FAA

ADMINISTRATION
FEDERAL AVIATION XXXXXXXX
WASHINGTON, D. C. XXXXX 20590

Official Business

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Colonel James C. Manatt
Attn: TDET/UFO
Director of Technology and Subsystems
Headquarters Foreign Technology Division
Wright-Patterson Air Force Base, Ohio 45433

TDET/UFO

FAA Radar Capability

Hq Federal Aviation Agency
800 Independence Avenue, SW
Washington, D.C. 20553

The Aerial Phenomena Branch requests information on whether the FAA radar network could feasibly be used to detect unidentified flying objects (UFOs) flying over the continental limits of the United States, particularly UFOs at altitudes at which a craft should be flying IFR.

JAMES C. MANATT, Colonel, USAF
Director of Technology and Subsystems

MEMO FOR THE RECORD

20 Sept. 1967

I talked to the FAA on base. The FAA radars see all objects from ground level to their max. height (40,000 ft. at most terminal radars and 60,000 ft. for center radars). None of these radars (except one in N.Y.) can determine the height of the objects on the screen. Objects over 24,000 ft. must have a secondary transponder (a device that sends an amplified code signal to FAA radar). This is called the becon return system. If an object does not return this signal or code (or does not have special permission to fly at these altitudes without a secondary transponder) the FAA simply assumes that it is less than 24,000 ft. The Faa is interested only in aircraft under 24,000 ft. that have requested aid of some type and aircraft that they are in the process of controlling. All others they ignore unless they see that the aircraft is in trouble such as a collision course with another craft. The FAA controller does not know of any phamplet or handbook with the above info. in it. He suggested that I contact Mr. Heenan or some one else in the 2750th Training Office, Air Training branch(70480) to see if they may have something.

26 Sept. 1967

Contacted Mr. Kerris of Air Training Branch. He knows of no booklet or manual that contains more info. regaurding the above topics. He suggested that I contact Mr. Wilson of the Regional Office Faa ,Lunkin(?) Airport, Cincinatti. Also suggested that I could contact the Indianapolis Center.

MEMO FOR THE RECORD

26 Sept. 1967

I again called the FAA on base and asked them if NORAD headquarters received a copy of all flight plans of planes on IFR. He said that they do.

I then called Lt. Col. Morton of ADC, Aeronautical Defensive Systems (52667) and asked him if NORAD kept track of all planes over 24,000 ft. He said that he thought that NORAD kept track of all planes over 4,000 ft. and traveling more than 120 knots.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20590

OCT 11 1967

IN REPLY REFER TO: AT-330

Colonel James C. Manatt
Director of Technology and Subsystems
Headquarters Foreign Technology Division
Wright-Patterson Air Force Base, Ohio 45433

Attention: TDET/UFO

Dear Colonel Manatt:

Your request regarding the use of FAA radar for detection of unidentified flying objects (UFOs) has been forwarded to this office for reply.

The United States Air Force and the University of Colorado are conducting a study project on UFOs in which the FAA is cooperating. Enclosed is a copy of the Notice (N 7230.29) to our personnel instructing them in the procedures to be followed.

Further information on this project and the reports obtained from the FAA could possibly be obtained from the University of Colorado.

Sincerely yours,

for Robert W. Martin, Chief
ATC Operations and
Procedures Division
Air Traffic Service

Enclosure

NOTICE

FEDERAL AVIATION AGENCY
Washington, D.C.

N 7230. 29

4/4/67

Cancellation Date: 12/31/67

SUBJ: REPORTING OF UNIDENTIFIED FLYING OBJECTS (RIS: AT 7230-96)

1. PURPOSE. This notice establishes procedures for reporting of unidentified flying objects (UFO's) by air traffic control specialists.

2. EFFECTIVE DATE. April 20, 1967.

3. REFERENCES. Aeronautical Communications and Pilot Services Handbook 7300.7.

4. BACKGROUND. The University of Colorado is conducting a study project on UFO's. One of their problems is to develop detailed and credible data. Since air traffic control specialists are skilled observers and in many facilities have access to radar, their cooperation is invaluable to the project success.

5. PROCEDURES. All reports submitted for this project are on a voluntary basis, but it should be noted that reports will be held in strict confidence and no details of sightings or names of persons will be released to news media. Telephone reports of radar UFO sightings shall not include names of radar sites from which the data was derived. This is to preclude release of classified information on joint-use radar.

   a. Initial reports on UFO sightings should be transmitted immediately on the FTS system to the University of Colorado by dialing 8-303-447-1000 and requesting phone number 443-~~6762~~ 2271. When the switchboard operator at the University of Colorado answers, advise that the Federal Aviation Agency is calling with a UFO report and the party designated to accept the call will be connected.

   b. Report should be brief and include such information as:

      (1) Time, place and duration of sighting.

      (2) Method of observation (radar, visual or both). Do not include name of radar site.

      (3) Number of objects seen.

      (4) Size, distance and motion of object.

      (5) Name of person calling and facility of employment.

Distribution: FAT-1, 2, 3, 5, 6 (1-5) WRM/AT-3

c. After initial reports of sightings, a later follow up by University of Colorado and collaborating scientists at other universities will take place in the form of interviews. Interviews will be conducted only on those sightings that hold special interest for UFO research and will be held at the convenience of the personnel. If the interview concerns a UFO sighting derived from joint-use radar, security clearances at the secret level must be confirmed for the interview group. A listing of those persons cleared will be provided to the air route traffic control centers through Compliance and Security channels.

d. Sighting information received from outside sources shall be handled as specified in Handbook 7300.7, paragraph 463.

APPROVED **APRIL 4, 1967** FEDERAL AVIATION AGENCY UNITED STATES OF AMERICA

A PRELIMINARY STUDY OF UNIDENTIFIED TARGETS OBSERVED ON AIR TRAFFIC CONTROL RADARS

By

Richard C. Borden, Electronics Division

and

Tirey K. Vickers, Navigation Aids Evaluation Division

Technical Development Report No. 180

CIVIL AERONAUTICS ADMINISTRATION
TECHNICAL DEVELOPMENT AND
EVALUATION CENTER
INDIANAPOLIS, INDIANA

May 1953

U. S. DEPARTMENT OF COMMERCE

Sinclair Weeks, Secretary

CIVIL AERONAUTICS ADMINISTRATION

F. M. Lee, Administrator

D. M. Stuart, Director, Technical Development and Evaluation Center

This is a technical information report and does not necessarily represent CAA policy in all respects.

The Air Navigation Development Board (ANDB) was established by the Departments of Defense and Commerce in 1948 to carry out a unified development program aimed at meeting the stated operational requirements of the common military/civil air navigation and traffic control system. This project, sponsored and financed by the ANDB is a part of that program. The ANDB is located within the administrative framework of the Civil Aeronautics Administration for housekeeping purposes only. Persons desiring to communicate with ANDB should address the Executive Secretary, Air Navigation Development Board, Civil Aeronautics Administration, W-9, Washington 25, D. C.

GPO 81-105177 — 1

TABLE OF CONTENTS

A PRELIMINARY STUDY OF UNIDENTIFIED TARGETS OBSERVED ON AIR TRAFFIC CONTROL RADARS

SUMMARY

This report describes the investigation of a type of unidentified moving target which has been observed recently in considerable numbers on the viewing screens of air traffic control radar equipment operated by the Civil Aeronautics Administration. This investigation was conducted by means of interviews with personnel concerned, by study and correlation of official records, and by firsthand observation of numerous targets on the Washington Microwave-Early-Warning (MEW) radar and on the Indianapolis ASR-2 radar.

It was determined that targets which are known to operating personnel by various terminologies such as "ghosts," "angels," or "pixies" do not represent new phenomena; nor are they peculiar to the Washington area. Correlation of controllers' reports with United States Weather Bureau records indicated that a surface temperature inversion was almost always noted when such targets appeared on the radar.

Firsthand observation in the tracking and subsequent motion analysis of 80 of these unidentified targets indicated that a large number of these were actually secondary reflections of the radar beam. Apparently these reflections were produced by isolated refracting areas which traveled with the wind at or near the temperature inversion levels.

Although the exact size, shape, and composition of these isolated areas are not known, it is believed that they may be atmospheric eddies produced by a shearing action of dissimilar air strata. It appears possible that such eddies may refract and focus the radar energy with a lens effect to produce small concentrations of ground return with sufficient intensity to show up on the radar display. It is also believed that the correlation of the appearance of these radar targets with visual reports of so-called "flying saucers" is due to the strong probability that both effects are caused primarily by abrupt temperature inversions.

Such radar targets are usually easy to recognize because of their generally weak return and slow ground speed. Unfortunately, radar returns from small helicopters sometimes present these same characteristics. Spurious targets of this type can become a nuisance under busy traffic conditions, particularly in localities where helicopter operations are prevalent.

INTRODUCTION

Closely related to a recent flood of visual reports of flying saucers, the sighting of scores of unidentified targets on the Washington Air Route Traffic Control Center (ARTC) radar aroused much publicity and speculation regarding the origin, composition, and import of these objects. Concerned with the possible detrimental effects of this situation on the control of air traffic, the Air Navigation Development Board requested the Technical Development and Evaluation Center of the CAA to investigate the problem.

The specific objectives of this study were:

1. To find out as much as possible about the nature of the targets themselves.
2. To determine whether this problem is new and peculiar to the Washington area or whether it had occurred previously at Washington and at other CAA radar locations.
3. To determine the effect of this problem on the control of air traffic.
4. To determine what changes should be made in the radar development program in order to cope with the situation.

OFFICIAL RECORDS

As one of the first steps in this study, all records of these phenomena reported in the logs of the Washington ARTC Center were tabulated. The tabulation, given as Table I of this report, was taken to the Analysis Section of the United States Weather Bureau where it was correlated with meteorological data for the periods involved. It was then discovered that a temperature inversion had been indicated in almost every instance when the unidentified radar targets or visual objects had been reported. Weather analysts were asked whether any unusual weather conditions had prevailed over the Washington area during the period covering the occurrences of large numbers of the unidentified radar targets. Their report may be condensed as follows:

Monthly Weather Summary, July 1952.

The heat wave that broke records in the eastern portion of the United States during the month of June continued on through July, becoming intensified during the latter part of the month. July weather maps were characterized by a well-developed Bermuda high

TABLE I

TABULATION OF UNIDENTIFIED RADAR TARGETS AND VISUAL OBJECTS
REPORTED TO WASHINGTON ARTC CENTER
MAY 23 TO AUGUST 16, 1952

Date 1952	Time EST	Number Targets	Radar Contact DCA CTR	DCA TWR	ADW APC	Visual Contact	Color	Location	Altitude MSL (feet)	Reported By	Radiosonde Observations: Temperature Lapse Rate	Humidity	Remarks
5-23	2000 to 0000	Estimated 50	x					DCA Terminal Area		Center	Inversions: 2°from 700 to 1500 ft., 1° from 9600 to 10,000 ft., otherwise normal	Normal	Speed 20 to 35 miles per hour. Followed curved course from 15 miles south of Arcola over Manassas, La Plata, and McLean.
7-10	Not Available	1				x		Quantico	2000	National 42	Not available for locality	Not available for locality	No details available.
7-13	0300	1				x	Blue-White	60 Miles Southwest DCA	11,000	Capt. Bruen National	DCA: Surface inversion 6° below 1000 ft.	DCA: Low, below measuring limits at 11,000 ft.	Came up to altitude of aircraft, hovered 2 miles to left of northbound aircraft. Pilot turned on all lights. Ball of light took off, going up and away.
7-14	2112	6				x	Red	Vicinity Langley Field	1000 to 2000	Pan-American Ferry 901	Norfolk: Superadiabatic lapse rate around 9000 ft. DCA: Surface inversion 2°	Norfolk: High, but fell off at 6000 ft. DCA: Sharp fall at 6000 ft.	Estimated speed 1000 miles per hour, heading northeast with sudden change to west-southwest.
7-19	2340	8	x	x				East and South ADW		Center	DCA: Surface inversion 3° isothermal between 8000 and 10,000 ft.	DCA: Above 10,000 ft. dropped, then increased slightly, dropping again at 15,000 ft.	Fair to weak targets, speed 100 to 130 miles per hour.
7-20	0100	7				x		DCA to Martinsburg		Capital 807	DCA: Surface inversion 3° isothermal between 8000 and 10,000 ft.	DCA: Above 10,000 ft. dropped, then increased slightly, dropping again at 15,000 ft.	Lights moved rapidly up, down, and horizontally. Also hovered.
7-20	Early Morning	1				x	Orange	Over ADW		USAF Personnel	DCA: Surface inversion 3° isothermal between 8000 and 10,000 ft.	DCA: Above 10,000 ft. dropped, then increased slightly, dropping again at 15,000 ft.	No details available.
7-20	0000 to 0540	Many	x					DCA Terminal Area		Center	DCA: Surface inversion 3° isothermal between 8000 and 10,000 ft.	DCA: Above 10,000 ft. dropped, then increased slightly, dropping again at 15,000 ft.	Radar checked, found all right. Targets moved at random. Maximum 10 at one time.
7-20	0300	1	x	x		x		DCA Terminal Area		Capital 610	DCA: Surface inversion 3° isothermal between 8000 and 10,000 ft.	DCA: Above 10,000 ft. dropped, then increased slightly, dropping again at 15,000 ft.	Light and radar target appeared to follow aircraft from vicinity of Herndon to 4 miles west of DCA airport.
7-23	0000 to 0800	Many	x					DCA Terminal Area		Center	DCA: Surface inversion 3° normal lapse rate above	DCA: Sharp decrease at 10,000 ft.	Movement generally southeast at 35 to 40 miles per hour, sometimes in pairs and threes. Mostly weak, occasionally strong.
7-26	2030	8	x	x				DCA Terminal Area		Center	DCA: Surface inversion 1° otherwise normal	DCA: Fell below measuring limits at 8000 ft.	Tower saw few targets, only one moving fast. Center noted other targets at 2200 EST.
7-27	1930	1				x	Dark	Riverdale		Lt. Wales (ADW)	DCA: Slight inversion at 1500 ft., small inversion at 18,000 ft.	DCA: High to 12,000 ft., fell off somewhat, sharp rise at 18,000 ft.	Small circular object, edge occasionally visible. No noise, speed est. at 50 to 60 miles per hour. Oscillating rolling motion moving northeast. Clouds moving southeast. Entered base of clouds.
7-27	2030	1				x		Greenbelt		Local Citizen	DCA: Slight inversion at 1500 ft., small inversion at 18,000 ft.	DCA: High to 12,000 ft., fell off somewhat, sharp rise at 18,000 ft.	Brilliant light, tremendous speed.
7-27	2112	2				x		10 Miles East Tyrone, Pa.		American 516	Not available for locality	Not available for locality	Vicinity thunderstorm. Darting around edges. Left no trail.
7-27	2040	1				x		Lynchburg, Va.		Local Citizen	Not available for locality	Not available for locality	Low, unsteady flight, moving north to south. Left no trail.
7-27	2200	1				x	Yellow	ADW	40,000 to 50,000 (est.)	Maj. Turlin	DCA: Slight inversion at 1500 ft., small inversion at 18,000 ft.	DCA: High to 12,000 ft., fell off somewhat, sharp rise at 18,000 ft.	Moved slowly, stopped, flickered, moved in arc.
7-27	2318	2		x				DCA Terminal Area		DCA Tower	DCA: Surface inversion 4°, steep lapse rate to 10,000 ft.	DCA: High at 10,000 ft., slow fall to 15,000 ft., fast fall above 15,000 ft.	Tracked on north-northeast heading from 6 miles south-southwest of antenna to antenna site at speed of 25 miles per hour.
7-28	0030	1				x		City of Washington		Local Citizens	DCA: Surface inversion 4°, steep lapse rate to 10,000 ft.	DCA: High at 10,000 ft., slow fall to 15,000 ft., fast fall above 15,000 ft.	Many sightings.
7-29	0130 to 0500	Many	x					DCA Terminal Area		Center	DCA: Surface inversion 4°, steep lapse rate to 10,000 ft.	DCA: High at 10,000 ft., slow fall to 15,000 ft., fast fall above 15,000 ft.	Movement from Herndon to Andrews, southeast heading, in belt 15 miles wide.
7-29	1230 to 1500	Many	x					DCA Terminal Area		Center	DCA: Steep lapse rate to 2000 ft., inversion 500 ft. thick to 2500 ft.	DCA: High to 5000 ft., sharp fall, then increasing to 100 per cent at 9000 ft.	No details available.
7-29	1500	3				x	White	10 Miles Southeast ADW		Bolling Field Pilot	DCA: Steep lapse rate to 2000 ft., inversion 500 ft. thick to 2500 ft.	DCA: High to 5000 ft., sharp fall, then increasing to 100 per cent at 9000 ft.	Round white objects.

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5-23	2000 to 0000	Estimated 50	x					DCA Terminal Area		Center	Inversions: 2° from 700 to 1500 ft., 1° from 9600 to 10,000 ft., otherwise normal	Normal	Speed 20 to 35 miles per hour. Followed curved course from 15 miles south of Arcola over Manassas, La Plata, and McLean.
7-10	Not Available	1				x		Quantico	2000	National 42	Not available for locality	Not available for locality	No details available.
7-13	0300	1				x	Blue-White	60 Miles Southwest DCA	11,000	Capt. Bruen National	DCA: Surface inversion 6° below 1000 ft.	DCA: Low, below measuring limits at 11,000 ft.	Came up to altitude of aircraft, hovered 2 miles to left of northbound aircraft. Pilot turned on all lights. Ball of light took off, going up and away.
7-14	2112	6				x	Red	Vicinity Langley Field	1000 to 2000	Pan-American Ferry 901	Norfolk: Superadiabatic lapse rate around 9000 ft. DCA: Surface inversion 2°	Norfolk: High, but fell off at 6000 ft. DCA: Sharp fall at 6000 ft.	Estimated speed 1000 miles per hour, heading northeast with sudden change to west-southwest.
7-19	2340	8	x	x				East and South ADW		Center	DCA: Surface inversion 3° isothermal between 8000 and 10,000 ft.	DCA: Above 10,000 ft. dropped, then increased slightly, dropping again at 15,000 ft.	Fair to weak targets, speed 100 to 130 miles per hour.
7-20	0100	7				x		DCA to Martinsburg		Capital 807	DCA: Surface inversion 3° isothermal between 8000 and 10,000 ft.	DCA: Above 10,000 ft. dropped, then increased slightly, dropping again at 15,000 ft.	Lights moved rapidly up, down, and horizontally. Also hovered.
7-20	Early Morning	1				x	Orange	Over ADW		USAF Personnel	DCA: Surface inversion 3° isothermal between 8000 and 10,000 ft.	DCA: Above 10,000 ft. dropped, then increased slightly, dropping again at 15,000 ft.	No details available.
7-20	0000 to 0540	Many	x					DCA Terminal Area		Center	DCA: Surface inversion 3° isothermal between 8000 and 10,000 ft.	DCA: Above 10,000 ft. dropped, then increased slightly, dropping again at 15,000 ft.	Radar checked, found all right. Targets moved at random. Maximum 10 at one time.
7-20	0300	1	x	x		x		DCA Terminal Area		Capital 610	DCA: Surface inversion 3° isothermal between 8000 and 10,000 ft.	DCA: Above 10,000 ft. dropped, then increased slightly, dropping again at 15,000 ft.	Light and radar target appeared to follow aircraft from vicinity of Herndon to 4 miles west of DCA airport.
7-23	0000 to 0800	Many	x					DCA Terminal Area		Center	DCA: Surface inversion 3° normal lapse rate above	DCA: Sharp decrease at 10,000 ft.	Movement generally southeast at 35 to 40 miles per hour, sometimes in pairs and threes. Mostly weak, occasionally strong.
7-26	2030	8	x	x				DCA Terminal Area		Center	DCA: Surface inversion 1° otherwise normal	DCA: Fell below measuring limits at 8000 ft.	Tower saw few targets, only one moving fast. Center noted other targets at 2200 EST.
7-27	1930	1				x	Dark	Riverdale		Lt. Wales (ADW)	DCA: Slight inversion at 1500 ft., small inversion at 18,000 ft.	DCA: High to 12,000 ft., fell off somewhat, sharp rise at 18,000 ft.	Small circular object, edge occasionally visible. No noise, speed est. at 50 to 60 miles per hour. Oscillating rolling motion moving northeast. Clouds moving southeast. Entered base of clouds.
7-27	2030	1				x		Greenbelt		Local Citizen	DCA: Slight inversion at 1500 ft., small inversion at 18,000 ft.	DCA: High to 12,000 ft., fell off somewhat, sharp rise at 18,000 ft.	Brilliant light, tremendous speed.
7-27	2112	2				x		10 Miles East Tyrone, Pa.		American 516	Not available for locality	Not available for locality	Vicinity thunderstorm. Darting around edges. Left no trail.
7-27	2040	1				x		Lynchburg, Va.		Local Citizen	Not available for locality	Not available for locality	Low, unsteady flight, moving north to south. Left no trail.
7-27	2200	1				x	Yellow	ADW	40,000 to 50,000 (est.)	Maj. Turlin	DCA: Slight inversion at 1500 ft., small inversion at 18,000 ft.	DCA: High to 12,000 ft., fell off somewhat, sharp rise at 18,000 ft.	Moved slowly, stopped, flickered, moved in arc.
7-27	2318	2		x				DCA Terminal Area		DCA Tower	DCA: Surface inversion 4°, steep lapse rate to 10,000 ft.	DCA: High at 10,000 ft., slow fall to 15,000 ft., fast fall above 15,000 ft.	Tracked on north-northeast heading from 6 miles south-southwest of antenna to antenna site at speed of 25 miles per hour.
7-28	0030	1				x		City of Washington		Local Citizens	DCA: Surface inversion 4°, steep lapse rate to 10,000 ft.	DCA: High at 10,000 ft., slow fall to 15,000 ft., fast fall above 15,000 ft.	Many sightings.
7-29	0130 to 0500	Many	x					DCA Terminal Area		Center	DCA: Surface inversion 4°, steep lapse rate to 10,000 ft.	DCA: High at 10,000 ft., slow fall to 15,000 ft., fast fall above 15,000 ft.	Movement from Herndon to Andrews, southeast heading, in belt 15 miles wide.
7-29	1230 to 1500	Many	x					DCA Terminal Area		Center	DCA: Steep lapse rate to 2000 ft., inversion 500 ft. thick to 2500 ft.	DCA: High to 5000 ft., sharp fall, then increasing to 100 per cent at 9000 ft.	No details available.
7-29	1500	3				x	White	10 Miles Southeast ADW		Bolling Field Pilot	DCA: Steep lapse rate to 2000 ft., inversion 500 ft. thick to 2500 ft.	DCA: High to 5000 ft., sharp fall, then increasing to 100 per cent at 9000 ft.	Round white objects.

TABLE I (Continued)

Date 1952	Time EST	Number Targets	Radar Contact DCA CTR	DCA TWR	ADW APC	Visual Contact	Color	Location	Altitude MSL (feet)	Reported By	Radiosonde Observations: Temperature Lapse Rate	Humidity	Remarks
7-30	2258	1				x		City of Washington		Local Citizen	Not available	Not available	Oblong light. Note: may have been light from airport ceilometer.
7-31	0810	1				x		25 Miles North Savage, Md.		Local Citizen	Not available for locality	Not available for locality	Ball of fire with tail. Shot upwards.
8-3	2000	1				x	Blue-White	50 Miles South DCA	19,000	Capital 982	DCA: Small surface inversion isothermal at 11,000 ft., small inversion at 14,000 ft.	DCA: Decreasing to very dry at 14,000 ft.	Moving southeast.
8-5	1600 to 0000	Some			x			DCA Terminal Area		ADW Approach Control	DCA: Small surface inversion	DCA: High throughout	No details available.
8-6	0000 to 0800	Many	x					DCA Terminal Area		Center	DCA: Small surface inversion	DCA: High throughout	Moving east to southeast at average speed of 38 miles per hour. First appeared 20 to 25 miles west of DCA. Winds to 20,000 ft. averaged 18 to 20 knots.
8-8	1400	3		x				DCA Terminal Area		DCA Tower	DCA: Normal	DCA: High throughout	Class 4 targets, speed 60 miles per hour, tracked from 18 miles north of DCA to 3 miles north of DCA.
8-9	2210	2	x	x				DCA Terminal Area		Center	DCA: Normal	DCA: High, decreasing to below measuring limits at 17,000 ft.	Heading east.
8-13	2100	1			x		Blue-White	City of Washington		Local Citizen	DCA: Surface inversion below 2000 ft., another between 8000 and 9000 ft.	DCA: High at surface, low above upper inversion, otherwise below limits	Moving in arc high overhead.
8-13	1958 to 0030	68	x					DCA Terminal Area		Center	DCA: Surface inversion below 2000 ft., another between 8000 and 9000 ft.	DCA: High at surface, low above upper inversion, otherwise below limits	Targets plotted on southeast and south headings at 24 to 59 knots. Most targets within 10 miles of radar antenna.
8-14	1956	1	x					15 Miles West DCA		Center	DCA: Surface inversion 6°, upper inversions at 13,500 and 15,000 ft.	DCA: High, decreasing sharply at 14,000 ft.	Target plotted on east-southeast heading, speed 53 knots, curved path.
8-14	2055	1			x			1 1/2 Miles Southwest ADW		ADW Weather	DCA: Surface inversion 6°, upper inversions at 13,500 and 15,000 ft.	DCA: High, decreasing sharply at 14,000 ft.	Slow-moving target.
8-15	2213 to 2244	5	x					DCA Terminal Area		Center	DCA: Surface inversion to 400 ft., isothermal to 1100 ft.	DCA: High, with sharp fluctuations between 16,000 and 23,000 ft.	Targets plotted on north to east-northeast headings, speed 28 to 45 knots.
8-16	0000 to 0450	7	x					DCA Terminal Area		Center	DCA: Surface inversion to 400 ft., isothermal to 1100 ft.	DCA: High, with sharp fluctuations between 16,000 and 23,000 ft.	Targets plotted on west-northwest to north-northwest headings, speed 21 to 43 knots.

LEGEND

- ADW = Andrews Air Force Base
- APC = Approach Control
- CTR = Center
- DCA = Washington
- EST = Eastern standard time
- est. = Estimated
- MSL = Mean sea level
- TWR = Tower

pressure area which remained in the vicinity of the southeastern coast line during the ~~entire period. This high pressure area was~~ responsible for an anticyclonic (clockwise) circulation of air over the eastern United States, a movement which continued during the month. This flow brought warm, moist air up from the Gulf of Mexico. The warm air mass usually extended up to about 10,000 feet. At higher levels the flow was from the west-southwest, and this continental air mass from the southwestern desert and drought area was hot and dry. Stagnation and heating of the air over the eastern United States was further increased because of an extremely strong band of westerly winds along the northern United States border, winds which prevented cold Canadian air masses from pushing south. Cyclonic activity was confined mostly to the area north of this band of westerly winds. There was a notable lack of thunderstorm activity in the Washington area. Physicists at the Naval Observatory reported that the amount of electrification in the air was very low.

The foregoing analysis indicated that the lack of cloud cover promoted solar heating in the daytime and rapid radiation cooling of the surface at night. This combination, with the prevailing light winds, was unusually conducive to the formation of temperature inversions during the hours of darkness.

Since the visual reports of flying saucers indicated that the observed lights spanned the same color range as the aurora borealis and since auroral effects closely follow sunspot activity, personnel of the Naval Observatory were consulted in order to determine whether any unusual sunspot activity had occurred during the period in question. They reported that there had been no unusual activity of this nature.

Reports from Other Locations.

The Washington ARTC Center is the only one equipped with air route surveillance radar. However, several CAA control towers are equipped with airport surveillance radar, Type ASR-1. A survey of these locations produced the following results:

ATLANTA, Municipal Airport. No unidentified targets of this nature have been reported.

BOSTON, Logan Field. Unidentified targets have been noticed on rare occasions. One slow-moving target was observed during instrument flying weather conditions about August 1, 1952. No interference with traffic has been caused by this problem.

CHICAGO, Midway Airport. Unidentified targets have been seen on many occasions, particularly when temperature inversions have been in effect and low smoke hung over the city. They are usually given as traffic information to other aircraft and occasionally form a nuisance problem, since there is a considerable helicopter activity at and around the airport.

CLEVELAND, Municipal Airport. Unidentified radar targets have been observed many times. The chief controller reported that on a recent occasion such targets moving slowly from west to east showed up in all portions of the scope face.

MINNEAPOLIS, International Airport. No targets of this nature have been reported.

NEW YORK, New York International Airport. No targets of this nature have been reported.

La Guardia Airport. Only one such instance was reported. At the time it was thought to be due to difficulties within the radar itself.

WASHINGTON, National Airport. Targets of this nature have been observed occasionally over a long period. Recent occasions are logged in Table I of this report.

HISTORICAL REFERENCES

The history of radar abounds with reports of strange echoes received from supposedly clear skies. Early observers suspected birds or stray weather balloons, but these were eliminated by visual checks. Conjecture that clouds of insects were responsible was also eliminated when such echoes were obtained in the dead of winter. Some connection with the weather was suspected after it was noted that echoes of this type became more numerous on summer nights under calm conditions. Additional evidence indicated that many of these echoes originated in the fine structures of the dielectric (refracting) layers of air-mass boundaries and in regions of air turbulence. Some of the sharpest echoes involved surfaces of pronounced transitions of the water-vapor content of the air. The bibliography at the end of this report contains numerous detailed references to these general phenomena.

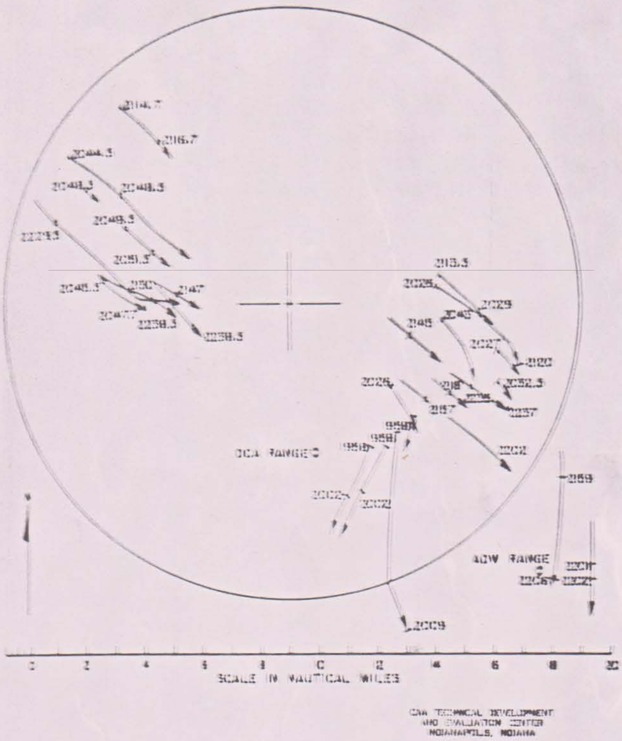

Fig. 1 Track Plots of Unidentified Targets, Washington MEW Radar, 1958 to 2242 EST, August 13, 1952

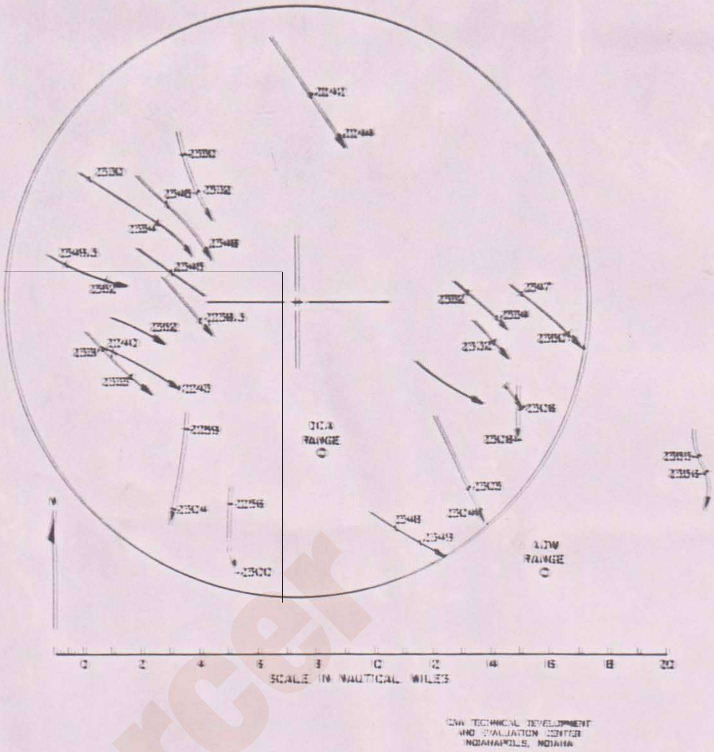

Fig. 2 Track Plots of Unidentified Targets, Washington MEW Radar, 2242 to 2352 EST, August 13, 1952

WASHINGTON OBSERVATIONS

August 13-14, 1952.

The observation period started at 1830 Eastern standard time (EST) on the evening of August 13. At the beginning of this period, the moving target indicator was gated to cancel out ground returns up to a range of 10 nautical miles. Beyond this range the scope was clear except for a few permanent echoes that were visible.

Suddenly, at approximately 1957 EST, a group of seven strong stationary targets became visible in an area about 15 miles north-northeast of the radar antenna. During the next two or three antenna revolutions, the area on the scope between Washington and Baltimore became heavily sprinkled with stationary targets in a belt about 6 miles wide. A group of additional targets became visible in an area approximately 10 to 15 miles south of the radar antenna. This was evidence of the beginning of a temperature inversion.

Within the next minute, at approximately 1958 EST, four unidentified moving targets showed up 5 miles southeast of the radar antenna and moved in a southerly direction away from it. When the radar beam was switched from high to low, the targets disappeared. The beam was switched back to high, and the targets returned.

Targets were uniformly small and usually had a weak, fuzzy appearance. However, the target intensity varied from sweep to sweep. Occasionally one or two very strong returns would be received in succession, followed by almost total blanking.

For the next four and one-half hours, many unidentified targets were carefully plotted with a grease pencil on the face of the Type VG scope. The time for each was entered on these plots in order to calculate ground speeds. To secure a permanent record, time data and track plots were transferred from the scope face to a sheet of frosted acetate. These plots are reproduced in Figs. 1, 2, and 3. The distribution of target ranges is shown in Fig. 4. The average distance that any target was tracked continuously was approximately 2.1 nautical miles.

The observation period was discontinued at 0030 EST on August 14, and steps were taken to secure all available meteorological data relevant to the observation period. The local radiosonde observation

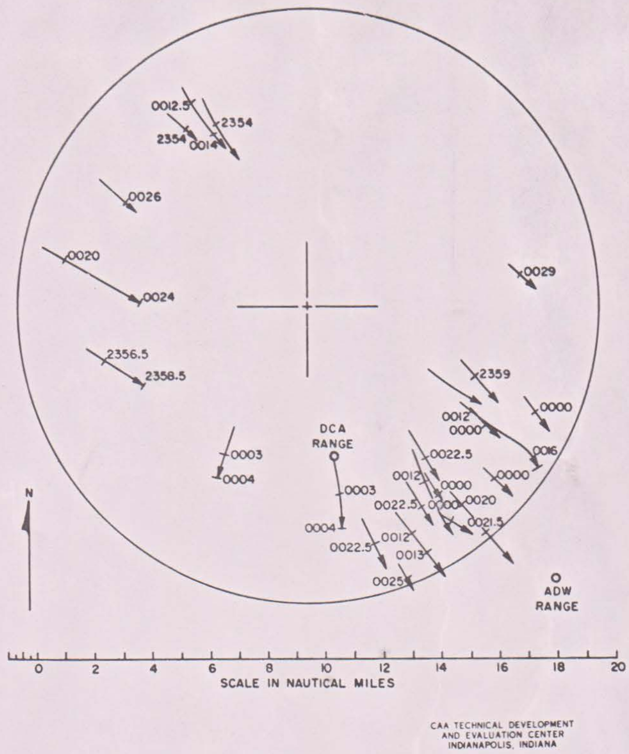

Fig. 3 Track Plots of Unidentified Targets, Washington MEW Radar, 2353 to 0029 EST, August 13-14, 1952

which was taken near the midpoint of the observation period, at 2200 EST on August 13, is reproduced in Fig. 5. Winds aloft, as observed at the same time, are listed in Table II.

August 15-16, 1952.

On the night of August 15-16, additional track plots were obtained by Washington ARTC Center personnel. During this period, the radar was operating on the high beam with the moving target indicator gated to 12 miles. The same stationary targets in the Washington-Baltimore belt and in an area 10 to 15 miles south of the radar antenna were visible again on the scope face.

Track plots for this period are shown in Figs. 6 and 7. The local radiosonde observation taken at 2200 EST on August 15 is reproduced in Fig. 8. Winds aloft, as observed at the same time, are listed in Table III.

ANALYSIS OF WASHINGTON DATA

It will be noted from Table I that many more unidentified targets are picked up by the Washington ARTC Center than by the Washington Airport Traffic Control Tower. This may be explained by the fact that the center is equipped with a MEW radar, while the tower is equipped with an airport surveillance radar, Type ASR-1. The most significant differences between the two types of equipment are listed in the following:

1. The peak power of the MEW is 3 decibels (db) higher than the ASR-1.
2. The average power of the MEW is 6 db higher than the average power of the ASR-1.
3. The MEW has a higher elevation angle coverage.
4. The MEW elicits approximately twice as many hits per scan per target since the scan rate of the MEW is 6 revolutions per

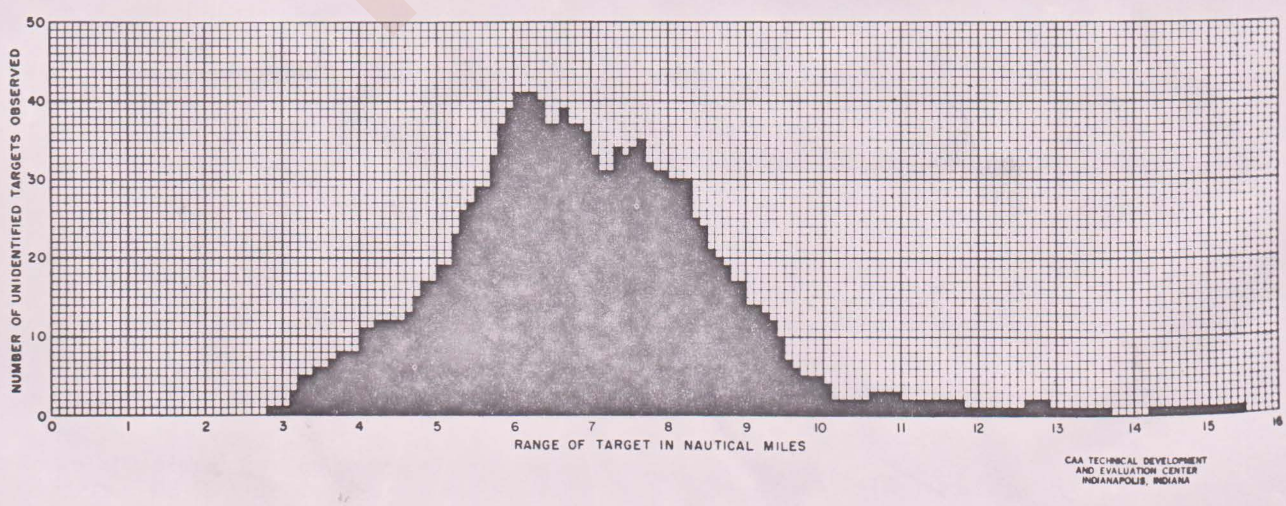

Fig. 4 Distribution of Target Ranges, Washington MEW Radar, August 13-14, 1952 Observation

minute (rpm). Additional specifications of these radars are listed in Table IV.

The almost simultaneous appearance of the first moving targets with the ground returns, 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.

It will be noted in Figs. 1, 2, and 3 that all targets observed in the first period were moving from the north or northwest. In Fig. 6 all targets were moving from the south or southwest, and in Fig. 7 all were moving from the west or northwest. The definite directional trend in each case eliminated the possibility that the unidentified targets were surface vehicles such as trains, trucks, automobiles, or boats. Had this been the case, some vehicles would have been moving in the reverse directions. In each case, target directions corresponded with the wind

TABLE II

WINDS ALOFT
WASHINGTON (SILVER HILL)
2200 EST August 13, 1952

Altitude (MSL)	Direction (Degrees)	Velocity (Knots)
Surface	Calm	0
1000	Calm	0
2000	350	12
3000	340	12
4000	320	14
5000	320	16
6000	300	18
7000	300	20
8000	310	20
9000	310	22
10000	300	26
11000	290	28
12000	290	29
13000	300	30
14000	300	28
15000	290	29
16000	300	29
17000	300	29
18000	300	30
19000	300	32
20000	300	38
21000	290	38
22000	280	43
23000	280	48
24000	280	50
25000	270	52
26000	280	57
27000	270	61
28000	270	54
29000	270	55
30000	280	62
31000	270	63
32000	280	73
33000	280	84

TABLE III

WINDS ALOFT
WASHINGTON (SILVER HILL)
2200 EST August 15, 1952

Altitude (MSL)	Direction (Degrees)	Velocity (Knots)
Surface	170	5
1000	180	24
2000	190	26
3000	210	24
4000	210	23
5000	220	20
6000	220	16
7000	220	18
8000	220	17
9000	220	13
10000	240	12
11000	270	11
12000	270	13
13000	260	17
14000	260	21
15000	260	25
16000	270	25
17000	270	23
18000	270	22
19000	270	21
20000	260	20
21000	270	22
22000	280	24
23000	290	26
24000	280	26
25000	290	26
26000	300	30
27000	300	34
28000	300	38
29000	290	38
30000	290	36
31000	300	35
32000	300	35
33000	310	34
34000	310	40
35000	300	47
36000	300	49
37000	300	50
38000	300	48
39000	310	42
40000	320	38
41000	300	43
42000	300	53
43000	300	67
44000	310	69
45000	310	60

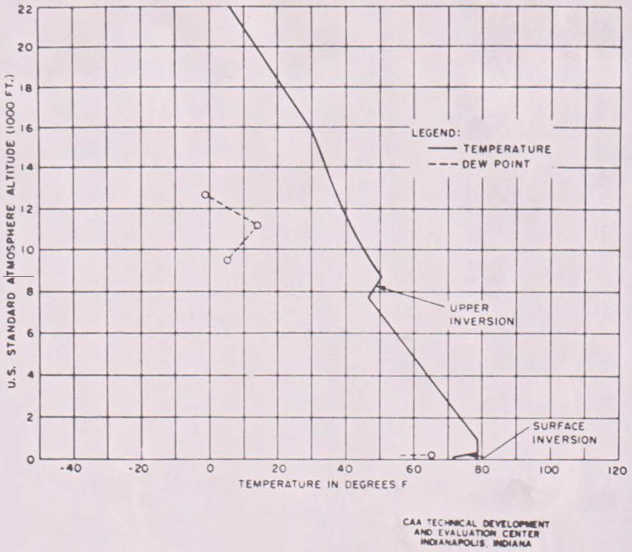

Fig. 5 Radiosonde Observation, Silver Hill, Washington, D. C., 2300 EST, August 13, 1952

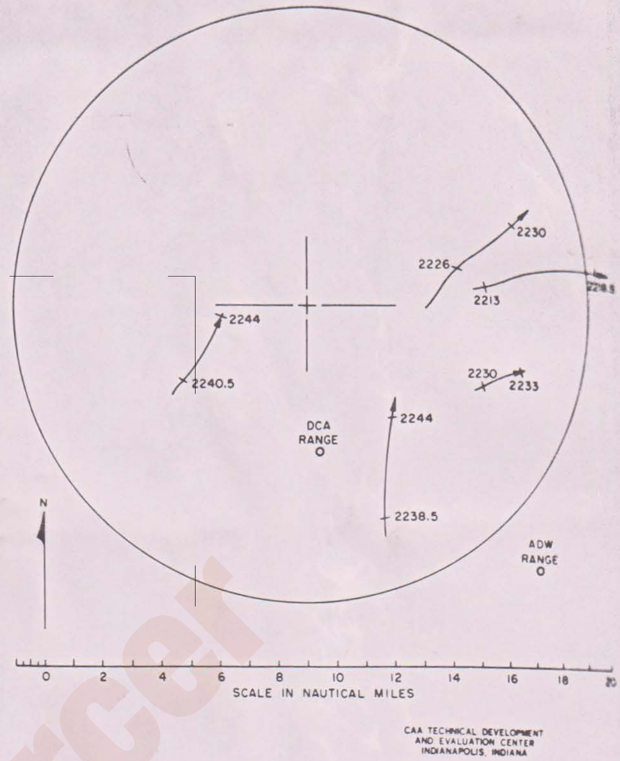

Fig. 6 Track Plots of Unidentified Targets, Washington MEW Radar, 2213 to 2244 EST, August 15, 1952

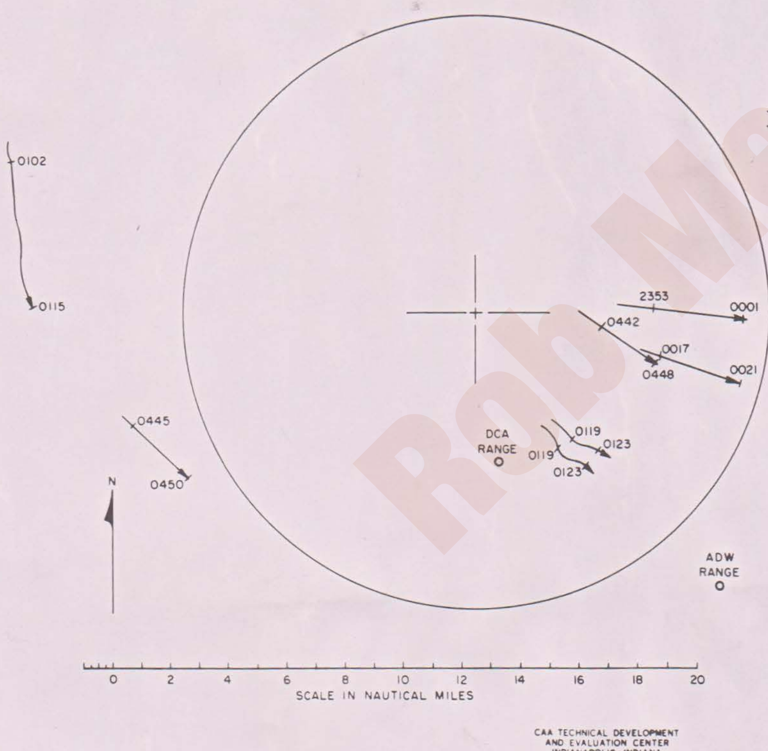

Fig. 7 Track Plots of Unidentified Targets, Washington MEW Radar, 2253 to 0450 EST, August 15-16, 1952

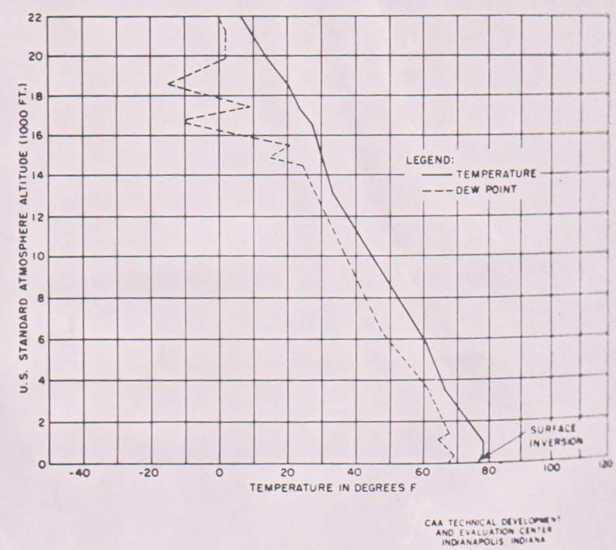

Fig. 8 Radiosonde Observation, Silver Hill, Washington, D. C., 2200 EST, August 15, 1952

directions reported aloft. This fact suggested that whatever was producing the targets was being carried by the wind.

The next step of the analysis was to determine, if possible, the altitude of the objects which produced the radar targets. Since the radar actually measures slant range which could in some cases be almost directly overhead from the high-beam MEW antenna, the minimum range of each target was used to determine the absolute maximum altitude of the object producing the target.

TABLE IV

RADAR EQUIPMENT CHARACTERISTICS

	Tower Radar	Center Radar
Type	ASR-1	MEW
Frequency	S-band	S-band
Pulse-repetition frequency	1,000	900
Pulse rate	0.5 microsecond	1 microsecond
Vertical coverage	6,000 feet at 6 miles	12,000 feet at 3 miles
Scan Rate	28 per minute	6 per minute
Display scopes	12DP7	12DP7 and VG2
Power output	200 kilowatts	400 kilowatts

For example, a target which came within five nautical miles of the radar antenna could not be above an altitude of five nautical miles, or 30,400 feet. With the use of the slant-range principle, the absolute maximum altitude of each target was determined and is listed in Table V. When attempting later to determine the probable altitude of each target by studying the winds aloft, it was useful to have these maximum altitude figures to eliminate the necessity for consideration of higher altitude levels.

Since winds aloft can vary considerably during the period of a few hours, it was decided to use in this analysis only data on targets which were under observation during the periods from one hour before to one hour after the observations of the local winds aloft. These targets are listed in Table V.

During the observation period on the night of August 13-14, all targets on a southerly heading had ground speeds of at least 24 knots. The only reported winds with a southerly heading had a velocity of only 12 knots. These were winds at the 2,000- and 3,000-foot levels. Targets on a southeasterly heading had a speed range of 32 to 48 knots. However, the only winds on this heading were from 14 knots at 4,000 feet to 38 knots at 20,000 feet.

During the August 15-16 observations, targets on a north or northeasterly heading had speeds of 35 to 42 knots. The only reported winds moving in this direction ranged between 5 and 26 knots from the surface up to 9,000 feet. Targets on easterly headings had speeds from 22 to 45 knots. The only reported winds moving in this direction had speeds of from 10 to 24 knots between 10,000 and 25,000 feet.

In Figs. 9 and 10, the directions and velocities of the winds aloft are plotted on a polar projection diagram together with the directions and velocities of the observed targets. Agreement between the directions of the winds and the directions of the targets is apparent.

One of the theoretically possible causes of the unidentified targets was the delayed-pulse or second-time-around effect inherent in the radar method of time measurement. With a second-time-around effect, objects beyond the normal sweep range of a radar can be displayed on the scope because of reception of an echo pulse elicited not by the transmitted pulse which triggers the range sweep but by the preceding transmitted pulse. The apparent velocity of the target on the radar is no greater than and normally less than the velocity of the object producing the return. The heading of the radar target would not necessarily be parallel to the heading of the object unless the object was on a course radial to the radar antenna. These effects are illustrated in Fig. 11.

If we assume then that an object producing a second-time-around radar target was being carried by the wind, the apparent velocity of the target would be no greater than the wind velocity. However, the analysis of the targets listed in Table V showed that

TABLE V

MOVEMENT DATA ON TARGETS TRACKED WITHIN ONE HOUR FROM START OF OBSERVATIONS OF WINDS ALOFT

Date Aug. 1952	Starting Time EST	Direction (Degrees)	Target Speed (Knots)	Reflector Speed (1/2 Target Speed)	Absolute Maximum Altitude (Based on Minimum Slant Range	Probable Altitude (Based on Winds Aloft)
13	2159	005	28	14	63000	2000
	2201	360	24	12	75000	2000
	2229	310	33	16.5	23000	8000
	2240	300	46	23	30000	9000
	2242	325	48	24	33000	9000
	2259	010	31	15.5	31000	2000
	2303	330	42	21	36000	8000
	2330	340	39	19.5	23000	5000
	2330	305	39	19.5	24000	8000
	2331	315	39	19.5	35000	8000
	2332	315	36	18	23000	8000
	2345	310	38	19	19000	8000
	2347	310	42	21	43000	8000
	2349	290	39	19.5	35000	7000
	2356	300	42	21	37000	7000
	2355	350	36	18	83000	2000
15	2213	260	45	22.5	34000	14000
	2226	225	35	17.5	24000	900
	2230	250	28	14	37000	10500
	2238	185	36	18	29000	900
	2240	210	42	21	18000	4500
	2353	275	23	11.5	29000	10500*

*This target could also have been a direct radar return from an object floating with the wind at 15000 to 17000 feet mean sea level.

they were actually moving at speeds approximately double the wind velocities reported for the directions involved. This fact eliminated the possibility that the targets were being produced by the second-time-around effect.

When the target velocities plotted in Figs. 9 and 10 were halved, those plotted points clustered very closely around the wind plots. Further investigation of the doubled-speed effect indicated that this effect could be produced if the original radar beam were reflected downward to give a ground return, as shown in Fig. 12. If we assume that some sort of horizontal reflector was present aloft and that the angle of reflection equalled the angle of incidence of the radar beam, any horizontal movement of the reflector would produce a movement twice as great in the image being received on the radar scope. Furthermore, the apparent motion of the image would be parallel to the motion of the reflector, as illustrated in Fig. 13.

When the observed target velocities were divided by two, the target motions corresponded closely to the reported wind directions and velocities at certain altitude levels. In nearly all of these cases the altitude levels, which are listed as probable altitudes in Table V, were at or adjacent to the temperature inversion levels.

With only one exception, no targets were seen moving at the speed and heading of the reported wind at any altitude. This suggested that the reflecting areas, which were capable of bending the radar beam, were nevertheless not of sufficient density to produce direct returns on the radar scope. Thus, it appeared likely that the reflection effect was being produced by the atmosphere itself. If this were the case, it would probably be a refraction rather than a reflection which was involved. This effect is shown in Fig. 14.

The uniformly small size of the observed targets as well as the relatively low frequency of their occurrences suggested that the conditions producing this effect were extremely localized and decidedly critical. Although the exact nature of the discontinuity

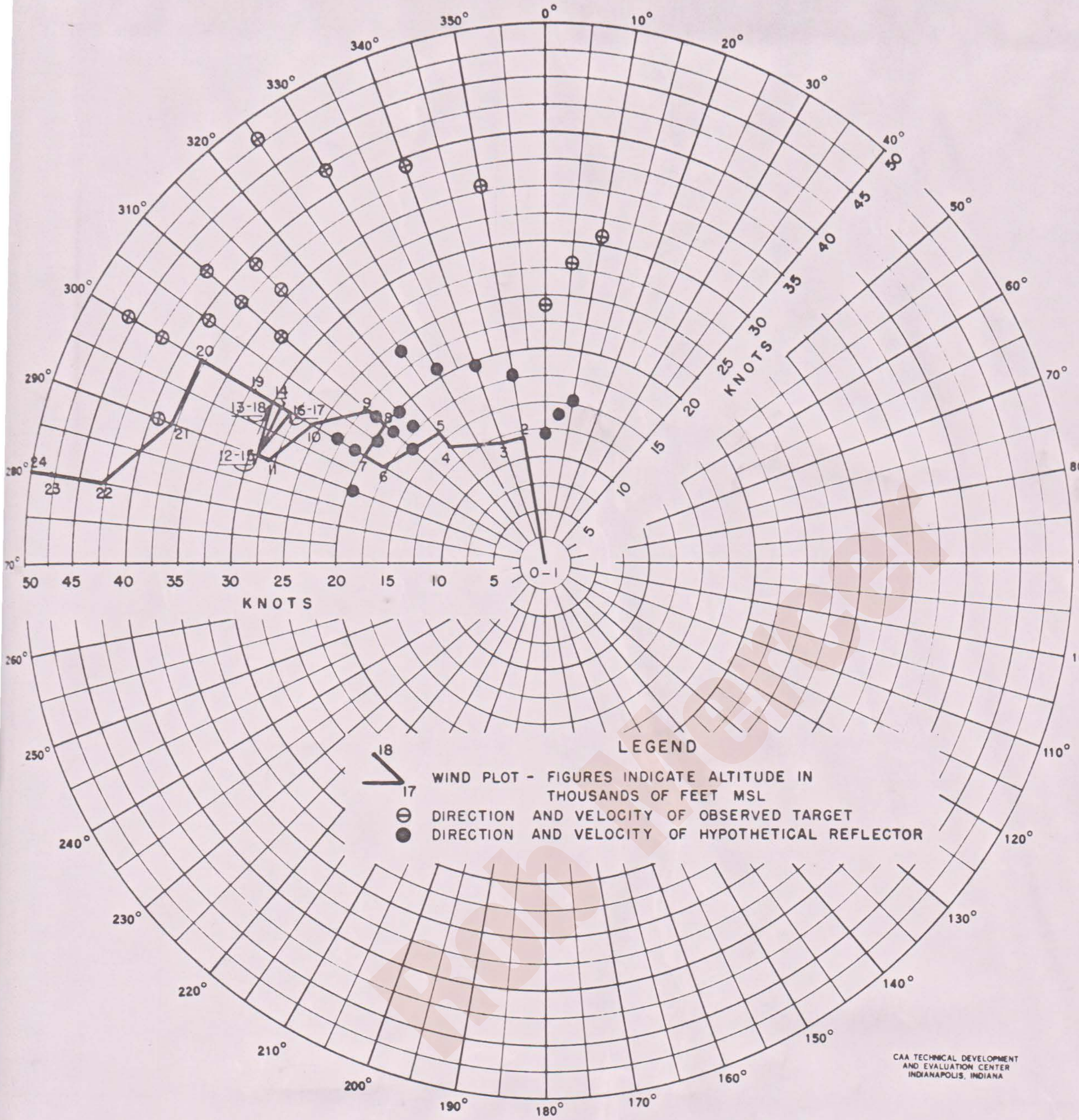

Fig. 9 Comparison Between Winds Aloft and Target Data, August 13, 1952 Observation

is not known, one possible explanation might be that it is an eddy in the atmosphere. Such eddies may be produced by the shearing effect of dissimilar air masses moving at different speeds and headings at or near the inversion boundary. They might under certain conditions produce bulges in the inversion layer, concentrating and directing the radar energy with a lens effect to produce a return signal strong enough to show up on the radar scope. The relatively short paths of some of the radar targets before their fade-out might be attributed to the dissipation of these eddies in the stratified air mass.

Intermediate speed checks on numerous targets indicated that individual velocities remained quite steady during the observation period. It became possible to predict with accuracy the progress of specific targets from minute to minute. There was no evidence of hovering or of sudden increases in speed by any target. It is believed that previous reports of sudden accelerations of targets to supersonic velocities were due to

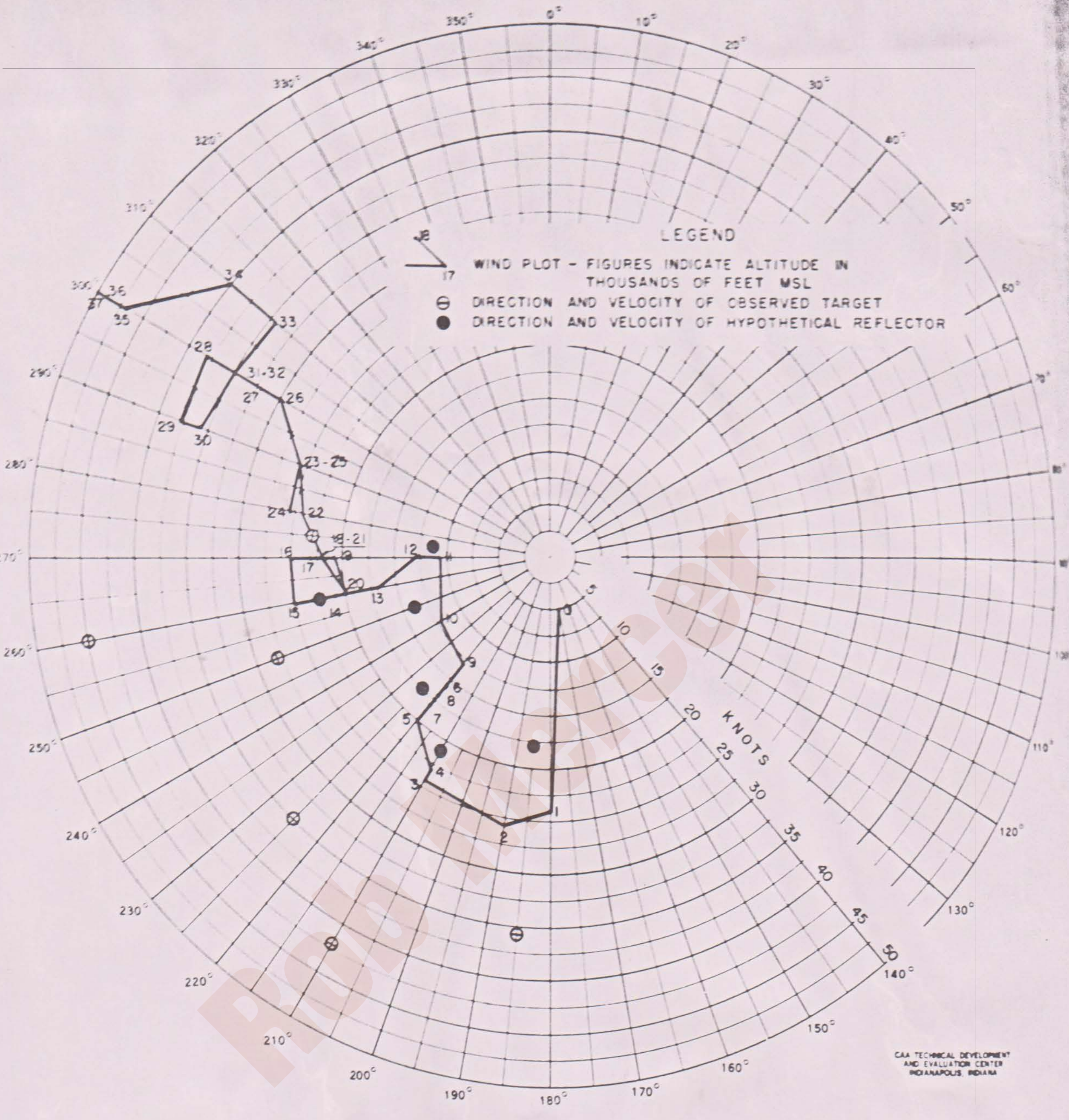

Fig. 10 Comparison Between Winds Aloft and Target Data, August 15, 1952 Observation

a controller's transfer of identity from a faded target to another target which was just appearing on a different section of the scope.

It would be unwise to assume that all unidentified slow-moving radar targets are caused by refraction of radar energy. Small rain clouds produce much the same appearance on the scope. Other targets could be direct returns from bird formations, balloons, or debris carried aloft by convection or tornadoes. It has recently been reported that more than 4,000 balloons are released in the United States every day by Government and civilian research organizations.[1] A recent analysis of more than 1,000 visual reports of unidentified flying objects by the Air Technical Intelligence Center at Wright-Patterson Air Force Base indicates that

[1] "Many Potential 'Saucers,'" Science News Letter, Vol. 62, No. 7, Aug. 16, 1952, p. 106.

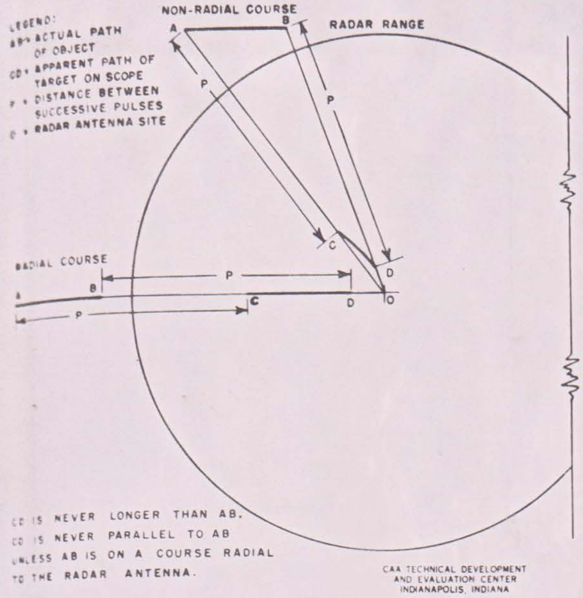

Fig. 11 Second-Time-Around Effect

21.3 per cent of these may be attributed to balloons.[2]

Examination of the logs of the Washington ARTC Center indicates that there is considerable correlation between the appearance of unidentified targets on the radar scope and the receipt of numerous visual reports of flying saucers. It should be noted that abrupt temperature inversions aloft can refract light in much the same way as radar waves and produce mirage effects. In a standard reference work on meteorology,[3] Humphreys reports that a temperature inversion (near the surface) of 1° C per meter bends down a light ray into an arc whose radius is 0.16 that of the earth; an inversion of 10° C per meter gives an arc radius of 0.016 that of the earth, or approximately 60 miles. This effect makes it possible for an observer to see in the sky the sun or some other bright light that is actually well below the observer's horizon. On rare occasions, multiple images of the same object may be visible. It is believed that many visual sightings of flying saucers can be explained by this phenomenon.

[2] "Unidentified Aerial Objects Receive Careful Analysis by Air Force Experts," The Aircraft Flash, published by Department of the Air Force, Air Defense Command, Vol. 1, No. 4, Jan. 1953, p. 4.

[3] Humphreys, W. J., "Physics of the Air," McGraw-Hill Publishing Company, New York, 1940.

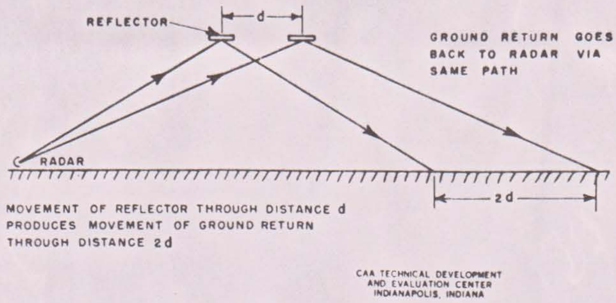

Fig. 12 Profile View Showing Effect of Moving Reflector

SUPPLEMENTARY OBSERVATIONS AT INDIANAPOLIS

November 4, 1952.

During test runs of the new ASR-2 radar equipment, a large number of unidentified moving targets appeared on the scope at approximately 4 p. m. The sun was low in the sky, and the sky was clear of all clouds. Ceiling and visibility were unrestricted. Pilot temperature reports from a departing aircraft indicated that a pronounced temperature inversion existed at the 6,000-foot level.

Although no targets were plotted, a check on several indicated that their movement corresponded to the direction of the wind at the inversion level, with a velocity roughly double the wind velocity. 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.

November 5, 1952.

At approximately 4 p. m., a group of similar targets appeared on the Indianapolis ASR-2 scope. Again the sky was clear of clouds; ceiling and visibility were unrestricted. Targets were strong, numerous, and of various shapes and sizes.

A simultaneous check of the L-band radar showed that only a few targets were being picked up by this equipment. The L-band targets appeared considerably weaker than those seen on the ASR-2 scope, although L-band aircraft targets appeared normal.

By manipulation of the ASR-2 antenna motor switch, it was possible to slew the antenna to beam it directly at some of the unidentified targets. The video return was displayed on an A-scope for closer analysis of the target characteristics. Comparisons were made with the A-scope characteristics of aircraft targets.

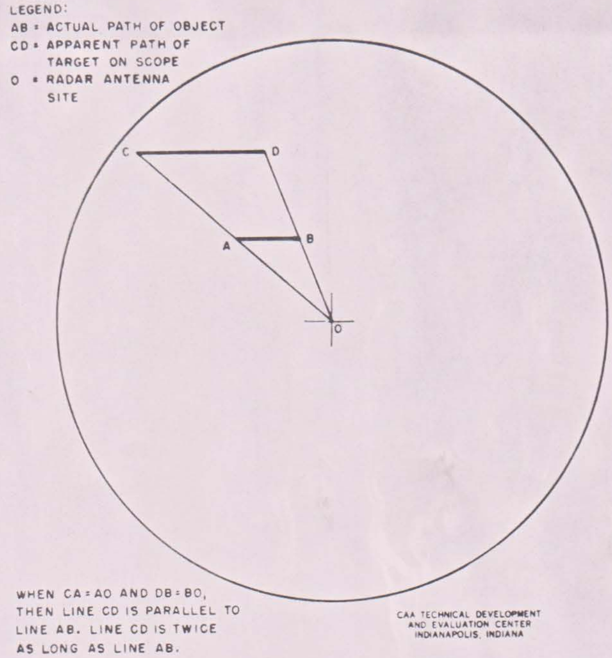

Fig. 13 Plan View of Reflection Effect

Aircraft targets showed sharp rise and decay times as well as relatively constant shape and amplitude. The unidentified targets showed gradual rise and decay times; amplitude and shape showed wide variations, which resulted in a random interlaced signal envelope similar to that returned by rain and cloud formations. These target characteristics are sketched in Fig. 15.

ANALYSIS OF SUPPLEMENTARY OBSERVATIONS

The reduced target returns from the L-band radar indicated that the reflecting areas are formed by atmospheric disturbances or discontinuities rather than by some form of ionization. If the cause were ionization, it would be expected that the lower frequency of the L-band equipment would increase the susceptibility of the radar energy to reflection or refraction effects. An example of this trend is that of ionospheric layers which produce no appreciable reflection of ultra-high-frequency energy but cause strong skip propagation of the lower radio frequencies.

EFFECT ON AIR TRAFFIC CONTROL OPERATIONS

The generally weak and fuzzy appearance as well as the slow speed of spurious radar targets usually enable them to be

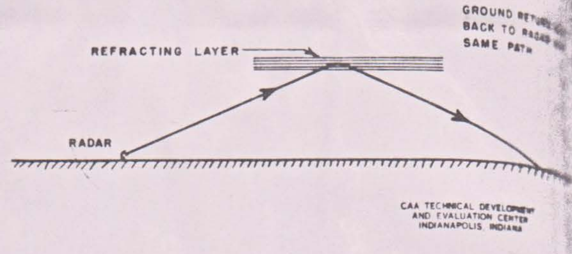

Fig. 14 Refraction of Radar Beam

recognized as such by experienced radar controllers. Normally these targets have but little effect on traffic control, because they occupy very little space in relation to the entire scope area and their progress or course is very slow. The most dangerous possibility from the traffic control standpoint is the chance that one of these targets might be a helicopter.

If their course will not collide with that of an aircraft target, such targets are generally disregarded. If the course will collide with an aircraft target, some control action is indicated because of the helicopter hazard. In such cases, prudent controllers will give traffic information to pilots regarding the unidentified target, particularly at night under visual flight rule conditions. Where a collision course is involved, pilots would rather be warned about a spurious target than not be warned about a legitimate one.

At the present time, very little instrument flying is done by helicopters. Therefore, unidentified targets of this type are not usually given as traffic information to pilots known to be operating on instruments.

CONCLUSIONS

1. It is believed that most of the unidentified targets observed on the Washington MEW radar during the period beginning on the night of August 13, 1952 and the period beginning on the night of August 15, 1952 were ground returns caused by reflection phenomena closely connected with the temperature inversions in the lower atmosphere.

2. Unidentified radar targets of the type described in this report have been noticed since the early days of radar. Unusual weather conditions prevailing in the Washington area during the summer of 1952 were exceptionally conducive to the formation of these phenomena.

3. Present evidence indicates that the appearance of unidentified targets of this nature on radar scopes has but little effect on the control of air traffic. At its worst, it forms a nuisance by cluttering the scope

display and by requiring that additional traffic information or heading instructions be issued in order to protect other traffic against the possibility that such a target might be a helicopter.

4. In some cases, it would be desirable to provide the controller with a more positive method of identifying targets such as these so that he could determine quickly whether they are spurious or whether they are actual aircraft.

RECOMMENDATIONS

1. In order to secure additional evidence regarding the causes, extent, and effects of this type of phenomena, it would be desirable to secure additional target plots from the horizontal plotting scope of the Washington ARTC Center. It would also be desirable for all CAA air traffic control agencies which use radar equipment to log the occurrence of such targets. Notes regarding the extent and motion characteristics of them, together with their effects on the control of air traffic, would also be of value. It would be desirable to correlate all these reports with official United States Weather Bureau records.

2. Should additional research regarding these phenomena be undertaken, close coordination with the local office of the United States Weather Bureau is essential in order that observations can be made when conducive meteorological conditions are expected.

3. It is believed that more complete evidence could be obtained through the use of more flexible radar equipment. A tremendous asset in evaluating the nature of false targets would be the ability to track continuously a specific target through use of a manual slewing control. It would then be desirable to examine this target closely on an A-scope radar presentation. A number of commercially available synchroscopes are ideally suited for this purpose. The echo could be enlarged on such a presentation to a width of one inch or more. Examination of the resulting trace including such characteristics as steepness of rise and decay time, energy distribution, and fluctuations in amplitude

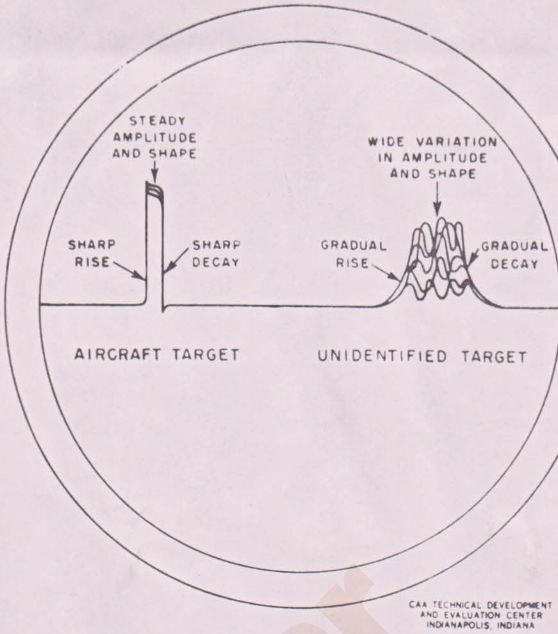

Fig. 15 Comparative A-Scope Target Displays

should make it possible to deduce a great deal regarding the source of the reflection.

4. Additional simultaneous observations of the phenomena on L-band and S-band radar equipment would be desirable. The availability of aircraft which could be guided by radar to the area of the target or to the primary reflecting area would also be advantageous. Additional information may be obtained by equipping the aircraft with an aero-psychograph as well as with suitable apparatus for measuring electrical charges in these areas.

5. When helicopter traffic becomes more prevalent, it may be desirable to provide the controller with some type of radar accessory which can detect propeller modulation and which can give him the means to determine positively whether an unidentified target is an aircraft or a reflection. It is recommended that this type of accessory be studied in connection with the proposed evaluation program for the ASR-2 radar.

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NO. 55-14

HEADQUARTERS NORTH AMERICAN AIR DEFENSE COMMAND
HEADQUARTERS CONTINENTAL AIR DEFENSE COMMAND
Ent Air Force Base, Colorado
1 December 1966

Operations

★ IDENTIFICATION OF AIR TRAFFIC

PURPOSE. Establishes policies and procedures, designates responsibilities, and outlines the methods and criteria to be employed for the identification of airborne objects within the North American Air Defense (NORAD) and Continental Air Defense (CONAD) system.

1. Scope. Applies to all United States and Canadian military forces assigned, attached, or otherwise made available to the Commander-in-Chief, NORAD, for the performance of his mission. Other commands and agencies having air defense responsibilities to CINCNORAD/CINCONAD will use this regulation for guidance.

2. Concept. The air defense identification process used throughout the NORAD/CONAD system is based on the following two-fold requirement:

a. During normal readiness, to detect and identify any unusual air activity within the perimeter areas of the North American continent which might be prejudicial to the national interests, or indicate an imminent air attack against vital targets in the United States and Canada and to preclude violation of sovereign air space. To meet this requirement, Air Defense Identification Zones have been established around the periphery of the combat zone and the northern extremities of the NORAD/CONAD area of responsibility, and stringent rules have been imposed to facilitate the identification of all air traffic penetrating and/or operating within these zones. Under this concept, unknown aircraft (tracks) will be identified as far from the target areas as is operationally feasible. This emphasis on perimeter identification allows the air defense system to relax the requirement to identify air traffic operating within the interior of the NORAD/CONAD area (defense areas) during periods of normal readiness.

b. During Air Defense Emergency, to establish and maintain the identity and control of, or control over, all airborne objects penetrating or operating within the NORAD/CONAD system. This requirement is met when additional restrictions, as authorized in national plans for security control of air traffic, are applied to the entire NORAD/CONAD area of responsibility.

3. Responsibilities. NORAD/CONAD subordinate commanders will insure that the identification of all airborne objects within their assigned areas of responsibility is carried out in accordance with the provisions of this regulation.

This supersedes NORADR/CONADR 55-14 dated 12 January 1962, as amended.
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★All paragraphs changed.

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Atch 1.

4. Explanation of Terms.

a. Identification. The determination of an airborne object's identity by means (or combination of means) of flight plan correlation, visual recognition, track behavior, electronic interrogation, origin and direction, and operating agreements not in conflict with the intent of this regulation.

b. Other terms established for use in this regulation are as prescribed in Attachment 1.

5. Identification Requirements.

a. Tracks (objects) Requiring Identification. All airborne objects, with the exception of those listed in paragraph 7, detected entering or operating within any identification zone in the NORAD/CONAD area of responsibility, will be identified in accordance with the criteria outlined in this regulation.

b. Time Limits for Identification. The maximum time allowable for initial identification of a track upon penetration or initial detection within an ADIZ is two minutes from the time the track is established by (or received at) the unit responsible for such identification. This time limit may be extended as necessary for the identification of aircraft operating in accordance with certain special agreements approved by NORAD elements of the air defense system.

c. Track Identification. Responsible NORAD/CONAD subordinate commanders will:

(1) Prior to the declaration of Air Defense Emergency, identify tracks as "Friendly," "Unknown," or "Hostile." ("Friendly" tracks may be subsequently classified in accordance with NORADM 55-1.)

(2) Identify tracks as "Friendly," "Unknown," or "Hostile," following the declaration of Air Defense Emergency, but prior to the completion of applicable procedures for the security control of air traffic and air navigation aids.

(3) Identify tracks as "Friendly" or "Hostile" following the declaration of Air Defense Emergency and upon completion of procedures for the security control of air traffic and air navigation aids including the grounding and/or diversion of air traffic as necessary. However, a NORAD/CONAD region commander may, at his discretion, accept an unknown beyond this period, pending further identification action, if the air defense situation in his area is not critical at the time.

6. Identification Criteria.

a. Friendly Tracks. The following methods and criteria are established for the identification of airborne objects as "Friendly." (Tracks with a primary identification of "Friendly" may be subsequently classified in accordance with NORADM 55-1.)

(1) Flight Plan Correlation. The principle NORAD/CONAD method of identification is based on flight plan correlation. Information derived from a flight plan giving details of an intended flight, updated by information obtained from inflight amendments and position reports, is compared with an actual track of an airborne object as obtained by radar or other source. If the information as to the proposed flight, and the information as to the established track, correlate with the following established criteria, the track may be identified "Friendly." The criteria for "Friendly" identification are as follows:

(a) Domestic ADIZ/CADIZ. Correlation within plus or minus five minutes from estimated time over a reporting point or point of penetration, and within ten nautical miles from centerline of intended track over estimated reporting point or point of penetration.

(b) Coastal ADIZ/CADIZ/DEWIZ/DEMIZ. Correlation within plus or minus five minutes from estimated time over a reporting point or point of penetration, and within twenty nautical miles from centerline of intended track over estimated reporting point or point of penetration.

(2) Visual Observations. A track may be identified "Friendly" when positive recognition of the "Friendly" character of the airborne object is reported by one of the following:

(a) Interceptor Pilot. Information obtained from an interceptor pilot in the course of an interception may be used for identification purposes.

(b) Qualified Observer. Information obtained from a qualified observer may be used for identification purposes. (Qualified observers are military or civilian personnel whose duties entail continuous association with air operations.)

(3) Previous Identification. Tracks previously identified "Friendly" and passed by adjacent Air Defense units and which remain under continuous surveillance, will be accepted as "Friendly" unless they create suspicion as outlined in paragraph 6b(2).

(4) Prior Arrangement. A track may be identified "Friendly" if it follows a plan of flight in accordance with a prior arrangement between the NORAD/CONAD commander concerned and the aircraft operator.

(5) Operating Agreements. Local or special arrangements or agreements relative to air defense identification are authorized. Operating agreements not in violation of the intent of this regulation may be established between NORAD/CONAD commanders concerned and other military commands. Agreements with other governmental agencies and/or industrial operators may be consummated in coordination with the ARTCC/ACC concerned.

b. Unknown Tracks. "Unknown" is an initial identification resulting from the inability to identify a track as "Friendly," using the criteria outlined in this regulation. Interception and recognition procedures for unknown tracks will be in accordance with standard tactics prescribed by services and component commands. The following criteria are established for the identification of tracks as "Unknown:"

(1) Any track requiring identification that cannot be identified by ground environment processes within the time limit prescribed in paragraph 5b.

(2) Any track, regardless of its location, creating suspicion as to its friendly intent by reason of course, speed, altitude, radio/telephone procedures, maneuvers, flight size, ECM activity, or other abnormality to an extent that further investigation is deemed advisable.

(3) The ground environment phase of identification will continue after a track is initially identified as "Unknown."

(4) Immediately after a track is identified "Unknown," appropriate action will be initiated to identify the object by visual recognition, through interception, whenever such action is deemed advisable and feasible. Any track identified by intercept, which belongs to a nation possessing a high threat potential, will be immediately reported by voice through normal tactical circuits to the NORAD COC. (Reference Attachment 2.) (NOTE: Intercept action may be delayed and/or withheld on "Unknown" tracks which, in the opinion of the appropriate NORAD/CONAD commander, do not constitute a threat.)

c. Hostile Tracks. Methods and criteria for identification of tracks as "Hostile" will be as prescribed in NORAD Regulation 55-6, Rules of Engagement.

d. Pending Tracks. A track detected outside a perimeter identification zone, on a heading toward the North American continent, may be designated a Pending track. This indicates that identification action will be required if and when the track penetrates the ADIZ boundary or correlation line. Pending tracks will be forward-told to the NORAD COC.

7. Exceptions. Aircraft may be automatically identified as "Friendly" under the following conditions only during conditions of less than Air Defense Emergency. The following exceptions do not preclude further questioning or investigation by the air defense element concerned if circumstances indicate that such action is advisable.

a. Track Behavior. When operating within or penetrating any air defense identification zone north of 28 degrees 00 minutes north latitude or west of 85 degrees 00 minutes west longitude at a true air speed of less than 180 knots.

b. Origin and Direction.

(1) When a track originating within a defense area is identified "Friendly" then penetrates or operates within an identification zone and is under continuous surveillance, the "Friendly" identification can be maintained.

(2) When a track is originated within a defense area or domestic identification zone and maintains an outbound heading into or through a perimeter identification zone, (excluding flights entering the Alaskan Domestic ADIZ from a southerly or easterly direction, e. g., Canada).

c. Free Areas. When originating in and remaining within a free area, as designated by a NORAD/CONAD region commander. NORAD/CONAD commanders may also designate specific areas within their areas of responsibility as temporary "free areas" for special circumstances such as Search and Rescue Operations. Identification within these "free areas" will be established by prior arrangements (reference paragraphs 6a(4) and (5)). Upon declaration of Air Defense Emergency, "free areas" as defined herein will be abolished.

8. Supplementary Identification Methods.

a. Electronic Identification. Electronic identification (IFF/SIF) when used in conjunction with flight plan data on military aircraft operating in conformance with NORAD classified IFF/SIF instructions may be the basis for identification as "Friendly." Civil Air Traffic Control Radar Beacon System (ATCRBS) may be used in conjunction with flight plans, operational procedures, and identifying actions, as specified herein, to assist in identifying "Friendly" from "Unknown" traffic. Prepositioned route data may be substituted for flight plan information when EWOs are being executed. (Reference NORADM 55-4.)

b. Voice Authentication. Voice authentication, using appropriate KAA-29 in conjunction with basic identifying actions, may be used as an additional means of determining the "Friendly" identity of airborne objects.

c. Scope-to-scope correlation of air defense radar plots with positional information obtained from air traffic control facilities on aircraft under air traffic control may be used as an additional method for establishing initial identification or reidentification. This procedure will not apply in periphery areas.

9. Supplementary Instruction. NORAD/CONAD region and component commanders are authorized to supplement this regulation, as required, to establish specific responsibilities and operating procedures for their area.

10. Augmentation Information Folder. A copy of this regulation will be maintained in the Augmentation Information Folder (AIF). Reference NORAD Regulation 55-5, Augmentation Information Folder (AIF).

FOR THE COMMANDER-IN-CHIEF:

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GLOSSARY OF TERMS

The following definitions are established for the purpose of this regulation:

1. Air Defense Identification Zone (ADIZ/CADIZ). Airspace of defined dimensions designated by the Administrator of Federal Aviation Agency (FAA), U. S. and/or Minister Department of Transport (DOT), Canada, within which the ready identification, location, and control of aircraft is required in the interest of national security.

a. Domestic ADIZ/CADIZ. An Identification Zone situated within the continental land mass of the United States, Alaska, or Canada, and territorial waters.

b. Coastal ADIZ/CADIZ. An Identification Zone over the coastal waters adjacent to the United States, or extending seaward from the territorial waters of Canada.

c. DEWIZ. An Identification Zone of defined dimensions extending upwards from the surface, in the vicinity of the DEW Line in Canada, and around the entire coastal area of Alaska.

d. DEMIZ. A military identification zone of defined dimensions extending upwards from the surface, in the vicinity of DEW East in Greenland.

2. Aircraft Movements Information Section (AMIS). A facility established by the Federal Aviation Agency (FAA) and/or Department of Transport (DOT) to provide for collection, processing, and dissemination of flight movement information for use by air defense facilities.

3. Air Route Traffic Control Center/Area Control Center (ARTCC/ACC). Federal Aviation Agency (FAA), and Department of Transport (DOT) facility established to provide adequate supervision of air traffic within a specified control area.

4. Correlation Line or Point. A reference line or point(s) established by NORAD region or division commander(s) from which "penetration" or "time-over" for a flight is computed for the purpose of flight plan correlation. A correlation point is any point used for flight plan correlation purposes.

5. Defense Area. Airspace over the United States or Canada other than airspace designated as an Air Defense Identification Zone, but within which the ready control of air traffic is required in the interest of National Security during Air Defense Emergency.

6. Defense Visual Flight Rules (DVFR). Visual flight rules (VFR) applicable to flights which originate within, operate within, or penetrate an air defense identification zone toward the combat zone.

7. Established Track. A radar plot on which movement has been confirmed by subsequent radar data. (Normally, a track will be established within two minutes.)

8. Flight Plan Information (Air Movement Data). A statement of the air traffic clearance and procedures to be followed on a particular flight. This data is processed by an Air Movements Information Section and forwarded to the appropriate Air Defense Direction Center(s).

9. Free Area. A specified area, as defined by a NORAD/CONAD region commander, within an Air Defense Identification Zone. All air traffic originating and remaining within the boundaries of such an area in accordance with prearranged procedures may be automatically identified as "Friendly" under conditions less than Air Defense Emergency.

10. Friendly (F). Identification of an airborne object based upon established criteria.

11. Hostile (H). Identification of an airborne object as being hostile in intent based upon established criteria.

12. KAA-29. A voice authentication code used primarily for air-to-ground and ground-to-air communications.

13. Air Defense Emergency. An emergency condition, declared or confirmed by either CINCNORAD or CINCONAD, or higher authority, which exists when attack upon the continental United States, Alaska, Canada, or U.S. installations in Greenland by "Hostile" aircraft or missiles is considered probable, is imminent, or is taking place.

14. Pending (P). An established track for which identification action may be required.

15. Reporting Point. A geographical location in relation to which the position of an aircraft is reported.

16. Unknown (U). A track identification indicating a track which cannot be otherwise identified within a specified period of time.

17. Origin. Refers to the point of initial radar detection.

INTERCEPTION AND RECOGNITION PROCEDURES

1. General. All interceptor aircraft engaged in air defense activities in defense of the North American continent, and the approaches thereto, wherein CINCNORAD/CINCONAD exercises operational control, will be governed by the following interception and recognition procedures when scrambled for an identification interception:

a. Interceptors will fly no closer to the intercepted aircraft than is necessary for positive visual recognition.

b. Dangerous or reckless flying for the purpose of obtaining recognition is prohibited.

c. Practice intercepts will not be made against civilian aircraft.

d. Every effort will be made by the interceptor pilot to prevent startling intercepted aircraft crews. The effect desired is one which assures personnel in the intercepted aircraft that the interceptor is making a routine investigation in the interest of properly conducting the mission of this command.

e. VFR and IFR interception patterns will be in accordance with standard tactics prescribed by the component command to whom the interceptor is assigned.

f. Identification by interplane radio communication will not be attempted by interceptor pilots except when ordered by the controlling air defense facility. When so ordered by the controlling air defense facility, and upon intercepting jet and four or more engine type bomber aircraft, interceptor pilots will further challenge the bomber for recognition purpose. The interceptor pilot will fly alongside the bomber on a steady course and contact the bomber on UHF radio, and challenge, using KAA-29. Correct answer by the bomber to the voice challenge may be used to identify the aircraft as "Friendly."

g. The interceptor pilot will keep the controlling air defense facility advised of marginal conditions of visibility.

h. When more than one interceptor is employed on an interception, only one pilot will effect visual recognition. The remaining aircraft will maintain surveillance from a position where an attack could be made against the intercepted aircraft. One such surveillance aircraft will, where possible, record the identification particulars as transmitted by the pilot effecting visual recognition.

i. The pilot effecting recognition, or another member of the intercept force, will report the quantity, type, nationality, ownership, and any unusual behavior of the intercepted aircraft to the controlling air defense facility in accordance with established reporting procedures. Aircraft serial numbers or registration letters will be obtained and reported only when considered necessary, and requested by the controlling air defense facility.

j. If the intercepted aircraft is positively identified as "Friendly," the interceptor will withdraw immediately and proceed in accordance with instructions received from the controlling air defense facility.

k. If the intercepted aircraft cannot be positively identified as "Friendly," the interceptor will maintain surveillance and contact the controlling air defense facility for further instructions.

l. The controlling air defense facility, when unable to identify an aircraft through information passed by the interceptor pilot, or other means, will immediately notify the appropriate NORAD region combat center giving all relevant information.

VIOLATION/INCIDENT REPORTING PROCEDURES

Military and civil aircraft which do not comply with published identification procedures and criteria will be reported by NORAD region and CONAD division commanders in accordance with the following violation and/or incident reporting policy.

1. Violations of Air Defense Identification Zones whose areas are associated solely with Canada or the United States will be forwarded through appropriate channels as directed by Canadian or U.S. directives.

2. Violations of Air Defense Identification Zones within a NORAD region whose area of responsibility encompasses the land mass and seaward approaches of both Canada and the United States will be processed as follows:

a. United States military aircraft violations, regardless of where the violation occurs, will be routed to appropriate U.S. authorities in accordance with instructions provided by USAF Air Defense Command and Alaskan Air Command. In addition, if the violation occurs within Canadian airspace, a copy of the violation report will be routed as directed by Canadian Forces Air Defence Command Instructions (CFADCI).

b. Canadian military aircraft violations, regardless of where violation occurs, will be routed to appropriate Canadian authorities in accordance with instructions provided by CFADCI.

c. All Canadian and U.S. civil, foreign civil, and foreign military aircraft violations will be routed through the national channels depending on where the violation occurs. If appropriate to continental U.S. airspace, they will be routed as directed by ADCR 55-24, Alleged Violations of ADIZ and Prohibited Area Flying Rules. If appropriate to Canadian airspace, they will be routed as directed in CFADCI. If appropriate to Alaskan airspace, they will be routed as directed by AACR 55-45.

3. Violations of Air Defense Identification Zones associated with nations other than Canada and the U.S. will be forwarded by the CONAD commander in accordance with instructions promulgated by Headquarters USAF, USAF ADC and the nation concerned.

4. Format for reporting will be in accordance with instructions contained in the Canadian or U.S. documents, whichever applies.