gives the story of most of this work and Chapter 3 of Section IV gives the detailed reports on individual cases.

It is important to distinguish between photographic prints and the negatives from which they are made. There are many ways in which an image can be added to a print, for example, by double-printing from two negatives. Negatives, on the other hand, are somewhat more difficult to alter without leaving evidence of the fact. We therefore decided wherever possible to concentrate our study of photographic case upon the negatives. This was not, of course, possible in every instance

examined.

A barber whose shop is in Zanesville, Ohio, but whose home is in the suburb of Roseville, has made a widely publicized pair of UFO photographs. He did not attempt to exploit them in a big way. He merely exhibited them for local interest (and stimulation of his barbering business) in the window of his shop. There they remained for more than two months until they were discovered by a big city newspaperman from Columbus, Ohio, who arranged to sell them to the Associated Press. They were distributed in February 1967 and have been often printed in various magazines after their original presentation in many newspapers.

Early in the project we became acquainted with Everitt Merritt, photogrammetrist on the staff of the Autometrics Division of the Raytheon Company of Alexandria, Virginia. He undertook to do an analysis of the photographs. A pair of prints was supplied to Merritt by NICAP.

Each of the pair shows the home of the photographer, a small bungalow, with a flying saucer flying over it. The flying saucer looks like it might be almost as large as the house in its horizontal dimension. The photographer says that he was leaving home with a camera when he chanced to look back and see the saucer flying over his home. He says he quickly snapped what we call picture A. Thinking the UFO was about to disappear behind a tree, he ran to the left about 30 ft. and snapped picture B, having spoiled one exposure in between. He estimated that there was less than a two minute interval between the two pictures, with A followed by B.

Merritt studied the negatives themselves by quantitative photogrammetric methods, and also did some surveying in the front yard of the Roseville home, as a check on the calculations based on the photographs. From a study of the shadows appearing in the picture, he could show conclusively that actually picture B was taken earlier than picture A, and that the time interval between the two pictures was more than an hour, rather than being less than two minutes as claimed.

The photographic evidence contained in the negatives themselves is therefore in disagreement with the story told by the man who took the pictures. Two letters written to him by the Colorado project requesting his clarification of the discrepancy remain unanswered.

We made arrangements with Merritt for his services to be available for photogrammetric analysis of other cases. These methods require a pair of pictures showing substantially the same scene taken from two different camera locations. Unfortunately this condition is seldom met in UFO photographs. Only one other pair came to our attention which met this criterion. These were the much publicized pictures taken on 11 May 1950 near McMinnville, Ore. (Case 46). But in this case the UFO images turned out to be too fuzzy to allow worthwhile photogrammetric analysis.

Other photographic studies were made for the Colorado project by Dr. William K. Hartmann, (Section III, Chapter 2).

Hartmann made a detailed study of 35 photographic cases, (Section IV, Chapter 3) referring to the period 1966-68, and a selection of 18 older cases, some of which have been widely acclaimed in the UFO literature. This photographic study led to the identification of a number of widely publicized photographs as being ordinary objects, others as fabrications, and others as innocent misidentifications of things photographed under unusual conditions.

On p. 43 of the *Look* Special on "Flying Saucers" there is a picture of an allegedly "claw-shaped" marking on the dry sand of a beach. Some of the dark colored moist sand making up the "claw mark" was shipped to Wright-Patterson AFB and analyzed. The liquid was found to be urine. Some person or animal had performed an act of micturition there.

A report by Staff Sergeant Earl Schroeder which says "Being a native of this area and having spent a good share of my life hunting and fishing this area, I believe that the so-called 'monster' (if there

was such) could very well have been a large black bear." His report also notes that "during the week of July 26 the local TV stations showed a program called 'Lost in Space.' In this program there were two monsters fitting their description controlled by a human being."

Summarizing, the investigation report says, "There was food missing from the picnic table which leads to the belief that some animal was responsible for the black shape portion of the total sighting. There are numerous bears and raccoons in the area."

Another photograph presented in the *Look* Special is of a pentagonal image, though called hexagonal. Photographic images of this kind arise from a malfunctioning of the iris of the camera and are quite commonplace. It is hard to understand how the editors of a national illustrated magazine could be unfamiliar with this kind of camera defect.

13. Direct and Indirect Physical Evidence

A wide variety of physical effects of UFOs have been claimed in the UFO literature. The most direct physical evidence, of course, would be the actual discovery of a flying saucer, with or without occupants, living or dead. None were found. Claims which we studied as direct evidence are those of the finding of pieces of material which allegedly came from outer space because it is a product of a different technology, so it is said, than any known on earth. Another kind of direct evidence studied were allegations that disturbance of vegetation on the ground, or of the soil was due to an UFO having landed at the place in question.

The claimed indirect physical evidence of the presence of an UFO is of the nature of effects produced at a distance by the UFO. Accounts of sounds, or the lack of sounds, associated with UFOs, even though reports of visual observation indicated speeds of the UFO far in excess of the velocity of sound were common. Whenever a terrestrial solid object travels through the atmosphere faster than the speed of sound, a sonic boom is generated. The argument has been advanced that the

absence of a sonic boom associated with UFOs moving faster than cutoff Mach (see Section VI, Chapter 6) is an indication of their being a product of a technology more advanced than our own because we do not know how to avoid the generation of sonic booms. Another category of indirect physical effects are those associated with claims that UFOs possess strong magnetic fields, vastly stronger than those that would be produced by the strongest magnets that we know how to make.

There are many UFO reports in which it is claimed that an automobile's ignition failed and the motor stopped, and in some cases that the headlights failed also, and that after this happened, an UFO was seen nearby. Usually such reports are discussed on the supposition that this is an indication that the UFO had been the source of strong magnetic field.

Reports of both direct and indirect physical evidence were studied by various staff members of the Colorado project, principally by Dr. Roy Craig, whose account of these studies is contained in Chapters 3 and 4 of Section III.

These studies resulted mostly in lack of substantiation of the claims that have been made. Claims of terrestrial magnetic disturbances at various Antarctic bases were either unconfirmed or seemed to be closely related to a practical joke that was played on a base commander.

During the period of field study of this project only one case of automobile engine malfunction came to our attention. There was some ground for skepticism about the report in that it was made by a diabetic patient who had been drinking and was returning home alone from a party at 3:00 a.m.

Some laboratory tests showed that engine failure due to the action of an external magnetic field on the car's ignition coil would require fields in excess of 20,000 gauss, at the coil. Owing to the magnetic shielding action of the sheet steel in the car body, the strength of the field outside the car would have to be considerably greater than this. But magnetic fields of such intensity would alter the state of

magnetization of the car itself.

The process of forming car bodies by cold-forming the sheet steel introduces some quasi-permanent magnetization into car bodies. Since all of the bodies of a given make in a given year are usually made with the same molds on the same presses they are all magnetized in the same pattern.

In the case in question we found that the car body that had been subjected to the presence of the UFO was magnetized. The pattern of magnetization quite closely resembled that of a car of the same make and year that was found a thousand miles away in a used car lot in Boulder, Colo. From this we can infer that the car that was supposedly near the UFO, had not been subjected to a strong magnetic field, otherwise this would have permanently changed the state of magnetization of the body of the exposed car.

In the area of direct physical evidence, probably the most interesting result of investigation was the analysis of a piece of metallic magnesium which was alleged to have come from an UFO that exploded over a stretch of tidal water at Ubatuba, São Paulo, Brazil in 1957. This was one of several pieces of magnesium from the same source that had been sent to the society editor of a Rio de Janeiro newspaper at the time.

Later one of the pieces was subjected to elaborate chemical analyses in government laboratories in Brazil. The results of the analysis are given in great detail in the first of the Lorenzen books (1962), the full account occupying some forty pages. The claimed result of these studies was that the laboratory work showed the metallic magnesium to be purer than any ever made by man on Earth. Therefore it could not have been a product of earthly technology, therefore it came from an extraterrestrial source.

Mrs. Lorenzen kindly supplied one of the magnesium specimens to the Colorado project. We arranged to have it studied by the method of neutron activation analysis in a laboratory in Washington, D. C. The

result, which is presented in detail in Chapter 3 of Section III, was that the magnesium metal was found to be much less pure than the regular commercial metal produced in 1957 by the Dow Chemical Company at Midland, Michigan. Therefore it need not have come from an extra-terrestrial source, leaving us with no basis for rational belief that it did.

14. Radar Sightings of UFOs

The public became generally aware of radar at the end of World War II when the story of its important use in that war was told, after having been kept secret for some 12 years. A good non-technical account of this development is given in R. M. Page, *The Origin of Radar* (1962).

The word radar is an acronym for *R*ADIO *D*ETECTION AND *R*ANGING. Basically, most radar systems operate in the following way. A transmitter sends out short pulses of electromagnetic energy at regular intervals. These are sent out through an antenna designed to radiate a narrow beam within a small angle of its main direction. This beam of pulses travels outward at the speed of light. If it encounters an obstacle, which may be a metallic object like an airplane, a rain storm, or a bird or a flock of birds, it is partially scattered in all directions from the obstacle. In particular a part of the beam is scattered back toward the transmitter. When it arrives back at the transmitter it is received and indicated or displayed in various ways, depending on the special purpose for which the system was designed. By the fact of there being a returned signal at all, the function of detection is accomplished. By the time delay involved between the transmission of the outgoing signal and the return of the back-scattered signal, the distance of the scattering object is inferred, thus accomplishing the function of ranging.

To get a beam of sufficiently narrow distribution in angle as to enable inferring from what direction the scattered signal was returned, the antenna must have a diameter of the order of ten times the

wavelength of the radio waves which it uses.

In the period since 1945 the technology has had an enormous development so that nowadays there are elaborate networks of land and ship-based radar systems, as well as radar systems carried by most airplanes, which have become vitally necessary to the safe operation of civil and military aircraft. In addition to the use of radar in connection with navigation, it has become a valuable tool in meteorological work in that distant rain storms can be detected by radar. Also the trails of ionized air left by meteorites can be detected and studied by radar, providing for the first time the means for observing meteorites in the daytime.

There are many popular misconceptions about radar. It is important at the outset to realize that the returned radar signal does *not* give a sharply focussed image or picture of the obstacle that has been detected. What one gets when it is displayed on a cathode-ray screen is simply a diffuse blob of light indicating that *something* is there, in the direction the antenna is pointed (with some exceptions) and at the distance indicated by the time delay between transmission and reception of the back-scattered pulse. Of course, a large airplane gives a more intense signal than a flock of small birds at the same range, and skilled operators learn to make valid inferences about the nature of the object detected from other things that they know about the general situation together with the magnitude of the returned signal.

It is important also to recognize that the propagation of the outgoing and the back-scattered pulses is ordinarily assumed to be rectilinear and at the normal speed of light. But the actual propagation is affected by temperature and humidity difference in the air path along which the radio pulse travels. This can give rise to anomalous propagation that is analogous to but in detail not identical with the effects which give rise to mirages in the propagation of light through such an atmosphere. Usually the radar set operator does not know

enough about the actual atmospheric conditions to make allowance for effects of this kind and, if they happen to be pronounced, can be led to make erroneous decisions. Another point is that, although the antenna sends out most of its energy in a single narrow beam, small amounts of energy go out in several other directions, known as side-lobes, so that a large or a nearby object in the direction of a side-lobe can give rise to a received signal that is indistinguishable from a small or distant object in the direction of the main beam.

The overall radar system is a rather complicated set of electronic equipment which can malfunction in various ways giving rise to internally generated signals which the operator will tend to regard as reflections made by outside obstacles which are in reality not there.

Usually the returned radar signals are displayed on the screen of a cathode ray tube and observed visually by the operator. On this account, subjective judgments of the operator enter into the final determination of what is seen, how it is interpreted and how it is reported. The data obtained from radar systems are thus not as completely objective as is often assumed. In some few instances subjectiveness is somewhat reduced by the fact that the cathode ray screen is photographed, but even when this is done there is a subjective element introduced at the stage where a human observer has to interpret the photograph of the radar screen.

Radar operators do report unidentified targets from time to time and so there exists a category of UFO cases in which the unidentified flying object was seen on a radar screen. In a few cases there is a close correlation between an unknown thing in the sky seen visually and something also displayed on radar.

However in view of the many difficulties associated with unambiguous interpretation of all blobs of light on a radar screen it does not follow directly and easily that the radar reports support or "prove" that UFOs exist as moving vehicles scattering the radio pulses as would a metallic object. The Colorado project engaged the services of the

Stanford Research Institute to make a general study of the functioning of radar systems from the point of view of the relation of their indications to UFOs. The study which was carried out resulted in the production of Section VI Chapter 5, by Dr. Roy H. Blackmer, Jr. and his associates, R. J. Allen, R. T. H. Collis, C. Herold and R. I. Presnell.

Studies of specific UFO radar reports and their interpretation are presented in Section III, Chapter 5 by Gordon Thayer. Thayer is a radio propagation specialist on the staff of the Environmental Science Services Administration in Boulder. In his chapter, Thayer presents a detailed analysis of some 35 cases, some of which are visual, others radar, and some are both. Both optical and radar phenomena are treated together because of the similarity in the wave propagation problems involved.

In his summary of results he says: " . . . there was no case where the meteorological data available tended to negate the anomalous propagation hypothesis. . ." However, Thayer points out that adequate meteorological data for a thorough interpretation is often lacking so that a great deal more observational material of this kind would be needed in order to deal with a larger proportion of all of the reported UFO radar cases.

In view of the importance of radar to the safe operation of all aircraft, it is essential that further research be done leading to the most precise knowledge possible of anomalous propagation of radar signals. However, it is felt that this can best be done by a direct attack on the problem itself rather than by detailed field investigation of UFO cases.

15. Visual Observation made by U.S. Astronauts

The popular UFO literature makes occasional reference to UFOs seen by the U.S. astronauts in the space program operated by the National Aeronautics and Space Administration. We do not know of similar reports by Soviet astronauts but they may well have seen similar things.

In flights conducted between 12 April 1961 and 15 November 1966,

thirty U.S. and Russian astronauts spent a total of 2,503 hours in orbit. The Colorado project was fortunate in that Dr. Franklin Roach, one of the principal investigators, has worked closely with the astronaut program in connection with their visual observations and so was already quite familiar with what they had seen and also was able to conduct further interviews with several of them on the basis of close personal acquaintances already established.

Roach presents a detailed account of what they saw as related to the UFO question in Section III, Chapter 6. Nothing was seen that could be construed as a "flying saucer" or manned vehicle from outer space. Some things were seen that were identified as debris from previous space experiments. Three sightings that are described in detail remain quite unidentified and are, Roach says, "a challenge to the analyst."

Roach emphasizes that the conditions for simple visual observation of objects near the satellite are not as good as might be naively supposed. As he describes them, "The conditions under which astronauts made their observations are similar to those which would be encountered by one or two persons in the front seat of a small car having no side or rear windows and a partially covered, very smudged windshield." Moreover, the astronauts were kept occupied with other observations and activities during their flight and so did not have extended periods of time in which to concentrate on visual observation of their surroundings. Most of the available visual observations therefore have to be regarded as a by product rather than a primary purpose of the program in which they were engaged.

The conclusion is that nothing definite relating to the ETH aspect of UFOs has been established as a result of these rather sporadic observations.

16. Public Attitudes Toward UFOs

Opinion polls are widely employed nowadays to measure public attitudes on various important and trivial issues. It is natural

therefore to apply the same method to a determination of public attitudes toward various phases of the UFO question.

Studies of this sort are not studies of the UFOs themselves, but an attempt at determination of what the American public thinks about UFOs. Some UFOs either do or do not come from outer space, and the fact of the matter would not be determined by finding out what the opinion of the American people about it may be. Nevertheless we considered that public attitudes do play a role in policy formation in America, and therefore it was appropriate to carry on some work in this area.

In 1947, 1950 and 1966 brief surveys of public attitudes on UFOs or flying saucers were conducted by the American Institute of Public Opinion, popularly known as the Gallup poll. Arrangements were made by the Colorado project for a more detailed study to be made during the spring of 1968. This was done for us by the Opinion Research Corporation. Findings of the earlier studies and of the study made for us are presented in Chapter 7 of Section III.

The first two studies indicated respectively that 90% and 94% of the American adult public had heard of flying saucers. The first of these results, taken within months of the original June 1947 sightings at Mt. Rainier indicates the extraordinary interest which the subject aroused from the outset. The 1966 survey indicated that 96% of the adult public had heard of flying saucers.

In the 1966 poll people were asked,

"Have you, yourself, ever seen anything you thought was a 'flying saucer'?"

The result was that 5% of the 96% who had heard of them answered yes to this question. The sample was designed to be representative of the American population, 21 years of age and older, of whom there are some 100 million. This is the basis of the oft-quoted statistic that five million Americans have said that they think they have seen a flying saucer.

In the same 1966 poll, 48% said they thought the things called flying saucers were "something real," and 31% said that they were "just people's imagination." The question does not distinguish between various kinds of "real" things, such as weather balloons, aircraft, planets, mirages, etc., so the result by no means indicated that 48% believe they are visitors from outer space. That question was not included in the 1966 poll.

The 1966 poll asked whether the person interviewed thinks "there are people somewhat like ourselves living on other planets in the universe?" The question thus bears solely on ILE, not on whether such intelligences do in fact visit the Earth. Of the 1,575 interviewed 34% thought yes, 45% thought no, and 21% had no opinion.

There were no statistically significant regional differences between East, Midwest, South and West with regard to the proportion of the population which had heard of, had seen, or believed in the reality of flying saucers. However, as to belief in ILE, the existence of people on other planets, this belief was held by only 27% of southerners, as compared with 36% of easterners, 37% of midwesterners and 36% of westerners. The lower proportion of southerners who believe in ILE is statistically significant, that is, outside the range of chance variation due to finite size of sample. Although statistically significant, it is causally unexplained.

Significant variation with age is shown in responses to belief in the reality of flying saucers, and to belief in intelligent life on other planets. About 50% of persons under 60 believe in the reality of flying saucers as compared with about 33% of persons over 60. On the other hand, a significantly smaller proportion of those under 50 believe in ILE, than do those over 50. On both of these points, the decline in the number of "believers" among older people is mostly due to the increase of those having "no opinion" rather than to an increase of the number of "non-believers." Here again the poll gives no basis for conclusions as to the reasons for these differences.

As to dependence on sex , 22% of men or women have no opinion as to the "reality" of flying saucers. Significantly more women than men believe in their reality:

	% Real	% Imaginary
Men	43	35
Women	52	26

The poll showed that increased amount of formal education is associated with an increased tendency to believe in the reality of flying saucers. Perhaps this result says something about how the school system trains students in critical thinking.

An interesting correlation is found between tendency to believe in UFO reality, and to believe in ILE with having had a personal experience of having seen an UFO. The results are:

	% believing UFOs are real	% believing in ILE
Signers	76	51
Non-sighters	46	34

As before, causal relations are unexplored: we do not know whether seeing is believing, or believing is seeing.

In the 1968 study conducted for the Colorado project by the Opinion Research Corporation, 2,050 adults over 17 years of age, living in private households in the continental United States were interviewed. In addition teenagers in the same household with an adult who was interviewed were also interviewed to give a sample of their views. Separate studies of opinions held by college students were conducted. These are reported in Section III, Chapter 7.

In the 1968 survey, 3% of adults replied affirmatively to "Have you, yourself, ever seen an UFO?" This parallels the 5% who answered affirmatively in the 1966 Gallup poll to the similar question, "Have you ever seen anything that you thought was a 'flying saucer'?" One might think that the smaller number in 1968 could be explained by perhaps less familiarity of the public with the term UFO than with the

term flying saucer. This seems hardly likely, however, in that the question was part of a total interview in which the meaning of the term UFO would have become clear from the general context of other questions in the interview. It seems to us therefore that this poll actually indicated a smaller percentage of sighters than the earlier one.

An important finding is that 87% of those who said that they had seen an UFO, also declared that they had reported it to no one, other than to family or friends, that is, to no one by which it would have received official attention. Thus only about one-eighth of sightings were reported anywhere, and not all of these were reported to the Air Force. Hence if all sightings were reported to the Air Force, this result indicates that the number of reports received would be more than eight times as many as are now being received. From the small fraction who did report to the Air Force, it seems a fair inference that most of these non-reporting sighters did not think that what they saw constituted a security hazard.

In contrast, 56% of the non-sighters declared that they would report it to the police if they saw an UFO. We find this rather large discrepancy between the promised reporting behavior of the non-sighters and the actual reporting behavior of the sighters quite puzzling.

17. Other Psychological Studies

Consideration was given to a variety of modes of conducting psychological and psychiatric research into the UFO phenomenon. The possibility that an "experimental UFO" might be launched and reports of its sighting studied was given serious consideration and rejected on three grounds: In view of the fact that this was a government-sponsored, university-based study, it was felt that experiments in which the public might regard itself as having been victimized by what amounted to a hoax were unwise. Such experiments also might give rise, we thought, to the erroneous notion that the study regarded UFO phenomena *solely* as the result of misinterpretation of natural or man-made phenomena. Finally, we were advised by some of our experts in

the psychological disciplines, that a "mock-up" UFO would introduce unknown variables that would render inconclusive any results derived from the conduct of experiments with it (see Section VI, Chapter 10).

Turning to the realm of psychiatry, we decided to refrain from mounting a major effort in this area on the ground that such a study could not be given priority over other investigations. This decision was buttressed by the evidence that we rapidly gathered, pointing to the fact that only a very small proportion of sighters can be categorized as exhibiting psychopathology and that, therefore, there is no reason to consider them any more suitable for study than psychotic or psychoneurotic individuals who belong to any other statistical class of the population as a whole (see Section VI, Chapter 3).

18. Instrumentation for UFO Searches

As remarked earlier, the short duration of most UFO sightings, the delays in reporting them and the delays caused by communication and travel, make it essentially impossible that investigators can bring physical observing equipment to a report site quickly enough to make UFO observations in that way. There is another way that is often proposed for getting better observational data than is now available; namely, to set up a permanently manned network of observing stations at various places in the country to observe such UFOs as might come within their range.

Such a network of stations might be set up solely for the purpose of UFO study, or it might be established in conjunction with one of the networks of stations which exist for other astronomical or meteorological purposes. This latter alternative, of course, would be much less expensive than the former, or could give a greater coverage for the same expenditure.

We gave considerable attention to the possibilities and difficulties in this direction (Section VI, Chapter 9). At first we hoped that some definite results could be obtained by such cooperation with existing stations in a way that would make results available for this report.

An all-sky camera was operated during most of August 1967 at Harrisburg, Penna. during an UFO flap in that locality (Case 25) but no interesting results were found on some 9,000 photographs. It would be quite expensive to operate a network of such cameras on a routine basis all over the United States. The likelihood of interesting images being recorded would be very small. Because of the short duration of an UFO appearance a proper plan for use of the all-sky camera would involve frequent processing and examination of the film, otherwise the presence of an UFO would not be recognized until long after it had disappeared. This would greatly increase the cost of operation of such a network.

Another suggestion that is often made is to make UFO studies in connection with the radar networks operating in this country for air traffic control under auspices of the Federal Aviation Agency. Consideration was given to this possibility and it was concluded that it is quite out of the question to burden this network with additional duties of any kind. The air traffic control operators are now heavily burdened with the work of safely guiding civil and military aviation. During the summer of 1968 especially, the heavy overloads that sometimes exist on the system were emphasized by troublesome traffic delays in the neighborhood of several of the nation's major airports. It would be quite out of the question to ask the air traffic controllers to assume the responsibility of watching for UFOs in addition to their primary responsibilities. It would likewise be impracticable for a separate group of personnel to be installed at these stations to watch the same radars for UFOs.

The Prairie Network is a group of camera stations operated in the mid-west by the Smithsonian Institution in connection with the Harvard Meteor Program. Its primary purpose is to detect and record meteor trails in such a way as to guide a search for actual meteoritic bodies that strike the earth's surface. The field headquarters of this network is at Lincoln, Neb.

We prepared a listing of reported UFO sightings since 1965 that

fell within the geographic limits of this network and through the kind cooperation of the Smithsonian Institution obtained the records of the network for the times and locations of these sightings. About half of the sightings were so lacking in specific information that, Frederick Ayer reports, (Section VI, Chapter 9) "even if an object had been recorded by the film it would have been impossible to correlate it with the sighting." About one-third of the sightings could not be traced on the film because of overcast skies. Some 18% of all the UFO sightings were identified on the network's records with a fair degree of probability. Nearly all of these were identified as astronomical objects. Some consideration was given to the costs and likelihood of success of adapting the Prairie Network instruments to UFO searches without interfering with their primary purpose. We think that something might be done along this line at reasonable expense, but we do not make a positive recommendation that such a program be undertaken because of the inconclusiveness of the information that we believe would be gathered.

Another existing program that was studied for unrecognized UFO records was that of scanning the night sky for study of air glow from the upper atmosphere, and of zodiacal light. Detailed study was made of two records obtained from a station on the Hawaiian Islands. One of these remains unidentified but is thought to be related to an artificial satellite for which no information is readily available. The other was definitely identified as a sub-orbital missile launched from Vandenberg AFB on the coast of southern California. Mr. Ayer, p. 1233, concludes that "because of their relatively extensive sky coverage, scanning photometers can be considered useful instruments in the conduct of UFO searches." This, however, is not to be construed as a recommendation that a network of scanning photometer stations be established for this purpose.

Consideration was also given to the adaptability to UFO search purposes of radars of the type used by the Weather Bureau, and the radar station of the Radar Meteor Project of the Smithsonian Institution

located near Havana, Ill.

Although frequent claims are made in the UFO popular literature of magnetic disturbances due to the presence of UFOs, a consideration of various official magnetometer records produced no evidence of an effect of this kind that, in our judgment would warrant the setting up of an observational program to look for UFOs by their alleged magnetic effects.

19. Conclusion

In our study we gave consideration to every possibility that we could think of for getting objective scientific data about the kind of thing that is the subject of UFO reports. As the preceding summary shows, and as is fully documented in the detailed chapters which follow, all such efforts are beset with great difficulties. We place very little value for scientific purposes on the past accumulation of anecdotal records, most of which have been explained as arising from sightings of ordinary objects. Accordingly in Section I we have recommended against the mounting of a major effort for continuing UFO study for scientific reasons.

This conclusion is controversial. It will not be accepted without much dispute by the UFO amateurs, by the authors of popular UFO books and magazine articles, or even by a small number of academic scientists whose public statements indicate that they feel that this is a subject of great scientific promise.

We trust that out of the clash of opinions among scientists a policy decision will emerge. Current policy must be based on current knowledge and estimates of the probability that further efforts are likely to produce further additions to that knowledge. Additions to knowledge in the future may alter policy judgments either in the direction of greater, or of less attention being paid to UFO phenomena than is being done at present.

We hope that the critical analysis of the UFO situation among scientists and government officials that must precede the determination of official policy can be carried out on a strictly objective basis.

Attacks on the integrity of various individuals on either side of this controversy ought to be avoided. The question of an individual's integrity is wholly distinct from the issue of what science should do in the future about UFOs.

In the Congress of the United States concern about the UFO problem from a defense viewpoint is the province of the House Committee on Armed Services. Concern about it from the point of view of the nation's scientific research program comes under the House Committee on Science and Astronautics. Here there seems to be a valid situation of overlapping jurisdictions because the UFO problem can be approached from both viewpoints.

A particular interest in the UFO problem has been shown by Congressman J. Edward Roush of Indiana, who is a member of the House Committee on Science and Astronautics. He performed a valuable service by arranging for the holding of a "Symposium on Unidentified Flying Objects" in Washington on 29 July 1968 (see references). As pointed out by one of the symposium participants, Prof. Carl Sagan of the department of astronomy of Cornell University, the presentations made in that symposium incline rather strongly to the side of belief that large-scale investigations of the UFO phenomenon ought to be supported in the expectation that they would be justified by what some speakers called "scientific paydirt."

We studied the transcript of this symposium with great care to see whether we would be led, thereby, to any new material related to this study. We did not find any new data.

Several of the contributors to that symposium have become trenchant advocates in the past several years of a continuing major government investment in an UFO program. Several have long urged a greater degree of congressional interest in this subject. The symposium of 29 July afforded them an occasion on which, with the utmost seriousness, they could put before the Congress and the public the best possible data and the most favorable arguments for larger government activity in this field.

Hence it is fair to assume that the statements presented in that symposium represent the maximum case that this group feels could be made. We welcome the fact that this symposium is available to the public and expect that its data and arguments will be compared with those in this report of this study by those whose duty it is to make responsible decisions in this area.

We have studied this symposium record with great care and find nothing in it which requires that we alter the conclusions and recommendations that we have presented in Section I, nor that we modify any presentation of the specific data contained in other sections of this report.

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Section III

The Work of the Colorado Project

The seven chapters that follow describe the details of the scientific studies carried out by members of the project staff in the physical and social sciences. Most of the studies were, as Dr. Craig points out, closely related to the project's examination of specific cases. Detailed reports of the cases are found in Section IV.

Chapter 1
Field Studies
Roy Craig

1. Introduction

Reports of UFO observations, elaborate in description as they sometimes are, are usually lacking information which would concretely define the nature of the object observed or the experience described. When specific information describing an unidentifiable object is presented, the reliability of that information must also be evaluated, and some corroboration or independent verification is necessary.

At its outset in November 1966, the information with which this project had to work consisted of old reports, some of which had been investigated quite thoroughly by official and private agencies, and press accounts of current sightings, in which the information was generally fragmentary. New information regarding sightings which had never been revealed to the public also occasionally came to our attention. In all cases, additional information, varying in nature for different cases, was desired. Field investigations were undertaken in an effort to obtain such information.

2. Old UFO Cases

The project acquired copies of Project Blue Book and NICAP reports of UFO cases which had been discussed in popular UFO writings or which were regarded as having unusual scientific interest. Some of these reported sightings had been so extensively publicized that they have acquired the status of "Classic" cases.

In December 1966, early in the project history, we attempted to augment available information regarding one such case: the 1952 Washington, D.C., radar sightings (see Section III Chapter 5), by on-site

re-investigation of the case. While this inquiry provided valuable new experience in the problems of investigating UFO phenomena, it brought little or no new information to light.

In general, testimony of witnesses recorded shortly after their experiences can be considered more reliable than their re-telling of the story two to 20 years later, both because of failures of memory and because of a tendency to crystallization of the story upon repeated retelling. For this reason, re-examination of witnesses in "classic" cases was not considered a useful way for the project to invest time. Field investigation of classic cases was therefore limited to those in which existing reports contained a serious discrepancy which might be resolved.

In one classic case, field investigation was undertaken primarily to locate that portion of a strip of 16mm. motion picture film made in 1950 which, the photographer said, showed most clearly the structure of UFOs he had photographed (Case 47). The photographer had claimed that this portion had been removed from his film when he lent it to the Air Force for study before the film was returned to him by ATIC experts.

The results of the investigation emphasized the vicissitudes of memory and the difficulties of establishing a crucial fact some 18 years after the event. Rather than reducing the uncertainty in the case, the investigation created greater uncertainty because it revealed further discrepancies in accounts of the sighting.

The case also was of special interest because earlier photographic analysis by Dr. R.M.L. Baker, then of Douglas Aircraft Corporation, indicated that the photographed objects probably were not aircraft, contrary to their "identification" in Project Blue Book records. Identification as other man-made or natural objects apparently had

been ruled out primarily on the basis of wind direction on the alleged date of the sighting.

Since a detailed account of this sighting is given in Chapter 3, Section IV, only that information is presented here which illustrates the difficulties arising in attempts to investigate an event which occurred years previously, even when the primary and most of the principal secondary witnesses are still available.

This writer visited the photographer seeking details that might confirm or disprove his claim that the Air Force had admitted confiscating part of the film. The photographer had asserted that he possessed a letter from the Air Force containing precisely such an admission. If the letter could be produced, it might then be possible for the project to recover the allegedly missing film for study. A first-hand account of the sighting also was desired. At Great Falls, Mont. where the film was made, residents who had seen the film before it was sent to the Air Force were interviewed, newspaper accounts were searched, and attempts were made to resolve discrepancies in these reports. The only other person who reportedly witnessed the filming was, at the time of the event, serving as secretary to the photographer. She was interviewed by telephone.

1) The photographer had an extensive accumulation of papers and news clippings relating to his UFO film, much of it referring to his participation in a commercially produced documentary on UFOs released in 1956. No Air Force (or other) letter admitting that part of the film had been removed could be found among these accumulated papers. The photographer nevertheless insisted that he had such a letter, and suggested that many such items had been misplaced when he had changed his residence.

2) He also professed to no knowledge of the Air Force's "identification" of the filmed objects as two F-94 airplanes circling to land at the Great Falls Air Base, now renamed Malmstrom AFB. He remembered no aircraft in the sky near the time of his UFO sighting, and

thought the aircraft explanation absurd. Nor did he recall that he had claimed in the documentary film, and in letters which are part of the Blue Book case file, to have seen two airplanes approaching Great Falls Air Base just after he took his UFO movies.

3) Several residents of Great Falls who were said to have seen the UFO film before it was loaned to the Air Force denied having seen it at that time. Others who had seen it both before and after it was lent to the Air Force firmly believed that not all the original film was returned by the Air Force. This claim was generally accepted as true by Great Falls residents. However, no measurements of film footage had been made before and after the loan to the Air Force, so that claims of film cropping could not be verified. Blue Book files contained some evidence lending credence to this claim. The original letter of transmittal of the film from Great Falls AFB to Wright-Patterson AFB stated that approximately 15 ft. of film were being transmitted. Only some 7 ft. were analyzed by Dr. Baker in 1956.

4) The secretary was the only witness to the UFO filming. She remembered distinctly seeing a single object and rushing outside the baseball stadium with her employer to watch him film it. She was certain it could not have been an airplane, because its appearance was quite different from that of a plane. She remembers seeing only one object, while the movie unambiguously shows two, almost identical objects moving across the sky.

5) Records had shown that two F-94s did land at Great Falls Air Base at 11:30 and 11:33 a.m. on 15 August 1950, about the time the UFO film was assumed to have been made. Local newspapers for this period, however, revealed that the semi-professional baseball team that the photographer managed did not play in Great Falls on that date but, rather, played in Twin Falls, Idaho several hundred miles away. The team played no home games in Great Falls between

9 August and 18 August. According to the account of the UFO sighting, the photographer was at the base ball park to prepare for the game to be played that afternoon; if this general account of the conditions of the UFO filming is accepted, the 15 August date must be erroneous. The relevance of the landing of the particular airplanes to which official identification of the filmed objects was assigned thus became highly questionable. Weather data which indicated the objects were moving against the wind, and thus could not have been balloons, also became irrelevant.

Reexamination of the record, in view of this date discrepancy, shows some early uncertainty as to whether the movies were taken on 5 August or 15 August. Acceptance by the Air Force of 15 August as the sighting date, and explanation of the filmed objects in terms of aircraft in the vicinity on that date, seems somewhat careless, since the presence of the photographer in Great Falls on that date of the photograph appears improbable. There is no question that the film was made in Great Falls, Mont. An identifiable water tower located there appears on the film. The date the movie was made is entirely open to question, however. Elimination of a balloon explanation depends upon knowledge of wind direction and that knowledge is available only if the date is known. Information regarding the date is not now available.

6) An indication of the manner in which representatives of the Air Force dealt with the photographer, after the original UFO report was submitted in 1950, is given in a written statement to him from Air Materiel Command Headquarters. After examination of the film, which clearly showed two images crossing the sky and passing behind the distant water tower, the statement read". . . our photo analysts were unable to find on it anything identifiable of an unusual nature. Our report of analysis must therefore be negative." This writer prefers to leave interpretation of this statement to the reader.

This limited field investigation of a classic case revealed more discrepancies in the file record reports than it resolved. It produced no firm evidence that part of the film had been retained by the Air Force, and no leads through which such film might be located, if it had been retained.

Other field investigations of "classic" sightings involving photographs were somewhat more productive of new information. In the Ft. Belvoir photographic case for example, the doughnut-shaped structure in the photos was unequivocally identified when Dr. Hartmann showed the photographs to Army experts at Ft. Belvoir (Case 50).

During review of other classic cases it was possible, in some instances, for project investigators to develop new, pertinent information. This information generally depended upon recorded data, such as weather data, which could be acquired by telephone, mail, or library reference. Knowledge of atmospheric conditions prevailing at the time of radar UFO sightings, for example, allowed analysis of sighting reports in the light of current knowledge of radar propagation. Thus, atmospheric information was useful in evaluating classic cases such as the 1952 Washington, D.C. sightings (see Section III, Chapter 5), in which on-site interviewing had contributed no new information. Since our experience generally showed that new interviews of witnesses in classic cases did not produce dependable new information, few on-site investigations of such cases were undertaken.

3. Old Cases Not on Record:

Because of the existence of our study, people told us of UFO sightings that had never previously been reported to any study group. A graduate student described three large craft which flew in 1956, slowly just above tree-top level, over a clearing in woods where, as a Boy Scout he and other Scouts were camping.

A U.S. Navy captain related such an unreported experience. In 1962, he and four members of his family saw what appeared to be an elongated cylindrical object silhouetted against stars. His brief account reads:

While returning from a movie at about 9:30 p.m., on Palatine Road about 5 mi. west of (location X), an object was sighted above the tree tops crossing from South to North at a slow rate of speed. At first it appeared like the lighted windows of a railroad passenger car, although on continued observation the lighted windows appeared in a more circular arrangement. We stopped the car and the entire family stepped outside and watched as it slowly moved away. There was no sound whatsoever. The night was warm, clear, and with no wind. The object (appeared) to be about 1000-2000 ft. in altitude on a level course.

The captain has served in the Navy for 25 years and had been a pilot for 26 years.

An Air Force major, on active duty at an air base described an experience he and his family had several years ago while driving across Texas. While stopped at a remote gasoline station just after dawn, the major and his son heard and watched two strange conical vehicles. They rose from behind a small hill, crossed the highway near them, and soared off into the sky, according to the major's account.

The numerous reports of this type were extremely interesting, and often puzzling. Many incidents were reported by apparently reliable witnesses. However, since they had happened in the relatively distant past, these events did not offer the project much prospect of obtaining significant information about the objects apparently sighted. There was no possibility of finding residual physical evidence at the site, and, in the typical case, the date of the event was uncertain, making it impossible to locate recorded relevant information such as weather data.

One old case (Case 5) which was not on public record did seem to warrant investigation. Our early information, from an apparently highly reliable source indicated that radar scope pictures, electronic counter-measure graphic data, and U.S. Air Force Intelligence debriefing records regarding the event should be in existence and available for our study.

The case came to our attention when an Air Force officer attending the project's conference for base UFO officers mentioned that he had encountered an unknown aerial phenomenon about ten years earlier. At the time of the event he reported it to Air Force intelligence personnel.

The incident involved the crew of a B-47 equipped with radar surveillance devices. The B-47 was operating from a Strategic Air Command base, and the report of the incident was thought to have been sent to Air Defense Command Intelligence. No report of the incident was found in Blue Book files or in the files of NORAD headquarters at Ent AFB. Lacking adequate information on an impressive case, project investigators sought to locate and interview members of the original B-47 crew, hoping to determine how the incident had been officially identified and to trace AF reports on it.

The B-47 crew consisted of pilot, co-pilot, navigator, and three officers who operated special radar-monitoring equipment. The three officers most directly involved with the UFO incident were pilot, co-pilot, and the operator of #2 monitoring unit. Their descriptions of the 1957 experience over the Dallas-Ft. Worth area were in broad agreement. Details of the experience are given in Case 5.

The UFO encountered was a glowing ball of light, as "big as a barn," which apparently emitted or reflected electromagnetic radiation at both 2800 MHz and visible frequencies. For an extended period it maintained a constant position relative to the moving

airplane, at 10-mi. range. It disappeared suddenly and reappeared at a different location, both visually and on airborne and ground radars. Since visual and radar observation seemed to coincide, reflection of ground radar did not seem a satisfactory explanation. Other explanations such as airplanes, meteors, and plasma also seemed unsatisfactory.

At first glance, the case seemed ideal for investigation by the project, since B-47s engaged in such operations routinely wire-record all conversations within the aircraft and between the ground during missions and are equipped with radar scope cameras and devices for recording graphically electronic counter-measure data. The pilot believed that such records had been turned over to intelligence officers after landing at the air base. The co-pilot and radar specialist were interviewed, but they said that since this mission was only for equipment checkout, neither wire nor film was taken aboard, and no data were recorded. The three crew members agreed that a full account of the experience had been given to Intelligence personnel at the air base from which the plane was operating. The pilot recalled the crew's completing a lengthy standard questionnaire regarding the experience some days after the event. However, the other two crew members recalled only an Intelligence debriefing just after landing and believed it was not more than two days after this event that the entire crew left for temporary duty in England. Thereafter they heard nothing further about the UFO.

Efforts to locate an intelligence report of this event were made at our request by Aerospace Defense Command Headquarters. Neither intelligence files nor operations records contained any such report, according to the information we received. An inquiry directed to Strategic Air Command Headquarters elicited response from the Deputy Commander for Operations of the Air Wing involved. He said a thorough review of the Wing history failed to disclose any reference to an UFO incident on 19 September 1957.

UFO reports filed in Wing Intelligence are destroyed routinely after six months. Since Project Blue Book, which maintains permanent UFO records, had no report of this event, we concluded that there existed no Air Force record that we could study.

The question of reliability of the crew's oral report remains. The individuals involved were trained, experienced observers of aerial events. None had encountered anything else of this nature before or since, and all were deeply impressed by the experience. Inconsistencies in the various accounts of the event itself were minor, and of a nature expected for recollection of an impressive event ten years past. There was serious lack of agreement regarding information recorded during the flight and events subsequent to landing. On the basis of criteria commonly applied, however, these observers would be judged reliable.

If the report is accurate, it describes an unusual, intriguing, and puzzling phenomenon, which, in the absence of additional information, must be listed as unidentified. In view of the date and nature of the mission, it may be assumed that radar "chaff" and a temperature inversion may have been factors in the incident. (See Section VI, Chapter 5). A temperature inversion did exist at 34,000 ft. The fact that the electromagnetic energy received by the monitor was of the same frequency as that emitted by the ground radar units makes one suspect the ground units as the ultimate source of this energy. Whether such factors are pertinent or coincidental to the experience of this B-47 crew remains however, open to debate. For a detailed analysis of this case see Section III, Chapter 5, pp. 203-207.

For the purposes of this discussion the case typifies one of the difficulties inherent in the investigation of older sighting reports: The first information that the investigator receives leads him to believe that further inquiry may well adduce reliable records of a strange event, for example, recordings of intercommunication within the aircraft and between air and ground; photographs of radarscope targets; graphic data from other instrumentation; written reports

of crew debriefings. Yet the most diligent efforts by project investigators failed to disclose the existence of any record.

4. Emphasis on Current Reports:

Such experiences convinced project investigators that field investigation should concentrate on current UFO reports. A properly equipped investigator might obtain accurate descriptive information about an unidentified object if he arrived on the scene shortly after a sighting, or during a sustained or repetitive sighting. Early in the study a few field trips had already been made to check current sighting reports, but the investigators had not been adequately equipped to gather quantitative data. In some interesting cases, the project had depended upon the reports of members of civilian UFO organizations who investigate UFO reports in their localities. In some instances their findings supplemented information from official Air Force investigation.

While the cooperation of private groups was helpful, objective evaluation of the sighting required obtaining as much first-hand information as possible. This could be done only when sustained or repetitive sighting situations occurred. In the case of isolated sightings, the project sought to send an investigator to the location as soon as possible, since the possibility of gathering meaningful data decreased rapidly with time, particularly when residual physical evidence was reported. For this reason, it was essential that the project receive immediate notification of any significant sighting.

Reports of apparently significant sightings usually reached us days or weeks after the event. Notification through official channels was inadequate because many sightings reported to news media apparently were not reported to the Air Force. Although Air Force Regulation 80-17A (Appendix B) stipulated that Air Force bases were to submit all UFO reports to the project, few reports

were received from this source during the Spring of 1967. During this time Frank Edwards (1967) claimed that he and NICAP were each receiving some 100 UFO reports per week. Since many of these reports would not have been judged significant by any investigator, the project established an early notification network designed to filter out obviously insignificant reports and to notify us immediately of apparently significant sightings anywhere in the continental United States.

5. The Early Warning System:

Our organization for providing early notification of UFO sightings utilized official and semi-official agencies, and private groups. Reporters and editors, although operating outside this structure, occasionally supplemented the system by telephoning us about sightings in their areas. The Federal Aviation Agency assisted by providing a mechanism (see Appendix F) whereby air traffic controllers were to report unidentified radar targets to us immediately, and several reports were received from this source. Similar assistance was extended (see Appendices G and H) by the U.S. Weather Bureau and by Region 2 of the U.S. Forest Service. Cooperation also was obtained from the Volunteer Flight Officer Network (VFON), a cooperative organization of more than 30,000 flight personnel of more than 100 airlines in about 50 countries. This organization, under the direction of Mr. H.E. Roth of United Airlines, transmits reports of sightings deemed to be satellite re-entries, whether or not the object observed is immediately identifiable. Arrangements were made with VFON for rapid transmittal to us of all unidentified aerial objects. Although few such reports were received from this network, its coverage of over 2,000,000 unduplicated route miles and its efficient system of communication promised monitoring of a large portion of the earth's atmosphere and quick reporting of observations.

A major component of our system for early notification consisted of a network of civilian observers distributed in carefully selected locations across the United States, and designated as the Early Warning Network (see Appendix I). Selected individuals were asked to serve as early warning coordinators for their areas, evaluating UFO sightings in their vicinities, and immediately notifying us of apparently significant sightings. Most of the coordinators were recommended by NICAP or APRO, and the majority were associated with one or both of these organizations. Many of the coordinators were technically trained. All served without compensation, sometimes at considerable personal sacrifice. They were a major source of information received regarding current UFO sightings, and the project is grateful for their generous assistance.

Reports of current UFO sightings were received by telephone and details specified on a standard early warning report form (Appendix J) were immediately recorded. If the report seemed promising, additional checking by telephone was begun immediately. This generally included calling a law enforcement agency, air base, newspaper editor, or others to get independent descriptions of the local situation. When possible witnesses were also phoned for additional information.

Since the aim was to have field teams at the site as quickly as possible, the decision whether to send a team to investigate had to be made on information available at this point. That information was often disturbingly incomplete. Rather than risk missing opportunities to get first-hand photographic, spectroscopic, magnetic, electromagnetic, or visual data, however, the project elected to err in the direction of dispatching a team even though the case might later prove valueless.

The decision to investigate was made by a standing committee of three or four senior staff members. The decision was based upon

the committee's evaluation of the expectation that significant information could be obtained through field investigation. This expectation was judged on the basis of the apparent reliability of the source and the nature of the reported event. If the event had been observed independently by different groups of people, was reported to differ markedly from known or expected phenomena, and particularly if the sighting was a continuing event or one that had recurred frequently, field investigation was undertaken. Special attention was given to events in which physical evidence, such as alleged landing marks, residues, or measurable alterations in properties of objects in the environment, might be discovered and studied.

6. Investigation Capability and Philosophy

By May 1967 teams of project investigators were available at all times for field investigations and were geared to reach a sighting location anywhere in the United States within 24 hours from receipt of the initial report. Equipment carried varied according to expected requirements. A standard field kit enabled the team to take 35mm photographs and 8mm motion pictures, check the spectrum of a light source, measure radioactivity, check magnetic characteristics, collect samples, measure distances and angles, and to tape record interviews and sounds (see inventory list, Appendix K). Special equipment, such as an ultrasonic detector (Case 20) and two-way radio equipment, was utilized in some instances. An all-sky camera was installed and used for one series of field investigations (Case 21). In this case, the investigator established a base of operations at a location from which UFO reports were generated, publicized his presence, and had an aide who received telephone calls and relayed UFO reports immediately to him in his telephone-equipped automobile. He surveyed the area in this manner for several weeks.

In some investigations, a single investigator was deemed sufficient, but most investigating teams consisted of a physical

scientist and a psychologist. Although each had his own area of special interest, they assisted each other in all aspects of the investigation. In a few cases, psychological testing of individuals who reported UFO sightings was done in the field (see, for example cases 33, 38, 42).

The aim of the field investigation was always to obtain useful information about UFO phenomena. We did not consider it our function to prove beyond doubt that a case was fraudulent if it appeared to be so. When an investigation reached the point, as sometimes happened, that the reality of the reported experience became highly doubtful, there was little to be learned from further inquiry. If unlawful or unethical practice were involved, we considered obtaining proof of this outside the realm of our study.

7. Types of Current Cases Studied

A. Typical investigation

Although field teams entered a wide variety of situations and were often able to establish firm identifications, a common situation was one in which the lack of evidence made the investigation totally inconclusive.

Near Haynesville, La., for example, (Case 10) a family had reported observing a pulsating light which changed from a red-orange glow to a white brilliance which washed out their car headlights and illuminated the woods on both sides of the highway. The driver had to shield his eyes to see the highway. About 0.6 mi. farther down the highway, the driver reportedly stopped the car and, from outside the automobile, watched the light, which had returned to its original glow. The light was still there when he stopped observing and left the area about five minutes later.

Although our investigating team made an aerial survey of the area and watched for reappearance of the phenomenon, and the principal

witness continued to search the area after the team left, no revealing new information was discovered, and the source remains unidentified.

In another case (39) a lone observer reported that his car had been stalled by an UFO he observed passing over the highway in front of his car. While the project generally did not investigate single-observer cases, this one presented us with the opportunity to check the car to see if it had been subjected to a strong magnetic field. Our tests showed it had not. Lacking any other means of obtaining additional information, the investigators left with the open question of what, if anything, the gentleman had actually experienced.

A series of sightings around Cape Ann, Mass. (Case 29) offered testimony of numerous witnesses as evidence of the presence of a strange object, described as a large object with numerous lights which lit and disappeared in sequence. The investigating team was convinced, after interviewing several of the witnesses, that they had indeed seen something in the sky. The team was not able, at the time, to identify what had been seen. The chairman of the NICAP Massachusetts Subcommittee, Mr. Raymond E. Fowler, continued the investigation and subsequently learned that an aircrew from the 99th Bomb Wing, Westover AFB, had dropped 16 white flares while on a practice mission about 30 mi. NE of Cape Ann. The flare drop coincided in time and direction with the observed "UFO." As Mr. Fowler suggested, the "object" enclosing the string of lights must have been constructed by imagination.

In this case as in others, the key to the solution to the puzzle of a previously unexplained sighting was discovered. Additional cases probably were not identified as ordinary phenomena merely because of lack of information. Hence the label "unidentified" does not necessarily imply that an unusual or strange object was present. On the other hand, some cases involve testimony which, if

taken at face value, describes experiences which can be explained only in terms of the presence of strange vehicles (see, for example, Case 6). These cases are puzzling, and conclusions regarding them depend entirely upon the weight one gives to the personal testimony as presented.

B. Pranks and Hoaxes

For varying reasons, UFO-related pranks are commonly perpetrated by the young, the young at heart, and the lonely and bored. Our field teams were brought to the scene more frequently by victims of pranksters than by the pranksters themselves.

In one instance, (Case) the individual chiefly involved expressed serious concern that this project might conclude that flying saucers do not exist. Whether or not this concern was a factor in production of his photographs, this gentleman, would, by normal standards, be given the highest possible credibility rating. A recently retired military officer, he now holds a responsible civilian job. He is a man in his mid-forties who is held in high regard in the community. According to Air Force records, he served as an officer for 16 yr. and was rated a Command Pilot. He logged over 150 hr. flying time in C-47's in 1965. He presented two 35mm color slides of a flying saucer asserting that he took the photographs from an Air Force C-47 aircraft he was piloting. The object photographed was clearly a solid object of saucer shape. He claimed the pictures were taken in 1966, while he was off flight status and piloting the plane "unofficially" when he was aboard as a passenger. It was because of this circumstance, he claimed, that he did not report the UFO incident to the Air Force.

While the latter argument seemed reasonable, it was puzzling that no one else on the plane apparently reported the UFO. According to the officer, the co-pilot who remained in the cockpit was unaware that he had taken the UFO pictures. The reason the officer had not been taken off flight status was never revealed, but the Air Force Office

of Special Investigations informed us that there was "nothing on file in his medical records to cast doubt on his veracity."

In spite of the Officer's apparent reliability, investigation disclosed that the photographs were probably not taken at the time or place claimed. While he asserted that he barely had time to snap the two photographs through the window of the C-47, the numbers on the sides of the slide frames showed that the two slides had not been taken in immediate sequence. Comparison of these numbers with the numbers on other slides from the same roll of film also showed the UFO photographs to have been made after the officer retired from the Air Force and had moved to a new community. While the frame numbers stamped on mountings of the slides might conceivably have been erroneously stamped, as the officer claimed, such an error would not account for discrepancies in the frame numbers on the film itself, which are present when the film leaves the factory. The officer did not know that the film itself was prenumbered.

Case 23 is an example of a simple prank by the young at heart. A pilot, about to take off from an Air Force base in an airplane equipped with a powerful, movable searchlight, suggested to his co-pilot, "Let's see if we can't spook some UFO reports." By judicious use of the searchlight from the air, particularly when flashes of light from the ground were noticed, the pilots succeeded remarkably well. Members of the ground party, hunting raccoons at the time, did report an impressive UFO sighting. Our field team found, in this case, an interesting opportunity to study the reliability of testimony.

A common prank is the launching of hot-air balloons, with small candles burning to keep the air heated. Instructions for making such balloon using plastic dry-cleaners' bags and birthday candles have appeared in newspapers and magazines across the nation.

UFO reports frequently result from such balloon launchings. The lights are reported to go out one by one, and sometimes the UFO "drops brilliant streams of light" as burning candles fall from their balsa-wood or drinking-straw mountings. Cases 18 and 45 are examples of this type prank.

The instance described in case 18 was a flight of three plastic bags over Boulder, Colo., on 1 April 57. The date is probably significant. They were observed and reported as UFOs by students, housewives, teachers, university professors, and a nationally prominent scientist. A newspaper reported one student's claim that the telephone he was using went dead when the UFO passed over the outdoor booth which housed it. Although plastic bags were suspected as the explanation, we were not certain of this until several days after the event. Because of unexpected publicity given the UFO sightings, the students who launched the balloons decided to inform the project of their role in the event.

Case 45 is noteworthy as an example of extreme misperception of such a balloon. One adult observer described this 2 ft. x 3 ft. plastic bag floating over a building in Castle Rock, Colo., as a transparent object 75 ft. long, 20 ft. wide, and 20 ft. high, with about 12 lights in a circle underneath. He thought the object was about 75 ft. away. According to his description, the lights were much brighter than his car headlights; although the lights did not blind him, they lit up the ground near by.

While this observer may still believe he saw something other than the plastic balloon bag, such a balloon was launched at the time of his observation and was observed by others to rise over the same building.

The last three examples mentioned are ones in which the UFO observer was the victim of pranksters. We conclude that in similar cases the prank is never discovered, and the UFO report remains in the "unknown" or "unresolved" category. Undiscovered pranks, deliberate hoaxes, and hallucinations, were suspected in some other field investigations.

C. Pranks out of Hand

What starts out as a prank occasionally develops a notoriety so widespread that the prankster becomes enmeshed in a monstrous web of publicity from which he can no longer extricate himself. One elderly security guard (Case 26) on lonely, boring, pre-dawn duty in a waterfront area, fired his pistol at an oil drum used as a waste container. He was within the city limits of Los Angeles, but the site was isolated. Invention of an UFO, either to "explain" his illegal firing of a weapon within the city limits or to generate a bit of excitement, would be understandable under such circumstances. His tale of a 90 ft., cigar-shaped UFO, against which his bullets flattened and fell back to earth, where he picked up four of them, was a sensation. This gentleman was bewildered by the reaction to his nationally broadcast story. He and his wife were harassed by phone calls from coast to coast. The police, civilians, and Colorado project investigated. Even after admitting to police that his shots had been fired at the steel drum which bore bullet-size holes and dents, he could not disconnect himself from the widely publicized UFO version of his story.

In any instance in which commitment to an apparently faked story seemed so strong that hoax or ignorance could no longer be admitted without serious psychological sequence, project members considered it neither desirable from the individual's standpoint nor useful from the project's standpoint to pursue the case further.

D. Naive Misinterpretations

Unfettered imaginations, triggered into action by the view of an ordinary object under conditions which made it appear to be

extraordinary, caused reports of UFOs having such impressive features that our field teams investigated. Such a case was 15, in which the observer reported evening observations of a green light as large as a two-story building, sometimes round and sometimes oblong, which landed several times per week 5-20 mi. to the west of his house. He reported having seen through binoculars two rows of windows on a dome-shaped object that seemed to have jets firing from the bottom and that lit up a very large surrounding area. The motion was always a very gradual descent to the western horizon, where the object would "land" and shortly thereafter "cut off its lights." Our investigators found this gentleman watching the planet Venus, then about 15° above the western horizon. He agreed that the light now looked like a planet, and, had he not seen the object on other occasions when it looked closer and larger, he would not have known it was really an UFO.

Light diffusion and scintillation effects (see Section VI, Chapter 4) were also responsible for early morning UFO observations, and Venus was again most frequently the unknowing culprit. Case 37, as initially reported to us, was a particularly exciting event, for not only had numerous law enforcement officers in neighboring communities observed, chased, and been chased by an UFO of impressive description, but, according to the report, the pilot of a small aircraft sent aloft to chase the UFO had watched it rise from the swamp and fly directly away from him at such speed that he was unable to gain on it in the chase. Both the light plane and the unidentified object, according to the initial report, were observed on the local Air Traffic Control radar screen. According to the descriptions, the object displayed various and changing colors and shapes. Appearing as big as the moon in the sky, it once stopped about 500 ft. above a police car, lighting up the surroundings so brightly that the officers inside the car could read their wrist watches. As indicated in

the detailed report of this case, supporting aspects of the main sighting report fell apart one by one as they were investigated, leaving us again pointing to Venus and finding the law enforcement officers surprised that she could be seen at mid-day near the position in the sky their UFO had taken after the early morning chase.

E. Misinterpretation Supported by Official Misinformation

One case impressed us not so much because of the description of the UFO as because of official information given to the observers by Air Force representatives. The Air Force not only failed to correct the observers' misinterpretation but by giving erroneous information, caused the proper interpretation to be withdrawn from consideration. Details of the case are reported by project investigator James E. Wadsworth in Section IV, Case 28. The discussion presented here is designed to serve as a basis for comment regarding the failure to recognize and reveal misinterpretations of known phenomena.

A series of recurring sightings by multiple witnesses was reported from near Coarsegold, Calif. Coarsegold is in the Sierra Nevada foothills northeast of Fresno. The sightings were of special interest because they had been recurring for several months and remained unidentified after preliminary investigation by NICAP members in the area. These sightings offered the project the unusual opportunity of observing, photographing, and studying an object or objects which were being reported as UFOs.

Dr. Franklin E. Roach and Mr. Wadsworth were sent by the project to conduct the investigation, NICAP members on the scene furnished results of their preliminary investigation and names and addresses of principal witnesses. The witnesses had organized a loose network for UFO surveillance using Citizens Band radio for communication covering an area of about 80 mi. radius. They not only had observed strange lights in the sky over several months, but also had photographed them and recorded the dates and times of their appearance and descriptions of their motions.

One to six UFOs had been sighted per week, sometimes several during the same night. About 85% of the sightings followed a recognizable pattern: Orange-white lights above the valley at night moved, hovered, disappeared and reappeared, and occasionally merged with one another. Other sightings were of varying nature, and some seemed to warrant separate investigation. Most of the observations had been made from a ranch 1,800 ft. above the valley floor. Several others often in radio communication with the ranch owner, had witnessed the same events, and the witnesses were of apparently high reliability. The ranch owner, for example, had a background of police and military investigative experience.

After interviewing primary witnesses, looking at photographs, and listening to tape recordings of descriptions of previous sightings, the project field team joined the ranch owner and his wife in night watches. At 10:30 p.m. on the second night of observation, a light appeared low in the southern sky travelling W to E at approximately 1° of arc per second. After about 10 sec. more detail became visible. The source of this light was identified as a probable aircraft with conventional running lights and anti-collision beacon.

At the same time, another light had appeared to the east of the presumed aircraft, moving W to E at about the same rate. It appeared as a dull orange light, showing some variation in intensity as it moved. No accurate estimates of distance could be made. Although this light was not manifestly on an aircraft, the possibility that it was could not be ruled out. The rancher, however, said that this was exactly the sort of thing they had been observing frequently as UFOs. He was disappointed that this one had not appeared as close and bright as on other occasions.

After about 15 sec., the UFO seemed to flicker and then vanish.

The original object continued eastward, disappearing into the distance in the manner of an ordinary aircraft. Duration of observation was less than a minute. Photographs of the unidentified light were taken by the project team on a high-speed Ektachrome film.

Dr. Roach withdrew from the investigation taking the camera containing the exposed film to the Eastman Laboratories at Rochester, N.Y., for special processing, film calibration, and color analysis of film images. Mr. Wadsworth continued the investigation. The next night, he and the rancher observed UFOs at midnight and again at 12:42 a.m. They appeared as bright orange lights, showing no extended size but varying in intensity. They hovered, moved horizontally, and vanished. The rancher said that these were good, solid sightings of UFOs. Mr. Wadsworth thought they might be the lights of low-flying aircraft whose flight path produced the illusion of hovering when the plane was flying along the observer's line of sight. The presence of planes in the vicinity at the time, however, was not established.

The next morning it was learned that at least two other persons had observed the UFOs at midnight and 12:42 a.m. The rancher telephoned the UFO officer at Castle Air Force Base about 30 mi. west of Coarsegold. The officer declared that no aircraft from the base were aloft at the time of the sighting and promised that the sighting would be investigated and appropriate action taken.

Since the presence of aircraft as a possible explanation of the UFOs had been denied by the local air base, Mr. Wadsworth arranged to observe the UFO activity from the vantage point of the highest fire lookout tower in the area. The tower afforded an excellent view of the valley area below. The observers were equipped with cameras, binoculars, compass, and other field-kit items, and maintained two-way radio contact with the rancher for coordination of observations.

At midnight one orange light after another appeared over the valley. The lights, observed simultaneously by the project investigator

and a NICAP member at the tower and by the rancher at his house, appeared to brighten, dim, go out completely, reappear, hover, and move back and forth. Sometimes two lights would move together for a few moments and then separate. Only point source lights were observed, and there was no sound. The visible paths of the lights were not continuous. The lights would repeatedly go out, to reappear elsewhere or not at all. At times they became so dim as to be almost impossible to follow with binoculars. At other times they appeared to hover, flare up, then go out completely. The rancher believed the lights flared up in response to signals flashed at them with a spotlight, and it was true that many times when he flashed there followed a flare up of the UFOs. Mr. Wadsworth felt, however, that this was a coincidence, since the lights exhibited frequent flare-ups independently of signals. This behavior continued for about 1.5 hr.

From the higher vantage point of the tower it was possible to determine a general pattern of movement that was not apparent from below, since the pattern's northernmost end was not within the rancher's field of view.

Mr. Wadsworth concluded that these lights, and the similar ones of the previous night, notwithstanding assertions to the contrary from the base UFO officer, must be aircraft operating out of Castle Air Force Base. Careful observations through binoculars of the extreme northern end of the pattern had revealed lights moving along what must have been a runway lifting off, circling southwards, and following the behavior pattern previously observed before returning to land at a northern location coinciding with that of Castle AFB.

The rancher was skeptical of this identification. The following night he drove with Mr. Wadsworth toward the air base. En route, more orange lights appeared as before, but through binoculars these could now be identified as aircraft. As they approached the base, they could plainly see landings and take-offs in progress.

Subsequently it was learned that most of the night-flying at Castle AFB involved tankers and B-52s in practice aerial refuelling operations. Castle AFB is a training center for mid-air refuelling with 400 to 500 sorties launched from the base each month, both day and night. Flight schedules from the base, obtained later, showed planes scheduled to be in the air at the times the UFOs were observed. The planes carried large spotlights which were switched on and off repeatedly. This accounted for the observed flare-ups and disappear-reappear phenomena. The apparent hovering was due to the fact that part of the flight pattern was on a heading toward Coarsegold. Closings followed by separations were the actual refuelling procedures. The absence of sound was accounted for by distance, and the color variation, orange to white, by variable haze scattering of the light.

Maps obtained from Castle AFB show flight patterns for these operations wholly consistent with the sightings. Descriptions of lighting configurations of the tankers and bombers also were consistent with this identification.

While these sightings were not particularly impressive individually, being essentially lights in the night sky, the frequency of reports was sustained at a high level for nearly a year, and the observers had noted the UFOs occasionally since the fall of 1960. Observations were widespread and attracted much attention. The phenomenon seemed strange to the observers, defying simple explanation. Although the stimulus was conventional aircraft, the aircraft behavior, lighting, and flight paths presented an unconventional appearance to witnesses who were not familiar with in-flight refuelling practice.

Prior to the Colorado project investigation none of the observers had driven to the airbase while sightings were occurring to check the aircraft hypothesis. This was true in part because

the rancher had called the air base on several occasions to report sightings, and had received misleading information several times to the effect that the sightings could not be accounted for by planes from that base. On one occasion, Mr. Wadsworth took the telephone to hear this information conveyed to the rancher.

It should have been simple enough for representatives from Castle AFB to explain to inquiring citizens that the sightings were of practice refuelling operations, and to identify the UFOs as aircraft from their base. Why was this not done? Was the Public Information Office at Castle AFB actually not aware of the activities of its own base? Was misinformation released deliberately? If base representatives investigated the reports of UFOs and were not able to explain the sightings, the UFO report should have been sent to Project Blue Book at Wright-Patterson AFB and to the University of Colorado. The project had received no such report. Had Project Blue Book? If not, why not?

It is Air Force practice not to investigate reports of UFOs which are described merely as lights in the sky, particularly lights near an air base, and such reports need not be forwarded to Blue Book. In the Coarsegold sightings, however, according to the rancher and his wife, their reports had been investigated by officers from Castle AFB and the UFOs had remained unidentified. Thus, the reports should have been forwarded to Blue Book.

Blue Book files yielded a single report on this series of sightings, describing the Castle AFB officers' interview with the rancher's wife after the rancher had reported numerous sightings by himself and neighbors during the two week period starting 9 October, 1966. (The rancher was absent when Castle AFB officers investigated his report.) The report to Blue Book stated, "Officers who interviewed Mrs. _____ can offer no explanations as to what those individuals have been sighting. Descriptions do not compare with any known aircraft activity or capability."

The file also carried a notation that Castle AFB was to forward to Blue Book information required in AFR 80-17, but this information had not been received; therefore, the case was being carried as "insufficient data." There was no evidence of any follow-up or further effort to get the information.

What were the UFO descriptions which did not, in the view of investigating officers, compare with any known aircraft activity or capability? The housewife's description of what she and others had seen, as recorded by the interviewing officers, referred to pulsating and glowing lights varying between shades of white, red and green occasionally remaining stationary on a nearby ridge and capable of moving in any direction at greatly variable speeds, generally exceeding that of jets observed in the area. In particular, she once noted a vertical ascent at a very rapid speed. On one occasion, her husband was able to distinguish a rectangular-shaped object with very bright lights at the corners.

The description contained other references to appearance and motion. However, it is obvious that, when taken literally and without allowance for common errors in perception and cognition and without allowance for subjective interpretations, the descriptions, as the officers stated, did not conform with aircraft capability. Failure to make such allowance left the sightings unidentified.

F. Non-events

Two types of non-events received brief attention of our field teams. One involved predicted events revealed to us by persons claiming special psychic and communication powers. The other involved claimed UFO events at Air Force bases.

Predictions of UFO landings and close appearances were received from several sources (e.g. Case 19). One or two such psychic predictions were checked. The predicted flying saucer failed to materialize.

One non-event of the second type is presented as Case 30. Others were recorded only as internal project memoranda, and are not

presented as case reports. In each instance, conflicting information was received by this project. The initial information that an UFO event had occurred sometimes reached us as a rumor. A phone call to the Air Base UFO Officer or to the reported internal source of the information yielded confirmation that an event that should be of interest to a UFO study had occurred, but further information would have to be obtained through official channels. Unless such confirmation was obtained, the information, although received from a source which was usually reliable, was rejected as rumor.

In Case 30 , a civilian employee at an air base in California, contacted by telephone regarding a rumored sighting, confirmed that an UFO event had occurred at that base, and that a report of the event had passed across his desk and had been sent on to proper authorities. Those authorities, contacted with difficulty by telephone, insisted that no UFO event occurred at that base on or near that date. The employee, when contacted again later for additional information, replied only that he had been told to "stay out of that."

Conflicting information regarding a fast-moving radar track which was claimed to be unidentified and later "classified" similarly leaves nothing for study when official notification is received that there was no such event at the given time and place.

In one instance, the base UFO officer had no knowledge of a supposed UFO alert at his base on a given date and time. According to our information, jet interceptors alerted to scramble after a UFO were rolled out armed with rockets, taxied to the runway, but did not take off. The UFO officer, however, realized that such an event would have involved fighter craft at his base which are under a different command than the SAC command which he represented. Air Defense Command personnel could have an UFO report, the officer indicated, without telling SAC personnel about it. He then checked with the fighter defense squadron stationed at this SAC base, talking with people who were on duty at the time of the rumored event. He reported to us that there was an alert at the indicated date and time

and that fighters were deployed to the runway ready to scramble. This action was taken on orders from the squadron's headquarters at another base. The alert to scramble was said to be definitely not UFO-related but any other information regarding the cause of the alert would have to come from that headquarters. Further inquiry, through Pentagon channels, elicited only a denial that there had been an alert to that particular fighter squadron on the given date. In the absence of some independent source of information, we had no means of determining whether or not there was an alert and, if so, whether or not it was in fact triggered by the report of an unidentified flying object.

S. Remarks and Recommendations:

Instances in which there was less than full cooperation with our study by elements of the military services were extremely rare. Our field teams invariably were cordially received and given full cooperation by members of the services. When air bases were visited, the base commander himself often took personal interest in the investigation, and made certain that all needed access and facilities were placed at our disposal.

Field teams observed marked difference in the handling of UFO reports at individual air bases. At some bases, the UFO officer diligently checked each report received. On the other hand, at one base, which we visited to learn what a local Air Force investigation had revealed regarding a series of UFO sightings in the area, we found that none had been conducted, nor was one likely to be. Sighting reports received at the base by telephone, including one we knew to have been reported by the wife of a retired Naval officer, resulted in partial completion of a standard sighting form by the airman who received the call. This fragmentary information was then filed. The UFO officer argued that such reports contained too little information for identification of what was seen. He insisted that the information was insufficient to warrant his sending them to Project Blue Book. There was no apparent attempt to get more

information. In this instance, what the woman had seen was later identified by interested civilians as a flare drop from an Air Force plane.

While Air Force cooperation with our field teams was excellent and commendable, the teams frequently encountered situations in which air base public relations at the local level left much to be desired.

Official secrecy and classification of information were seldom encountered by project investigators. In the few instances when secrecy was known to be involved, the classified reports were reviewed and found to contain no significant information regarding UFOs.

Reviewing the results of our field investigations, one must note the consistent erosion of information contained in the initial report. Instead of an accumulation of evidence to support a claim of the sighting of an unusual flying vehicle, erosion of claimed supporting evidence to the vanishing point was a common investigative experience. As shown by examples in the above discussion, this was true of both current and older cases. As an investigation progressed, the extraordinary aspects of the sighting became less and less dominant, and what was left tended to be an observation of a quite ordinary phenomenon.

Current sightings which we investigated and left unresolved were often of the same general character as those resolved. The inconclusiveness of these investigations is felt to be a result of lack of information with which to work, rather than of a strangeness which survived careful scrutiny of adequate information. In each current report in which the evidence and narrative that were presented were adequate to define what was observed, and in which the defined phenomenon was not ordinary - that is, each observation that could be explained only in terms of the presence of a flying vehicle apparently representing an alien culture - there were invariably discrepancies, flaws, or contradictions in the narrative and evidence which cast strong doubt upon the physical reality of the event reported.

Of the current cases involving radar observations, one remained particularly puzzling after analysis of the information, since anomalous propagation and other common explanations apparently could not account for the observation (see Section III, Chapter 5 and Case 21).

While the current cases investigated did not yield impressive residual evidence, even in the narrative content, to support an hypothesis that an alien vehicle was physically present, narratives of past events, such as the 1966 incident at Beverly, Mass., (Case 6), would fit no other explanation if the testimony of witnesses is taken at full face value. The weight one should place on such anecdotal information might be determined through psychological testing of witnesses; however, advice given us by psychologists at the University of Colorado Medical Center indicated that such testing would be of questionable significance if done as long as a year or two after the event. Since we had no such impressive cases among more recent sightings, the opportunity for significant psychological testing of witnesses in such cases was not presented. Depending upon the weight given to old anecdotal information it permits one to support any conclusion regarding the nature of UFOs that the individual wishes to draw.

If UFO sighting reports are to be checked and studied, this should be done as soon as possible after the event, before witnesses' stories become crystallized by retelling and discussion. Such field investigation, undertaken on any scale for any purpose, should be done by trained investigators. The Coarsegold incident described above exemplifies the futility of an investigation which does not take into account subjective and perceptual considerations, as well as knowledge of events occurring in and above the atmosphere. The experience of seeing the planet Venus as a UFO that trips a magnetic UFO-detector, chases police cars at 70 mph, flies away from aircraft, changes size and shape drastically, lands about ten mi. from a farmhouse, and descends to 500 ft. above a car and lights up the inside of the

vehicle; of seeing a plastic dry cleaners' bag, of sufficient size to cover a single garment, as a UFO 75 ft. long and 20 ft. wide when only 30 ft. away; of seeing rows of windows in planets and in burning pieces of satellite debris which have re-entered the atmosphere, of seeing the star Sirius as an UFO which spews out glowing streams of red and green matter; seeing aircraft lights as flying saucers because the observer could not believe there are that many airplanes flying around her town; or other experiences of this general type are ones with which an effective investigator must be familiar.

It is obvious that not all UFO reports are worthy of investigation. What kinds of reports should be investigated? Persons who have lengthy experience working with UFO reports give varying answers to this question. NICAP discards unsubstantiated tales of rides in flying saucers, on the basis that their investigators have found no evidence to support these claims but have found considerable evidence of fraud (NICAP 1964). Air Force practice is to neglect reports of mere lights in the sky, particularly around air bases or civil landing fields, for experience has shown the UFOs in such reports to be lights of aircraft or other common lighted or reflecting objects. Both Dr. J. Allen Hynek, scientific consultant to the Air Force on UFOs, and Dr. Peter M. Millman (1968), who is presently in charge of the handling of UFO reports in Canada and has had an active interest in UFO reports for nearly 20 years, have said they do not favor any field investigation of single-observer sightings because of the difficulty in deriving useful scientific information from such reports.

Such policies and recommendations have grown out of much experience and practical considerations. Their authors are very much aware of the fact that a rare event certainly might be witnessed by a single observer. It also is obvious that if an extraterrestrial intelligence were assumed to be present, there is no logical reason to assume that it would not or did not make contact with a human being. Yet those who have worked with UFO reports for decades with

a conscious attempt to be objective have encountered so many non-productive reports of certain types that they have concluded that those classes of reports are not worth the effort of field investigation.

Our own field experience leads this writer to question the value of field investigations of any UFO reports other than those which

- a) offer a strong likelihood that information of value regarding meteors, satellites, optics, atmospheric properties, electrical phenomena, or other physical or biological phenomena would be generated by the investigation;
- b) present clear indication of a possible threat to a nation or community whether in the form of international or intra-national hostilities, physical or biological contamination of environment, panic, or other emotional upheaval, or
- c) are of interest as sources of information regarding the individual and collective needs and desires of human beings.

If there were an observation of a vehicle which was actually from an alien culture, the report of this observation certainly would deserve the fullest investigation. Our experience indicates that, unless the sighting were of a truly spectacular and verifiable nature, such a report would be buried in hundreds or thousands of similar reports triggered by ordinary earthly phenomena. While a large fraction of these reports could be discarded after establishment of the earthly cause, the report of interest would remain buried in others which contained too little evidence for identification, and the report itself probably would not be distinguishable from them. For this reason, this writer would not recommend field investigations of routine UFO reports if the intent of that investigation is to determine whether or not an alien vehicle was physically present. A verifiable report of a spectacular event, such as an actual landing of an alien vehicle, conceivably could thus be missed by neglect; however, this is unlikely, since such a report would probably be so unusual in character as to attract immediate attention.

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Chapter 2
Analysis of UFO
Photographic Evidence

William K. Hartmann

1. Introduction

The first reported photograph of a UFO after the Arnold sighting of 24 June 1947, was made on 4 July 1947 in Seattle, Washington. (Ruppelt, 1956, p.32) The object was identified as a weather balloon. This first photograph is typical of the photographic evidence that has accrued since: It accompanied a "wave" of reports and was inconclusive in establishing the existence of any extraordinary aircraft.

Although photographic evidence, in contrast to verbal testimony, might be considered "hard" data, experience has indicated that one cannot assume that a photograph of an airborne disk is more credible than a verbal report. Even if it were true that cameras never lie, photographers sometimes do. A photograph may be more interesting than a verbal account; indeed, if we knew that "flying saucers" existed, the best documented photographs would be extremely valuable in establishing their properties. But in the absence of proof of the existence of such aircraft, we are concerned at this stage with the credibility of reports.

The most convincing case of photographic evidence would involve not only multiple photographs but multiple photographers, unrelated and unknown to each other, a considerable distance apart (preferably tens of miles), whose photographs demonstrably show the same UFO. No such case is known to the Colorado project.

The Colorado project studies of UFO photographs are based on this approach. The question that is central to the study is: *does the report have any probative value in establishing the existence of flying saucers?* A question definitely secondary in importance (and conducive to unproductive arguments) is: What is the final explanation of each photograph?

That is to say, our principal task is to examine UFO photographic evidence that is alleged to indicate the existence of "flying saucers," and make a judgment as to whether the evidence supports this assertion. Photographic evidence is peculiarly open to the contention that one must establish what is shown, before one can say that it is not a "flying saucer." This argument is invalid. It is not necessary to prove that an object is an orange before establishing that it is not a mushroom. Exhaustive attempts to establish the identity of each object or image recorded were therefore not made. Yet possible interpretations were suggested in many cases where it was concluded (for one reason or another) that there was no evidence of an unusual phenomenon.

2. Selection of Cases

Time and funds did not permit exhaustive investigation of all interesting cases. About 90% of the cases could be assigned second or third priority upon inspection or brief study. Such a priority rating was based on a judgment that the case had little potential value in establishing the existence of "flying saucers." The remaining 10% of the cases were of first priority and required intensive study, some as much as a month of full-time effort. A "residual" of about 2% to 5% of all cases remained unexplained after this process. It is such a residual that is the core of the UFO problem (both in photographic cases and more generally).

The O'Brien committee (see Appendix A) suggested that the proposed university study of UFOs give emphasis to current reports. However, certain older, "classic" cases from the last two decades contain the most significant photographic evidence. Neglect of them would justifiably be open to criticism. Hence, the present photographic study includes both new cases and independent reevaluations of older cases.

3. Sources of Data

1. Project Blue Book

Material on a number of older cases was obtained from the Aerial Phenomena Office (Project Blue Book) at Wright-Patterson Air Force Base, Ohio. In many cases, these files were not sufficiently organized or complete to permit an intelligent evaluation of the report. Further investigation was carried out in these instances.

2. APRO

Cordial relations were maintained with APRO, and through the kind assistance of Mr. and Mrs. J. Lorenzen much first- or second-generation photographic material was made available.

3. NICAP

Contacts for the exchange of information on photographic cases were established with NICAP in the spring of 1967, and files on a number of cases were made available to us at that time.

4. J.E. McDonald

The help of Dr. McDonald, Institute for Atmospheric Physics, University of Arizona, who conducted a study of UFO phenomena concurrently with this study, was invaluable in bringing a number of cases to our attention.

5. Other

Many individuals submitted reports directly to us and other recent cases were investigated by our field teams. Certain news organizations, in particular BBC, Time-Life, Inc., and United Press International were very helpful in obtaining material. Dr. R.M.L. Baker, Computer Sciences, Inc., kindly made available to us his files on the Great Falls, Tremonton, and Vandenberg AFB motion pictures. Dr. J. Allen Hynek, of Northwestern University also rendered valued assistance in providing materials for analysis.

4. Hidden Data

The problem of hidden data is characteristic of the study of UFO phenomena. Only about 12% of those persons who have seen flying objects they cannot identify actually report the sighting (Section III, Chapter 7). The indication that we are aware of only a small fraction of all sightings of

UFOs and the experience of investigators in uncovering photographs suggest that we have considerably less than half the photographs considered by their owners to show UFOs. Of the photographs that may have a bearing on the existence of extraordinary *aircraft* we probably have a larger fraction, since they are more interesting to their owners. The distinction is that an UFO photo may show just a point source of light, or an amorphous blob, while an alleged "flying saucer" photo must exhibit some detail. But even in these cases, the fraction may well be less than half.

Reasons for the existence of hidden data include: (1) apathy on the part of the photographer, (2) ignorance of what to do with the photographs, (3) fear of ridicule, (4) fear of becoming involved with authorities in situations involving security or military restrictions (e.g. Ft. Belvoir case), (5) fear of restrictions in JANAP-146.

It is also possible that data, generated by various technical recording equipment, such as all-sky auroral cameras, or the Prairie Network are another "hidden" source (Section VI, Chapter 9).

Finally, there is another class of "hidden data": sightings supposed to have occurred on various military bases but allegedly suppressed by military or intelligence authorities. We have heard many allegations of such cases. Usually they were not detailed enough to be fruitful, and in only one case was it possible for us, even with the cooperation of the Air Force, to locate any alleged photographs of UFOs. Such allegations of suppression may typically arise as a result of incidents like that described in Case 51. In this instance a bright UFO was recorded by several tracking cameras at Vandenberg AFB. The UFO was described as "streaking up past" a rocket during a launch. Project investigators recovered the films in question without difficulty. Study of them conclusively identified the UFO as the planet Venus. Meanwhile, however, the story had reached the rumor stage, and it is likely that belief that an UFO had paced a rocket was widespread as a result.

5. Quality of UFO Photographic Data

The statistical properties or the quantity of photographic data are less important than the content of a single case that might strongly indicate the existence of a hitherto unrecognized phenomenon. Nonetheless, it is a part of the problem that most of the data are of very low quality. A glance through typical UFO periodicals and books illustrates this. Many of the photographs are blurred, usually due to poor focus. Many are badly processed or light-struck. Many, usually because they are fabrications made with small models too close to the camera, show, against sharp backgrounds, objects that are hopelessly out of focus. Many photographs do not give the subjective impression of a metallic or luminous entity flying through the air at some moderate distance from the observers.

More specifically a large part of the data is inappropriate for analysis. Night-time photographs that show either point sources or amorphous blobs with no background or foreground fall in this category. Daytime photographs of objects of very small angular size are also of little value. A large number of reports consist of only one photograph, and single photographs are of much less photogrammetric value than sets.

Damage to negatives frequently renders them valueless for investigative purposes. An investigator visiting one witness found a baby playing on the floor with the negatives. (McMinnville, Case 46) A crucial spot on another set of negatives was burned out by a dropped match, assertedly by accident. (North Eastern, Case 53) Loss of original negatives or prints is reported, as in Santa Ana (Case 52).

Accurate descriptive testimony, even in photographic cases is also difficult to obtain. For example, a witness described an UFO as "half as large as the moon"; his photograph and sketch show a disk having an angular diameter of about 15° .

6. Natural Phenomena Photographed as UFOs

A number of natural phenomena, well known in various branches of the scientific community, but little known to the general public, have been reported as UFOs. Three classes of these are meteorological, astronomical, and photographic.

Plate 1 shows an excellent example of a lenticular cloud. These thin clouds are usually related to irregularities in ground elevation (hence classified as "orographic" clouds), and sometimes appear stacked, one above the other, like a pile of saucers. A number have appeared in UFO reports.

Plate 2 illustrates a sub-sun, produced by reflection of the sun off a laminar arrangement of flat ice crystals (Minnaert, 1954, p. 203). The Gulfstream aircraft case is tentatively attributed to a sub-sun (see Case 54).

Plate 3 is a time exposure of the moon, showing trailing due to the earth's rotation. The explanation of such a photograph of the moon is obvious to anyone familiar with astronomical photographs. Yet a similar picture showing the trails of the moon and Venus was widely printed in newspapers across the country in March 1966. The trails were described as two UFOs.

Although aurora displays can produce colored, fast-moving arcs of light of various shapes and brightnesses, it does not appear that auroras are involved in a substantial number of UFO reports. No UFO photographs were attributed to auroras in this study.

A number of purely photographic effects can result in UFO-like images. Two classes are very common. The first is film damage. Creases or unusual pressure produce dark images on negatives and bright spots on prints made from them. Chemical damage during development can produce either bright or dark spots on negatives or prints. The second class is internal reflections, or lens flares produced by unwanted light paths through the camera optics. Many widely circulated UFO photographs are unquestionably the result of lens flares. Symmetry about a line connecting the flare to a bright light source in the photograph is usually the clue to identification of a lens flare photograph.

Plates 4 and 5 show examples of reported "UFOs" identified as film defects, and Plate 6 shows an example of a lens flare (see also Menzel and Boyd, 1963).

Man-made objects such as balloons and rocket exhaust trails, especially illuminated by a low sun during twilight have also produced many UFO reports (N.M. aircraft Case 55). A number of photographs of bright, nearly stationary point sources in a daylight or twilight sky may be balloons.

7. Fabrications

Fabrications represent a delicate problem. Nowhere in the discussion of photographic cases have I conclusively labeled one as a hoax, although I have shown that this hypothesis is entirely satisfactory in a number of cases.

Hoaxes are not new in UFO investigations. The Maury Island (Wash.) incident of 1947 has been called "the first, possibly the second-best, and the dirtiest hoax in UFO history." (Ruppelt, 1956). Photographs allegedly taken by one of the witnesses to the incident had been "misplaced," he said. Eventually, he, a companion, and an "investigator" hired by a magazine publisher admitted that the incident was a fabrication. Before the case was closed, much money and time had been spent, and two Air Force investigating officers had been killed when their Air Force B-25 crashed during the inquiry into the "sighting." According to Ruppelt, the federal government considered prosecuting the hoaxers, but later abandoned the idea.

Often a photograph apparently fabricated to amuse friends results in a full-blown UFO report. The friends take the photograph seriously and tell others. Eventually a local newspaper prints both picture and story. From there it may be distributed nationally by the press wire services, or one of the private UFO investigating organizations such as APRO or NICAP. In view of the demonstrable avocational interest of some persons, especially young persons, in producing "flying saucer photos," one must be especially wary of any alleged UFO photo that *could* have been easily fabricated under the circumstances.

Fabrications may be thought of in two broad categories: "physical," of a real *object*, which is then alleged to be an UFO; or "optical,"

the producing by optical and other means of an *image* falsely alleged to be a real physical entity at the scene. Retouched negatives, double exposures, and superimposed images are examples of the latter. Generally, physical fabrications meet tests of consistence in lighting and shadow but fail tests of size or distance. Most commonly, photographs of models are out of focus, or have inconsistent focus between the "UFO" and other objects at its alleged distance. Optical fabrications, on the other hand, may show inconsistencies in lighting between background and UFO details, or in the case of montages, image flaws.

Plate 7 is an example of the simplest and most common type of physical fabrication - a disk-shaped model thrown into the air by hand. Plates 8 and 9 are examples of more complex fabrications - a model suspended from a string and a night-time photograph of a hand-held model illuminated by flashlight. These three photographs were made by the writer. Plates 8 and 9 were made for comparison with the Santa Ana and North East UFO photographs (Cases 52 and 53). Plates 10, 11, and 12 are examples of optical fabrications made by the writer.

8. Techniques of Analysis

Photographic evidence acquires probative value only when known natural phenomena can be ruled out and it can be shown that a fabrication was not easy or convenient.

Early in the study, it was decided not to select or analyze each case by a predetermined routine. Rather, cases were studied in terms of their individual characteristics. Diagnostic characteristics included such properties as (1) potential stereoscopy, (2) reports by multiple visual witnesses, (3) cloud motions, (4) use of haze to define distance, (5) accurate altitude and azimuth data, (6) structure and shape of object, (7) geometry of motion, and (8) geometry of lighting and shadows. Initial selection of cases to be studied was also influenced by the degree to which other students of UFO phenomena regarded them as significant.

In the course of the investigation, analysis of the foregoing characteristics of UFO photographs resulted in our developing a set of protocols useful in the assigning priorities to UFO photographs

for study. These results are described in section 10 of this chapter.

The cases selected for investigation were analyzed as completely as possible. The techniques are demonstrated in the case reports themselves (Part IV, Chapter 3).

9. Review and Summary

The project gathered information on 35 photographic cases that occurred in 1966-68. These may be assumed to be a more or less representative cross-section of photographic cases. Of this 35-case current cross-section only two, Calgary and North Pacific (Cases 57 and 56), were initially selected as first priority cases. On investigation, neither case yielded data deemed to be of probative value. Second priority cases among the 1966-68 group were Camarillo (identified probably as airborne debris), Gulfstream Aircraft (sub-sun), and Sonora (airborne debris). Many of the remaining 1966-68 cases of lower priority had low strangeness or insufficient data for analysis.

The final disposition of the 35 cases is summarized in Table 1. The figures are thought to be representative of UFO photographic cases. That is, roughly one quarter are fabrications, one quarter are misidentifications, a quarter have such low information content as to be unfit for analysis, another quarter are clearly recorded but lack sufficient data for analysis. The residual cases that are genuinely puzzling constitute at most a very small percentage.

In addition to these current cases, 18 older reports, including some by advocates of the existence of "flying saucers," were also studied.

Of the 35 cases only those in which the nature of the evidence or the credentials of the witness were judged to have the highest *a priori* probability of producing evidence for an unknown phenomenon were assigned first priority for study. Table 2 shows the classifications finally assigned to these first priority cases. Of them some 60% were found to be identifiable or to lack probative value. Two cases

TABLE 1. Classification of 35 Current Photographic Cases

Evidence for probable fabrication	9
Misidentified natural or man-made phenomena	7
Insufficient data for analysis (night-time shots, point sources, amorphous blobs, etc.)	12
Inconclusive data (unidentified unusual objects shown, but little or no analysis possible; possible fabrications)	7
Unidentified after analysis (real objects with high strangeness)	0

35

TABLE 2. Classification of 11 First-Priority Cases

Inconsistencies between testimony and photos, internal inconsistencies in photos, or evidence for fabrication	Barra da Tijuca North Eastern North Pacific Santa Ana
Identified natural or man-made phenomena	Fort Belvoir Vandenberg AFB Tremonton
Not amenable to analysis	Calgary
Unidentified after analysis (indication of real objects with high strangeness), conceivable but unlikely misiden- tification of birds, aircraft, etc.	Great Falls
Clearly either a fabrication or an extraordinary object ("flying saucer")	McMinnville

survived analysis: Great Falls (motion pictures of two bright light sources difficult to reconcile with known aircraft) and McMinnville (two photographs of a saucer-shaped craft).

Since the selection of older, "classic" cases was limited, it is probable that the "residual" of unexplained photographic cases could be increased well beyond these three cases if there were additional research. Whether or not anything of probative value would be found is a matter of speculation.

10. Conclusions

Our experience also leads us to conclude that UFO photographic cases can best be selected for study and analyzed on the basis of the following criteria:

(1) Subjective evaluation Do various photographic factors (focus, clarity, sharpness, contrast) and the testimony combine to make the case appear credible? Does it have *potential* in providing probative evidence for the reality of an unusual phenomenon?

(2) Known phenomena Is any known phenomenon rationally acceptable as an explanation of the observation? Phenomena considered must be based on a wide experience with meteorological, astronomical, optical, and photographic effects. Can the report be a case of mistaken interpretation?

(3) Fabrications Can the case be accepted as having been made in good faith? Are there any signs of tampering with the negative? (Are the negatives or original prints available?) Do the negatives represent a continuous sequence? Are focus, sharpness and other characteristics quantitatively in accord with the alleged sightings? Are light and shadows internally consistent on each photo?

(4) Consistency with testimony In addition to the internal evidence of the photographs themselves, are the photographs consistent with the witness testimony? Is lighting consistent with alleged time and direction of sighting? Are time intervals between photos consistent with testimony?

(5) Physical and geometric tests What peculiar characteristics suggest tests? Is the object in front of or behind any landscape features? Is contrast and focus consistent with alleged distance? What can be learned from motions and time intervals? Can the flight path be estimated from the sequence of positions and angular sizes?

The Colorado study of UFO photographic evidence failed to disclose conclusive evidence of the existence of "flying saucers." Nor did it, of course, establish that such objects do not exist. I believe that it is significant, however, that a number of the most widely heralded "classic" cases were either identified or were shown to be of little probative value in the present study. This finding suggests that much of the case for the reality of "flying saucers" has been built on very inadequate research into widely publicized reports. Some examples of such cases, the reality of which has been rejected after intensive study by the project, are summarized briefly below:

Barra da Tijuca, Brazil, (Case48): A magazine photographer and a reporter allegedly saw and made five photographs of a large disk that passed overhead. The photographic sequence shows the disk approaching (edge on) in the distance, and passing by in a credible series. A report on the case by O.T. Fontes, of Brazil, (APRO, 1961) "pronounce(s) them authentic" and purports to establish

their authenticity with "top-secret documents" from Brazilian Air Force files kept since 1951. The documents purport to demonstrate "the absolute impossibility of a hoax." Study of photographs enlarged from the APRO copies shows that the disk in the fourth photograph (Plate 30) clearly illuminated from the left, with bold shadows, but a palm tree as well as other confused foliage on the hillside below appear to be illuminated from the right. The discrepancy was first pointed out by Menzel and Boyd (1963).

North Eastern (Case 53): Two photographs show a bright, amorphous object that reportedly swept past four boys who were photographing the moon at night. The image on the photographs is strikingly suggestive of an out-of-focus plate-like object supported by a human arm and hand photographed by time-exposure. According to the original report, (NICAP, 1965) the "arm" was an invisible gaseous discharge from the UFO. A photograph (plate 9) that demonstrates how such an image can be fabricated was made by taping a plate to a small handle. The apparent transparency of the "gaseous discharge" was simulated by moving the arm during the time exposure. In the light of such simple reproduction of these photographs, I have concluded that this case is of no probative value.

Fort Belvoir, Va., (Case 50): Six exposures made on this Army base show a ring-shaped object being enveloped in a white, puffy cloud. The photographs were proclaimed as "First Published Photos of the Amazing Ring-Shaped UFO" (Rankow, 1967). Aides of the commanding officer at Fort Belvoir demonstrated to a project investigator that this was a vortex cloud generated by atomic bomb simulation demonstrations that were frequently carried out at the base some years ago. Positive identification was obtained.

North Pacific (Case 57): Three boys in their back yard photographed a disk that allegedly passed overhead. The object was not reported by any other witnesses. The incident was given considerable publicity and the two photographs were published by APRO. In an

interview the boys stressed that they had accurately re-enacted the event and that the time interval between the two photographs was very short, about eight seconds; however, the cloud patterns were markedly different. Separately confronted with the marked discrepancy in cloud structure between the two photographs, the boys each said they could not account for it, though they reaffirmed the story of the sighting. The photographs cannot therefore be considered as satisfactory evidence for the existence of "flying saucers."

Santa Ana, Calif., (Case 52): A traffic engineer, of good reputation, with excellent references, and with experience as a former policeman, allegedly saw and made three photographs of a metallic disk and a fourth photograph of a vortex smoke ring allegedly left by the departing disk. Interruption of radio transmissions from his vehicle, reportedly associated with the presence of the disk, was confirmed by the engineer's supervisor. The series of photographs has been widely published and widely regarded as one of the best cases. Detailed investigation revealed several serious discrepancies. For example, a study of the weather data at surrounding stations indicates that an early morning cloud cover had entirely dissipated well before the report was made, yet the fourth photograph shows a background of moderately dense, gray clouds. Other circumstances surrounding these photographs reduce further their probative value.

In the course of my study I was able to simulate effectively the first three photographs by suspending a model by a thread attached to a rod resting on the roof of a truck and photographing it (Plate 8). Without assuming the truth or untruth of the witness' story, this has led me to conclude that the case is of little probative value.

Vandenberg AFB, Calif., (Case 51): Tracking films from a rocket launch show a bright object apparently rushing up past the rocket just after second stage ignition. The films were first described in a textbook (Baker, 1967). The film sequence was taken very seriously because several cameras in different locations simultaneously recorded the object. Interest in the case was heightened by its resemblance to a number of apocryphal accounts of UFOs pacing rockets. The Colorado project at once obtained the films through official channels. Tracking data showed that the rocket was moving toward the horizon past the calculated position of Venus at the time.

To summarize conclusions relating to UFO photographs:

1. About half of the photographic reports are clearly identifiable as known phenomena or can be demonstrated to contain internal geometric or other inconsistencies.
2. About half can be ultimately classified as being inconclusive or presenting insufficient data to furnish probative evidence of an unknown phenomenon. Most single-witness cases must fall in the latter category. Most night-time photographs, point-source objects, and amorphous objects without background or foreground must be relegated to this category for lack of satisfactory quantitative tests that can be performed on them.
3. A number of cases initially described publicly by UFO enthusiasts as representative of the strongest evidence for the reality of extraordinary aircraft were either conclusively identified as ordinary phenomena or shown to have serious internal inconsistencies.

4. The number of identified or fraudulent cases is irrelevant to the existence or non-existence of extraordinary objects or "flying saucers."

5. A very small fraction of potentially identifiable and interesting photographic cases remain unidentified.

Some conclusions relating to these residual photographic cases are:

1. None of them conclusively establishes the existence of "flying saucers," or any extraordinary aircraft, or hitherto unknown phenomenon. For any of these cases, no matter how strange or intriguing, it is always possible to "explain" the observations, either by hypothesizing some extraordinary circumstance or by alleging a hoax. That is to say, none of the residual photographic cases investigated here is compelling enough to be conclusive on its own.

2. Some of the cases are sufficiently explicit that the choice is limited to the existence of an extraordinary aircraft or to a hoax.

3. The residual group of unidentifieds is not inconsistent with the hypothesis that unknown and extraordinary aircraft have penetrated the airspace of the United States, but none yields sufficient evidence to establish this hypothesis.

In summary, about 10% of the photographic cases can initially be selected as "first priority" cases, i.e. interesting and detailed enough to investigate. After investigation, there remains a small residual, of the order of 2% of all cases, that appears to represent well recorded but unidentified or unidentifiable objects that are airborne - i.e. UFOs. Yet there is insufficient evidence to assert that any one of these represents an unusual or extraordinary phenomenon. We find no conclusive evidence of unidentified aircraft or "flying saucers." The photographic data has been poorly presented in the past, and the frequency of hypothetical "flying saucers" appears much smaller than has been popularly assumed; it may be zero. The present data are compatible with, but do not establish either the hypothesis.

that (1) the entire UFO phenomenon is a product of misidentification, poor reporting, and fabrication, or that (2) a very small part of the UFO phenomenon involves extraordinary events.

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Chapter 3
Direct Physical Evidence
Roy Craig

Several types of physical effects have been presented as evidence that an object of unusual nature had been present at a given location. Such effects consist of: (1) markings on ground, vegetation, or objects with which an UFO, as something from an UFO, reportedly made direct or indirect physical contact; (2) material residue allegedly deposited from or by an UFO; and (3) articles or portions of articles manufactured by intelligent beings, but reportedly not produced by known cultures. A fourth known conceivable type of physical evidence, consisting of a non-earthly or captured "flying saucer," would be most impressive as evidence. The existence of this type of evidence has been suggested by some reporters, such as Moseley (1967), who reported the claim that a captured flying saucer was held at a military base in Ohio, and Allen (1959), who presented a photograph of a tiny humanoid creature and four adult Earth residents, claiming that the creature was a crewman of a saucer which crashed near Mexico City in 1950. During the course of this study, however, no indication was found that this fourth type of evidence has ever existed.

1. Markings Allegedly Made By UFOs

Claims of evidence of the first type are common. UFO reports contain numerous descriptions, often with supporting photographs of saucer "nests" -- areas where soil, grass, cattails, or other vegetation had been flattened, burned, broken off, or blown away, allegedly by an UFO that landed or hovered there. The Lorenzens (1967) also have described six cases in which sets of circular or wedge-shaped depressions

were allegedly made by the landing legs of unidentified vehicles. A number of other cases of the landing-gear imprint type have been reported, including incidents at Presque Isle State Park, Pa., 31 July 1966; South Hill, Va., 21 April 1967; and Tucson, Ariz., 9 October 1967. These three cases were examined and analyzed by Project Blue Book. Hall (1964) and others have listed other cases in which ground impressions are claimed as evidence that unknown physical objects had been present. Hall's listing also includes a half dozen "nest" reports, and a 13-ft. ring imprint of a general type earlier reported in a case described by Maney and Hall (1961).

Reports of ring imprints are not uncommon. Four cases, involving ring imprints generally about 30 ft. in diameter and 6 - 12 in. wide were reported in August and September, 1967, in three different Canadian provinces. In Camrose, Alberta six different rings were reported. Photographs of the Camrose rings were received by this project for evaluation.

Claims of the saucer nest type of evidence were made in a few of the current cases investigated by the field teams (e. g. Cases 22 , 25 , 38). In some cases, the "nest" seemed imaginary. In other cases, the reality of an imprint, of a type which conceivably could have been made by a large saucer or by a being from a saucer, was evident (as in Case 22). However, in all such cases, it was impossible to establish as factual the claims that the imprints actually were made by an extraordinary object or being.

If the evidence displayed could have been the result of human or animal activity, or lightning or other natural events, the probability that it was so caused is much greater, in absence of independent evidence to the contrary, than the probability of its creation by an extra-terrestrial vehicle or being: therefore, the burden of proof must lie with the person claiming a strange origin.

The independent evidence most frequently claimed is presence of unusual radioactivity at the site. In cases where such claims were checked by our field teams, (32 , 42) the claim was found to be untrue. In one case (22), radioactive material was found to be present by Canadian investigators and in other cases, (e. g. Fisherville, Va., 12-21-64) which could no longer be checked, testimony by persons other than the UFO observer supported a claim that the site was found to be radioactive. In such cases, however, if radioactive material actually were present, the possibility that it was placed there by humans cannot be ignored. If humans are known to have visited the site before official confirmation of presence of radioactive material has been made, and the material found is either a naturally occurring radioactive mineral or a commercially available luminous paint, the presence of this material serves to weaken any claim of strange origin of the markings.

The existence of an imprint of odd shape or a circular area of crushed vegetation often can be established. Its mere existence does not prove, however, that the marking was made by a strange being or vehicle. Demonstration of a connection between such markings and strange objects has thus far not been accomplished. Attempts to establish such connection must still depend upon personal testimony. Generally, personal testimony includes the reported sighting of an UFO in the area of the discovered imprints or nest. Quite frequently, however, UFO origin of the markings is assumed, even though no UFO was seen in the area near the time the markings must have been made. This was true of the Camrose rings, whose appearance did not differ markedly from tracks left by wheels of farm vehicles. In case 38 , "nests" were reportedly discovered in the forest just after the field team investigated a multitude of UFO reports in the region. The project sent photographs of these circular patches of forest damage to Dr. Carl E. Ostrom, Director of Timber Management Research, U. S.

Forest Service, for comment. Dr. Ostrom listed four natural causes of such patches of forest damage. He indicated that members of the Forest Service had observed similar damage in other regions under ecological conditions similar to those in the area in which these "saucer nests" were reported. Although UFOs had been reported in the general region, there again was no direct connection between them and the patches of timber damage, the existence of which could be accounted for by quite earthly processes.

Generally there are no physical tests which can be applied to a claimed saucer landing site to prove the origin of the imprints. Occasionally, the degree of compaction of soil by UFO "landing legs" is presented as evidence that the force was extraordinary. However, if the compaction could have been achieved by a human with a sledge hammer, for example, compaction measurements are of little significance, since they do not yield information regarding the cause of compaction. Chemical tests of soil can sometimes be used to disprove a claim, but are not likely to support a claim of strange origin of markings, since there is no obvious reason to expect chemical alteration. For example, samples of soil from a golf course at Port Townsend, Wash. were submitted to this project for analysis (Case 1406P, 1074T, project files). One sample was taken from a burned area where an UFO, reportedly observed earlier by several youngsters, was assumed to have touched down. Comparison samples from unaffected areas nearby were also studied. Gas chromatography showed the existence of hydrocarbon residues in the sample from the burned area, indicating that gasoline or other hydrocarbon had been used to make this particular "saucer nest." An empty lighter-fluid can was found in the area a few hundred yards away.

2. Material Allegedly Deposited by UFOs

An elusive material, called "angel hair" in UFO publications, is sometimes reported to have been deposited by UFOs. Seventeen cases involving "angel hair" were listed by Maney and Hall (1961) for the

period 1952 through 1955. In fourteen there was an associated sighting reported of an UFO. The "angel hair" is described as a fibrous material which falls in large quantities, but is unstable and disintegrates and vanishes soon after falling. It has also been described as filaments resembling spider webs, floating down to earth, hanging from telephone wires and tree branches and forming candy-floss-like streamers. These streamers, which sometimes are reported to cover areas as large as 0.25 sq. mi., also are reported to vanish on touch, burn like cellophane when ignited, and sublime and disappear while under observation. A somewhat similar evanescent residue, described as a luminous haze or a misty, smoke-like deposit, was reported in three cases discussed by the Lorenzens (1967), and "angel hair" cases are also described by Michel (1958), who suggested that the material be collected and preserved at low temperature for crystal structure study by X-ray diffraction. Hall (1964) has stated that many deposits of "angel's hair" have been nothing but cobwebs spun by ballooning spiders. On at least one occasion, he wrote, small spiders have actually been found in the material. In other cases, the composition or origin of the "angel's hair" is uncertain. During the course of this study, one sample of dry white powder was submitted to the project for analysis. It had been collected from beneath the eaves of a house over which "angel hair" was reported to have settled, leaving a sticky deposit. (Project files 1406P, 1074T). Since the major cationic component of this powder was titanium, it was concluded that the powder was the residue of a commonly used house paint containing a titanium oxide pigment. Few recent UFO reports have involved material of the "angel hair" type.

A second type of material often is assumed, because of the circumstances of its appearance, to have been dumped by UFOs. The material is commonly referred to as "space grass," and has appeared unexpectedly

in fields and yards after falling from the sky. Generally, no sighting of identified or unidentified objects is associated with the fall. The material is composed of metallic threads of lengths varying from a fraction of an inch to a foot or more, generally with many threads intertwined into a loose mass. Typical material of this type is described by Keel (1967), who suggests that UFOs are using the earth as a kind of garbage dump. Actually, "space grass" is aluminum "chaff" of the various sizes and types used by military aircraft to confuse tracking radar (see Section VI, Chapter 5).

Samples of material sent to the project for analysis because of their assumed UFO association were most commonly "space grass." The first sample was received from observers of two "space ships" reported over Manhattan Beach, Calif., on 5 February 1957. The material appeared 24 hr. after the sighting and was reported to have been radioactive when found. It was not radioactive when received. Analysis demonstrated it to be 1145 alloy hard aluminum foil chaff dipoles with both a slip and a stripe coating applied to the surface of the foil. Since the slip coating was color coded red, it could be identified as a product of the Foil Division of Revere Copper and Brass Incorporated, Brooklyn, N. Y. The company identified the chaff as its product. This chaff could have been dropped by aircraft. It also could have been carried aloft by sounding rockets or balloons, and released at high altitudes for radar tracking. It is certain, however, that this sample of "space grass," like other such samples submitted to the project for analysis, had a quite earthly origin, and was not deposited by vehicles of extra-terrestrial origin.

3. Parts of UFOs, or UFO Equipment

Frank Edwards (1966) discusses three cases in which an UFO or part of an UFO is claimed to have been recovered : (1) a flying disc was reported to have crashed on Spitzbergen Island in 1952 and to have been recovered, badly damaged but intact, by the Norwegian

Air Force; (2) a 1 lb. fragment from a 2 ft. diameter glowing disk which was reportedly intercepted over Washington, D. C., in 1952; and (3) a 3,000 lb. mass of "strange metal" was found about 1 July 1960, in the St. Lawrence River in Quebec, and considered by a Canadian UFO investigator to be possibly a portion of a very large interstellar device which came into this solar system at an unknown time in the past.

Efforts have been made to determine to what degree any of these claims might be factual. In the Spitzbergen case, Mr. Finn Lied, Director, Norwegian Defence Research Establishment, replied that the only articles he knew of having been recovered in Norway have been traced back to rocket and satellite hardware. Mr. Tage Eriksson, of the Research Institute of National Defence, Sweden, replied that neither the Swedish Air Force nor the Research Institute of National Defence has at any time taken part in an investigation of a crashed UFO in Spitzbergen or elsewhere. A U. S. Air Intelligence Information Report, dated 12 September 1952, revealed that the Norwegian government knew nothing of such an object. The story apparently was the work of a West German reporter. It first appeared in the German newspaper "Berliner Volksblatt" for 9 July 1952. The original newspaper report stated definitely that the silver discus-like body was 48.88 m. in diameter and made of an unknown metal compound; its meters and instruments had Russian symbols, and it appeared to have a range of some 30,000 km. Significantly, the aspects of this first report implying that the vehicle was of Russian origin have been selectively neglected by subsequent writers, particularly those who urge that the claimed wreckage is extra-terrestrial in origin. It seems well established that this story has no basis in fact.

Representatives of Air Force Project Blue Book claimed no knowledge of the disc fragment discussed by Edwards, who claimed the successful

search for this fragment was confirmed by Lt. Cdr. Frank Thompson of the U.S. Navy. The fragment, said to have been dislodged by gunfire from a Navy jet, reportedly fell to the ground, where it was found, still glowing, an hour later by U.S. military ground search crews. Reports of UFO events over Washington, D. C., in 1952 contain no reference to such a gunfire incident. If such a fragment did exist and was classified "Secret" as was claimed, its existence and whereabouts would not necessarily be revealed to this project. A request for official confirmation that the claimed fragment did or did not exist and does or does not exist was forwarded to U.S. Air Force Headquarters. A reply was received from J. W. Clinton, by direction of the Chief of Information, Department of the Navy. Mr. Clinton indicated that a thorough search of all Navy records available failed to reveal any account of a Navy jet fighter's encounter with an UFO in July 1952 or at any other time. Perhaps more significant, however, were the facts that Navy records of the year 1952 carried only one Frank Thompson, an individual who had retired from active duty several years before 1952 with the rank of lieutenant, not lieutenant commander. Navy fighters based near Washington were armed only for firing practice conducted far out at sea over a restricted firing area. Navy aircraft armed with live ammunition, Mr. Clinton pointed out, would have been usurping an Air Force function if they had been present over Washington, D. C., as interceptors. Mr. Clinton concluded: "The incident is not beyond the realm of possibility, but due to the nature of the Navy's jet operations about the Washington, D. C. area at the time, it was very highly unlikely."

The 3,000-lb. mass of metallic material from the St. Lawrence River was the subject of several communications received by this project. Among these was a letter from Mrs. Carol Halford-Watkins, Secretary of the Ottawa New Sciences Club (Project file 1326-P). The Club now has custody

of the specimen. The Club does not claim that the piece of metal is, in fact, part of a spaceship; however, its members do not reject this possibility. Mrs. Halford-Watkins generously offered samples of the material for analysis and provided photographs of the object and a description of details of the find and analyses of the material. The Canadian Arsenal's Research and Development Establishment (CARDE) had examined the non-homogeneous material, and described it as high-manganese austenitic steel. CARDE personnel considered the material the normal product of a foundry, consisting of slag with semi-molten scrap imbedded in it. The object was not believed to have fallen in the location where it was found, which is near Quebec City, in a channel of the St. Lawrence River which carries water only at high tide, for there was no crater nor splattered material in the vicinity.

A Quebec newspaper had reported that a fiery object fell out of the sky with an accompanying sonic boom rocking the area, prior to discovery of the massive metal in the river. Members of Ottawa New Sciences Club who investigated, however, were unable to find anyone in the area who had actually heard or seen the object fall. Since no connection could be seen between the existence of this metal or slag and the UFO question, no further analysis of the material was undertaken by the project. This writer examined the metallic mass at Ottawa and agreed with the CARDE conclusion that it was ordinary foundry waste.

Examination of claimed evidence of any of the three general types revealed a tendency of some persons to attribute to UFOs any track material, or artifact which seemed unusual and strange, even when there had been no sighting of an UFO in the vicinity. The 3,000 lb. metallic mass is one example. Another example was a ground depression and connecting system of crooked, thread-like tunnels found near Marliens, France, on 9 May 1967, and reported in *The Flying Saucer Review* (1967). The radar chaff "space grass" described above also illustrates this tendency. Metal spheres, a foot or two in diameter, have also been found in fields or woods and reported as mysterious UFOs or UFO evidence. These hollow spheres actually are targets used to calibrate radar sets. One such object, not considered an "UFO" by the finder in this case, but arousing

widespread interest, was found on an Arkansas farm on 3 November 1967. The sphere had been manufactured by the Universal Metal Spinning Company of Albuquerque, N. M. for the Physical Science Laboratory of New Mexico State University at Las Cruces. These spheres, according to the manufacturer, are made of aluminum, vary in diameter from 3-3/16 in. to 28 in., and are deployed from aircraft, balloons, or rockets. In ordinary use, they fall freely, reaching a terminal velocity of about 90 mph. They are normally dropped only in uninhabited regions. Such spheres, found in Australia, were mentioned in an UFO context by Edwards (1967).

A 5 in. metal object found on a lawn in Colorado, near a burned spot its own size where it evidently had struck while still hot was thought perhaps to have fallen from outer space during the night, since it was not on the lawn when it had been mowed the previous day. This object was easily identified as the power lawn mower's muffler.

Any artifact reportedly found at the site of an alleged UFO landing, collision, or explosion presents the primary problem of establishing a relationship between the artifact and the UFO. During the course of this study reports reaching us of events from which such artifacts might be recovered have invariably been sufficiently vague and uncertain to make doubtful the reality of the event described. Analysis of the artifact is therefore meaningless unless the analysis itself can demonstrate that the artifact is not of earthly origin. Samples of material were submitted to this project from two reported events which occurred during project operation. In one case (42) a tiny irregular piece of thin metal had reportedly been picked up from among the beer-can tabs and other earthly debris in an area beneath the reported location of a hovering UFO. It was said to have been picked up because it was the only object in the area that the local investigator could not identify immediately. Analysis showed the sample to be composed chiefly of iron. No additional effort was made

to prove that it was or was not a piece of corroded metal can, for project investigators saw no reason to assume it was related to the UFO, even if the reported UFO were real. In the other case, two metal samples were submitted, through APRO headquarters, reportedly from the site of an UFO-automobile collision of 16 July 1967. One of these, a tiny piece of thin, rolled metal, was shown by analysis to be an alloy of magnesium, aluminum, and zinc. The other sample, weighing several grams, was an iron--chromium--manganese alloy in unworked, crystalline state. Large crystals extending from one surface suggested this sample had solidified at the edge of a vessel from which the rest of the melt had been poured. Both of these materials could be produced by conventional technology. Proof that they are residue from a strange object would require demonstration that they were actually found at the site; that they were not there prior to the reported UFO event and could not have been brought there by the automobile or by other means subsequent to the event; that there was dependable continuity of custody of samples between discovery and analysis; and that there was, indeed, an UFO involved in the reported event. In other words, the existence of these materials, since they are easily producible by earthly technology, can not serve as evidence that a strange flying object collided with the automobile in question.

One case described at great length in UFO literature (Lorenzen, 1962) emphasizes metal fragments that purportedly fell to earth at Ubatuba, Sao Paulo, Brazil from an exploding extra-terrestrial vehicle. The metal was alleged to be of such extreme purity that it could not have been produced by earthly technology. For that reason, this particular material has been widely acclaimed as a fragment of an exploded flying disc. Descriptions of the material's origin and analyses occupy 46 pages of the Lorenzen book and the material is referred to in a high percentage of UFO writings. These fragments of magnesium metal -- undoubtedly the

most famous bits of physical evidence in UFO lore -- were generously loaned to the Colorado project by Jim and Coral Lorenzen of APRO for analysis.

The story which associated these fragments with an UFO is even more tenuous than most UFO reports, since the observers could never be identified or contacted because of the illegibility of the signature on the letter which described the event. According to the account by Olavo T. Fontes, M.D., a Rio de Janeiro society columnist wrote, under the heading, "A Fragment From a Flying Disc "

We received the letter: "Dear Mr. Ibrahim Sued. As a faithful reader of your column and your admirer, I wish to give you something of the highest interest to a newspaperman, about the flying discs. If you believe that they are real, of course. I didn't believe anything said or published about them. But just a few days ago I was forced to change my mind. I was fishing together with some friends, at a place close to the town of Ubatuba, Sao Paulo, when I sighted a flying disc. It approached the beach at unbelievable speed and an accident, i.e. a crash into the sea seemed imminent. At the last moment, however, when it was almost striking the waters, it made a sharp turn upward and climbed rapidly on a fantastic impulse. We followed the spectacle with our eyes, startled, when we saw the disc explode in flames. It disintegrated into thousands of fiery fragments, which fell sparkling with magnificent brightness. They looked like fireworks, despite the time of the accident, at noon, i. e. at midday. Most of these fragments, almost all, fell into the sea. But a number of small pieces fell close to the beach and we picked up a large amount of this material - which was as light as paper. I am enclosing a sample of it. I don't know anyone that could be trusted to

whom I might send it for analysis. I never read about a flying disc being found, or about fragments or parts of a saucer that had been picked up. Unless the finding was made by military authorities and the whole thing kept as a top-secret subject. I am certain the matter will be of great interest to the brilliant columnist and I am sending two copies of this letter - to the newspaper and to your home address."

From the admirer (the signature was not legible), together with the above letter, I received fragments of a strange metal.....

Following the appearance of this account, the claim was published that analyses of the fragments, performed by a Brazilian government agency and others, showed the fragments to be magnesium of a purity unattainable by production and purification techniques known to man at that time. If this proved to be true, the origin of the fragments would be puzzling indeed. If it could then be established that the fragments had actually been part of a flying vehicle, that vehicle could then be assumed to have been manufactured by a culture unknown to man.

The first step in checking this claim was independent analysis of the magnesium fragments, and comparison of their purity with commercially produced pure magnesium. A comparison sample of triply sublimed magnesium, similar to samples which the Dow Chemical Company has supplied on request for at least 25 years, was acquired from Dr. R. S. Busk, Research Director of the Dow Metal Products Dept., Midland, Mich. Since it was assumed that extremely small quantities of impurities would need to be measured, neutron-activation analysis was selected as the analytical method. The samples were taken to the National Office Laboratory, Alcohol and Tobacco Tax Division, Bureau of Internal Revenue,

at which the personnel had no special interest in the UFO question. The neutron irradiation and gamma spectrometry were personally observed by this writer. The analysis was performed by Mr. Maynard J. Pro, Assistant Chief, Research and Methods Evaluation, and his associates. Original irradiation data and gamma-spectrometer read-out tapes are preserved in project files.

The material irradiated was a chip broken from the main fragment. It was immersed in HCl to remove surface contamination. After washing, the sample presented a bright, shiny, metallic surface. The absence of chlorine emissions in the gamma-ray spectra after neutron activation showed both that washing had been thorough and that chlorine was not present in the sample itself. The concentrations of eight impurity elements were measured. Results are given in parts per million parts of sample, with limits of error estimated on the basis of greatest conceivable error. The "UFO fragment" compared with the Dow material as follows:

Element	Parts Per Million	
	Dow Mg.	Brazil UFO
Mn	4.8 \pm 0.5	35.0 \pm 5.
Al	not detected (<5)	not detected (<10)
Zn	5. \pm 1.	500. \pm 100.
Hg	2.6 \pm 0.5	not detected
Cr	5.9 \pm .12	32.0 \pm 10.
Cu	0.4 \pm 0.2	3.3 \pm 1.0
Ba	not detected	160. \pm 20.
Sr	not detected	500. \pm 100.

Mn, Al, Zn, Hg, and Cr values were obtained from direct gamma spectrometry and half-life measurement; Cu, Ba, and Sr values were obtained by gamma spectrometry after radiochemical separation of the elements. In the latter cases, known standard samples of these elements were irradiated and analyzed concurrently with the specimen. Results, within the limits of error indicated, should be quite dependable. Since spectrographic analyses routinely performed on purified magnesium show no other elements present at concentrations of more than a few parts per million, the analytical results presented above show that the claimed UFO fragment is not nearly as pure as magnesium produced by known earthly technology prior to 1957, the year of the UFO report.

The neutron activation analysis also was utilized as a means of checking the magnesium isotopic content. The suggestion had been made (Jueneman, 1968) that the fragment might be composed of pure Mg^{26} , and therefore the magnesium isotopic content of this fragment should be determined. The suggestion was based on assumed qualities of such a pure isotope and on a density figure of 1.866 gm/cc, which had been reported for the center of one of the magnesium pieces "as determined in replicate using a Jolly balance" (Lorenzen, 1962). It is interesting that this figure was chosen over the density figure of 1.7513 gm/cc, also reported in the Lorenzen book, which was determined at a US Atomic Energy Commission laboratory by creating a liquid mixture in which the fragment would neither float nor sink, and measuring the density of the liquid. The quantity of Mg^{27} isotope produced by neutron activation [$Mg^{26} (n, \gamma) Mg^{27}$], as determined by gamma spectrometry after activation, showed that the Brazil sample did not differ significantly in Mg^{26} isotope content from other magnesium samples.

Although the Brazil fragment proved not to be pure, as claimed, the possibility remained that the material was unique. The high content of Sr was particularly interesting, since Sr is not an expected impurity in magnesium made by usual production methods, and Dr. Busk knew of no one who intentionally added strontium to commercial magnesium. The sample was, therefore, subjected also to a metallographic and microprobe analysis at the magnesium Metallurgical Laboratory of the Dow Chemical Company, through the cooperation of Dr. Busk and Dr. D. R. Beaman. Again, all work was monitored by this writer. Microprobe analysis confirmed the presence of strontium and showed it to be uniformly distributed in the sample (see Case 4). In all probability, the strontium was added intentionally during manufacture of the material from which the sample came. Metallographic examinations show large, elongated magnesium grains, indicating that the metal had not been worked after solidification from the liquid or vapor state. It therefore seems doubtful that this sample had been a part of a fabricated metal object.

A check of Dow Metallurgical Laboratory records revealed that, over the years, this laboratory made experimental batches of Mg alloy containing from 0.1% - 40% Sr. As early as 25 March 1940, it produced a 700 gm. batch of Mg containing nominally the same concentration of Sr as was contained in the Ubatuba sample.

Since only a few grams of the Ubatuba magnesium are known to exist, and these could have been produced by common earthly technology known prior to 1957, the existence and composition of these samples themselves reveal no information about the samples' origin. The claim of unusual purity of the magnesium fragments has been disproved. The fragments do not show unique or unearthly composition, and therefore they cannot be used as valid evidence of the extra-terrestrial origin of a vehicle of which they are claimed to have been a part.

4. Conclusion

This project has found no physical evidence which, in itself, clearly indicates the existence in the atmosphere of vehicles of extraordinary nature. Belief in the existence of such vehicles, if such belief is held, must rest on other arguments.

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Chapter 4
Indirect Physical Evidence
Roy Craig

1. Introduction

Reports of unidentified flying objects, particularly those reported to have come quite close to the observer, frequently describe physical effects due to the presence of the UFO. The most frequently claimed effects are electric or electromagnetic in nature. They include unexplained stoppage of automobile motors; failure of automobile headlights; interference with radio, T.V., and electric clock operation; power failures; magnetic field disturbances; and sudden temporary increases in gamma radiation levels. One publication (Hall, 1964) lists 106 UFO cases in which electromagnetic effects are a significant feature of the UFO report. Forty-five of these involve stalled automobile motors, generally accompanied by headlight failure,

Physiological effects of UFOs are also frequently reported. They include strange reactions of animals, feelings of pressure, heat, or "prickly sensations," and, occasionally, lapse of consciousness by a human observer.

While such physical or physiological effects are frequently reported, they are not invariably a part of UFO reports. Some report stoppage of the observer's automobile, while others chase the UFOs in their cars, the operation of which is unimpaired. Our field teams also have noted that strange animal reactions, and even interference with telephone operation, have been claimed in cases in which the UFO was later identified as a bird or a plastic balloon. Such instances confuse the issue, but do not prove that in other cases there is no relation between claimed unusual physical and psychological effects and UFO sightings.

Claims of strange animal reactions or unusual human sensations when an UFO is near cannot be verified by examination of residual evidence, for no physical evidence remains after the event. Certain physical effects, however, might be expected to leave a detectable alteration in the affected object, or a permanent record of an instrumented measurement of a physical quantity. Attempts to find and examine such evidence are reported in this chapter.

One expected physical effect is noteworthy because of its absence. In numerous reports, the UFO is seen, visually or by radar, to be moving at presumed speeds far exceeding the speed of sound, yet no sound, particularly no sonic boom, is heard. Our present knowledge of physics indicates that any material object moving through the atmosphere at such speeds would *necessarily* create a pressure wave in the atmosphere resulting in a sonic boom. This expected physical effect is discussed in Section VI, Chapter 6.

2. Radiation Level Excursions

In 1952-53, Project Blue Book personnel investigated claimed correlations of visual sightings of UFOs with rapid rises of radiation counts on radiation-detecting devices (Blue Book, 1953). The events allegedly occurred near Mt. Palomar Observatory in October 1949, and at the Los Alamos Scientific Laboratory in 1950, 1951, and 1952. Air Force investigators examined their records and searched, as well, for reports of unrecorded UFO sightings. They found no evidence of UFO observations which would correlate with the Los Alamos high-radiation occurrences.

The Blue Book investigators also reviewed a Navy report of the October 1949 incidents at Mt. Palomar. According to the Air Force report, on two occasions at Mt. Palomar at the same time that radiation detectors indicated a sudden burst of radiation, "personnel from the observatory observed something in the air."

In one instance, according to the Navy report, the observed object was judged to have appeared similar to a bird. In the other the similarity was to a formation of aircraft. There was strong indication that, whatever the identities of the observed object, the observations and the radiation excursions were strictly coincidental.

No instances of radiation excursions coincident with UFO sightings were reported to the Colorado project, which has therefore not had an opportunity to study at firsthand any possible relationship between such events.

3. Terrestrial Magnetic Disturbances

Popular lore associates the presence of UFOs with local disturbances of the earth's magnetic field. "UFO detectors" have been designed to sense such disturbances, sounding an alarm when a sudden change in the magnetic field alters the orientation of a magnet in the "detector."

During the investigative phase of this project, an observer near Denver, Colo., reported that his detector had sounded. He telephoned project headquarters to inform us that he had sighted an UFO overhead. Responding to this call, project investigators drove to the scene and observed a light in the daylight sky pointed out to them by the observer. They watched the light move westward at a rate later calculated to be $15^{\circ}/\text{hr}$. Its coordinates during the period of observation were those of the planet Venus.

The project attempted to verify reports of the association of magnetic disturbances with UFO sightings in the Antarctic during the period March-September 1965 (Project file 1257-P). In this effort the project was greatly assisted by Commander Jehu Blades of the NROTC unit at the University of Colorado. Cmdr. Blades had served as commanding officer of the U.S. Antarctic "wintering-over" party at McMurdo Station in 1965. Argentine newspapers had given extensive coverage to a report that on 3 July 1965 personnel of the Orcadas Naval Station in the

Antarctic observed the presence of a strange luminous body simultaneously with a small deviation in the earth's magnetic field. The episode lasted for 40 min. Information from the British Antarctic Survey (Blades, 1967) indicated that the British station at Deception Island had received reports of moving colored lights seen from the Argentine station on Deception Island on 7 June, 20 June, and 3 July 1965; from the Chilean station on the latter two dates, and from the British station on 2 July. An UFO observed by two men on 20 November 1965, at an Antarctic field approximately $74^{\circ} 30'S$, $17^{\circ} 00'W$, was judged to have been a radiosonde balloon launched from the British station at Halley Bay.

Base Commander C.D. Walter, of the British base at Deception Island recalled receipt, during the early winter of 1965, of a variety of UFO reports from the Argentine station. Reports subsequently came from the Chilean station. The phenomena seen by the Chileans were reported as being above the Argentine base, while those seen by the Argentinians were reported as located above the Chilean base.

Mr. Walter reported that the one observation reported by a member of the British base was made by the cook at the base and was looked upon as rather a joke. There also was a suggestion that practical jokes were being played upon the commandant of the Argentine base.

No UFO observations on Deception Island were made by scientific personnel. Mr. Walter also mentioned that a nacreous cloud was observed at the British Base F on the Argentine Islands on 4 July at the same time as a defect developed in the magnetic instruments. While the instrument fault was soon corrected, misinterpreted radio reports of the event may have led to UFO interpretations, and even to claims of magnetic effects of the UFO.

Dr. Erich Paul Heilmair, Director of the Astronomical Observatory, Catholic University of Chile, reported that observations of white luminous

flying objects, made by nine people at the Chilean "Presidente Aquirre Cerda" Antarctic base on 3 July 1965, were made by untrained persons, and suggested that reports of the observations should be accepted with reserve. The objects were said to have been seen for 20 minutes as they crossed the SW end of Deception Island travelling at "full speed" in a NW-SE direction, at 45° elevation.

According to Dr. Heilmaier's information, the phenomenon was also observed at the British base and the Argentine station, and variations of the magnetic field were recorded by magnetometers at the Argentine station. Dr. Heilmaier was unable to supply details of these observations.

Capt. Jose Maria Cohen, Argentine Navy, reported that the magnetic variations registered on the Deception Island instruments were not outside the limits of normal variation.

Microfilm copies of magnetograms recorded at the Orcadas Observatory on 3 July 1965 were obtained and examined. The magnetic deviation recorded during the reported UFO sighting was small, an order of magnitude lower than deviations observed during magnetic storms, and well within normal daily fluctuations. Consequently, we must conclude that the 1965 Antarctic expedition reports offer little convincing evidence that an unidentified object caused a terrestrial magnetic disturbance. No data which could serve as firm evidence that an UFO caused a magnetic disturbance have been brought to our attention.

4. Automobile Engine Malfunction and Headlight Failure

Reports of temporary stalling of automobile motors by UFOs constitute one of the more puzzling aspects of UFO reports. The automobiles are invariably reported to operate normally after the UFO leaves the vicinity, and no permanent damage to the car's ignition or lighting system is indicated.

One explanation advanced for such effects has been that UFOs somehow ionize the air to such an extent that normal internal combustion is prevented. This is considered unlikely because no concomitant physiological or physical effects that such ionization would cause are reported. Mechanisms capable of short-circuiting automobile electrical systems do not take into account the claim that normal operation resumes after departure of the UFO.

There remains the hypothesis that automobile motors are stopped or their performance interfered with by magnetic fields associated with UFOs. To test this hypothesis, the project sought, as the first step, to determine the minimum magnetic field strength that would cause motor malfunction. Tests of the effect of a high intensity magnetic field on individual components of an automobile ignition system have been carried out at a major national laboratory using an electromagnet capable of producing a field up to 10 kg (kilogauss) across an area 9 in. in diameter. The engineer has requested that his identity not be disclosed in this report. At a meeting sponsored by the project in Boulder, he presented his experimental results. He used a simplified simulated automobile ignition system, placing each component in turn in the magnetic field, which was increased slowly from --20 kg. The distributor was turned by an electric motor outside the magnetic field. His results are shown in Table 1.

Table 1

Item in Field	Field Direction	Effects
Spark Plug	Coaxial with arc	Slightly brighter spark
Spark Plug	Perpendicular to arc	Moved arc to side of electrodes, 20 kilogauss did not stop arcing.
Coil (Steel Container)	Perpendicular to center line	Occasionally interrupted spark at 20 kilogauss.
Coil (Aluminum Container)	Perpendicular to center line	Spark started missing at about 4 kilogauss, stopped at 17 kilogauss.
Lead acid battery with resistive load (1A current)	Parallel to battery plates	Voltage dropped from 12.3 at zero field to 12.0 volt at 20 kilogauss.
Light	Parallel and perpendicular to filament	No effect on brightness or current (resistance) up to 20 kilogauss.

The spark plug was at atmospheric pressure with a normal gap of about 0.025 inches.

Two coils were used, a 12V aluminum-cased coil, without a voltage-dropping resistor, typical of European cars, and a 6V steel-cased coil of American manufacture. The iron core of the aluminum-cased coil saturated at 16 kg. When the core is saturated, the charging current does not change the magnetism enough to generate a high voltage. The steel casing of the 6V coil apparently provided enough magnetic shielding to extend the saturation point to something greater than 20kg. external field.

If we accept these measurements, they indicate that a car with its ignition coil in a steel container (standard in cars of American manufacture) would continue to operate in magnetic fields less than 20 kg. However, since the entire ignition system is shielded by the steel hood and body of the car, it is apparent that very intense magnetic fields external to the car would be required if automobile stoppage should be due to magnetic effects.

Rather than attempt to assess the probability that intense magnetic fields are generated by UFOs, or to calculate hypothetical field intensities at variable distances from an UFO, we chose to test the magnetic field hypothesis by looking for direct evidence that automobiles reportedly affected by the presence of UFOs had in fact been subjected to the effects of a magnetic field that was sufficiently intense to cause motor malfunction. Magnetic mapping of car bodies as a means of obtaining information about the magnetic history of an automobile was suggested by Mr. Frederick J. Hooven, formerly of the Ford Motor Company, and now Adjunct Professor of Engineering Science at the Thayer School of Engineering, Dartmouth College, Hanover, N.H. Mr. Hooven and members of the General Parts Division of Ford Motor Company, notably Mr. David F. Moyer, manager of advanced manufacturing engineering, applied the magnetic mapping technique to an automobile that had allegedly been directly beneath an UFO for several minutes. During that time, the driver reportedly could not accelerate the automobile, which seemed to be moving under the control of the UFO. Residual radio and car instrument malfunctions also were claimed. The full study of this case, carried out at the expense of the Ford Motor Company, is reported as Case 12. A summary of the magnetic signature aspects of the case is presented by Mr. Hooven as follows:

When a piece of ordinary low-carbon steel, such as automotive sheet metal, is stressed beyond the elastic limit, as in forming or stretching, it becomes "work-hardened" to an extent sufficient

to enable it to retain a substantial degree of permanent magnetism. Thus, it ordinarily will retain a substantial portion of the earth's magnetic field as it existed at the time of forming. This can easily be demonstrated by hammering a nail on an anvil, with the nail pointing north/south, which will result in permanently magnetizing the nail in the direction of the earth's field.

The external sheet metal parts of an automobile, such as the door panels, hood, deck lid, roof, and minor body panels, are ordinarily formed under conditions that remain constant for the duration of the yearly model, and often for three or four years. Thus, the parts of a given make and model car are all likely to have come from a single source, or at the most two sources, no matter where the car is assembled. The dies that form these parts ordinarily remain undisturbed during the service life, subject to repeated blows that cause them to become magnetized by the magnetic field of the earth, and forming parts that all take on a similar pattern of magnetism.

Other processes that leave their magnetic imprint on the sheet metal parts of the car, are the use of magnetic lifting devices, spot-welding, and (where used) chrome-plating, with the result that each make and model car has a pattern of magnetism retained in its sheet metal parts that is as distinctive of that make and model as a finger print is of an individual.

This characteristic was utilized in the tests reported in Case 12, as a suggested technique whereby vehicles could be examined for some indication of their history so far as magnetic environment is concerned. The vehicle was carefully mapped with a magnetometer, and the complex pattern of magnetic remanence was compared with that of three other vehicles of the same make, model, and year chosen at random. It proved

to be identical to two of them; it was established that the third had been wrecked and repaired.

It was not established by these tests just what strength of magnetic field would be required to change the established pattern of the production vehicle, but it is obviously a greater amount than a car experiences in the normal course of its life. It was likewise assumed that this value would be smaller than any field capable of interfering with the car's operation.

Since the magnetic pattern on the tested car was substantially unchanged from new, it was concluded on the basis of the above assumptions that the car has not been subject to any ambient magnetic field, either unidirectional or alternating, of sufficient intensity to interfere with its normal functioning. This would have been sufficient to conclude that the permanent magnets in the car could not have been demagnetized, as was at first suspected, without the necessity of removing the instruments for testing, since any field that would have affected the permanent magnets in the car would have been sufficient to change the retained magnetism in the car's sheet metal.

Magnetic effects have been considered to be the most plausible causes of reported automobile malfunctioning in UFO encounters, and the magnetic-mapping technique offers an effective means of determining whether or not a given vehicle has been subjected to intense fields. It does not provide information respecting other possible environmental causes of vehicle malfunction.

Mr. Hooven's assumption that the minimum strength of magnetic field required to change the established magnetic pattern would be smaller than any field capable of interfering with the car's operation has been verified by a test with 1 kg. field. A magnetron magnet was passed over specified points on the front deck of a 1962 Chevrolet Corvair, and the alteration in magnetic pattern was noted. A 0.4 cm. paper tablet was kept between the magnet and the car deck to prevent physical contact. The maximum field strength penetrating the tablet was measured with a Bell "120" gaussmeter, with Model T-1201 probe, and was found to be 1 kg. (one inch away from the tablet, which was held against the magnet poles, the maximum field was measured as 235 g.). The observed alterations in magnetic pattern are shown in Table 1 which gives the directions a compass needle pointed when the compass was placed on the selected test points 6 in. apart located as shown in Fig. 1. The measurements also demonstrate both the permanence of pattern alteration and alteration due to bending and straightening of the car deck. The car was facing 180° T. during all measurements.

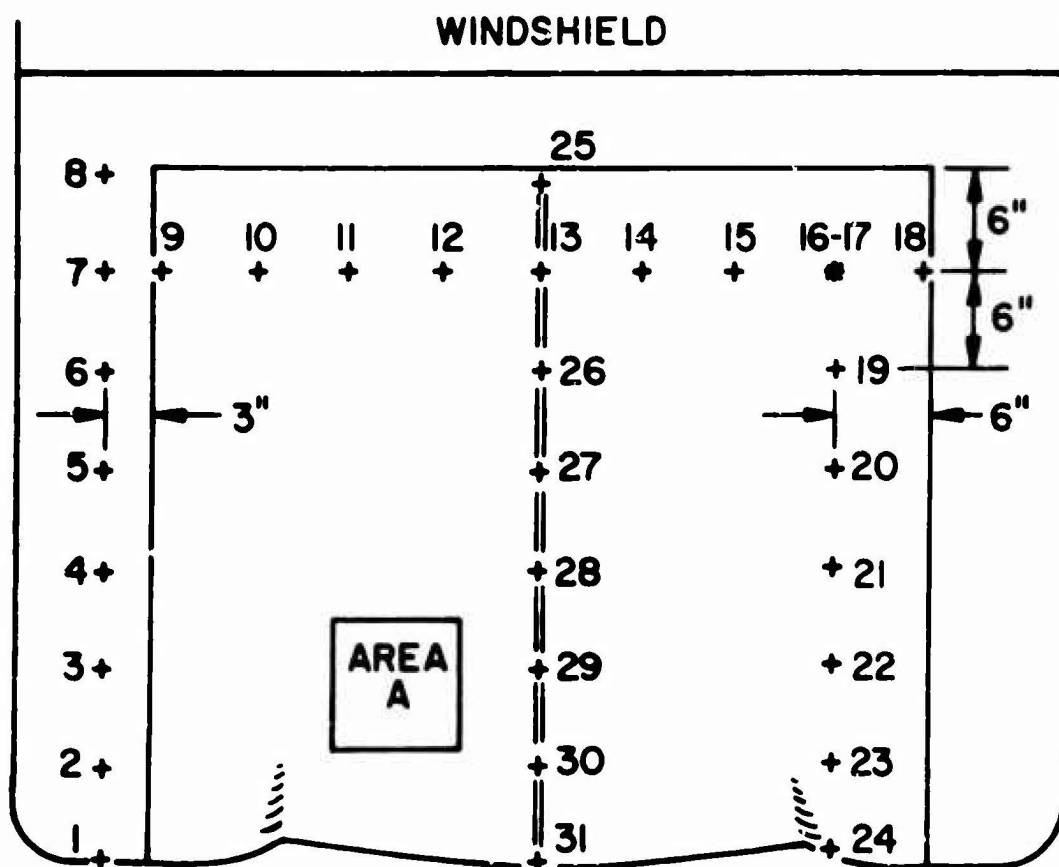
The third and fourth columns of Table 1 show definitely that the passage of 1-kg. magnetic field completely determines the residual magnetic pattern. Subsequent compass readings, except for unexplained anomaly at point 29, show the last alteration to be the one retained. The car under study was involved in a collision on 21 August. Figures in the right column of Table 1 show the magnetic pattern after straightening and repainting. All compass readings shown are accurate to within 2°-3°. Each set of readings was recorded without reference to prior readings, with which they were compared only subsequently. The reproducibility, in most cases, is surprising. When test points were near sharp changes in magnetic orientation, a slight error in point relocation

Table 1

Test Point Number	Compass Readings 18 July 1968			Subsequent Compass Readings		
	Original	After passage of magnet, N pole on E side of point	After passage of magnet, N pole on W side of point	5 August	15 August	After collision and repair
25	29	295	68	66	68	60
13	38	275	80	78	78	70
26	349	275	89	90	89	44
27	10	275	91	90	90	67
28	22	280	85	72*	67	53
29	13	265	85	52*	39	1
30	13	271	76	12*	10	352
31	6	305	26	355*	2	3

*After readings were taken on 18 July, the magnet was brought to Area A and twisted over it. The altered readings for points 28-31 on 5 August can be assumed to have been altered 18 July by the nearness of the magnet to these points. (See Fig. 1) (It was not noticed how close the magnet was to these points. Estimated minimum is 2 to 6 in.)

Figure 1



180° M.

FRONT DECK OF CORVAIR

Table 2

Test Point No.	Compass Readings		
	18 July	5 August	15 August
A-1	74	69	63
A-2	98	105	108
A-3	127	150	147
A-4	153	178	175
A-5	171	192	190
A-6	176	200	207
A-7	58	48	45
A-8	76	66	72
A-9	104	112	112
A-10	132	162	158
A-11	159	195	192
A-12	176	221	220

Table 3

Test Point No.	Compass Readings			
	Original 18 July	5 August	15 August	Post Wreck 4 September
9	310	266	263	275
10	292	236	228	256
11	197	130	143	65
12	56	350	337	56
13	38	78	78	70
14	25	317	327	20
15	22	347	351	5
16	332	328	331	356
18	67	69	69	72

would cause major variation in compass readings. Such slight location error probably accounts for the lack of agreement in the 5 August and 15 August columns of Table 1, which shows data taken to test the permanency of a pattern previously scrambled by twisting the magnet over the area. Points A-1 through A-12 are specific points 1 in. apart on each of two parallel lines 2 in. apart within Area A. The agreement of the two right columns shows both that the test points were accurately relocated and that the pattern was retained.

While we did not determine the minimum magnetic field which would alter the car pattern, an indication that its value would be only a few gauss is given in data shown in Tables 1 and 2, and Table 1 is included here for that reason.

As seen in Table 3, 5 August readings were significantly different from the original values for all points other than 16 and 18. After the original values were determined on 18 July, the magnet had been passed directly over point 13 and within an inch of point 9 (The magnet was passed over points 1-8 in variable orientation, showing initially that the pattern was thus changed. The data for passage over points 25-31 were chosen for presentation in Table 1 because of the observable determination of residual orientation.) These passes of the magnet, plus its passage over Area A, apparently altered the magnetic pattern at all points which were less than a foot from the magnet (note altered values on 5 August for points 9-15 in Table 3, points 28-31 in Table 1).

More precise quantitative tests of the effect of magnetic fields of varying strength on the residual magnetic pattern of automobiles would be interesting. The above tests, however, show that a 1 kg. field is more than adequate to alter this pattern permanently.

One case of reported car stoppage, occurring during the term of the Colorado project, was studied in the field (Case 39) using a simple compass of good quality. The correspondence of magnetic signature of the affected car with that of a comparison car of the same make and model in a different geographical location was striking. The correspondence showed that the automobile in question had not been subjected to a magnetic field of high intensity.

Magnetic mapping of the bodies of automobiles involved in particularly puzzling UFO reports of past years, such as the November 1957 incidents at Levelland, Texas, would have been most desirable, but the cars were no longer available for study.

The technique is simple and would be quite useful to any field team studying an event in which stalling of a car by an UFO is claimed. Investigators should interpret the results with caution, however, since denting and straightening of the car body does alter the magnetic signature. As demonstrated in the test reported above, the signature also can be changed easily with a simple horseshoe magnet.

5. Unexplained Electric Power Interruptions

(This section prepared by Mr. R. J. Low)

A listing of electrical power interruptions from 1954 through 1966 appears as Appendix E of the Federal Power Commission report, Prevention of Power Failures. This list contains none of the 15 disturbances of power systems tabulated in *The UFO Evidence* (NICAP, 1964), and its supplement as having been coincidental with sightings of UFOs near the affected power systems.

The 148 power interruptions listed in the resume are those "which were sufficiently important to gain publicity." Since none of the reported UFO-related power failures tabulated by NICAP is reflected in the FPC resume, we may conclude that none of them was of major public consequence. This is also apparent from the descriptions of the incidents given by the authors of *The UFO Evidence*.

Rather than investigate events that, from the standpoint of power systems operations and impact on the public, were not significant, it appeared more fruitful to determine whether there were power failures that could not be satisfactorily explained. The FPC report for the 13 years from 1954 through 1966 includes a total of 148 failures. In three instances although the events that initiated the disturbances were identified, the causes are listed as "unknown". In one case (Los Angeles, 19 July 1966), the event is described: "Breaker Operations - Cause

Unknown"; in the second (Chicago, 22 Nov. 1966) "Transformer Relay Operation - Cause Unknown"; and in the third (Austin, Texas, 14 Dec. 1966): "Lines Tripped Out - Cause Unknown." It has not been suggested, so far as we are aware, that these outages are related to UFO sightings. No sighting is listed in the Colorado project's printout of sighting reports for 19 July or 22 November; a sighting recorded for 14 December occurred elsewhere.

An FPC Order No. 331, issued 20 December 1966, requires all entities engaged in the generation and transmission of electric power to report significant interruptions of bulk power supply to the Commission. Through 12 June 1967, 52 power interruptions were reported in accordance with Order No. 331.

Of the 52, three were not explained. These are, together with the explanatory material given, the following:

Tennessee Valley Authority, 25 February 1967 -- A high-temperature detector removed a transformer from service at Johnson City, Tenn. No damage was apparent and when restored to service the transformer continued to function normally. Loads of 36,700 kw. were interrupted for 36 min.

Carolina Power & Light Company, 1 May 1967 -- 25,000 kw. of load in the city of Rocky Mount, N.C., was interrupted for about 1 hr. when the 110 kw. bus at the Rocky Mount substation tripped. Cause of the interruption is unknown.

Pennsylvania Power & Light Company, 12 June 1967 -- Approximately 78,000 customers and 163,000 kw. of load in Lycoming and Schuylkill counties were interrupted at 2:01 p.m., EDT, when a 330 kv. lightning arrester failed on a 220/66 kv. transformer bank at Frackville Substation. The failure occurred during clear weather and the cause was unknown. Service was restored to 113,000 kw. within 15 min. and to the remaining 50,000 kw. within 24 min.

Eight UFO sightings are recorded in the project's printout on the date of the first outage, none of them in Tennessee; three on the date of the second, none in North Carolina; and one, not in Pennsylvania, on the date of the third.

The causes of power failures are usually not announced until after the period of most intense public interest has passed. Although usually the cause of the outage will be traced very quickly, power officials may be and often are reluctant to make prompt announcement of it, for fear that subsequent analysis will reveal the initial conclusion to be incorrect. Occasionally, it is several days before the cause is located. The public, however, begins to lose interest in what happened very soon after power is restored, so that circumstances of outages, because they can be determined immediately, are usually reported more fully and covered more prominently than their underlying causes.

J. L. McKinley, Manager of System Operations, Public Service Company of Colorado, assisted us with the technical aspects of the study of possible UFO-related electric power system failures. As a member of the North American Power Systems Interconnection Committee, Mr. McKinley is concerned with and informed about all aspects of power generation, transmission, and distribution in the local area and in the nation as a whole. We asked him whether there are power outages, the underlying cause of which remains unexplained. In a letter dated 11 October 1967, he answered as follows:

I am not aware of any major power disturbances the causes of which are concealed behind a cloak of mystery. When we say that a 'cause is unknown', we mean that we have not found, after reasonable inspection, physical evidence of the cause. For example, a transmission line faults, circuit breakers open, and the relays sensing the fault causing the tripout show a ground target, which means that one of the phase conductors has been grounded. If the fault is instantaneous from a lightning strike, the circuit breakers will close, restoring the line in service. If the fault is permanent the circuit breakers will close and

again open. In either event an inspection will result; in the case of the lightning strike, some physical evidence of the strike may be evident; in the case of the permanent fault, the cause will be found, perhaps a tree has fallen into the line, etc. If no physical evidence is apparent upon inspection, a subsequent breakdown of some component may result, improper functioning of control or protection equipment may be found on routine tests, or, if the same fault occurs frequently, a much more intensive effort will locate the cause. Sometimes large birds will cause transmission lines to trip and it is very difficult to find evidence of physical damage, the dead bird or feathers, etc. being the only evidence.

Equipment failures causing power outages are usually very easy to locate unless such outages result from the malfunctioning of the more sophisticated types of control or protection devices. Then specialized technicians must resort to extensive testing of the performance of these devices.

The Rocky Mountain Power Pool at Casper meeting on 13 June 1967, the North American Power Systems Interconnection Committee meeting at Vancouver, B.C. on 17-18 July 1967, and the Western Operating Committee meeting at Boise on 25-26 July 1967 were asked whether there is reason to suppose that some power interruptions are caused by or related to the appearance of UFOs. None of these experts replied in the affirmative.

In *Incident at Exeter* (Fuller, 1966), the massive power failure in the Northeast of 9 November 1965 is described as follows:

The blackout caused by the failure of the Northeast Power Grid created one of the biggest mysteries in the history of modern civilization...

By November 11, *The New York Times* was reporting that the Northeast was slowly struggling back toward normal, but that

the cause of the blackout was still unknown. Authorities frankly admitted that there was no assurance whatever that the incredible blackout could not occur again, without warning.

There was a curious lack of physical damage...only a few generators were out of action as a result of the power failure, not a cause. What's more, the utilities were able to restore service with the exact same equipment that was in use at the time of the blackout. What happened that night was not only far from normal; it was mystifying. If there had been a mechanical flaw, a fire, a breakdown, a short circuit, a toppling transmission tower, the cause would have been quickly and easily detected. Mechanically, however, the system as a whole was in perfect repair before and after the failure.

William W. Kobelt, of Walkill, N.Y., is one of the thousands of line patrol observers who, according to *The New York Times* went into action to try to discover the trouble. He is typical of all the others. He flew over the lines of the Central Hudson Gas and Electric Corporation at daybreak after the blackout. Cruising close to treetop level, he checked wires, insulators, cross arms and structures of the high-power transmission lines. He looked for trees, branches which might have fallen over the wires. "We looked for trouble - but couldn't find any at all," he said.

Robert Ginna, Chairman of the Rochester Gas and Electric Corporation, said that his utility had been receiving 200,000 kw. under an agreement with the New York State Power Authority, which operates the hydroelectric plants at Niagara Falls. "Suddenly, we didn't have it," he said. "We don't know what happened to the 200,000 kilowatts. It just wasn't there."

The difficulty was traced to a remote-controlled substation at Clay, N.Y., near Syracuse, where, according to Mr. Fuller, all was found to be in order.

"Something else happened outside Syracuse, however, which was noted briefly in the press, and then immediately dropped without follow-up comment," according to the Fuller account. The "something else" was the sighting of a huge red ball of brilliant intensity about 100 ft. in diameter just over the power lines near the Clay substation. The reported observation by a private flight instructor and his student passenger was made from a plane approaching Hancock Field, Syracuse. Five persons, according to Fuller, including Robert C. Walsh, Deputy Commissioner for the Federal Aviation Agency, reported this UFO sighting which was said to have occurred at 5:16 p.m., the moment the outage commenced. Observations of other unusual aerial objects, according to Mr. Fuller, were reported from New York City, N.Y., West Orange and Newark, N.J., Philadelphia, Pa., Holyoke and Amherst, Mass., and Woonsocket, R.I. Here is author Fuller's conclusion:

In spite of the lengthy report issued by the FCC, (sic) the Great Blackout has still not been adequately explained. Ostensibly, backup Relay #Q-29 at the Sir Adam Beck generating station, Queenston, Ontario, was eventually pinpointed as the source of the massive failure. But further investigation, hardly noted in the press, showed that nothing in the relay was broken when it was removed for inspection. In fact, it went back into operation normally when power was restored. The line it was protecting was totally undamaged. "Why did everything go berserk?" *Life* Magazine asks in an article about the blackout. "Tests on the wayward sensing device have thus far been to no avail." A later statement by Arthur J. Harris, a supervising engineer of the Ontario Hydroelectric Commission, indicated that the cause was still a mystery. "Although the blackout has been traced to the tripping of a circuit breaker at the Sir Adam Beck No. 2 plant, it is practically impossible to pinpoint the initial cause." As late as January 4, 1966, *The New York Times* in a follow-up story indicated a series of questions regarding the prevention of future blackouts. The new items says:

"These questions more or less are related to the cause, still not fully understood, of last November's blackout..."

The A.P.R.O. Bulletin of November-December 1965 expresses a similar view of the events of that night.

Finally, in testimony before a symposium on UFOs conducted by the House Committee on Science and Astronautics on 29 July 1968, Dr. James E. McDonald referred to the possibility that UFOs might have caused the power failure.

Let us now examine the FPC report. Volume I states that "the Commission's initial report, published December 6, 1965, pinpointed the initiating cause of the interruption as the operation of a backup relay on one of the five main transmission lines taking power to Toronto from Ontario Hydro's Sir Adam Beck No. 2 Hydroelectric Plant on the Niagara River. This relay, which was set too low for the load which the line was carrying, disconnected the line." Volume III gives a detailed chronology (to the hundredth of a second) of the events following the initial tripout of Q-29, as follows:

The initial event was the operation of a backup relay at Beck Generating Station which opened circuit Q29BD, one of five 230-kv. circuits connecting the generation of Beck to the Toronto-Hamilton load area. Prior to the opening of circuit Q29BD at Beck, these circuits were loaded with Beck generation plus almost 500 megawatts of power flowing to Beck over the two tie lines from New York State. Of this 500 megawatts, about 300 megawatts were scheduled for use in Ontario and the remaining 200 megawatts were in replacement of power flowing from the Saunders plant into New York at Massena. The loading on Q29BD, based on digital computer flows and examination of the Beck Station tie line and totalizing graphic charts, was indicated to be 361 megawatts at about 0.93 power factor and a voltage of 248 kv. This pickup setting was, therefore, in excess of the indicated average line loading. The precise cause of the backup relay energization is not known. A momentary and relatively small change in voltage might have been responsible as the pickup

setting is inversely proportional to the square of the voltage. Alternatively the line megawatt loading could have increased slightly above 361 megawatts due to a change in system loading or a change in tap position of the phase shifting transformer at Saunders, St. Lawrence. Shortly before circuit Q29BD tripped, a tap setting change had been made in such a direction as to increase the power flow. In any event the pickup setting of the line backup relay was reached and the circuit opened at the Beck end.

The opening of circuit Q29BD resulted in the sequential tripping of circuits Q23BW, Q25BW, Q24BD, and Q30AW. After the opening of the first two circuits, determined by an event recorder at Beck, the oscillograph at Beck started and established the sequential openings of circuits Q25BW, Q24BD, and Q30AW.

The opening of the five Beck 230-kv. circuits occurred over a period of 2.7 seconds, during which the initial flow of 500 megawatts from the western New York area toward Beck reversed and reached an estimated value of about 1,200 megawatts into western New York for a total change of 1,700 megawatts. This surge of excess power continued eastward and southward from Niagara, and back into Canada over the 230-kv. tie line at St. Lawrence. This line was opened by protective relaying and separated the Ontario system, with the exception of Beck and its adjacent area, from the remainder of the interconnection.

Generators in western New York and at the Beck Station accelerated toward an out-of-step condition and separated from the remaining system. The separation from the New York State Electric & Gas system was effected by the opening of the Meyer-Hillside 230-kv. circuit at 3.53 seconds and the Stolle Road-Meyer circuit at 3.57 seconds, as recorded by oscillographs at Niagara and Stolle Road. Simultaneously with the separation from New York State Gas & Electric, the

PJM system separated from western New York due to the tripping of the Dunkirk-Erie 230-kv. line and the lines running east and west from Warren, Pa.

At almost the same time, separation from central New York began when line protective relays operated to open the two Rochester-Clay 345-kv. circuits at 3.56 and 3.61 seconds. The computer simulation demonstrated that the parallel lower voltage circuits opened immediately thereafter.

Moses-St. Lawrence generating station in northern New York, now connected to New England and central New York, continued to accelerate toward an out-of-step condition, tripping the two Moses-Adirondack circuits at 3.98 and 4.01 seconds. This was followed by automatic generator dropping at Moses-St. Lawrence in an attempt to maintain area stability. At this late stage, this did not prevent the opening of the Plattsburgh-Essex 230-kv. circuit at 4.11 seconds. Automatic reclosure was unsuccessful on the two Moses-Adirondack 230-kv. circuits at 4.79 and 4.81 seconds. Northern New York was now effectively separated from central New York and New England. The switching sequences in the St. Lawrence area separation were determined from oscillographic records at Moses-St. Lawrence, and were not duplicated successfully in the computer simulation.

The separation of western New York from central New York was followed by the separation of central New York from PJM at approximately 4 seconds with the opening of the 230-kv. Hillside-East Towanda line, the North Waverly-East Sayre line and the Goudey-Lennox line. This separation was followed by a surge of about 900 megawatts from New Jersey to Consolidated Edison across the Fresh Kills-Linden circuit. This caused two lines in series with the Fresh Kills-Linden circuit to open at Greenwood approximately 7 seconds after the initial event. The opening of these circuits separated eastern New York and New England from PJM.

Within 12 min. power generation in lower Ontario, N.Y., and New England (except for Maine and eastern New Hampshire) virtually ceased.

Volume I of the FPC report states that "the causes which can trigger severe disturbances are practically unlimited. Many of them are derivatives of severe storms, seemingly unaccountable equipment failures, or even the fallibility of well trained system operators and maintenance men." The initial disturbances themselves are often quite minor and are sometimes difficult to trace, but the initiating event in the Great Northeast blackout holds no mystery. Quoting from *IEEE Spectrum* (February 1966):

At 5:16:11 p.m., a backup relay, protecting line Q29BD, operated normally and caused the circuit breaker at Beck to trip the unfaulted line. The power flow on the disconnected line shifted to the remaining four lines, each of which then became loaded beyond the critical level at which its backup protective relay was set to function. Thus the four remaining lines tripped out in cascade in 161 cycles' time (2.7 seconds).

The relay that triggered the disturbance was one of five backup sensing devices (one backup relay per line) that protect the lines against failure of the Beck primary relays, or of circuit breakers at remote locations. According to the FPC report, the five backup relays were installed in 1951, and, in 1956, a breaker on one of the 230-kv. lines failed to open (reason not explained) following a fault. In January 1963, as a result of a re-evaluation study of its backup protection requirements, Ontario Hydro modified these relay settings to increase the scope of their protective functions.

Figure 6 indicates the set of conditions under which this type of relay would trip. The evidence suggests that, at 5:16:11, the load and generation characteristics of the Canada-United States interchange caused such a condition to be reached.

The FPC report further states that the relay settings made in 1963 at the Beck plant were in effect at the time

of the November 9 power failure. The backup relay on the line Q29BD was set in 1963 to operate at about 375 MW and the 160 Mvar at a bus voltage of 248 kV and, although the load-carrying capacity of each of these lines is considerably higher, it was necessary to set each backup relay to operate at a power level below the line's capacity to provide the desired protection and to achieve coordination with other relays on the system. This setting was believed to be sufficiently high to provide a safe margin above expected power flows.

When the backup relays were modified and the power levels were set in 1963, the load on the northbound lines from Beck No. 2 was appreciably lower than the trip setting of the backup relay. Recently, the megawatt and megavar loadings on the transmission lines from Beck to the north, because of emergency outages in a new Ontario Hydro steam-electric plant, have been very heavy. This temporary situation produced a deficiency in Ontario generation, with the result that a heavier inflow of power from the United States interconnections was necessary.

According to Ontario Hydro spokesmen, the average flow had reached 356 MW (and approximately 160 Mvar) in the line that tripped out first, but momentary fluctuation in the flow is normal. Therefore, at 5:16 p.m., as already mentioned, the power flow apparently reached the level at which the relay was set; it functioned in accordance with its setting, and its circuit breaker tripped out the line. Ontario Hydro also informed the FPC that its operating personnel were not aware that the relay on line Q29BD was set to operate at a load of 375 MW.

6. Conclusions

Of all physical effects claimed to be due to the presence of UFOs, the alleged malfunction of automobile motors is perhaps the most puzzling.

The claim is frequently made, sometimes in reports which are impressive because they involve multiple independent witnesses. Witnesses seem certain that the function of their cars was affected by the unidentified object, which sometimes reportedly was not seen until after the malfunction was noted. No satisfactory explanation for such effects, if indeed they occurred, is apparent.

A search for residual indirect physical evidence failed to yield any recorded or otherwise verified instances which establish a relationship between an UFO and an alteration in electric or local magnetic fields or in radiation intensity. The Northeast electric power failure appears adequately explained without reference to the action of UFOs. No evidence has been presented to this project that supports the claim that any such power failure was UFO related.

In addition to instrument readings, residual effects on materials can also be investigated. Magnetic mapping of affected automobile bodies, if used with proper reservation, is suggested as one useful procedure for obtaining such evidence, since the original magnetic pattern of the body of a given automobile can be determined.

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Chapter 5

Optical and Radar Analyses of Field Cases

Gordon D. Thayer

1. Introduction

In Chapters 4 and 5 of Section VI unusual atmospheric conditions causing anomalous propagation of electromagnetic waves are described. In the present chapter an analysis is made of some of the most puzzling UFO phenomena. Most of them involve combined radar and visual contacts. All 31 combined radar-visual sightings, two visual-only, and two radar-only cases in the project files are analyzed in an effort to determine whether or not anomalous modes of propagation could account for the details of such sights. Since both visual and radar sightings are analyzed below, readers whose familiarity with atmospheric propagation of light and radio waves is limited are urged to read Chapters 4 and 5, Section VI, before reading what follows in the present chapter.

In evaluating UFO phenomena it is seldom possible to arrive at an incontrovertible conclusion; rather, it is necessary to introduce admissible hypotheses and then attempt to determine the probability of their correctness through the study of generally inadequate data. In the case of the anomalous propagation hypothesis, extreme examples of anomalous propagation imply extreme conditions in the state of the atmosphere, and data on these unusual atmospheric conditions are either scarce or non-existent. Meteorological measurements that may be on record for a time and place appropriate to a particular UFO incident will usually be only generally indicative of the propagation conditions that existed during the incident. The meteorological instrumentation necessary to record the extremely sharp gradients of temperature of humidity that are associated with strong partial reflections of electromagnetic waves is either beyond the state of the art or so difficult to

construct and operate that the measurements required have not yet been attempted.

Nevertheless, there is strong inferential evidence that such sharp gradients do exist in the atmosphere (see Section VI, Chapter 4), but experiments capable of detecting such gradients have not been made. The fact that, for example, a temperature change of 10° C over a distance of 1 cm. has not yet been observed in the free atmosphere is not proof that such gradients do not exist.

The following set of hypotheses were considered as possible explanations for each of the UFO phenomena studied:

1. That the phenomenon was caused by a mechanical or other device designed for transportation, surveillance, or other related objectives, and which may or may not have been controlled by extraterrestrial beings.
2. That the phenomenon was caused by a conventional airplane, balloon, blimp, or other man-made device.
3. That it was a natural phenomenon, star, meteor, etc., perhaps seen under unusual circumstances;
4. That it was an unknown natural phenomenon;
5. That it was a product of unusual conditions of radar or optical propagation, possibly involving natural or artificial phenomena observed and/or recorded in unusual aspect.

The purpose of the investigation reported in this chapter was to determine, for the 35 cases included, the extent to which hypothesis No. 5, either alone or in combination with Nos. 2 and 3 could satisfactorily account for the circumstances of the UFO report. In each case the probability that some other hypothesis, such as Nos. 1 or 4, could more satisfactorily account for the sighting had to be evaluated.

There is always the danger in this sort of procedure that the true explanation for a particular event is not contained in a given set of *a priori* hypotheses. One obvious omission from the list above is the hypothesis that a particular UFO report was a hoax. Since

hoaxes are not part of the subject matter of this chapter, all cases have been studied under the assumption that all observers involved were reporting, to the best of their abilities and beliefs, the details of an event which they did not fully understand.

The 35 UFO cases examined in this chapter were classified using the following criteria:

- I. Primarily visual This class includes those cases where the first and most significant contact was visual, or where the visual contact was preponderant and more positive than any radar contacts.
 - A. Star-like Cases where the visual reports were of one or more small, bright objects without pronounced motion, round or without definite shape. Cases where visual description appeared to be similar to a diffracted star-like object were also included.
 - B. Meteor-like Cases where visual reports resembled meteor phenomena: rapidly moving star-like object, or small glowing object, with or without "smoke trails", sparks, fragmentation, etc.
 - C. Blurry light or glow Cases where descriptions were of a blurry or glowing object of undefined or amorphous shape.
 - D. Other Cases not fitting any of the above three criteria. Six cases were in this sub-group, including one dark, opaque, "jelly-fish" shaped object, three balloon-like objects, one aircraft-like object and one well-defined, structured saucer-shaped object.
- II. Primarily radar This class includes those cases where the first and most significant contact was by radar, or where the radar contact was preponderant and more positive than any visual contacts.
 - A. AP-like Cases where the radar scopes showed a confused or random distribution of images, blips that showed erratic or discontinuous motion, or other patterns bearing a general similarity to anomalous propagation (AP) returns.

B. Blip-like. Cases where the radar target (or targets) showed characteristics similar to the return from a solid object (such as an aircraft, etc.), and where the target did not display erratic or discontinuous behavior. Acceleration or velocity in excess of known aircraft capabilities, or periods of immobility, were not considered to be contrary to normal target behavior.

In the following section cases of particular interest are treated in detail; these cases generally fall into one of three categories:

- (a) Cases that are good examples of inconsistencies tending to confuse any conclusions that might be arrived at;
- (b) Cases that are typical of a sub-group of UFO reports that have the same probable explanation;
- (c) Cases that are difficult or seemingly impossible to explain in terms of known phenomena.

2. Presentation of Radio Refractive Index Data

Two methods of presenting vertical profiles of radio refractivity in graphical form are used in this chapter. Both methods are based on the use of the radio refractivity, N , where

$$N = (n - 1) \times 10^6,$$

since the radio refractive index, n , is always very close to unity in the atmosphere. The maximum value of N that is likely to be encountered in the atmosphere is not much over 400; values close to 500 may occasionally be experienced over the surface of the Dead Sea, 1200 ft. below sea level, in the summer months.

A feature of all vertical profiles of N is a general decrease with height; the departures of any given profile from the average decrease with height are the significant features for anomalous propagation of radio waves. Therefore the refractive index profiles illustrated for many of the UFO cases in the following section are given in terms of A-units (Bean, 1966a) where

$$A(z) = N(z) + 313 [1 - \exp\{-0.14386z\}];$$

here $N(z)$ is the actual refractivity profile, a function of height, z , in kilometers, and the last term represents the average decrease with height of an average radio refractivity profile

$$N(z) = 313 \exp\{-0.14386z\}.$$

The number 313 is an average surface refractivity value. An N-profile that is not abnormal will, when plotted on a graph with $A(z)$ as abscissa and z as ordinate, appear as a fairly straight vertical line, perhaps with a slight tilt in one direction or the other. On the other hand, an N-profile with strongly super-refractive or subrefractive display a marked zigzag character on an $A(z)$ vs. z plot. The use of A-units allows a more generous scale size for the abscissa than would be the case for N-unit plots.

Ray tracings, calculated and plotted by a digital computer, are illustrated for a few of the refractivity profiles. The computer also calculates the M-profile, and plots it on the same graph as the ray tracing. M-units are defined by

$$M(z) = N(z) + \frac{z}{a},$$

where "a" is the radius of the earth. This is equivalent to adding 156.9 N-units per km. to the observed profile. Since the ducting gradient (see Chapter VI -- 4) is $-156.9 \text{ N. km}^{-1}$, any layer with such a gradient will be represented on an $M(z)$ plot as a vertical line. Layers with $dN/dz > -156.9 \text{ km}^{-1}$ (not ducting) will show a trace slanting up to the right, whereas strong ducts with $dN/dz < -156.9 \text{ km}^{-1}$ will show a trace slanting up to the left. Hence the M-unit plot is very convenient for exposing the existence or non-existence of radio ducts in $N(z)$ data.

3. Analysis of Selected UFO Incidents by Classes.

In the discussions that follow the UFO incidents are referred to by the case numbers assigned to them in the UFO project files. The

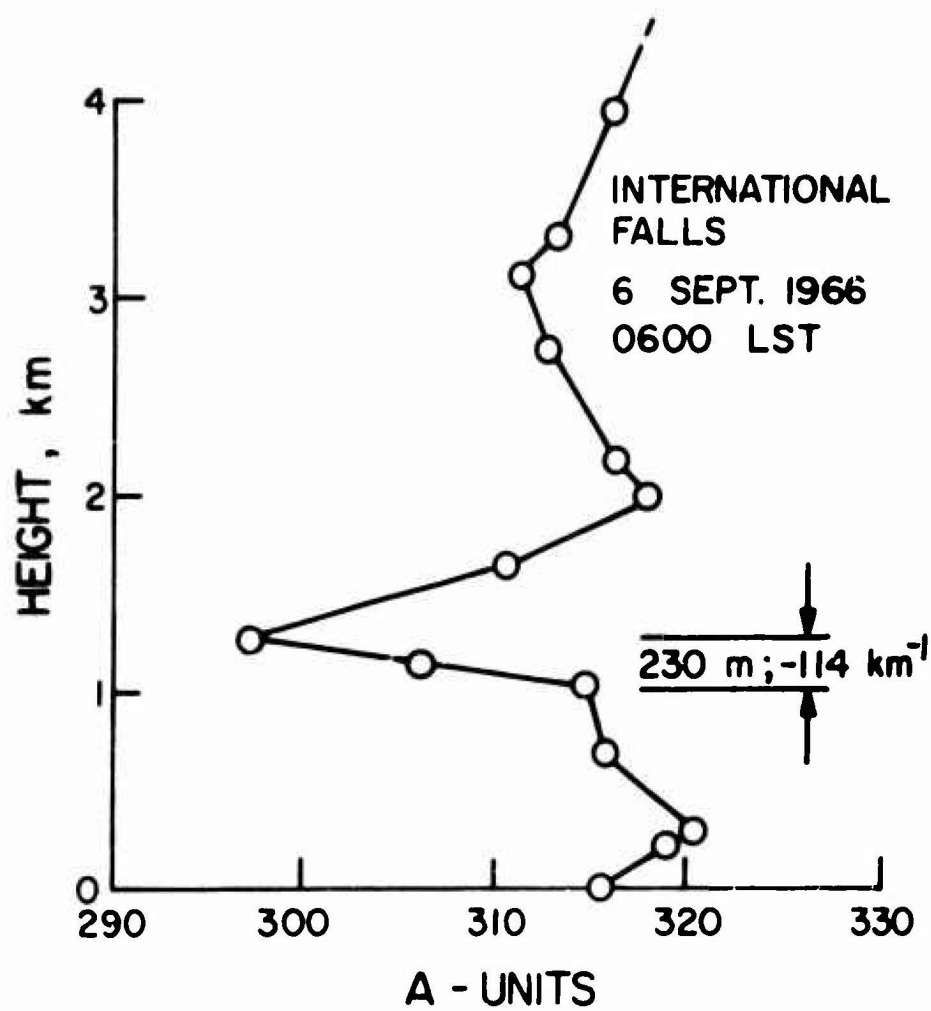
letter refers to the origin of the case: B-number cases are from USAF Project Blue Book files, N-numbers are for cases supplied by NICAP (National Investigations Committee for Aerial Phenomena), C-numbers refer to cases that were investigated by personnel of the Colorado project, and X-numbers were given to cases that were received after the cut-off date for inclusion in the regular files (i.e., after the computer analysis of all project file cases had already been completed). X-number cases are also identified by their B-, N-, or C- number.

Class I-A: Primarily visual, star-like cases.

1321-B. This is a good example of a misidentified star combined with an apparently uncorrelated radar return causing an UFO report to be generated. The incident took place at Finland Air Force Base (60 mi. NE of Duluth), Minn., with a civilian sighting near Grand Marais, Minn., (50 mi. NE of Finland AFB) on the night of 5-6 September 1966, between 2130 and 0015 LST (0330-0615 GMT). The weather was clear, ceiling unlimited, visibility more than 15 mi.; a display of Aurora Borealis was in progress. Applicable radio refractivity profile is shown in Fig. 1. Visual reports of a "white-red-green" object "moving but not leaving its general location" were received at Finland AFB about 2130 LST. An FPS-90 search radar was activated but there was "too much clutter to see anything in that area . . ." At 2200 LST a return was detected; it "flitted around in range from 13 to 54 mi., but always stayed on the 270° azimuth." A pair of F-89s was scrambled from Duluth AFB and searched the area at altitudes of 8,000 - 10,000 ft. The two aircraft "merged with blip, apparently wrong altitude, no airborne sighting"; the radar operators insisted the target was at 8,000 - 10,000 ft., the same altitude at which the scrambled aircraft were flying. The pilots reported that they "only observed what was interpreted to be a beacon reflection."

Available meteorological data show that the winds were southwesterly, 7 knots at the surface, and northerly (320° to 30°) at

Figure 1



25 to 65 knots aloft. The closest available radiosonde data (International Falls 1200 GMT 0600 LST) 6 September, show a temperature inversion and strong humidity lapse through a layer extending from 1029 - 1259 m. above the surface. The gradient of radio refractivity through this layer averaged -114N/km (corrected for radiosonde sensor lag). This layer would be expected to show a significant partial reflection at radio frequencies. If the layer were present over Finland AFB at the same elevation, it could have produced false targets by partial reflection of real ground targets, which would have appeared to be at altitudes of from 8,300 - 9,800 feet because of the geometry of such reflected targets (see Section VI, Chapter 5). This agrees well with the reported "UFO" altitudes of 8,000 - 10,000 ft.

Anomalous propagation echoes are not usually confined to a single direction. There are three possible explanations in this case and in other similar cases: a single real object was being tracked; the radar operators were not looking for targets on other azimuths; the partially reflecting layer may have been anisotropic (i.e. displaying a preferred direction for strongest reflection). There is no direct physical evidence for the existence of such anisotropic layers, but no studies have been made to determine whether or not they might exist. Apparent anisotropy in radar AP returns has often been observed, although not usually over such a narrow azimuth range as was apparently the case at Finland AFB.

Regarding the visual reports submitted, the comment of the investigating officer at Finland AFB is of particular interest:

The next evening, at 2200 hours, the "white-red-green" object reappeared in the sky at exactly the same position it had appeared on 5 September. This officer observed it and determined it to be a star which was near the horizon

and would settle beneath the horizon after midnight. It did appear to "sparkle" in red-green-white colors, but so do other stars which can be pointed out from this mountain top.

The officer refers to Rangoon Mountain, elevation 1,927 ft., from which many of the visual observations were made.

The star that the officer saw was in all probability λ Scorpio (Shaula) a magnitude 1.7 star at -37° declination and 17 hr. 31 min. right ascension. It would have set at just about 1:30 a.m. 90th meridian time, if the horizon were unobstructed. An obstruction of only 4° would cause λ Scorpio to "set" at 1:15 a.m. CST; a 4° angle is equivalent to a 35 ft. tree or building at a distance of 500 ft. The southerly declination would indicate that the star was in the southwest, which is compatible with the visual reports that were submitted.

Additional meteorological effects may have been present in this case. In particular, the southwesterly surface winds present are quite likely to have advected relatively cool, moist air from nearby Lake Superior under the elevated warm, dry layer noted previously, thus tending to increase the strength of the inversion and associated humidity lapse. Some of the optical effects noticed by the observers in this instance, strong red-green scintillation, apparent stretching of the image into a somewhat oval shape, and the red fringe on the bottom, may have been due to strong and irregular local refraction effects in the inversion layer (or layers).

This UFO report seems to have resulted from a combination of an unusually scintillating star and false radar targets caused by AP from a strong elevated layer in the atmosphere. This pattern is found in a number of other cases.

Reports with elements similar to the preceding case are:

113-B* Nemuro AF Detachment, Hokkaido, Japan, 7 February 1953, 2230 LST (1230 GMT). Weather was clear. Visual description fits a scintillating star (flashing red and green, later white with intermittent

*Case numbers referred to thusly are so listed in the project's files.

red and green flashes, then later steady white) rising in the east (only motion was slow gain in altitude, "[I believe] that the object did not move with respect to the stars in its vicinity"). CPS-5 radar painted a single pip at 85° azimuth, range 165 mi., which operator regarded as interference. Visual object was horesighted with radar antenna and azimuth read as 91° ± 2°. Elevation estimated as 15° initially (2230 LST). No stars brighter than magnitude 3 were in this azimuth between 0° and 30° elevation angle at that time. Blue Book file suggests Deneb or Regulus as likely objects, but their positions are far away from the sighted object. In view of two observers' comments that light "shown from beneath" object, it is very probable that they saw a lighted Pibal balloon, possibly launched from the Russian-held Kurile Islands to the east and northeast of Hokkaido (launch time 1200 GMT). The investigating officer noted the exceptionally good visibility prevalent in the area on clear nights.

1306-B. Edwards AFB, Kernville, Calif., 30 July 1967, 2217-2400 LST. Weather: clear, calm, warm (83°F). Two civilians reported observing one or two blue, star-like objects that appeared to circle, bob, and zigzag about a seemingly fixed star; these objects "instantly disappeared" about 1 hr. 45 min. after sighting. Edwards AFB RAPCON radar picked up "something" at about 2230 LST "for several sweeps." Plip seemed to be moving south at about 50-60 mph. There is no apparent connection between the radar and visual reports. The visual UFO did not appear to move at 50-60 mph. Data, including weather data, on this report are insufficient to form an opinion. The most likely possibility seems to be that the visual UFO consisted of the direct image plus one or two reflected images of the "fixed star" that the observer reported. What may have produced the reflected images remains conjectural. For example, a turbulent layer of air with strong temperature contrasts could produce images similar to those described by the witnesses. The instantaneous disappearance of the UFOs is consistent with an optical phenomenon.

As for the radar "track", a blip appearing for only "a few sweeps" could be almost anything: noise, AP, or possibly a real target flying near the lower limits of the radar beam.

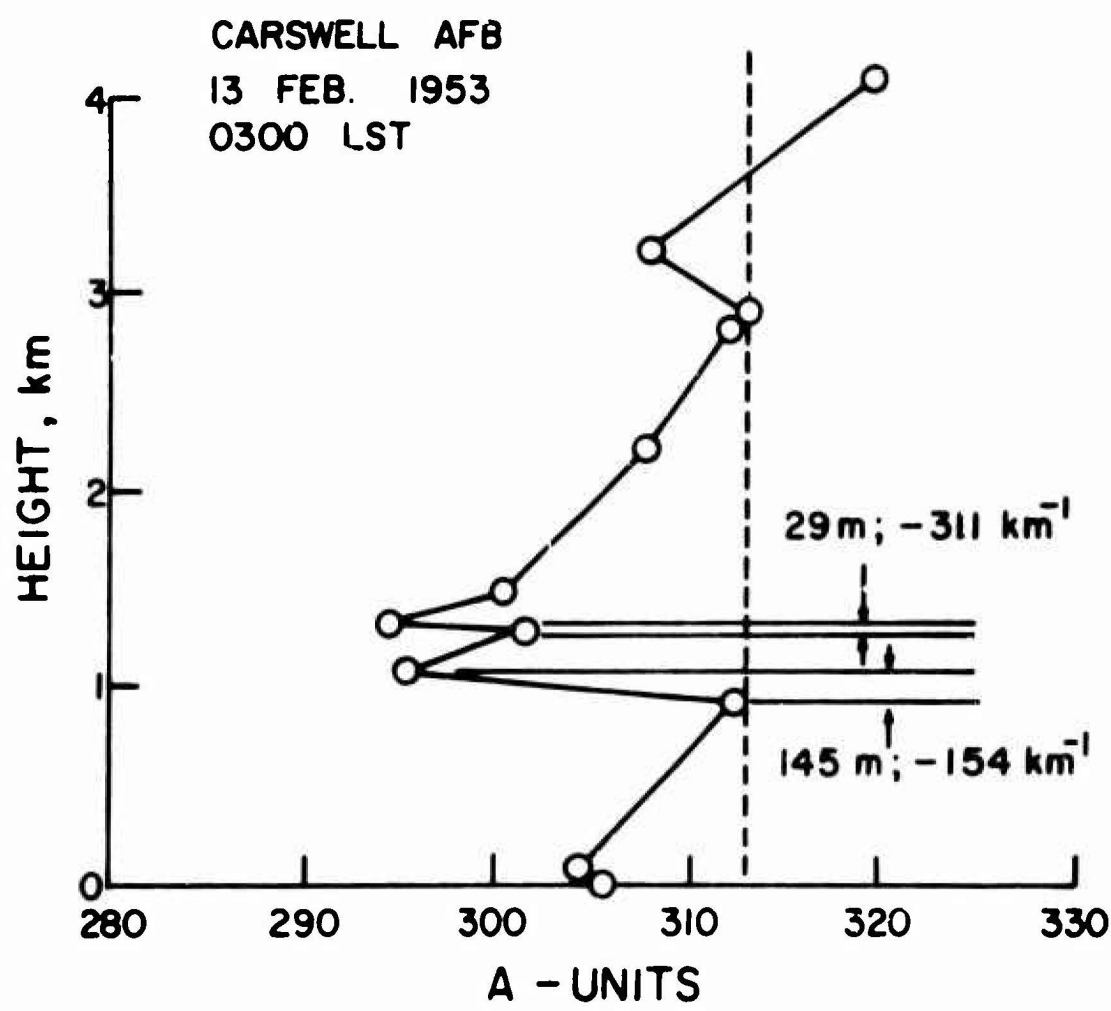
1212-B. Tillamook, Ore., 13-14 March 1967, 2230-0008 LST. Weather: clear with "stars plainly visible," some ground fog, thin broken cirriform clouds estimated at 10,000 ft., visibility 15 mi. This is a good example of some of the confusion that arises in reporting UFO incidents. Initial visual observer reports indicated object at about 45° to 50° elevation angle, yet when the Mt. Hebo radar station "contacted target" it was at 39 mi. range, 9,200 ft. height. This is an elevation angle of only about 2°. This inconsistency seems to have gone unnoticed in the Project Blue Book file on the case. The radar target, as plotted, stayed at 39 mi. range and slowly increased height to 11,200 ft., then shifted almost instantaneously to 48 mi. range. Subsequently the radar target slowly gained altitude and range, disappearing at 55 mi. and 14,000 ft. (still at about a 2° elevation angle). The azimuth varied between 332° and 341° during this time. Average apparent speed of the radar track was low: the first part of the track was at zero ground speed and a climb rate of about 100 ft/min, the second part of the track was at an average ground speed of about 16 mph. and a climb rate of about 100 ft/min. In between there is a jump of 9 mi. range in one minute, a speed of 540 mph. The characteristics of this radar track are suggestive of radar false targets or slow-moving AP echoes. The jump may be a point where one echo was lost, and another, different echo began coming in. This effect is apparently a frequent cause of very high reported speeds of UFOs (Borden, 1953). The visual reports are suggestive of either a scintillating star if the reported angle is higher than actual, or an aircraft. There was an electronic warfare aircraft "orbiting" at high altitude seaward of Tillamook at the time of the sighting, and

it seems quite plausible that this was the visual UFO. However, this was discounted in the Blue Book report because the aircraft's position did not check with the radar contact.

115-B. Carswell AFB (Fort Worth area), Tex., 13 February 1953, 0235 LST. Weather: clear with visibility unlimited; temperature inversion layer with sharp humidity lapse at 3,070 ft. altitude, elevated radio duct at 4,240 ft. altitude. Applicable refractivity profile for 0300 LST shown in Fig. 2. Visual observers saw a "formation" of three bright lights which performed a series of maneuvers suggestive of an aircraft with landing lights doing several rolls and then climbing rapidly and heading away. Operators then attempted to pick up the object on an APG 41 radar, and after about two minutes they brought in two apparently stationary targets on the correct azimuth. It seems likely that these returns were from ground objects seen via partial reflection from the strong elevated layers (gradients -154 and -311 km^{-1}). The visual sighting was probably an aircraft.

237-B. Haneda AFB (Tokyo), Japan, 5-6 August 1952, 2330-0030 LST. Weather: "exceptionally good," 0.3 cloud cover about 10 mi. north and 10 mi. south of the contact area, "excellent visibility," isolated patches or low clouds, Mt. Fuji (60 n. mi.) "clearly discernible," scattered thunderstorms in mountains northwest, temperature at Haneda 78°F , dew point 73°F . Observers saw a bright, round light (about 1 mrad arc) surrounded by an apparently dark field four times larger, the lower circumference of which tended to show some bright beading. It was low in the sky at about 30° - 50° azimuth. Object appeared to fade twice, during which time it appeared as a dim point source. It disappeared, possibly becoming obscured by clouds, after about an hour. The sky at Haneda AFB was overcast by 0100 LST. One of the visual observers noted that near the end of the sighting the object seemed somewhat higher in the sky and that the moon seemed proportionately higher in elevation. The pilot of a C-54 aircraft coming in for a

Figure 2



landing was directed to observe the object and he replied that it looked like a brilliant star, and he dismissed the sighting as such.

When the controller at Shiroy AFB was asked to look for target on GCI radar, he could find nothing for 15 min. He stated: "There were three or four blips on low beam but none I could definitely get a movement on or none I could get a reading on the RHI (range-height indicator) scope." A new controller taking over at 2345 LST "believed" he made radar contact with the object and an F-94 was scrambled. This officer stated: "The target was in a right orbit moving at varying speeds. It was impossible to estimate speed due to the short distances and times involved." By the time the F-94 arrived in the area of the "bogie," Shiroy GCI had lost radar contact; regaining contact at 0017 LST "on a starboard orbit in the same area as before." The F-94 was vectored in to the target, and at this point the timing becomes confused. The Shiroy controller states that the F-94 "reported contact at 0025 (LST) and reported losing contact at 0028 (LST)." The F-94 radar operator states: "At 0016 (LST) I picked up a radar contact at 10° port, 10° below, at 6,000 yd. The target was rapidly moving from port to starboard and a lock-on could not be accomplished. A turn to the starboard was instigated [sic] to intercept target which disappeared on scope in approximately 90 sec. No visual contact was made with the unidentified target." Shiroy GCI had lost the F-94 in ground clutter, and had also lost the target. It is not clear whether the GCI radar ever tracked the fast-moving target described by the F-94 crew. The maximum range of the F-94's radar is not given in the Blue Book report.

The F-94 pilot stated that the weather was very good with "exceptional visibility of 60-70 miles," yet this fast-moving UFO, obviously far exceeding the F-94's airspeed (about 375 knots), was seen by neither the aircraft crew nor the observers on the ground at Shiroy GCI even though the UFO track crossed over very close to Shiroy GCI number four. There are many other inconsistencies in the

report of the incident besides the timing and the lack of visual contact by the F-94 crew. The bright, quasi-stationary object sighted NE of Haneda AFB, and seen also from Tachikawa AFB (about 30 mi. west of Haneda AFB), should have been visible to the south of Shiroy AFB, but was never seen by any of a large number of persons there who attempted such observations. Also, at 0012 LST the object being tracked by GCI's CPS-1 radar reportedly "broke into three smaller contacts maintaining an interval of about $\frac{1}{4}$ mile." The blips on the CPS-1 were described as small and relatively weak, but sharply defined.

Two things seem apparent: (1) the object seen at Haneda and Tachikawa AFB was much farther away than the observers realized; (2) the visual UFO and the target tracked by radar were not the same. The first statement is supported by the inability of the observers at Shiroy to see anything to the south; the second statement is supported by numerous inconsistencies between the visual and radar sightings. The two most important of these latter are: (1) During times when the GCI radar could not find the target, the visual object was in about the same location as during those times when it could be found on radar; (2) The visual object was seen for at least five min. after the time when the airborne radar on the F-94 indicated that the UFO had left the area at a speed well in excess of 300 mph.

The most likely light source to have produced the visual object is the star Capella (magnitude 0.2), which was 8° above horizon at 37° azimuth at 2400 LST. The precise nature of the optical propagation mechanism that would have produced such a strangely diffracted image as reported by the Haneda AFB observers must remain conjectural. Complete weather data are not available for this case, but it is known that the light SSE circulation of moist air from Tokyo Bay was overlain by a drier SW flow aloft. A sharp temperature inversion may have existed at the top of this moist layer, below which patches of fog or

mist could collect. The observed diffraction pattern could have been produced by either (1) interference effects associated with propagation within and near the top of an inversion, or (2) a corona with a dark aureole produced by a mist of droplets of water of about 0.2 mm. diameter spaced at regular intervals as described by Minnaert (1954). In either event, the phenomenon must be quite rare. The brightness of the image may have been due in part to "Raman brightening" of an image seen through an inversion layer.

Nor can exact nature of the radar propagation effects be evaluated, due to the lack of complete weather data. However, a substantial inference that the radar returns were of an anomalous propagation nature is derived from:

- (1) the tendency for targets to disappear and reappear;
- (2) the tendency for the target to break up into smaller targets;
- (3) the apparent lack of correlation between the targets seen on the GCI and airborne radars;
- (4) the radar invisibility of the target when visibility was "exceptionally good."

Singly, each of the above could be interpreted in a different light, but taken together they are quite suggestive of an anomalous propagation cause.

In summary, it appears that the most probable causes of this UFO report are an optical effect on a bright light source that produced the visual sighting and unusual radar propagation effects that produced the apparent UFO tracks on radar.

104-B. Goose AFB, Labrador, 15 December 1952, 1915-1940 Local Mean Solar Time. Weather: clear and visibility unlimited (30 mi.). The crews of an F-94B fighter and a T-33 jet trainer saw a bright red and white object at 270° azimuth while flying at 14,000 ft. The aircraft attempted an intercept at 375 knots indicated air speed, but

could not close on the UFO. After 25 min. of reported chase, although the aircraft had covered a distance of only about 20 mi. (about 3.5 min. at 350 knots ground speed) the object faded and disappeared. During the chase, the radar operator in the F-94B had a momentary lock-on to an unknown target at about the correct azimuth for the UFO. Since this was so brief, it was felt (by Air Intelligence, presumably) that the set had malfunctioned. No GCI contact was made.

The official Air Force explanation for this UFO incident is that the aircraft were chasing Venus which was setting about the time of the sighting, and that the radar "target" was simply a malfunction. It seems likely that this explanation is essentially correct. However, it is unlikely that experienced pilots would have chased a normal-appearing setting Venus. It is more probable that the image of Venus was distorted by some optical effect, possibly a slight superior mirage, and that loss of the mirage-effect (or the interposing of a cloud layer) caused the image to fade away. All items of the account may be explained by this hypothesis, including the report that the object had "no definite size or shape," as the image would no doubt be somewhat "smeared" by imperfections in the mirage-producing surface. The small-angle requirement of a mirage is satisfied since the pilots reported the object seemed to stay at the same level as the aircraft, regardless of altitude changes that they made (another indication of great distance).

14-N. This file actually consists of two similar cases reported by a Capital Airlines pilot with 17 years and 3,000,000 mi. logged. The first case occurred over central Alabama the night of 14 November 1956; the second case was on the night of 30 August 1957, over Chesapeake Bay near Norfolk, Va.

The first sighting took place about 60 mi. NNE of Mobile, Ala. while on a flight from New York to Mobile in a Viscount at "high altitude," probably about 25,000 ft. It was a moonless, starry night

and there was an occasionally broken undercast. The object seen was described as an intense blue-white light about 1/10 the size of the moon ($\sim 3'$ arc) and about "seven or eight times as bright as Venus at its brightest magnitude." It first appeared 2210 LST at the upper left of the Viscount's windshield falling towards the right and decelerating rapidly as a normal meteor would. Pilot and co-pilot both took it to be an unusually brilliant meteor. However, this "meteor" did not burn out as expected, but "abruptly halted directly in front of us and began to hover motionless." The aircraft at this time was over Jackson, Ala. and had descended to 10,000 ft. The pilot contacted Bates Field control tower in Mobile and asked if they could see the object which he described to them as "a brilliant white light bulb." They could not see it. The pilot then asked Bates to contact nearby Brookley AFB to see if they could plot the object on radar. He never learned what the result of this request had been. The object began maneuvering "darting hither and yon, rising and falling in undulating flight, making sharper turns than any known aircraft, sometimes changing direction 90° in an instant -- the color remained constant, -- and the object did not grow or lessen in size." After a "half minute or so" of this maneuvering, the object suddenly became motionless again. Again, the object "began another series of crazy gyrations, lazy eights, square chandelles, all the while weaving through the air with a sort of rhythmic, undulating cadence." Following this last exhibition, the object "shot out over the Gulf of Mexico, rising at the most breath-taking angle and at such a fantastic speed that it diminished rapidly to a pinpoint and was swallowed up in the night."

The whole incident took about two minutes. The pilot remembers noting that the time was 2212 EST. The object appeared to be at the same distance from the aircraft, which was flying a little faster than 300 mph. during the entire episode.

The second incident reported by this pilot, the 30 August 1957, Chesapeake Bay report, occurred as he was flying another Capital Airlines Viscount at 12,000 ft. approaching Norfolk, Va. There was a Northeast Airlines DC-6 flying at 20,000 ft. "directly above" the Viscount. In this case, the object "was brilliant; it flew fast and then abruptly halted 20 mi. in front of us at 60,000 ft. altitude." The Northeast pilot looked for the object on radar and "could get no return on his screen with the antenna straight ahead but when tilted upward 15° he got an excellent blip right where I told him to look for the object."

This object "dissolved right in front of my eyes, and the crew above lost it from the scope at the same time. They said it just faded away. This sighting covered "several minutes."

These two similar sightings are very difficult to account for. The first sighting over Alabama has most of the characteristics of an optical mirage: an object at about the same altitude seeming to "pace" the aircraft, the meanderings being easily accountable for as normal "image wander." However, there are two aspects that negate this hypothesis: (1) the manner of appearance and disappearance of the UFO is inconsistent with the geometry of a mirage; the high angle of appearance at the top of the windshield is particularly damaging in this regard; (2) there was no known natural or astronomical object in the proper direction to have caused such a mirage. Venus, the only astronomical object of sufficient brightness, was west of the sun that date; Saturn had set 4 hr. 30 min. earlier, and there was not even a first magnitude star near 190°-210° azimuth, 0° elevation angle.

The second sighting is equally difficult to explain as a mirage, which seems to be the only admissible natural explanation in view of the pilot's experience as an observer. The reasons are twofold:

(1) the apparent angle at which the object was observed is incompatible

with a mirage; (2) there was apparently a radar return obtained from the object which is incompatible with the hypothesis that it was an astronomical object, the most likely mirage-producer.

The pilot stated that the Northeast DC-6 flying at 20,000 ft. "painted" the UFO at 15° elevation and a range of 20 mi. This would place the UFO at about 48,500 ft., the pilots estimate of 60,000 ft. apparently being in error. Presumably then, the elevation angle as viewed from the Capital Viscount was about 19°. It is very unlikely that any temperature inversion sufficient to produce a mirage would be tilted at such an angle. For a near-horizontal layer to have produced such an image (plus the radar return) by partial reflection of a ground-based object seems equally unlikely. The largest optical partial reflection that such a layer might produce at an angle of 19° would be about 10^{-14} as bright as the object reflected (see Section VI, Chapter 4). This is a decrease of 35 magnitudes. Such a dim object would be ordinarily invisible to the unaided eye.

In summary, these two cases must be considered as unknowns.

1065-B. Charleston, S. C., 16 January 1967, 1810 LST. The observational data in this case are insufficient to determine a probable cause for the sighting. A civilian "walked out of his house and saw" two round objects. He estimated that they were about 30° above the horizon. They appeared to be "silver and blue, with a red ring." These objects were alternately side by side and one above the other, and a beam of light issued "from the tail end." The observer does not state how he knew which was the "tail end," or even at what azimuth he saw the objects. They "vanished in place," still at 30° elevation.

After the Charleston AFB was notified of the sighting, some unidentified returns were picked up on an MPS-14 search radar. An investigating officer later determined that these returns were spurious. The case file states :

[The officer] called [8 March 1967] to provide additional information in regard to the radar sighting. [The officer] was informed by the Charleston AFB that the radar paints were not of UFOs. A check of the equipment was made and it was learned that the individual monitoring the radar set had the "gain" [control] on the height finder turned up to the "high" position. This caused the appearance of a lot of interference on the radar scope. Personnel at Charleston AFB determined the paints on the radar to be this interference. The personnel turned the gain on high again and picked up more "UFOs". When the gain was turned down the UFOs disappeared.

There apparently were no radar UFOs in this case. The residue is a visual sighting by a single observer with insufficient data for evaluation. What the observer saw could conceivably have been (a) a mirage with direct and reflected images of a planet (Jupiter was at 58° azimuth, 5° elevation) or a bright star, (b) an aircraft, or (c) a genuine unknown (i.e., a possible ETI object). There is no real evidence either for or against any of these possibilities.

I-B: Primarily visual, meteor-like cases.

1323-B. Sault Saint Marie AFB, Mich., 18 September 1966, 0100 LST. Weather: clear, calm. There is a very brief Blue Book file on this incident. Two sergeants of the 753rd Radar Squadron saw a bright light, elliptical in shape and apparently multicolored of unsaturated hues, which appeared low over the treetops to the SE and moved in a straight line toward the west, disappearing "instantaneously" in the WSW. Duration of this sighting was 2-5 sec. The report states that the object was also tracked by a long-range AN/FPS-90 heightfinder with azimuth, range, and altitude "available on request." Since this

information is not included in the folder, no firm conclusion may be reached as to the probable cause of the radar sighting or even as to whether or not the radar and visual objects were correlated.

The general visual appearance, brightness range, motion and mode of disappearance are all compatible with the hypothesis that the object was a large meteor. Some large meteors display even more unusual appearance than this report. If it was a meteor, the radar may have actually tracked it; radar tracks of large meteors are not unknown. Of course, the radar track may have been spurious, or may have indicated that the object was unnatural. The tracking data would be required to settle the point.

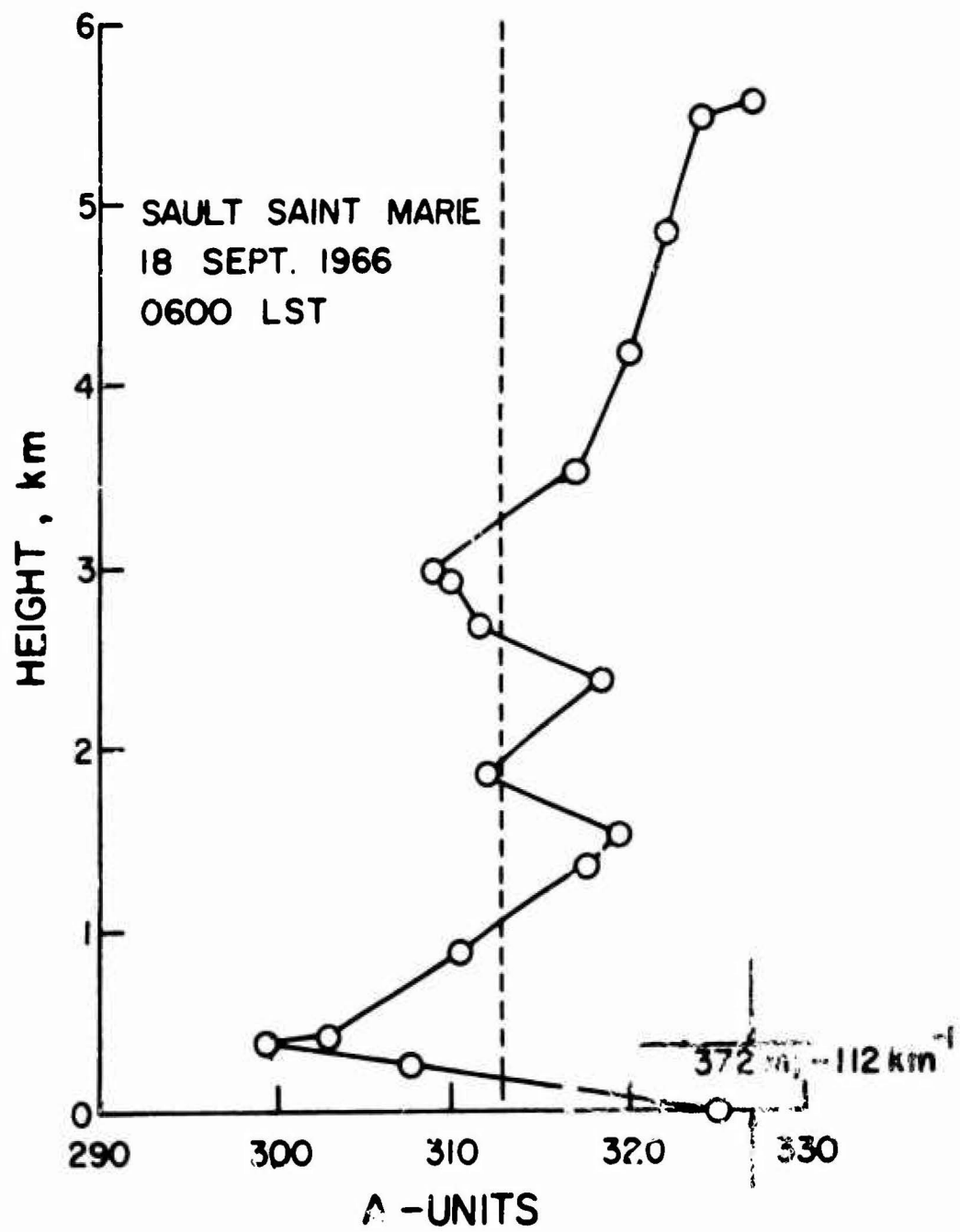
The radio refractivity profile for 0600 LST, shown in Fig.3 indicates that an intense super-refractive layer existed within the first 372 m. (1220 ft.) above the surface. This profile is conducive to the formation of AP echoes on ground-based radar, so there is some possibility that the observed radar data in this UFO incident may have been spurious. This case would seem to merit further investigation.

1206-N. Edmonton, Alberta, 6 April 1967, 2125-2200 LST.

Weather: "very clear," cool, temperature about 35°F, little or no wind at surface, stars "bright," no moon. Observers state that a bright object appeared in the NNW low on the horizon, moving fast, appeared to hover, and then disappeared. The night before, a whitish object like a normal star "only much larger" had appeared in the same place (NNW). A Pacific Western Airlines pilot independently reported "chasing" a UFO whose position was relayed to him by GCA radar from Edmonton International Airport. This UFO appeared to move somewhat erratically, was seen only briefly by the pilot as a "reddish-orange lighted effect," and did not travel the same course as the visual object described above.

The general atmospheric conditions prevailing during this sighting were conducive to AP. The description of the GCA radar track is suggestive of AP (quasi-stationary target appearing to "jump" in position), and the description of the UFO of 5 April is suggestive of the diffracted image of a star seen through a sharp temperature

Figure 3



inversion. In the absence of detailed meteorological data, the most probable conclusion seems to be that the primary sighting was a meteor and that no genuine UFO case exists here. However, this case also might merit a more intensive investigation.

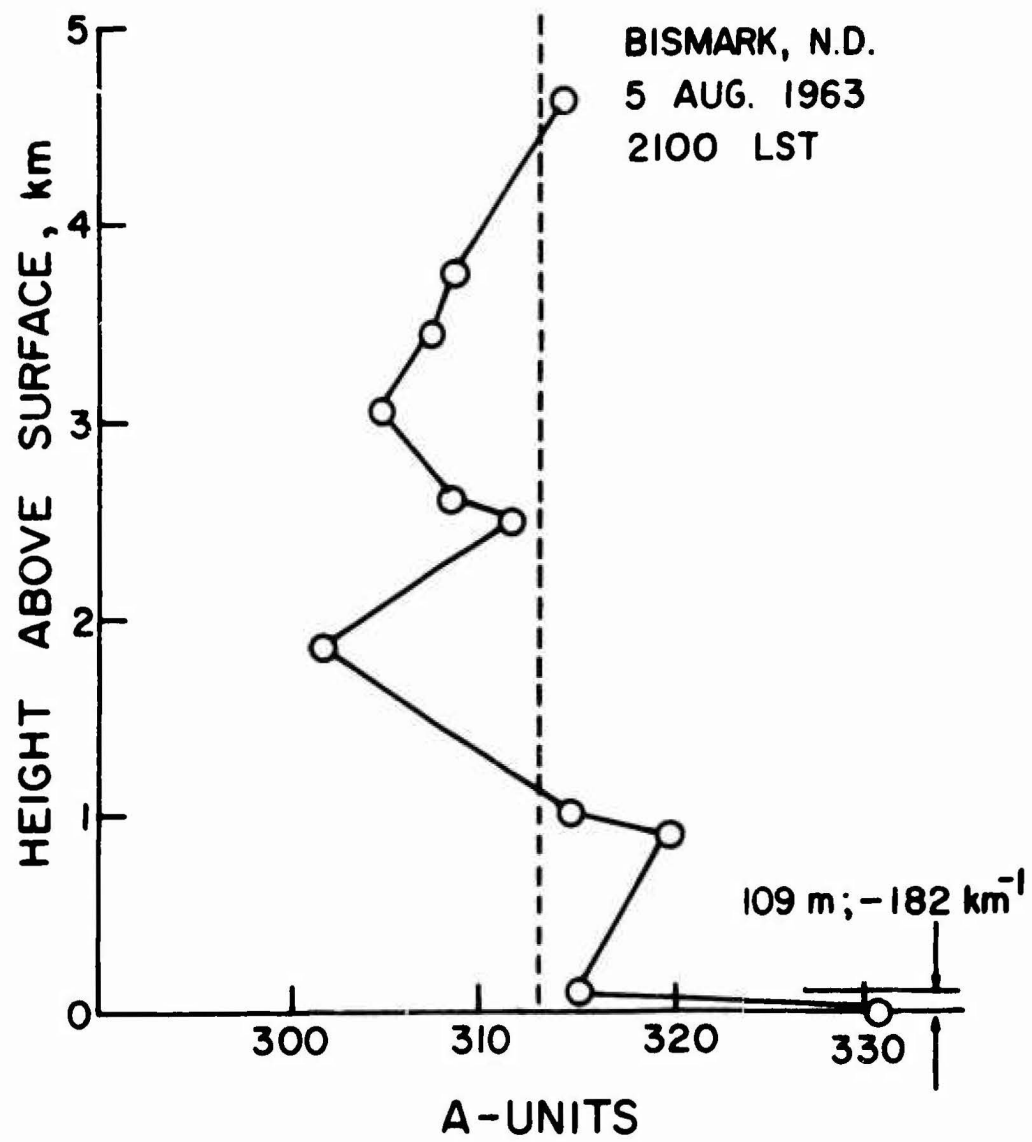
1207-B. Paris, Tex., 7 March 1967, 1645 LST. Weather: clear, visibility 15 mi. This is an unconfirmed report by a single observer who could not even be reached for verification of the report by members of this project staff. He claimed to have seen two lights that "made a 90° turn at high speed, appeared to separate and come back together again and then went straight up. Speed varied from fast to slow to fast, in excess of known aircraft speed." The last statement is the witness's interpretation. He stated that radar at Paris AFB had tracked this UFO, but all military radar installations in the area disclaim any UFO tracks that night. It seems probable that the visual sighting was either an aircraft, whose sound was not heard by the witness for some reason, or a pair of meteors on close, nearly parallel paths. The quick dimming of a meteor burning out may be interpreted as a 90° turn with sudden acceleration away from the observer of a nearly-constant light source, which then seems to disappear in the distance.

I-C: Primarily visual, blurry light or glow.

15-B. Blackhawk and Rapid City, S. Dak., and Bismarck, N. Dak., 5-6 August 1953, 2005-0250 LST. Weather: clear, excellent visibility, stable conditions, temperature inversions and radio surface ducts prevalent. See Fig. 4. The night was dark and moonless.

The initial incident in this chain of UFO sightings was the sighting by a GOC (Ground Observers Corps) observer of a stationary "red glowing light" at 2005 LST near Blackhawk, S. Dak. This light soon began to move some 30° to the right, "shot straight up," and moved to the left, returning to its original position. A companion thought it was "just the red tower light" (a warning light on an FM

Figure 4



transmitter tower normally just visible from their location). The report was relayed to the Rapid City Filter Center, and three air-men from the radar site were sent outside to look for the UFO. They saw what was undoubtedly a meteor, judging from their description. The radar operator when informed of the new sighting began to search for unidentified targets. He found many.

Over the course of the next four hours a large number of unidentified blips appeared on the Rapid City radar. Many of those were transitory, moving blips with a fairly short lifetime, usually being "lost in the ground clutter." An F-84 fighter was vectored in to a stationary blip near Blackhawk, and the pilot "chased" a UFO which he found at the location on a heading of 320° M. without gaining on it. The F-84 was probably chasing a star, in this case Pollux (mag. 1.2) which was in the correct location (335° true azimuth, near the horizon).

When the Blackhawk GOC post called in that the original object had returned for a third time, another F-84 was vectored in on the visual report, as no radar contact could be made. The pilot made a "visual contact" and headed out on a 360° magnetic ($\sim 15^{\circ}$ true) vector. At this point the radar picked up what apparently was ghost echo, that is, one that "paced" the aircraft, always on the far side from the radar. The fighter in this instance was probably chasing another star, the image of which may have been somewhat distorted. The pilot's report that the visual UFO was "pacing" him appears to have strengthened the radar operator's belief that he was actually tracking the UFO, and not a ghost echo. The star in this instance may well have been Mirfak (mag. 1.9), which, at 2040 LST, was at azimuth 15° and about 5° to 7° elevation angle. The second pilot, upon being interviewed by Dr. Hynek, stated that he felt he had been chasing a star, although there were some aspects of the

appearance of the object that disturbed him. He also stated that the radar gunlock, which he had reported by radio during the chase, was due to equipment malfunction, and that the radar gunsight continued to malfunction on his way back to the base. This equipment was never subsequently checked for malfunctioning (i.e., not before or during the official AF investigation of the incident).

The Bismarck, N. Dak. sightings began when the Bismarck Filter Center was alerted to the "presence of UFO's" by Rapid City. At 2342 LST the sergeant on duty there and several volunteer observers went out on the roof and shortly spotted four objects. The descriptions of these objects by the various observers were consistent with the hypothesis that they were stars, although some apparent discrepancies caused early AF investigators to deduce by crude triangulations that the sighted objects must have been nearby. It now appears that all four objects were stars viewed through a temperature inversion layer. The observers stated that the objects resembled stars, but that their apparent motion and color changes seemed to rule out this possibility.

Dr. Hynek's summary of the probable nature of the four Bismarck objects is enlightening:

Object #1, which was low on the horizon in the west and disappeared between midnight and 0100 hr. was the star Arcturus observed through a surface inversion. Arcturus was low on the horizon in the west and set at approximately 1220 (LST) at 289° azimuth.

Object #2 -- was the star Capella observed through a surface inversion. At 0011 CST Capella was at 40° azimuth and 15° elevation [and] at 0200 CST [it] was at 53° azimuth and 30° elevation, which agrees with the positions given by [the two witnesses].

Objects #3 and #4 were, with a high degree of probability, the planet Jupiter and the star Betelgeuse, observed through

a surface inversion. Jupiter's . . . stellar magnitude was -1.7 [and it] was low on the eastern horizon at approximately 92° azimuth. Betelgeuse . . . was also low on the eastern horizon at approximately 81° azimuth.

The statement of one of the witnesses at Bismarck includes the following comments:

. . . they appeared much brighter than most of the stars and at times appeared to take on a rather dull bluish tint.

They appeared to move in the heavens, but at a rather slow rate and unless a person braced his head against some stationary object to eliminate head movement it would be hard to tell that they were moving.

The one in the west eventually disappeared below the horizon and the one in the northeast gradually seemed to blend in with the rest of the stars until it was no longer visible.

The last statement is typical of the description given by witnesses who have apparently observed a bright star rising through an inversion layer. It would seem to be circumstantial evidence of the diffraction-brightening predicted by Raman for propagation along an inversion layer (see Section VI Chapter 4). However, there is an alternative explanation that simple diffractive blurring or smearing of a star's image, by spreading the available light over a larger area of the eye's retina, may cause a psychological illusion of brightening of the object.

The meteorological conditions were generally favorable for anomalous propagation at both locations. The refractivity profile for Rapid City 2000 LST 5 August shows a 0.5°C temperature inversion over a layer 109 m. thick, although the resulting refractivity gradient is only -77 km^{-1} (Fig. 5). The 0800 LST profile (Fig. 6) shows a pronounced elevated

Figure 5

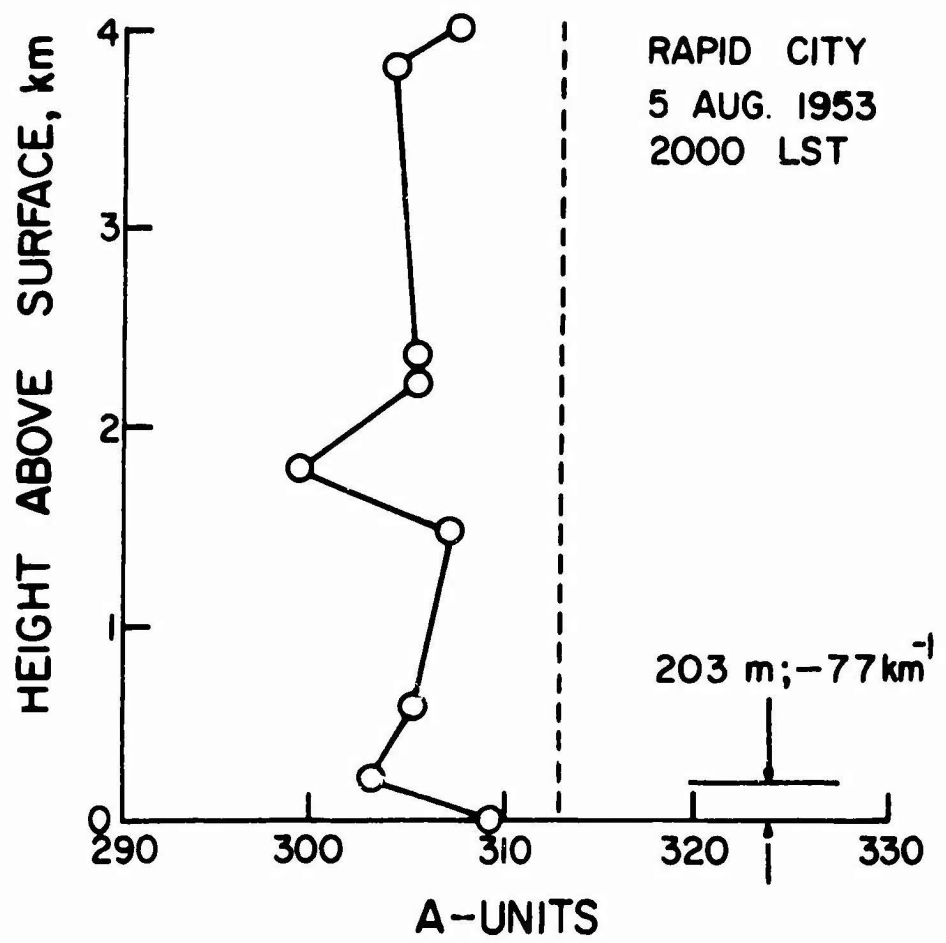
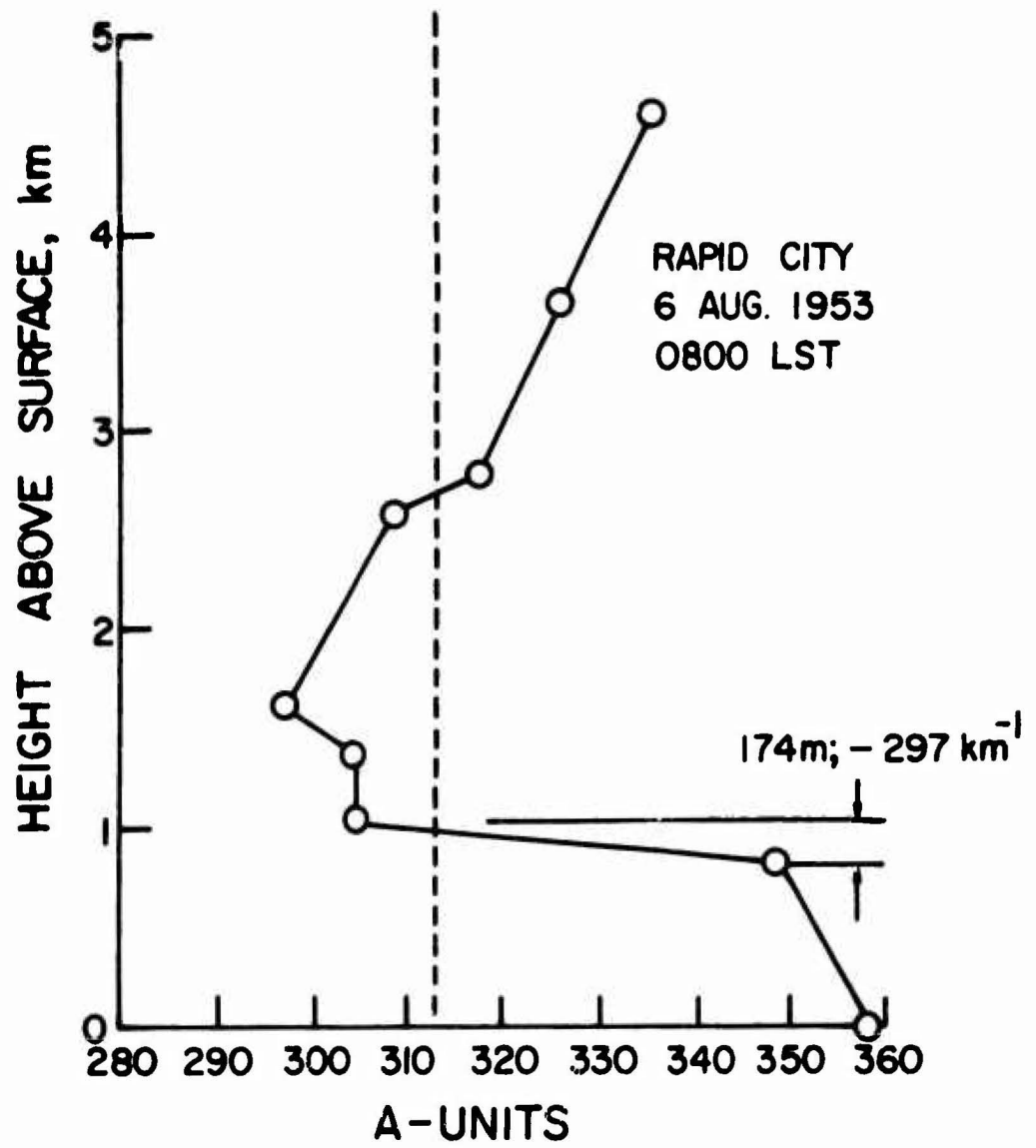


Figure 6



duct between 833 and 1,007 m. with a gradient of -297 km^{-1} ; a 3.2° elevated inversion is reported through this layer. A strong inversion layer evidently formed during the night and was "lifted" to the 833 m. level by solar heating after sunrise at about 0500 LST.

The Bismarck profile for 2100 LST 5 August (Fig. 4) shows a 1.2°C temperature inversion between the surface and the 109 m. level, the resulting layer forming a radio duct with a refractivity gradient of -182 km^{-1} . It is noteworthy that the Bismarck sightings show more evidence of optical inversion-layer effects than the Rapid City sightings.

In summary, the Rapid City-Bismarck sightings appear to have been caused by a combination of (1) stars seen through an inversion layer, (2) at least one meteor, (3) AP echoes on a GCI radar, and (4) possible ghost echoes on the GCI radar and malfunction of an airborne radar gunsight (although the commanding officer of the Rapid City detachment was later skeptical that there had in fact ever been even a ghost echo present on the GCI radar).

Case 5*. Louisiana-Texas (Ft. Worth) area, 19 September 1957, sometime between midnight and 0300 LST. The weather was clear. The radio refractive index profiles for Ft. Worth, for 1730 and 0530 LST, 18-19 September 1957, are shown in Figs. 7 and 8. The aircraft was flying at an altitude between 30,000 and 35,000 ft. as recalled 10 years later by the witnesses involved. There was a slight temperature inversion at an altitude of 34,000 ft., which may have been associated with a jet stream to the north.

There is a possibility that a very thin, intense temperature inversion was present that night over certain localized areas at an altitude of about 34,000 ft., a layer capable of giving strong reflections at both radar and optical frequencies. There are many aspects of the visual appearance of the UFO that are strongly suggestive of optical phenomena: the bright, white light without apparent substance, the

*Cases referred to thusly are found in Section IV.

Figure 7

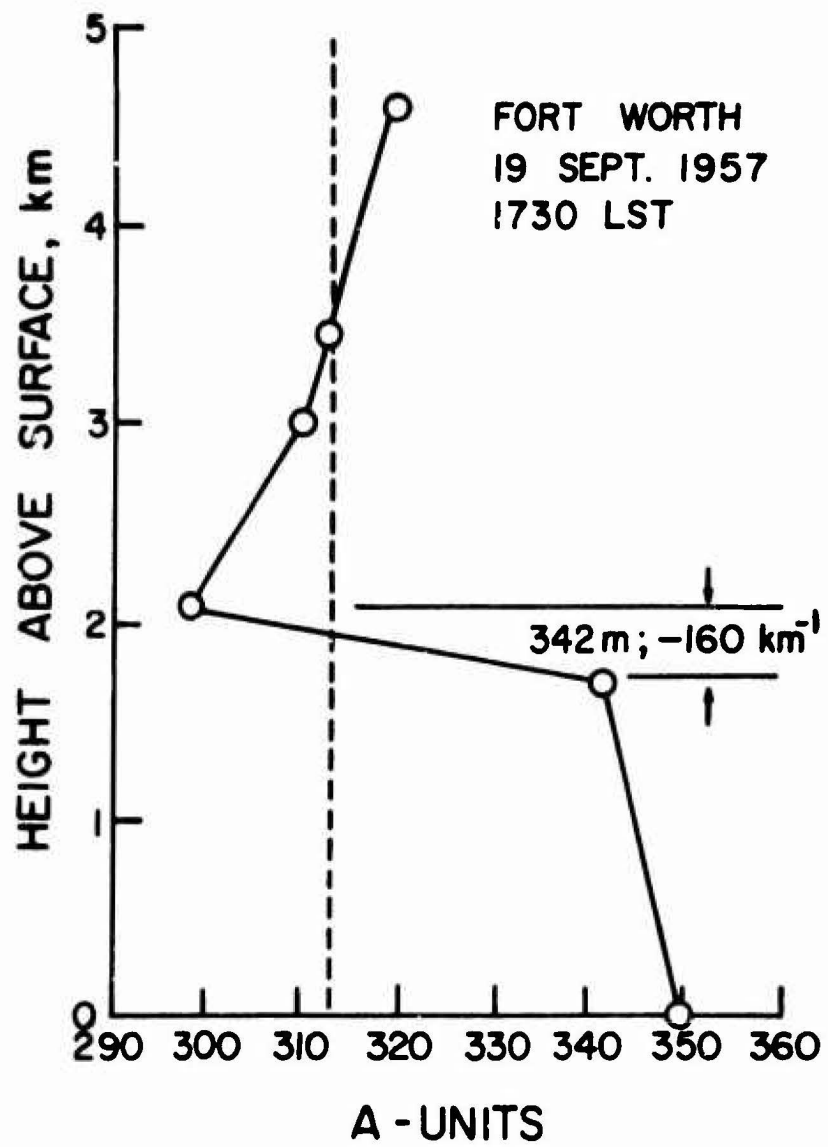
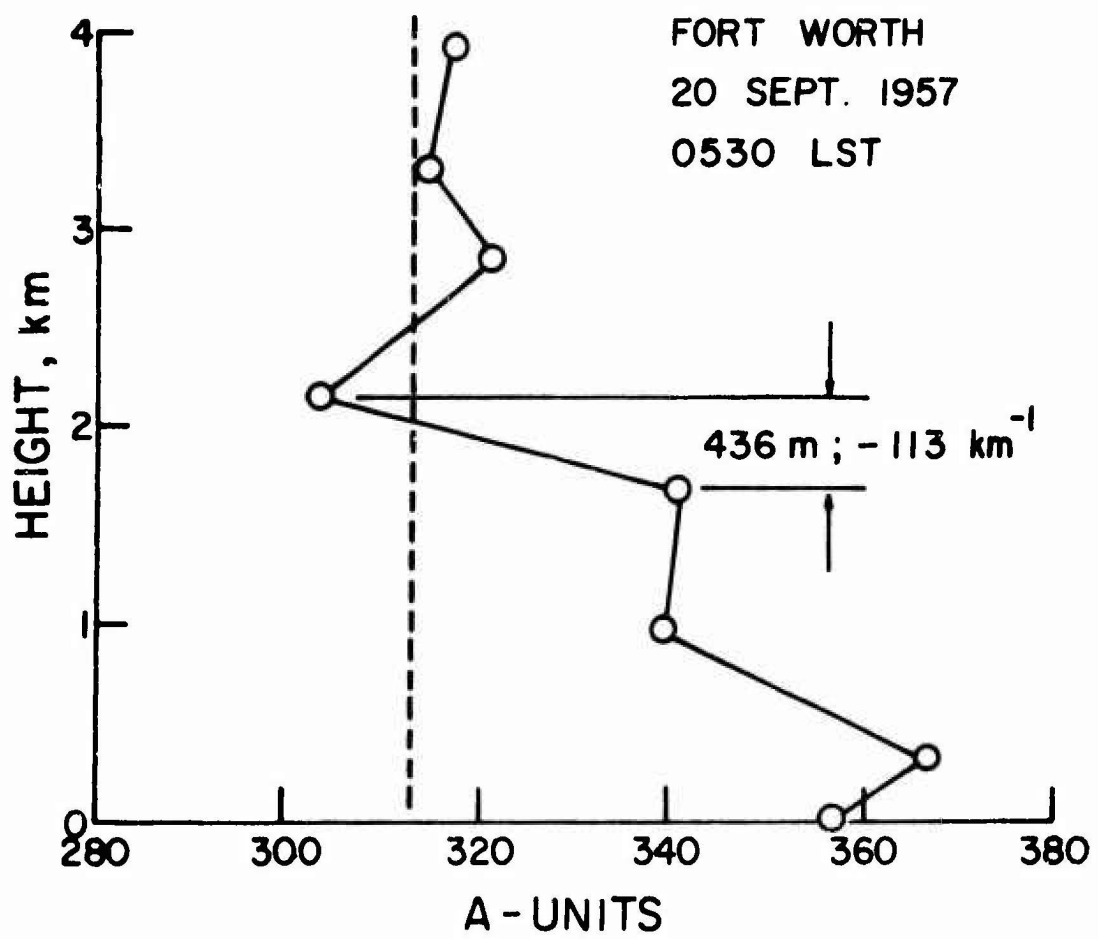


Figure 8



turning on and off "like throwing a switch," the amorphous red glow without "any shape or anything of this nature." The radio refractivity profile for the time of the sighting, with several strong super-refractive layers, is conducive to the formation of radar AP echoes. The description of the GCI radar targets is suggestive of AP phenomena:

All of a sudden they would lose it, or something.

They had it and then they didn't, they weren't sure. There was a lot of confusion involved in it. They'd give you these headings to fly. It would appear to just -- they had maybe a hovering -- capability and then it would just be in a different location in no time at all.

This type of behavior is typical of moving AP targets. The elevated duct shown on the Fort Worth profiles is very thick, and seems fully capable of causing these effects.

In summary, it is possible to account for the major details of the sighting through three hypotheses:

(1) The UFO at 30,000 to 35,000 ft. may have been a combined radio-optical mirage of another aircraft, at great distance, flying just below a thin inversion layer which was also just above the B-47's flight path. This aircraft would have had to have (a) displayed landing lights which were turned off (creating the first sighting), (b) been equipped with 2800 MHz radar, and (c) displayed a red running light (causing the red glow).

(2) The GCI UFOs were AP echoes.

(3) The last "red glow" at "15,000 feet" may have been a ground source, which became obscured or was turned off as the aircraft approached.

There are many unexplained aspects to this sighting, however, and a solution such as is given above, although possible, does not seem highly probable. One of the most disturbing features of the

report is the radar operator's insistence, referring to ground and airborne radars, that " . . . this would all happen simultaneously. Whenever we'd lose it, we'd all lose it. There were no "buts" about it, it went off." Another unexplained aspect is the large range of distances, bearing angles, and to some extent, altitudes covered by the UFO. The radar operator's comment that the return "had all the characteristics of -- a ground site -- CPS6B," indicates that an airborne radar source is unlikely due to the large power requirements. There remains the possibility that the "red glow" was the mirage of Oklahoma City which was in about the right direction for the original "red glow" and presumably had a CPS6B radar installation, but subsequent direction and location changes would seem to rule out this possibility and the grazing angle at the elevated inversion layer would be too large for a normal mirage to take place.

In view of these considerations, and the fact that additional information on this incident is not available, no tenable conclusion can be reached. From a propagation standpoint, this sighting must be tentatively classified as an unknown.

I-D: Primarily visual, miscellaneous appearance: balloon-like aircraft-like, etc.

Over Labrador, 30 June 1954, 2105-2127 LST. Weather:
(at 19,000 ft.) clear, with a broken layer of stratocumulus clouds below, excellent visibility. No radar contact was made in this incident.

A summary of the pilot's first-hand account of his experience reads :

I was in command of a BOAC Boeing Strato
cruiser en route from New York to London via Goose
Bay Labrador (refuelling stop). Soon after crossing
overhead Seven Islands at 19,000 feet, True

Airspeed 230 kts, both my copilot and I became aware of something moving along off our port beam at a lower altitude at a distance of maybe five miles, in and out of a broken layer of Strato Cumulus cloud. As we watched, these objects climbed above the cloud and we could now clearly see one large and six small. As we flew on towards Goose Bay the large object began to change shape and the smaller to move relative to the larger

We informed Goose Bay that we had something odd in sight and they made arrangements to vector a fighter (F94?) on to us. Later I changed radic frequency to contact this fighter; the pilot told me he had me in sight on radar closing me head-on at 20 miles. At that the small objects seemed to enter the larger, and then the big one shrank. I gave a description of this to the fighter and a bearing of the objects from me. I then had to change back to Goose frequency for descent clearance. I don't know if the fighter saw anything, as he hadn't landed when I left Goose for London.

The description of the UFO in this case, an opaque, dark "jelly-fish-like" object, constantly changing shape, is suggestive of an optical cause. Very little meteorological data are available for this part of the world on the date in question, so that the presence of significant optical propagation mechanisms can be neither confirmed nor ruled out. Nevertheless, certain facts in the case are strongly

suggestive of an optical mirage phenomenon:

(1) The UFO was always within a few degrees of a horizontal plane containing the aircraft, thus satisfying the small-angle requirement;

(2) The aircraft flew at a steady altitude of 19,000 ft. for the 85 n. mi. over which the UFO appeared to "pace" the aircraft, thus the plane maintained a constant relationship to any atmospheric layer at a fixed altitude;

(3) The dark UFO was seen against a bright sky background within 15° - 20° of the setting sun; nearly identical images, displaying "jellyfish-like" behavior may be commonly observed wherever mirages are observed with strong light-contrast present. The reflection of the moon on gently rippling water presents quite similar behavior.

The suggestion is strong that the UFO in this case was a mirage: a reflection of the dark terrain below seen against the bright, "silvery" sky to the left of the setting sun. The reflecting layer would be a thin, sharp temperature inversion located at an altitude just above that of the cruising aircraft. Most of the facts in this incident can be accounted for by this hypothesis. The dark, opaque nature of the image arises from the contrast in brightness and the phenomenon of "total reflection." The arrangement of the large and small objects in a thin line just above the aircraft's flight path, as well as the manner of disappearance, are commensurate with a mirage. As the mirage-producing layer weakens (with distance) or the viewing angle increases (was the aircraft beginning its descent at the time?), the mirage appears to dwindle to a point and disappears. This type of mirage is referred to as a superior mirage and has often been reported over the ocean (see Section VI, Chapter 4).

The principal difficulty with this explanation, besides having to hypothesize the existence of the mirage-producing layer, is how to account for the anisotropy of the mirage. Anisotropy of this sort, i.e. a mirage limited to certain viewing azimuths, is common in earth-bound mirages when viewed from a single location. But a mirage layer through which a reflected image could be seen only in one, constant principal direction (plus a few small "satellite" images) over a distance of 85 n. mi. is quite unusual.

There remains the slim possibility that the aircraft itself produced the mirage layer through intensification (by compression induced by the shock wave of the aircraft's passage through the air) of a barely subcritical layer, i.e. one in which the temperature gradient is just a little bit less than the value required to produce a mirage. This hypothesis would satisfy the directional requirement of the sighting, but the resulting scheme of hypotheses is too speculative to form an acceptable solution to the incident.

This unusual sighting should therefore be assigned to the category of some almost certainly natural phenomenon, which is so rare that it apparently has never been reported before or since.

304-B. Odessa, Wash., 10 December 1952, 1915 LST. Weather: clear above undercast at 3,000 ft.; aircraft at 26,000-27,000 ft. Two pilots in an F-94 aircraft sighted a large, round white object "larger than any known type of aircraft." A dim reddish-white light seemed to come from two "windows." It appeared to be able to "reverse direction almost instantly," and did a chandelle in front of the aircraft. After this the object appeared to rush toward the aircraft head-on and then would "suddenly stop and be pulling off." The pilot banked away to avoid an apparently imminent collision, and lost visual contact. Fifteen minutes later the aircraft radar picked up something which the crew assumed was the UFO, although there

is no evidence that it was. The object was reported to be moving generally from west to east at 75 knots. It was never sighted.

This sighting has been described as a mirage of Venus, although the reported 75 knot speed and 270° direction of motion is in contradiction to this hypothesis. The general description of the object as well as the reported motion is suggestive of a weather balloon. However, the peculiar reversals of direction, although they could have been illusory, and particularly the loss of visual contact are at odds with the balloon hypothesis.

The radiosonde profile for Spokane, 1900 LST, is shown in Fig.9 and is inconclusive. The tropopause, where the sharpest temperature inversions are likely, is at about 30,500 ft. above sea level, too high to have produced a mirage visible at 26,000-27,000 ft.

The closeness of the timing between the radiosonde release at 1900 LST and the sighting at 1915 LST suggests that the F-94 crew may have seen a lighted pibal balloon. The description given, including the two dimly-lit "windows," is typical of the description of a pibal balloon by those not familiar with weather instrumentation. Such a balloon would rise to at least 17,000 ft. in 15 min., and the reported motion, 270° at 75 knots, is in excellent agreement with the upper winds at the highest level plotted for the Spokane profile: 280° at 66 knots at 18,000 ft.

19-X. 361-B. Kirtland AFB, Albuquerque, N.M., 4 Nov. 1957, 2245-2305 LST. Weather: scattered clouds with high overcast, visibility good, thunderstorms and rain showers in vicinity, light rain over airfield. Observers in the CAA (now FAA) control tower saw an unidentified dark object with a white light underneath, about the "shape of an automobile on end," that crossed the field at about 1500 ft. and circled as if to come in for a landing on the E-W runway. This unidentified object appeared to reverse direction at low altitude, while out of sight of the observers behind some buildings, and climbed suddenly to about

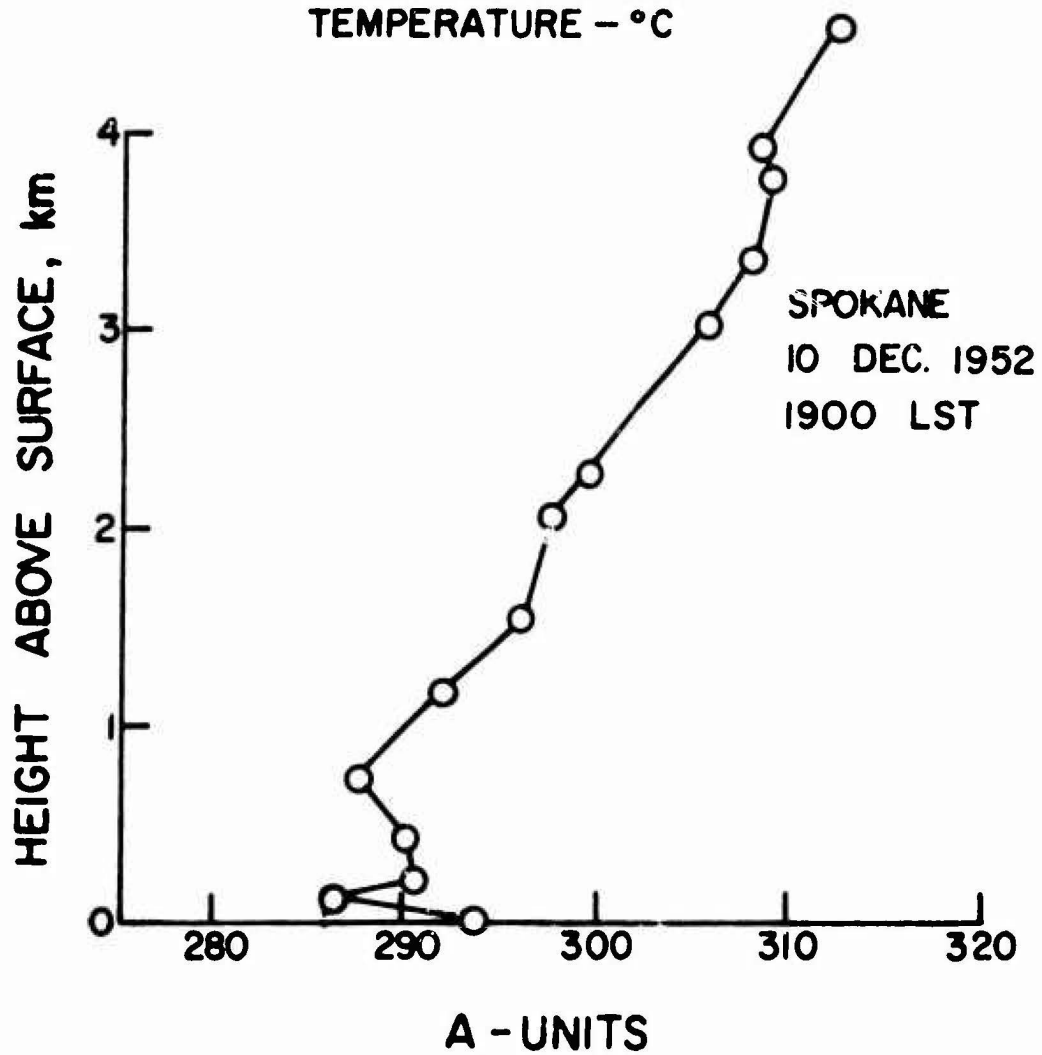
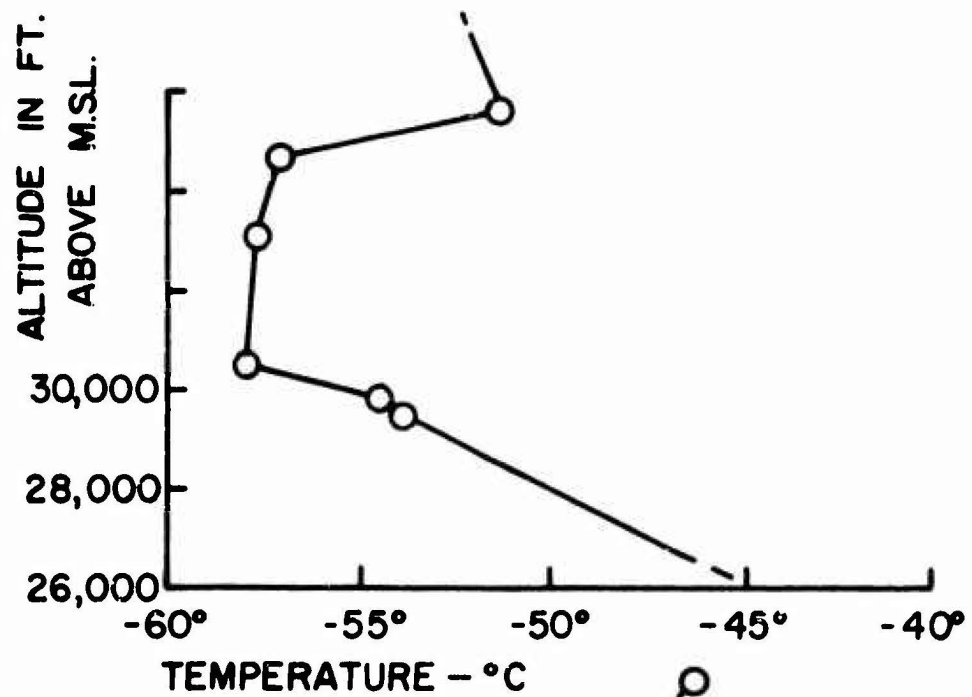


Figure 9

200-300 ft., heading away from the field on a 120° course. Then it went into a steep climb and disappeared into the overcast.

The Air Force view is that this UFO was a small, powerful private aircraft, flying without flight plan, that became confused and attempted a landing at the wrong airport. The pilot apparently realized his error when he saw a brightly-lit restricted area, which was at the point where the object reversed direction. The radar blip was described by the operator as a "perfectly normal aircraft return," and the radar track showed no characteristics that would have been beyond the capabilities of the more powerful private aircraft available at the time. There seems to be no reason to doubt the accuracy of this analysis.

1482-N. About 15 mi. east of Utica, N. Y., 23 June 1955, 1215-1245 LST. Weather: overcast at 4,000 ft., visibility good below. Reported by the co-pilot of a Mohawk Airlines DC-3. They were cruising at 5,000 ft. at 160 knots, when he noticed an object passing approximately 500 ft. above at an angle of about 70° (20° from vertical). It was moving at "great speed." The body was "light gray, almost round, with a center line Beneath the line there were several (at least four) windows which emitted a bright blue-green light. It was not rotating but went straight." The pilot also saw this UFO; they watched it for several miles. As the distance between the DC-3 and the UFO increased, the lights "seemed to change color slightly from greenish to bluish or vice versa. A few minutes after it went out of sight, two other aircraft (one, a Colonial DC-3, the other I did not catch the number) reported that they saw it and wondered if anyone else had seen it. The Albany control tower also reported that they had seen an object go by on Victor-2 [airway]. As we approached Albany, we overheard that Boston radar had also tracked an object along Victor-2, passing Boston and still eastbound."

The pilot and co-pilot computed the "speed" of the UFO at 4,500-4,800 mph. from the times of contact near Utica and at Boston. There are a number of inconsistencies in this report, aside from the most obvious one: the absence of a devastating sonic boom, which should be generated by a 150 ft. ellipsoidal object travelling at Mach 6 or better in level flight at 3,500 ft. It does seem likely that the Boston GCA report was coincidental and involved a different object.

The residue is a most intriguing report, that must certainly be classed as an unknown pending further study, which it certainly deserves. Statements from some of the other witnesses involved would help in analyzing the event, and should prove useful even 13 years after the fact. It does appear that this sighting defies explanation by conventional means.

10-X. [371-B.] Continental Divide, N. M., 26 January 1953, 2115-2200 LST. Weather: high, thin overcast, low scattered clouds, very good visibility. An airman stationed at the 769th AC&W Squadron at Continental Divide (elevation 7,500 ft.) observed a "bright reddish-white object" about 10 mi. west of the radar site and approximately 2,000 ft. above the terrain. The radar subsequently painted a strong, steady return at 9 mi. range and about 2,500-7,500 ft. above the surface. This object passed behind a nearby hill and reappeared, heading north at about 10-15 mph. Radar track confirmed this. The object then moved to the west at 12-15 mph to a point 18 mi. west of the radar site. It then turned north for about 10 mi., and subsequently turned back on a heading of 128° inbound to the station. Radar and visual contact was lost near the area where the object was first detected. Before disappearing, the object seemed to shrink in size and fade in color to a dull red.

There seems to be little doubt in this case that the visual and radar contacts were in fact of the same object. The obvious

interpretation is that the object seen and tracked on radar was a weather balloon, a lighted pibal used for obtaining data on upper winds. This explanation was considered and rejected by Air Force investigators for two reasons:

(1) The sighting occurred 1 hr. 15 min. after the scheduled release of the Winslow, Ariz. pibal, the only one that seemed likely to have showed up in the sighting area, and the balloon ought to have burst by then, since they generally burst at 30,000 ft., an altitude the Winslow pibal should have reached 25 min. after launch;

(2) The reported direction of movement was, at least part of the time, directly opposite to the reported upper winds as derived from the Albuquerque radiosonde flight. These winds were reported from the "west between 10,000 and 30,000 feet."

Actually, neither of these two reasons is sufficient to discount the balloon theory. In the first place, weather balloons are often released later than the scheduled time, and this possibility was apparently not checked. In the second place, pibal balloons are often known to leak and consequently to rise at a much slower rate than normal. Often they have so little bouyancy that they may be caught in local updrafts or downdrafts. These leaking balloons are usually carried away by the horizontal wind flow at such a rate that they are lost from sight of the observing station before they reach burst altitude. The pibal data from Winslow, Ariz. for 0300 GMT 27 January 1953, (2000 LST 26 January) is listed as "missing" above the 500 mb level (about 19,000 ft. m.s.l.), which is a strong indication that the balloon may have been leaking. It is therefore entirely conceivable that the Winslow pibal balloon could have been in the vicinity of Gallup, N. M. (west of the radar site) at 2115 LST on the night in question.

The problem of the observed direction of movement cannot be completely resolved, because it depends largely on an analysis of mesoscale

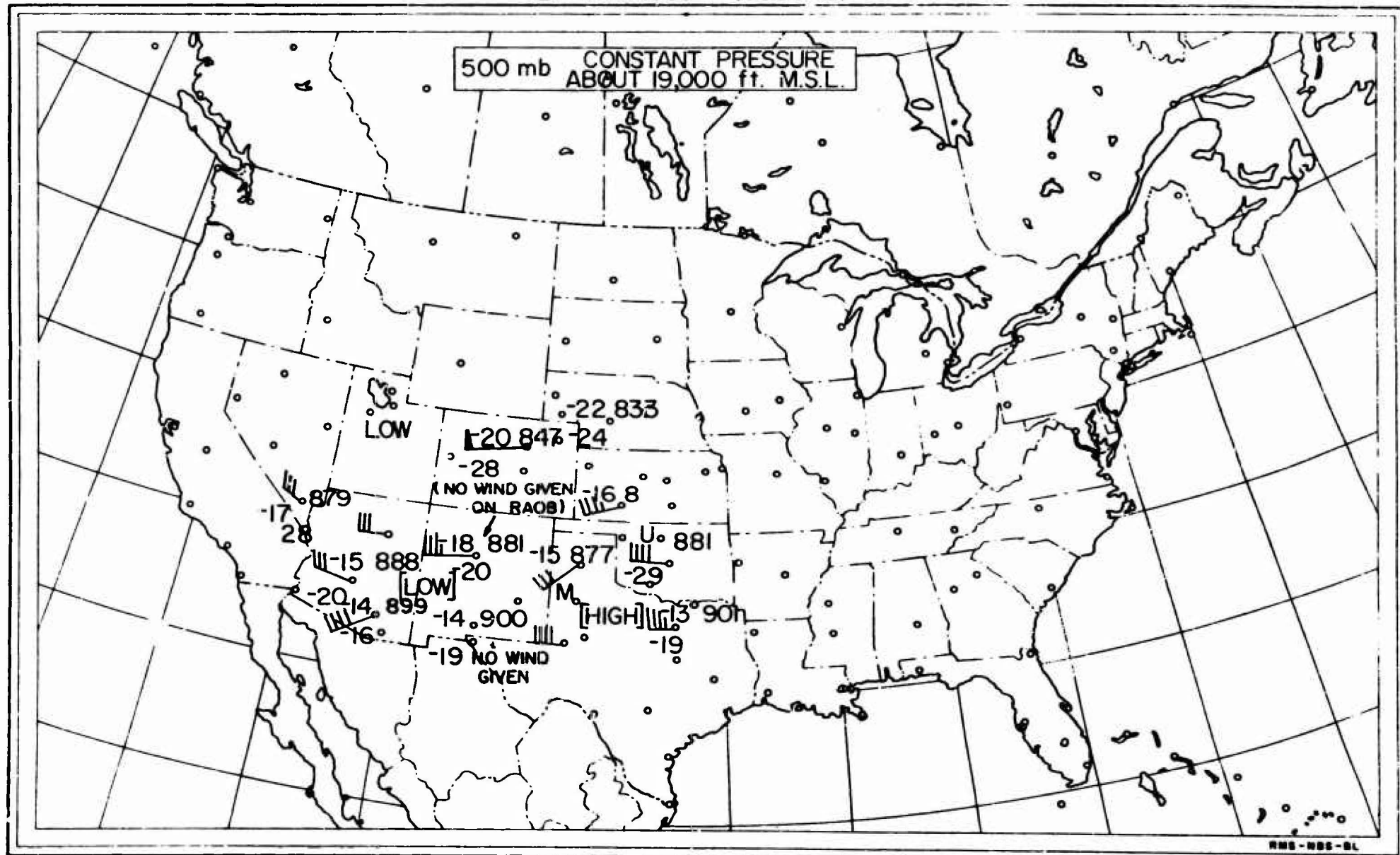
winds in the lower atmosphere, that is, on a scale smaller than ordinarily analyzed on synoptic weather maps. The synoptic maps for 2000 LST 26 January 1953, for the 700 mb (about 10,000 ft.), 500 mb (about 19,000 ft.), and 300 mb (about 27,000 ft.) levels are shown in Figs. 10 and 11.

Although the general windflow in the Arizona-New Mexico area for at least the 700 and 500 mb maps is from the west, there are indications of a secondary mesoscale circulation somewhere in the vicinity of the Arizona-New Mexico border, which is embedded in the general trough overlying the southwestern states. Especially significant are the winds at the 700 and 500 mb levels at Tucson and at Phoenix, mainly at the 500 mb level, which show evidence of a mesoscale cyclonic circulation in the area.

In view of the general meteorological situation at the time, a quite likely explanation for the Continental Divide sighting is as follows: The Winslow pibal balloon, which was leaking, was carried away to the east, probably sinking slowly as it went, and was lost from view of the Winslow weather station. Upon reaching the general vicinity of Gallup, N. M. the leaking balloon was probably caught up in a local cyclonic vortex and updraft, which, being instigated by the mesoscale cyclonic flow in the region may have formed on the windward side of the range of low mountains forming the Divide in that area. This would have caused the balloon to be carried toward the north, slowly rising, as first observed. This would be followed in sequence by a turn to the west, and ultimately, upon reaching a somewhat higher level, a turn toward the southeast again as the balloon became caught in the more general flow from the west and northwest prevailing at middle levels in the atmosphere.

This hypothesis fits the details of the observations rather well, and considering the lack of additional information or data

27 JAN. 1953 (0300 Z)



LOW = MESOSCALE SYSTEM

Figure 11

27 JAN. 1953 (0300 Z)

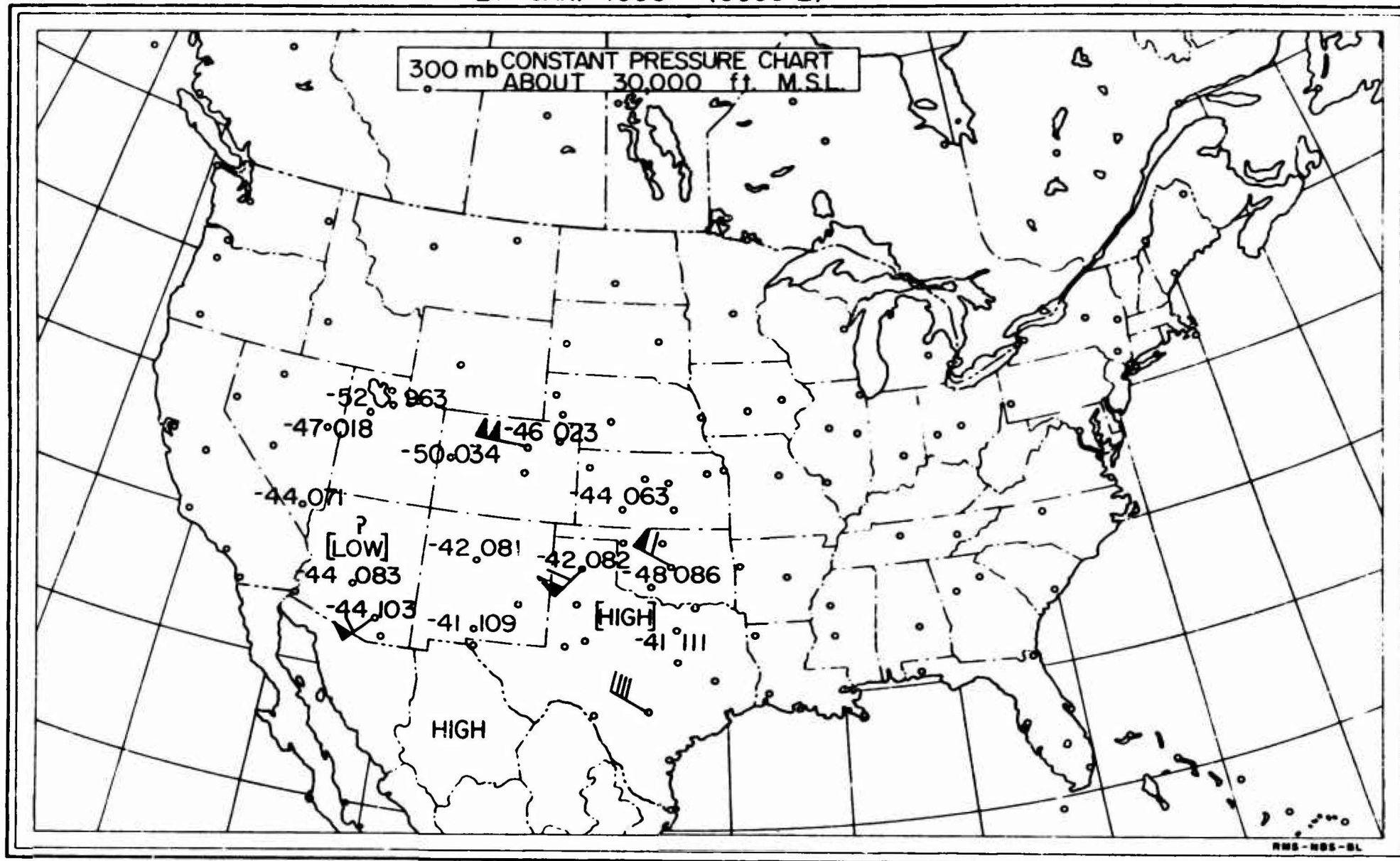


Figure 10

pertaining to this incident, the UFO should probably be tentatively identified as a weather balloon.

321-B. Niagara Falls, N. Y., 25 July 1957, 0025 LST. Weather: clear, excellent visibility. Observers saw a "circular brilliant white object with pale green smaller lights around its perimeter." Object appeared to move slowly at nearly constant altitude, and then went into a "fast, steep climb," disappearing in about 5-8 min. The object was tracked on a CPS-6B radar for about 3 min. moving from SW to NE, in agreement with prevailing winds in the area.

The rate of climb could not have been very great, or the object would not have remained in sight for "five to eight" minutes. The official AF view is that the object was a lighted balloon, and in the absence of other data or a more complete file on the case, there seems to be no more likely explanation.

Class II: UFO incidents that are primarily radar contacts, with or without secondary visual observations.

Class II-A: Primarily radar, with radar returns of an AP-like nature: fuzzy, vague, or erratic returns, multiple returns, sporadic returns, etc.

1211-B. McChord AFB, Seattle, Wash., 2 October 1959, 0020-0320 LST. Weather: clear, fog moved in at 0150 LST after initial sighting, wind from 10° at 10 knots (approx.). Radar at McChord AFB picked up a total of five or more unidentified tracks between 0020 to 0320 LST. These targets appeared to be at elevation angles of about 10°-20° and azimuths of 170°-190°. The range would change from 4,000 yd. to 8,000 yd., and the flight patterns were described as "erratic:" returns would occasionally appear in pairs. The radar blips were described as "weak." Data on the vertical beam width and the antenna pattern characteristics of the radar are lacking.

Visual observers were apparently told to go outside and look for an UFO at about 10° elevation and 190° azimuth. They found

one - "round," "the size of a quarter" (distance not specified), "white and blue flickering light," a rather good description of a scintillating star. There was a second magnitude star at precisely the correct azimuth (190°) at the time, although the elevation angle would have been only about 1° or so. A sharp temperature inversion, with mist trapped below it, could have easily produced the effect of larger size as well as increased the apparent elevation angle by about 1° . Even trained observers consistently over-estimate the elevation angle of objects near the horizon, as in the "moon illusion" (the apparent increase in size of the rising moon).

When "last seen," at about 0150 LST, the object was reported to be about 20° elevation and 170° azimuth. At that time another bright star (0.7 magnitude fainter than the first one) was located at about 172° azimuth and about 10° elevation, values commensurate with the apparent visual position (again, assuming over-estimate of elevation angle). Near the horizon these were the only two stars of third magnitude or greater in that part of the sky at that time.

The description of the radar targets, weak, erratic blips, together with the reported formation of a low-level fog (that hindered visual observations after 0150 LST), suggests the presence of a shallow temperature inversion-humidity trap that was producing AP echoes on the radar set. The UFO report states that temperature inversions were "prevalent" in the area.

In summary, this UFO incident appears to have been caused by radar AP echoes and associated visual star sightings, both observed at small angles through a surface temperature inversion-humidity trap layer.

103-B. Gulf of Mexico, off Louisiana coast (28° N 92° W), 6 December 1952, 0525-0535 LST (1125 GMT). Weather: clear, dry, light winds, visibility excellent, full moon. The radio refractivity

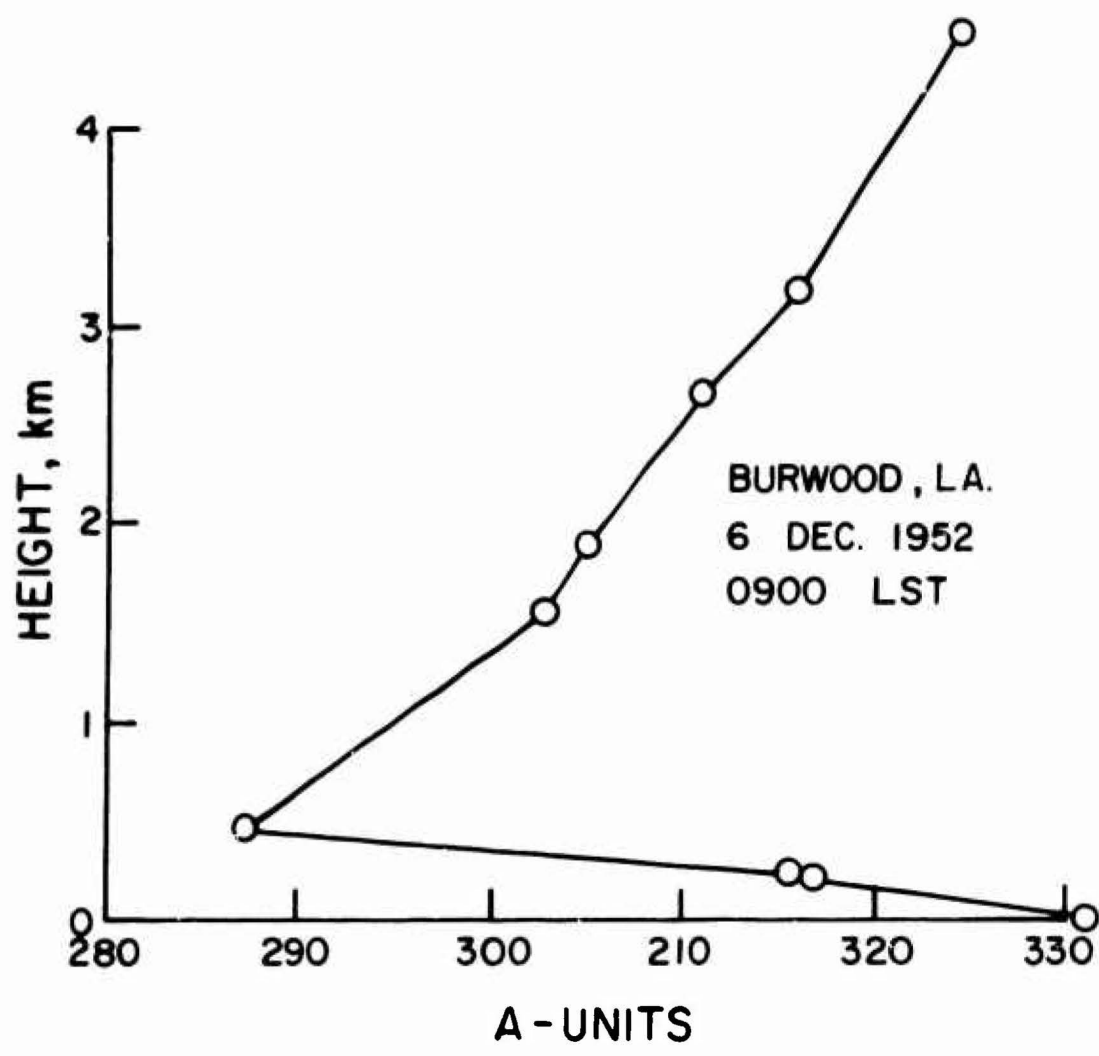
profile for Burwood, La., about 175 mi. NE of location of sighting, for 0900 LST is shown in Fig. 12 ; a very strong super-refractive layer is shown on this profile over a height interval extending from the surface to 456 m. (1,500 ft.). A sharp temperature inversion existed at the top of this layer. As an aircraft was returning to Galveston, Tex. at 20,000 ft. burn-off flares from oil refineries became visible. The radar was activated on 100 mi. range to check for the Louisiana coastline. The range to the nearest point on the coastline was about 89 mi. and assuming standard propagation conditions, the range to the radar horizon should have been on the order of 140 mi. Surprisingly, the coastline could not be seen on the radarscope. Instead a number of unusual echoes were observed. Initially there were four moving on a course of 120° true azimuth. These blips moved at apparent speeds of over 5,000 mph., coming within 15-20 mi. of the aircraft's position. Eventually they disappeared from the scope. The radar set was calibrated, but more blips appeared still moving SE across the scope.

Visual observations consisted of one or two blue-white flashes, one of which, as viewed from the waist blister, appeared to pass under a wing of the aircraft. All of these may have been above the horizon, since the wingtip would appear well above the horizon as viewed from this position. The observers stated that the flashes "did not alter course whatsoever." These visual sightings were probably Geminid meteors; the wing operations officer stated: "Visual sightings are indecisive and of little confirmatory value."

One of the radar witnesses stated: "One object came directly towards the center of the scope and then disappeared." After 10 min. of radar observation, a group of the blips merged into a half-inch curved arc about 30 mi. from the aircraft at 320° relative azimuth and proceeded across and off the scope at a computed speed of over 9,000 mph. After this, no more unidentified returns were noted on the radar.

The radar returns obtained in this incident were probably caused by the deep super-refractive layer near the surface shown in Fig. 12.

Figure 12



That this layer was present at the time and in the area is indicated by the failure of the aircraft radar to detect the Louisiana coastline even though burn-off flares on the shore were visible to the unaided eye. The layer was probably slightly stronger at the time of the incident, thus constituting a thick radio duct. A transmitter located above a radio duct and emitting a high enough frequency to be affected, as the radar undoubtedly was, does not excite propagation within the duct. This implies that the coastline below the duct would not be visible to the radar located above the duct.

The strange moving targets seen on the radar were probably caused by imperfections in the atmospheric layer forming the radio duct, allowing the radio energy to enter the ducting layer at various points. This would create sporadic ground returns. The returns may have been caused by a series of gravity waves running along the ducting layer in a SE direction; this is a phenomenon which is at present only poorly understood. In any event, spurious radar images have often been noted under propagation conditions of this sort, often moving at apparent speeds of from tens to thousands of miles per hour.

In summary, it seems most likely that the cause of this sighting can be assigned to radar AP, for which there is meteorological evidence, and meteors.

7-C. White Sands Missile Range, N. M., 2 March 1967, 1025-1132 LST. Weather: apparently clear (few meteorological data are available). A single witness at the summit of highway 70 over the Sacramento Mountains (Apache Summit, 9,000 ft. elevation) reported seeing "silvery specks" passing overhead from north to south. The witness called Holloman AFB, and range surveillance radar was requested to look for the objects. Two aircraft were scrambled, but neither reported a sighting, although they searched the area where the UFOs were reported.

Two radars were in operation. Both tracked a number of targets, most of which were stationary and so intermittent in nature as to prevent lock-on (see Case 16). Significantly, none of the radar targets was behaving in the manner described by this witness (i.e., moving steadily south at high altitude). Therefore, this incident is considered to be primarily a radar contact.

The probable nature of each of the three types of radar contact made is examined below.

(1) The stationary, intermittent targets. Most of these can be identified with terrain features, peaks or ridges, that would normally be just below the radar's line of sight. If the atmospheric conditions were such as to render these points just barely detectable by the radars, they would probably appear as intermittent, stationary targets of the type described.

(2) The object at 25,000 ft. that "drifted east three or four miles in about 10 minutes" was apparently moving with the prevailing upper winds from the west; it may have been a weather balloon, or some similar device.

(3) The circular track executed by the Holloman radar was interpreted by the radar engineers on the base as being a noise track. This seems quite likely, despite some apparent discrepancies noted in the report. If this track represented a real target, it is strange that the Elephant Mountain radar never picked it up, in spite of the fact that the apparent track passed within about 6.5 mi. of the second radar's location.

190-N. Detroit, Mich., March 1953, about 1000 to 1100 LST (exact date and time unknown). Weather: "perfectly clear." A USAF pilot and a radar operator, flying in an F-94B fighter on a practice training mission, were directed by GCI radar at Selfridge AFB to intercept some unknown targets which appeared to be over

downtown Detroit. The pilot and radar operator looked in that direction and saw "tiny specks in the sky, which appeared to look like a ragged formation of aircraft."

The aircraft at this time was about 30 mi. NW of downtown Detroit, and the targets "appeared to be over the city's central section." The pilot turned the aircraft to an intercept course. During this time, perhaps "three or four minutes," the objects were visible to the pilot as "a ragged formation traveling slowly in a westward direction;" the objects appeared to be "a little lower than our aircraft." The pilot started his intercept run under full military power, without afterburner, at approximately 500 mph.

The pilot recalls thinking several times that details of the unknowns, like wings, tails, etc. should have "popped out" as they approached, so that identification could be made, but they did not. The ground radar had both the F-94B and the unknowns "painted as good, strong targets." The unknowns could still not be identified, but "seemed to get a little larger all the time."

The F-94B's radar operator began to get returns and "thought he was picking up the targets." The pilot looked at his instruments to see if he could "inch out a little more speed without going into afterburner," and when he looked up again "every last one" of the objects was gone. The pilot asked GCI where the UFOs were, and was told they were still there, "loud and clear." They continued to fly headings given by GCI right into the center of the targets, flying and turning in "every direction," but there was nothing in sight. The pilot states: "Gradually the targets disappeared from ground radar after we had been amongst them for three or four minutes." The F-94B then returned to base.

Since the exact date of this sighting is unknown, no applicable meteorological data are available. Any explanation of this incident

must therefore remain speculative in nature. If the UFOs are considered to have been material objects, then they would have had to have shifted position some tens of miles in the "two to four" seconds while the pilot was looking down at his instruments. This does not explain why they continued to appear on the ground radar. The only admissible hypothesis would seem to be that they became invisible as the fighter approached, but this does not account for the fact that they could not be picked up on airborne radar while the aircraft was searching the area.

There is one hypothesis that seems to fit all of the observed facts: that the "ragged formation" was actually an inferior mirage (see Section VI, Chapter 4). The angular conditions are satisfied: the objects appeared "slightly below the level of the aircraft," and reflections of the sky above the horizon would seem dark when seen projected against the hazy sky directly over the city. A layer of heated air, trapped temporarily below a cooler layer by a stable vertical wind shear, could produce a wavy interface that would reflect the sky in a few spots. This phenomenon is quite similar to the familiar road mirage. Like a road mirage it suddenly disappears when one gets too close and the viewing angle becomes either too large or too small.

If the warm air below, the source of which would presumably have been the downtown area of Detroit, were also considerably moister than the cooler air above as is quite probable, then the radio refractive index would decrease quite suddenly across the interface. This would tend to produce anomalous propagation effects, including false echoes, on radar, and would explain why ground radar could continue tracking the unknowns when the pilot and airborne radar operator could no longer see them. The airborne radar, being immersed in the layer would probably not receive AP echoes of any duration other than, perhaps, occasional random blips.

After the aircraft had thoroughly mixed the opposing air currents by flying repeatedly through the interface as it searched for the targets, the ground radar returns would gradually fade away. This corresponds to what was actually observed.

In summary, without the data to make a more definitive evaluation of this case, the most likely cause seems to be a combined radio-optical mirage as described above. If so, this is another example of a natural phenomenon so rare that it is seldom observed: for a 0.25° critical mirage angle, the temperature contrast required is on the order of 10° or 15°C in the space of about 1 cm.

Washington, D.C. (see Appendix L) 19-20 and 26-27 July 1952.

Weather: mostly clear, a few scattered clouds, visibility 10 to 15 mi., temperature 76° to 87° F, dewpoint 61° to 72° F, surface winds from SE, light, near surface, from 300° to 320° aloft, light. Radio refractive index profiles are shown in Figs. 13, 14, and 15, in Md., at an elevation of 88 m. (289 ft.) above sea level. There are a tremendous number of reports of UFOs observed on these two nights. In most instances visual observers, especially in scrambled aircraft, were unable to see targets indicated on ground radar, or to make airborne radar contact. Ground radar observers were often able to find a return in the general area of reported visual contacts, especially in the case of ground visual reports where only an azimuth was given. A few excerpts from typical reports during these incidents are given below:

Control tower operator, Andrews AFB, 0100 to 0500 EST, 20 July 1952:

An airman became excited during the conversation and suddenly yelled "there goes one." I saw a falling star go from overhead a short distance south and burn out. About two minutes later (the airman) said, "There's another one;

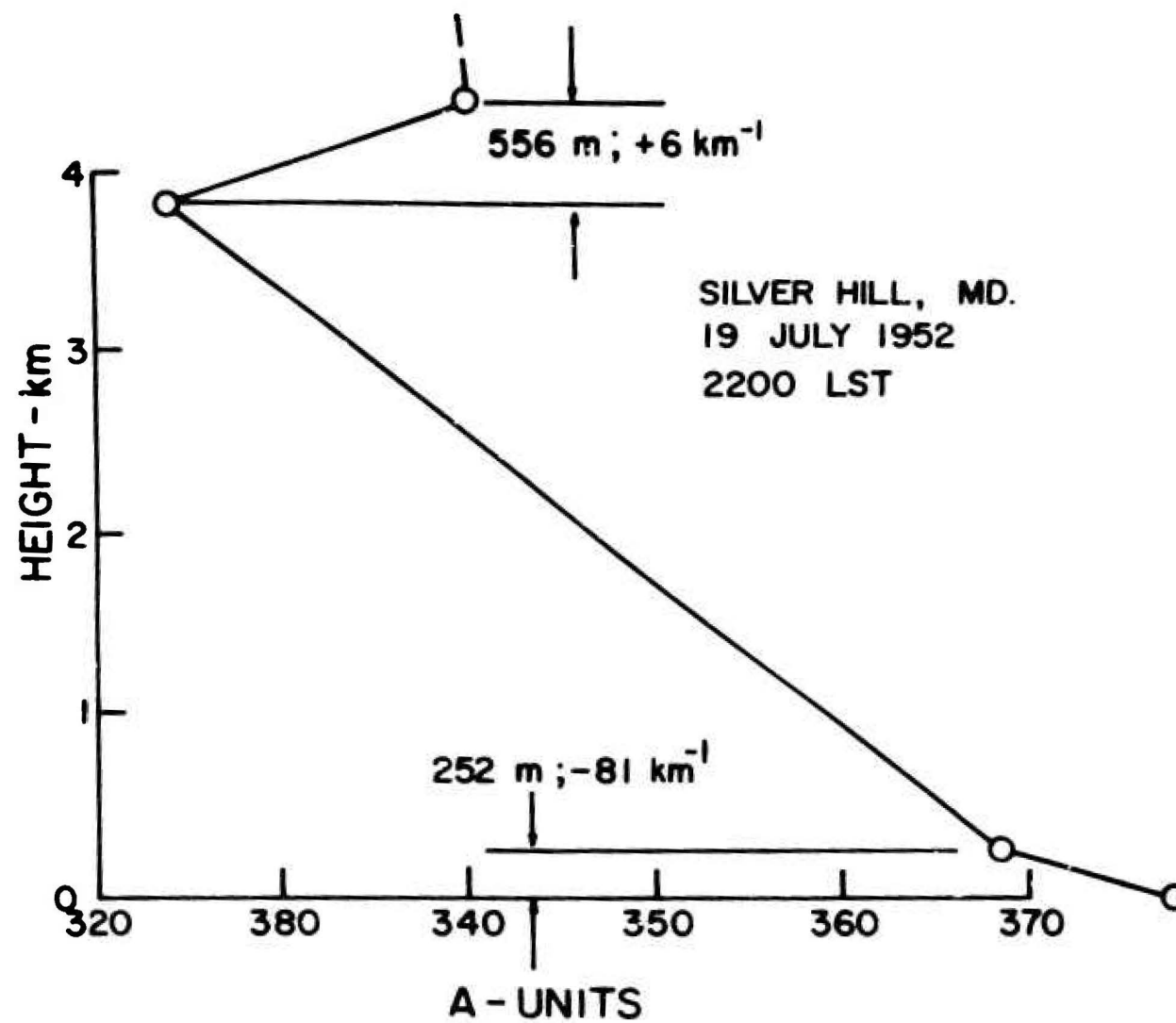
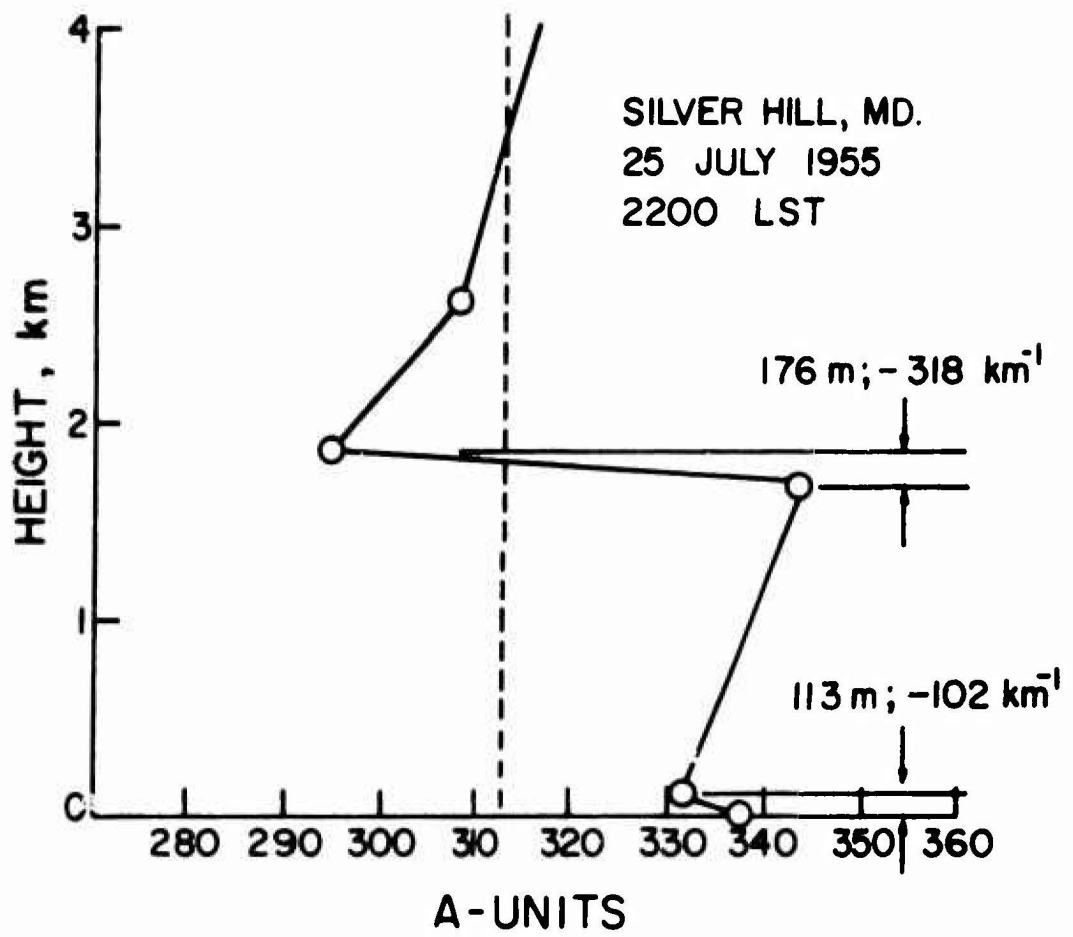


Figure 13

Figure 14



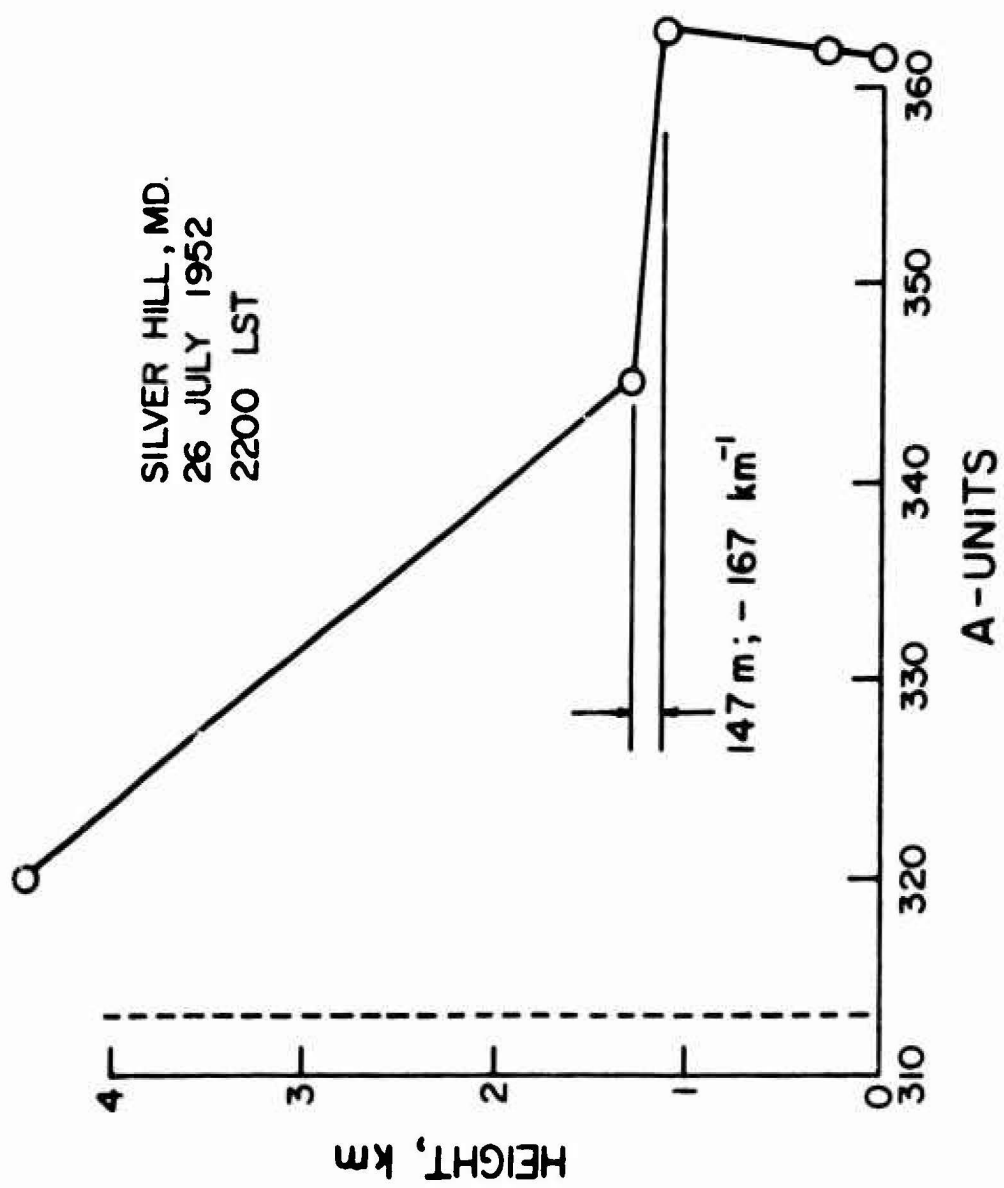


Figure 15

did you see the orange glow to the south?" I said I thought I saw it, but he pointed south and I had been looking southwest. I went up on the roof---and watched the sky in all directions. In the meantime Washington Center was reporting targets on their radar screen over Andrews. Andrews Approach Control observed nothing.

[The airman] was in the tower talking on the phone and interphones. He was watching a star and telling various people that it was moving up and descending rapidly and going from left to right, and [another airman] and I, listening to him from the roof, believed we saw it move too. Such is the power of suggestion.

This star was to the east slightly to the left of and above the rotating beacon. [The airman] reported the star as two miles east of Andrews and at an altitude of 2,000 ft.

A short time later, approximately 0200 hours, I saw a falling star go from overhead to the north. A few minutes later another went in the same direction. They faded and went out within two seconds. The sky was full of stars, the Milky Way was bright, and I was surprised that we did not see more falling stars.

All night Washington Center was reporting objects near or over Andrews, but Andrews Approach Control could see nothing, however they could see the various aircraft reported so their [radar] screen was apparently in good operation.

At 0500 hours Washington Center called me and reported an unknown object five miles southeast of Andrews field. I looked and saw nothing. That was the last report I heard.

A USAF Captain at Andrews AFB radar center:

At about 0200 EST Washington Center advised that their radar had a target five miles east of Andrews Field. Andrews tower reported seeing a light, which changed color, and said it was moving towards Andrews. I went outside as no target appeared on Andrews radar and saw a light as reported by the tower. It was between 10° and 15° above the horizon and seemed to change color, from red to orange to green to red again. It seemed to float, but at times to dip suddenly and appear to lose altitude. It did not have the appearance of any star I have ever observed before. At the time of observation there was a star due east of my position. Its brilliance was approximately the same as the object and it appeared at about the same angle, 10° to 15° above the horizon. The star did not change color or have any apparent movement. I estimated the object to be between three and four miles east of Andrews Field at approximately 2,000 ft. During the next hour very few reports were received from Washington Center. [According to Washington Center's account, however, the 0200 EST object was seen on radar to pass over Andrews and fade out to the southwest of Andrews -- G. D. T.] At approximately 0300 EST I again went outside to look at the object. At this time both the star and the object had increased elevation by about 10° . [The azimuth would have also increased about 10° , so that the observed change was apparently equal to the sidereal rate, 15° of right ascension per hour -- G. D. T.] The object had ceased to have any apparent movement, but still appeared to be changing color. On the basis of the second observation, I believe the unidentified object was a star.

The account of the airman referred to by the Andrews AFB control tower operator:

Airman [X] called the tower and reported he had seen objects in the air around Andrews; while we were discussing them he advised me to look to the south immediately. When I looked there was an object which appeared to be like an orange ball of fire, trailing a tail; it appeared to be about two miles south and one half mile east of the Andrews Range [station]. It was very bright and definite, and unlike anything I had ever seen before. The position of something like that is hard to determine accurately. It made kind of a circular movement, and then took off at an unbelievable speed; it disappeared in a split second. This took place around 0005 EST. Seconds later, I saw another one, same description as the one before; it made an arc-like pattern and then disappeared. I only saw each object for about a second. The second one was over the Andrews Range; the direction appeared to be southerly.

The account of a staff sergeant at Andrews AFB follows. He was apparently describing the same object that the radar center Captain had observed.

Later on we spotted what seemed to be a star northeast of the field, which was in the general direction of Baltimore. It was about tree top level from where I was watching. It was very bright but not the same color (as some apparent meteors). This was a bluish silver. It was very erratic in motion; it moved up from side to side. Its motion was very fast. Three times I saw a red object leave the silver object at a high rate of speed and move east out of sight. At this time I had to service a C-47 and lost sight of it for the night. The time was about 0330.

The visual sightings in these incidents seem to be either meteors, apparently quite numerous at the time, or stars, but a few descriptions are not adequate to make an identification and hence may represent unknowns.

The radar tracks reported, at various times, from Washington National Airport, Andrews AFB, and Bolling AFB are generally not correlated with each other, with airborne radar/visual observations, or with ground visual reports, except in a very general way, e.g., a star sighted on the azimuth supplied by the radar track.

An investigation of the radar tracks reported by Borden and Vickers (1953) is very informative. The authors observed, on the night of 13-14 August 1952, radar tracks very similar to those described in the 19-20 and 25-27 July incidents. The targets appeared to move with the upper winds at various levels at twice the observed wind speed, suggesting that they were ground returns seen by partial reflections from moving atmospheric layers of relatively small horizontal extent (i.e., patches of local intensification of a general super-refractive stratum). Borden and Vickers state:

The almost simultaneous appearance of the first moving targets with the [stationary] ground returns, [the latter] signifying the beginning of the temperature inversion, suggested that the target display was perhaps caused by some effects existing in or near the inversion layers.

The authors also relate similar target patterns observed during testing of a new radar at Indianapolis in November, 1952. They state:

Targets were larger, stronger, and more numerous than those observed by the writers during the Washington observations. At times the clutter made it difficult to keep track of actual aircraft targets on the scope.

In all major respects this report (Borden, 1953) is an excellent analysis of the probable radar situation during the July 1952, Washington sightings.

The atmospheric conditions in existence at the times of these UFO incidents, as shown in Figs. 13, 14, and 15, are rather peculiar. Refractivity profile for 19 July 2200 LST shows a surface inversion of 1.7°C (3.1°F) but the resulting refractivity gradient is only -81 km^{-1} , about twice the "standard" value. There is a rather unusual subrefractive layer at 3833 to 4389 m. produced by overlying moist air. Relative humidity drops from 84% at surface to 20% at base of this layer, then climbs to 70% at top of the layer. A number of significant levels are missing from this profile, which is common in 1952 Silver Hill profiles, but even so it is indicative of unusual atmospheric conditions. The radar sightings were made between 2340 LST and 0540 LST (July 20), and the atmospheric stratification was no doubt more strongly developed by that time. In addition, Silver Hill is at an elevation of 88 m. (289 ft.) above MSL, whereas Washington National Airport is at an elevation of only 13 m. (43 ft.). The intervening 75 m. is precisely that part of the atmosphere in which some of the most spectacular super-refractive and ducting layers would be expected to develop. Indeed, records for 1945-1950, during which radiosonde upper-air soundings were launched from Washington National Airport, reveal a much stronger tendency for the formation of anomalous propagation conditions than the Silver Hill data.

The profiles for 25 July and 26 July, 2200 LST are more complete than the 19 July profile, although some significant levels were noted as missing from the 26 July profile. Otherwise, the foregoing comments apply to these profiles as well. The 25 July profile shows a super-refractive surface layer and a strong elevated duct; there is a 4.6°C (8.3°F) temperature inversion through the elevated duct. It is perhaps significant that unidentified radar targets began appearing at 2030 LST

on 25 July. The 26 July profile has a 1.2°C (2.2°F) surface inversion without a humidity lapse sufficient to cause super-refraction; however, a 0.9°C inversion between 1115 and 1275 m. is associated with a sharp humidity drop and a resulting elevated duct with a gradient of -167 km^{-1} . This elevated layer is quite strong enough to produce AP effects on radar. Unidentified radar targets began appearing at 2050 LST on 26 July and continued until after midnight.

In summary, the following statements appear to be correct:

- (1) The atmospheric conditions during the period 19-20 and 25-27 July, 1952, in the Washington, D. C., area, were conducive to anomalous propagation of radar signals;
- (2) The unidentified radar returns obtained during these incidents were most likely the result of anomalous propagation (AP);
- (3) The visual objects were, with one or two possible exceptions, identifiable as most probably meteors and scintillating stars.

Wichita. Kans. area, 2 August 1965, "early morning hours"
up to "shortly after 0600" LST. Weather: clear, temperature 61°F to 70°F , wind at surface: light from WSW. This is classed as primarily radar since the bulk of the reports were from radar and the first visual object was never described. The refractivity profiles for Topeka, Kans. and Oklahoma City, Okla. are shown in Figs. 16 and 17.

During the early morning hours of 2 August 1965, the Wichita Weather Bureau Airport Station was contacted by the dispatcher of the Sedgwick County Sheriffs Department with regard to an object sighted in the sky near Wellington, Kans. (25 mi. south of Wichita). The radar operator, Mr. John S. Shockley observed what appeared to be an aircraft target near Udall, Kans., 15 mi. northeast of Wellington. This target moved northward at 40 to 50 mph.

During the next hour and a half several of these targets were observed on the radar scope over central Kansas moving slowly northward occasionally remaining stationary, or moving about erratically.

Figure 16

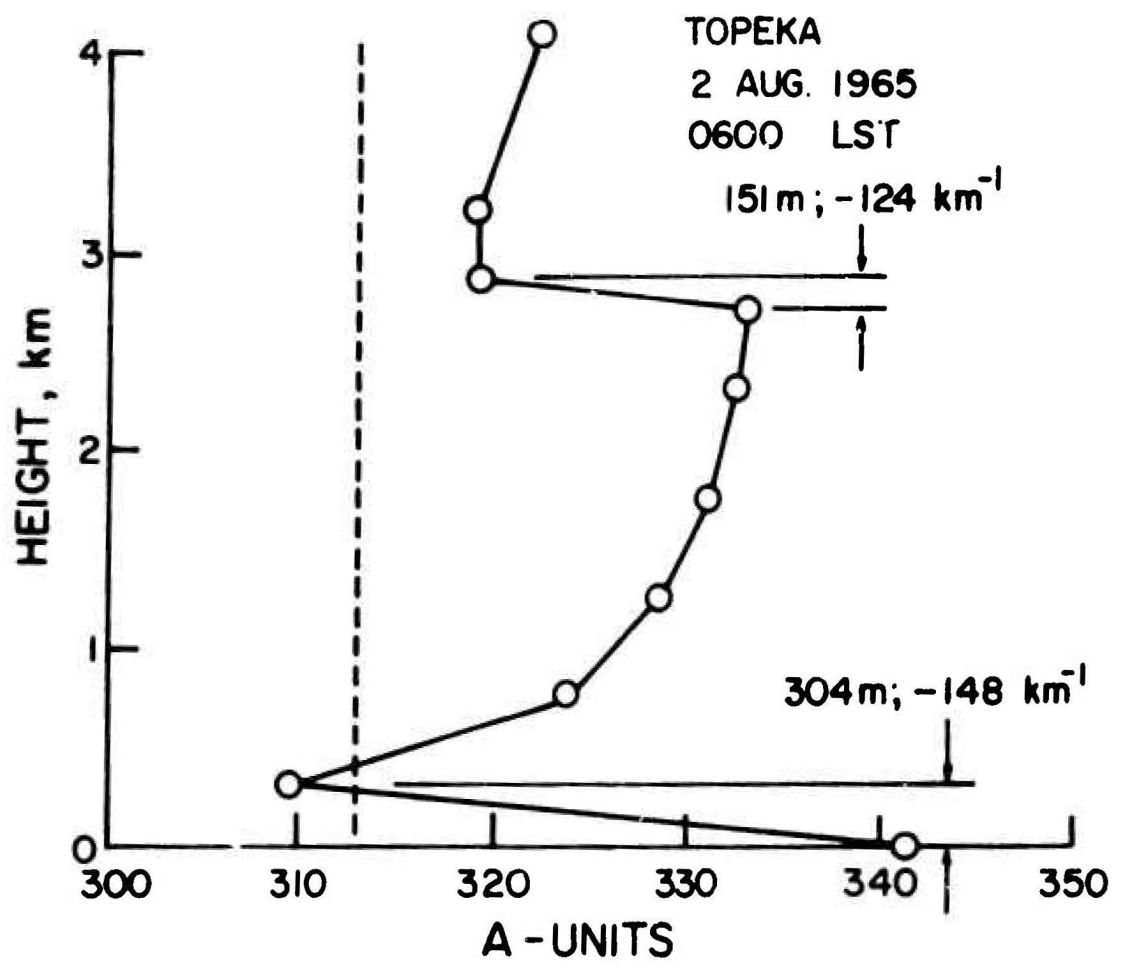
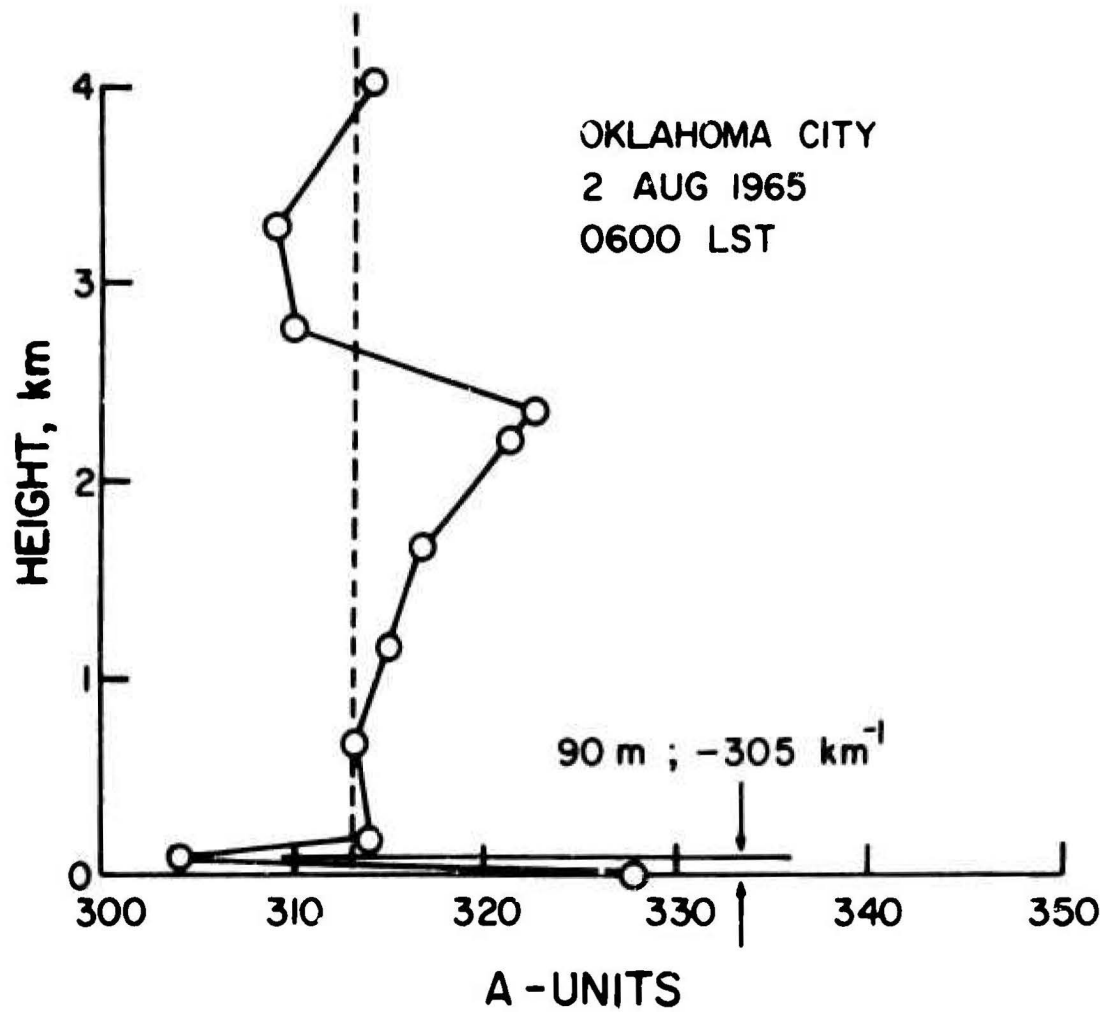


Figure 17



Mr. Shockley checked with the Wichita Radar Approach Control, however they were not able to observe a target simultaneously, with the exception of one aircraft south of McConnell Air Force Base near Wichita.

Later, a target was observed about seven miles NNW of Wellington, Kans., moving slowly southward. The Wellington Police Department was contacted and two officers went three miles west of the city, to see if they could observe anything. The target passed about one mile west of the city as observed on radar. The officers did not observe it until it was southwest of the city. They described it as a greenish-blue light that moved slowly away from them.

The dispatcher called again, with a report that two officers at Caldwell, Kans. (35 mi. south of Wichita) had sighted an object near the ground east of the city. A target was observed about two miles northwest of the city that moved northward and disappeared.

At daybreak, the dispatcher reported that the Wellington officers had an object in sight east of the city. Radar indicated a target in that area moving southward about 45 mph. Four or five people stopped their cars and watched the object with the officers. It was described as an egg-shaped object about the size of three automobiles, made of a highly polished silver metal.

Shortly after 0600C, a target was observed five miles north of Wellington moving southward. The target moved directly over the city to a point ten miles south of the city where it disappeared. The officers in Wellington were contacted but were able to observe absolutely nothing in the sky overhead during that time.

The radar was operated in long pulse, at 50 mi. range, with SIC off. The targets were coherent and appeared from six to nine thousand feet on the RHI scope during the early morning and about four or five thousand feet later in the morning.

The descriptions of most of the visual objects in this sighting are too cursory to allow for any reasonable conjecture as to the real

nature of the objects. One of the objects, described as "a greenish-blue light that moved slowly away," may have been a star.

In most instances the radar targets did not seem directly related to the visual UFOs. This is characteristic of radar anomalous propagation returns.

The refractivity profiles both show highly refractive surface layers, with a 6.7°C (12.1°F) surface inversion at Topeka and a 9.7°C (17.5°F) surface inversion at Oklahoma City. In addition, the Topeka profile shows a strong elevated layer at 2720 m. with a 0.6°C inversion. The temperature inversion at Oklahoma City produced a surface layer having an optical refractivity gradient (at 5570A) of -101 km^{-1} ; this layer would extend the theoretical optical horizon for the eye of an observer 2 m. above the surface of a smooth earth from the normal value of 5.6 km. (9 mi.) to 8.5 km. (about 14 mi.). Such inversions can produce many strange effects, including the visibility of objects normally well below the horizon.

In summary, since the atmospheric conditions were conducive to anomalous radar propagation, and the radar targets displayed AP-like characteristics, this incident may probably be classified as consisting of radar false targets, with associated optical sightings that may have been enhanced by a strong temperature inversion at the surface.

Class II-B. Primarily radar, returns mostly single, sharp, aircraft-like blips, behaving in a continuous manner (i.e., no sudden jumps, etc.).

19-B. Walesville-Westmorland, N. Y., 1-2 July 1954, 1105-1127 LST. Weather: apparently clear. On 1 July 1954 reports came into the AF Depot at Rome, N. Y. of an UFO having the appearance of a balloon. The officer in charge said he believed it to be a partially deflated

balloon, and if it were still there the next day, he would have it investigated.

On 1105 LST 2 July 1954, F-94C aircraft 51-13559 took off on a routine training mission. GCI requested the aircraft to change mission to intercept an unknown aircraft at 10,000 ft. The pilot identified a C-47 aircraft by tail number, and was then requested to check a second unidentified aircraft that was at low altitude and apparently letting down to land at Griffith AFB. The AF account states:

As the pilot started a descent, he noted that the cockpit temperature increased abruptly. The increase in temperature caused the pilot to scan the instruments. The fire warning light was on and the pilot informed the radar observer of this fact. The fire warning light remained on after the throttle was placed in "idle" so the engine was shut down and both crew members ejected successfully.

The aircraft crashed at the "Walesville Intersection," and was destroyed. The aircraft struck a house and an automobile, fatally injuring four persons.

The above account is from the official USAF accident report ("Summary of Circumstances"). There is no Blue Book file because no UFO was involved.

Conclusion:

- (1) The first object was probably a balloon;
- (2) There was no UFO in the aircraft accident case.

93-B. Wright-Patterson AFB, Ohio, August 1952, 1050-1113 LST. Weather: scattered clouds at 25,000 ft. This case, occurring almost over Project Blue Book's home base, is a very good example of confusion or contradictory evidence tending to obscure the true nature of a UFO incident.

At 1051 LST an unidentified radar track appeared 20 mi. NNW of Wright-Patterson AFB on the 664th AC&W Squadron's GCI radar at

Bellefontaine. The radar operator stated that the course was 240° at 400 knots. Elsewhere the report states 450 knots; how he determined this is not made clear. Two F-86 aircraft from the 97th Fighter-Interceptor Squadron, Wright-Patterson AFB, were vectored in and made visual contact at 1055 LST. Fighters stayed with the object until 1113 LST. The F-86s climbed to 48,000 ft., fell off, and made a second climb. One aircraft had airborne radar activated and received a "weak" return. The object was described as "silver in color, round in shape," and its altitude was estimated as 60,000-70,000 ft. The object appeared on the radar gunsight film as a "fuzzy, small image . . . with discernible motion . . . that could be any darn thing."

In this incident it is apparent that (1) the UFO was a real object and (2) the visual and radar sightings (both ground and airborne) were of the same object. All of the evidence points to a weather balloon except for the 400-450 knot speed, and the 240° flight path, which is against the prevailing upper winds. Known aircraft were ruled out because of the altitude. A U-2 would "fit," but the first one was not flown until 1955, and the visual appearance was all wrong. The radar returns eliminated astronomical objects, mirage was ruled out because of the high angles, and the sighting occurred "above the weather." The conclusion was: unknown.

However, buried deep in the report was the radar operator's note that "At the time it was dropped (1113 LST) object was five miles northwest of Springfield, Ohio." This allows the UFO's course to be plotted on a map; Figs 18 and 19, shows such a map plot. It is readily apparent from this that the UFO's true heading was about 111° at an average speed of only 44 knots. Apparently no one thought to make this simple check. Since the highest reported winds from the radiosonde launched at Dayton at 1000 LST were 260°/31 knots

Figure 18

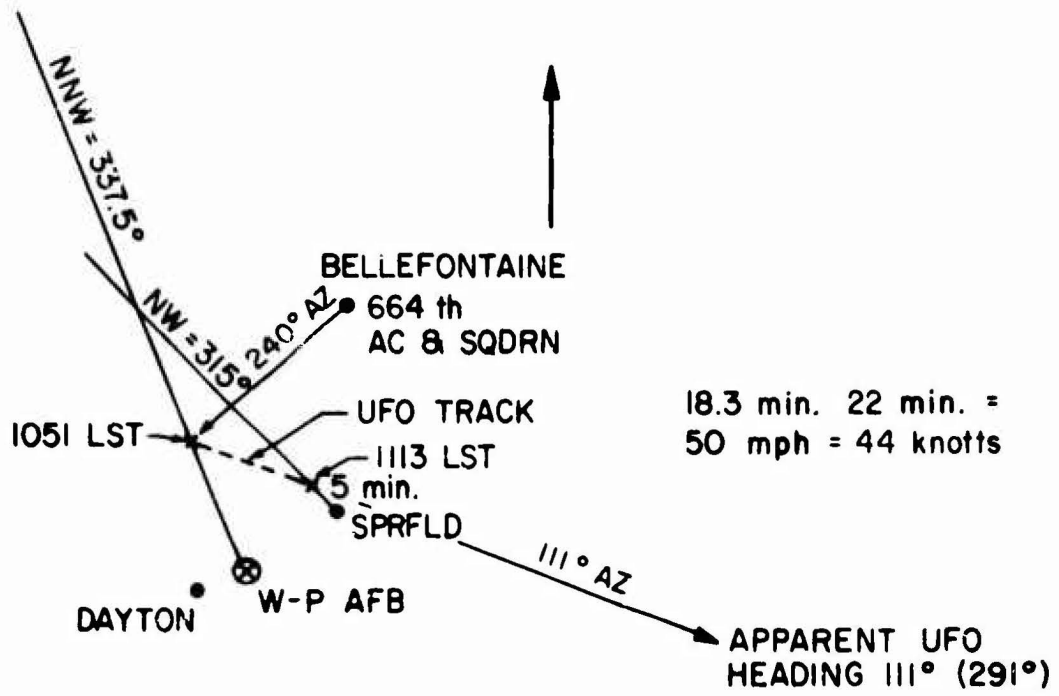


Figure 19

at 50,000 ft. and 270°/33 knots at 55,000 ft. the plotted track of the UFO is consistent with the observed upper winds. The blip was first "painted" at a 240° azimuth, which may explain where that quantity originated in the UFO movement report.

Conclusion: almost certainly a weather balloon. Note that the winds reported for the Wright-Patterson AFB 1000 LST show winds blowing first from the east, then from the SSE, ultimately from the west at higher altitudes. These winds were blowing in such a manner that it is conceivable that Wright-Patterson's own radiosonde balloon may have been the UFO in this incident.

7b-B. Near Charleston, W. Va., 4 May 1966, 0340 LST. Weather: Severe thunderstorms in area. Pilot of a Braniff Airlines Boeing 707 flying at 33,000 ft. observed on his left side what appeared to be a fast-flying aircraft with landing lights. Braniff's airborne radar recorded this unknown. Pilot requested the radar operator at Charleston sector of Indianapolis ARTC to look for traffic at his 8:30 or 9:00 position, and the radar picked up a track in this position. Return made a sweeping turn and disappeared off scope to the southwest.

An American Airlines pilot flying 20 mi. behind the Braniff plane saw the object. It appeared to him to be a normal aircraft with landing lights. This pilot stated he had often seen such aircraft with lights during AF refueling missions.

Estimated speed of the unknown was 750-800 mph. No unusual maneuvers were performed or any that were beyond known military aircraft capabilities at the time. AF explanation is that the unknown was an aircraft with landing lights on. This is consistent with the reported facts.

Case 2. Lakenheath, England, 13-14 August 1956, 2230-0330 LST. Weather: generally clear until 0300 LST on the 14th. (For details see Section IV.)

The probability that anomalous propagation of radar signals may have been involved in this case seems to be small. One or two details

are suggestive of AP, particularly the reported disappearance of the first track as the UFO appeared to overfly the Bentwaters GCA radar. Against this must be weighed the Lakenheath controller's statement that there was "little or no traffic or targets on scope," which is not at all suggestive of AP conditions, and the behavior of the target near Lakenheath -- apparently continuous and easily tracked. The "tailing" of the RAF fighter, taken alone, seems to indicate a possible ghost image, but this does not jibe with the report that the UFO stopped following the fighter, as the latter was returning to its base, and went off in a different direction. The radar operators were apparently careful to calculate the speed of the UFO from distances and elapsed times, and the speeds were reported as consistent from run to run, between stationary episodes. This behavior would be somewhat consistent with reflections from moving atmospheric layers -- but not in so many different directions.

Visual mirage at Bentwaters seems to be out of the question because of the combined ground and airborne observations; the C17 pilot apparently saw the UFO below him. The visual objects do not seem to have been meteors; statements by the observers that meteors were numerous imply that they were able to differentiate the UFO from the meteors.

In summary, this is the most puzzling and unusual case in the radar-visual files. The apparently rational, intelligent behavior of the UFO suggests a mechanical device of unknown origin as the most probable explanation of this sighting. However, in view of the inevitable fallibility of witnesses, more conventional explanations of this report cannot be entirely ruled out.

Kincheloe AFB, Sault Saint Marie, Mich., 11-12 September 1967, 2200-2330 LST. Weather: clear, ceiling unlimited, visibility unlimited (over 20 mi.), no thunderstorms in area, wind at surface $140^{\circ}/4$ knots, aloft $240^{\circ}-270^{\circ}/15-35$ knots. The radio refractivity profile from Sault Saint Marie for the most applicable time is shown in Fig. 21.

This is a good example of moving radar targets that cannot be seen visually, where there is a "forbidden cone" over the radar site. Some of the returns were even seen to approach within 5-15 mi. of the radar and disappear, apparently subsequently reappearing on the other side of the radar scope at about the same range that they disappeared. This sort of behavior is symptomatic of AP-echoes.

The meteorological data tend to confirm this interpretation. The refractivity profile shown in Fig. 21 displays three peculiarities: a strong subrefractive layer at the surface, a strong elevated duct at 325-520 m. (about 1100-1700 ft.) and a super-refractive layer at 1070-1360 m. (about 3,500-4,500 ft.). A ray-tracing is shown for this profile in Fig. 20. The ray shows noticeable changes in curvature as it passes through the different layers, an indication that strong partial reflections would be expected. With this profile, moving AP-echoes, produced in the manner described by Borden and Vickers (1953), could be expected to appear at apparent heights of between 2,000-3,000 ft. and 7,000-9,000 ft. No height information was supplied with this report, so the calculation above cannot be verified.

In summary, it appears that this is a case of observations of moving AP-echoes produced by unusually well stratified atmospheric conditions.

156-B. Gulf of Mexico, Coast Guard Cutter "Sebago," $25^{\circ}47'N$ $89^{\circ}24'W$, 5 November 1957, 0510-1537 LST. Weather: not given, but apparently some clouds in area. The most applicable radio refractivity

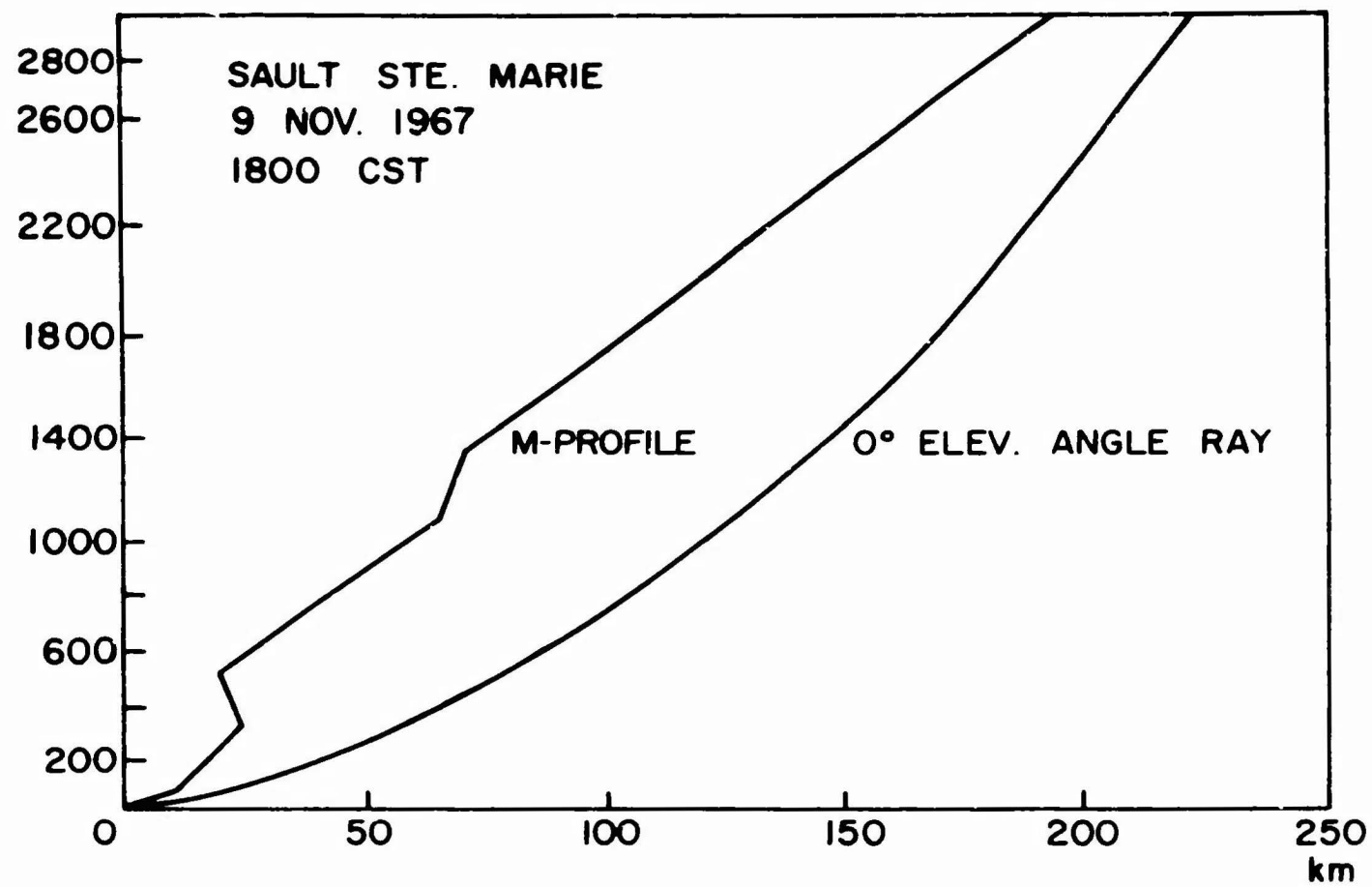
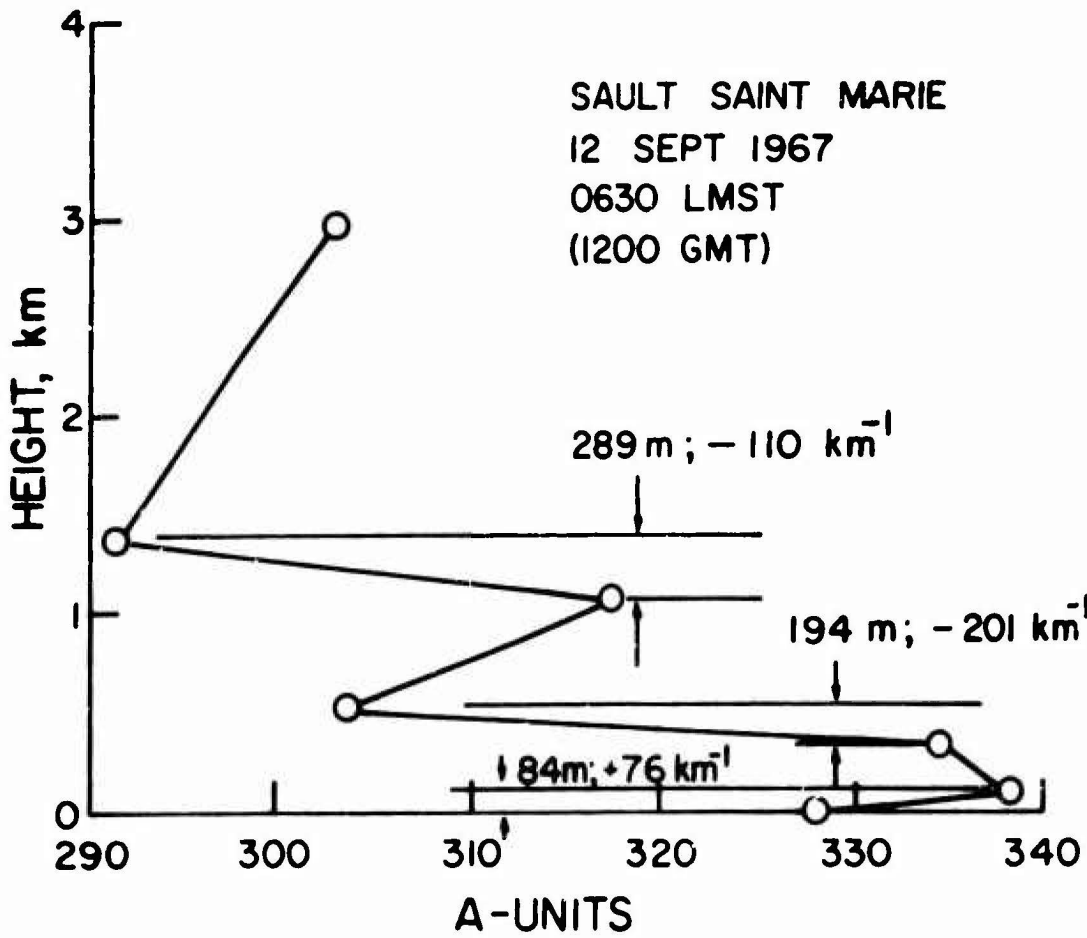


Figure 20

Figure 21



data available are for Key West, Fla. 0600 and 1800 LST, 5 November 1957. They are shown in Figs. 22 and 23. One visual and three radar objects were included in this case. The ship's heading was 23° true. The first contact was a radar blip picked up at 0510 LST at 290° true azimuth, 14 mi. It moved south, approached the ship within 2 mi., and returned north along ship's port side. Contact was lost at 0514 LST. Average speed of this UFO was calculated as 250 mph. At 0516 LST a new blip was picked up at 188° , 22 mi.; this target departed at a computed 650 mph., disappearing at 0516 LST at 190° , 55 mi. The third radar target was acquired at 0520 LST at 350° , 7 mi.; it appeared to be stationary. While the third radar target was being watched on the scope, a visual object was observed for about 3 sec. at 0521 LST travelling from south to north at about 31° elevation between 270° and 310° azimuth. The third radar target remained stationary for about 1 min. and then slowly moved to the northeast, finally accelerating rapidly and moving off scope at 15° , 175 mi.

The visual object was described as "like a brilliant planet;" it was undoubtedly a meteor, and in any event obviously was unrelated to radar target number three, the only radar target visible at the same time.

The radar targets were, with the possible exception of the first one, erratic and unpredictable in their movements. The second and third radar blips appeared suddenly, well within the normal pick-up range of the ship's radar. These two blips were probably caused by anomalous propagation. The two Key West profiles, although taken at some distance from the ship's position, are indicative of rather unusual atmospheric conditions in the area. Indeed, the 1800 LST profile is probably one of the most unusual radio refractive index profiles that has ever been observed. The atmospheric structure was apparently one of alternating very wet and very dry layers. Patterns of this sort are often very stable in these subtropical latitudes,

Figure 22

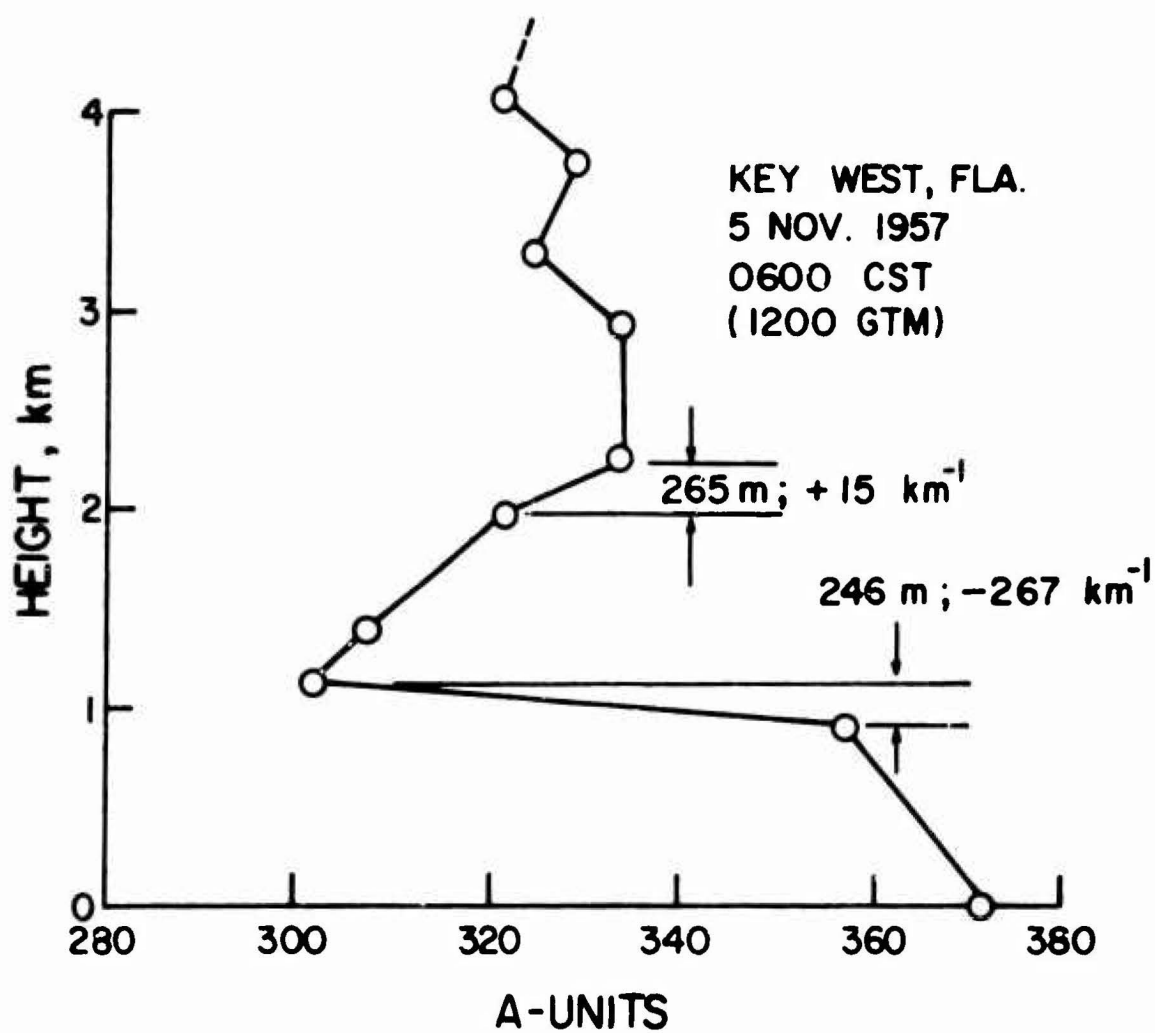
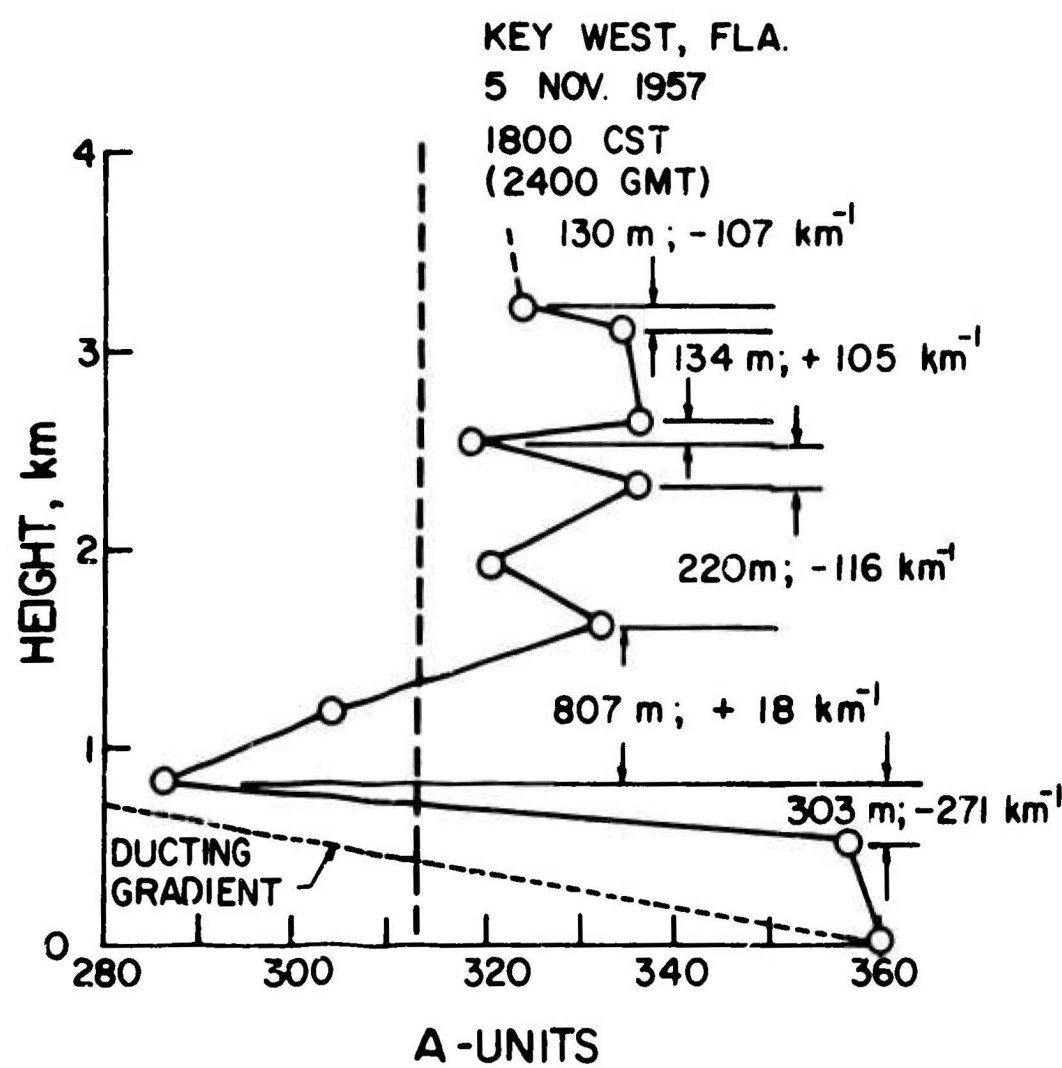


Figure 23



and tend to extend in rather homogeneous form over large horizontal distances. The ray-tracing of this profile, Fig. 23a, shows even greater changes in ray curvature. Strong partial reflections should be expected under these conditions.

The first radar target behaved generally like an aircraft, and the AF investigators were of the opinion that it was an aircraft, probably from Eglin AFB to the north.

In summary, the weight of evidence points toward anomalous propagation as the cause of the radar echoes, the first possibly being an aircraft. The visual object was apparently a meteor.

Coincidentally, the ship, SS Hampton Roads, at 27°50'N 91°12'W sighted a round, glowing object high in the sky that faded as darkness approached at 1740-1750 LST. This object appeared to move with the upper winds. AF investigators concluded that it was in all probability a weather balloon.

101-B. Canal Zone, 25 November 1952, 1806-2349 LST. Weather: generally clear, a few scattered clouds, ceiling and visibility unlimited, visibility at 2,000 ft. was 50 mi. Radio refractivity profiles for Balboa, 1000 and 2200 LST 25 November 1952, are shown in Figs. 24 and 25. Two unidentified objects were tracked by gun-laying radar during the period 1806-2349 LST. These objects, never present simultaneously, could have represented two tracks of the same object. The radar returns were described as "firm and consistent," and the objects were said to maneuver in a "conventional manner" at an average speed of 275 knots. Apparently the track speeds were as high as 720-960 mph. at times. Two B-26s, a B-17, and a PBM were scrambled but no radar or visual contact could be made with the unknowns. The UFOs were not spotted from the ground, with the exception of a single report that an officer saw, low in the sky, an "elongated yellow glow" giving a soft light like a candle. It moved quickly, disappearing in the

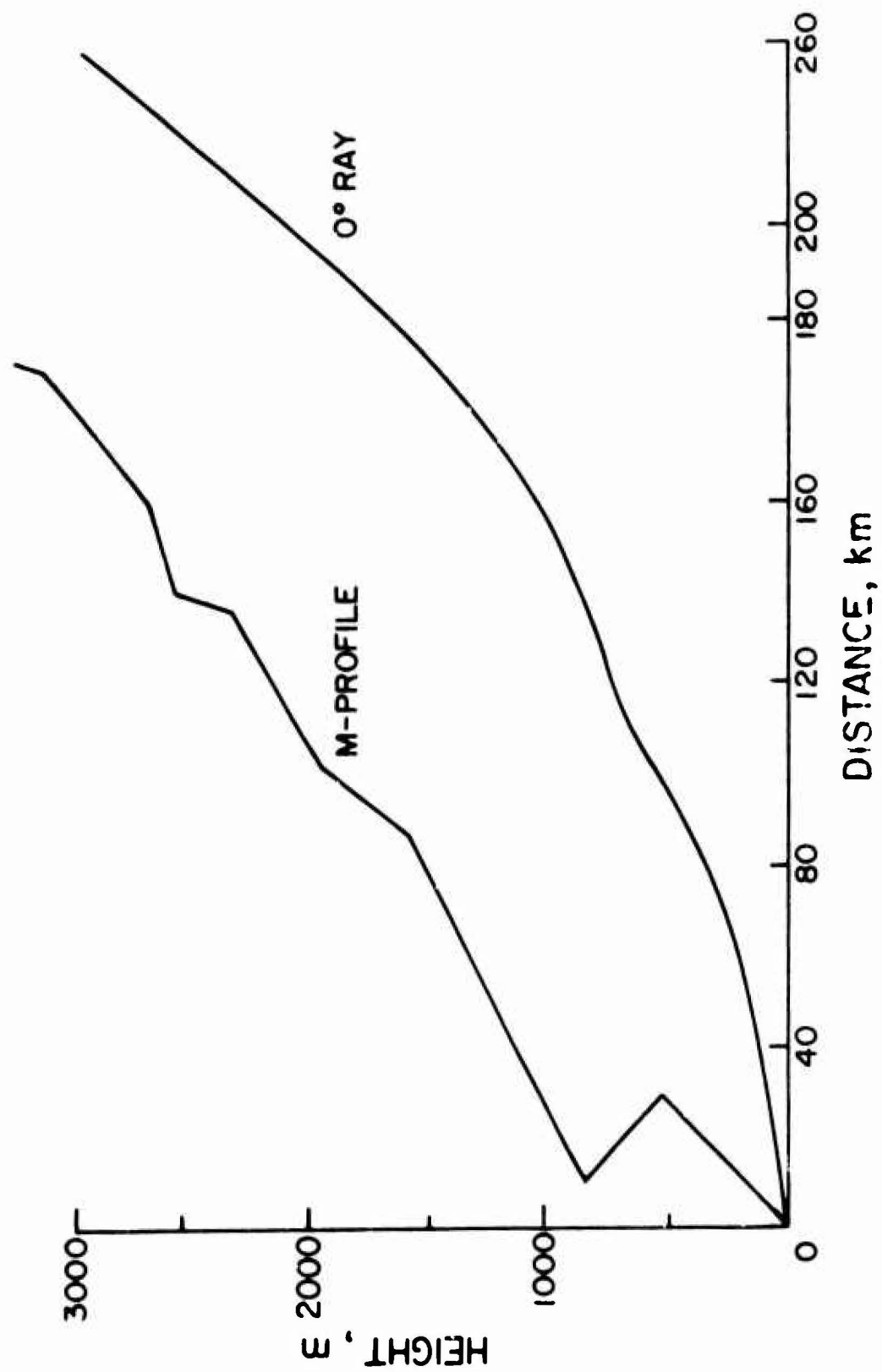


Figure 23-a

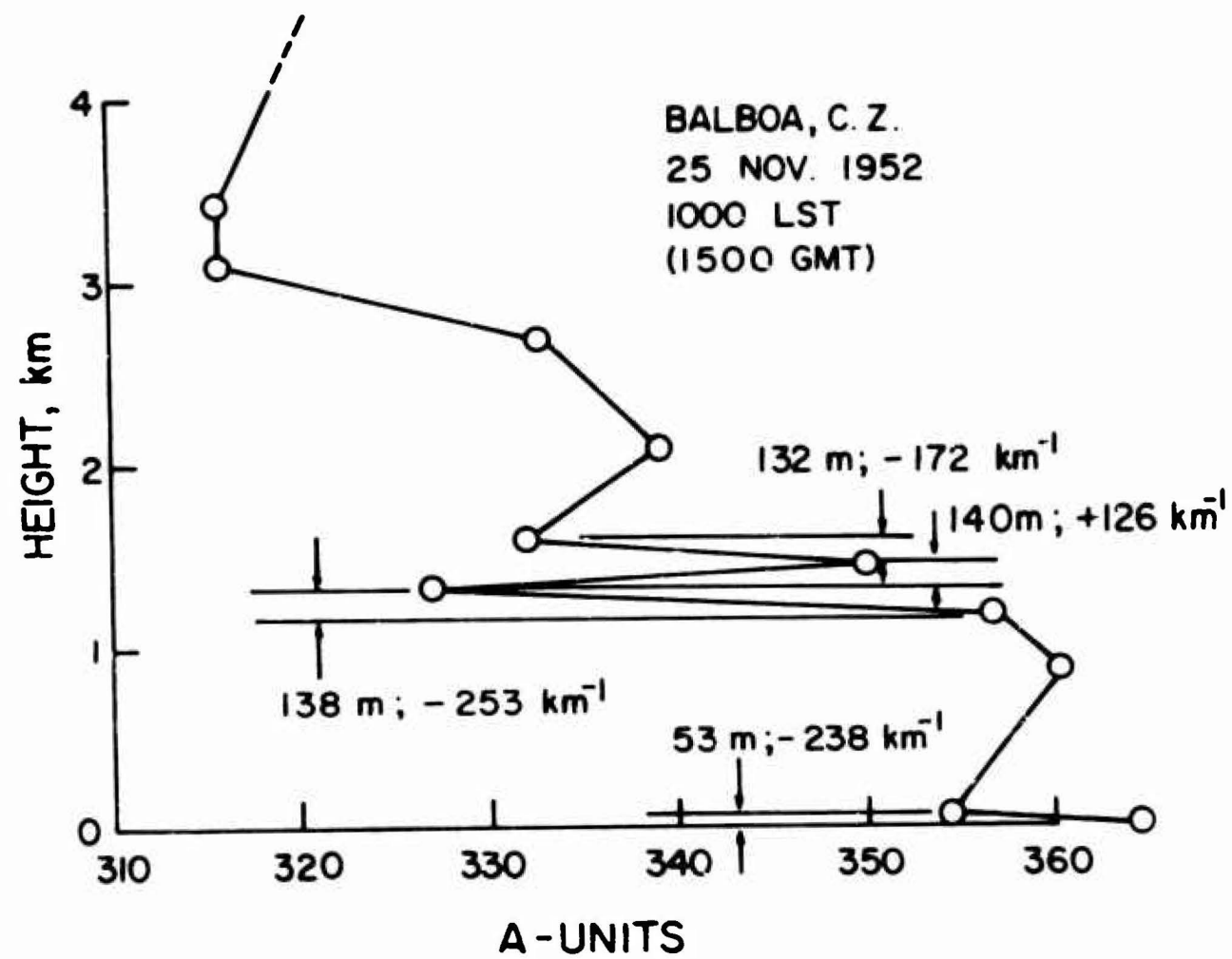


Figure 24

Table 4

Sample Characteristics, February 1968, ORC Caravan Survey: Adult Sample

The data in the table below compare the characteristics of the weighted ^{1/} Caravan sample with those of the total population, 18 years of age or over. The table shows that the distribution of the total sample parallels very closely that of the population under study.

	<u>Total</u>		<u>Men</u>		<u>Women</u>	
	<u>Popu-</u>	<u>Caravan</u>	<u>Popu-</u>	<u>Caravan</u>	<u>Popu-</u>	<u>Caravan</u>
	<u>lation</u>	<u>Sample</u>	<u>lation</u>	<u>Sample</u>	<u>lation</u>	<u>Sample</u>
<u>Age</u>						
18 - 29	26%	26%	25%	25%	26%	27%
30 - 39	18	18	19	17	17	19
40 - 49	19	20	20	20	19	19
50 - 59	16	16	16	18	16	15
60 or over	21	20	20	20	22	20
<u>Race</u>						
White	89%	89%	90%	89%	89%	89%
Nonwhite	11	11	10	11	11	11
<u>City Size</u>						
Rural, under 2,500 population	29%	31%	30%	35%	27%	27%
2,500 - 99,999	19	21)			
100,000 - 999,999	23	23)	70	65	73
1,000,000 or over	29	25)			
<u>Geographic Region</u>						
Northeast	25%	25%	25%	25%	25%	25%
North Central	28	26	28	26	28	26
South	30	33	30	33	30	32
West	17	16	17	16	17	17

^{1/} Weights were introduced into the tabulations to compensate for differences in size of household and variations in completion rates between rural and urban areas.

^{2/} Source: Latest data from U. S. Bureau of the Census, regular and interim reports.

Table 5

Sample Characteristics, February 1968, ORC Caravan Surveys: Teen Sample

The data in the table below compare the characteristics of the Caravan sample households with those of all households in the United States.

	<u>U. S. Households^{1/}</u>	<u>Caravan Sample</u>
<u>Geographic region</u>		
Northeast	25%	24%
North Central	28	27
South	30	32
West	17	17
<u>City size</u>		
Rural	28%	29%
2,500 - 99,999	19	22
100,000 - 999,999	23	23
1,000,000 or over	30	26
<u>Race</u>		
White	90%	89%
Nonwhite	10	11
<u>Family composition</u>		
No children	51%	48%
Children under 18	49	52
With teen-agers 12 - 17	21%	23%

^{1/} Source: Latest data from U. S. Bureau of the Census, regular and interim reports.

The names drawn came from four major sources: case reports from Blue Book, case reports from NICAP, personal reports (i.e., cases from individuals who directly contacted the project), and reports from the file of all cases which have been investigated or extensively reviewed by the project staff.

An attempt to obtain approximately 50 completed questionnaires each from the Blue Book, NICAP, and "Personal" files was undertaken by a systematic sampling procedure. In the case of the Colorado investigation file, the names and addresses of sighters were taken from all files extant at the time the sample was drawn. When more than one sighter per report was listed, the case was reviewed to determine who was the principal sighter, and only that person's name was drawn.

A large number of cases did not include satisfactory mailing addresses for sighters. Consequently, it was necessary to select the next occurring file that did include a complete address in either the United States or Canada. Following this procedure, a total of 139 cases were drawn from the Blue Book file to obtain 106 names and addresses, 140 cases from the NICAP file to obtain 95 names and addresses, and 55 cases from the Personal file to obtain 54 names and addresses.

In the spring of 1968, each person whose name was thus drawn was sent a letter explaining the purpose of the intended opinion survey and requesting his participation. Anonymity of the individual was assured. Enclosed with the letter was a reply postcard on which the sighter could indicate whether or not he would be able to participate. Some letters were returned by the post office for insufficient address; no reply was received to some letters. Of those from whom we received affirmative replies (and therefore to whom we sent questionnaires), most participated in the survey. A comparison of the percents participating, not participating, failing to reply to the request letter, and failing to receive the letter, for lack of sufficient address, for the four file sources appear in Table 6.

As would be expected, the rate of response is best for the "Personal" file. Most individuals represented in this file are those who volunteered information. In addition, a larger proportion of these cases occurred

Table 6
Response of Sighters from Project Files to Questionnaire

	Blue Book	NICAP	Personal Letters	Colorado	Total
Participants	20%	29%	57%	36%	32%
Non-participants	14	12	17	18	14
No Reply	47	55	22	44	45
Insufficient Address	19	4	4	2	9
Total Mailing	100%	100%	100%	100%	100%
N =	(106)	(95)	(54)	(39)	(294)

since the beginning of the project. Among the four files, the greatest proportion of letters returned for insufficient address were sent to sighters whose names were drawn from the Blue Book file. The proportion of "no reply" persons is difficult to interpret, because it is impossible to know how many letters were never received and how many were received but went unanswered. Both Blue Book and NICAP files have the greatest proportion of older sightings, which in part accounts for their relatively poorer rate of return. The final sighter sample, on which the analyses are based, consists of 21 sighters from the Blue Book file, 28 from the NICAP file, 31 from the Personal file, and 14 from the Colorado investigations file.

D. College survey

College survey data were obtained between 4 April and 13 May 1968 from 12 college samples, representing 10 colleges and universities. The total number of students participating in the survey is 719. The names of the institutions participating and those individuals who assisted us in obtaining subjects appear in Appendix M. All but three sources of respondents were courses in the behavioral sciences; one participating class was in a physical science department and two were special courses in flying saucers, one offered at the University of California at Davis and the other at Wesleyan University. A description of the samples appears in Table 7. In this table, sample numbers correspond to the order in which completed questionnaires were received; however, the order of schools in Appendix M, referred to above, is alphabetical. Most questionnaires were filled out during a class period by students present on the day the questionnaire was administered. In a few cases, volunteers, rather than every student present, provided the data. In most instances students were not aware, until after they had completed filling out the questionnaire, that the research was being sponsored by the Colorado project.

Although group, rather than individual responses were of interest, students were asked to place their names on the questionnaires, in order to discourage careless or irresponsible answers. (A few students chose not to provide their names; one class was required by its instructor to

Table 7
College -- University Sample Characteristics

Sample	N	Administered To	Course Title	Aware of CU Sponsorship
1	118	Class	Intro. Psychology	No
2	29	Class	Flying Saucers	No
3	88	Class	General Psychology	No
4	76	Class	Abnormal Psychology	No
5	99	Class	Psychology of Personality	No
6	95	Class	Child Psychology	No
7	26	Class	General Physics	No
8	19	Class	Flying Saucers	No
9	91	Class	Intro. Psychology; Psychology of Adult Life	No
10	44	Volunteers	Intro. Sociology	No
11	15	Volunteers	Intro. Sociology; Anthropology	Yes
12	19	Volunteers	Intro. Psychopathology	Yes

fill in the questionnaires anonymously). The results of Scott's study (1968) indicate that responses regarding UFO material under public conditions may be more cautious than under private conditions. Consequently, it was felt that if there were any sample bias in assessing students' views on UFOs and related topics, it would be in the direction of obtaining cautious answers. Moreover, national opinion survey respondents were assessed by personal interview (though anonymity was assured), and the participants of the sighter survey were aware that their names were known to the investigator (though, again, anonymity was assured). Requesting names from students, then, also make the conditions under which this information was obtained more comparable to the other surveys.

Because the results of the national survey of adults serve to reflect the opinions and attitudes of the American adult public, they are given the greatest emphasis in the following analyses. Because of time limitations, only a portion of the data collected on each of the four groups could be analysed.

Survey Instruments

The instruments of this study are both attitude scales and questionnaires. Because some instruments are common to all four surveys (adult, teen, college, and sighter) while others are not, the instruments are listed according to survey, so that the set of instruments used in each is apparent. A brief description of each instrument is provided the first time it is mentioned, except in those few instances in which the data from them are not included in the present analyses. In such cases, the description of the instrument will be found in Appendix N, where it precedes the instrument.

A. Adult sample, national opinion survey

1) UFO Opinion Questionnaire. This instrument is comprised of 29 statements regarding UFOs and related topics. All are presented as opinion statements; the respondent indicates whether he feels that the statement is definitely false, probably false, probably true, or definitely true.

The items are considered singly, as expression of opinion on separate topics, and as sets comprising the following scales:

a) Outer Space scale -- measures the degree to which respondents accept the hypothesis that UFOs are from outer space;

b) Evidence scale -- measures the degree to which respondents believe that there is evidence for the existence of UFOs (This scale, however, does not include items which suggest the origin of UFOs. The respondent may, if he wishes, reject the extra-terrestrial or outer space hypothesis, but still indicate that he believes there is evidence to support the hypothesis that UFOs do exist,

c) Adequacy scale -- measures the degree to which efforts of the government and its agencies in investigating UFO reports are perceived to be adequate;

d) Secrecy scale -- measures the degree to which government secrecy regarding information about UFOs is believed to exist.

A respondent's scale score was determined first by scoring the answer to each statement in the scale either zero or one, according to whether the response was in the direction of acceptance (1) or rejection (0) of the variable measured by the scale itself, then obtaining the mean score for those items of the scale which were answered.

Scale composition was determined jointly by manifest content and inter-item correlations, based on a sample of 205 of the surveyed adults, chosen by a systematic sampling procedure. The composition of each of the scales may be found in Table 8. Homogeneity rates (Scott, 1960) and coefficient alphas (Cronbach, 1951) for the scales appear in Table 8a. Scale intercorrelations (Pearson Product Moment Coefficients (McNemar, 1962)) may be found in Table 9.

2) A-B Scale -- (The instrument is not included in the present analyses. Its description appears in Appendix O).

3) Adult Background Questionnaire -- Includes questions concerning the following:

- a) demographic information;
- b) opinions regarding the reporting of UFO sightings;

Table 8
Item Composition of Attitude Scales

Scale	Question Number	Question
1. Outer Space	1.	Some flying saucers have tried to communicate with us.
	11.	Earth has been visited at least once in its history by beings from another world.
	13.	Intelligent forms of life cannot exist elsewhere in the universe.
	15.	Some UFOs have landed and left marks in the ground.
	23.	People have seen space ships that did not come from this planet.
2. Evidence	6.	No airline pilots have seen UFOs.
	8.	No authentic photographs have ever been taken of UFOs.
	24.	Some UFO reports have come from astronomers.
3. Competence	3.	The Air Force is doing an adequate job of investigation of UFO reports and UFOs generally.
	12.	The government should spend more money than it does now to study what UFOs are and where they come from.
	18.	The government has done a good job of examining UFO reports.
4. Secrecy	19.	There have never been any UFO sightings in Soviet Russia.
	22.	There is no government secrecy about UFOs.
	28.	Government secrecy about UFOs is an idea made up by the newspapers.

Table 8a
Reliability of Opinion Scales
 (based on adult sample)

Scale	Homogeneity Ratio	Coefficient Alpha
Outer Space	.31	.69
Evidence	.22	.46
Adequacy	.19	.46
Secrecy	.24	.49

Table 9
Intercorrelation of Opinion Scales
 (based on the adult sample)

Scale	1	2	3	4
1. Outer Space	-			
2. Evidence	.40	-		
3. Adequacy	-.32	-.26	-	
4. Secrecy	.22	.32	-.18	-

c) acquaintance with UFO phenomena.

4) Background Questionnaire of the Opinion Research Corporation -- Contains questions frequently asked by them for all clients.

B. Teen sample, national opinion survey

1) UFO Opinion Questionnaire.

2) Teen Background Questionnaire -- comprised of background questions appropriate for teen-agers.

C. Sighter survey

1) UFO Opinion Questionnaire.

2) Sighter Background Questionnaire -- includes demographic measures, questions regarding the reporting of UFOs, and question about information sources.

D. College survey

1) College information sheet.

2) UFO Opinion Questionnaire.

3) A-B Scale.

4) Current Events Questionnaire. (Neither the A-B Scale nor the Current Events Questionnaire is included in the present analyses. Their descriptions appear in Appendix P).

5) College Background Questionnaire -- comprised of background questions appropriate for college students.

Results and Discussion

The analyses of the data which are to be reported are of three kinds. The first section concerns the proportion of the population who identify themselves as sighters and the demographic characteristics of sighters and nonsighters. In the second section, the reporting of UFOs and attitudes toward reporting are examined. In the final section attitudes toward UFOs and related topics are discussed; data from each of the four groups surveyed are presented.

Sighters and nonsighters

All adults in the national survey were asked the question, "Have you, yourself, ever seen a UFO?" Three percent of the sample indicated that they had. In order to provide an analysis parallel to our analysis of the Gallup study's question, "Have you ever seen anything you thought

was a 'flying saucer'?" the replies to the above question were examined with respect to four demographic variables: region, sex, age, and education. It was found that the proportion of sighters in the various regions of the country, East, Midwest, South, and West, are similar. Equal percentages of men and women say that they have seen an UFO. There are also no differences among age or educational levels. Differences with respect to these demographic variables, except for region of the country, were also absent in the project's analysis of the 1966 Gallup data.

A point at which the results of the above analyses do not agree with those of the Gallup survey concerns the proportion of the public who say that they have seen an UFO. Three percent of our sample said they had seen an UFO while 5% of those polled in the Gallup survey indicated that they had seen as the question was worded, a "flying saucer." The difference between the results of the two surveys approaches statistical significance. The apparent discrepancy between the findings of the Gallup and the Colorado project surveys may be due to one or more variables, such as the difference in the wording of the two questions, or difference in sampling techniques.

The findings of the study undertaken by the Colorado project suggest that the actual number of sighters in the United States is approximately 3.75 million. This estimate is based on the continental U. S. civilian population, 18 years of age and over (*Current Population Reports*, 14 February 1968), the parameters of which were used in determining the survey sample characteristics.

The actual number of sighters may, however range from as few as 1,000,000 to as many as 5,000,000. (A range, as compared with a specific number, takes into account possible sampling variation).

Views on reporting

Attitudes toward the reporting of UFOs were covered in one of the Colorado project questionnaires by nine questions, five addressed to sighters and four to nonsighters. The previously conducted opinion surveys, by Gallup (1947, 1950, 1966) attempted to estimate the percentage of the American population who had heard of flying saucers and, in the 1966 survey, the number of sighters in the American population. However,

the Gallup organization did not attempt to determine what proportion of these self-designated sighters actually reported their sightings.

A study which provides a basis for comparison is one concerned with the reporting of crimes. It was made for the President's Commission on Law Enforcement and Administration by the National Opinion Research Center under the direction of Philip Ennis (1967a, 1967b). This study revealed that 51% of those interviewed who had been the victims of crimes did not report them to the police (1967b). After reviewing the reasons people gave for not notifying the police, Ennis made the following observations (Ennis, 1967b):

First there is strong resistance to invoking the law enforcement process even in matters that are clearly criminal. Second, there is considerable skepticism as to the effectiveness of police action.

Inasmuch as people show reluctance to report crimes, it should not be surprising to find that something thought to be an UFO frequently goes unreported by the sighter. In fact, it is commonly said that sighters are reluctant to report such events because of ridicule. (There are, in fact, some cases in which publicity and ridicule appear to have influenced the sighter to change jobs or move to another town).

The questions designed to assess the reporting process in the present study were asked of sighters to ascertain whether or not they had reported their sightings and the reasons for their decisions, and of nonsighters, under a hypothetical circumstance of having seen an unusual object suspected to be an UFO, to determine whether they thought they would report a sighting and their reasons for their decision. In addition, sighters who had reported their sightings were asked to express their degree of satisfaction with the way in which the report was handled.

The first of the questions concerns the agency to which sighters had reported an UFO; the second, the agency to which nonsighters would report an UFO. The responses of national survey nonsighters appear in Table 10 . Data for sighters identified in the national survey are not presented in the table because they are based on so few individuals that the results have no statistical validity. Data for sighters drawn from

Table 10
Preference of Nonsighters for Agency to Which to Report an UFO

Agency	Percent
Town or city official	10%
Police	56
Newspaper	10
Radio station	9
NICAP	5
APRO	3
Local UFO organization	8
Air Force	15
Airport	5
Weather bureau	5
Other	1
No one (other than family or friends)	16
Total	143%*
N =	(1608)

*In this and subsequent tables, percents are based on the total number answering the question.

project case files are also not presented, because the percentages obtained primarily reflect the sources from which the sighters' names were drawn.

The primary finding from the sighters' question is that 87% of sighters indicated that they reported the sighting to no one other than family or friends. It would seem, then, that most sightings have little chance of coming to the attention of an agency, whether official, semi-official, or private. The failure to report UFO sightings appears to be more prevalent, 87%, than the failure to report crime, 51%, as indicated in the Ennis reports (1967a, 1967b).

By contrast, only 16% of the nonsighters indicated that they would notify no one save family or friends. In addition, over half of the nonsighters, 56%, indicated they would notify the police. There is clearly, a considerable discrepancy between results for sighters and for nonsighters.

At least two possible explanations may account for the discrepancy between what people say they would do (responses of nonsighters) and what they in fact do, (responses of sighters) given the actual circumstance of a sighting:

- (1) The number of sighters in the study is small and thus may not accurately reflect the action of all sighters;
- (2) Entertaining the hypothetical situation of having seen something suspected to be an UFO and actually being confronted with the decision precipitated by a sighting are quite different events.

Although both sighters and nonsighters were asked for their reasons for reporting, responses from sighters identified in the national survey were not statistically meaningful because the answers are from so few respondents. Reasons given by nonsighters, which represent a response to a hypothetical situation, are interesting primarily in that they may be regarded as reflecting the views of most of the American public. As can be seen in Table 11, the dominant reason of nonsighters is "I would want to know what it was." The other alternative frequently endorsed is "because strange objects should be reported."

In the questionnaire for project sighters was an identical question. Project sighters' reasons appear in Table 12. These sighters, who

Table 11
Major Reason for Reporting Given by Nonsighters
Who Indicated They Would Report an UFO

Reason	Percent
I would want to know what it was	49%
Because strange objects should be reported	36
I would be worried about it	7
Because other people have seen UFOs	--
It is the best way to convince people that UFOs really exist	4
Other	3
Total	100%
N =	(1382)

Table 12
Reasons for Reporting Indicated by Sighters from Project Files

Reason	Percent
I wanted to know what it was	29%
Because strange objects should be reported	43
I was worried about it	6
Because other people have seen UFOs	2
It is the best way to convince people that UFOs really exist	11
Other	31
Total	122%*
N =	(94)

*Percents total more than 100% because multiple reasons were permitted.

filled in a questionnaire sent to them, tended to give more than one "major reason." The alternatives "because a strange object should be reported," "other" (reason supplied by the respondent), and "I wanted to know what it was" were most frequently indicated, in that order.

The sighters in the national survey who reported their sightings and the project sighters both were asked: "How satisfied were you with the way your report of the UFO was handled?" Those few sighters in the national survey who reported were about evenly divided between satisfaction and dissatisfaction; again problems of interpretation arise because the results are based on *only seven sighters*. The responses of project sighters are presented with qualifications. These individuals received their questionnaires directly from the project and the fact that they had been asked by us for further information may have altered their evaluations of the "handling of the report." More than two-thirds were satisfied. Not to be overlooked in the interpretation of these findings is the fact that their reports had survived the reporting process and had become case files.

The remaining national survey respondents, sighters who did not report and nonsighters who said they would not report a sighting, were asked to indicate which reasons influenced their decisions. Respondents were permitted to indicate as many reasons as influenced their decision, and they were asked to indicate the one reason that was the most important. A comparison of Table 13, a summary of *sighter* responses, and Table 14, a summary of *nonsighter* responses, shows that the *sighter* and *nonsighter* groups are quite similar. The most important reason of both for not reporting was that the event was probably "something normal that must have looked funny for one reason or another." Fear of ridicule was the reason second in order of importance for both sighters and nonsighters. The combined replies to alternatives 6 and 8 which are concerned with knowledge about whom to notify and how to notify is third in order of importance, and the combined replies to alternatives 4 and 5 which suggest ineffectiveness and indifference on the part of authorities rank only fourth.

These findings contrast markedly with those of Ennis, who found that more than one-half of the victims who did not report crimes had a negative

Table 15
Sighters' Reasons for Not Reporting the Sighting
to Anyone Other Than Family or Friends

	Reasons Influencing Decision	Most Important Reason
1. Did not want to take the time, might mean time lost from work	0%	0%
2. Afraid of ridicule; people would think I was a nut or crazy	28	19
3. Thought it was a private matter	26	8
4. Authorities couldn't do anything	19	4
5. Authorities wouldn't want to be bothered about it	23	6
6. Didn't know how to notify them or know that they should be notified	26	10
7. Too confused or upset to notify them	4	0
8. Didn't know to whom to report it	13	6
9. It was probably something normal that just looked funny for one reason or another	58	40
Total	197%*	92%**
N =	(35)	(34)

* Percents do not total 100 because multiple reasons were permitted.

** Percents are based on the total number on non-reporters answering the question. Eight percent of the respondents are not represented because they indicated more than one reason.

Table 14
Nonsighters' Reasons for Not Reporting the Sighting
to Anyone Other Than Family or Friends

	Reasons Influencing Decision	Most Important Reason
1. Would not want to take the time, might mean time lost from work	7%	1%
2. Afraid of ridicule; people might think I was a nut or crazy	38	20
3. Would think it is a private matter	12	4
4. Authorities could not do anything about it	21	7
5. Authorities would not want to be bothered about it	16	4
6. Do not know how to notify them or that they should be notified	22	4
7. Would be too confused or upset to notify them	9	3
8. Would not know to whom to report	31	12
9. Probably the thing seen would be something normal that just looks funny for one reason or another	63	43
Total	219%*	98%**
N =	(219)	(196)

* Percents do not total 100 because multiple reasons were permitted.

** Percents are based on the total number of nonsighters answering the question. Two percent of the respondents are not represented because they indicated more than one reason.

view of the effectiveness of the police (1967a). Although the present study is concerned not only with the police, but also with other agencies to which UFO phenomena might be reported, it appears that the treatment expected from such an agency is not the primary deterrent to reporting. If failure to report possible UFOs had the same origins as failure to report crime, ineffectiveness and indifference on the part of authorities should have attained a higher ranking among the alternatives.

The finding that most sighters do not report their sightings, and the nature of the reasons for not reporting, given by sighters and non-sighters alike, suggest two considerations regarding the reporting process. The first is related to rapport between the public and officials of public agencies. Having assumed that the event is "something normal," the sighter apparently feels that it is inappropriate to report it. "Appropriateness" may be the key concept here; the question raised is: "When is it appropriate to report something as a 'possible UFO'?"

The second consideration is access. Not knowing whom to notify and how to notify them reveals that the appropriate avenue is not available or, at least, is not visible to the individual. Hence the concepts of appropriateness and access seem to be interdependent in considering the problem of reporting.

Further consideration of "appropriateness" is beyond the domain of this discussion, but various public agencies, although concerned with different problems, have attempted to solve the problem of access by making it clear to the public who is to be contacted. Examples of such efforts include the establishment of poison control centers and suicide prevention services, which -- like the police and fire departments -- may be reached by phone at any time of day.

If the public is uncertain as to what agency is to be notified about a possible UFO, its uncertainty may mirror uncertainty among agencies themselves as to which of them should handle UFO reports. If such is the case (and our survey research has no information either to confirm or negate this possibility), it would account, in part, for both the uncertainty as to the correct procedure for reporting and the expectation that authorities may be either indifferent or ineffective. These findings

clarify some of the factors which influence the reporting process, as seen by the respondents at the time of the survey.

Attitudes and opinions

The attitudes and opinion of the respondents in the four surveys will be discussed first in terms of responses to the single opinion statements and, second, in terms of scores on attitude scales measuring four general concepts.

Attitudes and opinions are very similar concepts. Hilgard (1962) provides these basic definitions:

Attitude. An orientation toward or away from some object, concept, or situation; a readiness to respond in a predetermined manner to the object, concept, or situation.

Opinion. A judgment or belief involving an expectation or prediction about behavior or events.

The responses of the persons surveyed will be considered both as opinions and as attitudes.

The 29 opinion items used in the surveys and the percentages of adults and the percentages of teen-agers responding "true" and "false" to each statement appear in Table 15. Interpretation of these findings, however, requires a word of caution. First, it must be noted that the proportion in agreement with one item is not necessarily the same as that for an item similar to it. It appears that a change in wording or a slight change in emphasis results in different responses. For example, it is possible that the use of the word "science," instead of "scientists," or "government," instead of "government agency" or "Air Force," even in the same context will not render the same kinds of responses. Moreover, the items were initially selected to represent various beliefs which are frequently voiced with respect to the UFO problem. Consequently, some of the statements are fairly complex, and, as a result, complexity is another factor contributing to the variability in response. Therefore, the results appearing in Table 15 should be regarded simply as one way of describing public opinion.

Table 15 reveals some fairly consistent differences between the adult and teen samples. For example, a greater proportion of teen-agers

Table 15
Responses of Adults and Teen-agers to UFO Opinion Items

Item	Adults			Teen-agers		
	True	False	(N)	True	False	(N)
1. Some flying saucers have tried to communicate with us.	24%	76%	(1886)	37%	63%	(432)
2. All UFO reports can be explained either as well understood happenings or as hoaxes.	55%	45%	(1886)	53%	47%	(433)
3. The Air Force is doing an adequate job of investigation of UFO reports and UFO generally.	83%	17%	(1861)	72%	28%	(434)
4. No actual, physical evidence has ever been obtained from a UFO.	63%	37%	(1824)	54%	46%	(433)
5. A government agency maintains a Top Secret file of UFO reports that are deliberately withheld from the public.	69%	31%	(1852)	73%	27%	(434)
6. No airline pilots have seen UFOs.	41%	59%	(1820)	32%	68%	(432)
7. Most people would not report seeing a UFO for fear of losing a job.	33%	67%	(1839)	42%	58%	(445)
8. No authentic photographs have ever been taken of UFOs.	46%	54%	(1743)	34%	66%	(442)

<u>Opinion Survey</u> (cont.)				Adults			Teen-agers		
		True	False	(N)	True	False	(N)		
9.	Persons who believe they have communicated with visitors from outer space are mentally ill.	44%	56%	(1823)	38%	62%	(444)		
10.	The Air Force has been told to explain all UFO sightings reported to them as natural or man-made happenings or events.	60%	40%	(1804)	60%	40%	(443)		
11.	Earth has been visited at least once in its history by beings from another world.	28%	72%	(1809)	47%	53%	(443)		
12.	The government should spend more money than it does now to study what UFOs are and where they come from.	46%	54%	(1815)	63%	37%	(433)		
13.	Intelligent forms of life cannot exist elsewhere in the universe.	30%	70%	(1812)	22%	78%	(434)		
14.	Flying saucers can be explained scientifically without any important new discoveries.	46%	54%	(1807)	35%	65%	(429)		
15.	Some UFOs have landed and left marks in the ground.	41%	59%	(1788)	54%	46%	(433)		

<u>Opinion Survey</u> (cont.)		Adults			Teen-agers		
		True	False	(N)	True	False	(N)
16.	Most UFOs are due to secret defense projects, either ours or another country's.	57%	43%	(1798)	54%	46%	(431)
17.	UFOs are reported throughout the world.	87%	13%	(1801)	86%	14%	(433)
18.	The government has done a good job of examining UFO reports.	71%	29%	(1796)	58%	42%	(431)
19.	There have never been any UFO sightings in Soviet Russia.	27%	73%	(1698)	26%	74%	(433)
20.	People want to believe that life exists elsewhere than on Earth.	82%	18%	(1813)	75%	25%	(429)
21.	There have been good radar reports of UFOs.	62%	38%	(1736)	65%	35%	(429)
22.	There is no government secrecy about UFOs.	37%	63%	(1830)	31%	69%	(431)
23.	People have seen space ships that did not come from this planet.	40%	60%	(1807)	61%	39%	(430)
24.	Some UFO reports have come from astronomers.	67%	33%	(1718)	77%	23%	(429)
25.	Even the most unusual UFO report could be explained by the laws of science if we knew enough science.	73%	27%	(1818)	63%	37%	(423)

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<u>Opinion Survey (cont.)</u>		Adults			Teenagers		
		True	False	(N)	True	False	(N)
26.	People who do <i>not</i> believe in flying saucers must be stupid.	15%	85%	(1831)	15%	85%	(433)
27.	UFO reports have not been taken seriously by any government agency.	30%	70%	(1801)	29%	71%	(430)
28.	Government secrecy about UFOs is an idea made up by the newspapers.	26%	74%	(1779)	25%	75%	(442)
29.	Science has established that there are such things as "Unidentified Flying Objects."	76%	24%	(1824)	78%	22%	(440)

tend to agree with statements which suggest evidence for the existence of UFOs. However, the use of attitude scales, rather than single items, provides a more reliable estimate of opinion and a better basis for making group comparisons regarding a general topic.

Four scales based on the UFO items (see Table 16 for scale composition) were employed to determine whether individuals felt that UFOs were from outer space, whether they felt there was evidence for the existence of UFOs, whether the government was seen as handling the problem adequately, and whether secrecy in this matter was attributable to the government. Any scale score larger than .50 is in the direction of acceptance of the scale concept, e.g., evidence exists, secrecy exists, etc., while any score smaller than .50 is in the direction of rejection of the scale concept. The farther the score from .50, the stronger the acceptance or rejection.

Analyses of the findings by scale may be found in Tables 16, 17, and 18. Table 16 presents scale information for the adult and teen samples of the national opinion survey. Table 17 provides information on the sighter and nonsighter groups in the adult sample and on the sighter sample drawn from project files. The project sighters are unique in that they are all reporting sighters as compared with the national sighters, of whom 87% are nonreporters and in their willingness to participate in an opinion survey conducted by mail. Because these respondents are essentially self-selected by their willingness to participate in the survey, they may not be assumed to be representative of all sighters whose reports are in the case files of the Colorado project. The kind of bias this self-selection might introduce is unknown. Table 18 presents the information collected by the project from the college samples. The data on college students in the first column exclude students enrolled in the UFO classes. These latter students are represented in the second column.

Responses of students in UFO classes are interesting because of their exposure to material concerning UFOs and because of their high interest in the topic. Rather than attribute differences between this group and any other group to exposure to an UFO course, one might

Table 16
Opinion Scale Means and Standard Deviations for Adults
and Teen-agers, National Opinion Survey

Scale	Adult Sample	Teen Sample
Outer Space		
Mean	.39	.55
Standard Deviation	.31	.31
N =	(1659)	(437)
Evidence		
Mean	.60	.71
Standard Deviation	.34	.30
N =	(1629)	(434)
Adequacy		
Mean	.69	.56
Standard Deviation	.30	.32
N =	(1656)	(434)
Secrecy		
Mean	.70	.74
Standard Deviation	.32	.29
N =	(1631)	(440)

Table 17
Opinion Scale Means and Standard Deviations for Respondents in National
Sample and for Sample of Sighters from Project Files

Scale	Nonsighters*	Sighters Adult Sample	Sighters Project Sample
Outer Space			
Mean	.40	.65	.78
Standard Deviation	.31	.33	.27
N =	(1770)	(49)	(94)
Evidence			
Mean	.59	.83	.94
Standard Deviation	.34	.26	.14
N =	(1738)	(49)	(94)
Adequacy			
Mean	.70	.45	.34
Standard Deviation	.30	.36	.35
N =	(1769)	(49)	(94)
Secrecy			
Mean	.69	.83	.89
Standard Deviation	.32	.23	.21
N =	(1741)	(49)	(92)

*Adult Sample

Table 18
Opinion Scale Means and Standard Deviations for College Students and College
UFO Classes

Scale	College Students*	UFO Classes
Outer Space		
Mean	.55	.79
Standard Deviation	.32	.26
N =	(670)	(48)
Evidence		
Mean	.78	.85
Standard Deviation	.29	.21
N =	(668)	(48)
Adequacy		
Mean	.51	.24
Standard Deviation	.38	.33
N =	(669)	(48)
Secrecy		
Mean	.88	.92
Standard Deviation	.22	.17
N =	(669)	(48)

*Not included are students enrolled in Flying Saucer Classes.

assume that these students are essentially self-selected on the basis of their prior attitudes or interest.

On only two of the scales do the mean scale scores for any group represent views antithetical to those of another. Differences of mean opinion on the other two scales represent only differences in *degree* of acceptance or rejection.

On the outer space scale, adults tend to respond negatively to the hypothesis that UFOs are extra-terrestrial in origin, while teen-agers and college students, on the average, are almost neutral, and the two groups of sighters tend to react with greater degrees of acceptance of the possibility.

On the adequacy scale, both adults and teens are inclined to view the governments's efforts as adequate. The mean scale value for sighters, though of a middle position, leans toward a negative view of the government's adequacy in investigating the UFO problem. This finding cannot be explained solely in terms of sighters' first-hand experience with reporting, because most of the sighters in the national survey were non-reporters. The mean score of college students falls between those of teen-agers and sighters.

On the remaining two scales, differences of opinion are merely a matter of degree, with the mean scale scores for all groups in the same direction. It would appear that the majority of respondents in all groups feel that there is some evidence for the existence of UFOs, with the adults and teen-agers tending to be the most neutral. The adults tend to be the most cautious in their view, with a mean close to the midpoint of the scale. Teen-agers tend to give more support to the *possibility* that evidence for UFOs does exist, and both groups of sighters seem nearly certain that evidence does exist.

A similar pattern is evident for the responses regarding secrecy. All groups to a greater or lesser degree, tend to suspect government secrecy with regard to UFOs and UFO reports.

Differences between adult and teen scores on three of the four scales, the outer space, evidence, and adequacy scales, were found to be significant at the .01 level. At *t* test (McNemar, 1962), modified for the present

data was used; the sampling error for comparison of survey variable values was estimated, on the basis of sampling tolerances provided by ORC, to be approximately 20% greater than under the assumption of simple random sampling, yielding a design factor (Kish, 1965) of 1.20, which was incorporated in the t test.

Because these findings are the result of opinion surveys, they do not imply that, for example, evidence or secrecy actually exists. The findings only reflect opinions held by the adult, teen, college, and project sighter samples in our surveys, and only the findings for the adult and teen samples may be considered indicative of the opinions of adults and teens in the general population.

Correlates of attitudes

Our analysis of the 1966 Gallup data suggests that age and education, but particularly age, may be related to opinions regarding UFOs and related topics. In the analysis of the Gallup data, it appeared that the younger and the better educated persons are more likely to say that flying saucers are "real" and that there are "people somewhat like ourselves living on other planets in the universe." The differences between mean scores on four attitude scales for adults and teen-agers from the national opinion survey (Table 19) once again suggest that age may be a factor in determining attitude.

Two kinds of analyses of the adult survey sample were undertaken to examine the relationships between age and opinion and between education and opinion. In Table 19 are the scores for adults on the four scales by age. The younger the age group, the less the respondents tend to reject the extra-terrestrial hypothesis, the more inclined they are to believe that there is evidence for UFOs and government secrecy about them; younger respondents also tend to be slightly less satisfied with government handling of the "UFO problem."

Findings also related to age have been reported by David R. Deener (1967). In a survey of 1,200 persons conducted in New Orleans, La., he found that 61% of those polled under 25 years of age, 48% of those aged 25 to 29, and 34% of those aged 50 and over felt that flying saucers are real. When asked if they thought flying saucers come from outer

Table 19
UFO Opinion Scale Means and Standard Deviations by Age for Adults
National Opinion Survey

Age	Outer Space	Evidence	Adequacy	Secrecy
18-29				
Mean	.48	.68	.64	.77
Standard Deviation	.32	.33	.53	.29
N =	(474)	(473)	(477)	(472)
30-39				
Mean	.43	.63	.68	.76
Standard Deviation	.32	.34	.31	.28
N =	(369)	(366)	(370)	(366)
40-49				
Mean	.39	.59	.71	.69
Standard Deviation	.30	.33	.30	.33
N =	(361)	(357)	(362)	(360)
50-59				
Mean	.37	.58	.73	.66
Standard Deviation	.30	.32	.27	.34
N =	(290)	(283)	(291)	(286)
60-69				
Mean	.32	.52	.71	.58
Standard Deviation	.29	.31	.30	.33
N =	(190)	(182)	(187)	(182)
70 and above				
Mean	.27	.42	.77	.55
Standard Deviation	.28	.33	.22	.33
N =	(156)	(146)	(152)	(194)

space, 47% of those under 25, 27% of those aged 25 to 49, and 19% of those 50 and over answered yes (*Times-Picayune*, 5 November 1967). According to Strentz (1967), Eugene J. Webb obtained data in 1966 that indicated that as age increases, the proportion of respondents who think UFOs are from some other planet decreases. In that study, a greater proportion of younger than older respondents also felt that the government is concealing information about UFOs.

Patterns are less clear for the analyses by education, Table 20. It does appear, however, that education is related to attitudes regarding evidence and secrecy. Better educated individuals feel more strongly that both evidence and secrecy exist.

Because education and income are frequently examined together as determinants of socio-economic status, family income was chosen as an additional variable for the analysis of correlates. Instead of using mean scores for groups, a correlational approach was employed. Pearson Product Moment Correlation Coefficients (McNemar, 1962) were calculated. It was found that the correlation between age and education is -0.37 , age and family income, -0.33 , and education and family income, $+0.45$. The correlations of these three demographic variables with the four scales appears in Table 21. All correlations are significant at the .01 level, except for the correlation between family income and the adequacy scale, which is not statistically significant. Of the three demographic variables, age is the strongest single predictor of opinion.

The correlations of the scales with age seem strong enough to warrant some speculations regarding its role in the nature of opinion expressed. These findings reflect, perhaps, something interesting about either a) the change of beliefs and attitudes with age, or b) the changing nature of beliefs and attitudes. To test the former interpretation would necessitate a prospective study in which the same attitudes are assessed at five- or ten-year intervals, using the same respondents.

In consideration of the marked changes that have taken place in culture and technology during the past 40 years (noting that the oldest respondents in the sample were young adults 40 years ago) and particularly during the past 20 years (during which time the youngest members of the

Table 20
UFO Opinion Scale Means and Standard Deviations by Education for Adults,
National Opinion Survey

Education	Outer Space	Evidence	Adequacy	Secrecy
Less than 8th Grade				
Mean	.32	.49	.73	.55
Standard Deviation	.29	.32	.26	.36
N =	(188)	(177)	(188)	(179)
8th Grade				
Mean	.33	.51	.71	.60
Standard Deviation	.30	.33	.27	.33
N =	(200)	(193)	(196)	(189)
High School Incomplete				
Mean	.41	.58	.73	.67
Standard Deviation	.31	.32	.27	.31
N =	(431)	(408)	(416)	(409)
High School Completed				
Mean	.44	.64	.68	.73
Standard Deviation	.32	.34	.30	.30
N =	(632)	(618)	(621)	(618)
College Incomplete				
Mean	.45	.64	.63	.78
Standard Deviation	.32	.34	.35	.30
N =	(234)	(230)	(235)	(234)
College Completed				
Mean	.38	.67	.68	.80
Standard Deviation	.28	.34	.33	.29
N =	(221)	(220)	(222)	(220)

Table 21
Correlation of Age, Education and Family Income
with UFO Opinion Scales*

Scale				
	Outer Space	Evidence	Adequacy	Secrecy
Age	-.21	-.20	+.13	-.23
Education	+.08	+.16	-.07	+.23
Family Income	+.10	+.11	-.02	+.18

* Correlation coefficients are based on the adult sample.

sample were growing up and receiving most of their formal education), the second interpretation seems highly tenable. Because the younger people have been exposed exclusively or primarily to the "space age," an era of accelerated technological advance and an era in which educational objectives have moved from the acquisition of facts to an emphasis on inquiry and problem-solving, it may be that age differences for the outer space and the evidence scales may reflect a greater readiness on the part of younger people to accept as possible that which has not, at present, been demonstrated.

At one time flying to the moon was only fantasy; now the plans for the landing of the first manned spacecraft are being completed. In addition, not only the scientific community, but the general public are aware of special technical problems, such as those concerning "soft landings," and zero gravity conditions of space flight. At the same time, television, a major medium of entertainment and information, is able to give the appearance of reality to that which is technologically impossible -- at least at this time. As a result of these and other factors, the younger person may have a greater range of acceptance for "what might be" than the older generation.

Given the findings of the present study, one might suspect that reactions to various projected or hypothesized social, scientific, and technological changes would reveal similar kinds of age- and, perhaps, education-differences. Such changes might include chemical methods to increase the capacity for memory, human hibernation, permanently inhabited undersea colonies, or the major use of rockets for commercial transportation -- all of which have been included among projections for the future (Kahn and Wiener, 1967). The major implication of this discussion is that the present findings relating age and education to attitudes regarding UFO phenomena may, in large measure, reflect the changing technology and culture.

Inherent in the above speculations are at least two research questions which may be posed. The first of these concerns formal training in the sciences, the second concerns exposure to information sources.

The measure of education used in the present study simply represents years of schooling. If the above interpretations are correct in relating attitude to differential exposure to a changing technology and culture by way of age, it should prove interesting to examine further attitudes with respect to both the nature of the individual's education and to age. Attitudes of persons trained in the physical sciences might be compared with those of comparable levels of education in other fields; the views of older scientists within a discipline might be compared with those of the younger.

The second variable suggested by the present research is differential exposure to information sources. To what extent do age-related attitudes reflect differential exposure either to popular or to technical sources of scientific information? For example, do younger people have a greater knowledge of the sciences and in particular of recent scientific developments? Is interest in an exposure to science fiction predictive of attitudes about conditions not now technologically possible or culturally familiar? Such questions as these may clarify the apparent relationships which are suggested by the present findings regarding attitudes toward UFO phenomena.

Apart from these speculations, there are a number of procedures in the social psychology of UFO phenomena which merit consideration for further study, as William A. Scott has pointed out (1968), and which could not be studied by the Colorado Project.

Scott suggests that, for example, the cognitive correlates of UFO phenomena might be studied in terms of a) the subject's interest in and information about UFO phenomena; b) the degree and range of credibility that the subject attaches to reported sightings; c) the subject's knowledge of possibly confounding illusions and misinterpretations, e.g., atmospheric and astronomical phenomena; d) attitudes related to the process of hypothesis testing, the process of considering and rejecting alternative explanations, the rapidity with which the subject reaches a conclusion, and the certainty that he attaches to his interpretation; e) the degree of cognitive elaboration evidenced when the subject is exposed to a mock-up or experimental UFO.

Another area which the limitations of time and funds made it impracticable to study is that concerned with communication processes. Among the possible foci of study are the ways in which consensus develops among observers and the effects of communication upon that consensus. Still another approach might be the comparison of independent interpretations of the same UFO phenomenon. A related area of research might include studies of the effect of publicity on the frequency and nature of reports, the effect of the interviewers' (e.g., journalists', researchers') attitudes on the respondents' reports, and the effect of communication between subjects on the convergence and clarity of their reports.

Other suggestions for further studies of UFO phenomena, in the field of social psychiatry, are made by Rhine (Section VI, Chapter 3).

It is the writer's judgment that, in evaluating the feasibility and desirability of such further studies, their costs, material and non-material, need to be weighed against the potential usefulness of the resulting data. The ultimate value of further studies concerning the social psychological aspects of UFO phenomena may rest on the generality of the processes studied and the degree to which the research contributes to the advancement of the behavioral and social sciences.

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Section IV

Case Studies

In this section three kinds of specific cases are presented: 1) those of special interest that occurred prior to the commencement of the Colorado project; 2) those investigated in the field by project teams; and 3) those involving the analysis of photographs. In most instances, field investigation involved study of the sighting reports and, rarely, of the sighted object; in a few cases, only the analysis of purported UFO-related physical evidence was carried out. Information received regarding some older cases was reviewed but only when new information made new conclusions possible is it reported as a case. Examples are the 1952 sighting report of W. B. Nash and William Fortenberry and the 1954 sighting of J. H. Howard, both of which are discussed in Section III, Chapter 5. The renowned 1952 radar sightings at Washington, D.C., are also discussed in that chapter. Weather data concerning the Washington sightings are presented in Appendix L. None of these are presented as case studies in this section.

Many witnesses were willing to cooperate with the study only on the condition that their names be withheld. Consequently, a uniform policy of eliminating the name of the witness or witnesses in all cases has been followed, as their identities are irrelevant to the facts under study.

The region in which the sighting occurred is designated by its location in the northern or southern half of a time zone. Thus the designation "South Pacific" refers to the southern portion of the Pacific time zone. At the request of some of the witnesses to and participants in sightings, the names of places and other descriptive data have been changed. These changes have been invariably made, however, in such a way that every significant fact has been accurately presented and the case, as a whole, described in all its essentials.

Chapter I

Case studies predating the term
of the project

(Cases 1 - 10)

Case 1

South Mountain

Spring 1950

Investigators: Low, staff

Abstract:

A professional meteorologist saw an unidentified object flying beneath clouds. He believed the object to be a powered craft three to five feet in diameter. Positive identification cannot be made, although the possibility that the object was common earth debris is suggested.

Background:

A UFO sighting from the grounds of an Observatory had attracted attention because the observation was made by a professional meteorologist who is highly regarded in the scientific community. The meteorologist wrote the following account within an hour of his observation:

I saw the object between 12:15 and 12:20 p.m.
..... from the grounds of the Obser-
vatory. It was moving from the Southeast to the
Northwest. It was extremely prominent and showed
some size to the naked eye, that is, it was not
merely a pinpoint. During the last half of its
visibility I observed it with 4-power binoculars.
At first it looked like a parachute tipped at
an angle to the vertical, but this same effect
could have been produced by a sphere partly
illuminated by the sun and partly shadowed, or
by a disc-shaped object as well. Probably there
are still other configurations which would give
the same impression under proper inclination and

illumination. I could see it well enough to be sure it was not an airplane (no propeller or wings were apparent) nor a bird. I saw no evidence of exhaust gases nor any markings on the object.

Most fortunately the object passed between me and a small bright cumulus cloud in the Northwest. Thus it must have been at or below the cloud level. A few seconds later it appeared, apparently into the cloud.

Against the sky it was very bright but against the cloud it was dark. This could be produced by a grey body which would be bright against the relatively dark sky, but dark against the bright cloud. Alternatively, if the object were half in sunlight and half shadowed the sunlit part might have had no detectable contrast with the cloud while the shadowed part appeared dark.

I immediately telephoned the U.S. Weather Bureau (2-3 miles S.W. of the Observatory). They were estimating the cloud to be 6000 feet above the ground. Now estimates of cloud heights are rather risky, so I obtained their observations of temperature and dew point, and from the known lapse rates of these quantities in a convective atmosphere, calculated the cloud base to be at 12,000 feet. I believe this latter figure to be the more accurate one because later in the afternoon the cumulus clouds thickened but at all times remained well above the tops of our nearby mountains. These are about 6000 feet above us.

Thus, having some idea of the object's elevation and its angular diameter through the binoculars (about equivalent to a dime seen at

50 feet with the naked eye), I calculated its size to be 3 to 5 feet for a height of 6 - 12 thousand feet, and a zenith angle of about 45° . This size estimate could easily be in error by a factor or two, but I am sure it was a small object.

The clouds were drifting from the SW to the NE at right angles to the motion of the object. Therefore, it must have been powered in some way. I did not time it but for that elevation I would estimate its speed to be about 100 miles per hour, perhaps as high as 200 m.p.h. This too means a powered craft. However, I could hear no engine noise.

Investigation:

The meteorologist who reported this observation was interviewed. He could offer no information beyond his original report written 17 years earlier. In earlier correspondence with project personnel, however, he furnished copies of letters exchanged in 1961 with another interested scientist who suggested alternate explanations of his observation.

The crucial point in question was the height of the object, coupled with the direction of wind at that elevation. Did the object disappear into a cloud, thus showing it to be at cloud level, or was its abrupt disappearance due to reorientation of the object relative to the observer, such as the turning of a sheet of paper edgewise to the observer, or to passage of a reflecting object into the shadow of a cloud? In either of the latter cases, the observed object could have been much lower than cloud level in which case its motion could be accounted for by winds, and the requirement of self-propulsion would no longer pertain.

Loren W. Crow, Certified Consulting Meteorologist, was commissioned to analyze records of weather pertinent to this observation. He studied surface weather records, and winds aloft data from this South Mountain area. According to his report, winds were light and variable at all stations. He presented a vertical profile of cloudiness and the following evidence of strong vertical mixing. (Crow's Fig 4 is not included in this excerpt from his report).

Excerpts have been made from the detailed surface observations at three stations. It is worth noting that at approximately 12:30 (the observations actually being made prior to this filing time)...[two stations] carried a notation under remarks that dust devils were being observed. From the Glossary of Meteorology a *dust devil* is defined as a well-developed dust whirl. The following is a further quotation from that definition.

...A rapidly rotating column of air over a dry and dusty or sandy area, carrying dust, leaves and other light material picked up from the ground. When well developed it is known as a dust devil. Dust whirls form, typically, as the result of strong convection during sunny, hot, calm summer afternoons. This type is generally several yards in diameter at the base, narrowing for a short distance upward and then expanding again, like two cones apex to apex. Their height varies; normally it is only 100 to 300 feet, but in hot desert country they may be as high as 2000 feet....

The actual lowering of temperature between 12:30 and 13:30 at...[airport A] indicates that strong vertical mixing took place during that hour. It could have started in the vicinity of ... [city A], particularly over the warmer portions of local heat absorbing surfaces, a few minutes or an hour earlier.

The spread between dry bulb and wet bulb temperature was comparable at each of the three stations, indicating that they were in the same air mass. This spread was slightly less at the ...[airport A] than at...[city B or C]. Super-adiabatic temperature lapse rates would have been prevalent near the surface in the late morning hours.

Surface conditions were quite dry. The most recent rainfall above a trace recorded at both... [city A and airport A] occurred on May 4, sixteen days earlier. The amounts received at that time were .34 inch in... [city A] and .35 inch at the airport [A]. The maximum temperatures were well above normal for the month on May 20. The maximum of 83° at ... [city C] was the first such maximum that had been reached in 1950. A warmer maximum temperature had been recorded on only one day previously at...[city A].

The vertical wind profiles show only light winds prevailing at the level of the sighting. The direction of air flow at the sighting level as indicated by the pressure pattern would have been from the northeast. Velocity would have

been less than 10 mph and could have been overcome by local convective activity or the influence of any particularly large cloud development.

It is the author's opinion that within the hour prior to the sighting strong vertical mixing of the air in the first 3,000 feet above the surface would have been a typical pattern of air motion in the vicinity of the sighting. Horizontal flow of air would have been limited to velocities not exceeding 10 mph. Visibility would have been excellent.

In addition to his report, Crow expressed the opinion that some light, low density material must have been carried aloft by a localized dust whirl not too far from the observer. He suggested that at the time of sighting vertical motion no longer was being applied and the object was drifting slowly along a nearly horizontal path from NE toward NW. Although the witness reported cloud movement, Crow suggests that this observation could have been the result of movement of the object combined with very slight cloud movement, producing the impression that the cloud was drifting more than it actually was. A near-deflated child's balloon or a sheet of paper, carbon paper, or plastic at an altitude of 1500-3000 ft. could have caused observations similar to those reported.

Conclusions:

There is no way to establish the altitude of the reported object. It is not certain that the object was at cloud elevation, for there are other acceptable explanations of abrupt disappearance of such an object. Thus, the object may have been much nearer to the observer than he assumed, and may have been airborne debris.

Case 2

Greenwich

Summer 1956

Investigator: Staff

Abstract:

At least one UFO was tracked by air traffic control radar (GCA) at two USAR-PAF stations, with apparently corresponding visual sightings of round, white rapidly moving objects which changed directions abruptly. Interception by RAF fighter aircraft was attempted; one aircraft was vectored to the UFO by GCA radar and the pilot reported airborne radar contact and radar "gunlock." The UFO appeared to circle around behind the aircraft and followed it in spite of the pilot's evasive maneuvers. Contact was broken when the aircraft returned to base, low on fuel. The preponderance of evidence indicates the possibility of a genuine UFO in this case. The weather was generally clear with good visibility.

Background:

The existence of this very interesting radar-visual case was first brought to the attention of the project staff in winter 1968 by the receipt of an unsolicited letter from one of the principal witnesses, a retired USAF non-commissioned officer who was the Watch Supervisor at the GCA station on the night in question. This letter is rather well written, and since it forms the most coherent account of this UFO case, it is reproduced below in its entirety.

Reference your UFO Study: you probably already have this item in your file, but, in case you don't, I will briefly outline it and you can contact me for full details if you want them.

I retired (20 years service)...from the USAF. I have placed my name, rank, and serial number at the top of the page if you want to check on my authenticity. I was an Air Traffic Controller throughout my service career and utilized radar the last 16 years in the control of Air Traffic. I won't bother listing the types and locations, although I could supply all this if needed.

In 1956, ... (I can't remember the exact date or month), I was on duty as Watch Supervisor at... [GCA A] in the Radar Air Traffic Control Center. It was the 5:00 p.m. to midnight shift. I had either four or five other controllers on my shift. I was sitting at the Supervisor's Coordinating desk and received a call on the direct line (actually I'm not sure which line it was). Anyway, it was... [GCA B] calling and the radar operator asked me if we had any targets on our scopes travelling at 4,000 mph. They said they had watched a target on their scopes proceed from a point 30 or 40 miles east...to a point 40 miles west of...[GCA B]. The target passed directly over...[GCA B] RAF Station (also an USAF Station). He said the tower reported seeing it go by and it just appeared to be a blurry light. A C-47 flying over the base at 5,000 feet altitude also reported seeing it as a blurred light that passed under his aircraft. No report as to actual distance below the aircraft. I immediately had all controllers start scanning the radar scopes. I had each scope set on a different range-from 10 miles to 200 miles radius of...[GCA A]. At this time I did not contact anyone by telephone as I was rather skeptical of this report. We were using

full MTI on our radar, which eliminated entirely all ground returns and stationary targets. There was very little or no traffic or targets on the scopes, as I recall. However one controller noticed a stationary target on the scopes about 20 to 25 miles southwest. This was unusual as a stationary target should have been eliminated unless it was moving at a speed of at least 40 to 45 knots. And yet we could detect no movement at all. We watched this target on all the different scopes for several minutes and I called the GCA Unit at ...[A] to see if they had this target on their scopes also. They confirmed the target was on their scope in the same geographical location. As we watched, the stationary target started moving at a speed of 400 to 600 mph in a north, northeast direction until it reached a point about 20 miles north northwest of ...[A]. There was no slow start or build-up to this speed--it was constant from the second it started to move until it stopped.

I called and reported all the facts to this point, including...[B] GCA's initial report, to the ...Command Post... ...I also hooked in my local AFB Commanding Officer and my Unit (AFCS Communications Squadron) Commander on my switchboard. And there could have been others hooked in also that I was not aware of. I repeated all the facts known to this point and continued to give a detailed report on the target's movements and location. The target made several changes in location,

always in a straight line, always at about 600 mph and always from a standing or stationary point to his next stop at constant speed---no build-up in speed at all---these changes in location varied from 8 miles to 20 miles in length---no set pattern at any time. Time spent stationary between movements also varied from 3 or 4 minutes to 5 or 6 minutes (possibly even longer as I was busy answering questions---listening to theories, guesses, etc. that the conference line people were saying). This continued for some time. After I imagine about 30 to 45 minutes, it was decided to scramble two RAF interceptors to investigate. This was done I believe by ... Air Force calling the RAF and, after hearing what the score was, they scrambled one aircraft. (The second got off after as I will mention later.)

The interceptor aircraft took off from an RAF Station...and approached...[A] from the southwest. Radio and radar contact was established with the RAF intercept aircraft at a point about 30 to 35 miles southwest...[and] inbound to...[A]. On initial contact we gave the interceptor pilot all the background information on the UFO, his (the interceptor's) present distance and bearing from...[A], the UFO's (which was stationary at the time) distance and bearing from...[A]. We explained we did not know the altitude of the UFO but we could assume his altitude was above 15,000 feet and below 20,000 feet, due to the operational

characteristics of the radar (CPS-5 type radar, I believe). Also we mentioned the report from the C-47 over . . . [B] that relayed the story about the light which passed below him. His altitude was 5,000 feet.

We immediately issued headings to the interceptor to guide him to the UFO. The UFO remained stationary throughout. This vectoring of the intercept aircraft continued. We continually gave the intercept aircraft his heading to the UFO and his distance from the UFO at approximately 1 to 2 mile intervals. Shortly after we told the intercept aircraft he was one-half mile from the UFO and it was twelve-o'clock from his position, he said, "Roger, ...I've got my guns locked on him." Then he paused and said, "Where did he go? Do you still have him?" We replied, "Roger, it appeared he got behind you and he's still there." [There were now two targets; one behind the other, same speed, very close, but two separate distinct targets.]

The first movement by the UFO was so swift (circling behind the interceptor); I missed it entirely, but it was seen by the other controllers. However, the fact that this had occurred was confirmed by the pilot of the interceptor. The pilot of the interceptor told us he would try to shake the UFO and would try it again. He tried everything--he climbed, dived, circled, etc., but the UFO acted like it was glued right behind him, always the same distance, very close, but we always had two distinct targets. [Note: Target resolution on our radar at the range they were from the antenna (about 10 to 30 miles, all in the southerly sectors from...[A])

would be between 200 and 600 feet probably. Closer than that we would have got one target from both aircraft and UFO. Most specifications say 500 feet is the minimum, but I believe it varies and 200 to 600 feet is closer to the truth and, in addition, the tuning of the equipment, atmospheric conditions, etc., also help determine this figure.]

The interceptor pilot continued to try and shake the UFO for about ten minutes (approximate-- it seemed longer both to him and us). He continued to comment occasionally and we could tell from the tonal quality he was getting worried, excited and also pretty scared.

He finally said, "I'm returning to Station,[A]. Let me know if he follows me. I'm getting low on petrol." The target (UFO) followed him only a short distance, as he headed south southwest, and the UFO stopped and remained stationary. We advised the interceptor that the UFO target had stopped following and was now stationary about 10 miles south of...[A]

He rogered this message and almost immediately the second interceptor called us on the same frequency. We replied and told him we would advise him when we had a radar target, so we could establish radar contact with his aircraft. (He was not on radar at this time, probably had just taken off and was too low for us to pick him up, or too far away--we had most of the scopes on short range, so we could watch the UFO closely on the smaller range.) The number two interceptor called the number one interceptor by name (Tom, Frank--whatever his name was) and asked him, "Did you see anything?" Number one replied,

"I saw something, but I'll be damned if I know what it was." Number two said, "What happened?" Number one said, "He (or it) got behind me and I did everything I could to get behind him and I couldn't. It's the damndest thing I've ever seen." Number one also made a remark at this time to number two, that he had his radar locked on whatever it was for just a few seconds so there was something there that was solid. Number one then switched frequencies to his home base frequency. We gave number two the location of the UFO and advised him that we still didn't have him on radar, but probably would have shortly. He delayed answering for some seconds and then finally said, . . . [A] _____ (Identification aircraft call sign)--can't remember what call sign these aircraft were using. Returning home, my engine is malfunctioning." He then left our frequency.

Throughout this we kept all the agencies, . . . advised on every aspect, every word that was said, everything.

We then inquired what action they wanted to take. They had no more suggestions and finally they told us to just keep watching the target and let them know if anything else happened. The target made a couple more short moves, then left our radar coverage in a northerly direction--speed still about 600 mph. We lost target outbound to the north at about 50 to 60 miles, which is normal if aircraft or target is at an altitude below 5,000 feet (because of the radiation lobe of that type radar). We notified . . . Air Division Command Post and they said they'd tell everybody for us.

I made out a written report on all this, in detail for the officers in charge of my facility, and was told that unless I was contacted later for further information, he would take care of it. I don't know if a CERVIS report was submitted on this or not--I heard no more about it.

All speeds in this report were calculated speeds based on time and distance covered on radar. This speed was calculated many times that evening and although this happened quite awhile ago, the basic elements are correct.

Fig. 1 shows a map of the contact as drawn by the witness.

Investigation:

Since this case was discovered so late in the project, investigation was limited to a follow-up request for additional information from Project Blue Book, and analysis of the available details of the case by investigators familiar with radar and optical propagation anomalies.

Copies of the Project Blue Book files on the case were received in late August of 1968. A considerable amount of this material is reproduced below. One of the interesting aspects of this case is the remarkable accuracy of the account of the witness as given in the letter reproduced above, which was apparently written from memory 12 yr. after the incident. There are a number of minor discrepancies, mostly a matter of figures (the C-47 at 5,000 ft. was evidently actually at 4,000 ft.), and he seems to have confused the identity of location C with B; however, all of the major details of his account seem to be well confirmed by the Blue Book account.

There were ancillary sightings at . . . [C] besides those which instigated the UFO search by the . . . [A] GCA Unit but as subsequent airborne intercept attempts yielded neither radar nor visual contact, these accounts are not detailed below.

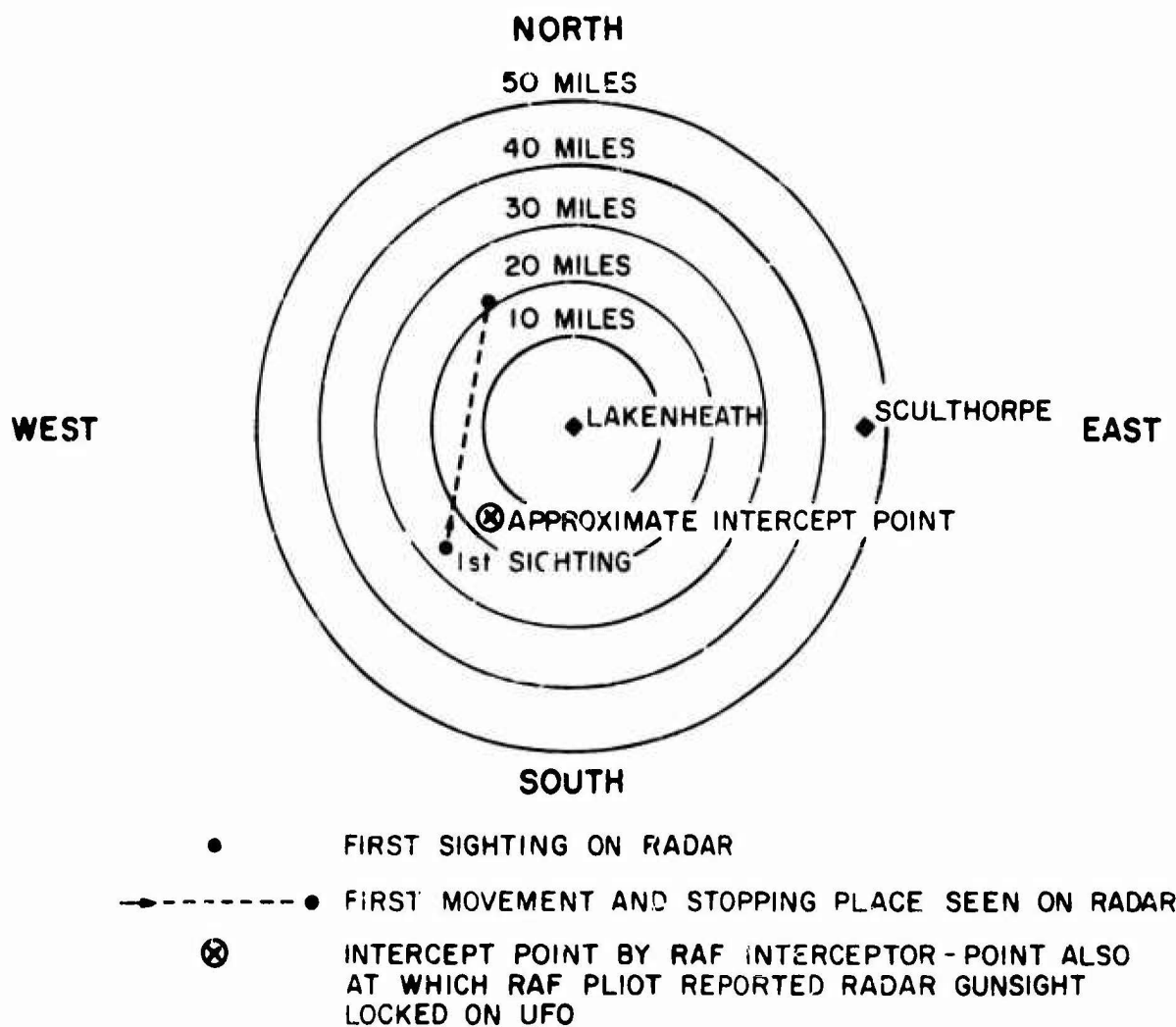


Fig. 1

At 22557,[C] GCA sighted object thirty miles east of station traveling westerly at 2000-4000 mph. Object disappeared on scope two miles east of station and immediately appeared on scope three miles west of station where it disappeared thirty miles west of station on scope. Tower personnel at[C] reported to GCA a bright light passed over the field east to west at terrific speed and at about 4000 feet alt. At same time pilot in aircraft at 4000 feet alt. over....[C] reported a bright light streaked under his aircraft traveling east to west at terrific speed. At this time....[C] GCA checked with RAF station....[A] GCA to determine if unusual sightings were occurring[A] GCA alerted [the] AAA stationed at[A] and[B] GCA to watch for unusual targets. Following info is the observations made by this station radar, tower and ground personnel placed in format required by AFR 2000-2: 1. Description of object(s): (A) Round white lights (B) One observer from ground stated on first observation object was about size of a ball. As object continued in flight it became a "pin point." (C) Color was white. (D) Two from ground observation undetermined number of blips appearing and disappearing on radar scopes. (E) No formation as far as radar sightings concerned. Ground observers stated one white light joined up with another and both disappeared in formation together. (F) No features or details other than the white light. (G) Objects as seen by ground observers and GCA radar have feature of

traveling at terrific speeds and then stopping and changing course immediately. 2. Description of course of objects: (A) Ground observers looked at sky and saw the object(s). RAF Station[A] GCA was alerted by[C] GCA to be on lookout for unusual targets. (B) Ground observers estimated objects were 20-2500 feet alt and were on a SW heading. Object stopped and immediately assumed an easterly heading. RAF Station[A] GCA and Air Traffic Control Center reports radar tracking from 6 miles west to about twenty miles SW where target stopped and assumed a stationary position for five minutes. Target then assumed a heading north westerly into the Station and stopped two miles NW of Station.[A] GCA reports three to four additional targets were doing the same. Radars reported these facts to occur at later hours than the ground observers. (C) Ground observers report no change in direction and objects disappeared on easterly heading. Radar sets stated no definite disappearance factors other than targets disappeared from scopes at approx 0330 GMT Aug 14. (D) Flight path was straight but jerky with object stopping instantly and then continuing. Maneuvers were of same pattern except one object was observed to "lock on" to fighter scrambled by RAF and followed all maneuvers of the jet fighter aircraft. In addition,[A] Radar Air Traffic Control Center observed object 17 miles east of Station making sharp rectangular course of flight. This maneuver was not conducted by circular path but on right

angles at speeds of 600-800 mph. Object would stop and start with amazing rapidity. (E) Objects simply disappeared. (F) Objects were observed intermittently by RAF Station.... [A] radars from 140310 to 140330. 3. Manner of observation: (A) Ground-visual, air-electronic and ground-electronic. Ground-electronic equipment was TS-1D, CPS 5, and CPN4 radars. Air-electronic was A-1 airborne radar equipment injet aircraft. Type of aircraft, Venom, operating out of RAF Station 4. Time and date of sighting: (A) Summer 140010Z through 140330Z. (B) Night (sky clear and nin/th of clouds--moonlight). 5. Location of observers RAF Station [A] 52°24'N 0°33'E. 6. Weather and winds-aloft conditions at time and place of sightings: (A) Clear sky until 0300Z shortly thereafter scattered clouds at 3500 ft. (B) From midnight until 0600Z surface wind was 230 deg at 15 knots; 6000 ft 290 deg at 24 knots; 16000 ft 290 deg at 35 knots; 16,000 ft 290 deg at 45 knots; 20,000 ft 290 deg at 53 knots; 30,000 ft 290 deg at 62 knots; 50,000 ft 290 deg at 75 knots. (C) Ceiling unlimited. (D) Visibility from 0001Z to 04000Z was 10 nautical miles. (E) 1/10 of sky covered at 0300Z. 8. Ground observers report unusual amount of shooting stars in sky. Further state the objects seen were definitely not shooting stars as there were no trails behind as are usual with such sightings. 9. Interception was undertaken by one British jet fighter on alert by.... [A] sector control. Aircraft is believed to have been a Venom. The aircraft flew over RAF Station

....[A] and was vectored toward a target on radar 6 miles east of the field. Pilot advised he had a bright white light in sight and would investigate. At thirteen miles west he reported loss of target and white light.[A] RATCC vectored him to a target 10 miles east of[A] and pilot advised target was on radar and he was "locking on." Pilot reported he had lost target on his radar.[A] RATCC reports that as the Venom passed the target on radar, the target began a tail chase of the friendly fighter. RATCC requested pilot acknowledge this chase. Pilot acknowledged and stated he would try to circle and get behind the target. Pilot advised he was unable to "shake" the target off his tail and requested assistance. One additional Venom was scrambled from the RAF Station. Original pilot stated; "clearest target I have ever seen on radar." Target disappeared and second aircraft did not establish contact. First aircraft returned to home Station due to being low on fuel. Second Venom was vectored to other radar targets but was unable to make contact. Shortly afterwards, second fighter returned to home Station due to malfunctions. No further interception activities were undertaken. All targets disappeared from scopes at approximately 0330Z. 10. Other aircraft in the area were properly identified by radar and flight logs as being friendly. All personnel interviewed and logs of RATCC lend reality to the existence of some unexplainable flying phenomena near this air field on this occasion. Not an Air Base; however, the controllers are

experienced and technical skills were used in attempts to determine just what the objects were. When the target would stop on the scope. The MTI was used. However, the target would still appear on the scope. All ground observers and reports from observers at[C] agree on color. Maneuvers and shape of object. My analysis of the sightings is that they were real and not figments of the imagination. The fact that three radar sets picked up the targets simultaneously is certainly conclusive that a target or object was in the air. The maneuvers of the object were extraordinary; however, the fact that radar and ground visual observations were made on its rapid acceleration and abrupt stops certainly lend credence to the report. It is not believed these sightings were of any meteorological or astronomical origin.

The material on the[C] sightings given at the beginning of the preceding account is typical; three other radar targets tracked by that station behaved in a similar manner and intercept attempts made from 2130 to 2215 GMT by an American T-33 jet aircraft were fruitless.

An analysis of this case from the viewpoint of possible anomalous propagation was made and appears in Chapter 7, Section VI.

Conclusions:

In view of the multiple radar sightings involved in this case, any conventional explanation for the occurrences reported would seem to require some sort of radar anomalous propagation. As pointed out in Chapter 7, the evidence for anomalous propagation in this case is rather uncertain. The temporary disappearance of the target as it appeared to overfly the[C] GCA is quite suggestive of anomalous propagation. The generally clear weather was conducive

to the formation of the atmospheric stratification that causes anomalous propagation, although it by no means follows that such formation would have actually occurred. In this connection, the apparent near-coincidence between the appearance of broken clouds (0330 GMT) and the disappearance of the radar targets (0330 GMT) could be significant.

On the other side must be balanced the generally continuous and consistent movements of the radar tracks reported by . . . [A], which are not at all typical of radar false targets caused by anomalous propagation. In addition, some of the maneuvers reported in the radar controller's letter to have been executed by the UFO are extremely unlikely to be duplicated by a false target, in particular stopping and assuming a new path after following the intercepting aircraft for some time. The comments of the Air Force officer who prepared the UFO message reproduced earlier are also significant.

In an early Air Force investigation it was suggested that the visual sightings might have been caused by the Perseid meteors. However, as Air Force Consultant Dr. Hynek pointed out:

It seems highly unlikely, for instance, that the Perseid meteors could have been the cause of the sightings, especially in view of the statement of observers that shooting stars were exceptionally numerous that evening, thus implying that they were able to distinguish the two phenomena. Further, if any credence can be given to the maneuvers of the objects as sighted visually and by radar, the meteor hypothesis must be ruled out.

Dr. Hynek also remarked:

The statement that radars reported these facts to occur at later hours than the ground observers' needs clarification inasmuch as it

contradicts other portions of the report which indicate that at least at certain times visual and radar sightings were simultaneous.

In retrospect it appears that what the statement in question may have been meant to imply was that the radars *continued* to report target (s) after visual contact had been lost; the statement does not necessarily imply that no simultaneous radar-visual sightings occurred.

In conclusion, although conventional or natural explanations certainly cannot be ruled out, the probability of such seems low in this case and the probability that at least one genuine UFO was involved appears to be fairly high.

Case 3

South Pacific

Winter 1957

Investigators: Hauser Research and Engineering Co.

Abstract:

Material which reportedly had dropped from a spaceship was found to be radar chaff dipoles manufactured by Revere Copper and Brass, Inc., Brooklyn, N. Y.

Background:

The Colorado Project received a sample of metallic material, in the form of short pieces of narrow ribbon which was asserted to be material from a spaceship. A nested pile of the material reportedly was found in the front of the home of the witnesses who had observed "two space ships" overhead 24 hr. previously.

The sample was not radioactive when received by the Project, but was said to have been highly radioactive when it fell in the Winter of 1957. The sample was accompanied by an analytical report from a laboratory near the area of the sighting. This report stated that the composition of the material differed from material used as radar "chaff," although aluminum was the main constituent.

Investigation :

The material was sent to the Hauser Research and Engineering Company, Boulder, Colo., for analysis and identification. Spectrographic analyses indicated a composition similar to that of radar "chaff," i.e. : aluminum foil coated with lead powder. The Hauser Company sent small samples of this material to major manufacturers of radar "chaff." Among their responses was the following, from Mr. V. B. Lane, Director of Technical Research, Foil Division, Revere Copper and Brass, Inc.

The chaff dipoles sent to us in your letter of 21 June 1967 were manufactured by this company.

The material is 1145 alloy hard aluminum foil with both a slip and a stripe coating applied to the surface of the foil. The stripe coating consists of lead powder suspended in Kerstyn lacquer. The slip coating is basically atomized Acruanx C suspended in a lacquer. Identification is possible since the slip coating was color coded. (red for Revere and, I believe, blue for Reynolds and green for Anaconda).

Generally speaking, the slip coat was last used in the fabrication of chaff units RR 39/AL and RR 44/AL. Your sample dipoles (tuned to S-band) could have come from either unit. These units were last produced in 1955-56 although a considerable supply was reworked in 1961-63. Since that time occasional small lots have been produced for test purposes. It is possible that some of this material was dropped by aircraft.

However, associating the chaff with a reported sighting of a UFO leads us to suspect another source. The chaff in question has been and is being used as a payload for sounding rockets and balloons. These devices are used to carry the chaff payload up to high altitudes and then the material is released for radar tracking. In some balloon devices, the chaff dipoles are supposed to remain within the balloon but occasionally they fall free.

Quite a few agencies employ these devices among them Sandia Corp., Albuquerque, New Mexico and Dewey-Almy Chemical Corp., Cambridge, Mass. Perhaps they

can associate a sounding device launch with the time of your reported sighting.

We can assure you, however, that the chaff in question was manufactured in Brooklyn, New York, USA and not in some remote corner of the galaxy.

Conclusion:

The material consisted of radar chaff dipoles manufactured by Revere Copper and Brass, Inc.

Case 4

Greenwich +3

Fall 1957

Investigator: Craig

Abstract:

A small piece of corroded magnesium metal, widely acclaimed as a fragment from an alien vehicle which exploded over a beach in Greenwich +3, was analyzed. The analysis disproved claims that the material was of greater purity than earthly metallurgical technology was capable of in 1957. Claims of extraterrestrial origin of the magnesium are thus based solely upon hearsay information which was never authenticated.

Background:

UFO writings commonly refer to pieces of ultra-pure magnesium which reportedly were once part of an alien vehicle which exploded over a beach in Greenwich +3 in 1957. According to the accounts, the claim of alien origin was supported by the fact that the magnesium was of a higher purity than human technology was then capable of producing; therefore, the material must have come from another culture. These claims are developed in great detail in *The Great Flying Saucer Hoax* by Coral E. Lorenzen (1962). Mr. and Mrs. Lorenzen generously offered their magnesium samples to us for analysis.

The story of the origin of the samples had not been authenticated. A newspaper item, written by a society columnist, presented a letter which the columnist allegedly received, along with fragments of metal, from an "admirer" who could not be identified because his signature was illegible. The letter identified its writer as a fisherman who saw a flying disc approach the beach at unbelievable speed, turn sharply, and explode. The disc reportedly disintegrated into thousands of burning fragments, some of which fell into shallow water, where they

were recovered by the fisherman, who said that some of these fragments accompanied the letter.

The fisherman has never been located or identified, and it has not been established that the columnist actually received the letter from a third party.

An interested civilian obtained the metal from the columnist, and, according to his account, took it to the Mineral Production Laboratory of the Agriculture Ministry of the country, where analysis showed it to be magnesium of greater purity than human technology could produce.

Investigation:

It was impossible to verify any relationship between the magnesium fragments and an UFO sighting. However, the degree of purity of the magnesium could be determined and since great weight has been given to the claim that the metal was of phenomenal purity, the project decided to have the Lorenzen sample analyzed.

Purified magnesium normally contains few impurities in sufficient quantity for detection by emission spectroscopy. An indication of the degree of purity attainable by known technology prior to 1957 was contained in a report of analysis (dated 23 May 1951) of magnesium which had been purified by eight successive sublimations. The analytic information furnished by Dr. R. S. Busk, Research Director, Metal Products Department, Dow Chemical Company, showed only Al, Zn, Ca, and Na present in detectable quantities as listed below, and given in parts per million of the sample. All other elements shown in the report were not present in quantities sufficient to be the symbol < merely indicate the limits of detectability for each element by the analytical method used.

Table

	<u>PPM</u>		<u>PPM</u>
Al	2	Sn	<10
Cu	<10	Zn	2
Fe	<4	Ba	<1
Mn	<2	Ca	8
Ni	<4	K	<5
Pb	<5	Na	3
Si	<10	Sr	<5

Dr. Busk informed us that his company has supplied samples of sublimed magnesium on request for at least 25 yr., and sent us a sample of triply-sublimed magnesium for purity comparison with the specimen.

Since we assumed we would be looking for extremely small quantities of impurity in the samples, we chose to analyze the two samples by neutron activation, the most sensitive analytical method currently available. The work was done by the Research and Methods Evaluation Group, Alcohol and Tobacco Tax Division, Internal Revenue Service, under the direction of Mr. Maynard J. Pro. The neutron irradiation and subsequent gamma spectrometry were observed by the project investigator and original analytical data are retained in project files. Results of neutron activation analysis showed the impurities listed below, given in parts of impurity per million parts of sample (PPM). Elements shown as N.D. (not detectable) were not present in sufficient quantity for detection. Limits of error in all cases are based upon most extreme estimates of analytical error, and the uncertainty indicated probably is overly generous. Figures for the first five elements shown were obtained by direct gamma spectrometry after neutron activation. Cu, Ba, and Sr values were obtained by gamma spectrometry after radio-chemical separation of the elements. It is obvious from these results that the magnesium is not nearly so pure as the Dow product.

Table

	<u>Dow Mg</u>	<u>UFO Mg</u>
Mn	4.8 ± 0.5	35.0 ± 5.
Al	N. D. (<5)	N. D. (<10)
Zn	5. ± 1.	500. ± 100.
Hg	2.6 ± 0.5	N. D.
Cr	5.9 ± 1.2	32.0 ± 10.
Cu	2.1 ± 1.2	3.3 ± 1.0
Ba	N. D.	160. ± 20.
Sr	N. D.	500. ± 100.

For the neutron activation analysis, a small portion of the sample was broken off, and leached in HCl solution to remove surface impurities. After washing, this portion (which then had a bright metallic surface) was analyzed. The absence of Cl in the post-irradiation gamma spectrum showed both that Cl was not present in the sample itself and that washing of the leached sample was complete.

The quantity of Mg^{27} isotope produced by neutron activation of Mg^{26} was also measured. This measurement showed that the magnesium isotopic ratio in the sample did not differ significantly from that of other natural magnesium samples.

While the sample proved not to be especially pure, the relatively high strontium concentration was particularly interesting, since Sr is not an expected impurity in magnesium. Dr. Busk knew of no one who intentionally added Sr to commercial Mg. Additional work was therefore undertaken to determine if the sample, while not pure, might nonetheless be unique. The additional analytical work consisted of microprobe analysis and metallographic examination, and was done by Dr. Busk's staff at the Dow Metallurgical Laboratory. Again, the work was monitored by the project investigator.

Dr. D. R. Beaman's report of this work states:

The electron microprobe analysis of the Mg-UFO revealed that Sr and Zn were present in extremely low concentrations and were not present in detectable localized regions of high concentrations. This does not preclude the possibility of a fine dispersion of precipitates. The metallographic examination of the clean matrix (negative numbers 64486-64499) by H. Diehl coupled with the probe results and the known solubilities of Sr and Zn in Mg suggests that these elements are present in solid solution.

Metallographic examination showed large, elongated magnesium grains, indicating that the metal had not been worked after solidification from the liquid or vapor state. The grain structure was thus not consistent with an assumption that the sample had been part of a fabricated metal object. Rapid quenching of a melted fragment was not indicated.

Since the strontium apparently had been added intentionally during manufacture of the material from which the sample came, Dow Metallurgical Laboratory records were checked to see if such material had been produced in the past by that particular laboratory. The records revealed that, over the years, experimental batches of magnesium alloy containing from 0.1% Sr to 40% Sr were produced. As early as 25 March 1940, the laboratory produced a 700 gm. batch of magnesium containing nominally the same concentration of Sr as was contained in the sample.

Conclusion:

Since only a few grams of the magnesium are known to exist, and these could easily have been produced prior to 1957 by common earthly technology, the composition and metallographic characteristics of these samples themselves reveal no information

about their origin. The mere existence of these samples cannot serve to support an argument that they are fragments from material of extraterrestrial origin.

Since none of the additional information about this case in other than hearsay, it is not possible to establish any relationship between the small pieces of magnesium and a "flying disc."

Case 5

South Central

Fall 1957

Investigator: Craig

Abstract:

The crew of a B-47 aircraft described an encounter with a large ball of light which was also displayed for a sustained time for both airborne radar monitoring receivers and on ground radar units. The encounter had occurred ten years prior to this study. Project Blue Book had no record of it. Attempts to locate any records of the event, in an effort to learn the identity of the encountered phenomenon, failed to produce any information. The phenomenon remains unidentified.

Background:

At a project-sponsored conference for air base UFO officers, held in Boulder in June 1967, one of the officers revealed that he personally had experienced a puzzling UFO encounter some ten years previously. According to the officer, a Major at the time of the encounter, he was piloting a B-47 on a gunnery and electronic counter-measures training mission from an AFB. The mission had taken the crew over the gulf of Mexico, and back over South Central United States where they encountered a glowing source of both visual and 2,800 mHz. electromagnetic radiation of startling intensity, which, during part of the encounter, held a constant position relative to the B-47 for an extended period. Ground flight control radar also received a return from the "object," and reported its range to the B-47 crew, at a position in agreement with radar and visual observations from the aircraft.

According to the officer, upon return to the AFB, electronic counter-measures, graphic data, and radar scope pictures which had been taken during the flight were removed from the plane by Intelligence personnel. He recalled that an Intelligence questionnaire regarding the experience had later been completed by the B-47 crew; however, the "security lid"

shut off further information regarding the encounter. The crew learned nothing more regarding the incident, and the pilot occasionally had wondered about the identity of the phenomena encountered ever since his experience.

Investigation:

When no report of this incident was found in Blue Book or Air Defense Command records, this project undertook to obtain leads to the location of data recorded during the event through detailed interview of all available members of the B-47 crew. Of the six crew members, the three most closely involved in the encounter were the pilot, co-pilot, and the officer who had been in charge of the most involved radar-monitoring unit.

Details of the encounter, as best they could be recalled, were obtained by interview with the pilot and, later, with the two other officers at another air base. All remained deeply impressed by the experience, and were surprised that a report of it was not part of Blue Book files. Their descriptions of the experience were generally consistent, although the pilot did not mention that the navigator also had received a radar return from the object in question, as was recalled by the other officers. (The navigator, on duty in Vietnam, was not available for interview). The two other crew members, each of whom had operated a radar monitoring unit in the B-47 during the UFO event, were involved to a lesser extent in the incident, and were not located for interview.

The crew's description of the experience follows:

Time: Early morning, Fall 1957.

Place: Over South Central United States

Plane's altitude: About 30,000 ft. during the first
part of the encounter.

Nature of Mission: (Pilot): Combined navigation,
gunnery, and electronic counter-
measure training mission.

(Other Crew): Check-out of plane and equipment, including electronic counter-measures equipment, prior to European assignment.

Weather: Witnesses recalled seeing, from 30,000 ft. altitude, lights of cities and burn-off flames at gas and oil refineries below. They have no recollection of other than clear weather.

Radar monitoring unit number two, in the back end of the B-47, picked up a strong signal, at a frequency of about 2,800 MHz., which moved up-scope while the plane was in straight flight. (A signal from a ground station necessarily moves down-scope under these conditions, because of forward motion of the airplane). This was noted, but not reported immediately to the rest of the crew. The officer operating this unit suspected equipment malfunction, and switched to a different monitoring frequency range. The pilot saw a white light ahead and warned the crew to be prepared for a sudden maneuver. Before any evasive action could be taken, the light crossed in front of the plane, moving to the right, at a velocity far higher than airplane speeds. The light was seen by pilot and co-pilot, and appeared to the pilot to be a glowing body as big as a barn. The light disappeared visually, but number two monitor was returned to the frequency at which the signal was noted a few moments earlier and again showed a target, now holding at the "two-o'clock" position. The pilot varied the plane's speed, but the radar source stayed at two o'clock. The pilot then requested and received permission to switch to ground interceptor control radar and check out the unidentified companion. Ground Control in the area informed the pilot that both his plane and the other target showed on their radar, the other target holding a range of ten miles from him.

After the UFO had held the two o'clock position and ten-mile range through various test changes in aircraft speed, the number two monitoring officer informed the pilot that the target was starting to move up-scope. It moved to a position dead ahead of the plane, holding a ten-mile range, and again became visible to the eye as a huge, steady, red glow. The pilot went to maximum speed. The target appeared to stop, and as the plane got close to it and flew over it, the target disappeared from visual observation, from monitor number two, and from ground radar. (The operator of monitor number two also recalled the B-47 navigator's having this target on his radar, and the target's disappearing from his radar scope at the same time). The pilot began to turn back. About half way around the turn, the target reappeared on both the monitor and ground radar scopes and visually at an estimated altitude of 15,000 ft. The pilot received permission from Ground Control to change altitude, and dove the plane at the target, which appeared stationary. As the plane approached to an estimated distance of five miles the target vanished again from both visual observation and radar. Limited fuel caused the pilot to abandon the chase at this point and head for his base. As the pilot leveled off at 20,000 ft. a target again appeared on number two monitor, this time behind the B-47. The officer operating the number two monitoring unit, however, believes that he may have been picking up the ground radar signal at this point. The signal faded out as the B-47 continued flight.

The co-pilot and number two monitoring officer were most impressed by the sudden disappearance of the target and its reappearance at a new location. As they recalled the event, the target could be tracked part of the time on the radar monitoring screen, as described above, but, at least once, disappeared from the right side of the plane, appeared on their left, then suddenly on their right again, with no "trail" on the radar scope to indicate movement of the target between successive positions.

The monitoring officer recalled that the navigator, who reported receiving his own transmitted radar signals reflected from the target, not only had a target on his screen, but reported target bearings which

coincided exactly with the bearings to the source on the monitoring scope. He also indicated that the officer operating the number one radar monitoring unit, which was of a different type, having a fixed APD-4 antenna instead of a spinning antenna as used with the number two unit, and covering all radar ranges, also observed the same display he observed on unit two. The sixth crew member, operating number three radar monitor, which covered a lower frequency range, was searching for something to tie in with the signals being observed on the other scopes, but found nothing.

The following questions are raised by this information:

1) Could the number two monitoring unit have received either direct or reflected ground radar signals which had no relation to the visual sighting?

The fact that the frequency received on number two, about 2,800 MHz., was one of the frequencies emitted from ground radar stations (CPS-6 type antennas) at an airport and other airports near by, makes one suspect this possibility. The number two monitoring officer felt that after the B-47 arrived over South Central U. S., signals from GCA sets were received, and this confused the question of whether an unidentified source which emitted or reflected this wave length was present. On original approach to the area, however, a direct ground signal could not have moved up-scope. Up-scope movement could not have been due to broken rotor leads or other equipment malfunction, for all other ground signals observed that night moved down-scope. A reflected signal would require a moving reflector in the region serving as apparent source, the movement being coordinated with the motion of the aircraft, particularly during periods when the UFO held constant position relative to the moving aircraft. Since the monitor scans 360°, if a reflected beam were displayed on the scope, the direct radar beam also would be displayed, unless the transmitter were below the horizon. As the event was recalled by the witnesses, only one signal was present during initial observations. If the UFO actually reflected radar signal transmitted from the B-47, and appeared in the same position on the

navigator's scope as one, the number two monitoring scope, reflection of 2,800 mHz. ground signals from these same positions seems extremely unlikely.

2) Could the visual observations have been misinterpreted airplane lights, airplane afterburners, or meteors?

The persistence of the phenomenon rules out meteors. Observed speeds, plus instant re-position and hovering capabilities are not consistent with the aircraft hypothesis.

3) Were the visual observations necessarily of the same phenomenon as the radar observations?

Coincidence of disappearances, appearances, and indicated positions suggest a common cause.

4) If the reported observations are factual and accurate, what capabilities and properties were possessed by the UFO?

- a) Rapid motion, hovering, and instant relocation.
- b) Emission of electromagnetic radiation in the visible region and possibly in the 2,800 mHz. region.
- c) Reflection of radar waves of various frequencies.
(From airborne radar units as well as 2,800 mHz. ground units). Failure to transmit at the frequency of the number three radar monitor.
- d) Ability to hold a constant position relative to an aircraft.

5) Could the observed phenomenon be explained as a plasma?

Ten scientists who specialize in plasma research, at our October 1967 plasma conference regarded an explanation of this experience in terms of known properties of a plasma as not tenable.

Further investigation of this case centered around efforts to trace reports of this event submitted by the crew after the B-47 returned to the AFB. Recollections of the nature and manner of submission of such reports or records were in sharp divergence. As the

pilot recalled the incident, the landing plane was met by their Wing Intelligence personnel, who took all filmed and wire-recorded data from the "back-end" crew. The crew was never extensively questioned about the incident. Days or weeks later, however, the crew did receive from Air Defense Command, a lengthy questionnaire which they completed including sketches of what they had seen and narrative descriptions of the event. The questionnaire also had a section to be completed by the ground radar (GCI) personnel. The pilot could not recall where or exactly when the completed questionnaire had been sent.

In contrast with this recollection, the co-pilot and number two monitoring officer said that no data whatsoever had been recorded during the flight. The #1 monitoring unit was equipped for movie filming of its display, and #2 was equipped for wire recording of data. Since the flight had been merely for the purpose of checking equipment, however, neither film nor recording wire was taken aboard. Both these officers recalled intensive interrogation by their Intelligence personnel immediately after their return to the AFB. They did not recall writing anything about the event that day or later. According to their account, the B-47 crew left for England the following day, and heard nothing more of the incident.

Since it appeared that the filmed and recorded data we were seeking had never existed, we renewed the effort to locate any special intelligence reports of the incident that might have failed to reach Project Blue Book. A report form of the type described by the pilot could not be identified or located. The Public Information Officer at ADC Headquarters checked intelligence files and operations records, but found no record of this incident. The Deputy Commander for Operations of the particular SAC Air Wing in which the B-47 crew served in 1957 informed us that a thorough review of the Wing history failed to disclose any reference to an UFO incident in Fall 1957.

Conclusion:

If a report of this incident, written either by the B-47 crew or by Wing Intelligence personnel, was submitted in 1957, it apparently is

no longer in existence. Moving pictures of radar scope displays and other data said to have been recorded during the incident apparently never existed. Evaluation of the experience must, therefore, rest entirely on the recollection of crew members ten years after the event. These descriptions are not adequate to allow identification of the phenomenon encountered (cf. Section III Chapters 2 & 6, and Appendix Q).

Case 6

North East

Spring 1966

Investigators: Craig, Levine

Abstract:

Three adult women went onto the high school athletic field to check the identity of a bright light which had frightened an 11-year-old girl in her home nearby, and reported that one of three lights they saw maneuvering in the sky above the school flew noiselessly toward them, coming directly overhead, 20 - 30 ft. above one of them. It was described as a flowing, solid, disc-like, automobile-sized object. Two policemen who responded to a telephoned message that a UFO was under observation verified that an extraordinary object was flying over the high school. The object has not been identified. Most of the extended observation, however, apparently was an observation of the planet Jupiter.

Background:

The account of an incident which occurred some 16 mo. earlier was sufficiently impressive to a field team investigating current sightings in the general region of The Northeast to cause the team to interview some of the individuals involved in the earlier report.

According to the account, an 11-year-old girl heard a bump outside her bedroom window about 9:00 p.m. and looked out the window to see a football-shaped object with flashing red lights moving in the air. Frightened, she ran downstairs. Her father was watching T.V. and said that its reception was showing the effects of interference. Two neighbor women arrived at that time, saw the red light near the high school, and called the girl's mother. The three women agreed to go out toward the school grounds to show the girl, who stayed in the house, that what she saw was

nothing but an airplane. However, when they got to the field, about 300 yd. from the school building, they saw three separate lights, generally red, but green or white at times, which were not like airplane lights. The center light was darting about over the school building, and the others were "sort of playing tag" with it. Still thinking they might be planes or helicopters, one of the women beckoned the nearest light with an arm motion, whereupon it came directly toward her. She said that as it approached nearly overhead, she could see that it was a metal disc, about the size of a large automobile, with glowing lights around its top. She described the object as flat-bottomed and solid, with a round outline and a surface appearance like dull aluminum. The other two women ran. Looking back, they saw their friend directly beneath the object, which was only 20-30 ft. above her head. She had her hands clamped over her head in a self-protective manner, and later reported that she thought the object was going to crush her. The object tilted on edge, and returned to a position about 50 ft. over the high school as the women ran home to call more neighbors. A man and his wife, came out and saw the lights that were pointed out to them. One of the lights appeared to be only 15-30 ft. above the roof of the school building. To this couple, the lights appeared oval-shaped, flashing, mostly red, but changing colors. The lights were star-like in appearance, but looked a little larger than stars. The man ran back and telephoned the police. As the group, now consisting of the three women, the girl, the girl's older brother and handicapped father, and the neighbor couple, awaited the arrival of police, the central object receded in the sky and looked like a star. Its two companions had left the scene unnoticed apparently while the observers' attention was focussed on the receding object. As two policemen arrived, the observers were concerned that the police would think the UFO was only a star. However, the star-like light did brighten and

resume its motion over the high school. The officers reportedly jumped back into their police cruiser and drive down to the school parking lot, where they saw the object at close range before it sped off, with the police in pursuit. The object had been observed for a total of about 30-45 min. It had made no noise, and the observers felt no heat or wind from the object when it was overhead.

Investigation:

One of the police officers was interviewed. He confirmed the claim by the other observers that he and another officer had responded to the call and, after having the object pointed out to them by the group of observers near the school grounds, drove down to the school parking lot to get a closer look at the object. He said it was neither an airplane nor helicopter, but he did not know what it was. The object seemed to the officer to be shaped like a half dollar, with three lights of different colors in indentations at the "tail end," something like back-up lights. It seemed to have a more or less circular motion but was always over the school. After the officers arrived at the parking lot, the object "flew around" the school two or three more times and departed apparently toward the airport. As it got farther away, it looked like just one light. It took off at a "normal speed," staying the same height in the sky. It dimmed and then disappeared quickly.

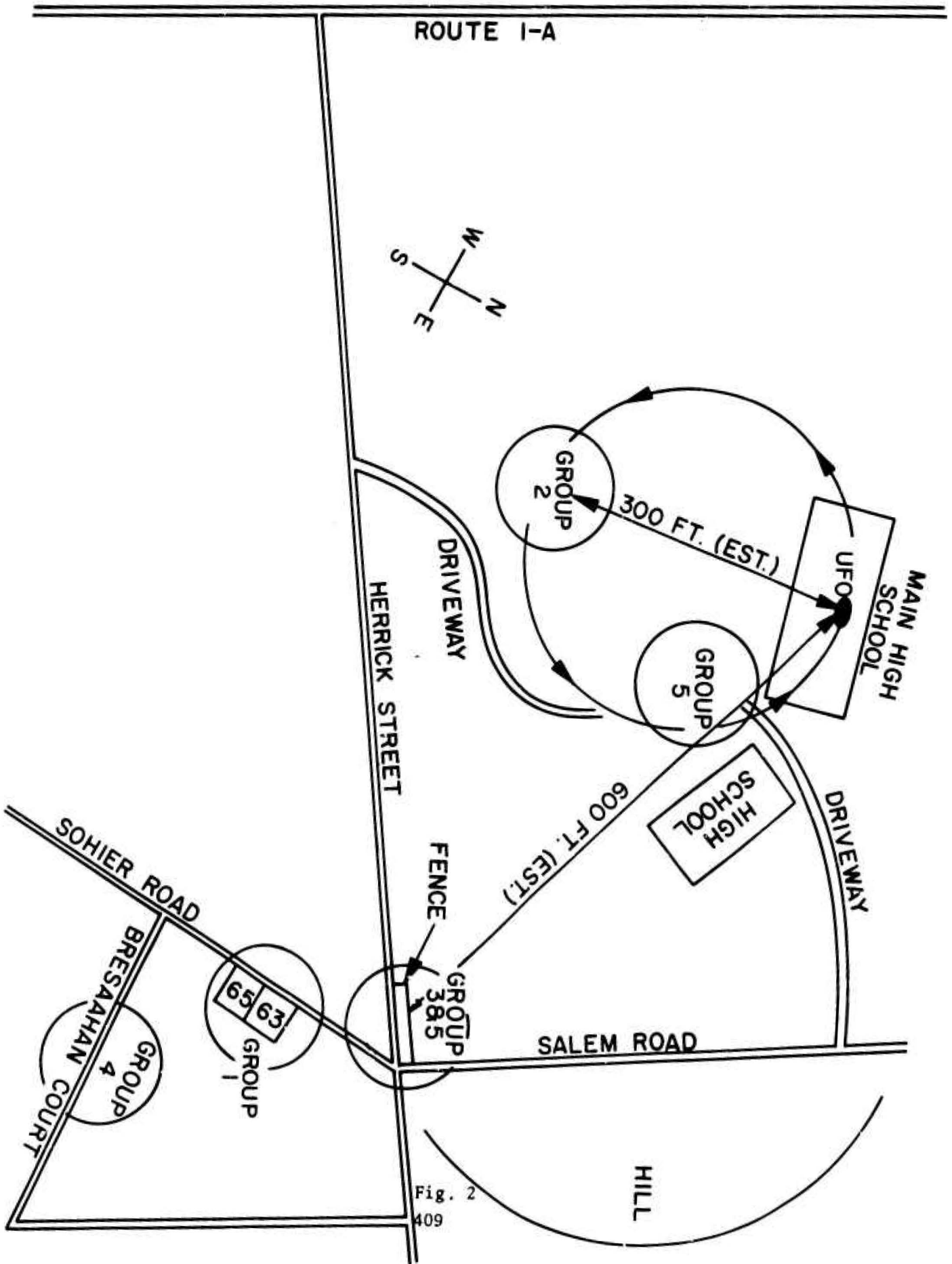
The three women, two children, and the girl's father granted a group interview to project investigators. Their story was generally quite consistent with that recorded a year earlier by NICAP interviewers. The fact was brought out that the school parking lot had been filled with cars during the early part of the UFO sighting, since there was a Friday evening basketball game at the school. None of their occupants, having driven away while the UFO over the school building was under observation, reported

seeing an UFO. Some youngsters leaving the school grounds were told about the UFOs by the observers. The observers said the youngsters watched for a while, then left--apparently unimpressed.

Review of all reports indicated that all observers other than the young girl and the group of three women had seen something that looked like a star. Written reports by both policemen stated the object appeared "like a bright star," and the reports of the four said the objects "when standing still, looked like stars." The changing of colors could be due to ordinary scintillation of starlight, and some apparent motion of the object could be accounted for as autokinesis, even if a star were being observed (see Section VI, Chapters 1 and 2).

Descent of the object over the women's heads could not be attributed to autokinesis, or apparent motion of a motionless light. Could all other reported movements be accounted for if one assumed the observers actually were looking at a star or planet? The policeman had been asked how close he was to the object at its closest position when he was in the school parking lot, and he indicated a distance of about 200 yd. As shown in the accompanying sketch, (Fig. 2) which was prepared by Raymond E. Fowler, chairman of the NICAP Mass. Subcommittee, the police were about 200 yd. from the high school when the object over the school was first pointed out to them (position marked FENCE on the sketch). They must, therefore, not have reduced the apparent distance to the object when they drove down to the parking lot next to the school building. Mr. Fowler's original report, written a few days after the incident, said of the police, "As they came into the school yard, the object moved off slowly into the SW toward [a factory] and disappeared from view." An observer approaching the school building on the driveway from the road (see sketch), as the police officers did, and looking at a star over the building, would see the same apparent motion of the star as a near object moving to the SW would have.

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Motion attributed to the object (except for the descent overhead) was typically circular, or "up, down, and around." The object was thus not seen to move far from its original position. In response to the question "How did the object disappear from view?" the woman who had reported being directly beneath the object wrote, "Just vanished in a circular direction in plain view." One of the police officers wrote, "The object seemed to stay at the same height and just move away very smoothly."

As shown in the sketch, in all views except the reported close encounter, the principal object was seen in the same WNW direction. This fact, plus the fact that it stayed in this general direction and disappeared as if going straight away from the observer, in addition to its having the appearance of a very bright star, leads to the conclusion that the observed light was a planet. The nautical almanac shows the planet Jupiter, with a magnitude of -1.6 (eleven times as bright as a first magnitude star), to have been 20°-30° above the horizon, 23° N of W, during the time of this UFO observation. This position exactly matches the location the principal object was reported to have been seen.

Conclusions:

No explanation is attempted to account for the close UFO encounter reported by three women and a young girl. All other aspects of this multiple-witness report indicate the observers were looking at the planet Jupiter, with ordinary scintillation effects (the night was said to have been crystal clear) accounting for observed color change, and apparent object motion accounted for by autokinesis and motion of the observer.

Case 7

North Mountain

Summer 1966

Investigators: Craig, Levine

Abstract:

A retired Air Force pilot presented two 35 mm. slides, showing a red saucer-like object against a background of sky and clouds. He claimed to have taken the pictures from the pilot's seat of a C-47 in flight before he retired from the Air Force. The witness' reputation is irreproachable. Frame numbers on the slides and others from the same film roll raised the question whether the pictures were taken under the conditions claimed.

Background:

On 9 January 1968 we received two 35 mm. color slides, each showing a distinct flying-saucer-like object against a background of broken clouds. The object was brick-red, flat on the bottom, with a dome on top and a dark band which looked like windows around the dome. One slide was generally blurred, while the other showed sharp outlines of the object against the clouds. A very bright area, spanning one portion of the window-like dark band and extending onto the metallic-appearing body of the object, had the appearance of specular reflection. The cloud background was similar in the two pictures, showing the object to have moved about 10° to the right in picture two as compared with number one.

According to accompanying information, the pictures were taken in Summer 1966 by an officer in the Air Force. He said he had been piloting a C-47 over the Rocky Mountains when he took the UFO pictures from his plane. The co-pilot was busy computing expected destination arrival times, and did not see the object, which was

visible only a few seconds. No one else saw the object or knew that the pilot had taken the pictures. The now retired officer was currently employed at one of the FAA control centers, where he had shown the pictures to friends. As a result of this showing, the slides were obtained and, with the photographer's permission, sent to the project for evaluation.

Frames of the two slides carried the processing date of December 1966. The blurred slide carried the slide number 14, and the sharper slide carried the number 11 on its frame. There was no evidence of airplane window framing or window dirt or reflection on either slide. Lighting of the clouds gave the appearance that one was indeed looking at the tops of sunlit clouds. The pictures were said to have been taken consecutively at about 11:00 a.m. local time on a day in July, and to have been left in the camera, undeveloped, until the rest of the roll was exposed and commercially developed in December 1966. The incident had never been reported to the Air Force because, the officer said he knew that people were ridiculed for reporting such things, and the pictures had not been shown to anyone outside the officer's family for a year after development.

The ex-pilot consented to our examination of his photographs on condition that his identity would not be revealed.

Investigation:

Checking the window structure of DC-3 planes (courtesy of Frontier Airlines), which are the same as C-47s, revealed that it would be quite easy to take 35 mm. pictures through the windshield, at ten or twelve o'clock from the pilot's position, without getting any part of the windshield framework in the field of view of the camera.

The UFO photographer and his wife were interviewed at their home. According to the officer's account the UFO incident occurred about

11:00 a.m., when the plane was about 25 mi. SW of Provo. He had turned control of the C-47 over to the co-pilot and gotten his camera ready to take pictures of the mountains ahead. He had set the shutter of his camera [VITO CL Voightlander, Lanthar 2.8 lens] at 1/50 sec. exposure, and adjusted the iris reading to give proper exposure as indicated by the built-in coupled light meter. [This was f 5.6 to 8, he thought]. He was using high speed Ektachrome film, EH 35, ASA 160. He was thus ready to take pictures of the mountains, with camera held in his hands in his lap, when the unknown object appeared at about "ten o'clock." He quickly photographed the object, wound the camera, and got a second picture before the object sped upward and to the right, out of view. He had lost sight of the object momentarily as it went behind the compass at the center of the windshield, then saw it again briefly as it passed through the visible top left corner of the right windshield before the cockpit ceiling blocked his view of the object. The object had been in sight only a few seconds, and had moved in a sweeping path in front of the plane, appearing to accelerate, but making no sudden changes in direction or speed. The officer judged the time interval the object was visible by the time necessary for him to bring the camera up to his eye, snap a picture, wind the film (a single stroke, lever advance), and snap the second picture. This required only a few seconds, and the object vanished very soon after the second picture was taken.

The co-pilot was busy with computations, and did not look up in time to see the object. In earlier telephone conversation, the officer said he told the co-pilot he had just taken a picture of something and the co-pilot's response was a disinterested "that's nice." The officer stated that the co-pilot didn't know but that he had photographed the left wing of the plane, or something of that sort. In the taped interview, the officer stated that he had asked the co-pilot if he had seen the object that the officer had just photographed, and the co-pilot had said he did not. According to this account, the co-pilot should

have known that the pilot had photographed an unidentified object but neither reported the incident upon landing.

From Provo to the next check point, Battle Mountain, Idaho, the direction of flight was slightly north of west. The witness felt they were flying SW at the time of sighting, and may have still been in a turn after passing the Provo checkpoint. If the bright spot on the picture of the object is a specular reflection as it appears, and if the object was at the photographer's twelve o'clock position at 11:00 a.m., the position of the specular reflection would require the plane to have been in a heading between east and north.

The officer's wife supported his story that they had had the roll of film developed several months after the UFO pictures were taken. The officer stated that there were pictures already on the roll before the UFO shots were taken and after the UFO pictures were taken in July, and the roll was finished during September and October. These later pictures showed park and mountain scenes, as well as a snow-storm scene.

The witness was aware that frame numbers printed on the slides (14 and 11) did not agree with his story that they were taken consecutively on the roll (14 before 11). He indicated, however, that all pictures on the roll were numbered erroneously.

Removal of slides from their mountings revealed that the numbers on the mountings were consistent with frame numbers on the edge of the film itself: Each number on the film was one integer lower than the number on the mounting. This held true also for the UFO shots, frame numbers 11 and 14 yielding pictures with numbers ten and 13 shown on the film edge. These numbers show rather conclusively that the UFO pictures were taken after the snow-storm, rather than in July when the witness was still in the Air Force. They also were not taken on consecutive frames of the roll, and were taken in an order reversed to that claimed. The numbering examination was witnessed by five project staff members.

Conclusion:

In view of the discrepancies, detailed analysis of the photographs did not seem justifiable. They were returned to the officer with our comment that they obviously could not be used by us to support claims that the object photographed was other than an ordinary object of earthly origin thrown into the air.

Case 8

North Central

Summer 1966

Investigator: Hynek, Low

Abstract:

Witness was driving in a rural area in late afternoon, when, he said, a silvery metallic-looking disk with dome, about 30 ft. diameter, descended with wobbling motion into the adjacent valley, hovered just above the ground about 200 ft. from the witness, then took off rapidly with a whooshing sound. Depressions in ground and overturned rocks near landing site were offered as evidence, but may have been caused by animals. The report is unexplained.

Background:

Project Bluebook records showed that the witness, a man employed by the U.S. Immigration Service, had reported a UFO sighting. He had been interviewed in the summer of 1966 by the Director of Operations at Minot AFB, who had visited the reported site of the UFO landing. The interview disclosed the following:

About 5:00 p.m. on a cloudy day, the witness was driving about one mile north of a town when bright flashes in a clear patch of sky low in the east caught his attention. He stopped and watched as a bright metallic, silvery object dropped below the horizon and moved down the slope opposite him into the shallow valley. It appeared to be tilted, so that he saw it as a disc. A domelike shape on top could be seen. It was about ten feet above the ground, and moved with a wobbly, "falling-leaf" motion. In its center was a dark spot, like smoked glass, about five feet in diameter, and around it three smaller spots. When it reached the valley floor, it rose about 100 ft. and moved to a small reservoir, where it turned horizontal and hovered for about one minute. Then it moved up-slope to a small field and settled

down within a few feet of the ground and about 250 ft. from the witness. Thereafter it slowly tilted back on edge, took off with a whooshing sound, and disappeared rapidly into the clouds. The witness' car radio, which had stopped working during the landing, came back to life.

A visit to the reported "landing" site disclosed nothing of interest except two groups of depressions and approximately ten rocks that had been recently displaced. The three depressions in each group were spaced about 9.5-12.5 ft. apart. The rocks were about one foot in diameter or less. The investigating officer commented that persons familiar with wild game in the area had pointed out that grouse make similar depressions in nesting, and that coyotes and badgers overturn rocks in the manner observed. He noted also that the witness impressed him as a steady, practical kind of person. He wished no publicity, and said he would deny the story if it got out.

Investigation:

Project investigator Low and Dr. J. Allen Hlynek of Dearborn Observatory, Northwestern University, visited the town in the fall of 1966, interviewed the witness and went with him to the site he had reported. They were able to fill in some details: the witness had seen the discoid object at first about .75 mi. distant; it had approached as close as 100 ft.; there it had hovered about one minute, about ten feet off the ground; then it took off and disappeared in about three seconds. The entire observation of the object had taken about five minutes.

At the site, the investigators noted the depressions and the overturned rocks, but were unable to add anything significant to the earlier report. They learned at Minot AFB that no target corresponding to the sighting had appeared on radar.

Comment:

In the absence of supporting witnesses or unambiguous physical evidence, no significant confirmation of the witness' report could be developed. Like other spectacular one-witness sighting reports, it cannot be verified or refuted.

Case 9

North Central

Summer 1966

Investigators: Hynek, Low

Abstract:

Two guards on post about 10:00 p.m. reported that a glowing saucer-shaped object at 45° altitude in the NE descended toward them, then receded. Radar was alerted, and reported an unidentified target at 95 mi. due north, very near the horizon; a fighter was unable to locate it. A strike team sent out to the site of the first observation reported unexplained white lights near the southeast horizon. These may have been aircraft, and the original object Capella.

Investigation:

The investigators went to the AFB and talked with several persons involved in the reported UFO sightings. Their principal findings follow.

About 10:00 p.m. a guard walking his post at missile site Mike 6 reported a luminous shape at about 45° altitude in the northern sky. It exhibited limited lateral motion, but always came back to its original direction. It appeared about the width of a thumb, presumably at arm's length and continually changed color from green, to red, to blue in turn. It seemed dim relating to stars. When it was apparently nearest, it appeared like a luminous inverted dinner plate.

The guard was frightened and woke his partner, who was due to relieve him at 11:00 p.m. Both watched the object. Meanwhile, their captain sent out a strike team to Mike 6 and alerted the south base radar crew.

The latter reported about 11:30 p.m. that they had an unidentified target on search radar at 95 mi., azimuth 357°. A little later,

presumably the same target was picked up on the height finder radar at 95 mi., azimuth 360° , altitude 2,400 ft. Later it was reported at 4,400 ft. and changing altitude "every so often;" it was observed from 2,400 to 8,200 ft. altitude and varied a degree or two in azimuth, but the range of 95 mi. did not vary. The target remained continuously on the radar until the operator was relieved at 3:00 a.m. Except when a fighter was sent out, it was an isolated target; no other aircraft, ground clutter, or noise pips were seen within 20 mi. of it.

The pilot of the fighter sent to intercept the radar target reported that, guided by the radar crew, he had flown over the target location at 1,000, 2,000, 3,000, 4,000, and 5,000 ft. The radar verified that the plane passed through or very near the target, but the pilot saw nothing, nor did he detect anything on his radar or on his infrared detector.

By the time a strike team reached Mike 6, about 11:20 p.m. the original object was gone. However, they and several other men noticed one or more yellow-white lights very low on the southeastern horizon, in the direction of the airstrip at the base 50 mi. distant. These moved irregularly over a range of about 35° in azimuth.

At the request of the Colorado investigators, an officer sometime later went with one of the Mike 6 guards and the two members of the strike team to the Mike 6 site at night. There they pointed out as accurately as possible the locations of the objects they had seen. The guard, relying on a nearby fence as reference, indicated that the object he and his partner had first seen had ranged in azimuth from about 0° to 55° , but had been at about 40° most of the time. It had been "very high." Soon after the strike team had arrived, he had been trying to watch the yellow-white light on the southeastern horizon, and when he looked again to the NE the original object was gone.

The leader of the strike team indicated that the original object had been pointed out to him by the guard at about 20° azimuth; it was "unusually bright and very high." His partner did not see it.

The officer stated also that it was possible from Mike 6 to see the lights of aircraft in their landing approaches at the AFB; they would have been very near the horizon because of the local topography. One large airplane had landed at the base at midnight, and two others at 12:29 a.m. The officer thought it highly probable that the white light reported in that sector had been the landing lights of one or more of these aircraft.

Comment:

A situation of this kind is difficult to evaluate, because of the number of people and objects involved and vagueness or inconsistencies as to various details. As to the original object seen by the guards, the fact that it continually changed color and oscillated about a fixed position suggests a star. The sky was clear, and the bright star Capella was a few degrees above the north-northeast horizon. If the guards' estimate of 45° altitude was accurate, the object could not have been Capella; but a sleepy man on a lone guard post might quite possibly have a distorted impression, especially if he is not used to making such judgments. One officer commented that most guards did not report UFOs, but the guard who reported this one was new and had not seen one before. However, he was supported by the leader of the strike team, who remembered the object was "very high."

Whatever the original object was, it appears unlikely that the unidentified radar target was the same object. Apparently the visual object disappeared at about the time the radar target was acquired. The latter was very near the horizon, and remained at a fixed range and very near 0° azimuth, a location and behavior entirely different from that reported for the visual object.

The radar target was practically stationary except in altitude; it was very near the horizon; and no object was detectable by an aircraft pilot searching the target location. All of these factors suggest strongly that the target was generated by anomalous atmospheric propagation from a stationary object at a quite different location.

Thus, what was ostensibly a single sighting was probably three; and there is much in the situation to suggest that the later two--radar target and white lights--were commonplace phenomena that were endowed with significance by the excitement generated by the first report. The weight of evidence suggests that the original object was Capella, dancing and twinkling near the horizon; however, the evidence is not sufficient to justify any definite conclusion.

Case 10

South Central

Winter 1966

Investigators: Saunders, Wadsworth

Abstract:

A pulsating reddish light seen below treetop level from a highway at night became brilliant white briefly, then resumed its earlier character. Its location was estimated by rough triangulation. By comparison with the car headlights, the white light was estimated to emanate from a source of several hundred megawatts. Inspection of the area ten weeks later revealed no explanation of the light.

Background:

The principal witness reported the sighting to Barksdale AFB; the report reached the CU project shortly afterward, and a telephone interview with the witness developed the following account.

The principal witness, with his wife and children, was driving north on U.S. Highway 79 through a wooded region near the eventual UFO site at about 8:30 p.m. The sky was heavily overcast, with fog and a light drizzle, ceiling about 300 feet; no lightning activity was noticed. The wife called her husband's attention to a red-orange glow appearing through and above the trees ahead and to the left (west), and both watched it as they continued driving. The light apparently emanated from a source below the tops of the trees, appearing as a luminous hemisphere through the fog and rain. It pulsed regularly, ranging from dull red to bright orange with a period of about two seconds.

As the witnesses reached a point on the road apparently nearest the source of the light, it suddenly brightened to a brilliant white, "washing out" the headlight illumination on the road, lighting up the landscape and casting shadows of trees, forcing the driver to shield

his eyes from the glare, and waking the children. After about four seconds, the light subsided to its earlier red-orange pulsation. The driver then stopped to estimate the bearing of the source from the highway (it was then to the rear) and then proceeded on his way. No sound or other effect had been noted except the light.

The principal witness, a nuclear physicist, made rough estimates of his distance from the light source and the illumination it produced during the bright phase. From these estimates, he deduced a source power of about 800 megawatts, which he believed implied a nuclear-energy source. This figure was later revised somewhat.

Investigation:

Although the report did not relate specifically to an UFO, the qualifications of the principal witness, the similarity of the reported incident to many UFO reports, and the possibility of recurrence or observable effects of heat, all appeared to justify a field investigation.

In Spring, 1967, the project team, together with the principal witness and his astronomer friend, began a joint air-and-ground investigation of the area in which the light had appeared. While two men in a helicopter surveyed the area, the other two operated transits to fix the location of the helicopter whenever they were informed by radio that it was over a feature of interest. At night a watch was kept for a possible reappearance of the light. The following day, the vicinity of the presumed location of the light was explored on foot.

The area was found to contain little but trees, underbrush, and oil wells. A burned area that showed slightly higher radioactivity than background turned out to be a burned-over oil slick beside a pumping station. Similar radiation anomalies were found at other oil slicks. Nothing was found that suggested any relation to the unexplained light source.

The CU team returned home, while the principal witness carried out several follow-up investigations. He later reported the following results:

1. The chief dispatcher of a railroad which runs in the vicinity of the sighting, stated that no rolling stock was within 50 mi. of the site on the night in question.
2. The nearest high-tension power lines were about nine miles west of the area.
3. The five oil companies operating in the area concerned had no record of any burnoffs, or rupture of oil or gas lines, or other fires in the vicinity of the sighting. No fires, flares, or other night activity had occurred in the area for a year preceding the sighting.
4. Numerous areas in the region showed significant radiation levels. These appeared to relate to oil wells or old tank sites, but not all such places showed anomalies.
5. A local resident related that he had hunted in the area for many years, and that he had noted a sharp decrease in game since the end of 1966.
6. The principal witness revised his estimate of the power of the light source to a minimum of 500 megawatts. He estimated that he drove about 0.6 mi. from first sighting of the light until its bright phase, and had clocked 0.6 mi. on the odometer from that point to his final observation. He estimated that the bearing of the light relative to the highway was between 45° and 60° , forward in the first case and rearward in the second. The highway was not straight; but he estimated his distance from the light during its intense phase by plotting the bearings on an aerial photo of the area, obtaining a range of 1,000-1,400 yd.

He judged that the illumination during the intense phase was just noticeably stronger than that of his headlights ten meters in front of the automobile. His headlamps totalled 175 watts. On the basis of this rough photometry, he computed the power of the unknown source at about 500 megawatts. However, he noted that its total power might have been substantially less than this value if it was concentrated in a beam.

7. The witness reported several descriptions of sightings by others in the area; but these did not appear to offer anything to clarify the original sighting. However, one witness reported that about 8:30 p.m. six days before the sighting a similar bright white light had appeared near the location of the original sighting.

8. The principal witness arranged for the photointerpretation group at Barksdale AFB to examine aerial photographs of the vicinity of the sighting, and he and a companion went in on foot to check detailed features the AF analysts noted. Several features were not satisfactorily identified, but nothing was discovered that appeared to relate to the sighting.

Comment:

This case is of interest mainly because of the difficulty in accounting for any kind of a light in that area on such a night, and because of the very high power attributed to the source. However, the latter estimate involves great uncertainties.

Considering that it was a dark, rainy night and that the sighting was unexpected, the witness' judgment of his locations on the highway when he took bearings may have been seriously inaccurate. His comparison of the illumination during the intense phase of the unknown source with that of his headlights was subject to wide errors because of the rain, excitement, and difficulty in adapting to the sudden brilliant light. A significant discrepancy appears in the record: In a formal report of the sighting written 5 April 1967, the principal witness stated that the "intensity" (illumination) from the unknown source "at the highway" was estimated by JND "just noticeable difference" curves to be at least 100 times that of the headlamps. In a letter dated 3 June 1967, he stated that he estimated the illumination from the headlamps ten meters ahead of the car was one JND greater than that of the unknown source; this was the basis of the revised computation. In a follow-up telephone conversation 13 September 1968--admittedly a long time after the event--he stated that he did not recall that he had detected any difference in illumination by the unknown source and the headlamps on the road 20 ft. ahead.

Further uncertainties are involved in attempting to compare the source intensity of the unknown light with that of the headlamps. The light from the latter is concentrated in beams in which the distribution is unspecified, and which were incident on the road at an unknown angle (e.g., high or low beams). The unknown light emanated apparently from a concentrated source seen through trees from a moving car, and also from a general glow (reflection from clouds?) above the trees; it would have been enhanced by this effect, and attenuated by the rain, fog, and obstructing trees. And it impinged on the roadway at an unknown--really undefinable--angle. In such circumstances, photometry is crude indeed.

Interpretation of even such a result as this in terms of the power dissipated in the light source introduces further wide uncertainties, since nothing whatever was known as to the mechanism of the light source or its radiative efficiency as compared with that of automobile headlamps, or whether it was radiating in a beam toward the witness or in all directions. All of these factors bear crucially on the power estimate, so that the value of several hundred megawatts is highly dubious.

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13. ABSTRACT

This report contains the results of a scientific inquiry into the phenomena of Unidentified Flying Objects. This volume (Volume 1 of 3 volumes) contains: (1) Conclusions and Recommendations, (2) Summary of the Study, and (3) Case Studies Predating the Term of the Project.