REPORT OF THE 1966/1967 TEST FIRINGS PROJECT HARP

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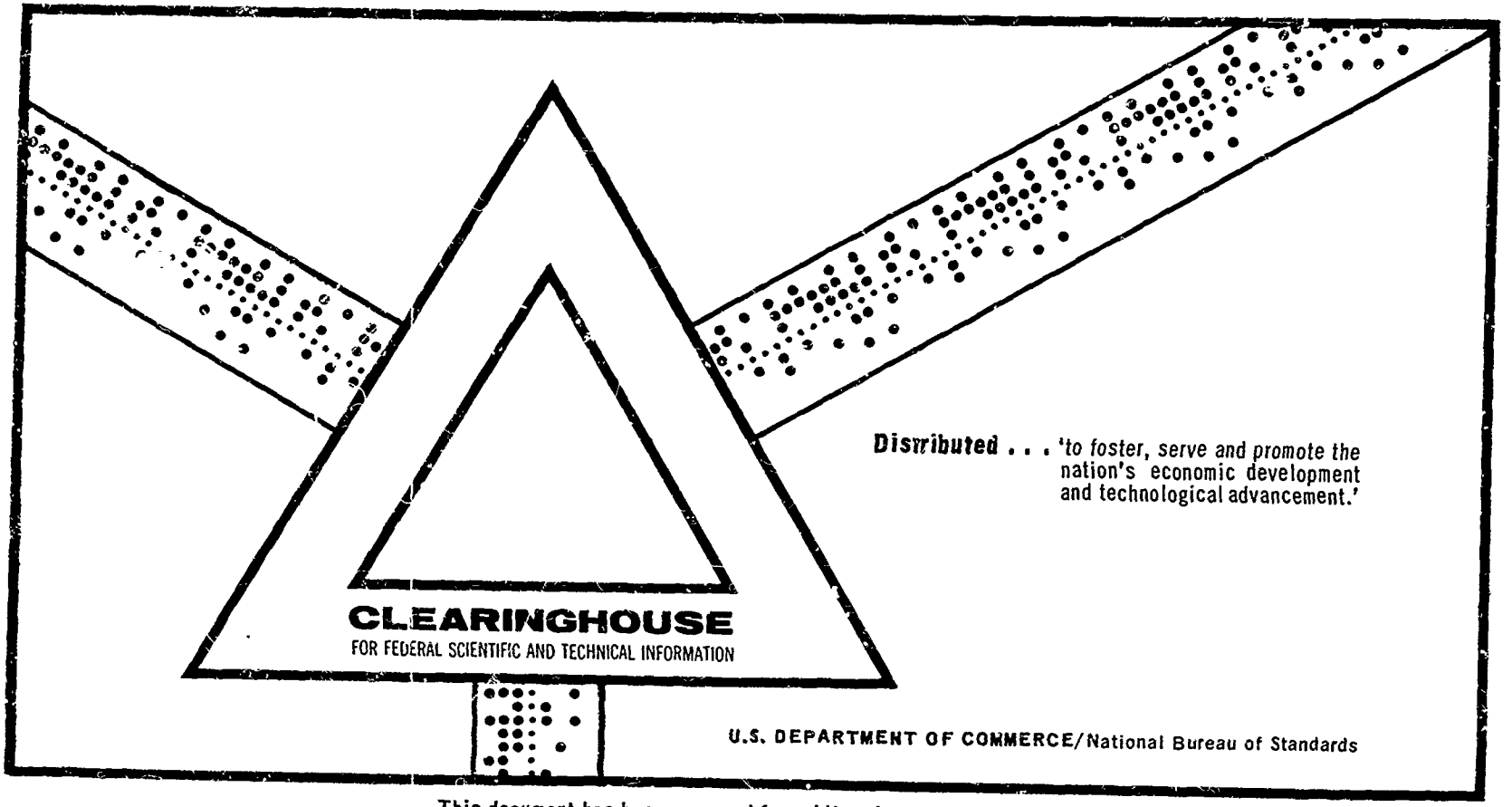
May 1969



McGILL UNIVERSITY
SPACE RESEARCH INSTITUTE
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REPORT
of the
1966/1967
TEST FIRINGS
PROJECT HARP

SRI-R-23

Prepared by:

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ABSTRACT

This report is a review and analysis of results of the test firings of Project HARP from the Barbados 16-inch gun during 1966 and 1967 until the 30th of June. The objectives of these firings were manifold, viz:

i) Scientific data gathering, primarily wind data in synoptic firings and their correlation with ionosonde drift data;

ii) Engineering tests of gun, propellant, and sabot performance;

iii) Engineering tests of instrumentation and payloads, including telemetry packages and sea impact devices;

iv) Engineering development tests of vehicles, viz: the Martlet 2D, Martlet 2G, Martlet 2G-1, and Lahive cones.

Fifty-nine rounds were fired during the report period. Thirty-five of these (i.e. the majority of shots) carried TMA release payloads on Martlet 2C (Mod. 2) vehicles. Five further rounds with Martlet 2C vehicles had the purpose of testing the sea impact device, telemetry packages, and Langmuir probes, whereas nine rounds were vehicle development tests. The remaining ten rounds were launch engineering test firings of slugs.

The test objectives were generally achieved. The gun performance was satisfactory, and the usefulness of inserting spacers between the propellant bags was again confirmed. In December 1966 the multipoint ignition method was successfully introduced, reducing the maximum pressure for the same charge weight considerably and increasing the muzzle velocity at the same pressure. Tests were also made with gun liners in order to reduce the barrel taper caused by extensive wear near the breech. These tests finally led to the installation of a permanent liner which gave satisfactory results.

The Martlet 2C vehicles performed with the usual reliability. The Martlet 2D design had been abandoned prior to this test series to be replaced by the much larger Martlet 2G, however, two surplus Martlet 2D vehicles were used for structural test firings in connection with tests on a gun liner and a TMA puff-puff release system, respectively. Tests of the Martlet 2G proved successful in one round in which a perfect flight trajectory was obtained.

The tests during the report period have shown a further progress in the development of instrumentation capable of withstanding the high launch accelerations. Furthermore, wind data were obtained in synoptic firings during three nights and in several single rounds.

The present report discusses the general results of the firings, and gives the detailed performance data of all rounds, the radar trajectory data, and the wind data. It concludes the series of reports on Project HARP firings from the Barbados 16-inch gun carried out by the Space Research Institute of McGill University.

ACKNOWLEDGEMENTS

The work described in this report was carried out as part of the continued HARP program. As such it has been a joint effort between the staff of the Space Research Institute (SRI) of McGill University and the personnel of the Ballistic Research Laboratories (BRL) of the U.S. Army, Aberdeen Proving Ground.

The support from Space Instruments Research (SIR), Atlanta, Georgia, and Computing Devices of Canada (CDC), Ottawa is also gratefully acknowledged.

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PART I

1.0 INTRODUCTION

From January 1966 until June 30, 1967 when the Space Research Institute ceased to be associated with McGill University, Project HARP had eight more test firing series with the 16-inch gun in Barbados. In all, 59 rounds were fired in these two years, 36 in 1966 and 23 in 1967. The test series were as follows:

February 1966 Series (XV): 20 shots from 17 to 25 February, 1966. (Rounds 180 to 199)

August 1966 Series (XVI): 4 shots from 15 to 25 August, 1966. (Rounds 200 to 203)

September 1966 Series (XVII): 10 shots from 19 to 20 September, 1966. (Rounds 204 to 213)

December 1966 Series (XVIII): 2 shots, 5 and 14 December, 1966. (Rounds 214 and 215)

Gun Test Shot: 1 Slug, 18 January 1967. (Round 216)

February 1967 Series (XIX): 10 shots from 15 to 17 February, 1967. (Rounds 217 to 226)

March 1967 Series (XX): 2 shots, 22 and 25 March, 1966. (Rounds 227 and 228)

May 1967 Series (XXI): 5 shots from 23 to 30 May, 1967.. (Rounds 229 to 233)

June 1967 Series (XXII): 5 shots from 21 to 24 June, 1967. (Rounds 234 to 238).

Table I lists the firings in chronological order.

Since the first test firing in January 1963, altogether 238 shots have been fired from the Barbados gun in the 4½ year period until the end of June, 1967.[x)]

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x) A list of all firing series is presented in Appendix A-1. For reports on previous firings, see References 1 to 8.

The purpose of the 1966/67 test series was manifold:

(i) Scientific data gathering, primarily wind shear data in synoptic firings and the corr lation of the results with ionosonde drift data.

(ii) Engineering tests of the gun, propellant, and sabots.

(iii) Engineering tests of instrumentation and payloads, including telemetry packages and Sofar impact devices.

(iv) Engineering development tests of vehicles, viz. the Martlet 2D, Martlet 2G, Martlet 2G-1, and Lahive Cones.

TABLE I

CHRONOLOGICAL LIST OF FIRINGS

Firing Series	Shot No.	Name	Date	Time AST	Vehicle Martlet	Payload	Purpose
XV	180	ANTIGUA	17 Feb 66	1334	2C Slug	-	Sabot Test
	181	INAUGUA	17 Feb 66	2103	2C Mod 2	5.5 LB TMA	Wind measurements
	182	CUBA	18 Feb 66	1101	2C Mod 2	SOFAR IMPACT DEVICE	Test of Impact Device
	183	MURPHIUS	20 Feb 66	1751	2C Slug	-	Gun Test
	184	DOMINICA	21 Feb 66	1030	2D	-	Vehicle and Sabot Test
	185	WOOD TS # 1	21 Feb 66	1543	Wood Slug	-	Gun and Propellant Test
	186	WOOD TS # 2	21 Feb 66	1705	Wood Slug	-	Gun and Propellant Test
	187	WOOD TS # 3	22 Feb 66	1300	Wood Slug	-	Gun and Propellant Test
	188	JAMAICA	23 Feb 66	1836	2C Mod 2	5.5 LB TMA	Synoptic series for wind shear and ionosonde data (Round No. 190 also Test of Telemetry package)
	189	ST. KITTS	23 Feb 66	2046	2C Mod 2	5.5 LB TMA	
	190	ST. LUCIA	23 Feb 66	2203	2C Mod 2	5 LB TMA + HDL Telemetry	
	191	MONTSERRAT	23 Feb 66	2321	2C Mod 2	5.5 LB TMA	
	192	NEVIS	24 Feb 66	0025	2C Mod 2	5.5 LB TMA	
	193	OCHO RIOS	24 Feb 66	0216	2C Mod 2	5.5 LB TMA	
	194	PUERTO RICO	24 Feb 66	0327	2C Mod 2	5.5 LB TMA	
	195	LA RAIZET	24 Feb 66	0425	2C Mod 2	5.5 LB TMA	
	196	ST. THOMAS	24 Feb 66	0523	2C Mod 2	5.5 LB TMA	
	197	WOOD TS # 4	25 Feb 66	1204	Wood Slug	-	Propellant Test
	198	ELEUTHERA	25 Feb 66	1420	2C Mod 2	SOFAR IMPACT DEVICE	Test of Impact Device
	199	FLAMINGO	25 Feb 66	1843	2C Mod 2	5.5 LB TMA	Wind measurements
XVI	200	DONNA	15 Aug 66	1933	2C Mod 2	5.5 LB TMA, SRI Telemetry	Wind measurements and Telemetry, Gun, and Performance Test
	201	TEST SLUG	16 Aug 66	1235	Wood Slug	-	Propellant and Gun Test
	202	FERNANDE	17 Aug 66	0522	2G	TMA	Vehicle Test
	203	TEST SLUG	25 Aug 66	1303	Wood Slug	-	Gun Test

TABLE I (Cont'd)

CHRONOLOGICAL LIST OF FIRINGS

Firing Series	Shot No.	Name	Date	Time AST	Vehicle Martlet	Payload	Purpose
XVII	204	ALPHA	19 Sep 66	1839	2C Mod 2	5.5 LB TMA + BML TELEMETRY with LANGMUIR PROBE	Synoptic series for wind shear and ionosonde data (Rounds Nos. 204 and 207 also Test of Telemetry and Langmuir Probe)
	205	BETA	19 Sep 66	2055	2C Mod 2	5.5 LB TMA	
	206	GAMMA	19 Sep 66	2224	2C Mod 2	5.5 LB TMA	
	207	DELTA	20 Sep 66	0010	2C Mod 2	5.5 LB TMA + BML TELEMETRY with LANGMUIR PROBE	
	208	EPSILON	20 Sep 66	0130	2C Mod 2	5.5 LB TMA	
	209	ZETA	20 Sep 66	0224	2C Mod 2	5.0 LB TMA	
	210	ETA	20 Sep 66	0318	2C Mod 2	5.5 LB TMA	
	211	THETA	20 Sep 66	0403	2C Mod 2	5.5 LB TMA	
	212	IOTA	20 Sep 66	0446	2C Mod 2	5.5 LB TMA	
	213	KAPPA	20 Sep 66	2225	2C Mod 3	LANGMUIR PROBE	Measurement of electron density
XVIII	214	INDEPENDENCE 1	5 Dec 66	1915	2C Mod 2	5.5 LB TMA	Vehicle and payload check with Pyro Vehicle Test
	215	INDEPENDENCE 2	14 Dec 66	1709	2G	-	
	216	TEST SLUG	18 Jan 67	1500	Wood Slug	-	Obturator Test
XIX	217	ANTRIM	15 Feb 67	1937	2C Mod 2	5.5 LB TMA	Synoptic series for wind shear and ionosonde data
	218	BELFAST	15 Feb 67	2117	2C Mod 2	5.5 LB TMA	
	219	CORK	15 Feb 67	2245	2C Mod 2	5.5 LB TMA	
	220	DUBLIN	15 Feb 67	2356	2C Mod 2	5.5 LB TMA	
	221	GARVAGH	16 Feb 67	0105	2C Mod 2	5.5 LB TMA	
	222	HOLLYWOOD	16 Feb 67	0210	2C Mod 2	5.5 LB TMA	
	223	KERRY	16 Feb 67	0323	2C Mod 2	5.5 LB TMA	
	224	LIMERICK	16 Feb 67	0417	2C Mod 2	5.5 LB TMA	
	225	NEWRY	16 Feb 67	0520	2C Mod 2	5.5 LB TMA	
	226	SHANKILL	17 Feb 67	1645	2G	kerosene, dummy release valve	Vehicle Test

TABLE I (Cont'd)

CHRONOLOGICAL LIST OF FIRINGS

Firing Series	Shot No.	Name	Date	Time AST	Vehicle Martlet	Payload	Purpose
XX	227	BANGOR	22 Mar 67	1315	2C Mod 2	CDC TELEMETRY package	Test of TELEMETRY package
	228	DONAGHADEE	25 Mar 67	1030	2C Mod 2	CDC TELEMETRY package	Test of TELEMETRY package
XXI	229	TEST SLUG 25	23 May 67	1227	METAL TS	-	Simulation of Weight and Charge for Martlet 2G1
	230	BRONSON	28 May 67	1703	2G1-B1	dummy rocket, telemetry	Vehicle and Instrumentation Test
	231	BANNOCK	30 May 67	1040	LAHIVE FLARE BODY	-	Vehicle Test
	232	CAMERON	30 May 67	1350	LAHIVE 15 deg cone	-	Vehicle Test
	233	DUNOON	30 May 67	1626	LAHIVE 10 deg cone	pyrotechnic payload	Vehicle Test
XXII	234	ACCRA	21 June 67	1900	2D	10 LB TMA	Vehicle Test
	235	CAIRO	21 June 67	2248	2C Mod 2	5 LB TMA	Wind measurements
	236	DURBAN	22 June 67	1951	2C Mod 2	5 LB TMA	Wind measurements
	237	ENTEBBE	22 June 67	2120	2C Mod 2	5 LB TMA	Wind measurements
	238	FREETOWN	24 June 67	2120	2C Mod 2	5 LB TMA	Wind measurements

2.0 GUN AND PROPELLANT

As in previous firings, gun evacuation was applied in the majority of the rounds (35 out of 59, and primarily in the TMA rounds).

The propellants used were again M8M.22, M8M.27 and WMM.225, the characteristics of which are well established and already reported upon in Ref. 8. Apart from these propellants mainly Pyro was used (in three rounds with the addition of M6.056) and in one round WM.245 was taken. In two of the M8M.27 rounds WM.048, and in two others, M8M.22 was added.

The technique of spacing the charge, successfully started in 1965 (Ref. 8) was continued and spacers inserted in most of the rounds, except in cases of a high charge weight i.e. of the order of 1300 lb., when no place for spacers was available. Starting in December 1966, also the promising multipoint ignition technique was applied in practically all rounds of 1967 and with good success.

Due to extensive wear of the gun barrel at the breech end it was decided to insert an experimental liner in order to reduce the barrel taper. The liner consisted of four sections, each four feet long. The two forward sections had a thickness of 1/16 inch, and the two rearward 1/8 inch. The material used was locally available mild steel sheet, hot rolled at the local foundry. The four sections were first inserted in the gun and welded along the longitudinal seams, then connected to each other by circumferential welds. Previously drilled ½ inch holes were plug welded to the gun in order to provide stiffness. The fitting of the sleeve to the gun, however, was not so good because of the small thickness of the material used.

One test slug (MURPHIUS) was fired at low charge to test the sleeve and its fit in the bore. The thin sections of the liner at the end were somewhat wrinkled, but otherwise the test was satisfactory. After some minor repairs and rewelding the gun liner was tested in a shot with working pressure (Martlet 2D round DOMINICA). In this round the vehicle failed in the gun, and the sleeve came out entirely. It was not possible to determine whether the sleeve or the vehicle were the cause of the failure; it was assumed, however, that a properly adapted gun liner would be useful. For this reason a permanent gun liner was installed at a later date, and satisfactory results were obtained.

3.0 FIRING PROGRAMS

The fifty-nine shots were grouped as follows:

(1) 35 Martlet 2C Mod 2 firings with TMA for wind measurements. Four of these rounds carried also a Langmuir probe and/or telemetry packages.

(2) 5 Martlet 2C firings (4 Mod 2, 1 Mod 3) for engineering tests of the SOFAR impact payload, telemetry packages and Langmuir probes.

(3) 10 Test Slug firings for gun, propellant, and sabot engineering tests.

(4) 2 Martlet 2D firings

(5) 3 Martlet 2G firings

(6) 1 Martlet 2G-1 firing, and

(7) 3 Lahive cone firings,

the last four groups for vehicle engineering tests (structural and performance tests).

Detailed flight performance data of all rounds are given in Part II.

3.1 Martlet 2C (Mod 2) TMA Rounds

The rounds, 35 in all, represent the largest portion of the 1966/67 firings. The Martlet 2C (Mod 2) vehicles (Fig. 1.1) and their TMA release mechanism performed with the usual reliability; only one vehicle failed (No. 193), and in another round (No. 204) the high velocity-high drag flight indicated some structural damage to the vehicle.

Apart from some single flights, three synoptic test series were flown with nine shots in each series: Rounds 188 to 196 in the night of 23/24 February, 1966; Rounds 204 to 212 in the night of 19/20

MATERIALS

BODY: AISI 4340
H.T. Rc 43/46
NOSE CONE: AISI 1045
NOSE TIP: AISI 1045
TAILFINS: ALUM. 75ST6
PISTON: ALUM. 24ST4
FIN NUT: AISI 4340
PUSHER PLATE SKIRT: ALUM. 7075T6
PUSHER PLATE CROWN: AISI 4340
H.T. Rc 43/45
PUSHER PLATE INSERT: PLYWOOD OBTURATOR SEAL

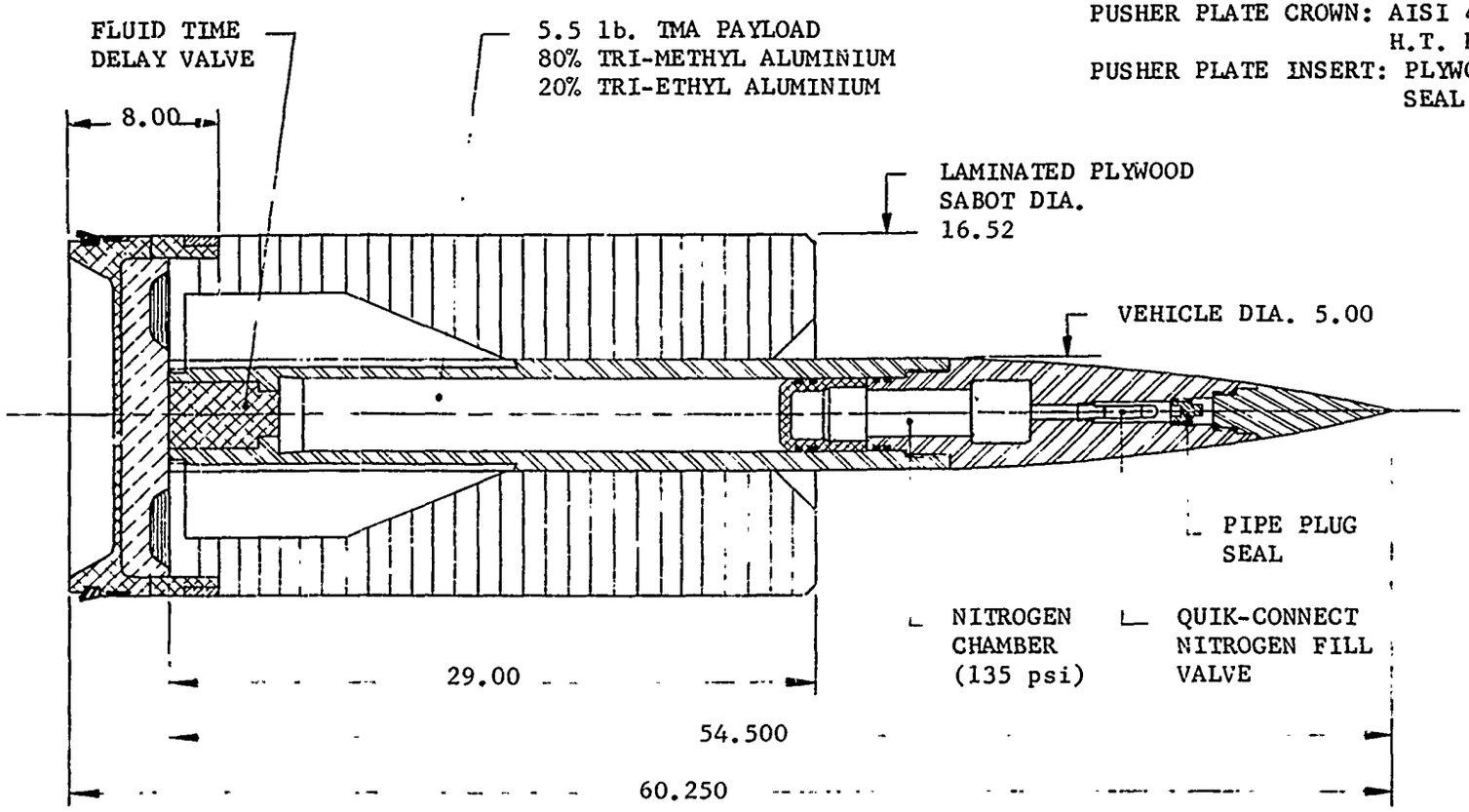


FIG. 1.1 MARTLET 2C(MOD. 2)- TMA PAYLOAD

September, 1966; and Rounds 217 to 225 in the night of 15/16 February, 1967. With few exceptions (bad weather or thin trail) good results were obtained in these rounds, providing wind data around the 100 kilometer altitude level.

In four of the 35 TMA rounds, also telemetry was carried; details are given in the following Section 3.2.

A summary of the flight results of all TMA rounds is given in Table II.

3.2 Martlet 2C Sofar, Telemetry, and Langmuir Test Rounds

Two Martlet 2C (Mod 2) were fired with a sea impact payload, No. 182-CUBA and No. 198-ELEUTHERA. The Sofar device apparently malfunctioned in the CUBA round, probably burning and damaging the vehicle with the result of a low apogee flight. In the second round, a satisfactory trajectory was obtained, but the impact device did not function. The water impact of the shot was heard by underwater microphones; no signal, however, was received from an underwater explosion of the Sofar bomb. This information of faulty performance of the device was an important engineering result and useful for future plans utilizing the device.

Two successful Martlet 2C (Mod 2) rounds, Nos. 227-BANGOR and 228-DONAGHADEE were fired to test a telemetry package developed by Computing Devices of Canada. In four of the TMA rounds (Section 3.1), also telemetry units were carried. No. 190-ST.LUCIA had an HDL telemetry command receiver system, with a 421.5 MHz crystal controlled receiver and a 245 MHz transmitter; for unknown reasons the system failed to work. No. 200-DONNA carried a 250 MHz telemetry payload made by SRI, with a flip-out antenna, but owing to antenna damage or malfunction, no telemetry was received.

TABLE II

MARTLET 2C (Mod 2) TMA FIRINGS

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
181 INAUGUA 17 Feb 66 2103 AST QE 85 DEG	Martlet 2C (Mod 2) with wood sabot, carrying 5.5 lb TMA	W_v: 183.5 W_s: 409.8 C: 900/20 (M8M.27/WM.048)	RD: 222 in RL: 20 tons ChV: 47,200 in^3 Rec: 41 in BE: No	St: 50,000 Mll: 50,000	EP: - R: (5900)	R: 400,000 (122)	Successful Shot producing good trails and wind data
188 JAMAICA 23 Feb 66 1836:30 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 183.5 W_s: 409.3 C: 930.0 (M8M.27)	RD: 222 in RL: 20 tons ChV: 47,200 in^3 Rec: 41 in BE: No	St: 42,000 Mll: 40,000	EP: - R: (5800)	R: 392,000 (119)	Successful Shot with "sunset" blue trail, but no wind data evaluated
189 ST. KITTS 23 Feb 66 2046 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 183.0 W_s: 408.8 C: 970.0 (M8M.27)	RD: 222 in RL: 28 tons ChV: 47,200 in^3 Rec: 41 in BE: 27 in Hg	St: 45,000 Mll: 44,700	EP: -	R: 430,000 (131)	Successful Shot producing good trail and wind data

W_v: Vehicle Weight
W_s: Shot Weight
C: Charge Weight

RD: Ram Distance
RL: Ram Load
ChV: Chamber Volume
Rec: Recoil
BE: Bore Evacuation

St: Strain Gauge
Mll: Crusher Gauges
R: Radar (Muzzle velocity of equivalent standard drag trajectory)

EP: Electrical Probe

TABLE II (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
190 ST. LUCIA 23 Feb 66 2203 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.0 LB TMA and an HDL telemetry nose cone	W_v: 184.0 W_s: 407.8 C: 975.0 (M8M.27)	RD: 222 in RL: 28 tons ChV: 47,200 in^3 Rec: 42 in BE: 27 in Hg	St: 45,000 Mil: 43,500	EP: -	R: 383,000 (117)	Successful regarding TMA trail and wind data but telemetry failed.
191 MONTSERRAT 23 Feb 66 2321 AST QE 85 DEG	Martlet 2C (Mod 2) carryin; 5.5 lb TMA	W_v: 183.5 W_s: 407.8 C: 975.0 (M8M.27)	RD: 223.5 RL: 19.0 tons ChV: 47,500 in^3 Rec: 42 in BE: 28 in Hg	St: 45,000 Mil: 41,750	EP: - R: (6100)	R: 433,000 (132)	Satisfactory trajectory and payload performance but low quality photographs and wind data due to bad weather.
192 NEVIS 24 Feb 66 0025 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 183.5 W_s: 410.3 C: 750/225 (M8M.27/.22)	RD: 222 in RL: 20 tons ChV: 47,200 in^3 Rec: 42 in BE: 28 in Hg	St: 50,000 Mil: 49,000	EP: - R: (6300)	R: 460,000 (140)	Successful shot producing good trail and wind data

TABLE II (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
193 OCHO RIOS 24 Feb 66 0216 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 183.5 W_s: 410.3 C: 610/355 (M8M.27/.22)	RD: 222 in RL: 14 tons ChV: 47,200 in^3 Rec: 41 in BE: 27 in Hg	St: 53,000 Mil: 53,500	EP: - R: -	R: -	Unsuccessful. Vehicle damaged.
194 PUERTO RICO 24 Feb 66 0327 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 183.5 W_s: 409.3 C: 850.0 (WMM.225)	RD: 224 in RL: 14 tons ChV: 47,600 in^3 Rec: 40 in BE: 27 in Hg	St: 53,000 Mil: 54,000	EP: - R: (5900)	R: 400,000 (122)	Successful shot producing good trail and wind data.
195 LA RAIZET 24 Feb 66 0425 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 184.0 W_s: 413.0 C: 850.0 (WMM.225)	RD: 225 in RL: 12 tons ChV: 47,800 in^3 Rec: 40 in BE: 27 in Hg	St: - Mil: 51,500	EP: - R: (6100)	R: 425,000 (130)	Satisfactory trajectory but TMA payload not released.
196 ST.THOMAS 24 Feb 66 0523:30 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 183.5 W_s: 408.3 C: 850.0 (WMM.225)	RD: 222 in RL: 18 tons ChV: 47,200 in^3 Rec: 39 in BE: No	St: - Mil: 48,500	EP: - R: (5700)	R: 380,000 (116)	Successful shot producing good trail and wind data

TABLE II (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
199 FLAMINGO 25 Feb 66 1843 AST QE 85 DEG	Martlet 2C carrying 5.5 lb TMA	W_v: 183.5 W_s: 404.5 C: 875.0 (WMM.225)	RD: 223 in RL: 14 tons ChV: 47,250 in^3 Rec: 39.5 in BE: 27 in Hg	St: - M11: 56,000	EP: - R: (6200)	R: 450,000 (137)	Successful shot producing good trail and wind data
200 DONNA 15 Aug 66 1933 AST QE 80 DEG	Martlet 2C (Mod 2) carrying an SRI telemetry package and 5.5 lb TMA	W_v: 187.0 W_s: 413.5 C: 700/165 (PYRO/M6.056)	RD: 188 in RL: 40 tons ChV: 39,950 in^3 Rec: 35 in BE: 27 in Hg	St: - M11: 38,200	EP: - R: (4700)	R: 229,000 (70)	Low apogee trajectory, therefore no trail. Telemetry not satisfactory.
204 ALPHA 19 Sep 66 1839 AST QE 85 DEG	Martlet 2C (Mod 2) carrying a BML telemetry package with a Langmuir Probe and 5.5 lb TMA	W_v: 186 W_s: 412 C: 825 (WMM.225)	RD: 188.0 in RL: 28.0 tons ChV: 39,950 in^3 Rec: 38.5 in BE: 26 in Hg	St: 52,300 M11: 53,500	EP: 6600 R: (5300)	R: 300,000 (91)	High drag flight indicating vehicle damage. No telemetry signal, very faint trail
205 BETA 19 Sep 66 2055 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 184 W_s: 410 C: 825 (WMM.225)	RD: 190 in RL: 16 tons ChV: 40,375 in^3 Rec: 39.5 in BE: 26 in Hg	St: 51,500 M11: 53,600	EP: 6550 R: (6000)	R: 414,000 (126)	Successful shot producing good trail and wind data.

TABLE II (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
206 GAMMA 19 Sep 66 2224 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 185 W_s: 412 C: 825 (WMM.225)	RD: 188 in RL: 28 tons ChV: 39,950 in^3 Rec: 38.5 in BE: 27 in Hg	St: 48,500 M11: 49,800	EP: 6320 R: (6300)	R: 442,000 (135)	Successful shot producing bright trail and wind data.
207 DELTA 20 Sep 66 0010:20 AST QE 85 DEG	Martlet 2C (Mod 2) carrying a BML Langmuir Probe with a telemetry unit and 5.5 lb TMA	W_v: 186 W_s: 409 C: 780 (WMM.225)	RD: 188 in RL: 32 tons ChV: 39,950 in^3 Rec: 32 in BE: 27 in Hg	St: - M11: 45,200	EP: 5980 R: (6000)	R: 390,000 (119)	Successful shot, good trail and wind data. No electron density data obtained.
208 EPSILON 20 Sep 66 0130 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 185 W_s: 405 C: 825 (WMM.225)	RD: 192 in RL: 34 tons ChV: 40,800 in^3 Rec: 39 in BE: 27 in Hg	St: 47,000 M11: 47,600	EP: 6470 R: (5600)	R: 360,000 (110)	Successful shot though high drag trajectory. Bright trail and good wind data.
209 ZETA 20 Sep 66 0224 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5 lb TMA	W_v: 184 W_s: 408 C: 825 (WMM.225)	RD: 194 in RL: 28 tons ChV: 41,220 in^3 Rec: 38.5 in BE: No	St: 48,200 M11: 48,100	EP: - R: (5800)	R: 373,000 (114)	Successful shot producing good trail and wind data.

TABLE II (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
210 ETA 20 Sep 66 0318 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 186 W_s: 411 C: 825 (WMM.225)	RD: 194 in RL: 24 tons ChV: 41,220 in^3 Rec: 39 in BE: 20 in Hg	St: 54,300 Mll: 55,100	EP: - R: (5900)	R: 400,000 (122)	Successful shot producing good trail and wind data.
211 THETA 20 Sep 66 0403 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 185 W_s: 414 C: 825 (WMM.225)	RD: 194 in RL: 24 tons ChV: 41,220 in^3 Rec: 39.5 in BE: 20 in Hg	St: 53,800 Mll: 55,300	EP: - R: (6000)	R: 417,000 (127)	Successful shot producing good trail and wind data.
212 IOTA 20 Sep 66 0446 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 186 W_s: 411 C: 825 (WMM.225)	RD: 194.0 in RL: 8.5 tons ChV: 41,220 in^3 Rec: 39.5 in BE: Yes (in Hg not available)	St: 44,600 Mll: 46,350	EP: not operational	R: 400,000 (122)	Successful shot producing good trail and wind data.
214 INDEPENDENCE 1 5 Dec 66 1915 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 184.5 W_s: 412.5 C: 1280 (PYRO)	RD: 185.25 in RL: 20 tons ChV: 39,570 in^3 Rec: 44.5 in BE: No	St: 43,000 Mll: 42,700	EP: - R: (5600)	R: 348,000 (106)	Successful trajectory, but thin rapidly dispersing trail. (Vehicle and payload check with PYRO)

TABLE II (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft (km)	Comments
217 ANTRIM 15 Feb 67 1937 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 184.0 W_s: 413.5 C: 1290.0 (PYRO)	RD: 187 in RL: 40 tons ChV: 39,700 in^3 Rec: 44 in BE: 27 in Hg	St: 46,000 Mil: 46,400	EP: - R: (5750)	R: 376,000 (115)	Successful shot producing trail but wind data reduction not possible.
218 BELFAST 15 Feb 67 2117 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 184 W_s: 418 C: 1320 (PYRO)	RD: 187 in RL: 40 tons ChV: 39,700 in^3 Rec: 45 in BE: 25 in Hg	St: 53,000 Mil: 53,500	EP: - R: (5900)	R: 399,000 (122)	Successful shot with good trail and wind data.
219 CORK 15 Feb 67 2245 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 184.5 W_s: 423.5 C: 1330.0 (PYRO)	RD: 187 in RL: 40 tons ChV: 39,700 in^3 Rec: 45 in BE: 25 in Hg	St: 47,000 Mil: 46,400	EP: 5680 R: (5700)	R: 367,600 (112)	Successful shot, good trail and wind data.
220 DUBLIN 15 Feb 67 2356 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 185 W_s: 419 C: 1320 (PYRO)	RD: 187 in RL: 40 tons ChV: 39,700 in^3 Rec: 45 in BE: 27 in Hg	St: 42,500 Mil: 43,600	EP: 5490 R: (5700)	R: 371,400 (113)	Successful shot, good trail and wind data.

TABLE II (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
221 GARVAGH 16 Feb 67 0105 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 185 W_s: 417 C: 1320 (PYRO)	RD: 187 in RL: 40 tons ChV: 39,700 in^3 Rec: 45 in BE: 25 in Hg	St: 44,000 Mil: 44,300	EP: 5710 R: (5800)	R: 380,000 (116)	Successful shot good trail and wind data.
222 HOLLYWOOD 16 Feb 67 0210 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 184.5 W_s: 420.5 C: 1320.0 (PYRO)	RD: 187 in RL: 20 tons ChV: 39,700 in^3 Rec: 45 in BE: 27 in Hg	St: 46,000 Mil: 47,000	EP: 5730 R: (5700)	R: 376,000 (115)	Successful shot; good trail and wind data.
223 KERRY 16 Feb 67 0323 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 184.5 W_s: 422.5 C: 1330.0 (PYRO)	RD: 187 in RL: 18 tons ChV: 39,700 in^3 Rec: 45 in BE: 27 in Hg	St: 46,000 Mil: 46,600	EP: - R: (5700)	R: 373,000 (114)	Successful shot with good trail and wind data.
224 LIMERICK 16 Feb 67 0417 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 185.0 W_s: 418.5 C: 1340.0 (PYRO)	RD: 187 in RL: 22 tons ChV: 39,700 in^3 Rec: 45 in BE: No	St: 47,000 Mil: 48,300	EP: - R: (5700)	R: 364,000 (111)	Successful shot with good trail and wind data.

TABLE II (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
225 NEWRY 16 Feb 67 0520 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.5 lb TMA	W_v: 184.5 W_s: 422.5 C: 1350.0 (PYRO)	RD: 187 in RL: 18 tons ChV: 39,700 in^3 Rec: 45 in BE: No	St: 52,000 M1': 51,600	EP: - R: (5800)	R: 381,000 (116)	Successful shot with good trail and wind data.
235 CAIRO 21 June 67 2248 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5 lb TMA	W_v: 185.0 W_s: 418.5 C: 1320.0 (PYRO)	RD: 187 in RL: 14 tons ChV: 39,700 in^3 Rec: 44.5 in BE: 28 in Hg	St: 40,000 M11: 43,100	EP: - R: (5600)	R: 355,000 (108)	Successful shot with good trail and wind data.
236 DURBAN 22 June 67 1951 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5 lb TMA	W_v: 184.0 W_s: 418.5 C: 1360.0 (PYRO)	RD: 187 in RL: 14 tons ChV: 39,700 in^3 Rec: 45.25 in BE: 26 in Hg	St: 41,000 M11: 46,700	EP: 5770 R: (5700)	R: 362,000 (110)	Successful shot with good trail and wind data.
237 ENTEBBE 22 June 67 2120 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5 lb TMA	W_v: 184.0 W_s: 415.5 C: 1380.0 (PYRO)	RD: 187 in RL: 14 tons ChV: 39,700 in^3 Rec: 45.25 in BE: 27 in Hg	St: 43,000 M11: 50,900	EP: Inconsistent Results R: (5900)	R: 393,000 (120)	Normal trajectory but TMA release mechanism failed.

TABLE II (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
238 FREETOWN 24 June 67 2120 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5 lb TMA	W_v: 181 W_s: 418 C: 860 (M8M.22)	RD: 187 in RL: 11 tons ChV: 39,700 in^3 Rec: 45.5 in BE: 28 in Hg	St: 38,000 Mll: 44,600	EP: Inconsistent Results R: (6100)	R: 440,000 (117)	Good trajectory but weak trail.

W_v: Vehicle Weight
W_s: Shot Weight
C: Charge Weight

RD: Ram Distance
RL: Ram Load
ChV: Chamber Volume
Rec: Recoil
BE: Bore Evacuation

St: Strain Gauge
Mll: Crusher Gauges
R: Radar (Muzzle velocity of equivalent standard drag trajectory)

EP: Electrical Probe

Three shots had BML (Ballistic Measurements Laboratory) payloads, 1750 MHz telemetry with Langmuir probes; two of these were piggyback experiments on TMA rounds. No telemetry was received from the first round, No. 204-ALPHA. The high velocity - high drag flight with a low apogee indicated some structural damage to the vehicle, and since two targets were seen by radar, it is assumed that a section of the nose cone broke off causing telemetry failure. In the second round, No. 207-DELTA, very weak telemetry signals were received from 4 to 30 seconds, probably due to a broken soldered antenna connection, but strong and normal signals from 109 seconds on for over 200 seconds until impact; apparently heating of the separated antenna connection repaired it. Although the Langmuir probe data received after 109 seconds were noise free they were not usable since the amplifier was saturated indicating a low resistance between the probe tip and the projectile body; this was possibly due to a charred or contaminated insulator section. The third BML shot, No. 213-KAPPA, was identical to the DELTA round except that a Martlet 2C (Mod 3) vehicle was used and no TMA was flown. The trajectory was successful but no telemetry signals were received; it is assumed that a partial loosening of the nose cone caused a failure of the antenna connection.

A summary of the flight results of these Martlet 2C rounds is given in Table III.

3.3 Test Slug Rounds

Ten test slugs were fired during the period of the report to test the performance of gun, propellant, and a sabot model. One of these ten rounds, No. 229, had a special task to simulate the weight and charge of the prototype Martlet 2G-1B, and to test the instrumentation to be employed in the following round.

TABLE III

MARTLET 2C - SOFAR AND TELEMETRY TEST FIRINGS

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
182 CUBA 18 Feb 66 1101 AST QE 80 DEG	Martlet 2C (Mod 2) with Aluminum sabot, carrying a 4 lb SOFAR impact device	W_v: 180.0 W_s: 370.5 C: 920.0 (M8M.27)	RD: 218 in RL: 20 tons ChV: 46,300 in^3 Rec: 39.5 in BE: 27 in Hg	St: 37,500 M11: 37,000	EP: - WF: 5400	R: 110,500 (33.6)	Unsuccessful shot; Low apogee flight of damaged vehicle.
198 ELEUTHERA 25 Feb 66 1420 AST QE 80 DEG	Martlet 2C (Mod 2) carrying a 4 lb SOFAR impact device	W_v: 186.0 W_s: 409.8 C: 875.0 (WMM.225)	RD: 223 in RL: 10 tons ChV: 47,250 in^3 Rec: 38 in BE: No	St: - M11: 53,500	EP: - WF: 6100 R: (6100)	R: 420,000 (128)	Successful trajectory but impact device did not function.
227 BANGOR 22 Mar 67 1315 AST QE 85 DEG	Martlet 2C (Mod 2) with a CDC telemetry package	W_v: 185.0 W_s: 417.5 C: 1110.0 (PYRO)	RD: 187.5 in RL: 18 tons ChV: 39,850 in^3 Rec: 40 in BE: No	St: - M11: 27,700	EP: - R: (4700)	R: 232,000 (71)	Successful round.
228 DONAGHADEE 25 Mar 67 1030 AST QE 85 DEG	Martlet 2C (Mod 2) with a CDC telemetry package	W_v: 185 W_s: 417 C: 660 (PYRO)	RD: 187.5 in RL: 14 tons ChV: 39,850 in^3 Rec: 27 in BE: No	St: 9,000 M11: 9,000	EP: - R:	R: 97,000 (29.6)	Successful round.

TABLE III (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
190 ST. LUCIA 23 Feb 66 2203 AST QE 85 DEG	Martlet 2C (Mod 2) carrying 5.0 LB TMA and an HDL telemetry nose cone	W_v: 184.0 W_s: 407.8 C: 975.0 (M8M.27)	RD: 222 in RL: 28 tons ChV: 47,200 in^3 Rec: 42 in BE: 27 in Hg	St: 45,000 M11: 43,500	EP: -	R: 383,000 (117)	Successful regarding TMA trail and wind data but telemetry failed
200 DONNA 15 Aug 66 1933 AST QE 80 DEG	Martlet 2C (Mod 2) carrying an SRI telemetry package and 5.5 lb TMA	W_v: 187.0 W_s: 413.5 C: 700/165 (PYRO/M6.056)	RD: 188 in RL: 40 tons ChV: 39,650 in^3 Rec: 35 in BE: 27 in Hg	St: - M11: 38,200	EP: - R: (4700)	R: 229,000 (70)	Low apogee trajectory, therefore no trail, Telemetry not satisfactory
204 ALPHA 19 Sep 66 1839 AST QE 85 DEG	Martlet 2C (Mod 2) carrying a BML telemetry package with a Langmuir Probe and 5.5 lb TMA	W_v: 186 W_s: 412 C: 825 (WMM.225)	RD: 188.0 in RL: 28.0 tons ChV: 39,950 in^3 Rec: 38.5 in BE: 26 in Hg	St: 52,300 M11:53,500	EP: 6600 R: (5300)	R: 300,000 (91)	High drag flight indicating vehicle damage. No telemetry signal, very faint trail
204 DELTA 20 SEp 66 0010:20 AST QE 85 DEG	Martlet 2C (Mod 2) carrying a BML Langmuir Probe with a telemetry unit and 5.5 lb TMA	W_v: 186 W_s: 409 C: 780 (WMM.225)	RD: 188 in RL: 32 tons ChV: 39,950 in^3 Rec: 32 in BE: 27 in Hg	St: - M11: 45,200	EP: 5980 R: (6000)	R: 390,000 (119)	Successful shot, good trail and wind data. No usable electron density data obtained
213 KAPPA 20 Sep 66 2255 AST QE 85 DEG	Martlet 2C (Mod 3) with Langmuir Probe	W_v: 171 W_s: 395 C: 780 (WMM.225)	RD: 194 in. RL: 14 tons ChV: 41,220 in^3 Rec: 36.5 in BE: 23 in Hg	St: 34,900 M11: 34,770	EP: 5700 R: (5700)	R: 357,000 (109)	Successful trajectory but telemetry failure.

W_v: Vehicle Weight
W_s: Shot Weight
C: Charge Weight

RD: Ram Distance
RL: Ram Load
ChV: Chamber Volume
Rec: Recoil
BE: Bore Evacuation

St: Strain Gauge
M11: Crusher Gauge
R: Radar

EP: Electrical Probe
WF: West Fastax
R: Radar (muzzle velocity of equivalent standard drag trajectory)

All these rounds gave satisfactory results with the exception of No. 216. In this round a wood slug was fired for seating of the obturator seals only, but the slug was disintegrated in the barrel. The first round of the period reported upon, No. 180-ANTIGUA, was an aluminum body, lead-filled, without fins, to test an aluminum sabot. The remaining eight slug rounds had the purpose of gun (liner, sleeve, welds) and propellant testing. The slug of No. 183-MURPHIUS, was a Martlet 2C wooden model launched with an aluminum pusher plate; the model was recovered, and fired again in Round No. 187, surviving also the second firing. In three rounds, Nos. 185, 186, and 197, laminate wood slugs with aluminum ends were used, and in two further rounds solid wood cylinders with attached pusher plates were fired to test the performance of the propellant, a new gun sleeve, and the durability of the welds in the chamber.

A summary of the flight results of all slug rounds is given in Table IV.

3.4 Martlet 2D Firings

The Martlet 2D was originally designed as a scaled-up version of the Martlet 2C to double the TMA payload capacity, and the first model was launched in March 1965. Since it was decided to replace this model by the Martlet 2G, two still available models were used in the report period for structural tests. One round, No. 184-DOMINICA, fired in February 1966, had the same body as the prototype, only the fin configuration was changed (Fig. 1.2a), and an aluminum sabot was used. In this round, however, which also had the purpose of testing the gun liner (see Section 2.0), the vehicle failed at launch, and the liner came out entirely. For the second round, No. 234-ACCRA, in June 1967, the body shape was changed, providing for a cylindrical instead of a tapered

TABLE IV

TEST SLUG FIRINGS

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
180 ANTIGUA 17 Feb 66 1334 AST QE 85 DEG	Martlet 2C Slug with aluminum sabot No payload	W_v: 183.0 W_s: 373.5 C: 900/20 (M8M.27/WM.048)	RD: 215 in RL: 20 tons ChV: 45,700 in^3 Rec: 39.5 in BE: No	St: 46,500 M11: 48,100	EP: - WF: 5900	R: -	Successful engineering test, slug launched intact
183 MURPHIUS 20 Feb 66 1751 AST QE 80 DEG	Martlet 2C Slug (wooden M2C model) with a wooden sabot and aluminum pusher plate. No payload	W_v: 25.0 W_s: 232.0 C: 337.5 (PYRO)	RD: 192 in RL: 40 tons ChV: 40,800 in^3 Rec: 2.0 in BE: No	St: - M11: 11,000	EP: -	R: -	Successful engineering test. Slug recovered.
185 WOOD TEST SLUG #1 21 Feb 66 1543 AST QE 80 DEG	Laminate Wood Slug with aluminum ends. No payload.	W_v: 394.0 W_s: 394.0 C: 800.0 (WMM.225)	RD: 206 in RL: 40 tons ChV: 43,800 in^3 Rec: 36 in BE: No	St: - M11: 38,000	EP: -	R: -	Successful gun and propellant test. Slug launched intact.

W_v: Vehicle Weight
W_s: Shot Weight
C: Charge Weight

RD: Ram Distance
RL: Ram Load
ChV: Chamber Volume
Rec: Recoil
BE: Bore Evacuation

St: Strain Gauge
M11: Crusher Gauge
R: Radar

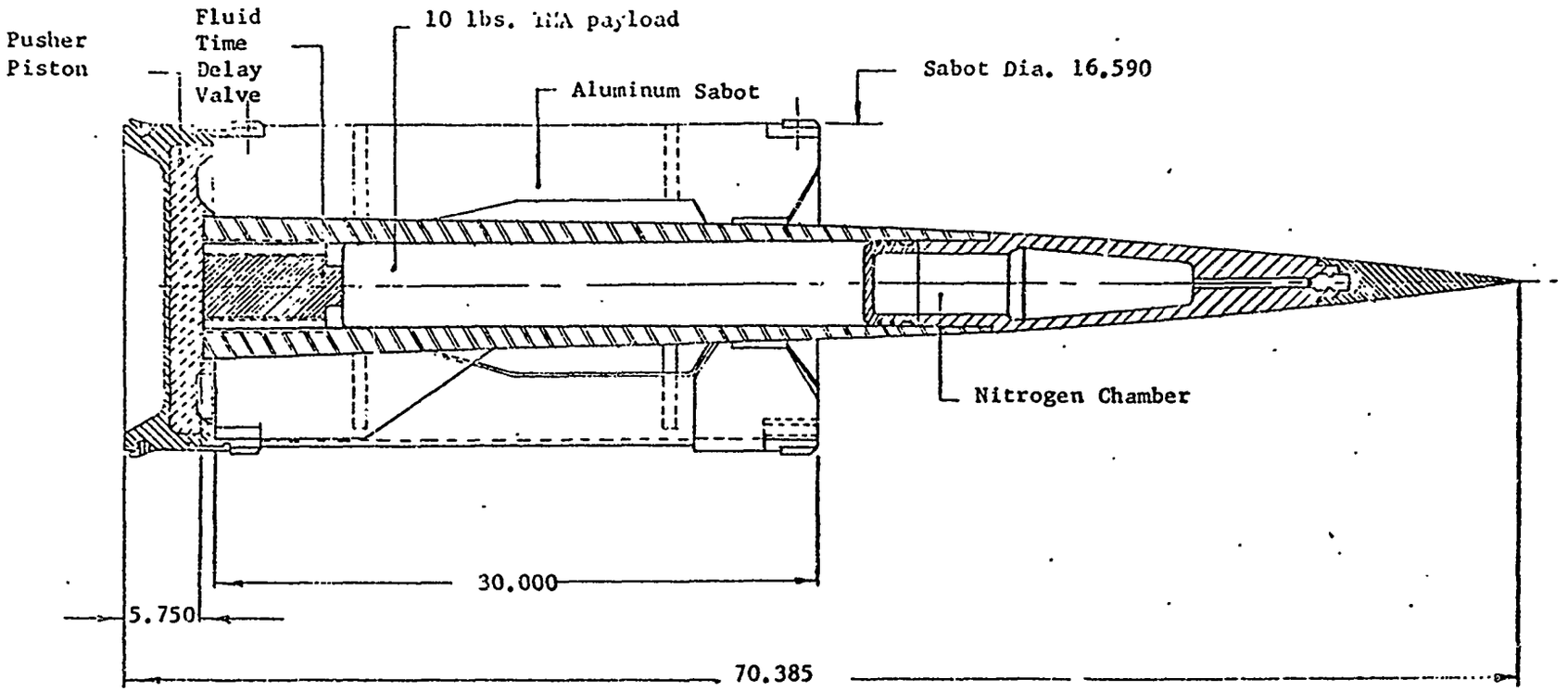
EP: Electrical Probe
WF: West Fastax

TABLE IV (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
186 WOOD TEST SLUG #2 21 Feb 66 1705 AST QE 80 DEG	Laminate Wood slug with aluminum ends. No payload.	W_v: 390 W_s: 390 C: 875 (WMM.225)	RD: 208.5 in RL: 40 tons ChV: 44,300 in^3 Rec: 36 in BE: No	St: 48,300 M11: 47,600	EP: - WF: 6100	R: -	Successful gun and propellant test. Slug launched intact.
187 WOOD TEST SLUG #3 22 Feb 66 1300 AST QE 80 DEG	Recovered Martlet 2C Model of Round 183 with wooden sabot and aluminum pusher plate. No payload	W_v: 25.0 W_s: 220.5 C: 560.0 (PYRO)	RD: 223.5 in RL: 6.0 $tons_3$ ChV: 47,500 in^3 Rec: 7.5 in BE: No	St: 6,000 M11: 6,000	EP: -	R: -	Successful shot. The vehicle was again recovered.
197 WOOD TEST SLUG #4 25 Feb 66 1204 AST QE 80 DEG	Laminate Wood slug with aluminum ends. No payload.	W_v: 413.5 W_s: 413.5 C: 787.5/100 (PYRO/WM.048)	RD: 224 in RL: 90 tons ChV: 47,500 in^3 Rec: 32 in BE: No	St: - M11: 34,500	EP: -	R: -	Successful as propellant test.

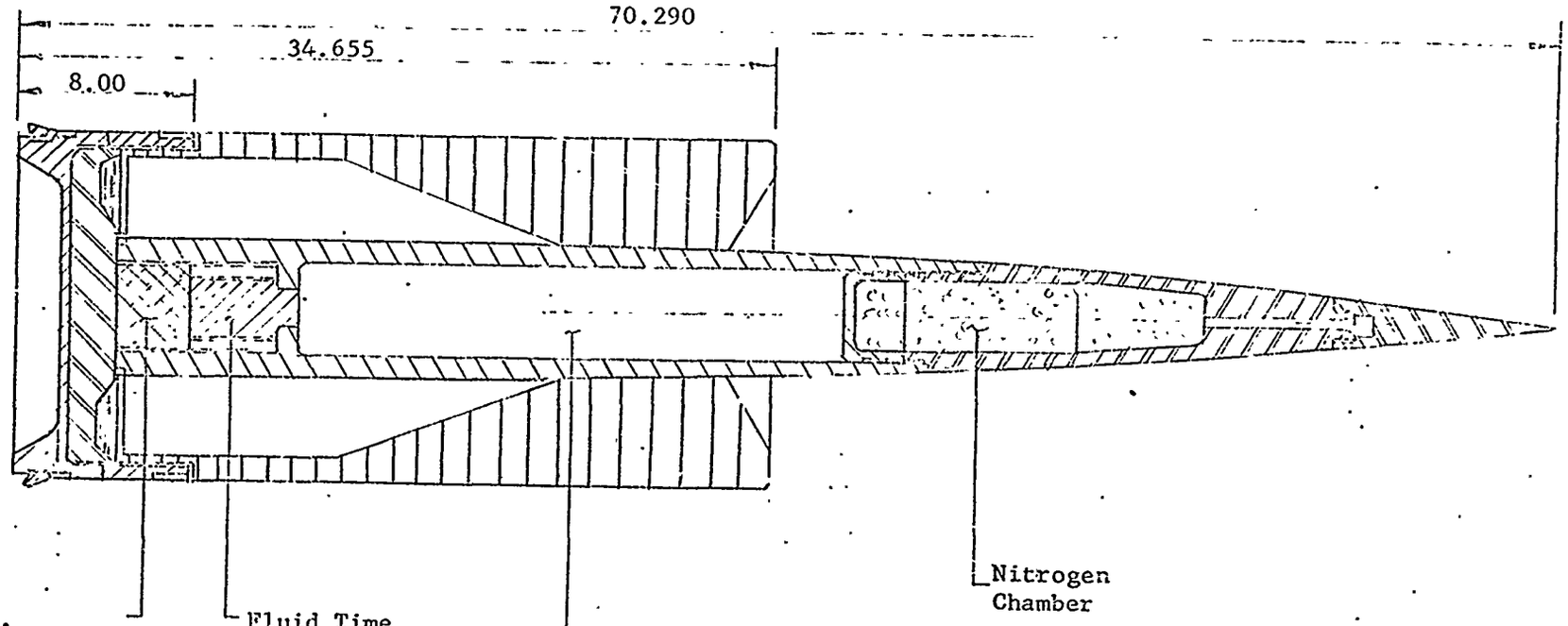
TABLE IV (Cont'd)

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
201 TEST SLUG 16 Aug 66 1235 AST QE 80 DEG	Solid Wood Cylinder with attached pusher plate. No payload	W_v: 410.5 W_s: 410.5 C: 706.5/180 (PYRO/M6.056)	RD: 188 in RL: 30 tons ChV: 39,950 in^3 Rec: 36 in BE: 27 in Hg	St: - M11: 58,300	EP: -	R: -	Successful as test of gun and propellant.
203 TEST SLUG 25 Aug 66 1303 AST QE 80 DEG	Wood Slug with attached pusher plate.	W_v: 432.0 W_s: 432.0 C: 706.5/180 (PYRO/M6.056)	RD: 188 in RL: 5 tons ChV: 39,950 in^3 Rec: 37 in BE: No	St: - M11: 67,300	EP: -	R: -	Successful test of gun.
216 TEST SLUG 18 Jan 67 1500 AST QE 80 DEG	Wood Slug. No payload	W_v: 350.0 W_s: 350.0 C: 550.0 (PYRO)	RD: 189 in RL: 12.5 tons ChV: 40,150 in^3 Rec: 14 in BE: No	St: 8,000 M11: -	EP: -	R: -	Slug disintegrated in barrel.
229 TEST SLUG 25 23 May 67 1227 AST QE 80 DEG	Metal Test Slug Simulation of Weight and charge for Martlet 2G-1 round	W_v: 1545.0 W_s: 1545.0 C: 1120 (PYRO)	RD: 221 in RL: 12 tons ChV: 46,900 in^3 Rec: 46.75 in BE: 27 in Hg	St: - M11: 39,100	EP: 3,750	R: 30,600 (9.3)	Satisfactory launch performance and trajectory. Some shortcomings of measuring equipment



MATERIALS: Body, Nose Cone, Nose Tip and Fin Nut - AISI 4340 Rc, 43-46
Tail Fins, Piston, and Pusher Plate Skirt - Alum. 7075 - T6
Pusher Plate Crown - AISI 4340
Pusher Plate Insert - Plywood
Sabot - Alum. 2014-T6

FIG. 1.2a MARTLET 2D



(8) Pusher Plate Crown - AISI 4340
(9) Pusher Plate Adapter - AISI 1020
(10) Pusher Plate Insert - Plywood
(11) Obturator
(12) Sabot - Plywood

MATERIALS - (1) Body - AISI 4340 R.C. 43-46
(2) Nose Cone - AISI 4340 R.C. 43-
(3) Nose Tip - " " " 46
(4) Tail Fins - Alum 75S T 6
(5) Piston - Alum 75S T6
(6) Fin Nut - AISI 4340 R.C. 43-46
(7) Pusher Plate Skirt - Alum - 75S T6

FIG. 1.2b MARTLET 2D (MOD 1)

afterbody section in the fin region (Fig. 1.2b). The payload was a 10 lb. payload of TMA with puff-puff release. The release valve operated satisfactorily throughout the flight; the apogee, however, was not high enough for the usual trail. The high drag trajectory could be explained by a broken fin which was later discovered in the launch area.

A summary of the flight results of these two rounds is given in Table V.

3.5 Martlet 2G Firings

The Martlet 2G was designed to replace the Martlet 2D by providing even more TMA capacity, i.e. up to 28.5 lb which is about five times the capacity of the Martlet 2C. The diameter of the cylindrical centre section is 7 inches; the afterbody boattail has a base diameter of 5 inches, and the total length of the vehicle attains 89.5 inches (Fig. 1.3). The vehicle is designed for a centre sabot 18.5 inches long with a diameter of 16.6 inches.

Three Martlet 2G structural test vehicles (Fig. 1.3) were fired in the report period, all with the same external dimensions but with some structural changes from one vehicle to the other. The first of the three rounds, No. 202-FERNANDE, carrying a 25 lb TMA payload, had an aluminum sabot with modified American Standard buttress grooves. In this round, the vehicle apparently suffered severe damage inside the gun and broke up completely. The cause of the failure was attributed to poor charge ignition (single point ignition) which shot the heavy propellant bags against the vehicle boom. The vehicle of the second round, No. 215-INDEPENDENCE 2, was structurally exactly the same as FERNANDE. The aluminum sabot had an American Standard buttress thread instead of grooves as in No. 202, and the lightening holes were drilled rather than milled, to reduce the manufacturing cost. The vehicle

TABLE V

MARTLET 2D FIRINGS

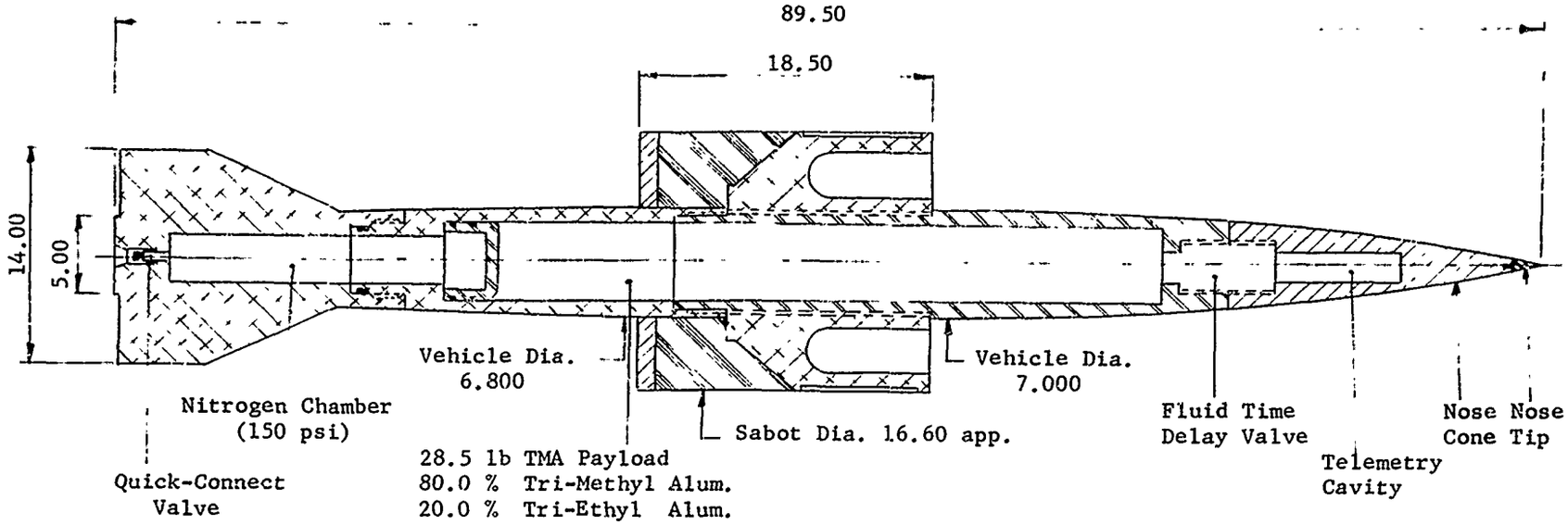
Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
184 DOMINICA 21 Feb 66 1030 AST QE 80 DEG	Martlet 2D with aluminum sabot	W_V: 279.25 W_S: 474.00 C: 900.00 (M8M.27)	RD: 192 in RL: 20 tons ChV: 40,809 in^3 Rec: 41 in BE: No	St: - M11: 43,500	EP: -	R: -	The vehicle failed at launch. The experimental gun liner came out entirely.
234 ACCRA 21 June 67 1900 AST QE 80 DEG	Martlet 2D carrying 10 lb of TMA with puff-puff release	W_V: 227.0 W_S: 464.0 C: 800.0 (M8M.22)	RD: 186.5 in RL: 18 tons ChV: 39,600 in^3 Rec: 39 in BE: 27 in Hg	St: - M11: 40,000	EP: 5,500	R: 73,600 (224)	High drag flight, low apogee. Puff-puff system operated, but too low for trail.

W_V: Vehicle Weight
W_S: Shot Weight
C: Charge Weight

RD: Ram Distance
RL: Ram Load
ChV: Chamber Volume
Rec: Recoil
BE: Bore Evacuation

St: Strain Gauge
M11: Crusher Gauge
R: Radar

EP: Electrical Probe



Materials: (1) Nose Tip-AISI 4340 Rc 40
(2) Nose Cone-Alum 7075 T6
(3) Body-AISI 4340 Rc 40
(4) Boom-Alum 7075 T6 x)
(5) Tailfin Body-Alum 7075 T6
(6) Piston-Alum 7075 T6
(7) Centre Sabot-Alum 7075 T6
Polycarbonate
Polyethylene

x) AISI-4340 Rc 43 in Round 226

FIG. 1.3 MARTLET 2G

carried a dummy payload of kerosene. This round was again not successful; smear photographs indicated a failure at the vehicle boom. For this reason, the boom material was changed to AISI 4340 R_c 43 to increase the boom strength, and the lightening holes in the aluminum sabot were filled with 7075 T-6 aluminum pipe to reduce the radial stresses, thus increasing the vehicle and sabot weight. With these changes, Round No. 226 - SHANKILL, carrying a kerosene payload and a dummy release valve was successful with a perfect trajectory.

A summary of the flight results is given in Table VI.

3.6 Martlet 2G-1 Firing

The Martlet 2G-1 was designed as a multistage vehicle, carrying rockets to obtain higher apogees or to put a payload into orbit. The first vehicle launched in Barbados was the Configuration "B", a cone-cylinder-boattail configuration with a maximum body diameter of 11.32 in, a total length of 178 in, and a fin span of 16.68 in (Fig. 1.4). A center sabot 34 in. long was used. The vehicle carried a dummy rocket, and within the dummy nozzle of the rocket a radar chaff package. At the forward end of the single stage rocket a payload canister was bolted, identical to those intended to be used in the live rocket flights. The rocket including nozzle and payload was supported within the vehicle by immersion in a liquid, a solution of zinc-bromide and water. A BRL 1750 MHz transmitter was installed at the aft end of the stabilizer boom. The payload canister contained, among other vehicle system elements, the 250 MHz telemetry package.

The round was preceded by a successful firing of a slug intended to test the propellant, ignition system, gun performance, instrumentation, etc. for a shot weight of the Martlet 2G-1 magnitude (No. 229 - see Section 3.3). The Martlet 2G-1 (Round No. 230 - BRONSON)

TABLE VI

MARTLET 2G FIRINGS

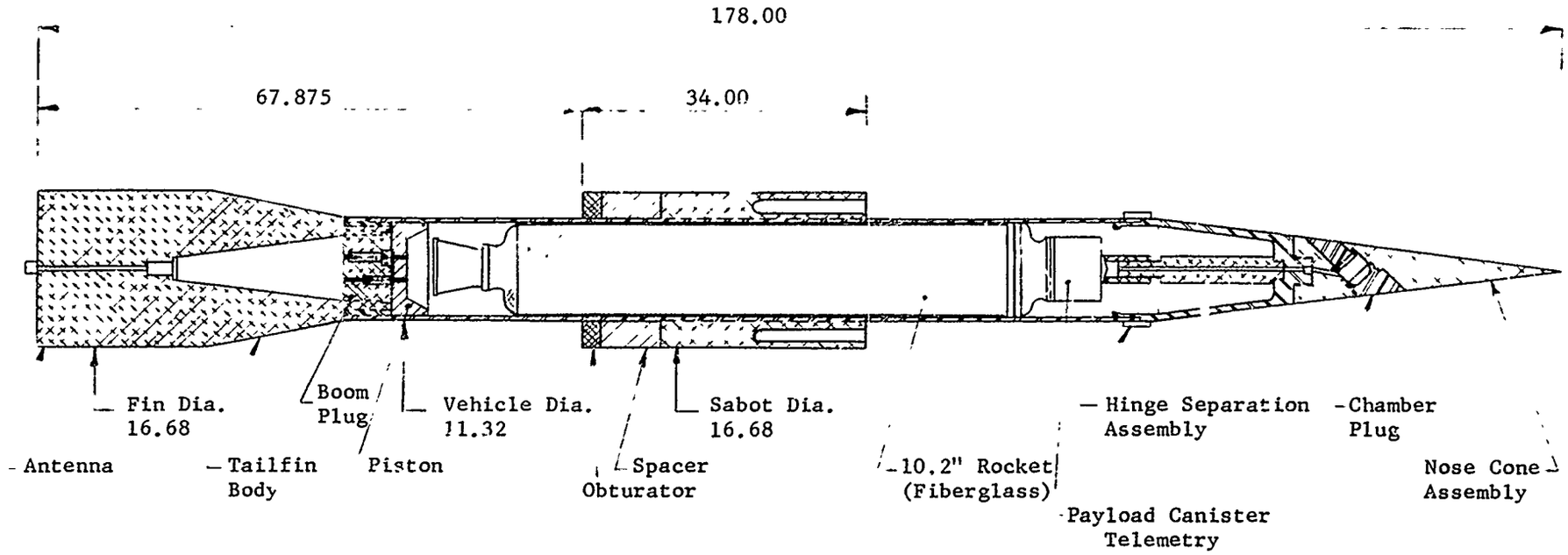
Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
202 FERNANDE 17 Aug 66 0522 AST QE 80 DEG	Martlet 2G carrying a payload of TMA with delay release mechanism	W_v: 281.5 W_s: 468.0 C: 500.0 (WM.245)	RD: 188 in RL: 24 tons ChV: 39,950 in^3 Rec: 29.5 in BE: No	St: - M11: 33,600	EP: 5140	R: -	Unsuccessful. Failure of vehicle in gun assumed.
215 INDEPENDENCE 2 14 Dec 66 1709 AST QE 85 DEG	Martlet 2G vehicle without payload	W_v: W_s: 475 C: 800 (WMM.225)	RD: 184 in RL: 100 tons ChV: 39,100 in^3 Rec: 42 in BE: No	St: 45,000 M11: -	EP: -	R: 11,000 (3.4)	Unsuccessful. Structural failure in rear vehicle section.
226 SHANKILL 17 Feb 1645 AST QE 80 DEG	Martlet 2G carrying a kerosene payload and a dummy release valve but no piston.	W_v: 333.0 W_s: 546.5 C: 775.0 (WMM.225)	RD: 188 in RL: 18 tons ChV: 39,950 in^3 Rec: 39 in BE: No	St: 32,000 M11: 31,800	EP: 5200	R: 228,700 (70)	Successful round; perfect flight of vehicle.

W_v: Vehicle Weight
W_s: Shot Weight
C: Charge Weight

RD: Ram Distance
RL: Ram Load
ChV: Chamber Volume
Rec: Recoil
BE: Bore Evacuation

St: Strain Gauge
M11: Crusher Gauge
R: Radar

EP: Electrical Probe



Materials: (1) Nose Cone-Alum 7075 T6
(2) Nose Cone Base-AISI 4340
(3) Body-AISI 4140
(4) Tailfin Body-Alum 7075 T6
(5) Piston-Lexan
(6) Centre Sabot-Alum 7075 T6
(7) Spacer-Lexan
(8) Obturator-Polyethylene

FIG. 1.4 MARTLET 2G1-B1

was launched five days later, on the 28th of May, 1967. In this round, however, the breech pressure of 47,000 psi was higher by 30% than that of the slug shot, and this probably resulted in launch stresses that exceeded the strength limitations of the body section in the region of the sabot. A breakup of the vehicle followed, apparently already in the gun although the gun was found to be undamaged.

A flight result summary of this round is given in Table VII. For a detailed "Post-Launch Report", see Ref. 9.

3.7 Lahive Test Rounds

The Low-Altitude, High-Velocity Experiments (Lahive) Program was initiated by the U.S. Army to obtain data necessary for a proper design of vehicles operating in the low-altitude, high-velocity regime. The test vehicles developed for these experiments were 10 degree and 15 degree cones, and bodies with a 15 degree flare, all with a base diameter of 14 inches (Fig. 1.5). A number of structural test firings had taken place at the horizontal Highwater range. Three further structural and test flights were made during the report period at Barbados with a launch elevation of 80 degrees. In Round No. 231 - BANNOCK, the Lahive flare body was launched; in the following two rounds, No. 232 - CAMERON and No. 233 - DUNOON, the 15 degree and 10 degree cones were tested. All three rounds were successfully launched; velocities over the first 150 ft of the trajectory as evaluated from the camera records were 6000, 6820, and 5560 ft/sec. The last round's low velocity, in spite of higher breech pressure, and the recovered pusher plate which was buckled and gas washed, possibly indicated a failure of the pyrotechnic payload of this round, causing some flight disturbance.

A summary of the flight results is given in Table VIII.

TABLE VII

MARTLET 2G-1 FIRING

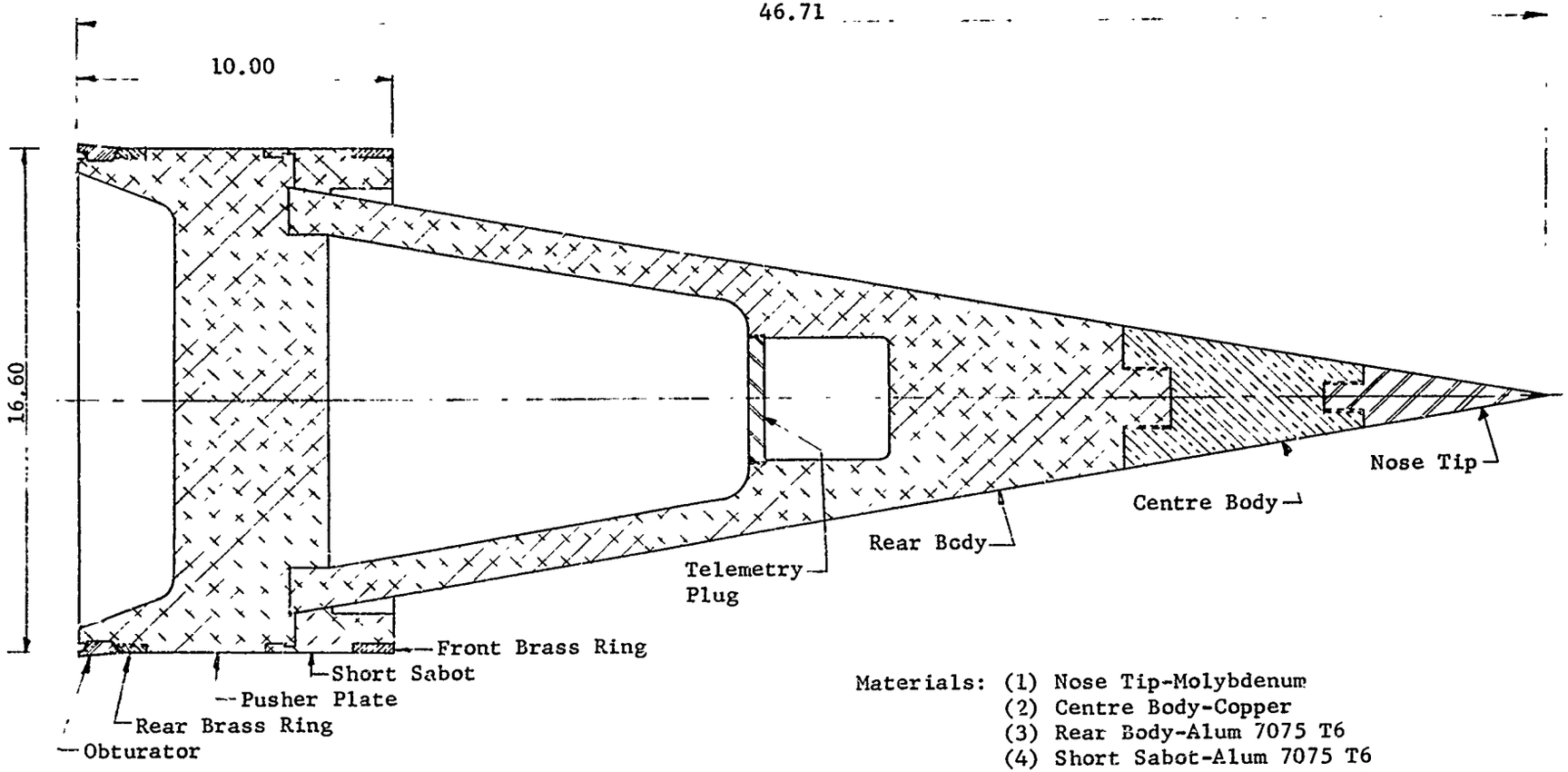
Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
230 BRONSON 28 May 67 1703 AST QE 80 DEG	Prototype Martlet 2G1 Series B configuration carrying a dummy rocket and BRL/SRI telemetry equipment.	W_v: 859 W_s: 1636 C: 1120 (PYRO)	RD: 260 in RL: 40 tons ChV: - Rec: 47.75 in BE: 26 in Hg	St: - Mil: 47,170	EP: -	R: -	Launch stresses due to high breech pressure apparently exceeded strength limitations, resulting in break-up of vehicle.

W_v: Vehicle Weight
W_s: Shot Weight
C: Charge Weight

RD: Ram Distance
RL: Ram Load
ChV: Chamber Volume
Rec: Recoil
BE: Bore Evacuation

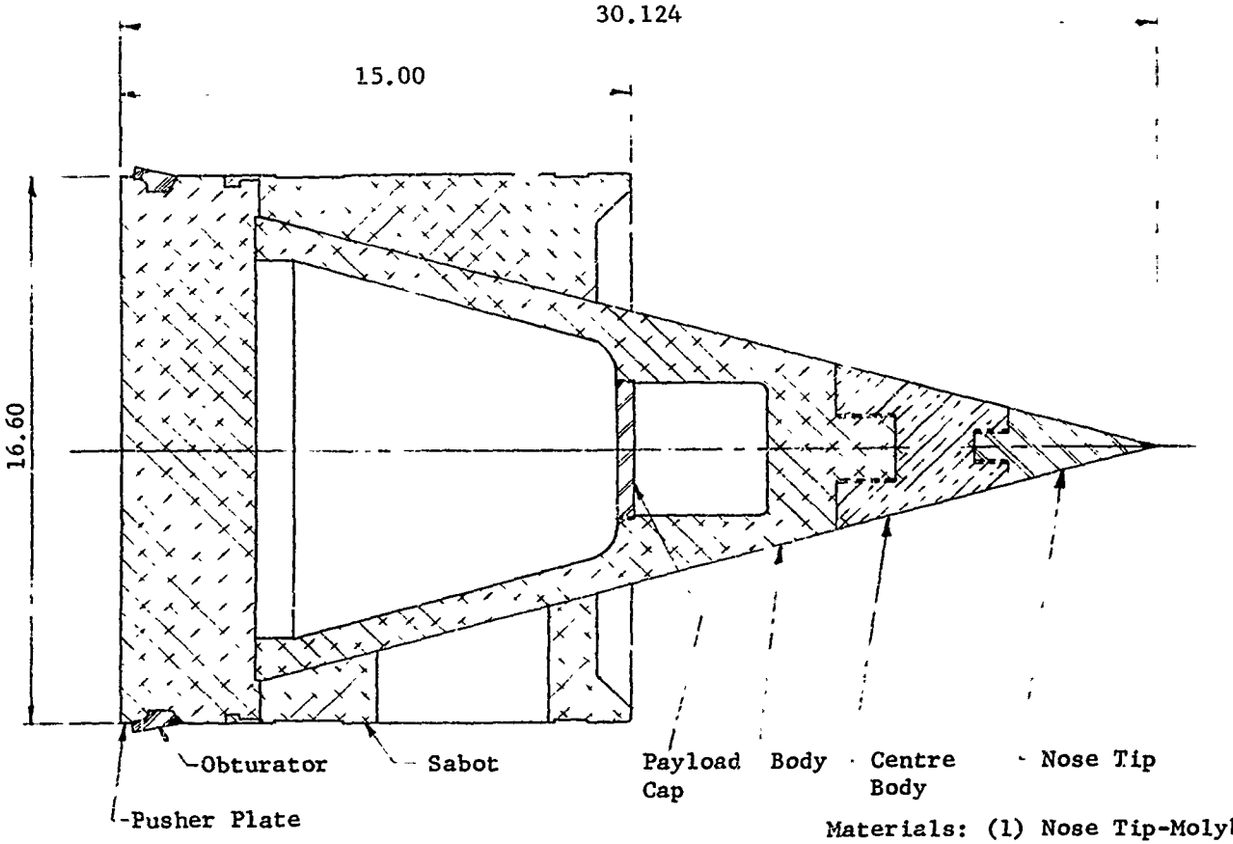
St: Strain Gauge
Mil: Crusher Gauge
R: Radar

EP: Electrical Probe



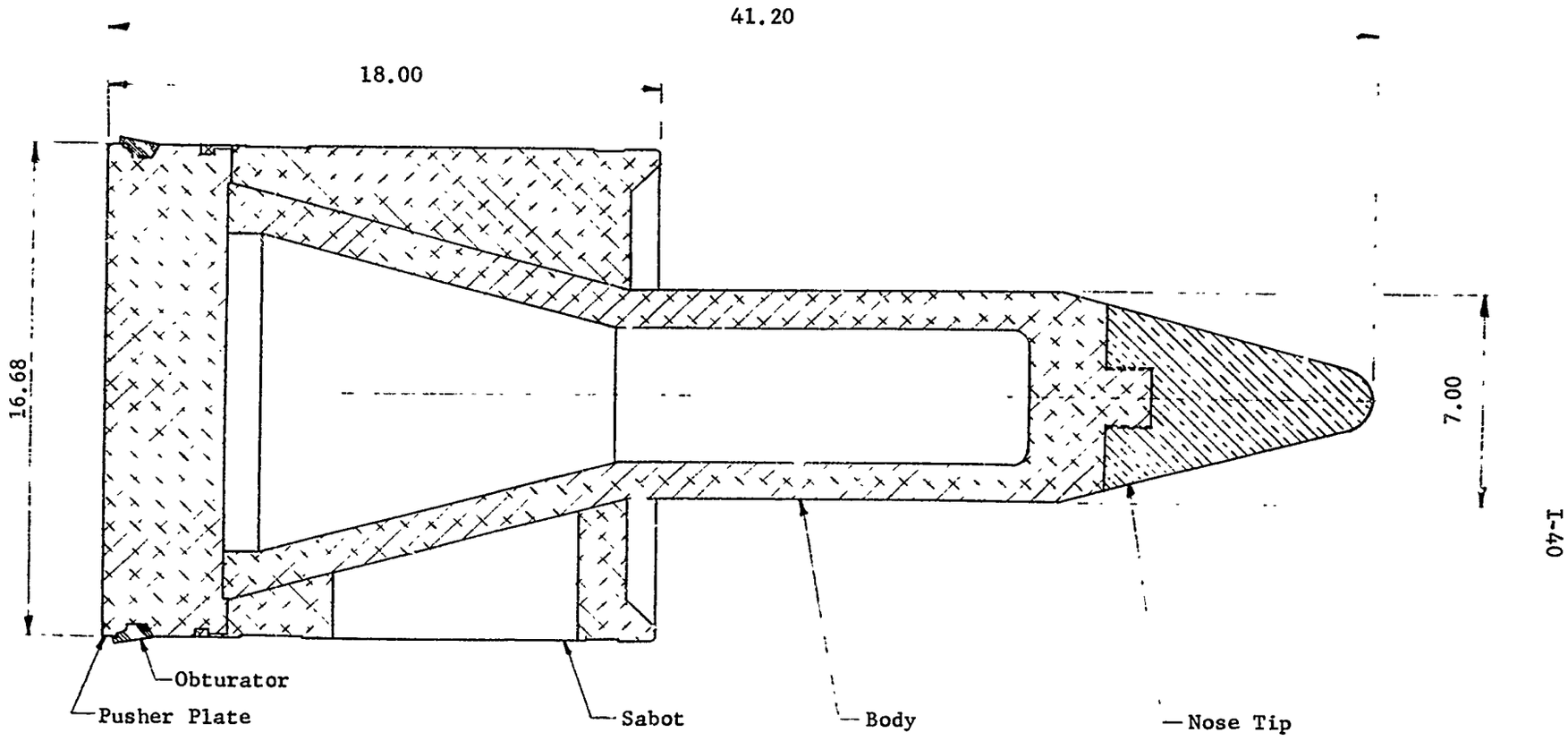
Materials:
(1) Nose Tip-Molybdenum
(2) Centre Body-Copper
(3) Rear Body-Alum 7075 T6
(4) Short Sabot-Alum 7075 T6
(5) Telemetry Plug-AISI 1010
(6) Front Brass Ring-ASTM AI 45-Grad B
(7) Rear Brass Ring-ASTM AI 45-Grad B
(8) Pusher Plate-Alum 7075 T6
(9) Obturator-Rubber

FIG. 1.5a 10 DEG LAHIVE CONE



Materials: (1) Nose Tip-Molybdenum
(2) Centre Body-Copper
(3) Body-Alum 7075 T6
(4) Sabot-Alum 7075 T6
(5) Payload Cap-AISI 1010
(6) Pusher Plate-Alum 7075 T6
(7) Obturator-Rubber

FIG. 1.5b 15 DEG LAHIVE CONE



Materials: (1) Nose Tip-Copper
(2) Body-Alum 7075 T6
(3) Sabot-Alum 7075 T6
(4) Pusher Plate-Alum 7075 T6
(5) Obturator-Rubber

FIG. 1.5c LAHIVE FLARE BODY

TABLE VIII

LAHIVE FIRINGS

Flight	Vehicle Description	Weight (LB)	Launch Data	Breech Pressure (psi)	Muzzle Velocity (ft/sec)	Apogee ft(km)	Comments
231 BANNOCK 30 May 67 1040 AST QE 80 DEG	LAHIVE FLARE BODY	W_v: 127 W_s: 319 C: 885 (M8M.22)	RD: 188 in RL: 18 tons ChV: 39,950 in^3 Rec: 39.5 in BE: No	St: 38,000 M11: 39,630	EP: Spurious readings. WF: 6000	R: -	Successful round.
232 CAMERON 30 May 67 1350 AST QE 80 DEG	LAHIVE 15 DEG CONE	W_v: 71 W_s: 224 C: 970 (M8M.22)	RD: 189 in RL: 9 tons ChV: 40,150 in^3 Rec: 39.75 in BE: No	St: 41,000 M11: 41,300	EP: Sp rious readings WF: 6820	R: 17,500 (5,3)	Successful round.
233 DUNOON 30 May 67 1626 AST QE 80 DEG	LAHIVE 10 DEG CONE with a short sabot and carrying a pyrotechnic payload.	W_v: 121.0 W_s: 270.5 C: 1000 (M8M.22)	RD: 188.5 in RL: 18 tons ChV: 40,050 in^3 Rec: 41.75 in BE: 25 in Hg	St: pre-triggered M11: 46,100	EP: pre-tr ggered WF: 5560	R: -	Indications that pyrotechnic payload failed in the gun.

W_v: Vehicle Weight
W_s: Shot Weight
C: Charge Weight

RD: Ram Distance
RL: Ram Load
ChV: Chamber Volume
Rec: Recoil
BE: Bore Evacuation

St: Strain Gauge
M11: Crusher Gauge
R: Radar

EP: Electrical Probe
WF: West Fastax

4.0 RESULTS

4.1 Gun and Propellant Ballistic Performance

The maximum breech pressures measured by crusher gauges and a strain gauge are given in Table IX for all 59 rounds. The agreement between strain gauge and crusher gauge data is satisfactory, with the exception of the last four rounds in the June 1967 series; the strain gauge data which are considerably lower than the crusher gauge results are probably not reliable owing to incorrect calibration. Muzzle velocities obtained by electrical probes are also included in Table IX and compared with the velocity data of the equivalent standard drag trajectories and the results of the photographs.[x)]

In most of the rounds spacers were used between the charge bags, unless the charge was so large that it filled the chamber completely. This method of loading had the advantage of giving a very smooth pressure-time curve; the effect on the pressure-muzzle velocity relation was insignificant.

From December 1966 on, Round No. 214, the multipoint ignition method was employed, reducing the maximum pressure considerably but increasing the muzzle velocity at the same pressure (Ref. 10). In most of the rounds with multipoint ignition, Pyro propellant was used. Test data are shown in Fig. 1.6 in comparison with the standard muzzle vel-

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x) In Table IX only the West Fastax results are included. The East Fastax films gave, on the average, muzzle velocities approximately 300 ft/sec higher than the West Fastax data. This discrepancy may be related to the timing system for the cameras: the reported framing rates of East Fastax were always higher than those of West Fastax. The West Fastax data, however, are considered to be more realistic as they agree better with the muzzle probe data where available.

TABLE IX

1966-1967 SERIES: MAXIMUM BREECH PRESSURES AND MUZZLE VELOCITIES

Round No.	Name	Vehicle Martlet	Shot Weight (lb)	Charge Weight (lb)	Propellant	Gun Evacuated	Chamber Volume (in^3)	Ram Load (tons)	Breech Pressure-psi M11	Breech Pressure-psi Strain	Muzzle Vel.ft/sec Probe	Muzzle Vel.ft/sec Cameras	"Radar"x)
180	ANTIGUA	2C Slug	373.5	900/20	M&M.27/WM.048	No	45,700	20	48,100	46,500	-	5900	-
181	INAUGUA	2C Mod 2	409.8	900/20	M&M.27/WM.048	No	47,200	20	50,000	50,000	-		5900
182	CUBA	2C Mod 2	370.5	920	M&M.27	Yes	46,300	20	37,000	37,500	-	5400	-
183	MURPHIUS	2C Slug	232.0	338	PYRO	No	40,800	40	11,000	-	-		-
184	DOMINICA	2D	474.0	900	M&M.27	No	40,800	20	43,500	-	-		-
185	TS 1	Wood Slug	394.0	800	WMM.225	No	43,800	40	38,000	-	-	5600	-
186	TS 2	Wood Slug	390.0	875	WMM.225	No	44,300	40	47,600	48,300	-	6100	-
187	TS 3	Wood Slug	220.5	560	PYRO	No	47,500	6	6,000	6,000	-		-
188	JAMAICA	2C Mod 2	409.3	930	M&M.27	No	47,200	20	40,000	42,000	-		5800
189	ST. KITTS	2C Mod 2	408.8	970	M&M.27	Yes	47,200	28	44,700	45,000	-		6100
190	ST. LUCIA	2C Mod 2	407.8	975	M&M.27	Yes	47,200	28	43,500	45,000	-		5800
191	MONTSERRAT	2C Mod 2	407.8	975	M&M.27	Yes	47,500	19	41,750	45,000	-		6100
192	NEVIS	2C Mod 2	410.3	975	M&M.27/.22	Yes	47,200	20	49,000	50,000	-		6300
193	OCHO RIOS	2C Mod 2	410.3	965	M&M.27/.22	Yes	47,200	14	53,500	53,000	-		-
194	PUERTO RICO	2C Mod 2	409.3	850	WMM.225	Yes	47,600	14	54,000	53,000	-		5900
195	LA RAIZET	2C Mod 2	413.3	850	WMM.225	Yes	47,800	12	51,500	-	-		6100
196	ST. THOMAS	2C Mod 2	408.3	850	WMM.225	No	47,200	18	48,500	-	-		5700
197	TS 4	Wood Slug	413.5	788/100	PYRO/WM.048	No	47,500	90	34,500	-	-		-
198	ELEUTHERA	2C Mod 2	409.8	875	WMM.225	No	47,250	10	53,500	-	-	6100	6100
199	FLAMINGO	2C Mod 2	404.5	875	WMM.225	Yes	47,250	14	56,000	-	-		6200
200	DONNA	2C Mod 2	413.5	700/165	PYRO/M6.056	Yes	39,950	40	38,200	-	-		4700
201	TS	Wood Slug	410.5	707/180	PYRO/M6.056	Yes	39,950	30	58,300	-	-		-
202	FERNANDE	2G	468.0	500	WM.245	No	39,950	24	33,600	-	5140		-
203	TS	Wood Slug	432.0	707/180	PYRO/M6.056	No	39,950	5	67,300	-	-		-

x) Muzzle velocity of equivalent standard drag trajectory

TABLE IX (Cont'd)

Round No.	Name	Vehicle Martlet	Shot Weight (lb)	Charge Weight (lb)	Propellant	Gun Evacuated	Chamber Volume (in^3)	Ram Load (tons)	Breech Pressure-psi M11	Breech Pressure-psi Strain	Muzzle Vel.ft/sec Probe	Muzzle Vel.ft/sec Cameras	"Radar"x)
204	ALPHA	2C Mod 2	412.0	825	WMM.225	Yes	39,950	28	53,500	52,300	6600		5300
205	BETA	2C Mod 2	410.0	825	WMM.225	Yes	40,375	16	53,600	51,500	6550		6000
206	GAMMA	2C Mod 2	412.0	825	WMM.225	Yes	39,950	28	49,800	48,500	6320		6300
207	DELTA	2C Mod 2	409.0	780	WMM.225	Yes	39,950	32	45,200	-	5980		6000
208	EPSILON	2C Mod 2	405.0	825	WMM.225	Yes	40,800	34	47,600	47,000	6470		5000
209	ZETA	2C Mod 2	408.0	825	WMM.225	No	41,220	28	48,100	48,200	-		5800
210	ETA	2C Mod 2	411.0	825	WMM.225	Yes	41,220	24	55,100	54,300	-		5900
211	THETA	2C Mod 2	414.0	825	WMM.225	Yes	41,220	24	55,300	53,800	-		6000
212	IOTA	2C Mod 2	411.0	825	WMM.225	Yes	41,220	8.5	46,350	44,600	-		6000
213	KAPPA	2C Mod 3	395.0	780	WMM.225	Yes	41,220	14	34,770	34,900	5700		5700
214	INDEPENDENCE 1	2C Mod 2	412.5	1280	PYRO	No	39,570	20	42,700	43,000	-		5600
215	INDEPENDENCE 2	2G	475.0	800	WMM.225	No	39,100	100	-	45,000	-		-
216	TS	Wood Slug	350.0	550	PYRO	No	40,150	12.5	-	8,000	-		-
217	ANTRIM	2C Mod 2	413.5	1290	PYRO	Yes	39,700	40	46,400	46,000	-		5750
218	BELFAST	2C Mod 2	418.0	1320	PYRO	Yes	39,700	40	53,500	53,000	-		5900
219	CORK	2C Mod 2	423.5	1330	PYRO	Yes	39,700	40	46,400	47,000	5680		5700
220	DUBLIN	2C Mod 2	419.0	1320	PYRO	Yes	39,700	40	43,600	42,500	5490		5700
221	GARVAGH	2C Mod 2	417.0	1320	PYRO	Yes	39,700	40	44,300	44,000	5710		5800
222	HOLLYWOOD	2C Mod 2	420.5	1320	PYRO	Yes	39,700	40	47,000	46,000	5730		5700
223	KERRY	2C Mod 2	422.5	1330	PYRO	Yes	39,700	18	46,600	46,000	-		5700
224	LIMERICK	2C Mod 2	418.5	1340	PYRO	No	39,700	22	48,300	47,000	-		5700
225	NEWRY	2C Mod 2	422.5	1350	PYRO	No	39,700	18	51,600	52,000	-		5800
226	SHANKILL	2G	546.5	775	WMM.225	No	39,950	18	31,800	32,000	5200		-

x) Muzzle velocity of equivalent standard drag trajectory

TABLE IX (Cont'd)

Round No.	Name	Vehicle Martlet	Shot Weight (lb)	Charge Weight (lb)	Propellant	Gun Evacuated	Chamber Volume (in^3)	Ram Load (tons)	Breech Pressure-psi Mil	Breech Pressure-psi Strain	Muzzle Vel.ft/sec Probe	Muzzle Vel.ft/sec Cameras	Muzzle Vel.ft/sec "Radar"x)
227	BANGOR	2C Mod 2	417.5	1110	PYRO	No	39,850	18	27,700	-	-		4700
228	DONAGHADEE	2C Mod 2	417.0	660	PYRO	No	39,850	14	9,000	9,000	-		-
229	TS No. 25	METAL TS	1545.0	1120	PYRO	Yes	46,900	12	39,100	-	3750		-
230	BRONSON	2G1-B1	1636.0	1120	PYRO	Yes	-	40	47,200	-	-		-
231	BANNOCK	LAHIVE FLARE	319.0	885	M8M.22	No	39,950	18	39,600	38,000	-	6000	-
232	CAMERON	LAHIVE CONE	224.0	970	M8M.22	No	40,150	9	41,300	41,000	-	6820	-
233	DUNOON	LAHIVE CONE	270.5	1000	M8M.22	Yes	40,050	18	56,100	-	-	5500	-
234	ACCRA	2D	464.0	800	M8M.22	Yes	39,600	18	40,000		5500		-
235	CAIRO	2C Mod 2	418.5	1320	PYRO	Yes	39,700	14	43,100	40,000	-		5600
236	DURBAN	2C Mod 2	418.5	1360	PYRO	Yes	39,700	14	46,700	41,000	5770		5700
237	ENTEBBE	2C Mod 2	415.5	1380	PYRO	Yes	39,700	14	50,900	43,000	-		5900
238	FREETOWN	2C Mod 2	418.0	860	M8M.22	Yes	39,700	11	44,600	38,000	-		6100

x) Muzzle velocity of equivalent standard drag trajectory

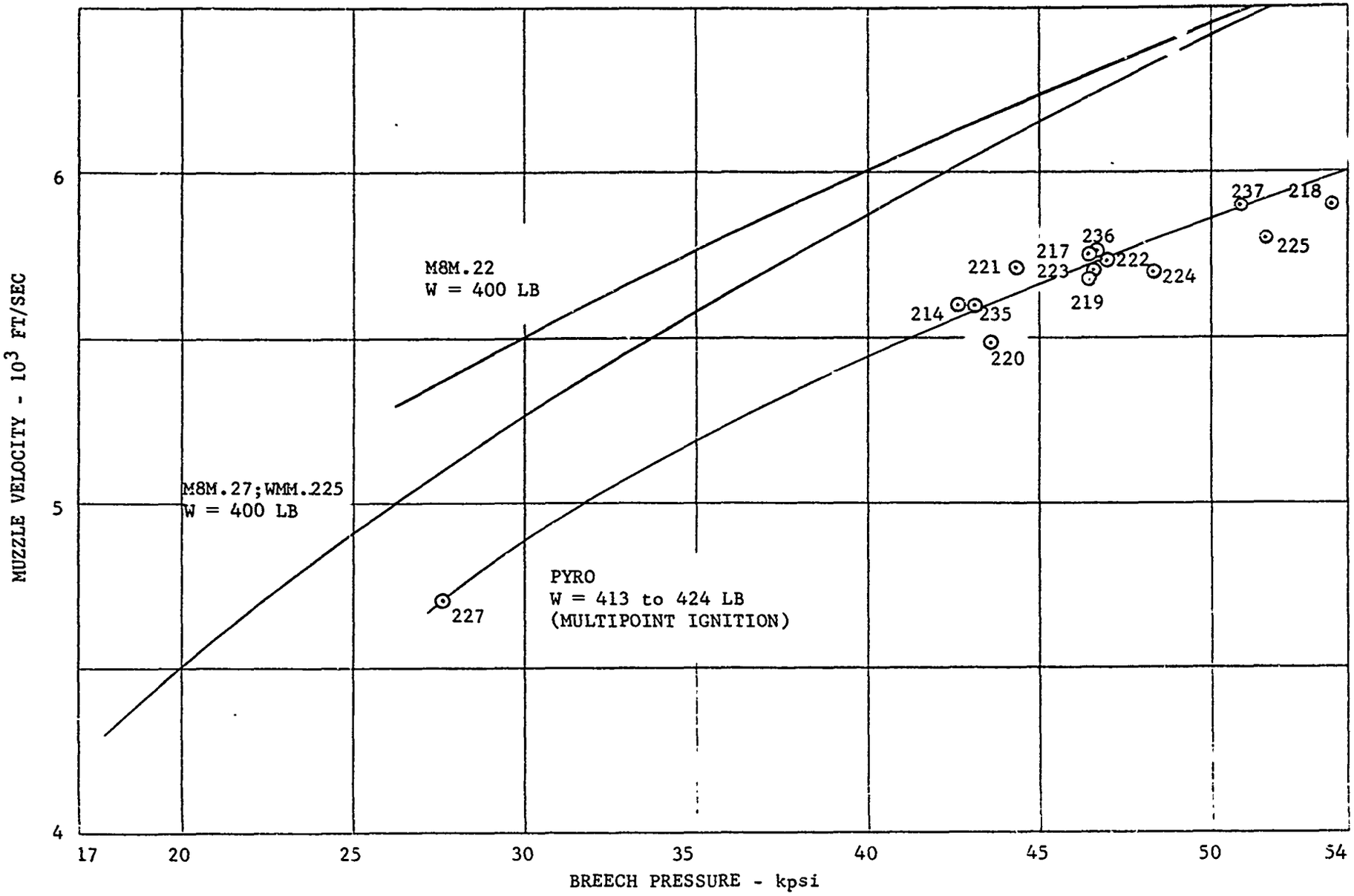


FIG. 1.6 MUZZLE VELOCITY VS BREECH PRESSURE

ocity-pressure curves for the M8M.22 and .27, and WMM.225 with single point ignition. It was found that Pyro with single ignition gave erratic results. In some rounds with single ignition, M6.050 and WM.048 propellant was added to the Pyro, and inconsistent results were obtained; it appeared that the propellant performance was sensitive to spacing as well as to the amount of M6. The effect of wrapping WM around another propellant was an increase in the burning rate.

4.2 Trajectory Results

A summary of the apogees and ranges obtained is given in Table X for all rounds. In several rounds apogee and range were measured by radar; where not, the apogee data were calculated from the available radar data, and the range data estimated from the apogee and computer results.

The apogee of the synoptic night series was, as usual, well above the 100 km level with up to 140 km in the rounds using M8M or WMM propellants. The Pyro rounds gave lower apogees, between 110 and 120 km but with a remarkable uniformity.

The record apogee obtained with the 16 inch gun in Yuma, November 1966, was 180 km = 112 miles.

Tables of the MPS-19 radar trajectory data are given in Part III.

4.3 TMA Trail Results

Most of the thirty-five TMA rounds, twenty-seven of them fired in three nine-round synoptic series, produced satisfactory trails

TABLE X

APOGEE AND RANGE DATA - 1966/1967 TEST FIRING SERIES

Round No.	Vehicle Weight lb	Muzzle Velocity ft/sec	Elevation deg	Apogee ft	Apogee km	Estimated Range ft	Comments
180	183.0	5900 WF	85	-	-	-	No radar data
181	183.5	(5900 R.)	85	400,000	122	135,000	
182	180.0	5400 WF	80	110,500	33.6	-	Vehicle damaged at launch.
183	25.0	-	80	-	-	-	No radar data
184	279.3	-	80	-	-	-	Vehicle failed at launch.
185	394.0	5600 WF	80	-	-	-	No radar data
186	390.0	6100 WF	80	-	-	-	No radar data
187	25.0	-	80	-	-	-	No radar data
188	183.5	(5800 R)	85	392,000	119	130,000	
189	183.0	(6100 R)	85	430,000	131	145,000	
190	184.0	(5800 R)	85	383,000	117	130,000	
191	183.5	(6100 R)	85	433,000	132	145,000	
192	183.5	(6300 R)	85	460,000	140	155,000	
193	183.5	-	85	-	-	-	Vehicle failed at launch.
194	183.5	(5900 R)	85	400,000	122	135,000	
195	184.0	(6100 R)	85	425,000	130	145,000	
196	183.5	(5700 R)	85	380,000	116	125,000	
197	413.5	-	80	-	-	-	No radar data
198	186.0	6100 WF	80	420,000	128	288,000	
199	183.5	(6200 R)	85	450,000	137	150,000	
200	187.0	(4700 R)	80	229,000	70	158,000x)	
201	410.5	-	80	-	-	-	No radar data
202	281.5	-	80	-	-	-	Failure of vehicle in gun
203	432.0	-	80	-	-	-	No radar data

x) Measured Data

TABLE X (Cont'd)

Round No.	Vehicle Weight lb	Muzzle Velocity ft/sec	Elevation deg	Apogee ft	Apogee km	Estimated Range ft	Comments
204	186.0	6600	85	300,000	91	130,000	High velocity high drag flight
205	184.0	6550	85	414,000	126	140,000	
206	185.0	6320	85	447,000	137	149,000x)	
207	186.0	5980	85	386,000	118	113,000x)	
208	185.0	6470	85	360,000	110	120,000	High drag trajectory
209	184.0	(5800 R)	85	373,000	114	130,000	
210	186.0	(5900 R)	85	400,000	122	135,000	
211	185.0	(6000 R)	85	417,000	127	139,000	
212	186.0	(6000 R)	85	400,000	122	135,000	
213	171.0	5700	85	357,000	109	119,000	
214	184.5	(5600 R)	85	348,000x)	106	118,000x)	
215	475.0	-	85	11,000	3.3	-	Failure of vehicle in gun
216	350.0	-	80	-	-	-	Slug disintegrated in the barrel
217	184.0	(5750 R)	85	376,000	115	127,000	
218	184.0	(5900 R)	85	399,000	122	135,000	
219	184.5	5680	85	367,600	112	124,000	
220	185.0	5490	85	371,400	113	125,000	Low drag trajectory
221	185.0	5710	85	380,000	116	125,000	
222	184.5	5730	85	376,000	115	126,000	
223	184.5	(5700 R)	85	373,000x)	114	125,000	
224	185.0	(5700 R)	85	364,000x)	111	122,000	
225	184.5	(5800 R)	85	381,000	116	128,000	
226	330.0	5200	80	228,700x)	70	162,000x)	

x) Measured Data

TABLE X (Cont'd)

Round No.	Vehicle Weight lb	Muzzle Velocity ft/sec	Elevation deg	Apogee ft	Apogee km	Estimated Range ft	Comments
227	185.0	(4700 R)	85	232,000 x)	71	63,000	-
228	185.0	-	85	97,000 x)	29.6	28,100 x)	
229	1545.0	3750	80	30,600 x)	9.3	14,000 x)	
230	859.0	-	80	-	-	-	Failure of vehicle in gun
231	127.0	6000 WF	80	-	-	-	No radar data
232	71.0	6820 WF	80	17,500 x)	5.3	4,800 x)	
233	121.0	5560 SF	80	-	-	-	No radar data
234	227.0	5500	80	73,600 x)	22.4	21,300 x)	
235	185.0	(5600 R)	85	355,000 x)	108	95,000	
236	184.0	5770	85	362,000 x)	110	88,300 x)	
237	184.0	(5900 R)	85	393,000	120	103,000 x)	
238	181.0	(6100 R)	85	440,000	134	117,000 x)	

R: Radar (muzzle velocity of equivalent standard drag trajectory)

WF: West Fastax SF: Smear and Fastax

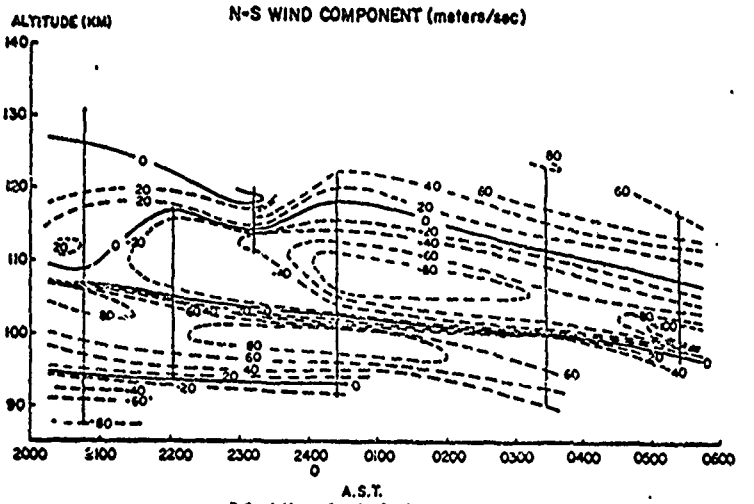
x) Measured Data

for wind data evaluation, and good photographs were obtained. As examples, trail photographs of Shot No. 181, Trail No. 43, are shown in Fig. 1.10a,b,c, and d.

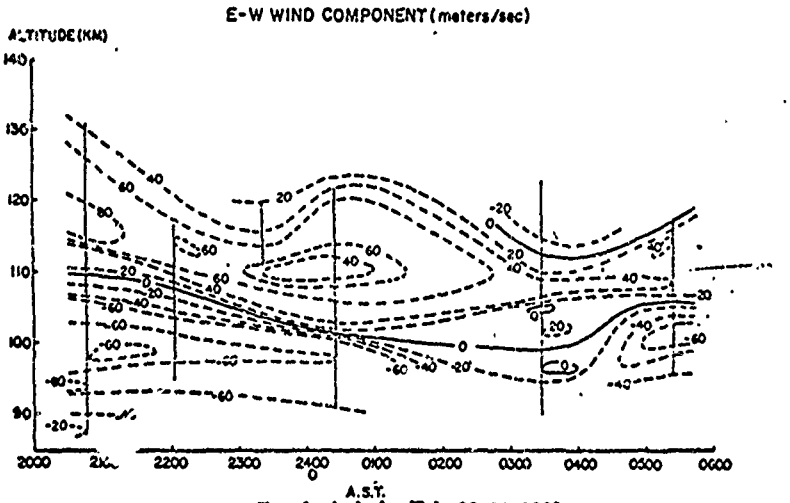
The analysis of these trails was made by Space Instruments Research, Atlanta, Ga., to give wind components, wind speed, and wind direction (Refs. 12 to 15). Tables and graphs of all these data for twenty-six rounds are given in Part IV.

The three synoptic series with their large number of trails available during the night hours from 2000 to 0500 (AST) made it possible to draw contour charts of the wind components. These are given in Fig. 1.7 for the night of February 23/24, 1966 (already published in Ref. 11), in Fig. 1.8 for the night of September 19/20, 1966 and in Fig. 1.9 for the night of February 15/16, 1967. It is of interest to note that the meridional contours show a definite descent of the constant wind speed lines throughout the night, whereas the zonal contours do not. This has already been observed in previous series. Not so clearly is this shown in Fig. 1.9a of the February 1967 series. In this case, however, the available data were not so as to define clearly the contours.

For a more detailed analysis of the nighttime variation of the ionospheric winds, see Ref. 11.



Meridional winds for Feb. 23–24, 1966



Zonal winds for Feb. 23–24, 1966.

FIG. 1.7 SYNOPTIC WIND MEASUREMENTS
23/24 FEBRUARY 1966

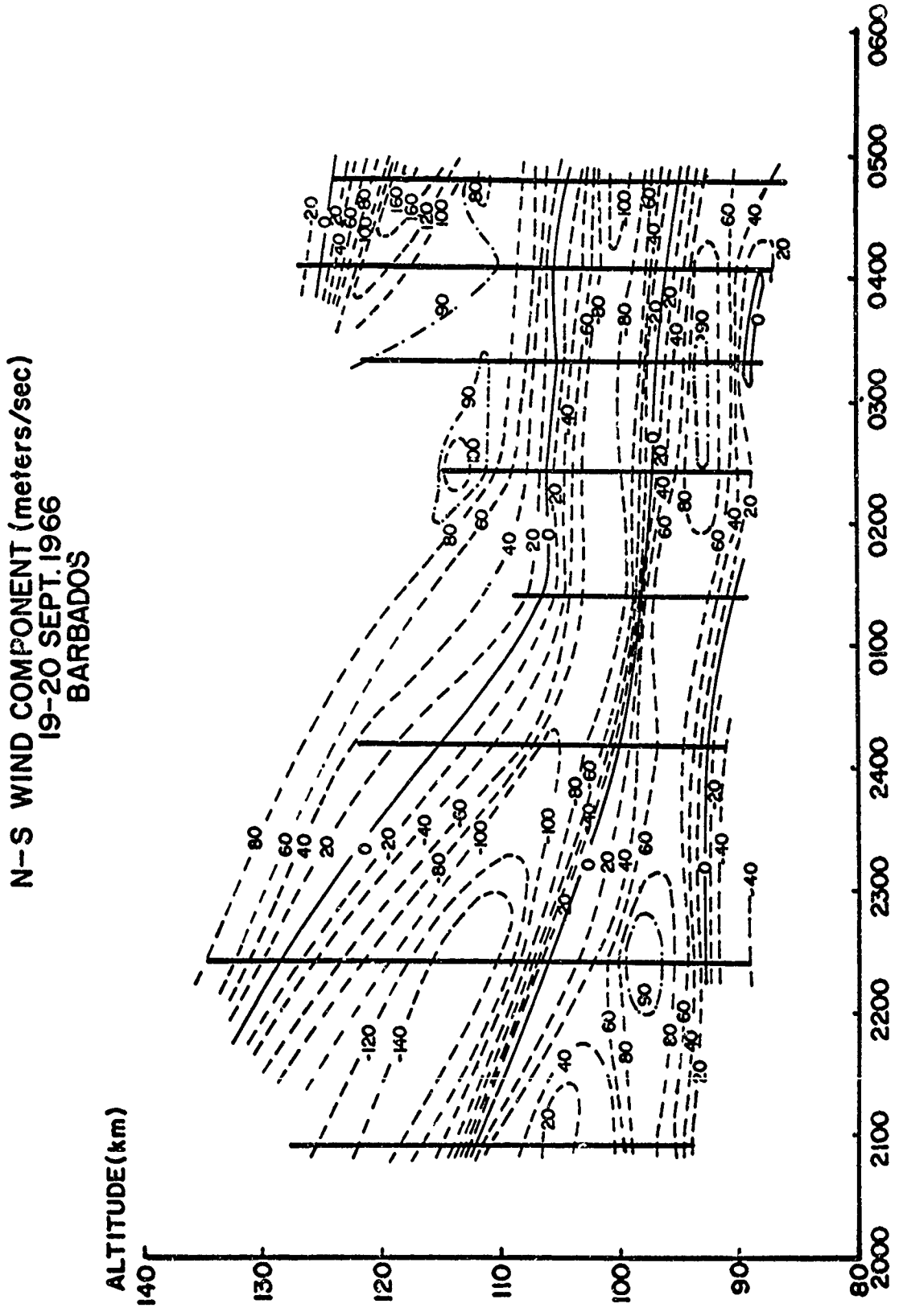

N-S WIND COMPONENT (meters/sec)
19-20 SEPT. 1966
BARBADOS
ALTITUDE(km)
140
130
120
110
100
90
80
2000
2100
2200
2300
2400
0100
0200
0300
0400
0500
0600
A.S.T.

FIG. 1.8a

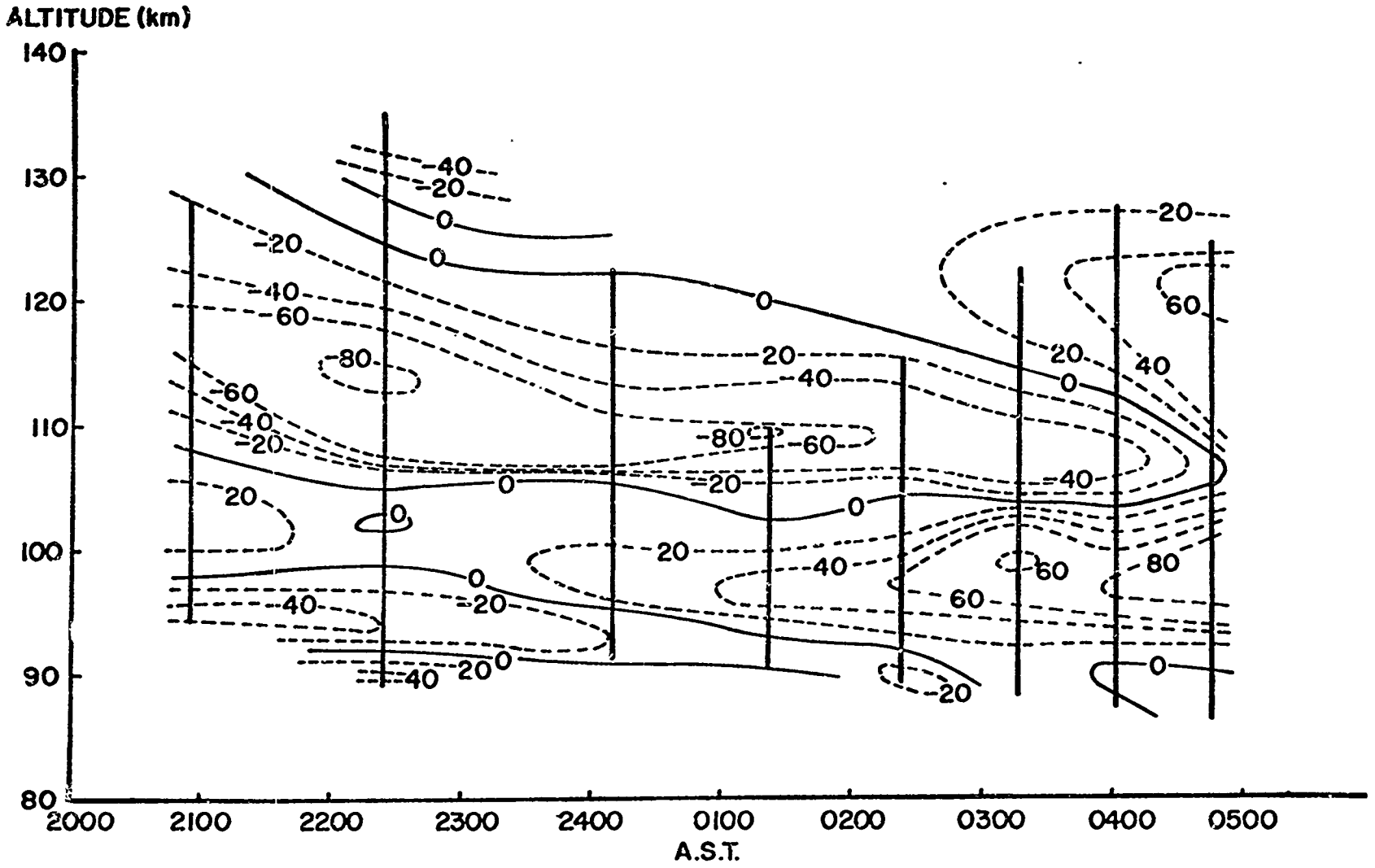

E-W WIND COMPONENT (meters/sec)
19-20 SEPT. 1966
BARBADOS
ALTITUDE (km)
140
130
120
110
100
90
80
2000
2100
2200
2300
2400
0100
0200
0300
0400
0500
A.S.T.

FIG. 1.8b

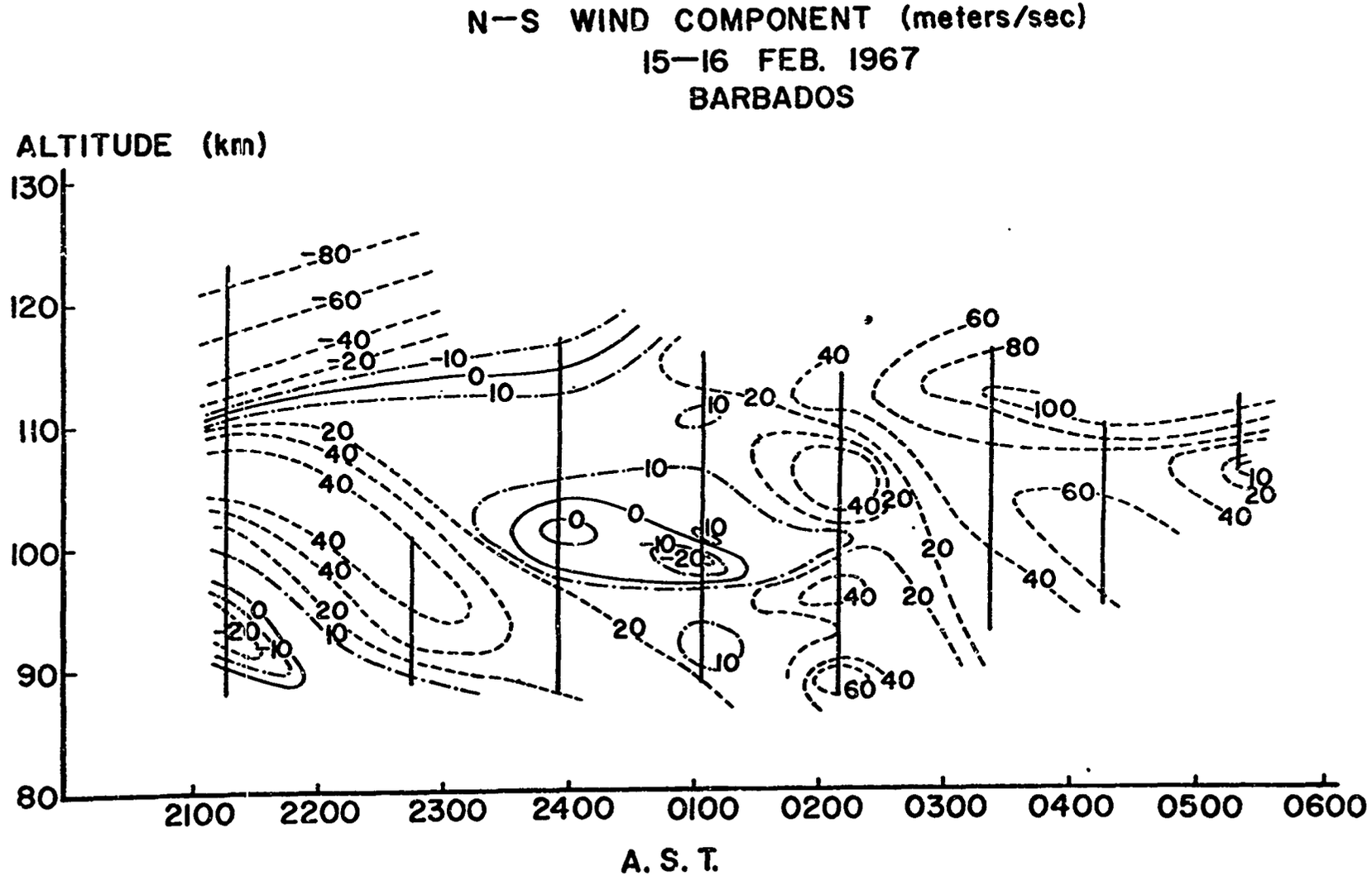

N—S WIND COMPONENT (meters/sec)
15—16 FEB. 1967
BARBADOS
ALTITUDE (km)
130
120
110
100
90
80
2100
2200
2300
2400
0100
0200
0300
0400
0500
0600
A. S. T.

FIG. 1.9a

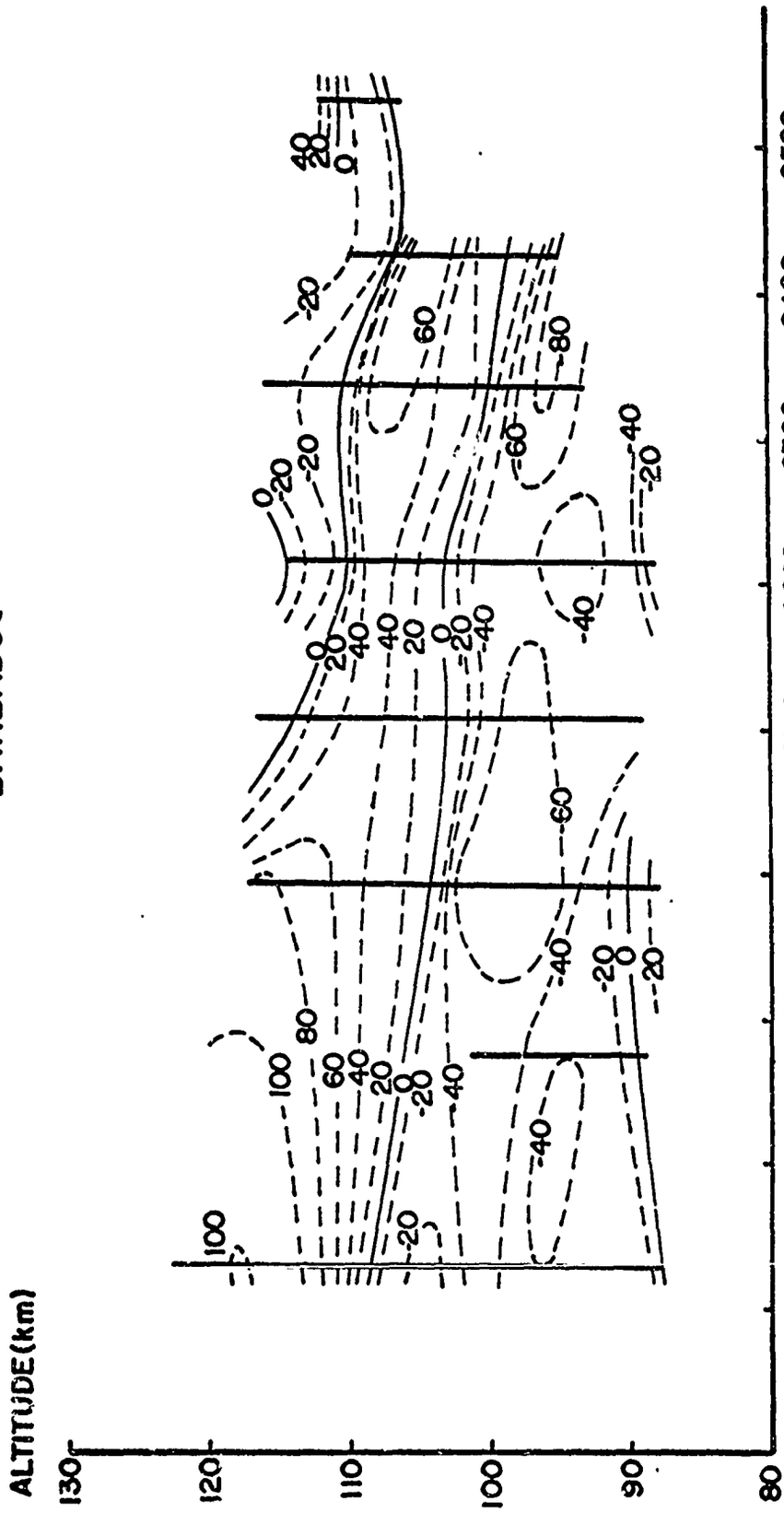

E-W WIND COMPONENT (meters/sec)
15-16 FEB. 1967
BARBADOS
ALTITUDE (km)
130
120
110
100
90
80
2100
2200
2300
2400
0100
0200
0300
0400
0500
A.S.T.

FIG. 1.9b

FIG. 1.10a INAUGUA TRAIL
AT T + 130 SEC (BARBADOS STATION)

FIG. 1.10b INAUGUA TRAIL
AT T + 190 SEC (BARBADOS STATION)

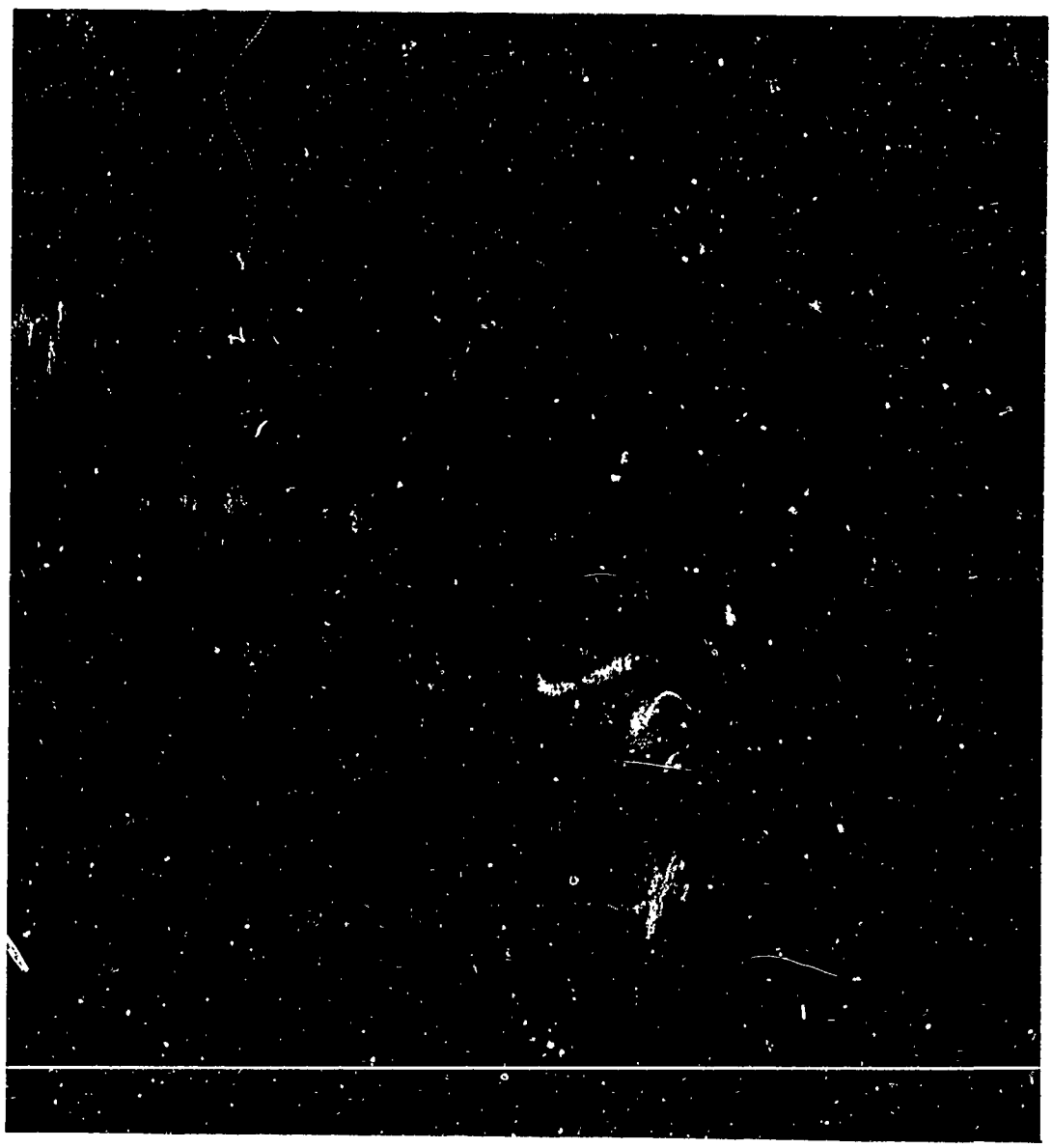


FIG. 1.10c INAUGUA TRAIL
AT T + 250 SEC (BARBADOS STATION)

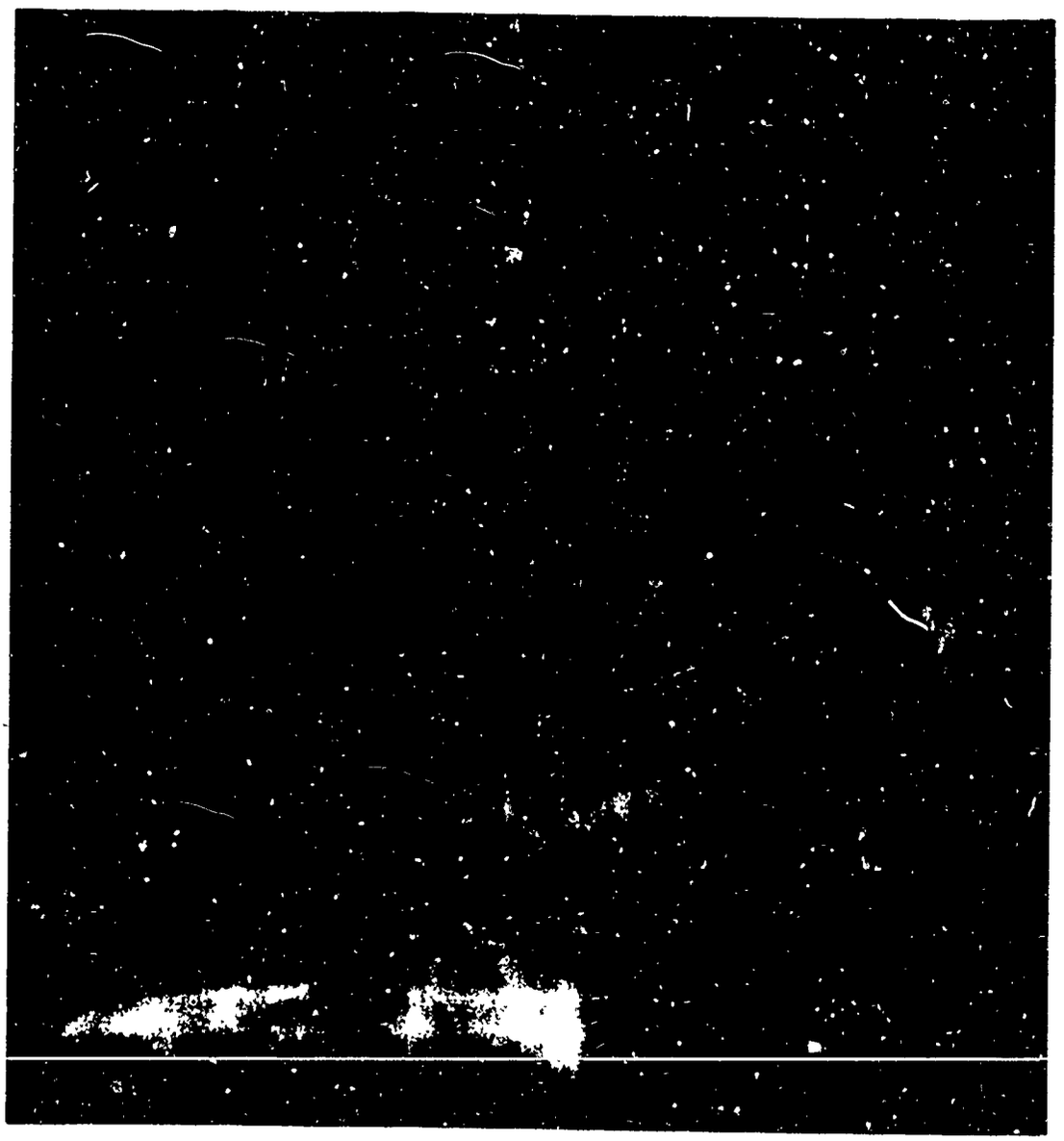


FIG. 1.10d INAUGUA TRAIL
AT T + 377 SEC (BARBADOS STATION)

5.0 SUMMARY AND CONCLUSIONS

The 1966/67 series of gun firings from the 16-inch Barbados gun continued successfully the vehicle, instrumentation and payload development tests in addition to the gathering of ionospheric wind data and their correlation with ionosonde drift data.

The performance of the gun was satisfactory, and the new methods of loading with spacers and multipoint ignition proved useful. The test with various propellants gave an insight into their performance. The best results were still achieved with M8M or WMM propellants, but it was remarkable that good and acceptable results could be achieved with the less expensive Pyro propellant under proper firing conditions. The installation of a permanent gun liner, to reduce the barrel taper, also proved successful.

The Martlet 2C displayed the usual reliability. The Martlet 2D design had been abandoned in favour of a much larger Martlet 2G; two still available Martlet 2D vehicles were used, however, for tests in connection with the gun liner and a TMA puff puff release system. The Martlet 2G model was successful in one round with a muzzle velocity of 5200 ft/sec, achieving a perfect flight trajectory.

The performance of the TMA payloads was satisfactory as usual. The Sofar sea impact device did not function although in one of the two rounds the impact of the shot was heard by underwater microphones. However, this information on faulty performance was an important engineering result regarding future plans for this device.

The rounds with telemetry packages were partially successful. In some shots, telemetry failure was apparently caused by the nose cone becoming loose or breaking off. It was afterwards discovered that there was an insufficient area of fiberglass at the base of the nose cone to

support it during launch acceleration.

It can be concluded that the tests of the report period have demonstrated a further progress in the gun launching technique and the development of instrumentation capable of withstanding the high launch accelerations.

In the four and a half years since the first shot from the Barbados gun in January 1963, a total of 238 rounds were fired with an increasing success ratio. The Martlet 2C vehicle, the work horse for scientific experiments, has proven highly reliable, and TMA synoptic firings have become routine with a firing rate of more than one round per hour. Development of larger models for scientific tests and for multistage rockets has been promising, clearing the way for a successful progress of the second part of Project HARP, i.e. firing rocket assisted vehicles to higher altitudes and into orbit around the earth.

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11. Murphy, C.H., Bull, G.V., "Nighttime Variation of Ionospheric Winds over Barbados, West Indies", Journal of Geophysical Research, Vol. 72, No. 19, October 1, 1967, pp. 4831-4837.

12. Fuller, R.N., "Upper Atmosphere Winds from Gun-Launched Vertical Probes (Barbados, 17-25 February 1966)", Space Instruments Research, Inc., BRL Contract 169, Report 5, January 1967.

    Also: Space Instruments Research, Inc., Photographic Prints of TMA Releases (Barbados, February 1966), BRL Contract 169.

REFERENCES (Cont'd)

13. Fagot, J., and Eppler, W., "Upper Atmosphere Winds from Gun-Launched Vertical Probes (Barbados, 19-20 September 1966)," Space Instruments Research, Inc., BRL Contract 169, Report 8.

Also: Space Instruments Research, Inc., Photographic Prints of TMA Releases (Barbados, September 1966), BRL Contract 169.

14. Fagot, J., and Eppler, W., "Upper Atmosphere Winds from Gun-Launched Vertical Probes (Barbados, 15-16 February 1967)," Space Instruments Research, Inc., BRL Contract 169, Report 9.

15. Fagot, J., and Eppler, W., "Upper Atmosphere Winds from Gun-Launched Vertical Probes (Barbados, 21-22 June 1967, Yuma, 12 June 1967)," BRL Contract 169, Final Report.

PART II

DETAILED FLIGHT PERFORMANCE

ROUNDS No. 180 - 238

FEBRUARY 1966 - JUNE 1967

Round No.	Name	Vehicle Martlet	Page	Figures
180	ANTIGUA	2C Slug	II-3	2.1
181	INAUGUA	2C Mod 2	II-6	2.2, a
182	CUBA	2C Mod 2	II-10	2.3, a, b
183	MURPHIUS	2C Slug	II-15	-
184	DOMINICA	2D	II-17	-
185	TS 1	Wood Slug	II-19	-
186	TS 2	Wood Slug	II-21	2.4
187	TS 3	Wood Slug	II-24	2.5
188	JAMAICA	2C Mod 2	II-27	2.6, a
189	ST. KITTS	2C Mod 2	II-31	2.7, a
190	ST. LUCIA	2C Mod 2	II-35	2.8, a
191	MONTSERRAT	2C Mod 2	II-39	2.9, a
192	NEVIS	2C Mod 2	II-43	2.10, a
193	OCHO RIOS	2C Mod 2	II-47	2.11
194	PUERTO RICO	2C Mod 2	II-50	2.12, a
195	LA RAIZET	2C Mod 2	II-54	2.13a
196	ST. THOMAS	2C Mod 2	II-57	2.14a
197	TS 4	Wood Slug	II-60	-
198	ELEUTHERA	2C Mod 2	II-62	2.15a
199	FLAMINGO	2C Mod 2	II-65	2.16a
200	DONNA	2C Mod 2	II-68	2.17a
201	TS	Wood Slug	II-72	-
202	FERNANDE	2G	II-73	-
203	TS	Wood Slug	II-75	-
204	ALPHA	2C Mod 2	II-76	2.18, a
205	BETA	2C Mod 2	II-80	2.19, a
206	GAMMA	2C Mod 2	II-84	2.20, a
207	DELTA	2C Mod 2	II-89	2.21a
208	EPSILON	2C Mod 2	II-93	2.22, a
209	ZETA	2C Mod 2	II-97	2.23, a
210	ETA	2C Mod 2	II-101	2.24, a
211	THETA	2C Mod 2	II-105	2.25, a
212	IOTA	2C Mod 2	II-109	2.26, a
213	KAPPA	2C Mod 3	II-113	2.27, a
214	INDEPENDENCE 1	2C Mod 2	II-117	2.28, a
215	INDEPENDENCE 2	2G	II-122	2.29
216	TS	Wood Slug	II-125	-

* Synoptic Series

DETAILED FLIGHT PERFORMANCE (Cont'd)

Round No.	Name	Vehicle Martlet		Pages	Figures
217	ANTRIM	2C Mod 2	*	II-126	2.30, a
218	BELFAST	2C Mod 2		II-130	2.31, a
219	CORK	2C Mod 2		II-134	2.32, a
220	DUBLIN	2C Mod 2		II-138	2.33, a
221	GARVAGH	2C Mod 2		II-142	2.34, a
222	HOLLYWOOD	2C Mod 2		II-146	2.35, a
223	KERRY	2C Mod 2		II-150	2.36, a
224	LIMERICK	2C Mod 2		II-154	2.37, a
225	NEWRY	2C Mod 2		II-158	2.38, a
226	SHANKILL	2G		II-162	2.39, a, b
227	BANGOR	2C Mod 2		II-167	2.40a
228	DONAGHADEE	2C Mod 2		II-170	2.41, a
229	TS No. 25	Metal TS		II-174	2.42a, b
230	BRONSON	2G1-B1		II-178	2.43
231	BANNOCK	LAHIVE FLARE BODY		II-182	2.44
232	CAMERON	LAHIVE 15 deg cone		II-185	2.45, a
233	DUNOON	LAHIVE 10 deg cone		II-189	-
234	ACCRA	2D		II-191	2.46a
235	CAIRO	2C Mod 2		II-194	2.47a
236	DURBAN	2C Mod 2		II-197	2.48, a
237	ENTEBBE	2C Mod 2		II-201	2.49, a
238	FREETOWN	2C Mod 2		II-205	2.50, a

* Synoptic Series

Round No. 180 - ANTIGUA

Date: 17 February 1966 - 1334 AST

Vehicle Description: Martlet 2C slug (aluminum body, lead-filled, without fins) with aluminum sabot.

Purpose of Test: Engineering test of aluminum sabot.

Weights:		
	Vehicle	183.0 lb
	Pusher and Obturator	117.5 lb
	Sabot	73.0 lb
	Shot Weight	373.5 lb

Centre of Gravity: 19.9 inches from base.

Launch Data:

Charge Weight	900 lb M8M.270 (10 bags) 20 lb WM.048
Spacing of Charge	340 x 300 x 280
Swedish Additive	15 sheets
Igniter	500 grams/bag (Al Powder)
Gun Elevation	85 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	215 in
Ram Load	20 tons
Chamber Volume	45,700 in^3
Recoil	39.5 in
Breech Pressure	M11: 48,100 psi Strain: 46,500 psi (Fig. 2.1)

Note: No evacuation (Mylar cover split at 15 in. vacuum of Mercury).

Camera Records:

The rear Smear camera did not record the vehicle since it was obscured in a smoke cloud. The front Smear camera recorded the nose of the vehicle which was visible above the smoke cloud.

All Fastax cameras functioned properly with the exception that there were no time marks on the East Fastax camera centered 140 ft ahead of the muzzle. Evaluation of other photographs gave the following

muzzle velocity:

West Fastax (6 in. lens, 160 ft above muzzle) - 5900 ft/sec.

Radar Records:

Both the M-33 and the MPS-19 radars failed to sight the vehicle.

Trajectory:

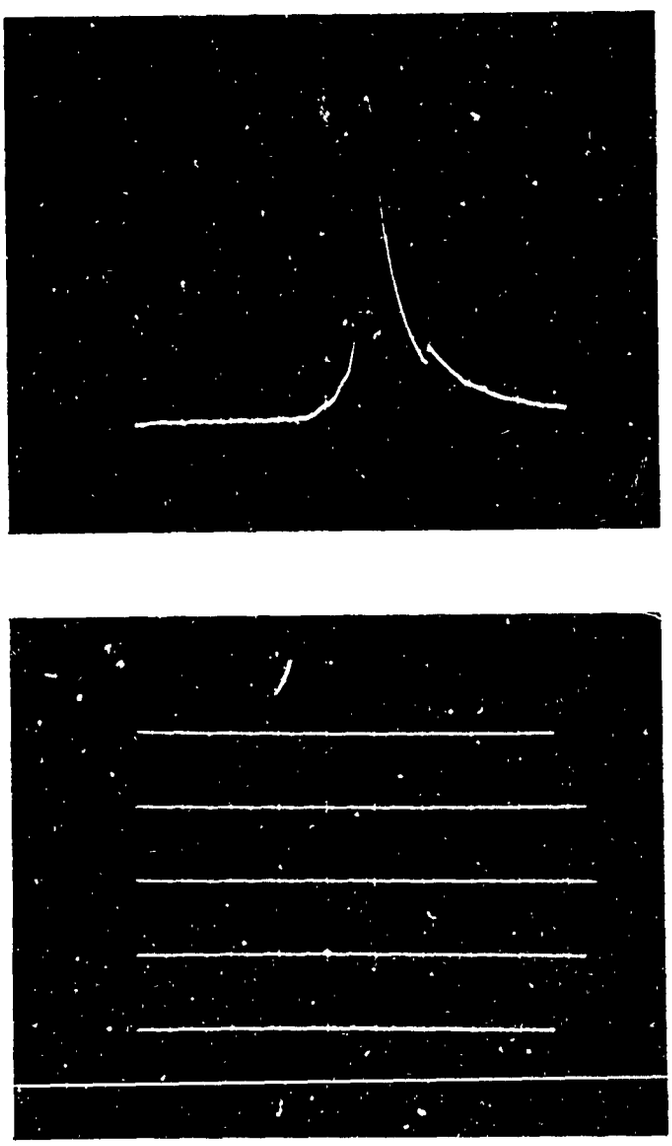
No data were obtained for the trajectory.

Summary:

The photographs show that the slug was launched intact. The shot was considered to be a success since the light weight aluminum sabot functioned satisfactorily.

ANTIGUA

17 February 1966 - 1334 AST



Maximum Breech Pressure: P_{max} = 46,500 psi

Charge: 900 lb M8M .270
20 lb WM .048

FIG. 2.1 STRAIN GAUGE RECORD OF BREECH PRESSURE

ROUND ANTIGUA

Round No. 181 - INAUGUA

Date: 17 February 1966 - 2103 AST

Vehicle Description: Martlet 2C (Mod 2) with wood sabot carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Measurement of wind profile.

Weights:		
	Vehicle	183.5 lb
	Pusher and Obturator	120.8 lb
	Sabot	105.5 lb
	Shot Weight	409.8 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	900 lb M8M.270 (10 bags) 20 lb WM.048
Spacing of Charge	340 x 300 x 280
Swedish Additive	15 sheets
Igniter	500 grams/bag
Gun Elevation	85 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	222 in
Ram Load	20 tons
Chamber Volume	47,200 in^3
Recoil	41 in
Breech Pressure	M11: 50,000 psi Strain: 50,000 psi (Fig. 2.2)

Note: No evacuation (Mylar cover split after 6 min. of evacuation).

Camera Records:

Smear and Fastax cameras were not used.

Radar Records:

The M-33 radar tracked the vehicle from T + 7 sec to T + 31 sec. The MPS-19 radar tracked from T + 3 sec to T + 90 sec. Neither apogee nor splash were observed.

Trajectory:

The radar data are plotted in Fig. 2.2a in comparison with the standard drag trajectory for a muzzle velocity of 5900 ft/sec and 85.0 deg elevation. The apogee derived from the radar data was 400,000 ft = 122 km, and the total range was estimated to be 135,000 ft.

TMA Trail Results:

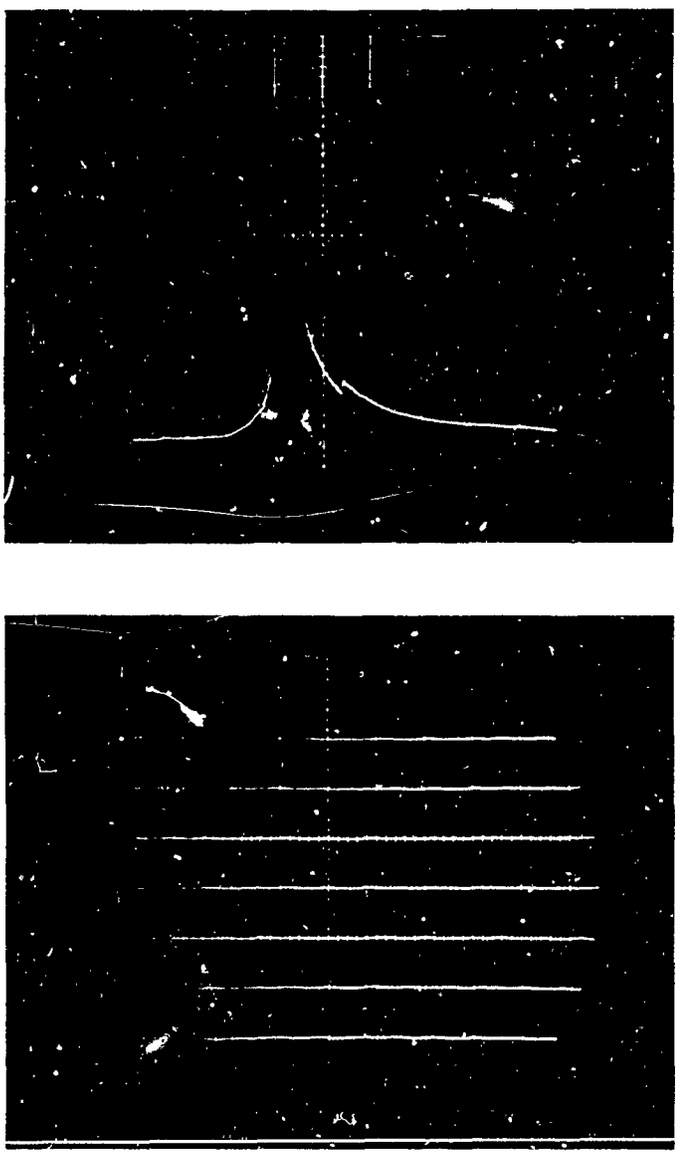
A very good TMA trail was photographed and wind data were obtained between altitudes of 92 and 123 km.

Summary:

The shot was successful. Trajectory and payload performance were satisfactory and good wind data were obtained.

INAUGUA

17 February 1966 - 2103 AST



TIME
20 milliseconds/division

Maximum Breech Pressure: P_{max} = 50,000 psi

Charge: 900 lb M8M .270
20 lb WM .048

FIG. 2.2 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND INAUGUA

INAUGUA

17 February 1966 - 2103 AST

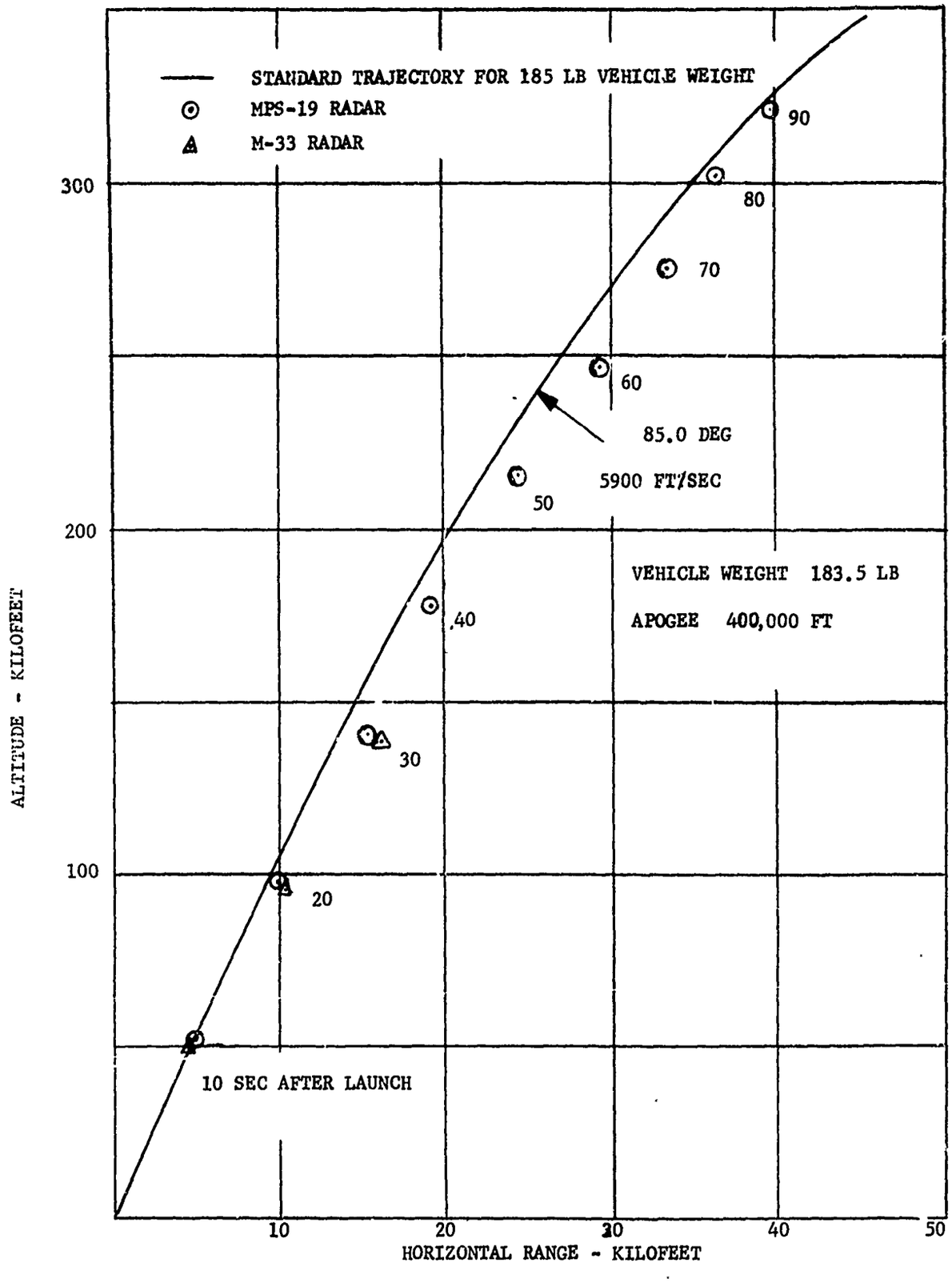


FIG. 2.2a MARTLET 2C INAUGUA ALTITUDE VS RANGE

Round No. 182 - CUBA

Date: 18 February 1966 - 1101 AST

Vehicle Description: Martlet 2C (Mod 2) with Aluminum Sabot, and carrying a 4 lb SOFAR impact device.

Purpose of Test: Engineering test of Aluminum Sabot and SOFAR impact device.

Weights:

Vehicle	180.0 lb
Pusher and Obturator	117.5 lb
Sabot	73.0 lb
Shot Weight	370.5 lb

Centre of Gravity: 22.4 inches from base.

Launch Data:

Charge Weight	920 lb M8M.270 (10 bags)
Spacing of Charge	340 x 300 x 280
Swedish Additive	15 sheets
Igniter	500 grams/bag (Aluminum powder)
Gun Elevation	80.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	218 in
Ram Load	20 tons
Chamber Volume	46,300 in^3
Recoil	39.5 in
Breech Pressure	M11: 37,000 psi Strain: 37,500 psi (Fig. 2.3)
Evacuation	27 in Hg of vacuum

Camera Records:

All cameras function properly. Evaluation of Fastax photographs gave the following muzzle velocities:

West Fastax (6 inch lens, 160 ft ahead of muzzle): 5400 ft/sec

East Fastax (10 inch lens, 140 ft ahead of muzzle): 5800 ft/sec

Radar Records:

The M-33 radar tracked the vehicle from T + 7 sec to T + 46 sec.

The MPS-19 radar tracked the vehicle from T + 10 sec to T + 90 sec. Apogee was recorded as 110,500 ft at T + 80 sec and azimuth 115 deg.

Trajectory:

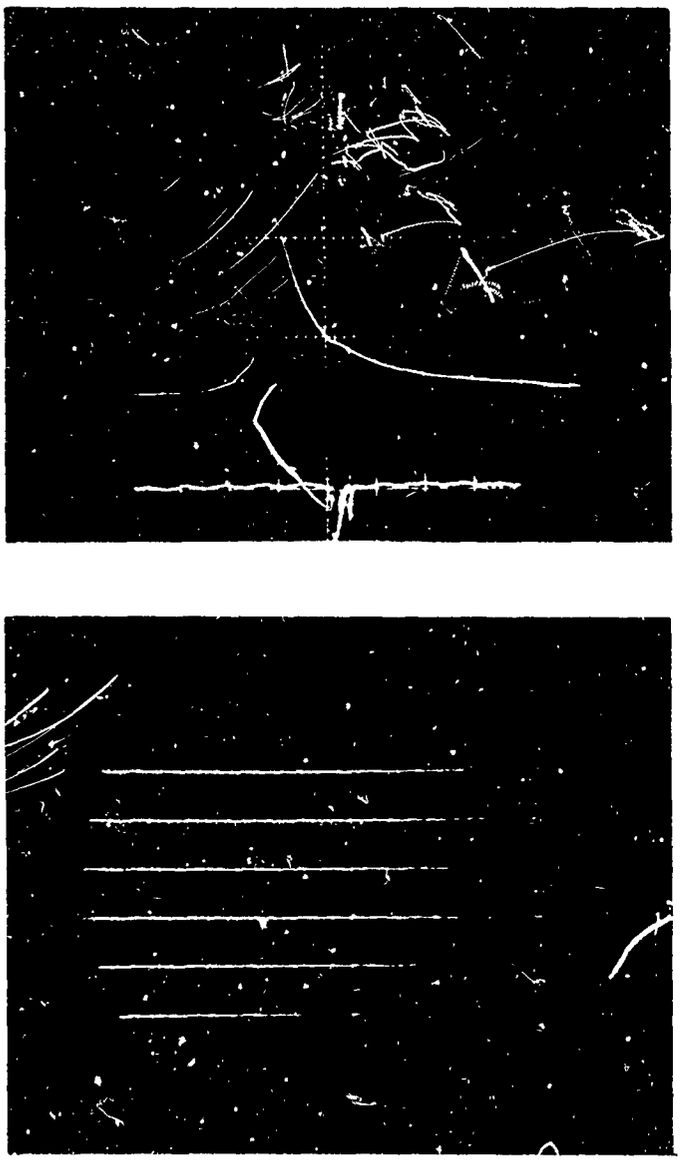
The radar data are reproduced in Fig. 2.3a. The vehicle had a low flight with apogee (as measured by the MPS-19 radar) at 110,500 ft = 33.6 km. The range at splash was not observed.

Summary:

This was an unsuccessful shot. Photographs (Fig. 2.3b), show a damaged vehicle with gas apparently ejecting from the nose cone. This may indicate that the SOFAR bomb malfunctioned, burning and creating internal pressures that damaged the vehicle. The drag of the damaged vehicle was apparently very high so that only a low apogee was achieved.

CUBA

18 February 1966 - 1101 AST



TIME

20 milliseconds/division

Maximum Breech Pressure
P_{max} = 37,500 psi

CHARGE: 920 lb M8M .270

FIG. 2.3 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND CUBA

CUBA

18 FEBRUARY 1966 - 1101 AST

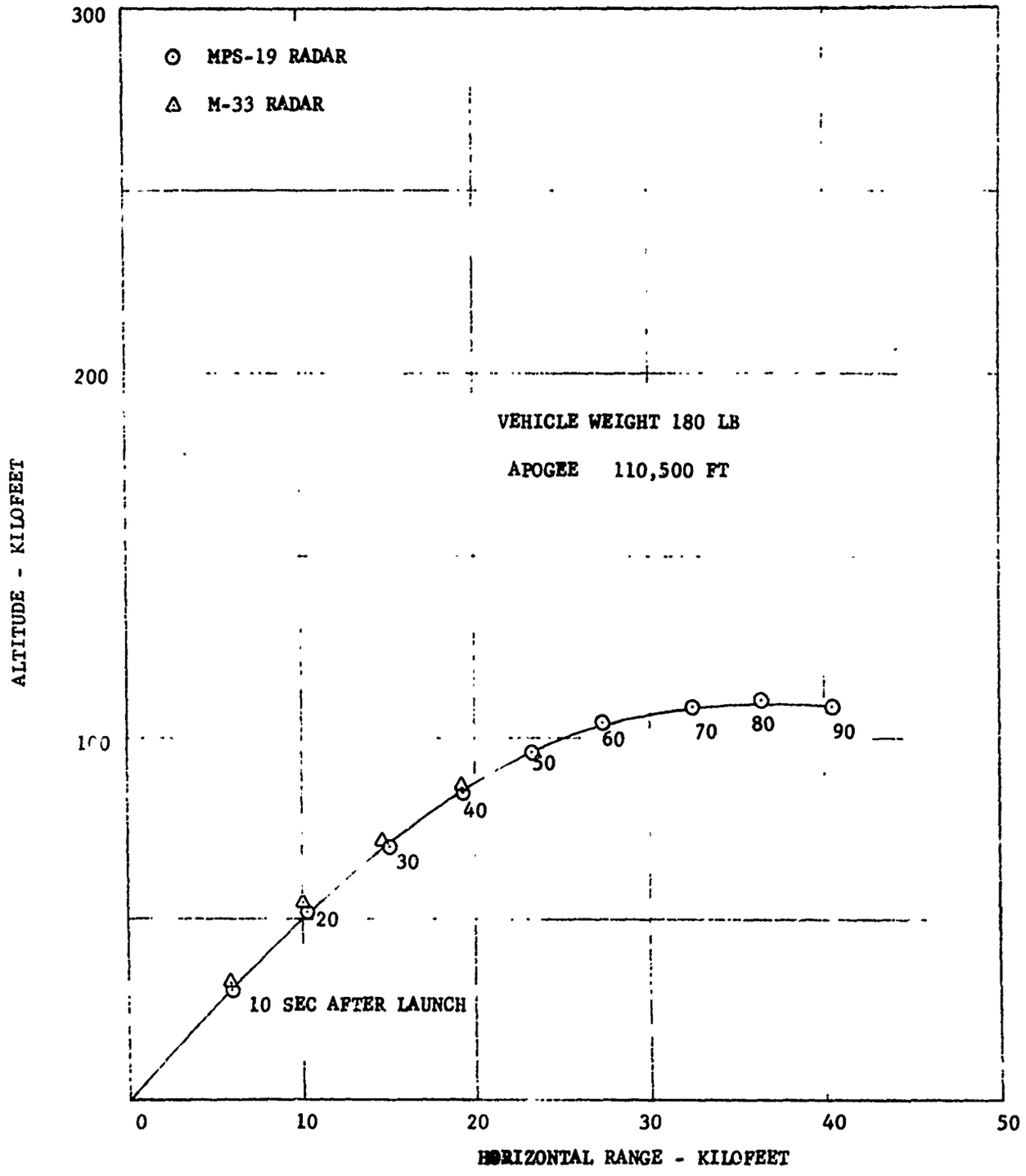
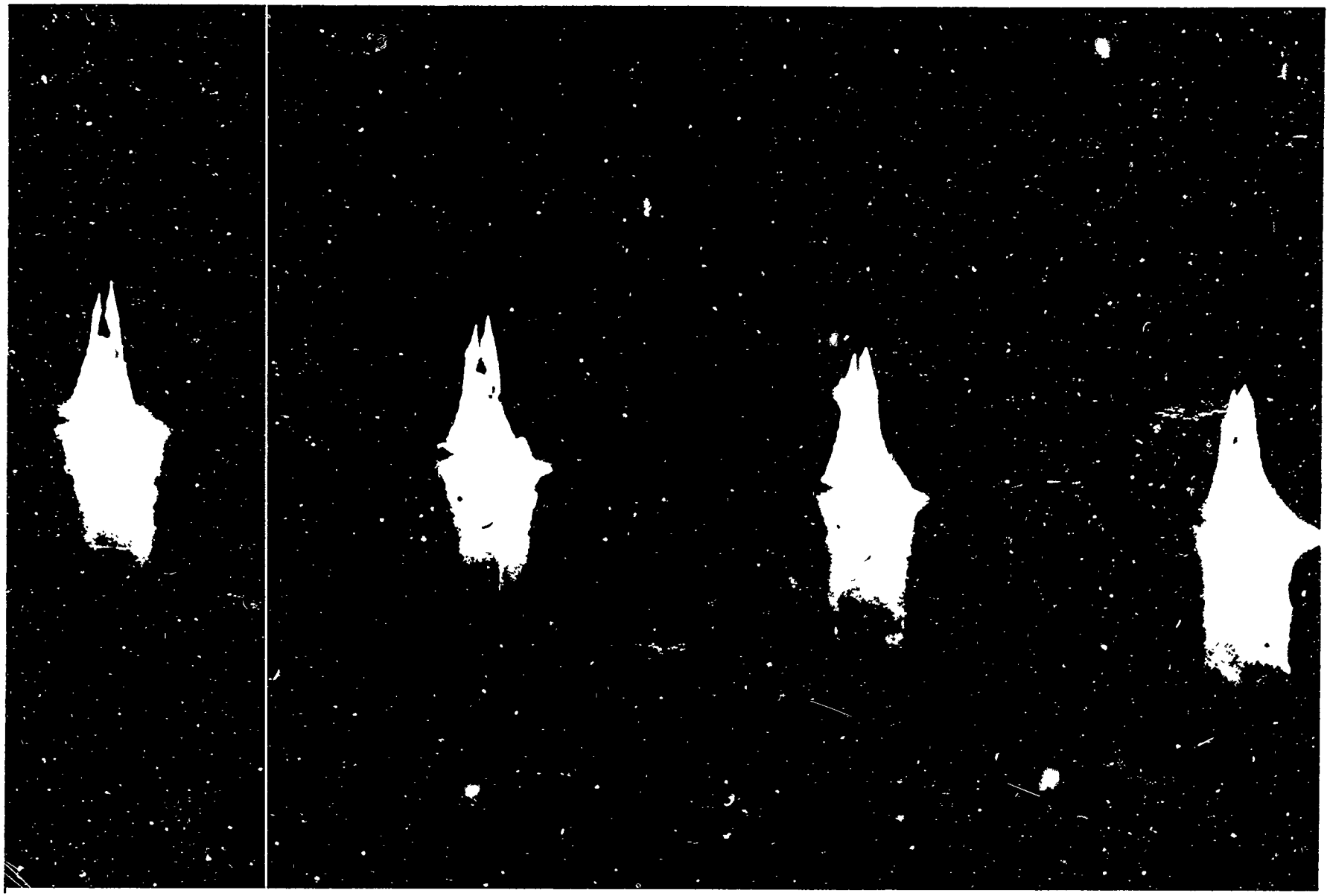


FIG. 2.3a MARTLET 2C CUBA

ALTITUDE VS RANGE



FASTAX - PHOTOGRAPH

FIG. 2.3b MARTLET 2C CUBA

Round No. 183 - MURPHIUS

Date: 20 February 1966 - 1751 AST

Vehicle Description: Wood test slug (Martlet 2C model) with a wooden sabot and an aluminum pusher plate.

Purpose of Test: The slug was fired to test an experimental liner in part of the bore.

Weights:

Vehicle	25 lb
Pusher and Obturator	107 lb
Sabot	100 lb
Shot Weight	232 lb

Gun Liner: The liner was inserted in the barrel at the breech end to reduce the barrel taper caused by continuous wear. This experimental liner consisted of four sections of mild steel sheet, each four feet long; the two forward sections had a thickness of 1/16 inch, the two rearward 1/8 inch. The sections were placed in the barrel and then connected with each other and the gun.

Launch Data:

Charge Weight	337.5 lb PYRO-ALN-IK-453 (3 Bags)
Igniter	500 grams/bag
Gun Elevation	80.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	192 in
Ram Load	40 tons
Chamber Volume	40,800 in^3
Recoil	2.0 in
Breech Pressure	M11: 11,000 psi Strain: Not available
Evacuation	No

Camera Records:

All cameras functioned but only the muzzle flash was visible because it was late in the day.

Radar Records:

No radar data are available. The M-33 radar did not sight the vehicle and there was no report from MPS-19.

Trajectory:

No trajectory data obtained.

Summary:

The wooden vehicle slug was recovered a few yards behind the Instrumentation Hut. The steel liner proved satisfactory with the small charge of this round; only the very thin sections were slightly wrinkled so that minor repairs and welding was needed.

Round No. 184 - DOMINICA

Date: 21 February 1966 - 1030 AST

Vehicle Description: Martlet 2D with aluminum sabot.

Purpose of Test: Engineering test of vehicle and aluminum sabot.

Weights:		
	Vehicle	279.25 lb
	Pusher and Obturator	126.75 lb
	Sabot	68.00 lb
	Shot Weight	474.00 lb

Launch Data:

Charge Weight	900 lb M8M.270 (9 bags)
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 300
Igniter	500 grams/bag
Gun Elevation	80.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	192 in
Ram Load	20 tons
Chamber Volume	40,800 in^3
Recoil	41 in
Breech Pressure	M11: 43,500 psi Strain: Not available
Evacuation	No

Camera Records:

All cameras functioned. Only what appeared to be fragments of the vehicle were recorded.

Radar Records:

The vehicle was not sighted by any of the radars.

Trajectory:

No trajectory data obtained.

Summary:

This vehicle failed in the barrel, and the gun liner which had been installed in the previous round (No. 183 - Murphius) came out entirely. It was not possible to determine whether the experimental sleeve or the vehicle caused the failure.

Round No. 185 - WOOD TEST SLUG #1

Date: 21 February 1966 - 1543 AST

Vehicle Description: Laminate wood slug with aluminum ends.

Purpose of Test: Test of propellant and gun.

Weight: Vehicle and shot weight 394 lb.

Launch Data:

Charge Weight	800 lb WMM.225 (8 bags)
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 200
Igniter	500 grams/bag
Gun Elevation	80 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	206 in
Ram Load	40 tons
Chamber Volume	43,800 in^3
Recoil	36 in
Breech Pressure	M11: 38,000 psi Strain: Not available
Evacuation	No

Camera Records:

The smear cameras obtained good pictures of the vehicle although with some blurring. Evaluation of Fastax photographs gave the following muzzle velocities:

West Fastax (6 in. lens, 160 ft ahead of muzzle) - 5600 ft/sec

East Fastax (10 in. lens, 140 ft ahead of muzzle) - 5900 ft/sec

Radar Records:

Neither radar sighted the vehicle.

Trajectory:

No trajectory data obtained.

Summary:

This was a successful test of gun and propellant. Although the trajectory was not observed, photographs show that the slug was launched intact.

Round No. 186 - WOOD TEST SLUG #2

Date: 21 February 1966 - 1705 AST

Vehicle Description: Laminate wood test slug with aluminum ends.

Purpose of Test: Test of propellant and gun.

Weights: Vehicle and Shot Weight 390 lb.

Launch Data:

Charge Weight	875 lb WMM.225 (9 bags)
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 275
Igniter	500 grams/bag
Gun Elevation	80.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	208.5 in
Ram Load	40.0 tons
Chamber Volume	44,300 in^3
Recoil	36 in
Breech Pressure	M11: 47,600 psi Strain: 48,300 psi (estimated) (Fig. 2.4)
Evacuation	No

Camera Records:

The rear smear camera and all Fastax cameras functioned well. The rear smear showed that the test slug was launched intact.

The following muzzle velocities were evaluated from Fastax photographs:

West Fastax (6 in. lens, 160 ft ahead of muzzle) - 6100 ft/sec

East Fastax (10 in. lens, 140 ft ahead of muzzle) - 6400 ft/sec

Radar Records.

There were no radar data. The M-33 radar did not sight the vehicle and the MPS-19 observed only the gas cloud.

Trajectory:

No trajectory data available.

Summary:

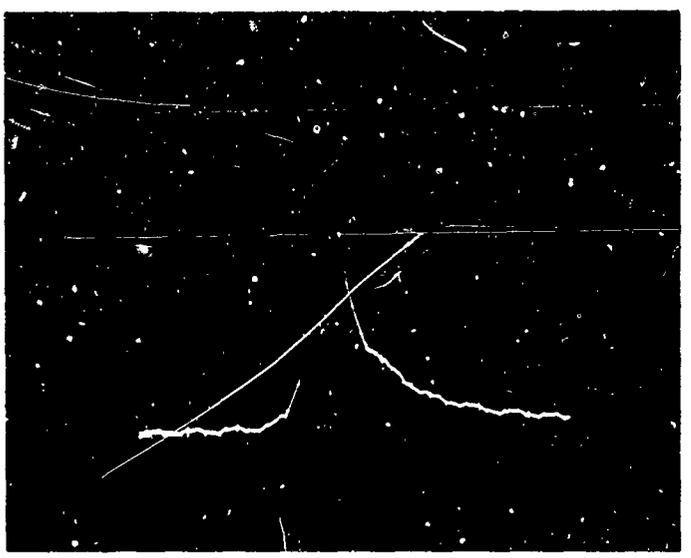
This was a successful ballistics test Although the trajectory was not observed, photographs show that the slug was launched intact.

WOOD TEST SLUG #2

21 FEBRUARY 1966 - 1705 AST

7,000 psi/division (estimated)

BREECH PRESSURE



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 48,300 psi (estimated)

CHARGE: 875 lb WMM.225

FIG. 2.4 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND WOOD TEST SLUG #2

Round No. 187 - WOOD TEST SLUG #3

Date: 22 February 1966 - 1300 AST

Vehicle Description: Wood test slug - the recovered Martlet 2C model of Round Murphius - with wooden sabot and an aluminum pusher plate.

Purpose of Test: Test of gun and propellant.

Weights:

Vehicle	25.0 lb
Pusher and Obturator	95.5 lb
Sabot	100.0 lb
Shot Weight	220.5 lb

Launch Data:

Charge Weight	560 lb PYRO (5 bags)
Igniter	500 grams/bag
Gun Elevation	80.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	223.5 in
Ram Load	6 tons
Chamber Volume	47,500 in^3
Recoil	7.5 in
Breech Pressure	M11: 6,000 psi Strain: 6,000 psi (estimated) (Fig. 2.5)
Evacuation	No

Camera Records:

Both smear cameras obtained good pictures of the slug. The East Fastax camera did not function. The West Fastax camera only obtained images of the muzzle blast.

Radar Records:

The MPS-19 radar tracked only the base of the vehicle. The M-33 radar did not sight the vehicle.

Trajectory:

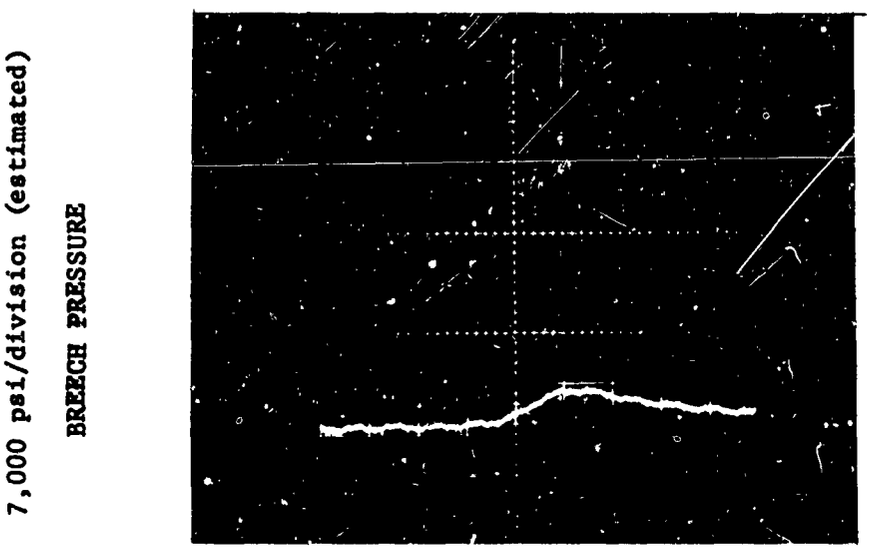
No trajectory data were obtained.

Summary:

The shot was successful. The vehicle was recovered between the West Fastax Station and the ocean; this was thus the second round the vehicle had survived.

WOOD TEST SLUG #3

22 FEBRUARY 1966 - 1300 AST



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 6,000 psi (estimated)

CHARGE: 560 lb PYRO .048

FIG. 2.5 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND WOOD TEST SLUG #3

Round No. 188 - JAMAICA

Date: 23 February 1966 - 1836:30 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	183.5 lb
	Pusher and Obturator	120.8 lb
	Sabot	105.0 lb
	Shot Weight	409.3 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	930 lb M8M.270 (10 bags)
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 330
Igniter	500 grams/bag
Gun Elevation	85.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	222 in
Ram Load	20 tons
Chamber Volume	47,200 in^3
Recoil	41 in
Breech Pressure	M11: 40,000 psi Strain: 42,000 psi (estimated) (Fig. 2.6)

Note: The Mylar cover split when an attempt was made to evacuate the gun barrel.

Camera Records:

Smear and Fastax cameras were not used for this shot.

Radar Records:

The M-33 radar tracked the vehicle from T + 8 sec to T + 40 sec. The MPS-19 radar tracked from T + 10 sec to T + 100 sec.

Neither apogee nor splash were observed.

Trajectory:

The radar data are plotted in Fig. 2.6a in comparison with a standard drag trajectory for a muzzle velocity of 5800 ft/sec. The apogee derived from the radar data was 392,000 ft = 119 km, and the total range was estimated to be 130,000 ft.

TMA Trail Results:

Cameras and payload functioned properly. The "sunset" blue trail was clearly seen but no wind data could be evaluated.

Summary:

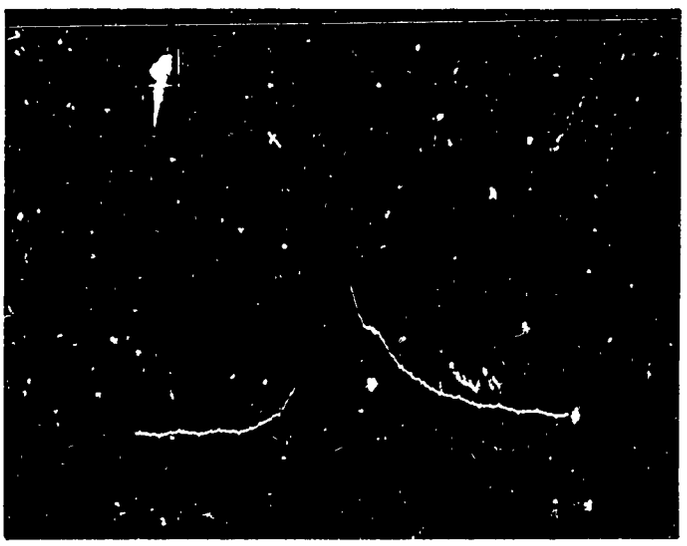
The shot was successful.

JAMAICA

23 FEBRUARY 1965 - 1836.30 AST

7,000 psi/division (estimated)

BREECH PRESSURE



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 42,000 psi

CHARGE: 930 lb M8M.270

FIG. 2.6 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND JAMAICA

JAMAICA

23 February 1965 - 1836:30 AST

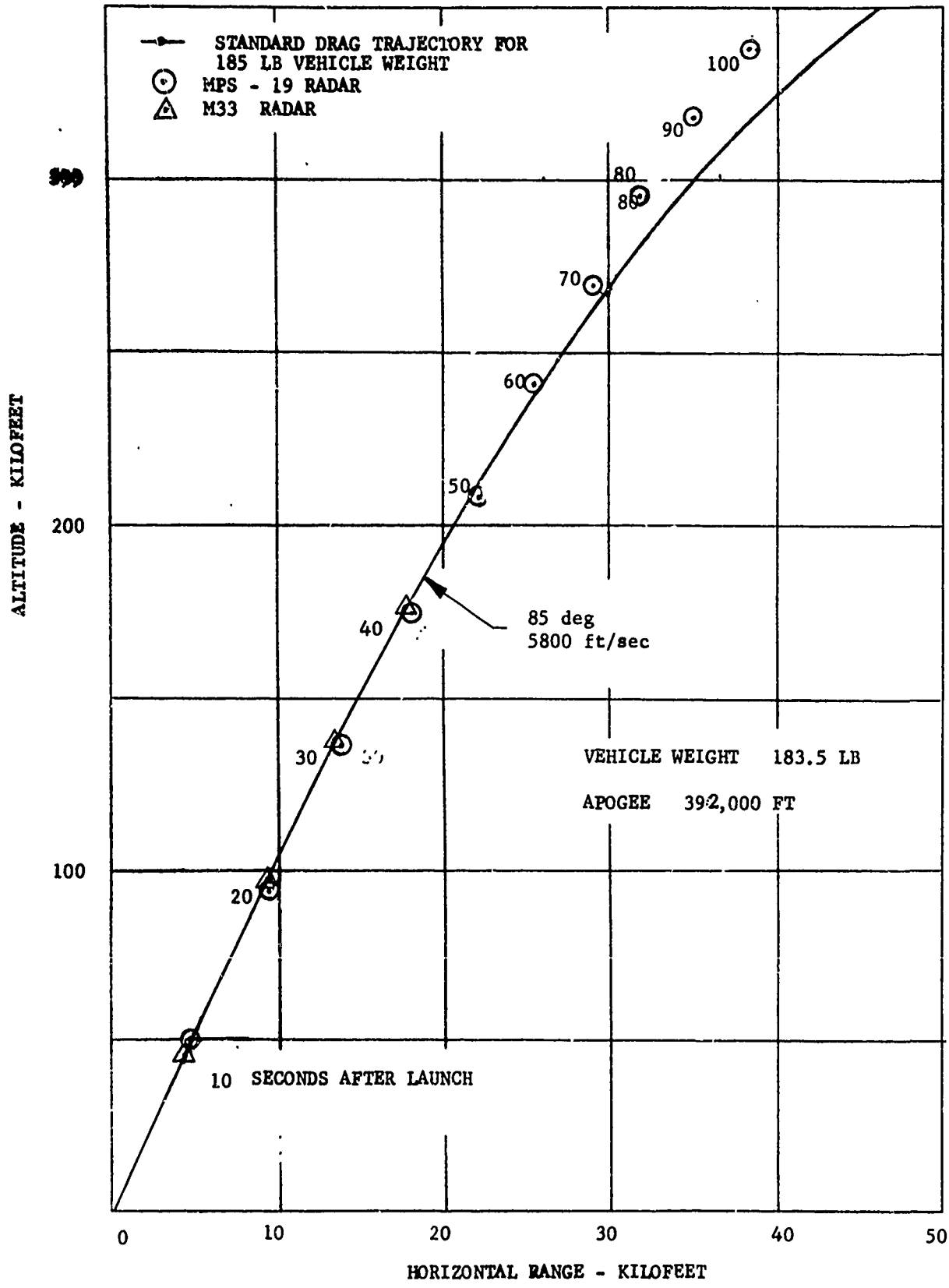


FIG. 2.6a MARTLET ⊛C JAMAICA
ALTITUDE VS. RANGE

Round No. 189 - ST. KITTS

Date: 23 February 1966 - 2046 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	183.0 lb
	Pusher and Obturator	120.8 lb
	Sabot	105.0 lb
	Shot Weight	408.8 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	970 lb M8M.270 (10 bags) Lot No. CAD 9034
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 370
Igniter	500 grams/bag
Gun Elevation	85.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	222 in
Ram Load	28 tons
Chamber Volume	47,200 in^3
Recoil	41.0 in
Breech Pressure	M11: 44,700 psi Strain: 45,000 psi (estimated) (Fig. 2.7)
Evacuation	27 in. Hg

Camera Records:

No Smear or Fastax cameras were used.

Radar Records:

The M-33 radar tracked from T + 5 sec to T + 33 secs and the MPS-19 radar tracked from T + 10 sec to T + 90 sec. Apogee and splash were not observed.

Trajectory:

The radar data are plotted in Figure 2.7a in comparison with a standard drag trajectory for a muzzle velocity of 6100 ft/sec. The apogee derived from the radar data was 430,000 ft = 131 km. Total range was estimated as 145,000 ft.

TMA Trail Results:

Payload and cameras functioned satisfactorily. A good trail was photographed and wind data were obtained between altitudes of 87 km and 131 km, with the exception for the region between 95 and 98 km; these data are not thought to be accurate because of poor photographic results in this region.

Summary:

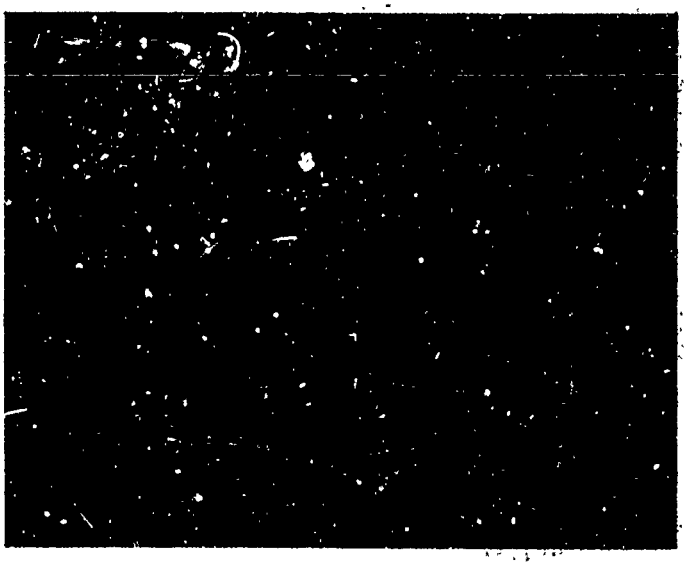
This shot was a success. Trajectory and payload performance were satisfactory and good data were obtained on upper atmosphere winds.

ST. KITTS

23 FEBRUARY 1966 - 2046 AST

7,000 psi/division (estimated)

BREECH PRESSURE



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 45,000 psi (estimated)

CHARGE: 970 lb M8M.270

FIG. 2.7 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND ST. KITTS

ST. KITTS

23 February 1966 - 2046 AST

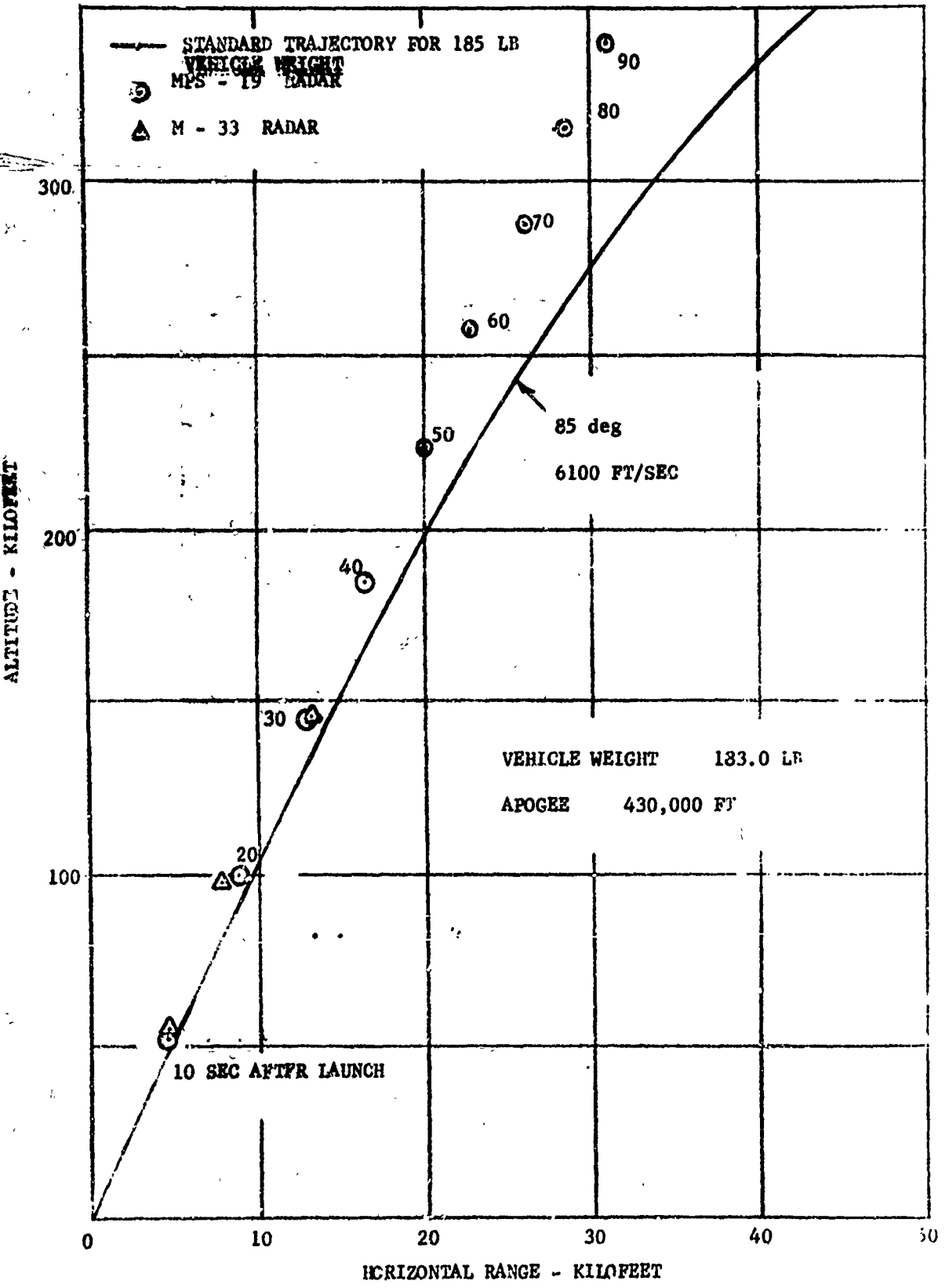


FIG. 2.7a MARTLET 2C ST. KITTS
ALTITUDE VS. RANGE

Round No. 190 - ST. LUCIA

Date: 23 February 1966 - 2203 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.0 lb TMA with delay release mechanism. The vehicle also carried an HDL telemetry nose cone.

Purpose of Test: Synoptic measurements of wind profiles, and to test the telemetry command receiver system.

Weights:

Vehicle	184.0 lb
Pusher and Obturator	120.8 lb
Sabot	103.0 lb
Shot Weight	407.8 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	975 lb M8M.270 (10 bags) Lot No. CAD 9032
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 375
Igniter	500 grams/bag
Gun Elevation	85.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	222 in
Ram Load	28 tons
Chamber Volume	47,200 in^3
Recoil	42 in
Breech Pressure	M11: 43,500 psi Strain: 45,000 psi (estimated) (Fig. 2.8)
Evacuation	27 in Hg of vacuum

Camera Records:

Smear and Fastax cameras were not used.

Radar Records:

The M-33 radar tracked the vehicle from T+5 to T+77 sec

There was very strong and regular cyclic variation in signal strength. It finally faded completely and the M-33 radar lost track of the vehicle.

The MPS-19 radar tracked the vehicle from T + 10 sec to T + 110 sec. Neither apogee nor splash was observed.

Trajectory:

The radar data are plotted in Figure 2.8a in comparison with the standard drag trajectory for a muzzle velocity of 5800 ft/sec. The apogee derived from the radar data were 383,000 ft = 117 km. The total range was estimated as 130,000 ft.

TMA Trail Results:

The payload functioned well and a good trail was photographed yielding data on winds between 95 km and 117 km.

Telemetry:

This round contained a 421.5 MHz crystal controlled receiver and a 245 MHz transmitter. The intended test was to send a 22 KC signal to the vehicle via the 421.5 MHz ground transmitter and back to the ground station via the 245 MHz transmitter. No signals were observed.

The antennae used on the vehicle were flush mounted quadra-loop antennae.

Summary:

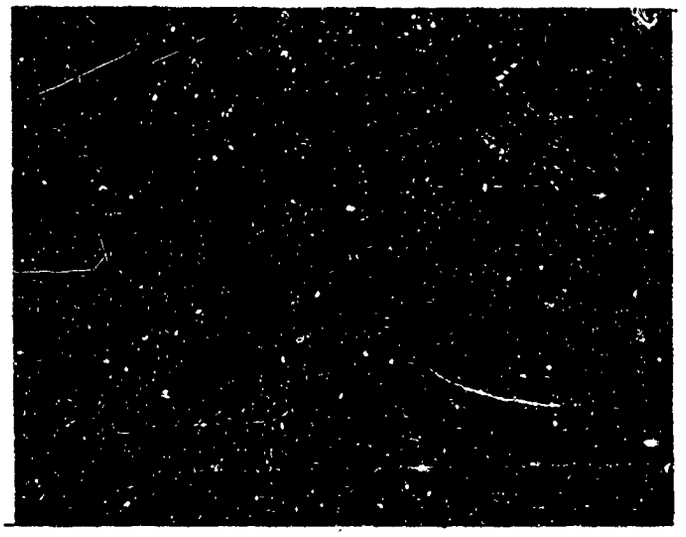
The shot was a partial success. The TMA payload functioned well but for unknown reasons the HDL nose cone telemetry failed to work.

ST. LUCIA

23 FEBRUARY 1966 - 2203 AST

7,000 psi/division (estimated)

BREECH PRESSURE



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 45,000 psi (estimated)

CHARGE: 975 lb M8M.270

FIG. 2.8 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND ST. LUCIA

II-38

ST. LUCIA

23 February 1966 - 2203 AST

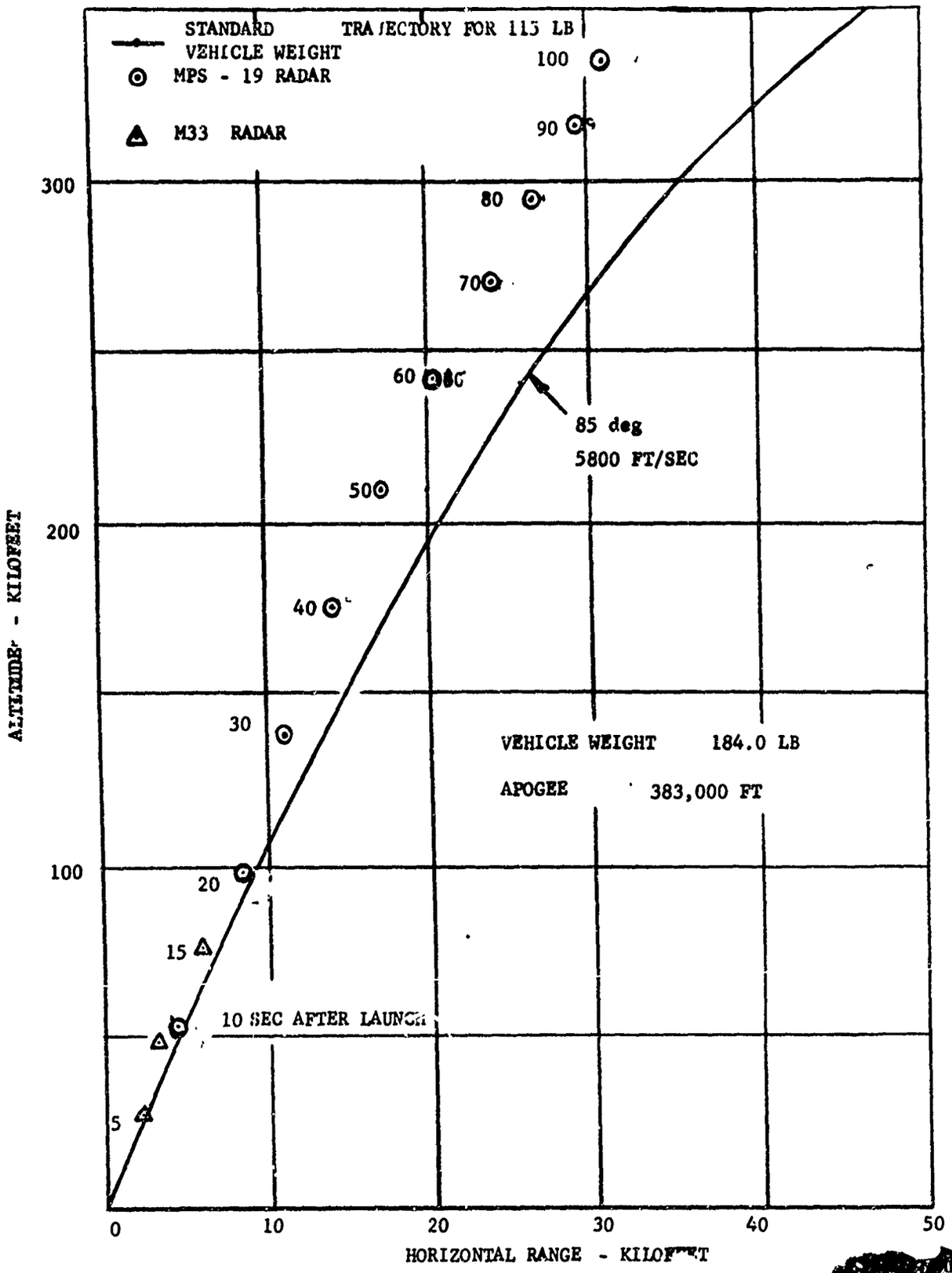


FIG. 2.8a MARTLET 2C ST. LUCIA

ALTITUDE VS. RANGE

Round No. 191 - MONTSERRAT

Date: 23 February 1966 - 2321 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	183.5 lb
	Pusher and Obturator	120.8 lb
	Sabot	103.5 lb
	Shot Weight	407.8 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	975 lb M&M.270 (11 bags) (325 lb Lot No. 9034, 650 lb Lot No. 9032)
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 375
Igniter	500 grams/bag
Gun Elevation	85.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	223.5 in
Ram Load	19 tons
Chamber Volume	47,500 in^3
Recoil	42 in
Breech Pressure	M11: 41,750 psi Strain: 45,000 psi (estimated) (Fig. 2.9)
Evacuation	28 in Hg of vacuum

Camera Records:

Smear and Fastax cameras were not used.

Radar Records:

The M-33 radar tracked the vehicle from T + 5 sec to T + 33 sec.

Apogee and splash were not observed.

Trajectory:

The trajectory obtained from the radar data is plotted in Figure 2.9a in comparison with a standard drag trajectory for a muzzle velocity of 6100 ft/sec. The apogee derived from these data was 433,000 ft = 132 km, with a total range of 145,000 ft.

TMA Trail Results:

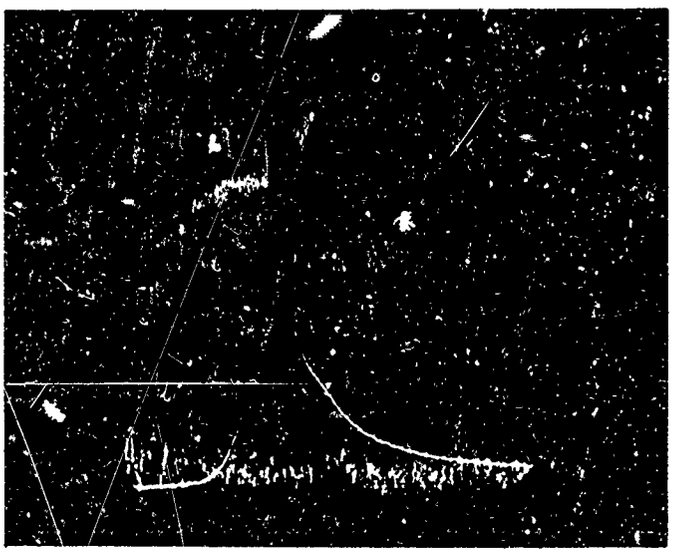
Cameras and payload functioned properly but photographs of the trail were of poor quality because of bad weather. Only a small portion of the trail (between 111 km and 120 km) was useable, and resultant wind data are considered less reliable than for other shots in this series.

Summary:

The shot was a moderate success. The trajectory and payload performance were satisfactory but as a result of poor weather conditions, photographs of the TMA trail were of low quality and only wind data of limited value were obtained.

MONTSERRAT

23 FEBRUARY 1966 - 2321 AST



7,000 psi/division (estimated)

BREECH PRESSURE

TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 45,000 psi (estimated)

CHARGE: 475 lb M8M.270

FIG. 2.9 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND MONTSERRAT

MONTSERRAT

23 February 1966 - 2321 AST

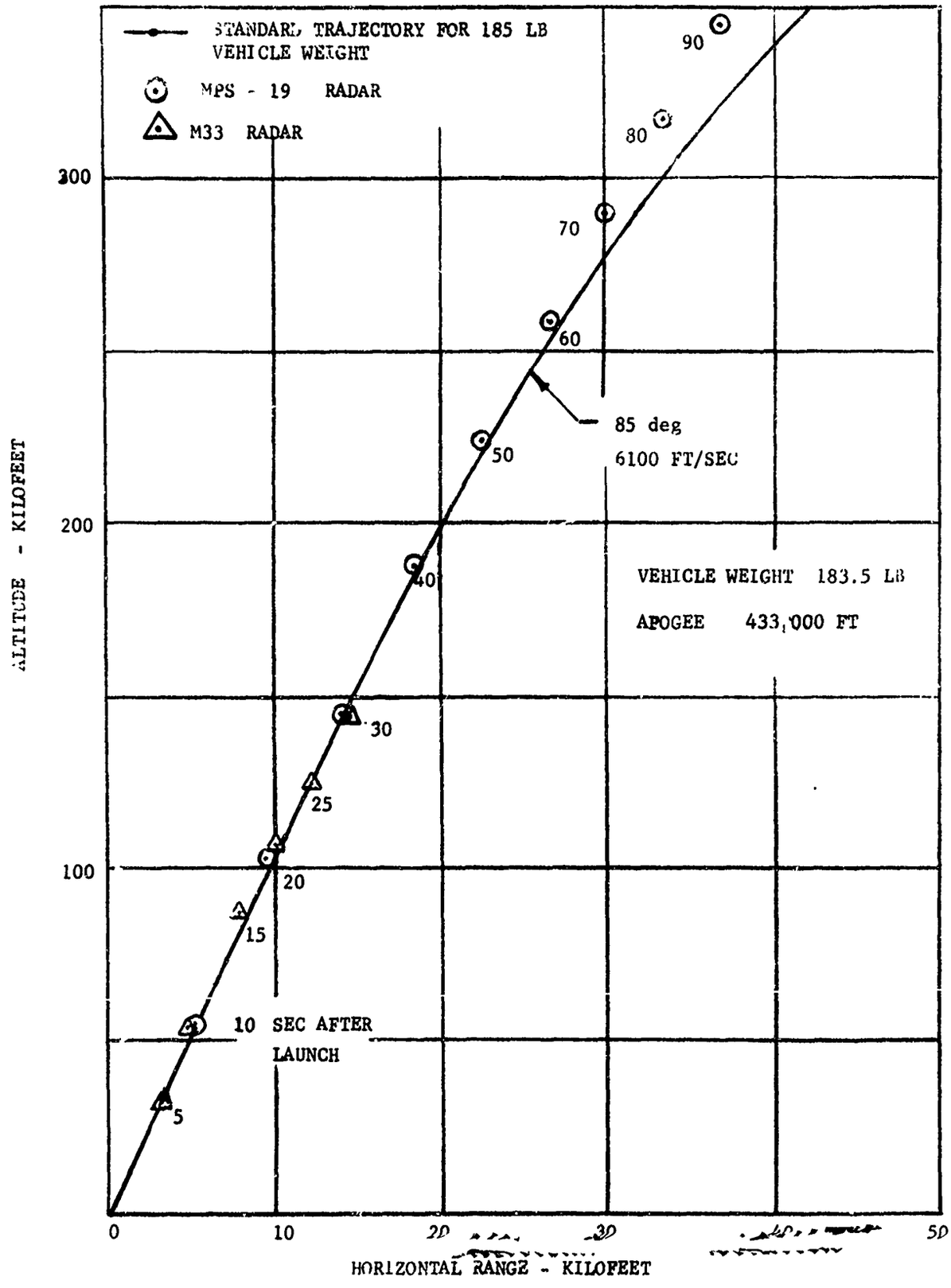


FIG. 2.9a MARTLET 2C MONTSERRAT
ALTITUDE VS. RANGE

Round No. 192 - NEVIS

Date: 24 February 1966 - 0025 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	183.5 lb
	Pusher and Obturator	120.8 lb
	Sabot	106.0 lb
	Shot Weight	410.3 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	975 lb M&M (12 bags) (225 lb Lot No. 9030 .218 Web 750 lb Lot No. 9034 .270 Web)
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 375
Igniter	500 grams/bag
Gun Elevation	85.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	222 in
Ram Load	20 tons
Chamber Volume	47,200 in^3
Recoil	42 in
Breech Pressure	M11: 49,000 psi Strain: 50,000 psi (estimated) (Fig. 2.10)
Evacuation	28 in Hg of vacuum

Camera Records:

Smear and Fastax cameras were not used.

Radar Records:

The M-33 radar did not track the vehicle. The tracking transmitter became non-serviceable at the same time as the gun fired.

The MPS-19 radar tracked the vehicle but no time scale was available due to loss of communications with launch control at launch.

Trajectory:

The trajectory (altitude vs. range) is shown in Figure 2.10a in comparison with the standard drag trajectory for a muzzle velocity of 6300 ft/sec. The apogee derived from the radar data was 460,000 ft = 140 km, and the total range was estimated as 155,000 ft.

TMA Trail Results:

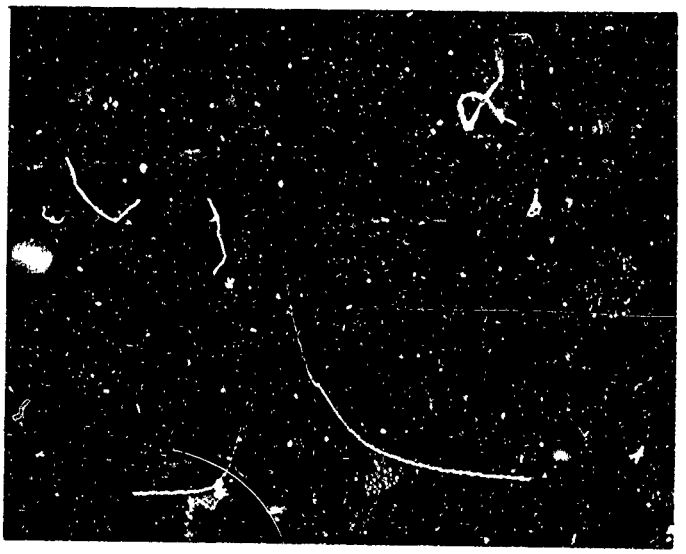
The payload functioned properly and a good trail was photographed, yielding data on winds between altitudes of 91 km and 122 km.

Summary:

The shot was successful.

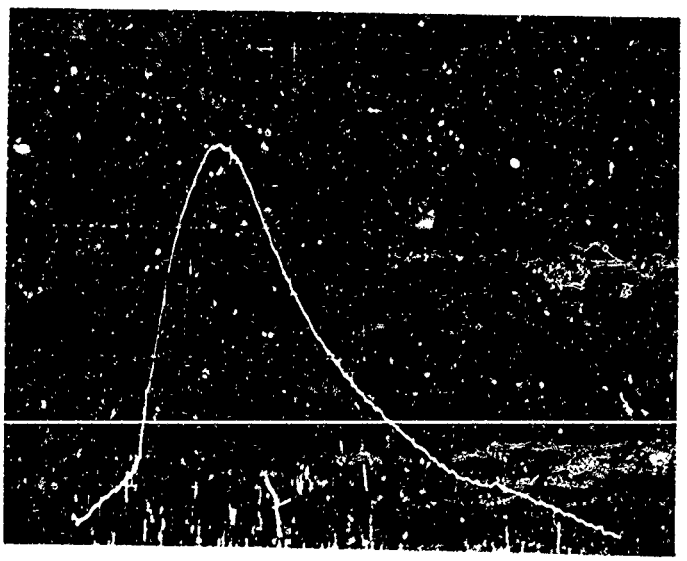
NEVIS

24 February 1966 - 0025 AST



7000 psi/division (estimated)
BREECH PRESSURE

TIME
Scope #1
20 milliseconds/division



TIME
Scope #2
5 milliseconds/division

Maximum Breech Pressure: P_{max} = 50,000 psi (estimated)

FIG. 2.10 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND NEVIS

NEVIS

24 FEBRUARY 1966 - 0025 AST

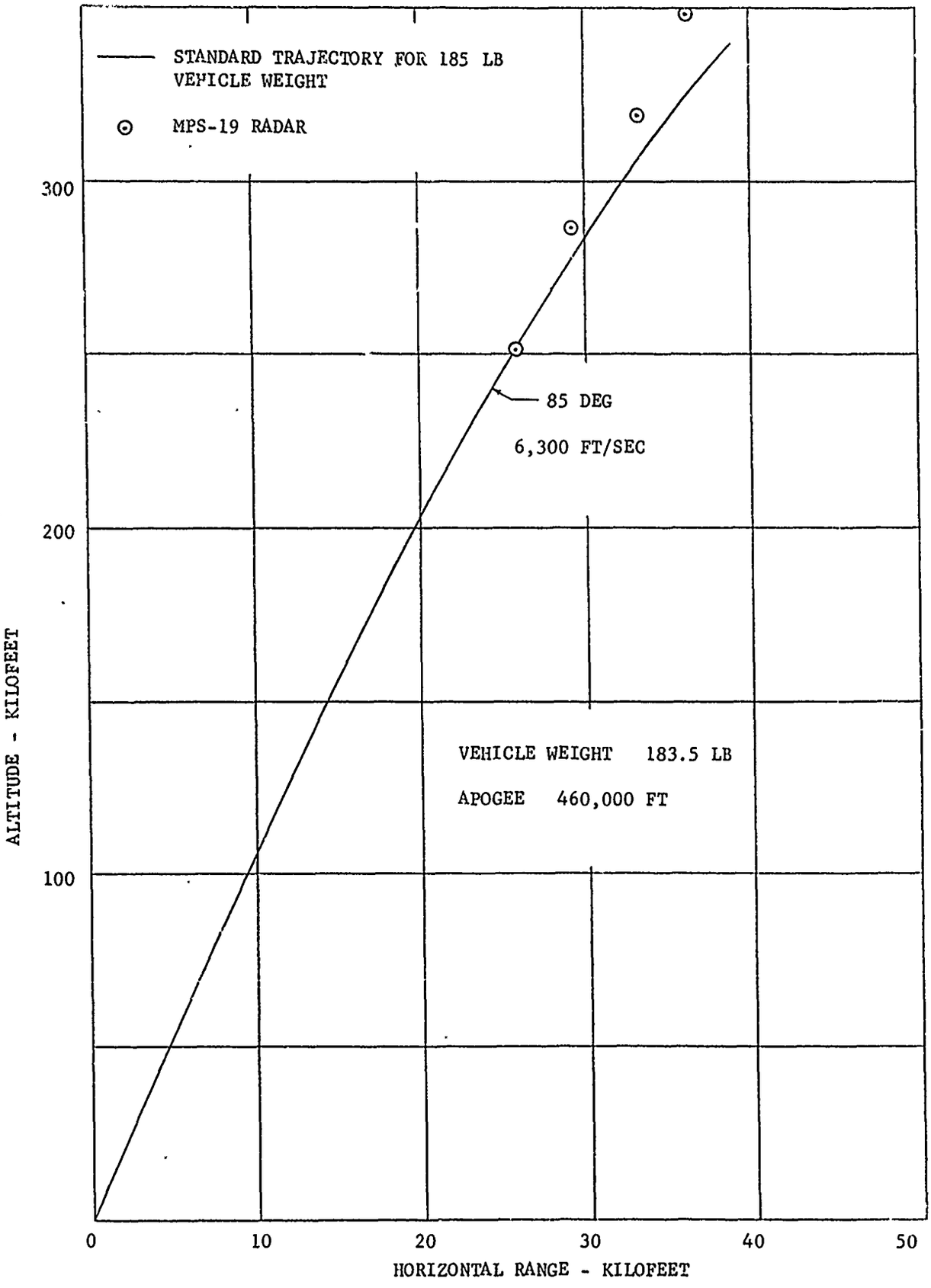


FIG. 2.10a MARTLET 2C NEVIS
ALTITUDE VS RANGE

Round No. 193 - OCHO RIOS

Date: 24 February 1966 - 0216 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	183.5 lb
	Pusher and Obturator	120.8 lb
	Sabot	106.0 lb
	Shot Weight	410.3 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	965 lb M8M (13 bags) (610 lb Lot 9034 .270 Web 355 lb Lot 9030 .218 Web)
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 365
Igniter	500 grams/bag
Gun Elevation	85.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	222 in
Ram Load	14 tons
Chamber Volume	47,200 in^3
Recoil	41 in
Breech Pressure	M11: 53,500 psi Strain: 53,000 psi (estimated) (Fig. 2.11)
Evacuation	27 in Hg of vacuum

Camera Records:

Smear and Fastax cameras were not used.

Radar Records:

The MPS-19 radar and the M-33 radar were unable to sight the vehicle.

Trajectory:

No trajectory data were obtained.

TMA Trail Results:

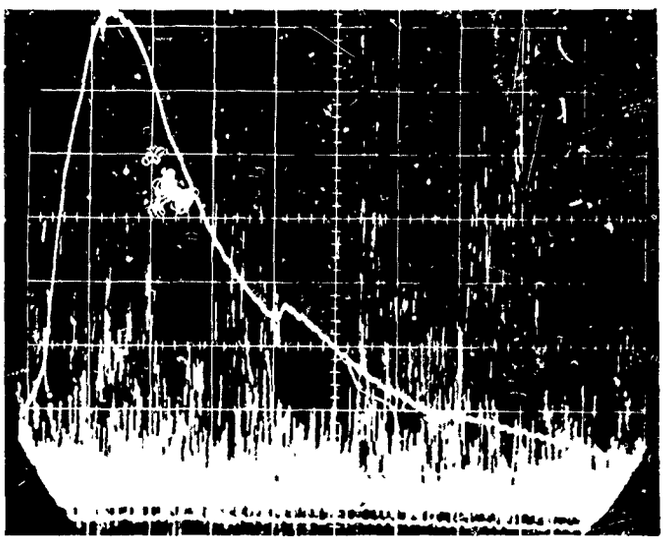
There were no results since the vehicle broke up at launch.

Summary:

This was an unsuccessful shot. The vehicle was recovered at the end of the runway in damaged condition (without fins and nose cone).

OCHO RIOS

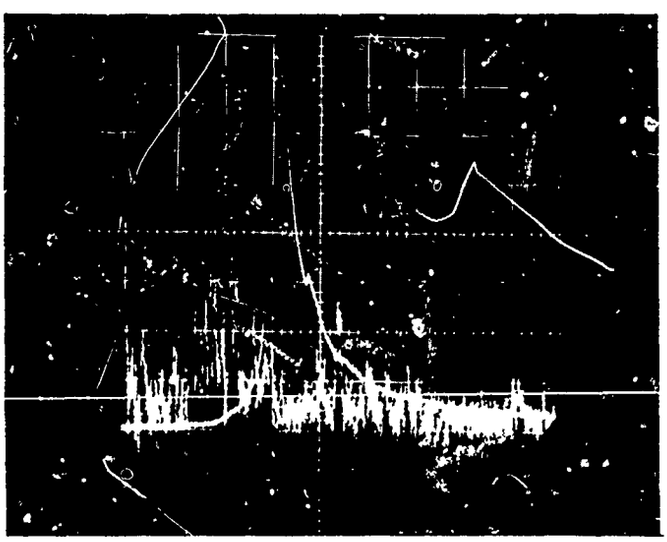
24 February 1966 - 0216 AST



7000 psi/division (estimated)
BREECH PRESSURE

TIME

5 milliseconds/division



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 53,000 psi (estimated)

CHARGE : 965 lb M8M .270 and .218

FIG. 2.11 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND OCHO RIOS

Round No. 194 - PUERTO RICO

Date: 24 February 1966 - 0327 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	183.5 lb
	Pusher and Obturator	120.8 lb
	Sabot	105.0 lb
	Shot Weight	409.3 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	850 lb WMM.225 (9 bags) Lot No. CAD 7502
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 250
Igniter	500 grams/bag
Gun Elevation	85.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	224 in
Ram Load	14 tons
Chamber Volume	47,600 in^3
Recoil	40 in
Breech Pressure	M11: 54,000 psi Strain: 53,000 psi (estimated) (Fig. 2.12)
Evacuation	27 in Hg

Camera Records:

No Fastax or smear cameras were used.

Radar Records:

The M-33 radar was unserviceable for tracking purposes and was used for surveillance only.

The MPS-19 radar tracked the vehicle from T + 10 sec to

T + 80 sec.

Neither apogee nor splash were observed.

Trajectory:

The MPS-19 radar results are plotted in Figure 2.12a in comparison with a standard drag trajectory for a muzzle velocity of 5900 ft/sec. It appears from the range data that the actual launch elevation was higher than 85 deg (approximately 86 deg). The apogee derived from the radar data was 400,000 ft = 122 km, and the total range was estimated as 135,000 ft.

TMA Trail Results:

The payload functioned satisfactorily and photographs were taken yielding wind data between altitudes of 90 km and 123 km.

Summary:

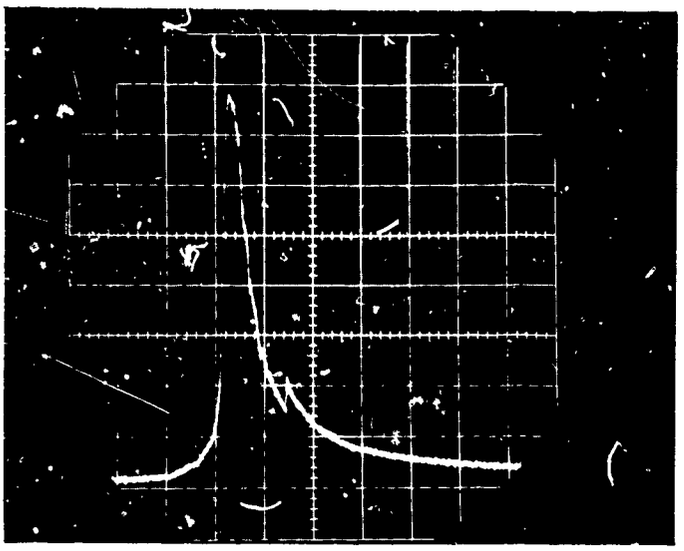
This shot was successful.

PUERTO RICO

24 FEBRUARY 1966 - 0327 AST

7,000 psi/division (estimated)

BREECH PRESSURE



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 53,000 psi (estimated)

CHARGE: 850 lb WMM.225

FIG. 2.12 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND PUERTO RICO

PUERTO RICO

24 FEBRUARY 1966 - 0327 AST

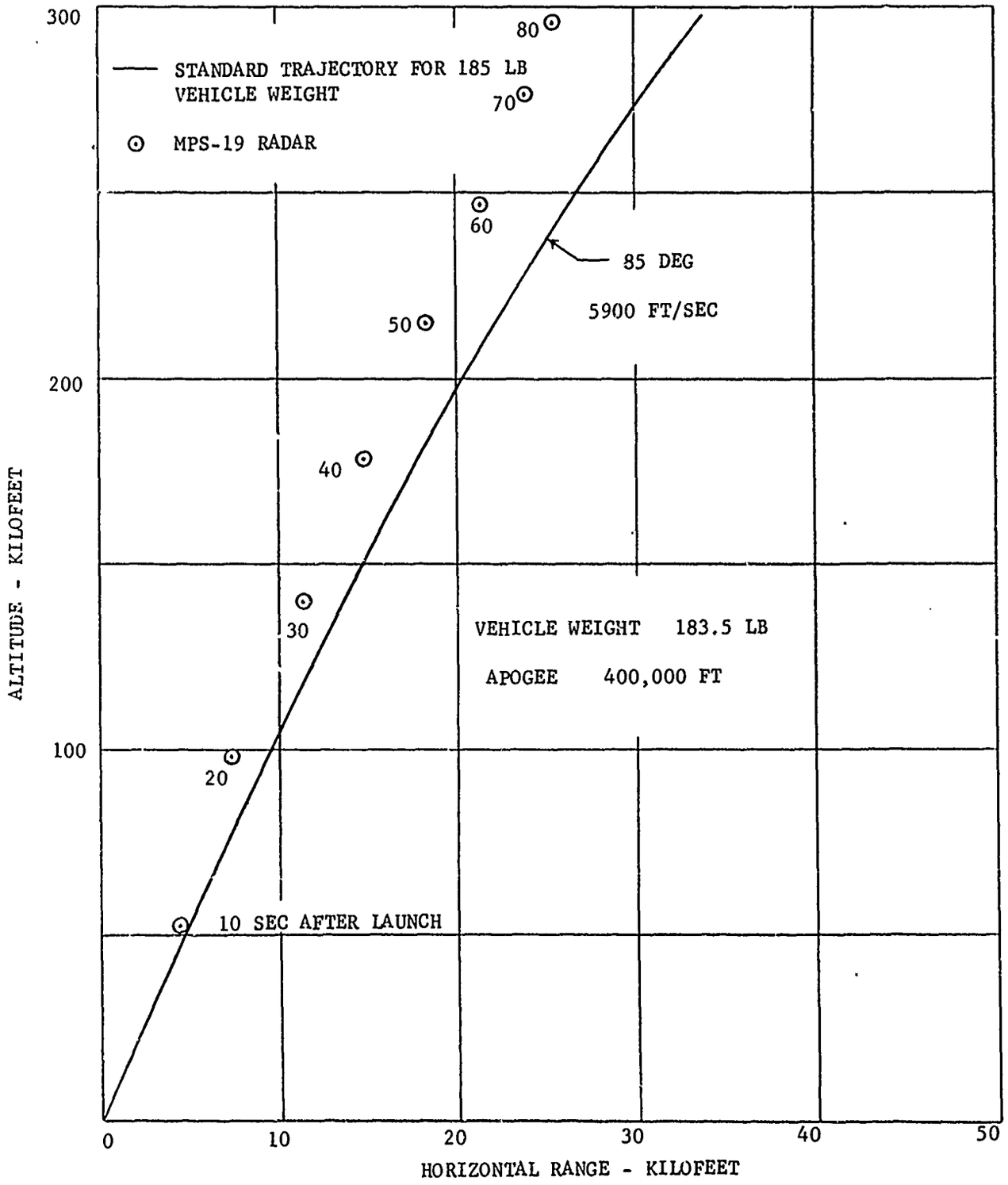


FIG. 2.12a MARTLET 2C PUERTO RICO

ALTITUDE VS RANGE

Round No. 195 - LA RAIZET

Date: 24 February 1966 - 0425 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	184.0 lb
	Pusher and Obturator	120.8 lb
	Sabot	108.5 lb
	Shot Weight	413.3 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	850 lb WMM.225 (9 bags) Lot No. CAD 7502
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 250
Igniter	500 grams/bag
Gun Elevation	85.0 deg
Crusher Gauges and Coppers	M11: 5
Ram Distance	225 in
Ram Load	12 tons
Chamber Volume	47,800 in^3
Recoil	40 in
Breech Pressure	M11: 51,500 psi Strain: Not available
Evacuation	27 in Hg

Camera Records:

No smear or Fastax cameras were used.

Radar Records:

The M-33 radar was unserviceable except for surveillance purposes.

The MPS-19 radar tracked the vehicle from T + 10 sec to T + 90 sec.

Neither apogee nor splash was observed.

Trajectory:

The MPS-19 data are plotted in Figure 2.13a in comparison with the standard drag trajectory for a muzzle velocity of 6100 ft/sec. The apogee derived from the radar data was 425,000 ft = 130 km, and the total range was estimated as 145,000 ft.

TMA Trail Results:

No trail was observed for this round. This may be related to the fact that the TMA had been loaded into the vehicle three months before firing.

Summary:

The vehicle was successfully launched along a satisfactory trajectory, but the TMA payload was not released.

LA RAIZET

24 FEBRUARY 1966 - 0425 AST

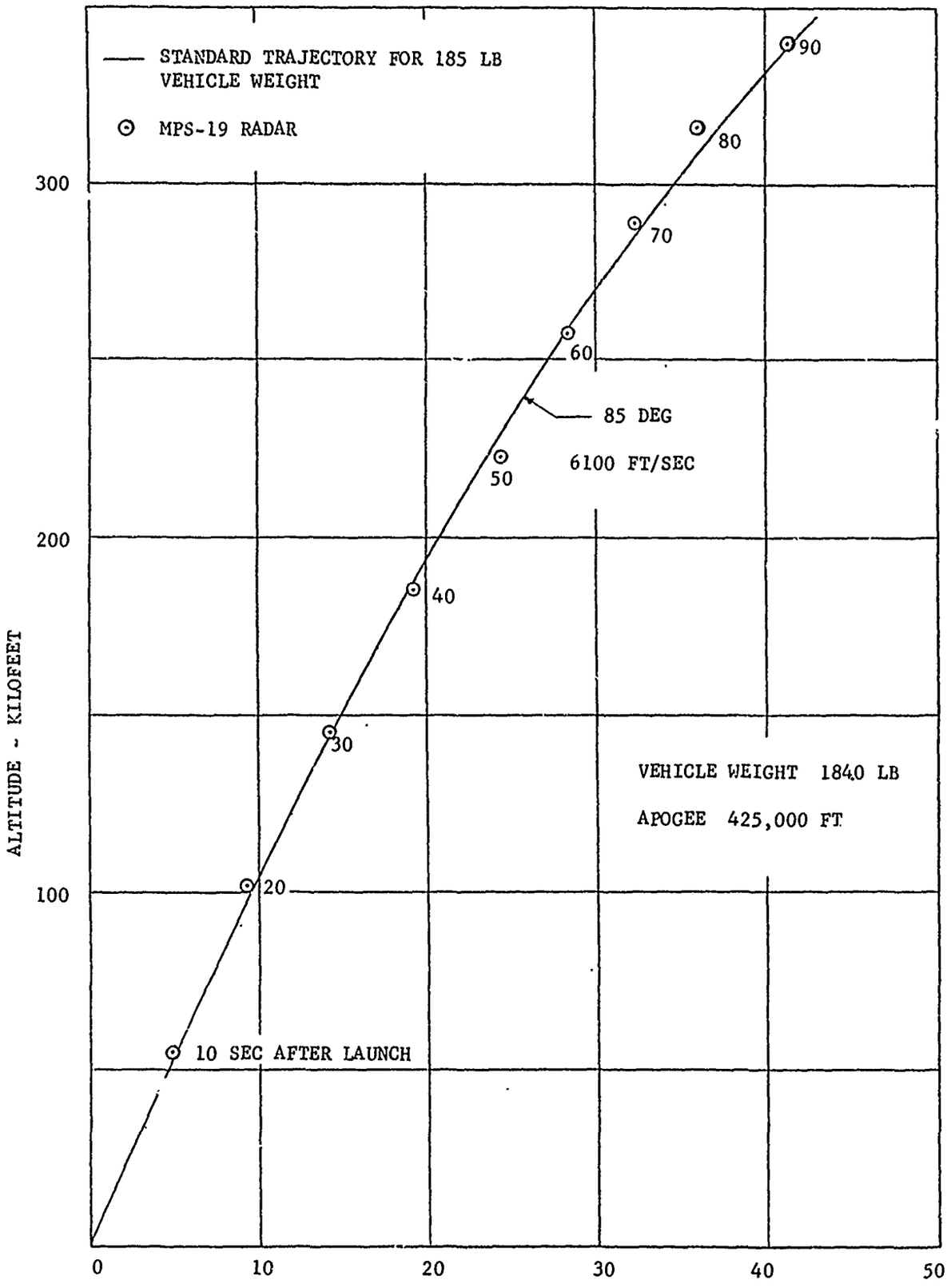


FIG. 2.13a MARTLET 2C LA RAIZET

ALTITUDE VS RANGE

Round No. 196 - ST. THOMAS

Date: 24 February 1966 - 0523:30 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test:

Synoptic measurements of wind profiles.

Weights:		
	Vehicle	183.5 lb
	Pusher and Obturator	120.8 lb
	Sabot	104.0 lb
	Shot Weight	408.3 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	850 lb WMM.225 (9 bags)
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 250
Igniter	500 grams/bag
Gun Elevation	85.0 deg
Crusher Gauges and Coppers	M11: 4
Ram Distance	222 in
Ram Load	18 tons
Chamber Volume	47,200 in^3
Recoil	39 in
Breech Pressure	M11: 48,500 psi Strain: Not available
Evacuation	No

Camera Records:

No smear or Fastax cameras were used.

Radar Records:

The M-33 radar was unserviceable for tracking purposes and was used for surveillance only.

The MPS-19 radar tracked the vehicle from T + 10 sec to

T + 120 sec.

Neither apogee nor splash was observed.

Trajectory:

The MPS-19 radar data are plotted in Figure 2.14a in comparison with the standard drag trajectory for a muzzle velocity of 5700 ft/sec. The range data indicate that the actual launch elevation was higher than 85 deg (approximately 86 deg). The apogee derived from the radar data was 380,000 ft = 116 km, and the total range was estimated as 125,000 ft.

TMA Trail Results:

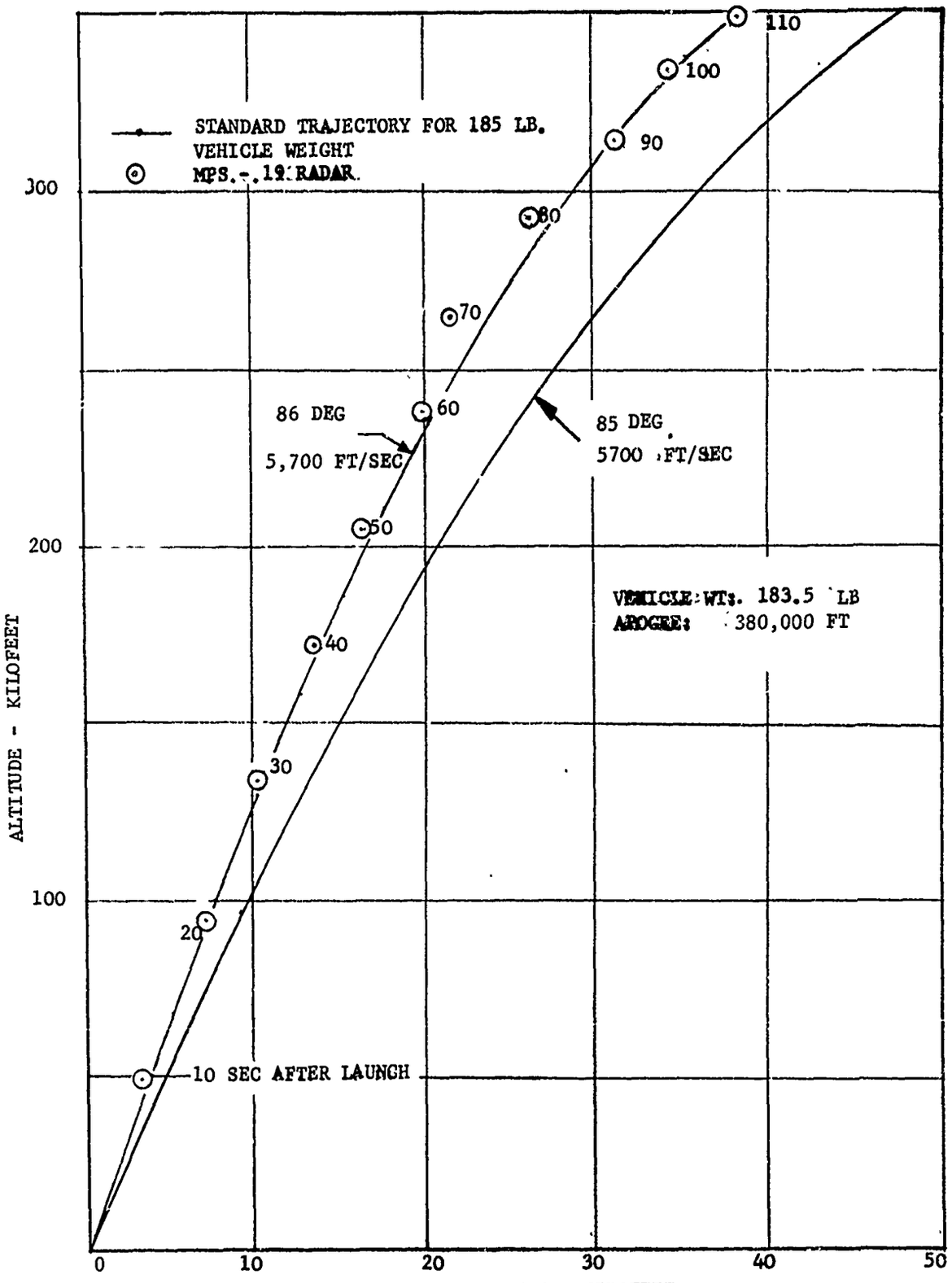
Cameras and payload functioned properly. Wind shear data were obtained between altitudes of 96 to 118 km.

Summary:

The shot was successful.

ST THOMAS

24 February 1966 - 0523:30 AST



FIF. 2.14a MARTLET 2C ST. THOMAS
ALTITUDE VS RANGE

Round No. 197 - WOOD TEST SLUG #4

Date: 25 February 1966 - 1204 AST

Vehicle Description: Laminated wood slug with aluminum ends.

Purpose of Test: Test of propellant.

Weights: Vehicle and shot weight 413.5 lb.

Launch Data:

Charge Weight	887.5 lb (7 bags of PYRO ALN-IK-HA-53 @ 1125 lb plus 100 lb of WM.048 wrapped around 5 bags of PYRO)
Spacing of Charge	225.0 lb PYRO, 40 lb WM x 225.0 lb PYRO, 40 lb WM x 225.0 lb PYRO, 20 lb WM x 112.5 lb PYRO
Igniter	500 grams/bag
Gun Elevation	80.0 deg
Crusher Gauges and Coppers	M11: 5
Ram Distance	224 in
Ram Load	90 tons
Chamber Volume	47,500 in^3
Recoil	32 in
Breech Pressure	M11: 34,500 psi Strain: Not available
Evacuation	None

Camera Records:

The front smear camera obtained a good image of the slug, but the rear smear camera was not in focus and obtained no useful image.

All Fastax cameras functioned.

Radar Records:

The M-33 radar did not sight the vehicle.

The MPS-19 radar tracked the base plate to T + 16 sec.

Trajectory:

No trajectory was obtained for this vehicle.

Summary:

The 100 lb WM wrapped around the PYRO propellant increased the burning rate.

Round No. 198 - ELEUTHERA

Date: 25 February 1966 - 1420 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a SOFAR impact test payload weighing 4 lb.

Purpose of Test: Engineering test of impact device.

Weights:		
	Vehicle	186.0 lb
	Pusher and Obturator	120.8 lb
	Sabot	103.0 lb
	Shot Weight	409.8 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	875 lb WMM.225 (9 bags) Lot No. CAD 7502
Swedish Additive	15 sheets
Spacing of Charge	300 x 300 x 275
Igniter	500 grams/bag
Gun Elevation	80.0 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	223 in
Ram Load	10 tons
Chamber Volume	47,250 in^3
Recoil	38 in
Breech Pressure	M11: 53,500 psi Strain: Not available
Evacuation	No

Camera Records:

All cameras functioned properly.

Both smear cameras obtained good images of the vehicle.

From evaluation of Fastax photographs, the following muzzle velocities were determined:

West Fastax (6 inch lens, 160 ft ahead of muzzle) - 6100 ft/sec

East Fastax (10 inch lens, 140 ft ahead of muzzle) - 6400 ft/sec

Radar Records:

The M-33 radar tracked the vehicle from T + 4 sec to T + 23 sec.

The MPS-19 radar tracked the vehicle from T + 10 sec to T + 80 sec.

Neither apogee nor splash was observed.

Trajectory:

The radar data are plotted in Figure 2.15a in comparison with a standard drag trajectory for a muzzle velocity of 6100 ft/sec. The apogee derived from the radar data was 420,000 ft = 128 km, and the total range was estimated as 288,000 ft.

Payload:

The water impact of the vehicle was heard by underwater microphones but no signal was received from an underwater explosion of the bomb.

ELEUTHERA

25 FEBRUARY 1966 - 1420 AST

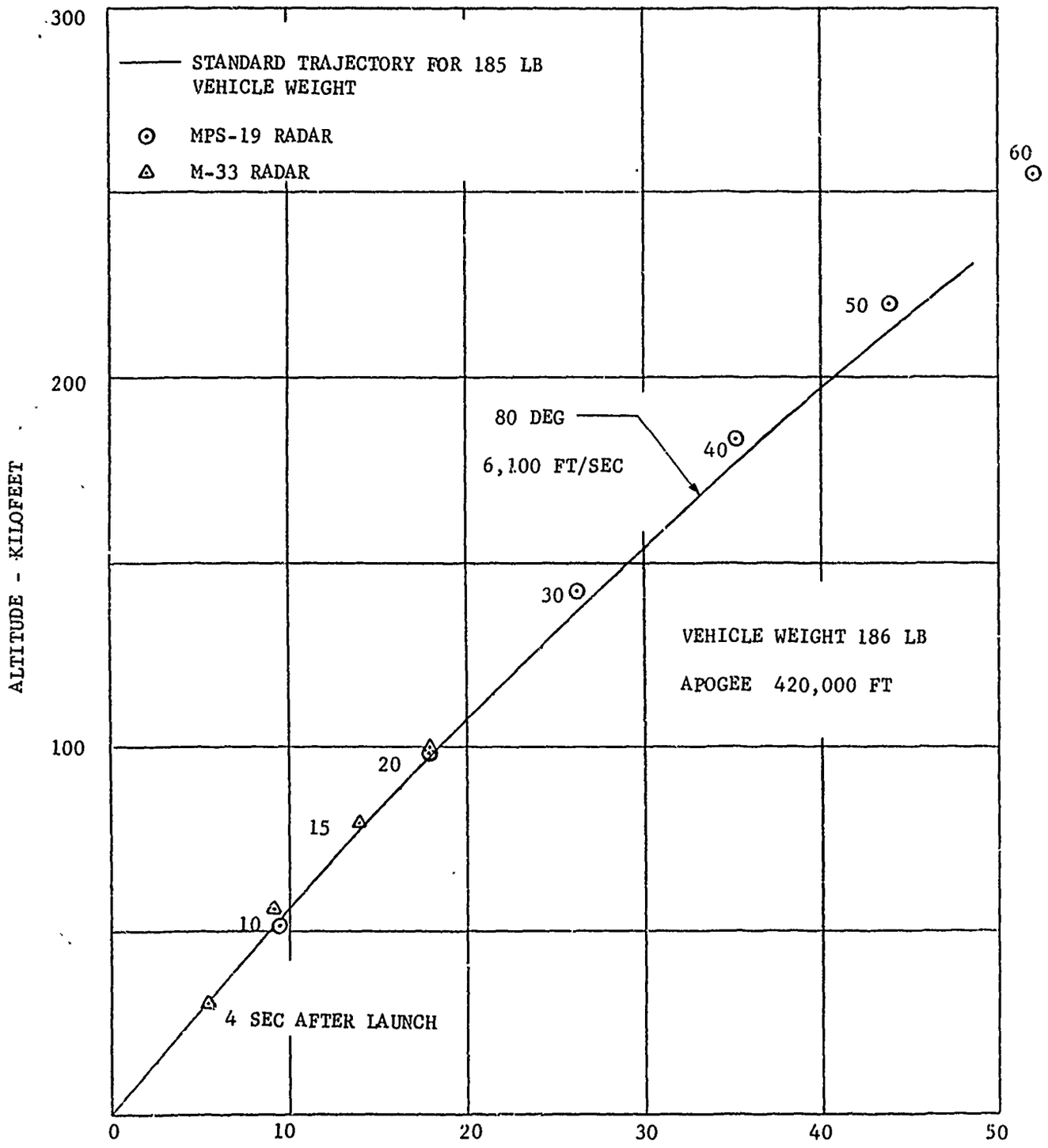


FIG. 2.15a MARTLET 2C ELEUTHERA

ALTITUDE VS RANGE

Round No. 199 - FLAMINGO

Date: 25 February 1966 - 1843 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	183.5 lb
	Pusher and Obturator	118.0 lb
	Sabot	103.0 lb
	Shot Weight	404.5 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	375 lb WMM.225 (9 bags) Lot No. CAD 7502
Swedish Additive	15 sheets
Spacing of Charge	300. x 300 x 275
Igniter	500 grams/bag
Gun Elevation	85.0 deg
Crusher Gauges and Coppers	M11: 4
Ram Distance	223 in
Ram Load	14 tons
Chamber Volume	47,250 in^3
Recoil	39.5 in
Breech Pressure	M11: 56,000 psi Strain: Not available
Evacuation	27 in. Hg of vacuum

Camera Records:

No smear or Fastax cameras were used.

Radar Records:

The M-33 radar tracked the vehicle from T + 6 sec to T + 30 sec.

The MPS-19 radar tracked from T + 10 sec to T + 90 sec.

Neither apogee nor splash was observed.

Trajectory:

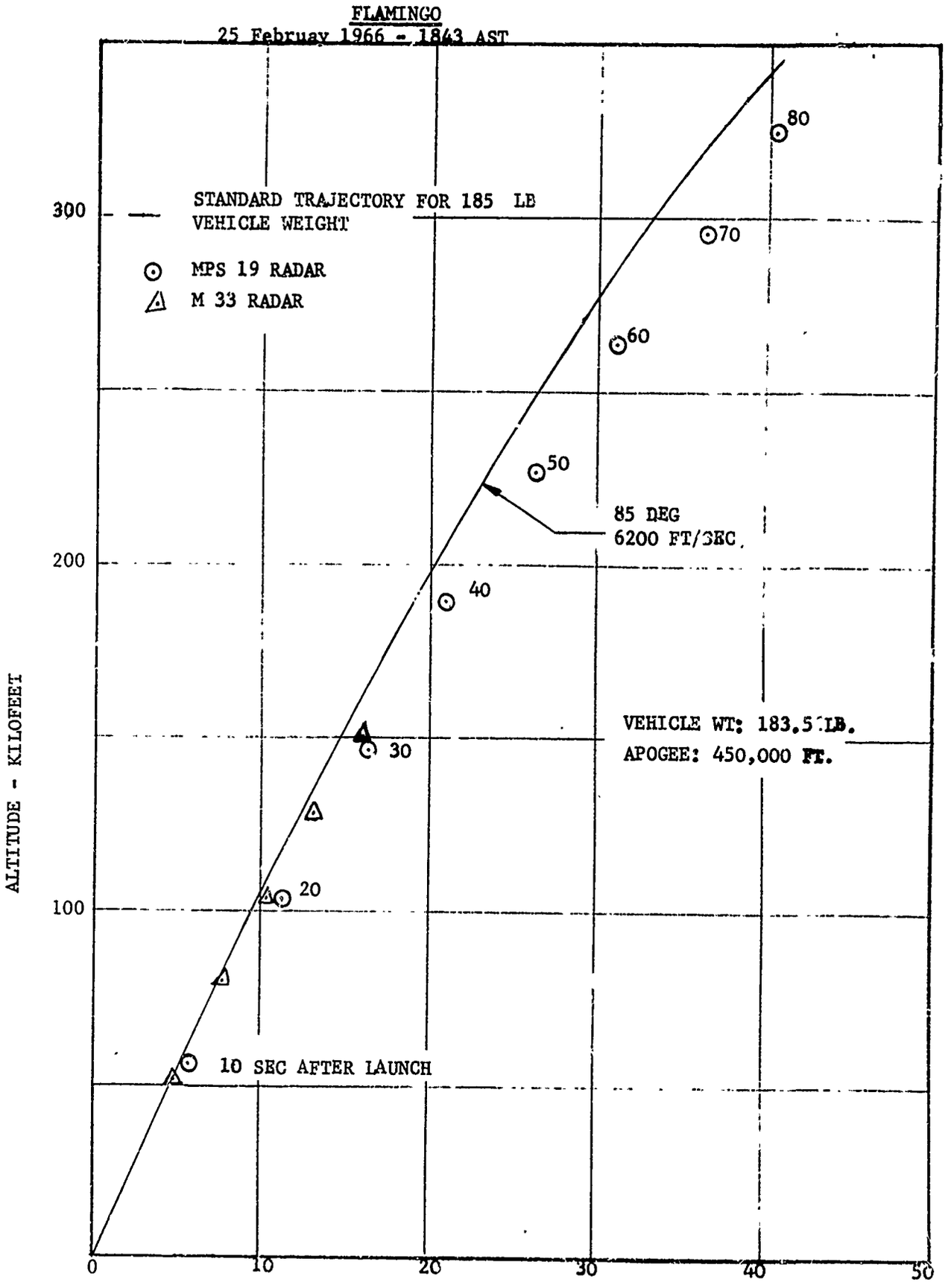
The radar data are plotted in Figure 2.16a in comparison with a standard drag trajectory for a muzzle velocity of 6200 ft/sec. The apogee derived from the radar data was 450,000 ft = 137 km and the total range was estimated as 150,000 ft.

TMA Trail Results:

Cameras and payload functioned properly resulting in wind shear data in the altitude range between 94 km and 130 km.

Summary:

The shot was successful.



FFG. 2.16a MARTLET 2C FLAMINGO
ALTITUDE VS RANGE

Round No. 200 - DONNA

Date: 15 August 1966 - 1933 AST

Vehicle Description: Martlet 2C (Mod 2) carrying an SRI telemetry package and a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Check of TMA payload performance, of the new sleeve in the gun barrel, the propellant performance, and the telemetry package.

Weights:		
	Vehicle	187.0 lb
	Pusher and Obturator	125.5 lb
	Sabot	101.0 lb
	Shot Weight	413.5 lb

Centre of Gravity: 22.33 inches from base.

Launch Data:

Charge Weight	700 lb Pyro (7 bags), Lot No. ALN-1K-4-HA-53 165 lb M6.056 (7 bags), Lot No. 6026
Spacing of Charge	190 x 270 x 160 x 245
Swedish Additive	18 sheets plus 8 sheets painted on chamber and extending 8 ft along bore
Igniter	350 grams/bag of black powder
Gun Elevation	80 deg
Crusher Gauges	M11: 3
Ram Distance	188 in
Ram Load	40 tons
Chamber Volume	39,950 in^3
Recoil	35 in
Breech Pressure	M11: 38,200 psi Strain: Not available
Muzzle Velocity (Probe)	Not available
Gun Evacuation	27 inches of Mercury

Camera Records:

No Fastax and smear cameras were used, nor were the K-46

camera stations manned since no measurement of wind data was intended.

Radar Records:

The M-33 radar tracked the vehicle from T + 6 sec to T + 45 sec. The MPS-19 radar tracked from T + 4 sec to T + 160 sec and again from T + 220 sec to impact at T + 250 sec.

Trajectory:

The radar data are plotted in Figure 2.17a in comparison with the standard trajectory for 4700 ft/sec. The apogee as measured by the MPS-19 radar was 229,000 ft = 70 km, and the total range was 158,000 ft. The data are in good agreement with those of the standard drag trajectory, 229,000 ft and 155,000 ft, respectively.

Note that in Figure 2.17a the reported range data and those reduced by 5000 ft have been given, the latter being in agreement with the M-33 radar data and the standard trajectory data. It appears that an incorrect reference point was used for the data of the radar report.

TMA Trail Results:

No trail was obtained as the vehicle only achieved a low apogee.

Telemetry:

Th 250 MHz telemetry package, with a flip-out antenna, was made by SRI, code named Highwater "Alphie". Some carrier wave was received at 247 MHz though without modulation. Antenna damage or malfunction was suspected.

Summary:

The PYRO propellant produced low breech pressure and consequently a low vehicle muzzle velocity, resulting in a low apogee trajectory. No TMA trail was therefore obtained. The gun performance appeared satisfactory but the telemetry performance was only moderately successful.

DONNA

15 AUGUST 1966 - 1933 AST

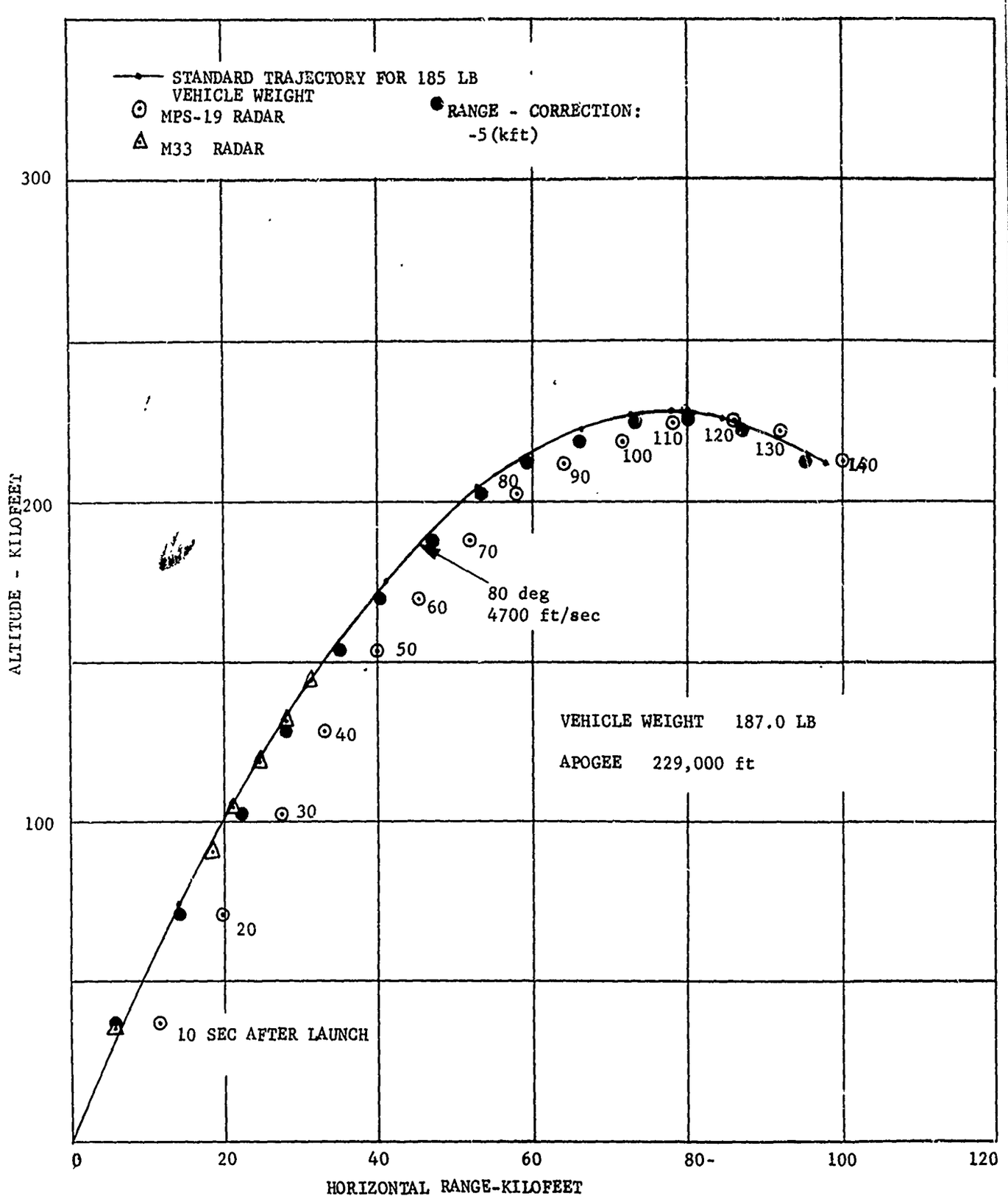


FIG. 2.17a MARTLET 2C (MOD 2) DONNA TRAJECTORY
ALTITUDE VS RANGE

Round No. 201 - TEST SLUG

Date: 16 August 1966 - 1235 AST

Vehicle Description: Solid wood cylinder with attached pusher plate.

Purpose of Test: To test performance of propellant and new gun sleeve.

Weights: Vehicle and shot 410.5 lb

Launch Data:

Charge Weight	706.5 lb Pyro (7 bags), Lot No. ALN-1K-4-HA-53 180.0 lb M6.056 (8 bags), Lot No. 6026
Spacing of Charge	205 x 272 x 249 x 160.5
Swedish Additive	18 sheets
Igniter	350 grams/bag of black powder
Gun Elevation	80 deg
Crusher Gauges	M11: 3
Ram Distance	188 in
Ram Load	30 tons
Chamber Volume	39,950 in^3
Recoil	36 in
Breech Pressure	M11: 58,300 psi Strain: Not available
Muzzle Velocity (Probe)	Not available
Gun Evacuation	27 inches of Mercury

Radar Records and Trajectory:

Both radars did not track so that no trajectory data were available.

Summary:

The gun performance was satisfactory although inspection revealed a failure of the inner liner at breech, and of the weld at front chamber and breech end of sleeve.

The propellant performance appears to be very sensitive as to spacing and to the amount of M-6.

Round No. 202 - FERNANDE

Date: 17 August 1966 - 0522 AST

Vehicle Description: Martlet 2G carrying a payload of TMA with delay release mechanism.

Purpose of Test: Engineering test

Weights:		
	Vehicle	281.5 lb
	Sabot	186.5 lb
	Shot Weight	468.0 lb

Launch Data:

Charge Weight	500 lb WM.245 (3 bags)
Spacing of Charge	None
Swedish Additive	15 sheets
Igniter	500 grams/bag
Gun Elevation	80 deg
Crusher Gauges	M11: 3
Ram Distance	188 in
Ram Load	24 tons
Chamber Volume	39,950 in^3
Recoil	29.5 in
Breech Pressure	M11: 33,600 psi Strain: Not available
Muzzle Velocity (Probe)	5140 ft/sec
Gun Evacuation	None

Camera Records:

The smear photographs showed only a gas cloud, and no vehicle was seen on the Fastax films.

Radar Records and Trajectory:

Both radars could not track the vehicle, and a following search pattern did not reveal anything; no fragments or any other evidence of vehicle failure were detected.

Summary:

The round was unsuccessful. Since the vehicle did not pass through the radar beams or camera focus areas, failure of the vehicle in the gun must be assumed. Fragments of sabot parts and vehicle picked up to the West of the gun line indicated that the airframe suffered severe damage inside the gun although the gun bore did not show such evidence.

Round No. 203 - TEST SLUG

Date: 25 August 1966 - 1303 AST

Vehicle Description: Solid wood cylinder with attached pusher plate.

Purpose of Test: To test the durability of the welds in the powder chamber.

Weights: Vehicle and shot 432 lb

Launch Data:

Charge Weight	706.5 lb Pyro (7 bags), Lot No. ALN-1K-4-HA-53 180 lb M6.056 (8 bags), Lot No. 6026
Spacing of Charge	159.5 x 272 x 273 x 182
Swedish Additive	18 sheets
Igniter	350 grams/bag of black powder
Gun Elevation	80 deg
Crusher Gauges	M11: 3
Ram Distance	188 in
Ram Load	5 tons
Chamber Volume	39,950 in^3
Recoil	37 in
Breech Pressure	M11: 67,300 psi Strain: Not available
Muzzle Velocity (Probe)	Not available
Gun Evacuation	None

Camera and Radar Records:

Cameras and radars not in operation.

Summary:

The round was successful. The welds have remained intact in spite of the extremely high breech pressure of 67,300 psi. Some very minor cracks have appeared within the welded area but these were shallow and subject to easy repair.

Round No. 204 - ALPHA

Date: 19 September 1966 - 1839 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a BML telemetry package with a Langmuir Probe and 5.5 lb TMA.

Purpose of Test: Synoptic measurements of wind profiles and test of telemetry package and Langmuir probe.

Weights:		
	Vehicle	186.0 lb
	Pusher and Obturator	125.0 lb
	Sabot	101.0 lb
	Shot Weight	412.0 lb

Centre of Gravity: 22 inches from base.

Launch Data:

Charge Weight	825 lb WMM.225 (9 bags) Lot No. 7504
Spacing of Charge	125 x 200 x 200 x 300
Swedish Additive	18 sheets
Igniter	500 grams/bag
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	188 in
Ram Load	28 tons
Chamber Volume	39,950 in^3
Recoil	38.5 in
Breech Pressure	M11: 53,500 psi Strain: 52,300 psi (Fig. 2.18)
Muzzle Velocity (Probe)	6600 ft/sec
Gun Evacuation	26 inches of Mercury

Camera Records:

Neither smear nor the Fastax cameras obtained an image of the vehicle.

Radar Records:

The M-33 radar did not operate. The MPS-19 radar recorded

a target with a weak signal separating from the vehicle at T + 4 sec. The vehicle was then tracked to T + 100 sec. The AGC-record indicated yawing of the target between 30 and 80 seconds after launch.

Trajectory:

The radar data are plotted in Figure 2.18a and compared with standard drag trajectories for a muzzle velocity of 5300 ft/sec. It appears that the effective launch elevation was smaller than 85 deg. The apogee as calculated from the radar data was 300,000 ft = 91 km, and the total range was estimated as 150,000 ft.

Since the actual muzzle velocity was in the order of 6600 ft/sec and the trajectory was similar to that of a standard trajectory with 5300 ft/sec, it must be assumed that the drag was considerably higher than standard.

Telemetry:

No signal received.

TMA Trail Results

There was a small intermittent leak at the start of the flight. The trail near apogee was very faint, as reported by all stations.

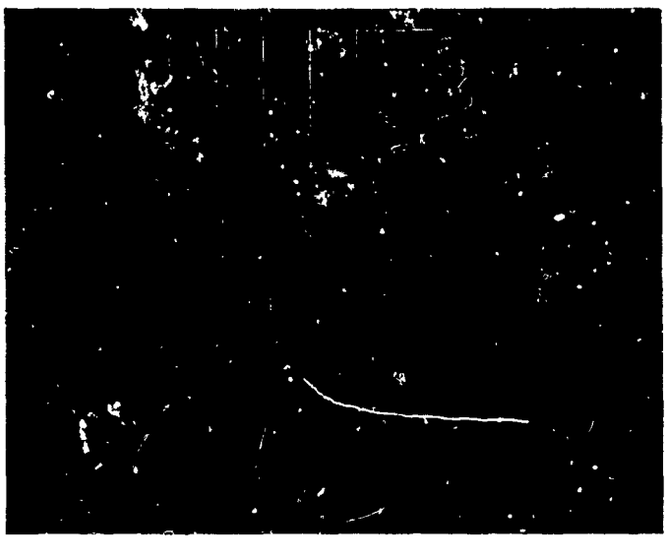
Summary:

The high velocity-high drag flight indicated some structural damage to the vehicle. It is assumed that a section of the nose cone broke off; this would explain that no telemetry signal was received, and two targets were seen by radar.

ALPHA

19 September 1966 - 1839 AST

9,700 psi/division
BREECH PRESSURE



18,900 psi/ohm
CALIBRATION
2 ohm

TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 52,300 psi

CHARGE: 825 lb WMM.225

FIG. 2.18 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND ALPHA

ALPHA

19 SEPTEMBER 1966 - 1839 AST

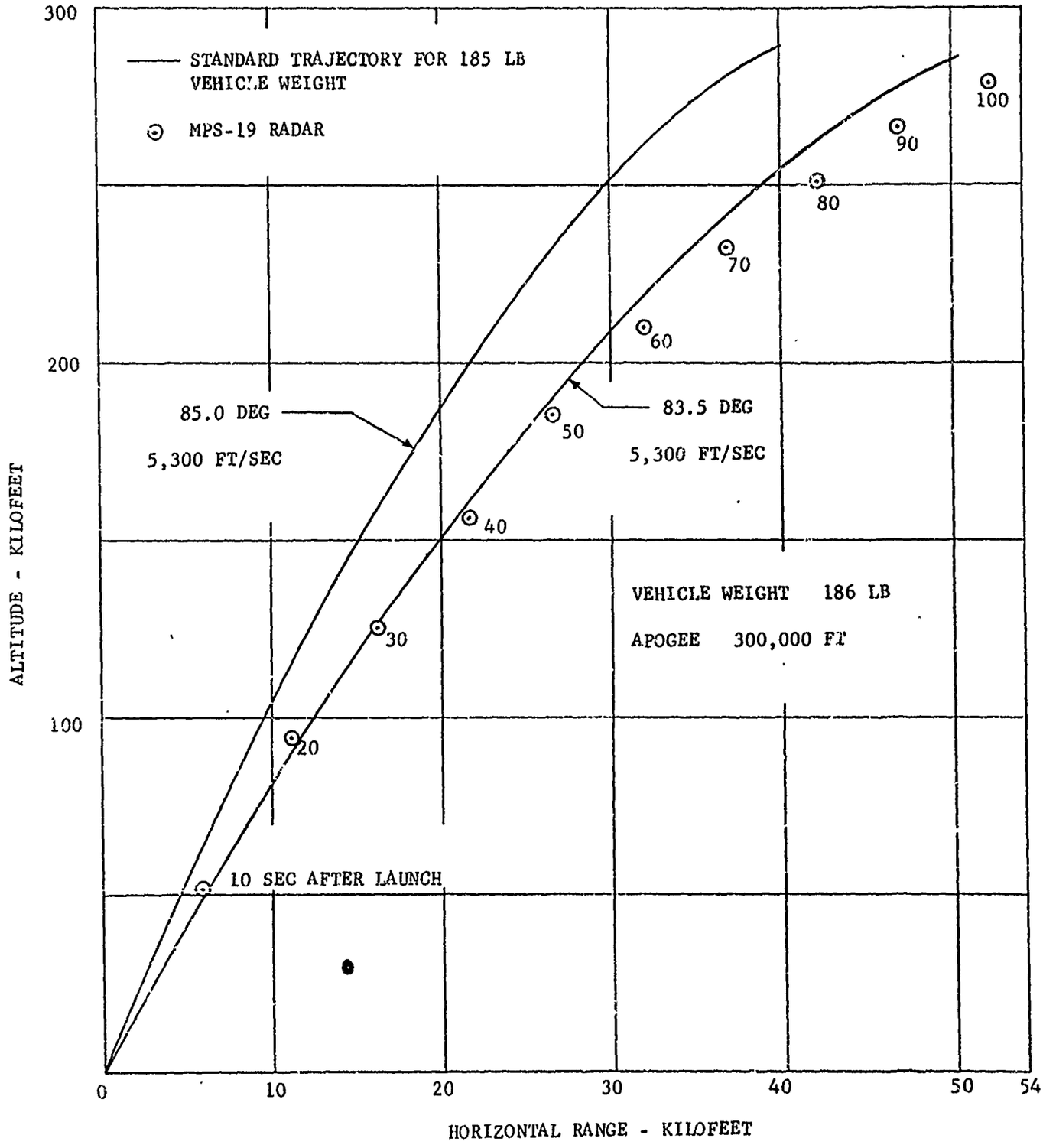


FIG. 2.18a MARTLET 2C (MOD 2) ALPHA

ALTITUDE VS RANGE

Round No. 205 - BETA

Date: 19 September 1966 - 2055 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	184.0 lb
	Pusher and Obturator	125.0 lb
	Sabot	101.0 lb
	Shot Weight	410.0 lb

Centre of Gravity: 22 1/8 inches from base.

Launch Data:

Charge Weight	825 lb WMM.225 (9 bags) Lot No. 7504
Spacing of Charge	125 x 200 x 200 x 300
Swedish Additive	18 sheets
Igniter	500 grams/bag
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	190 in
Ram Load	16 tons
Chamber Volume	40,375 in^3
Recoil	39.5 in
Breech Pressure	M11: 53,600 psi Strain: 51,500 (Fig. 2.19)
Muzzle Velocity (Probe)	6550 ft/sec
Gun Evacuation	26 inches of Mercury

Camera Records:

Fastax and smear cameras were not used.

Radar Records:

The MPS-19 radar tracked to T + 70 seconds.

Trajectory:

The MPS-19 radar data are plotted in Figure 2.19a in

comparison with a standard trajectory for a muzzle velocity of 6000 ft/sec. Since the measured velocity was 6550 ft/sec, a higher drag than standard must be assumed for this flight. The apogee derived from the radar data was 414,000 ft = 126 km, and the total range was estimated as 140,000 ft.

TMA Trail Results:

The round provided good TMA trails. There was, however, a continuous TMA leak during ascent.

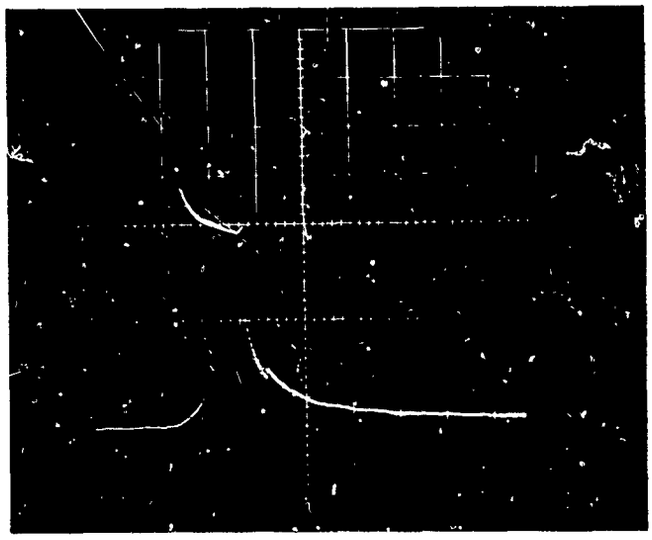
Summary:

The round was successful.

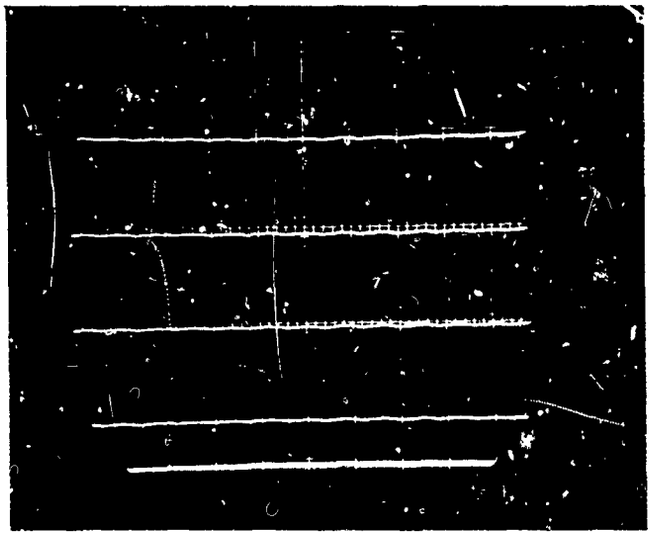
BETA

19 SEPTEMBER 1966 - 2055 AST

9,700 psi/division
BREECH PRESSURE



18,900 psi/ohm
CALIBRATION



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 51,500

CHARGE: 825 lb WMM.225

FIG. 2.19 STRAIN GAUGE RECORD OF BREECH PRESSURE
RCUND BETA

BETA

19 SEPTEMBER 1966 - 2055 AST

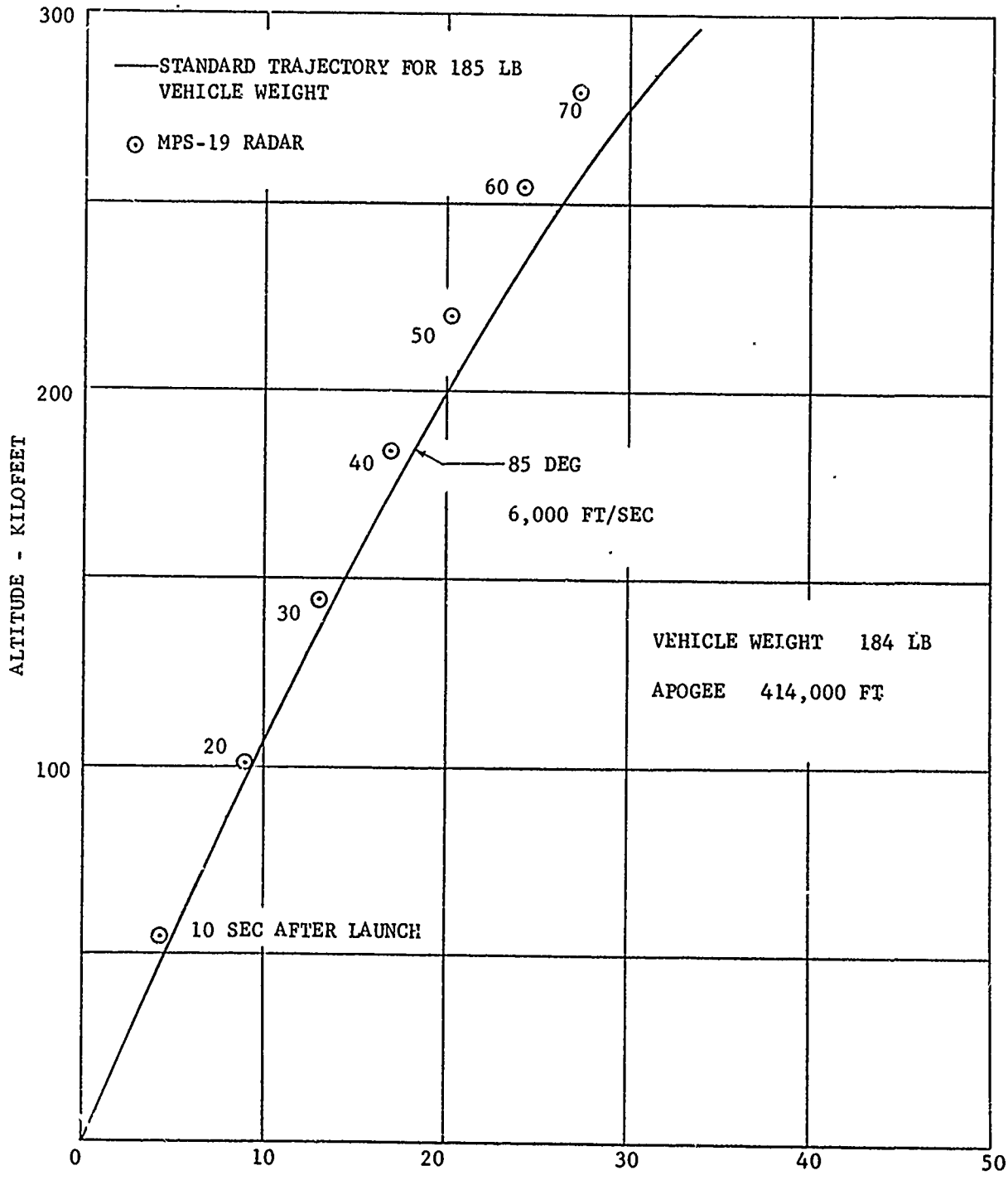


FIG. 2.19a MARTLET 2C (MOD 2) BETA

ALTITUDE VS RANGE

Round No. 206 - CAMMA

Date: 19 September 1966 - 2224 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	185.0 lb
	Pusher and Obturator	124.0 lb
	Sabot	103.0 lb
	Shot Weight	412.0 lb

Centre of Gravity: 22 1/8 inches from base.

Launch Data:

Charge Weight	825 lb WMM.225 (9 bags) Lot No. 7504
Spacing of Charge	125 x 200 x 200 x 300
Swedish Additive	18 sheets
Igniter	500 grams/bag
Gun Elevation	85 deg
Crusher Gauge	M11: 3
Ram Distance	188 in
Ram Load	28 tons
Chamber Volume	39,950 in^3
Recoil	38.5 in
Breech Pressure	M11: 49,800 psi Strain: 48,500 (Fig. 2.20)
Muzzle Velocity (Probe)	Left: 6310 ft/sec Right: 6330 ft/sec Average: 6320 ft/sec
Gun Evacuation	27 inches of Mercury

Camera Records:

No smear or Fastax cameras were used.

Radar Records:

The MPS-19 radar tracked the vehicle to T + 80 sec and observed the impact at T + 350 sec at a range of 149,000 ft.

Trajectory:

The MPS-19 Radar data are compared in Fig. 2.20a with a standard drag trajectory for a muzzle velocity of 6300 ft/sec. The agreement is satisfactory.

For this round, data from the Trinidad radar are also available, covering the trajectory to near impact (339 seconds after launch, altitude 37,000 ft. above sea level). The data plotted in Fig. 2.20b are in good agreement with the MPS-19 results. The measured apogee was 447,000 ft = 137 km, and the total range 149,000 ft.

TMA Trail Results:

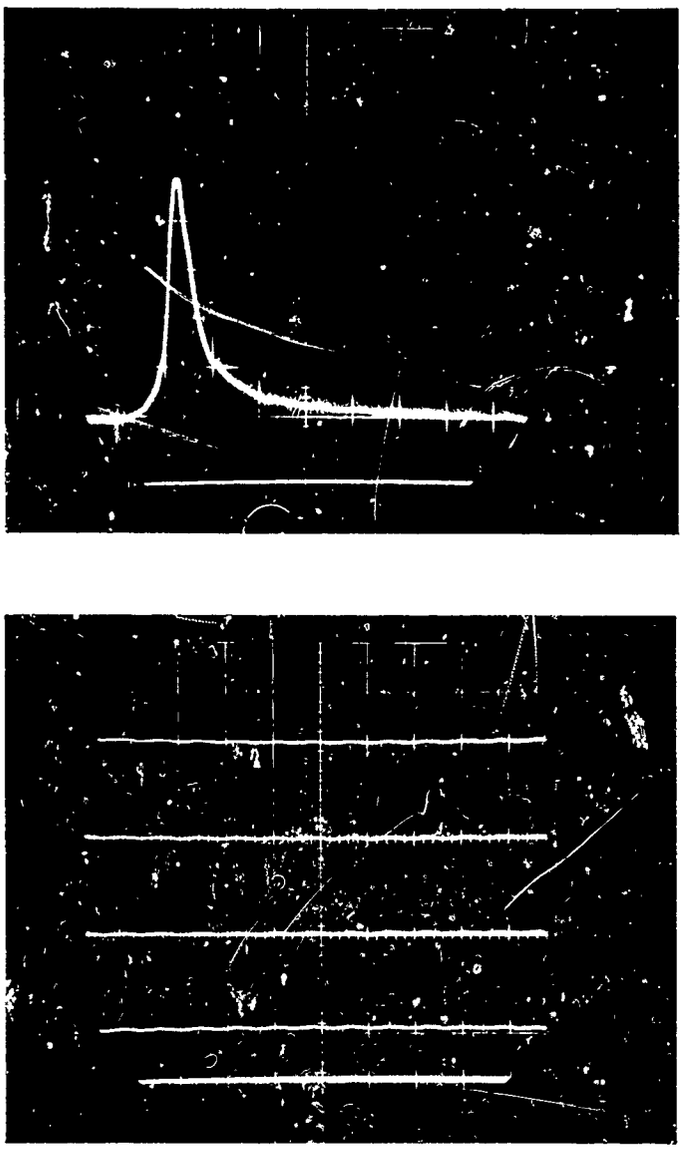
The flight was satisfactory with very little TMA leakage, and a bright trail was produced simultaneously with a pass of the Nimbus Satellite.

Summary:

The round was successful.

GAMMA

19 SEPTEMBER 1966 - 2224 AST



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 48,500 psi

CHARGE: 825 lb WMM.225

FIG. 2.20 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND GAMMA

GAMMA

19 SEPTEMBER 1966 - 2224 AST

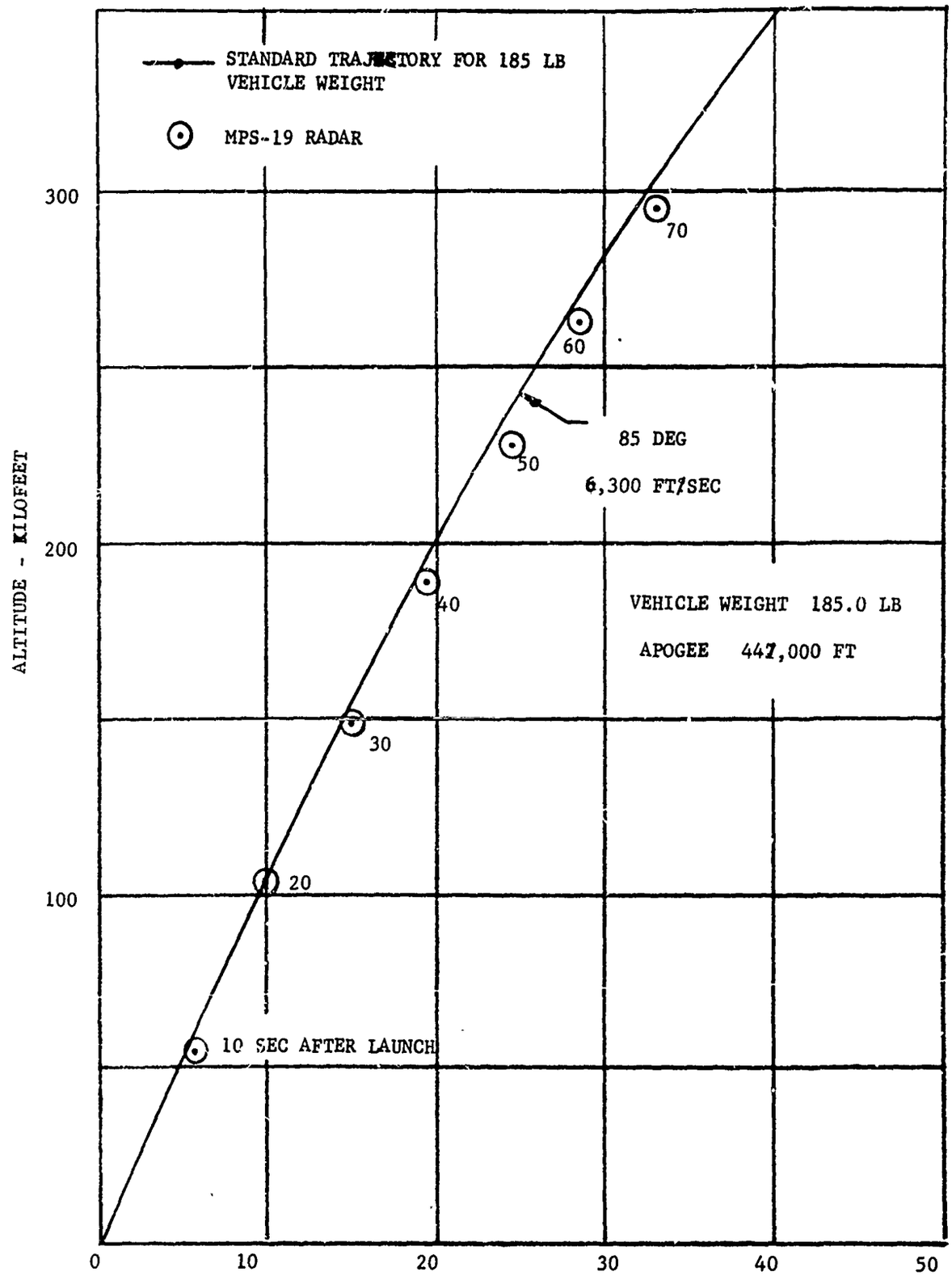


FIG. 2020a MARTLET 2C (MOD 2) GAMMA
ALTITUDE VS RANGE

GAMMA

19 SEPTEMBER 1966 - 2224 AST

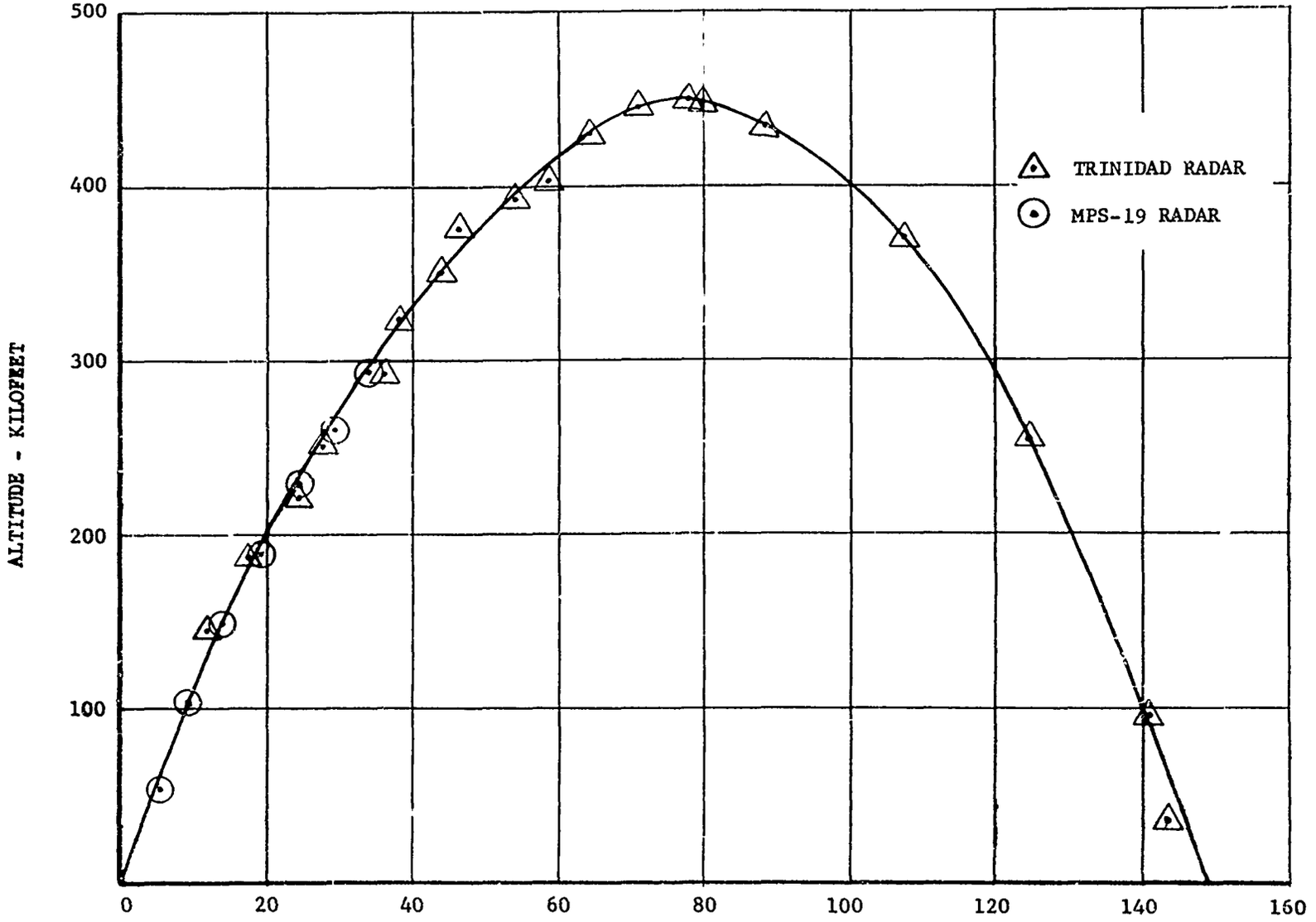


FIG. 2.20b MARTLET 2C (MOD 2) GAMMA
ALTITUDE VS RANGE

Round No. 207 - DELTA

Date: 20 September 1966 - 0010 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a BML Langmuir probe with a telemetry unit and 5.5 lb of TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles and test of telemetry package with Langmuir probe.

Weights:

Vehicle	186.0 lb
Pusher and Obturator	123.0 lb
Sabot	100.0 lb
Shot Weight	409.0 lb

Centre of Gravity: 22 inches from base.

Launch Data:

Charge Weight	780 lb WMM.225 (8 bags) Lot No. 7504
Spacing of Charge	180 x 200 x 200 x 200
Swedish Additive	18 sheets
Igniter	500 grams/bag
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	188 in
Ram Load	32 tons
Chamber Volume	39,950 in^3
Recoil	32.0 in
Breech Pressure	M11: 45,200 psi. Strain: Not available
Muzzle Velocity (Probe)	5980 ft/sec
Gun Evacuation	27 inches of Mercury

Camera Records:

No smear and Fastax cameras were used.

Radar Records:

The MPS-19 radar obtained a good track up to T + 120 sec.

Apogee or impact were not recorded.

Trajectory:

The radar data are plotted in Fig. 2.21a in comparison with a standard drag trajectory for a muzzle velocity of 6000 ft/sec.

Data of the Trinidad radar were also available for this round, covering almost the complete trajectory from launch to impact (15 seconds to 320 seconds after launch). This trajectory is shown in Fig. 2.21b, in comparison with the MPS-19 results. The measured apogee was 386,126 ft = 118 km, obtained at 150 seconds after launch, and the total range 113,000 ft.

Telemetry Records:

The telemetry signal was received at T + 4 sec but the power was very low, fading into the noise level at T + 30 sec. From T + 109 sec on, a strong signal was received until impact. The transmitter could operate in two modes, with low and high power; the initial transmission was evidently in the low power mode and at T + 110 sec the reduced battery voltage caused the transmitter to switch to the high power mode.

Langmuir Probe:

Noise-free data were received after 109 seconds but they were not usable owing to a saturated amplifier; this indicated a low resistance between the probe tip and projectile body due to a charred or contaminated nose insulator section.

TMA Trail Results:

There was no TMA leakage at launch and a good TMA trail was obtained.

Summary:

The round was successful.

DELTA

20 SEPTEMBER 1966 - 0010 AST

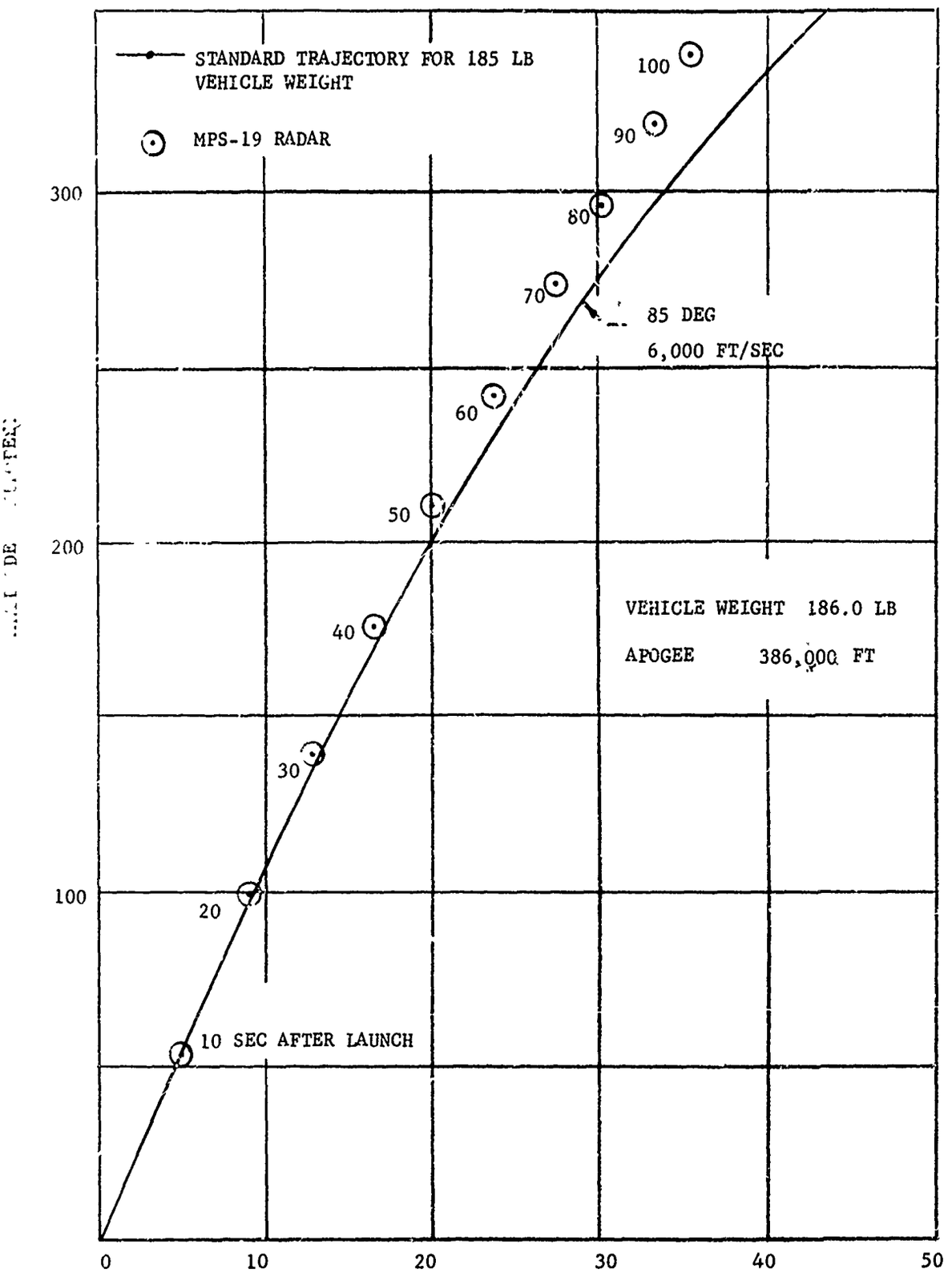


FIG. 2.21a MARTLET 2C (MOD 2) DELTA
ALTITUDE VS RANGE

DELTA

20 SEPTEMBER 1966 - 0010 AST

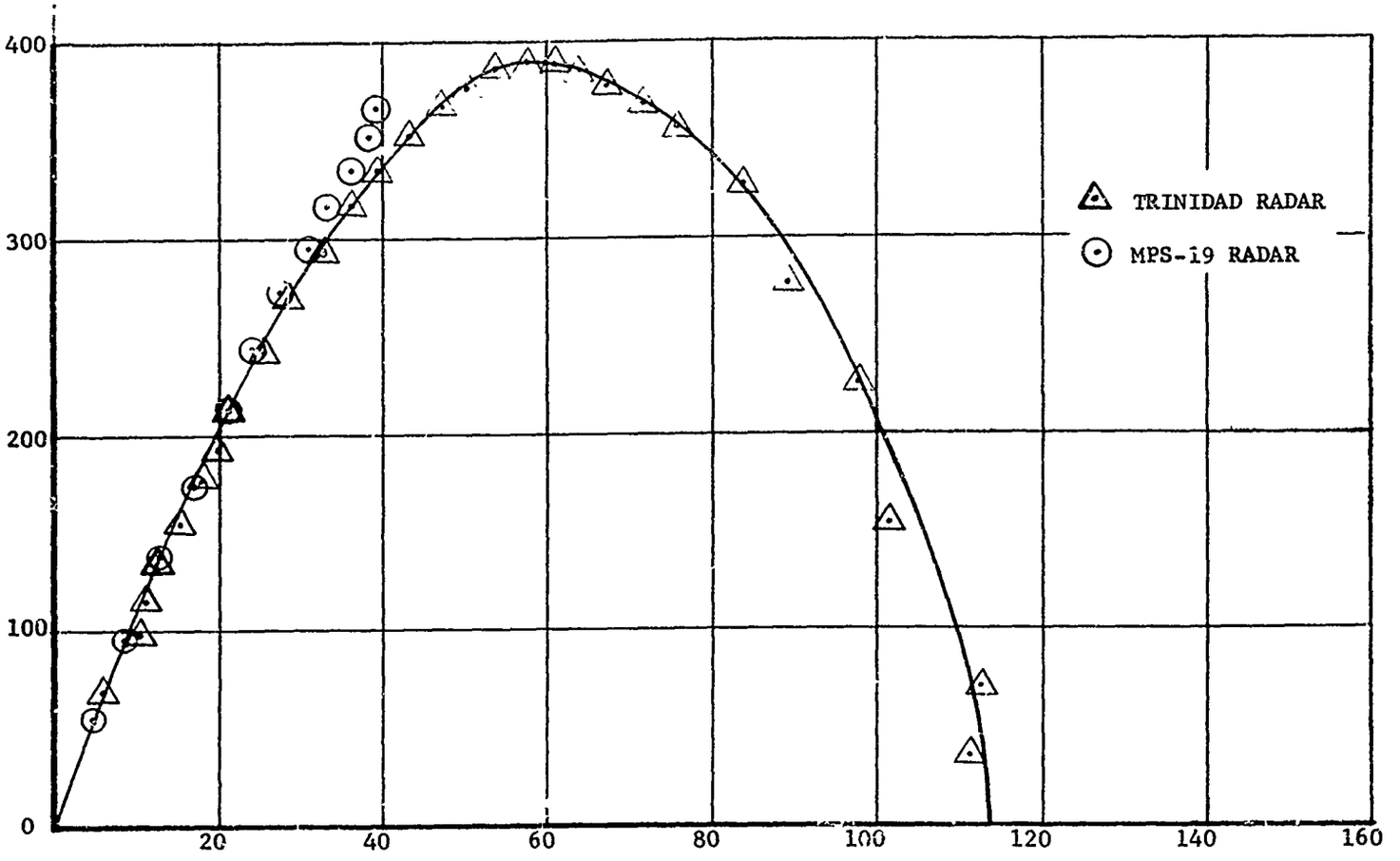


FIG. 2.21b MARTLET 2C (MOD 2) DELTA
ALTITUDE VS RANGE

Round No. 208 - EPSILON

Date: 20 September 1966 - 0130 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	185.0 lb
	Pusher and Obturator	124.0 lb
	Sabot	96.0 lb
	Shot Weight	405.0 lb

Centre of Gravity: 22 1/8 inches from base.

Launch Data:

Charge Weight	825 lb WMM.225 (9 bags) Lot No. 7504
Spacing of Charge	125 x 200 x 200 x 300
Swedish Additive	15 sheets
Igniter	500 grams/bag
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	192 in
Ram Load	34 tons
Chamber Volume	40,800 in^3
Recoil	39 in
Breech Pressure	M11: 47,600 psi Strain: 47,000 psi (Fig. 2.22)
Muzzle Velocity (Probe)	Left: 6440 ft/sec Right: 6500 ft/sec Average: 6470 ft/sec
Gun Evacuation	27 inches of Mercury

Camera Records:

Smear and Fastax cameras were not used.

Radar Records:

The MPS-19 radar tracked to T + 80 sec. Apogee and impact were not recorded.

Trajectory:

The radar data are plotted in Figure 2.22a in comparison to a standard drag trajectory for a muzzle velocity of 5600 ft/sec which is much lower than the measured velocity of 6470 ft/sec. This difference indicates a high drag trajectory. The apogee as derived from the radar data was 360,000 ft = 110 km, and the estimated total range was 120,000 ft.

TMA Trail Results:

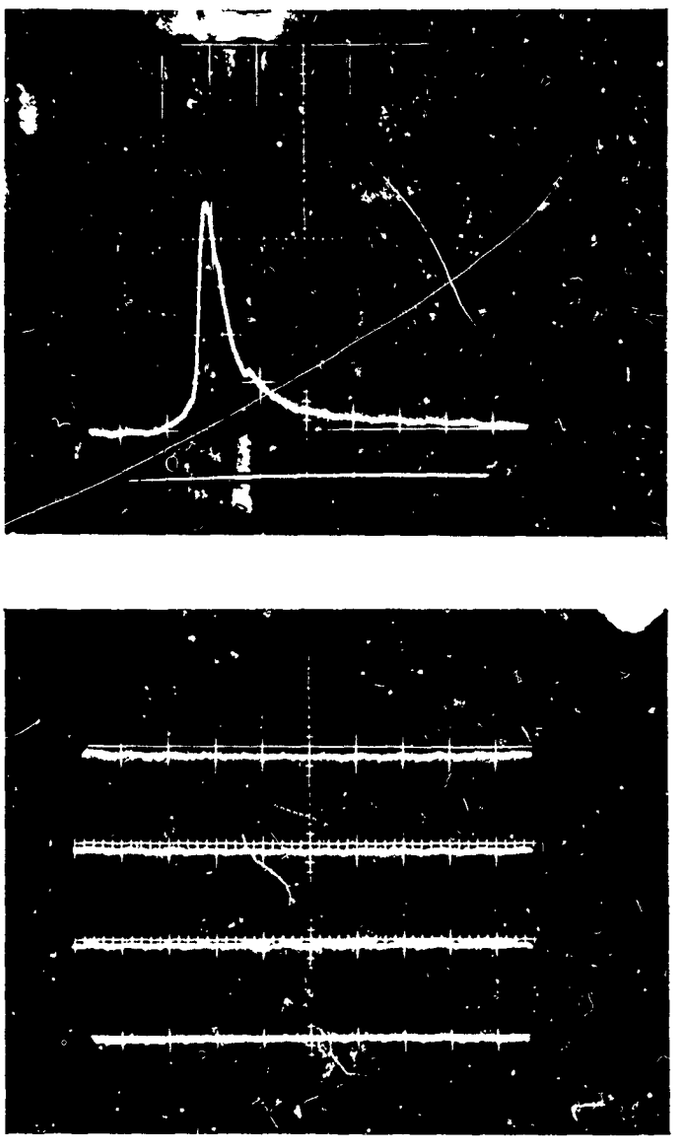
A bright TMA trail was produced.

Summary:

The round was successful.

EPSILON

20 SEPTEMBER 1966 - 0130 AST



Maximum Breech Pressure: P_{max} = 47,000 psi

CHARGE: 825 lb WAM.225

FIG. 2.22 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND EPSILON

EPSILON

20 SEPTEMBER 1966 - 0130 AST

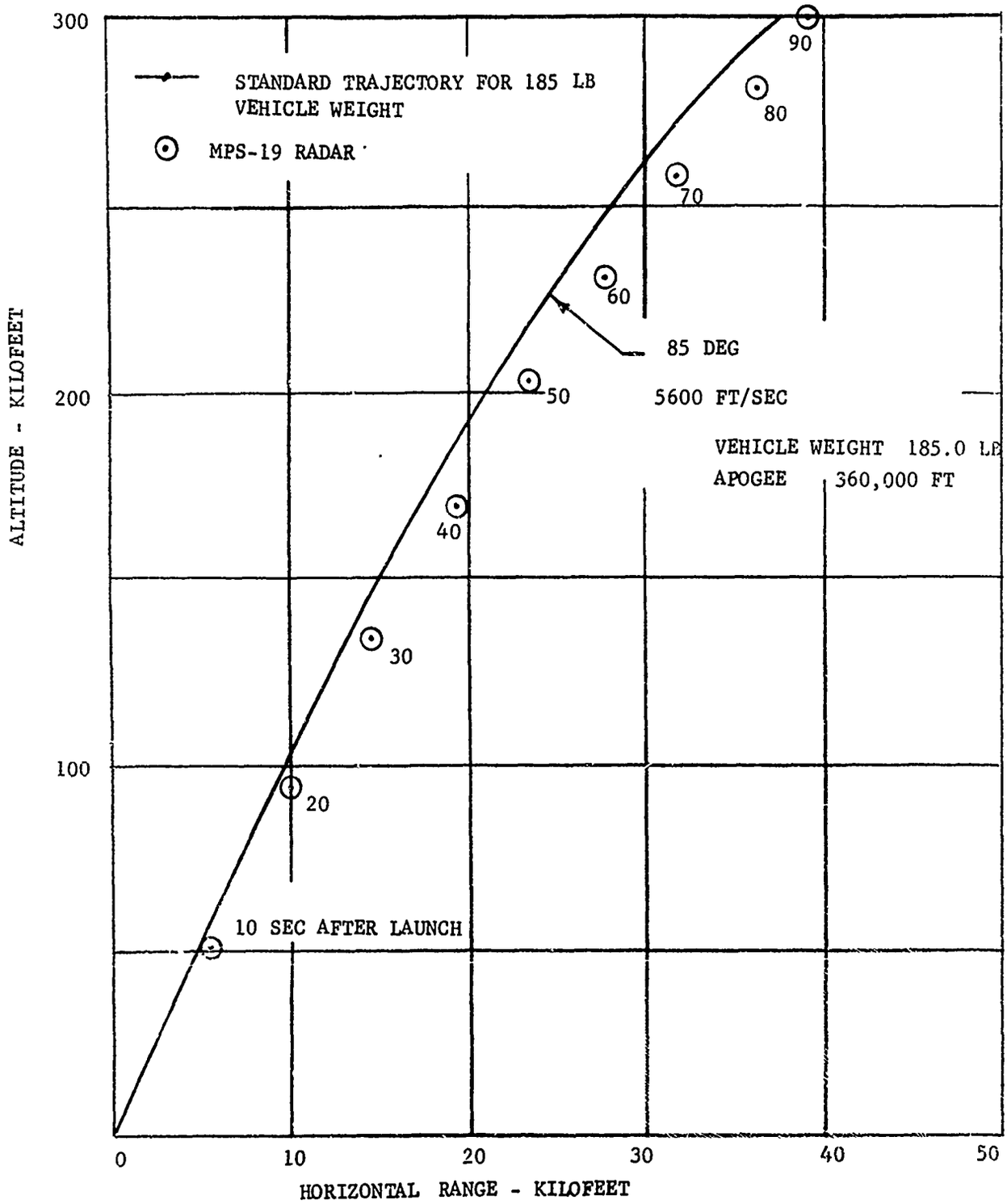


FIG. 2.22a MARTLET 2C (MOD 2) EPSILON

ALTITUDE VS RANGE

Round No. 209 - ZETA

Date: 20 September 1966 - 0224 AST

Vehicle Description: Martlet 2C (Mod 2), with a dummy telemetry nose cone, carrying a payload of 5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	184.0 lb
	Pusher and Obturator	124.0 lb
	Sabot	100.0 lb
	Shot Weight	408.0 lb

Centre of Gravity: Approximately 22 inches from base.

Launch Data:

Charge Weight	825 lb WMM.225 (9 bags) Lot No. 7504
Spacing of Charge	125 x 200 x 200 x 300
Swedish Additive	15 sheets
Igniter	500 grams/bag
Gun Elevation	85 deg
Crusher Gauges and Coppers	M11: 3
Ram Distance	194 in
Ram Load	28 tons
Chamber Volume	41,220 in^3
Recoil	38.5 in
Breech Pressure	M11: 48,100 psi Strain: 48,200 psi (Fig. 2.23)
Muzzle Velocity (Probe)	Not available
Gun Evacuation	None

Camera Records:

Smear and Fastax cameras were not used.

Radar Records:

The MPS-19 radar tracked the vehicle up to T + 90 seconds.

Trajectory:

The radar data are plotted in Figure 2.23a in comparison with a standard drag trajectory for 5800 ft/sec. The apogee calculated from the radar data was 373,000 ft = 114 km, and the total range was estimated as 130,000 ft.

TMA Trail Results:

The TMA payload was slightly smaller than usual because the nose cone for telemetry was used in this vehicle, but a good TMA trail was produced.

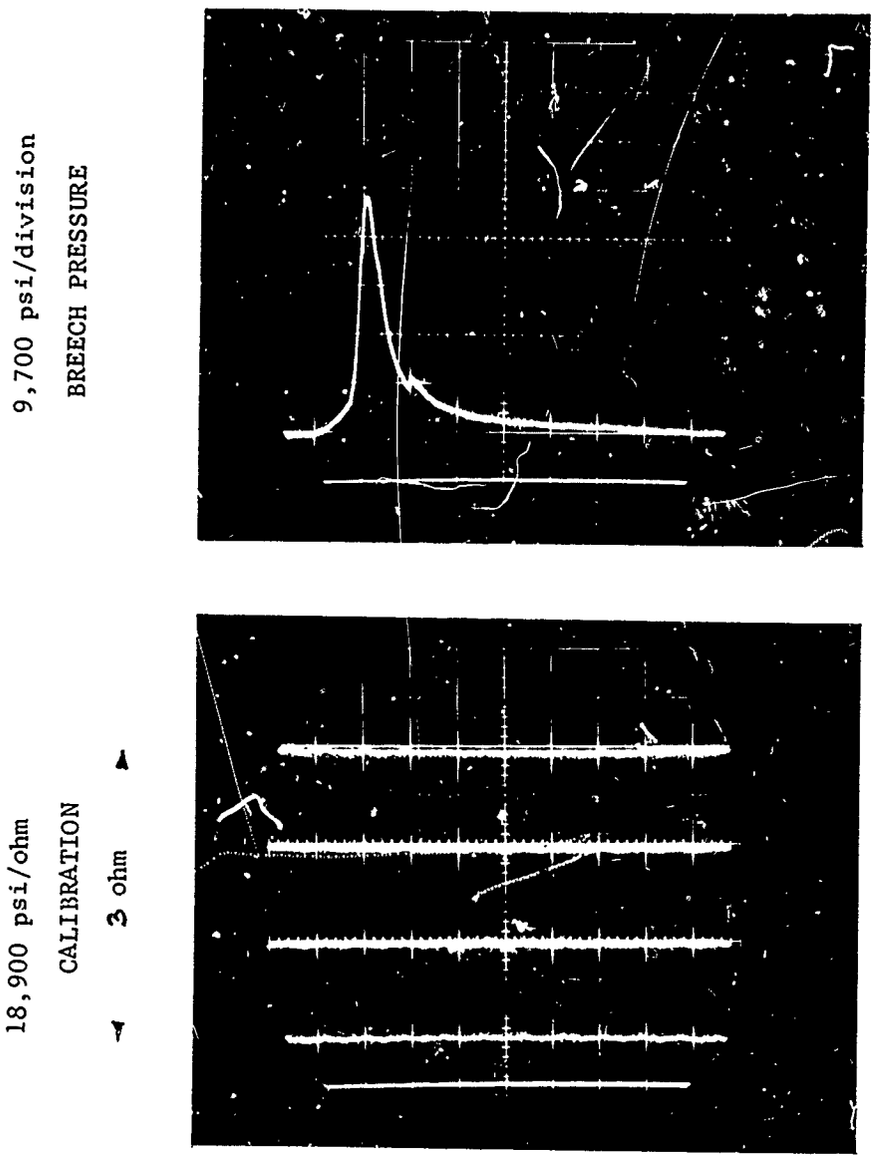
Summary:

The round was successful.

II-99

ZETA

20 SEPTEMBER 1966 - 0224 AST



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 48,200 psi

CHARGE: 825 lb WMM.225

FIG. 2.23 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND ZETA

ZETA

20 SEPTEMBER 1966 - 0224 AST

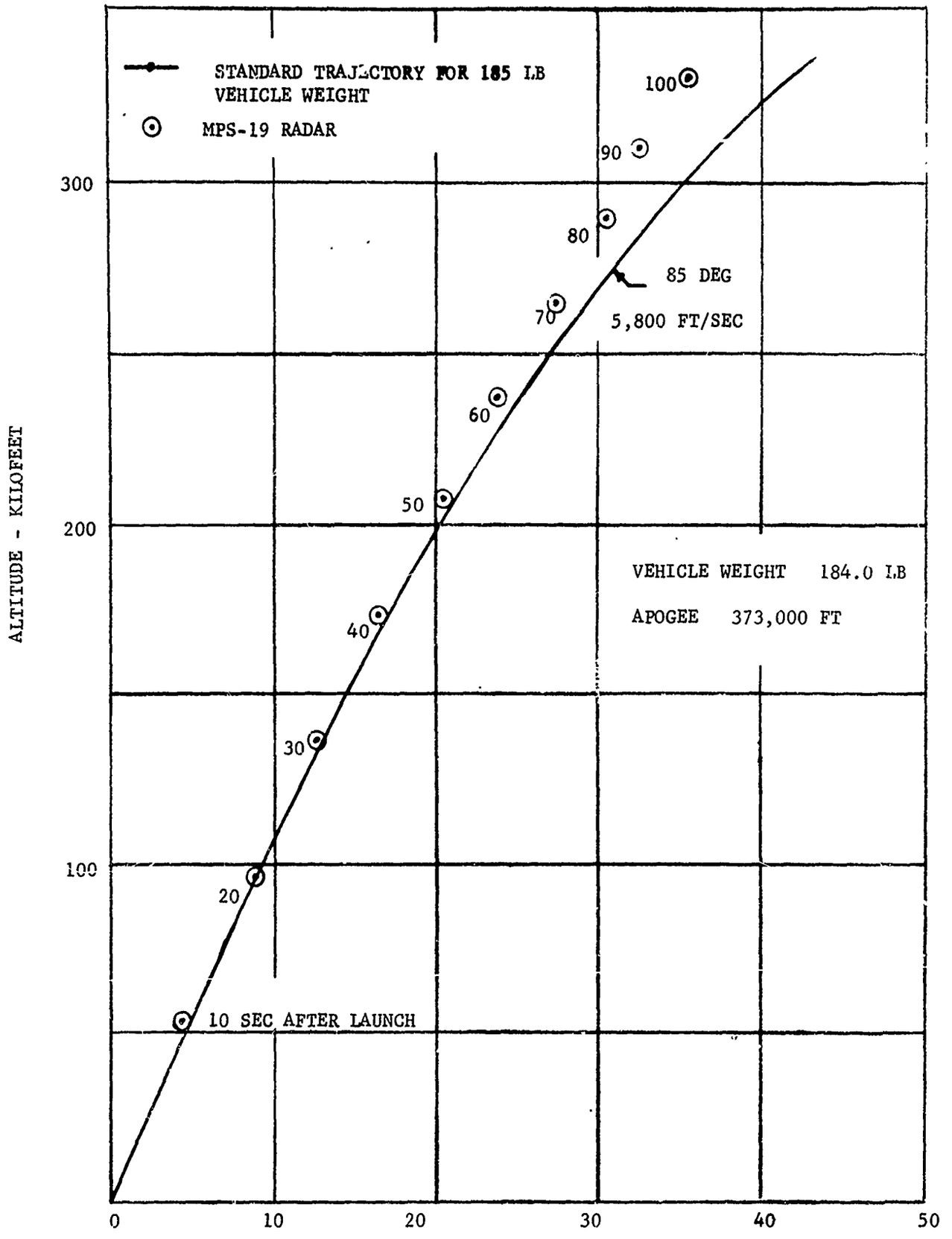


FIG. 2.23a MARTLET 2C (MOD 2) ZETA
ALTITUDE VS RANGE

Round No. 210 - ETA

Date: 20 September 1966 - 0318 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	186.0 lb
	Pusher and Obturator	124.0 lb
	Sabot	101.0 lb
	Shot Weight	411.0 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	825 lb WMM.225 (9 bags) Lot No. 7504
Spacing of Charge	125 x 200 x 200 x 300
Swedish Additive	15 sheets
Igniter	500 grams/bag
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	194 in
Ram Load	24 tons
Chamber Volume	41,220 in^3
Recoil	39.0 in
Breech Pressure	M11: 55,100 psi Strain: 54,300 psi (Fig. 2.24)
Muzzle Velocity (Probe)	Not available
Gun Evacuation	20 inches of Mercury

Camera Records:

Smear and Fastax cameras were not used.

Radar Records:

The MPS-19 radar tracked to T + 50 seconds; after that time the parametric amplifier became unstable.

Trajectory:

The radar data were compared with a standard drag trajectory for a muzzle velocity of 5900 ft/sec in Figure 2.24a. The apogee as derived from the radar data was approximately 400,000 ft = 122 km, and the total range was estimated as 135,000 ft.

TMA Trail Results:

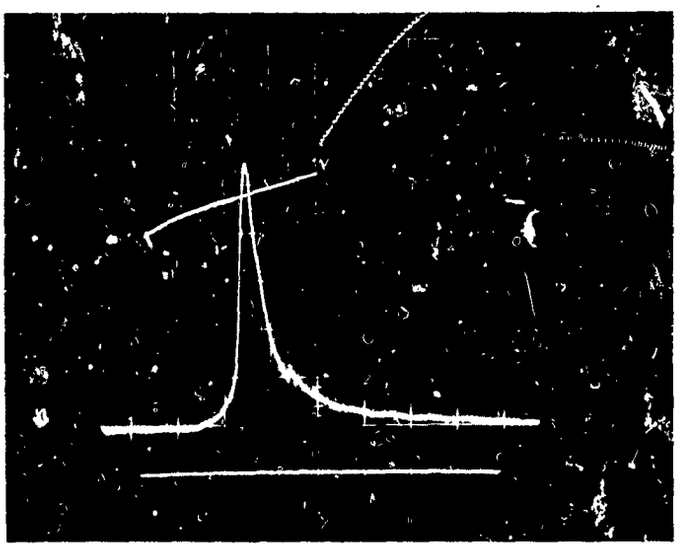
The flight produced a good TMA trail.

Summary:

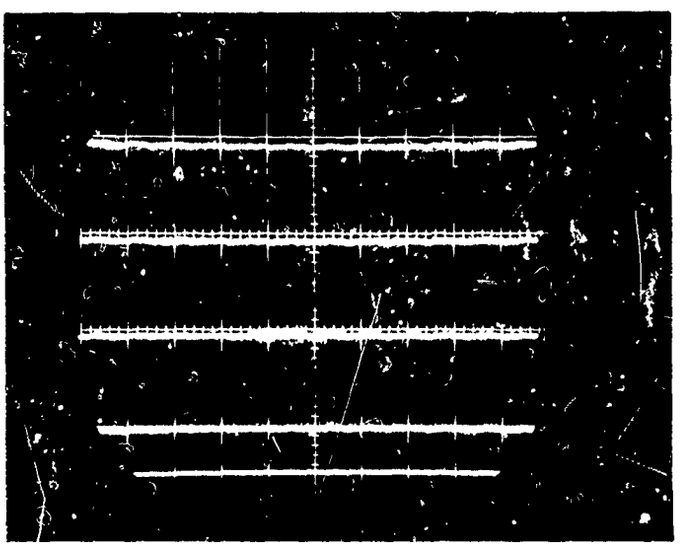
The round was successful.

ETA

20 SEPTEMBER 1966 - 0318 AST



9.700 psi/division
BREECH PRESSURE



18,900 psi/ohm
CALIBRATION
3 ohm

TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 54,300 psi

CHARGE: 825 lb WMM.225

FIG. 2.24 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND ETA

ETA

20 SEPTEMBER 1966 - 0318 AST

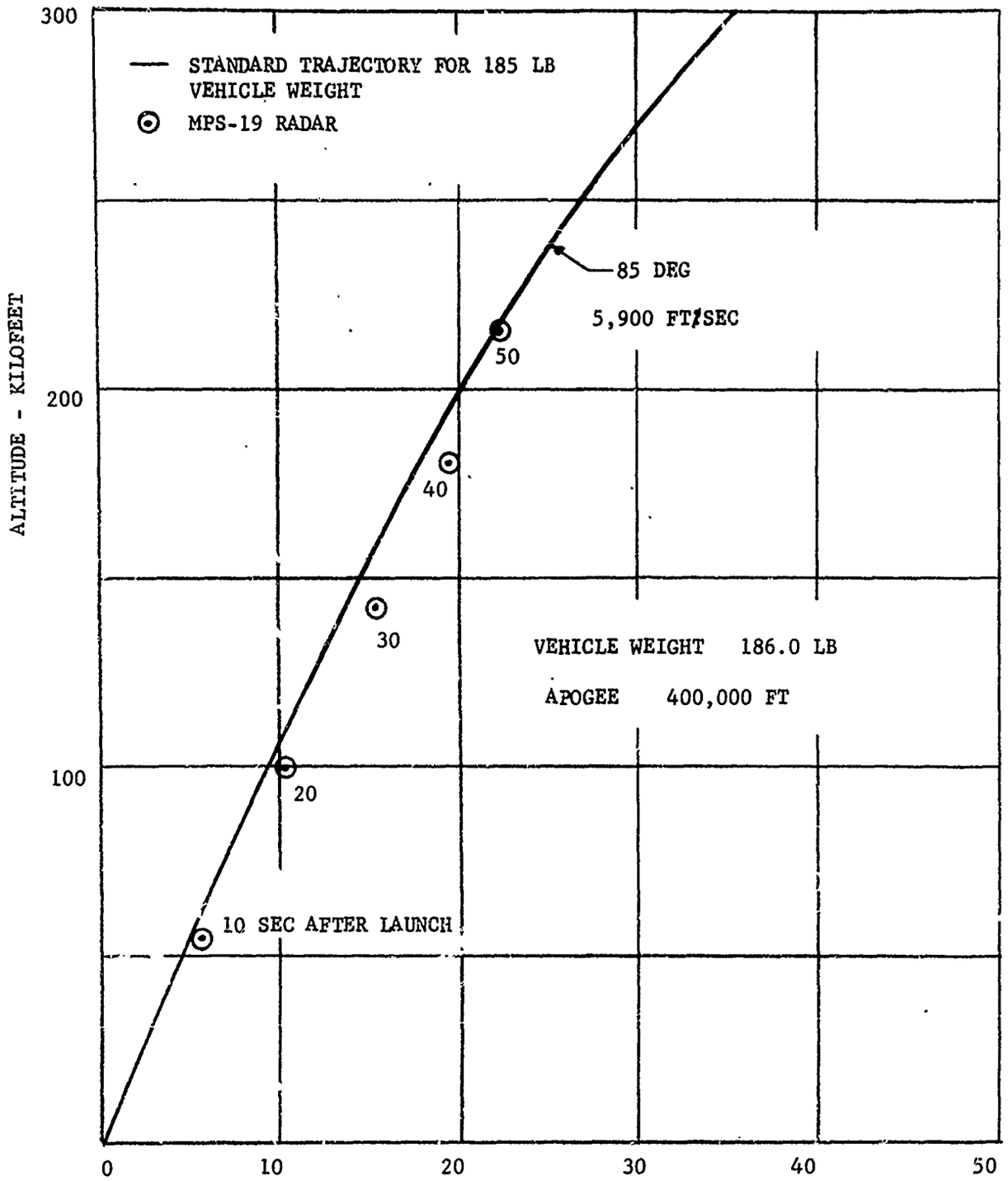


FIG. 2.24a MARTLET 2C (MOD 2) ETA

ALTITUDE VS RANGE

Round No. 211 - THETA

Date: 20 September 1966 - 0403 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	185.0 lb
	Pusher and Obturator	128.0 lb
	Sabot	101.0 lb
	Shot Weight	414.0 lb

Centre of Gravity: 22.25 inches from base.

Launch Data:

Charge Weight	325 lb WMM.225 (9 bags) Lot No. 7504
Spacing of Charge	125 x 200 x 200 x 300
Swedish Additive	15 sheets
Igniter	500 grams/bag
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	194 in
Ram Load	24 tons
Chamber Volume	41,220 in^3
Recoil	39.5 in
Breech Pressure	M11: 55,300 psi Strain: 53,800 psi (Fig. 2.25)
Muzzle Velocity (Probe)	Not available
Gun Evacuation	20 inches of Mercury

Camera Records:

Smear and Fastax cameras were not in operation.

Radar Records:

The MPS-19 radar tracked the vehicle to over T + 90 seconds.

Trajectory:

The radar data are plotted in Figure 2.25a in comparison with a standard drag trajectory for a muzzle velocity of 6000 ft/sec. It appears from this figure that the effective launching elevation was lower (about 1 deg) than the recorded 85 deg. The apogee as derived from the radar data was 417,000 ft = 127 km, and the total range was estimated as 139,000 ft.

TMA Trail Results:

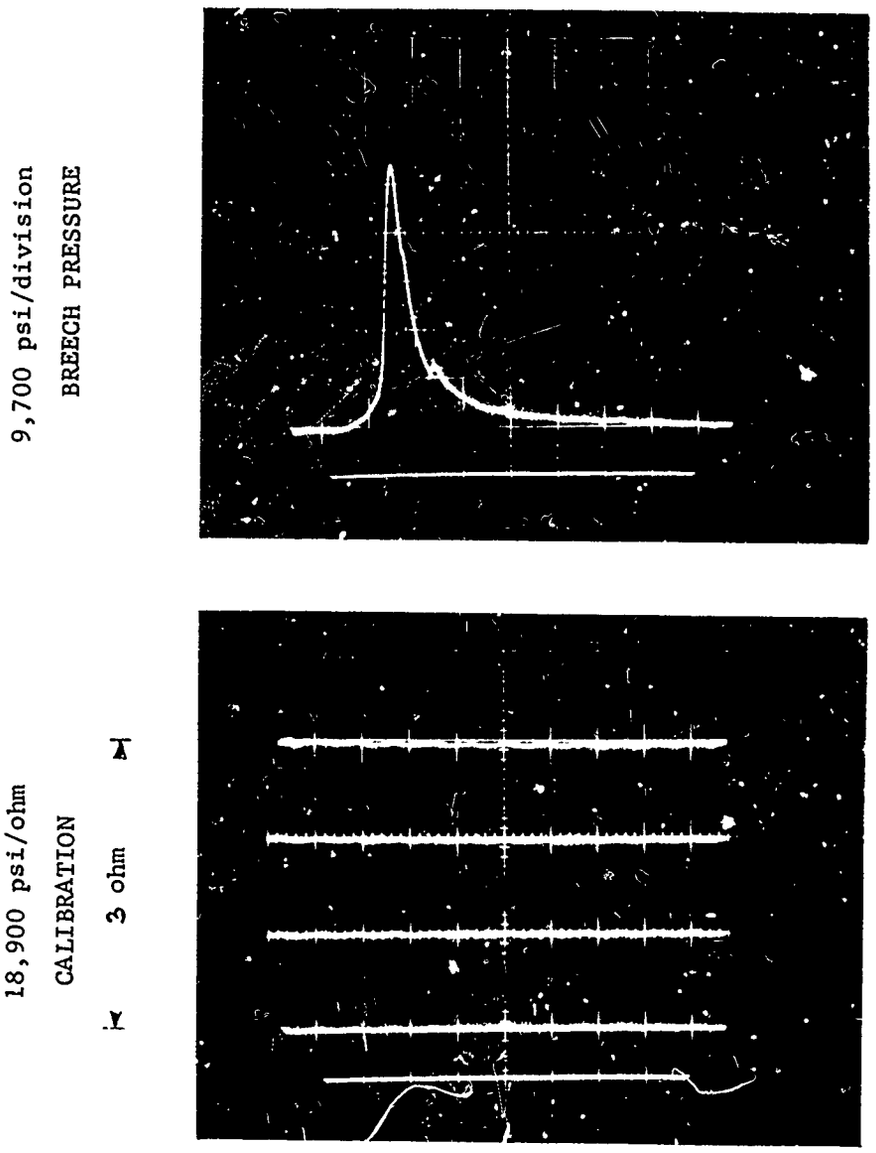
The flight produced a good TMA trail of a slightly reduced brightness.

Summary:

The round was successful.

THETA

20 SEPTEMBER 1966 - 0403 AST



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 53,800 psi

CHARGE: 825 lb WMM.225

FIG. 2.25 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND THETA

THETA

20 SEPTEMBER 1966 - 0403 AST

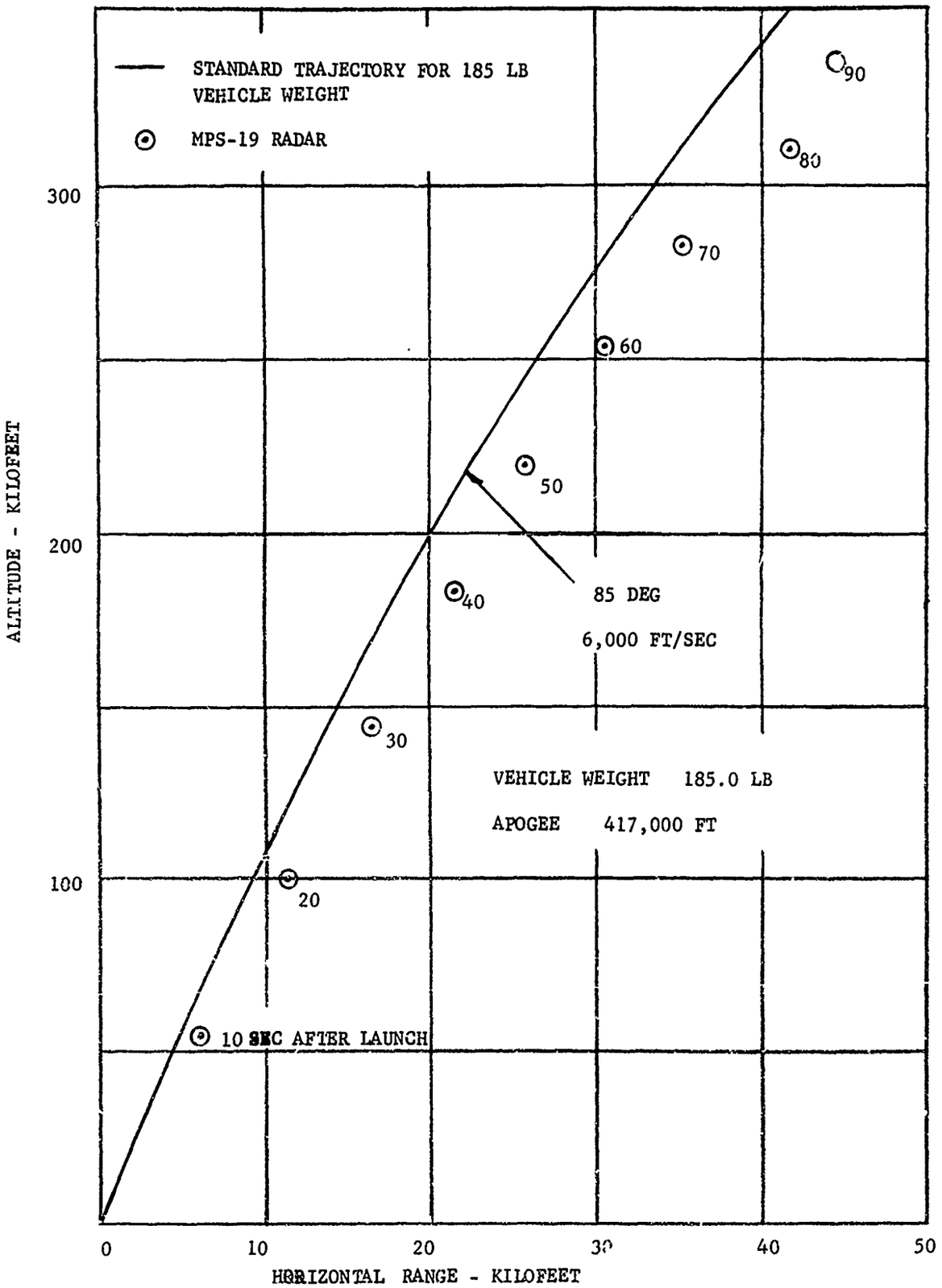


FIG. 2.25a MARTLET 2C (MOD 2) THETA
ALTITUDE VS RANGE

Round No. 212 - IOTA

Date: 20 September 1966 - 0446 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	186.0 lb
	Pusher and Obturator	124.0 lb
	Sabot	101.0 lb
	Shot Weight	411.0 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	825 lb WMM.225 (9 bags) Lot No. 7504
Spacing of Charge	125 x 200 x 200 x 300
Swedish Additive	15 sheets
Igniter	500 grams/bag
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	194 in
Ram Load	8.5 tons
Chamber Volume	41,220 in^3
Recoil	39.5 in
Breech Pressure	M11: 46,350 psi Strain: 44,600 (Fig. 2.26)
Muzzle Velocity	Probe not operational
Gun Evacuation	Yes (inches of Mercury not available)

Camera Records:

Smear and Fastax cameras were used in this round but no image was obtained as a result of poor lighting conditions.

Radar Records:

The MPS-19 radar tracked the vehicle to T + 77 seconds.

Trajectory:

The radar data are plotted in Figure 2.26a in comparison with a standard drag trajectory for a muzzle velocity 6000 ft/sec. The apogee as derived from the radar data was approximately 400,000 ft = 122 km, and the total range was estimated as 135,000 ft.

TMA Trail Results:

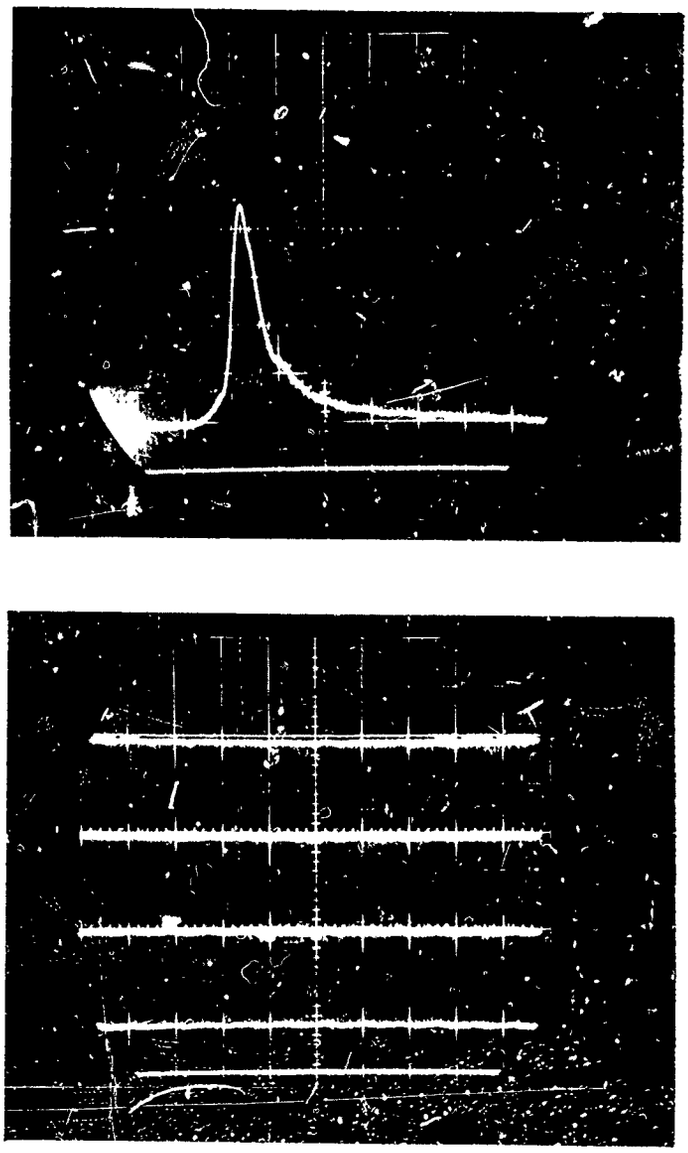
The flight produced a good TMA trail.

Summary:

The round was successful.

IOTA

20 SEPTEMBER 1966 - 0446 AST



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 44,600 psi

CHARGE: 825 lb WMM.225

FIG. 2.26 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND IOTA

IOTA

20 SEPTEMBER 1966 - 0446 AST

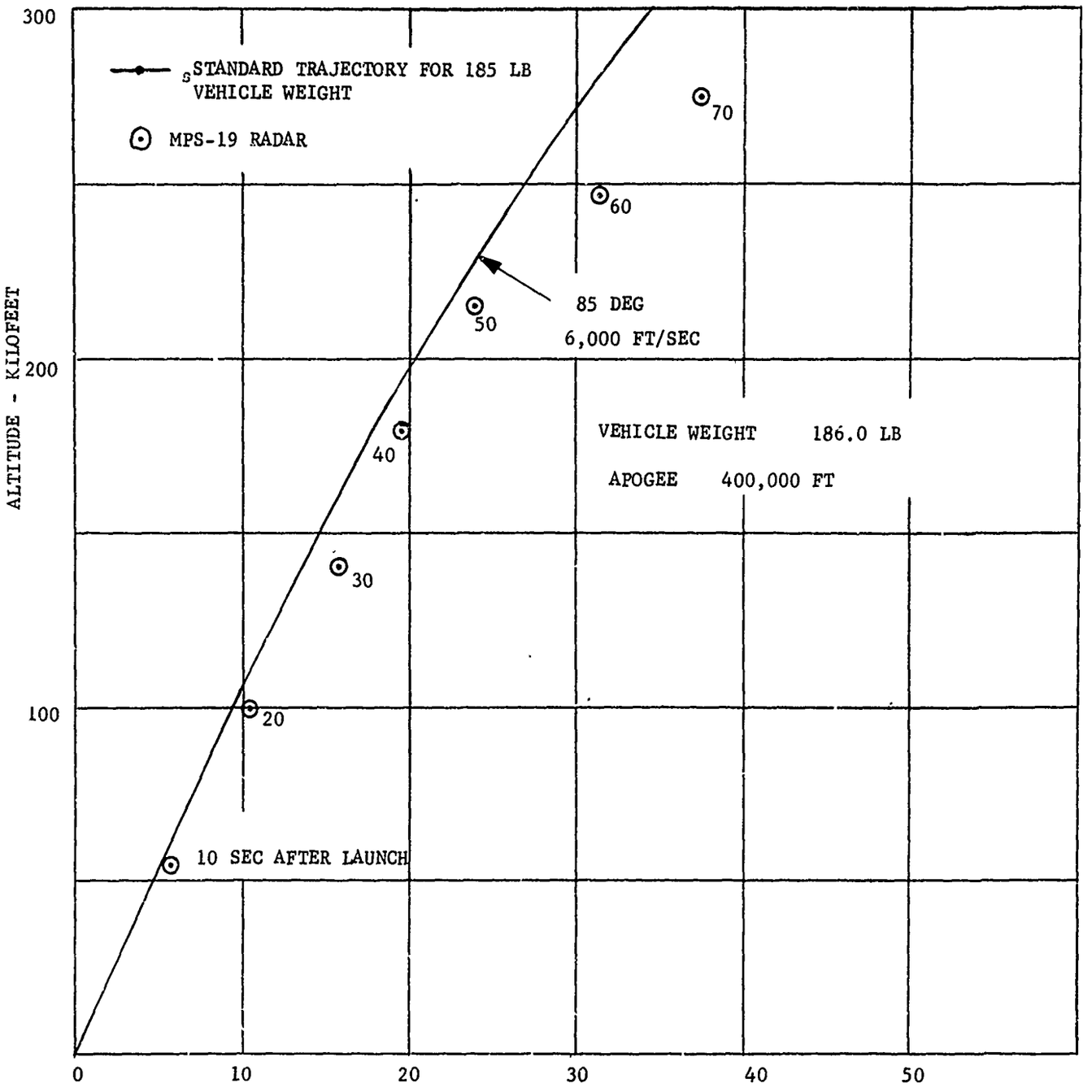


FIG. 2.26a MARTLET 2C (MOD 2) IOTA
ALTITUDE VS RANGE

Round No. 213 - KAPPA

Date: 20 September 1966 - 2255 AST

Vehicle Description: Martlet 2C (Mod 3) with Langmuir probe.

Purpose of Test: Measurements of electron density.

Weights:		
	Vehicle	171.0 lb
	Pusher and Obturator	124.0 lb
	Sabot	100.0 lb
	Shot Weight	395.0 lb

Centre of Gravity: 20.5 inches from base.

Launch Data:

Charge Weight	780 lb WMM.225 (8 bags) Lot No. 7504
Spacing of Charge	200 x 200 x 200 x 180
Swedish Additive	15 sheets
Igniter	500 grams/bag
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	194 in
Ram Load	14 tons
Chamber Volume	41,220 in^3
Recoi	36.5 in
Breech Pressure	M11: 34,770 psi Strain: 34,900 psi (Fig. 2.27)
Muzzle Velocity (Probe)	5700 ft/sec
Gun Evacuation	23 inches of Mercury

Camera Records:

Smear and Fastax cameras were not used.

Radar Records:

The MPS-19 radar tracked the vehicle up to T + 110 seconds.

Trajectory:

The radar data are plotted in Fig. 2.27a in comparison with a standard drag trajectory for 5,700 ft/sec muzzle velocity. The apogee derived from the radar data was 357,000 ft = 109 km, and the total range was estimated as 119,000 ft.

Langmuir Probe:

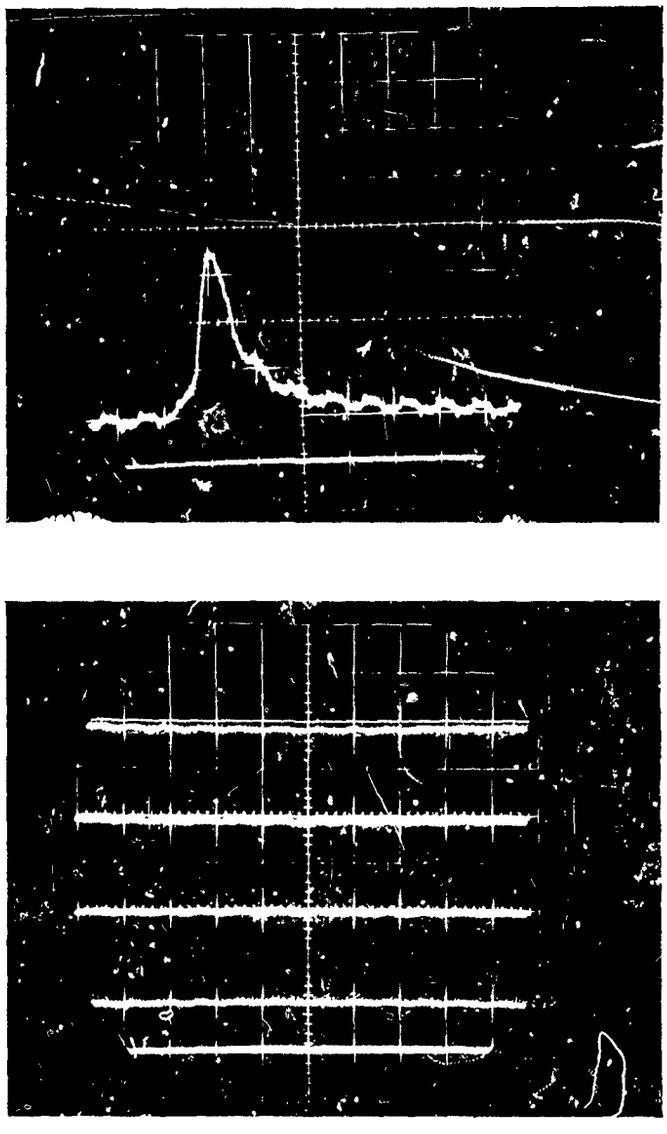
No telemetry signal was received. It was later found that there was insufficient area of fibreglass at the base of the nose cone to support it during launch acceleration. It is therefore assumed that a partial loosening of the nose cone caused a failure of the antenna connection.

Summary:

The trajectory was satisfactory but no results were obtained from the payload.

KAPPA

20 SEPTEMBER 1966 - 2255 AST



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 34,900 psi

CHARGE: 780 lb WMM.225

FIG. 2.27 STRAIN RECORD OF BREECH PRESSURE
ROUND KAPPA

KAPPA

20 SEPTEMBER 1966 - 2255 AST

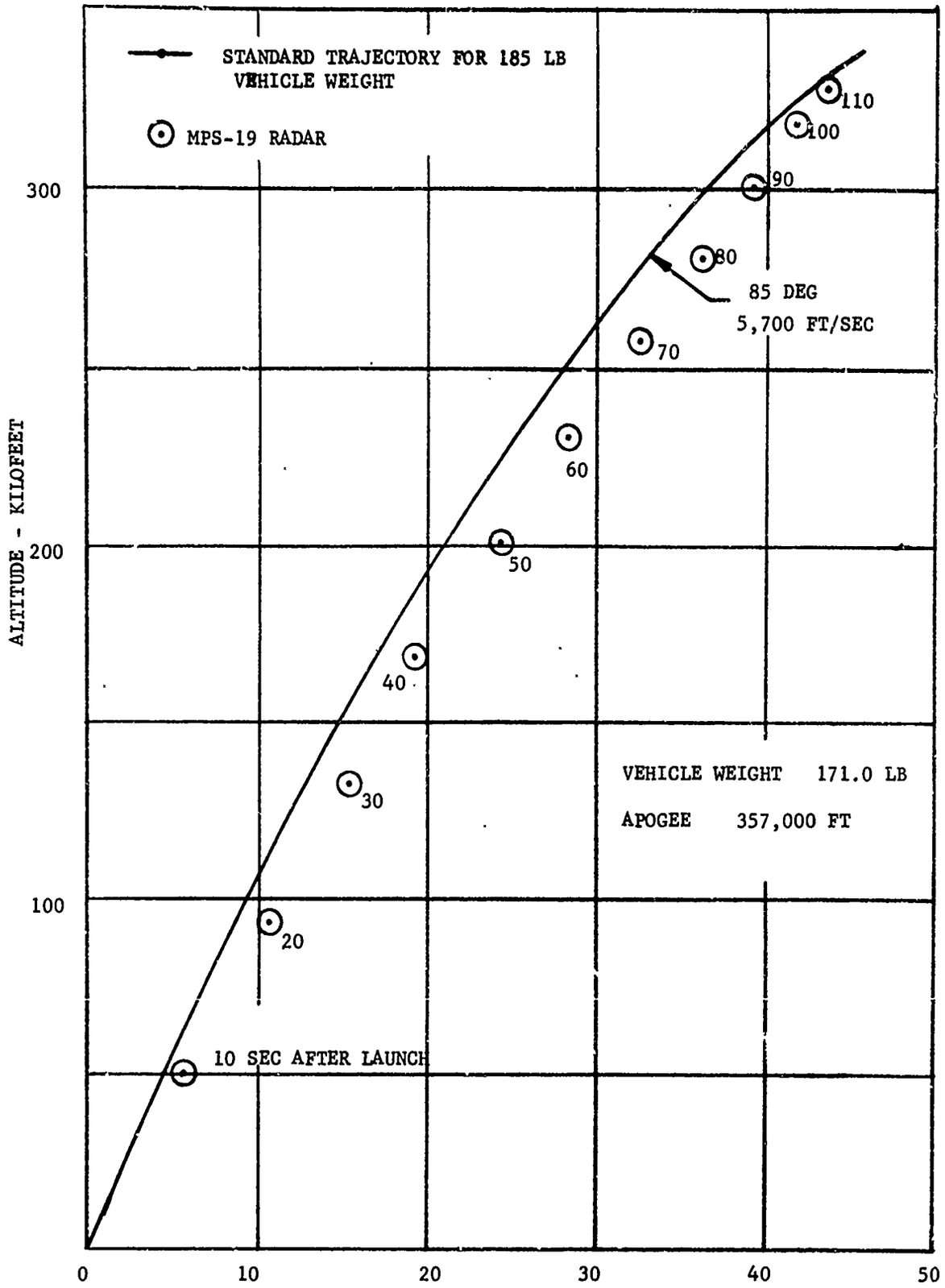


FIG. 2.27a MARTLET 2C (MOD 2) KAPPA
ALTITUDE VS RANGE

Round No. 214 - INDEPENDENCE 1

Date: 5 December 1966 - 1915 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Check of gun-vehicle-payload system with multipoint ignition Pyro charge.

Weights:		
	Vehicle	184.5 lb
	Pusher and Obturator	127.0 lb
	Sabot	101.0 lb
	Shot Weight	412.5 lb

Centre of Gravity: Not available

Launch Data:

Charge Weight	1280 lb Pyro (10 bags)
Spacing of Charge	Not available
Swedish Additive	Not available
Igniter	Pyro fuses, 120 V d.c. (Six-point ignition)
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	185.25 in
Ram Load	20 tons
Chamber Volume	39,570 in^3
Recoil	44.5 in
Breech Pressure	M11: 42,700 psi Strain: 43,000 psi (Fig. 2.28)
Muzzle Velocity (Probe)	Not available (reading was unrealistic)
Gun Evacuation	None

Camera Records:

Smear (front and rear smear) and Fastax (West Fastax) coverage in this round was intended as a further test of equipment and film for night photography. The vehicle, however, was not visible on any of the three films exposed, although it was painted white, and

the gun flash was expected to provide sufficient illumination.

The front smear photograph showed the pusher plate trailing a smoke cloud, and with some smoke in a conical formation ahead of the plate. This smoke and/or the pusher plate apparently cut off the illumination to the vehicle. The intercept points for the front and rear smear cameras were 150 ft and 130 ft, respectively, above the gun muzzle. These points were considered to be well above the smoke cloud as previous firings show. For this round, however, the films showed that the smoke cloud travelled well above the previous altitudes.

The West Fastax camera was aimed at the gun and provided measurement of the ignition and barrel travel time of 88 milliseconds. The intercept time at 130 ft ahead of the muzzle was 114 milliseconds (rear smear), and at 150 ft 118 milliseconds, which indicates a velocity of 5000 ft/sec for the pusher plate.

Radar Records:

The MPS-19 provided a perfect track beyond apogee which was reached at T + 150 sec. The impact was also observed at T + 310 sec.

Trajectory:

The radar data, plotted in Figure 2.28a, compare well with a standard drag trajectory for a muzzle velocity of 5600 ft/sec. The measured apogee was 348,000 ft = 106 km, and the total range was 118,000 ft.

TMA Trail Results:

The photographs made with a 4 x 5 Speed Graphic Camera showed a rather thin trail which dispersed rapidly.

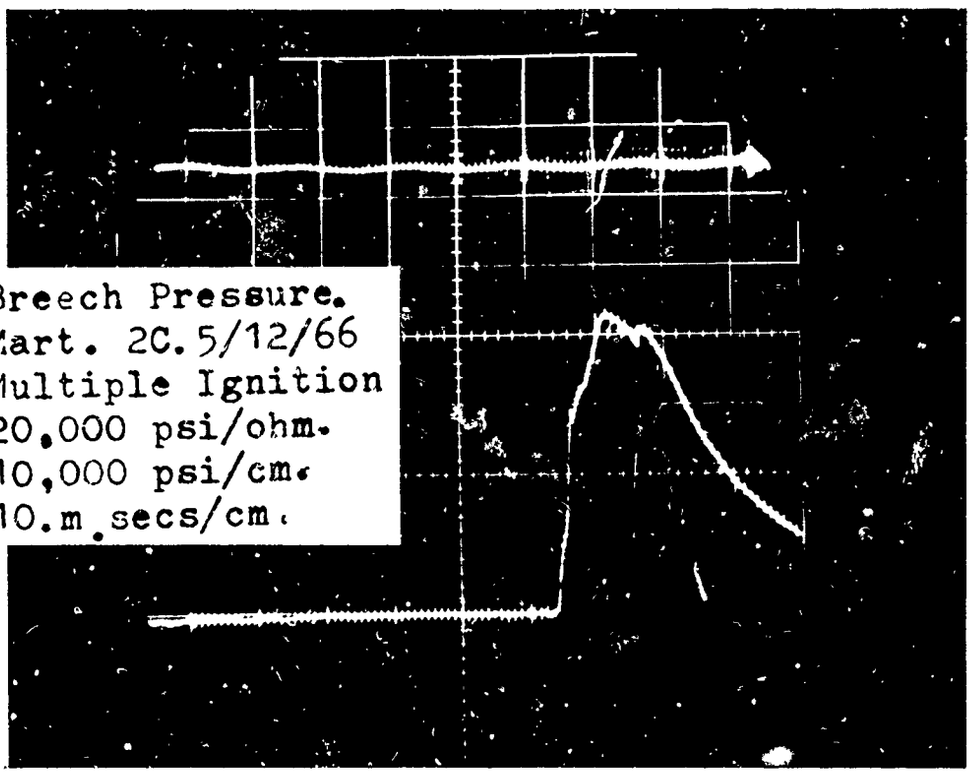
Summary:

The round was successful regarding gun and flight performance. The shot proved that the amount of 1280 lb of Pyro can be used with multiple ignition and is sufficient for Martlet 2C synoptic test firings.

The instrumentation did not prove fully satisfactory. The failure to obtain muzzle velocity data was partly due to the use of a single time interval meter, and partly due to the wooden sabots. A good breech pressure curve, however, was obtained, but the attempt to record both breech and muzzle pressure on the double trace scope was not successful since the muzzle pressure started much later than the breech pressure and outside the available sweep of 100 milliseconds.

INDEPENDENCE 1

5 DECEMBER 1966 - 1915 AST



10,000psi per cm (division)

BREECH PRESSURE

TIME

10 milliseconds per cm (division)

Maximum Breech Pressure: P_{max} = 43,000 psi

CHARGE: 1280 lb Pyro

FIG. 2.28 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND INDEPENDENCE 1

INDEPENDENCE 1

5 DECEMBER 1966 - 1915 AST

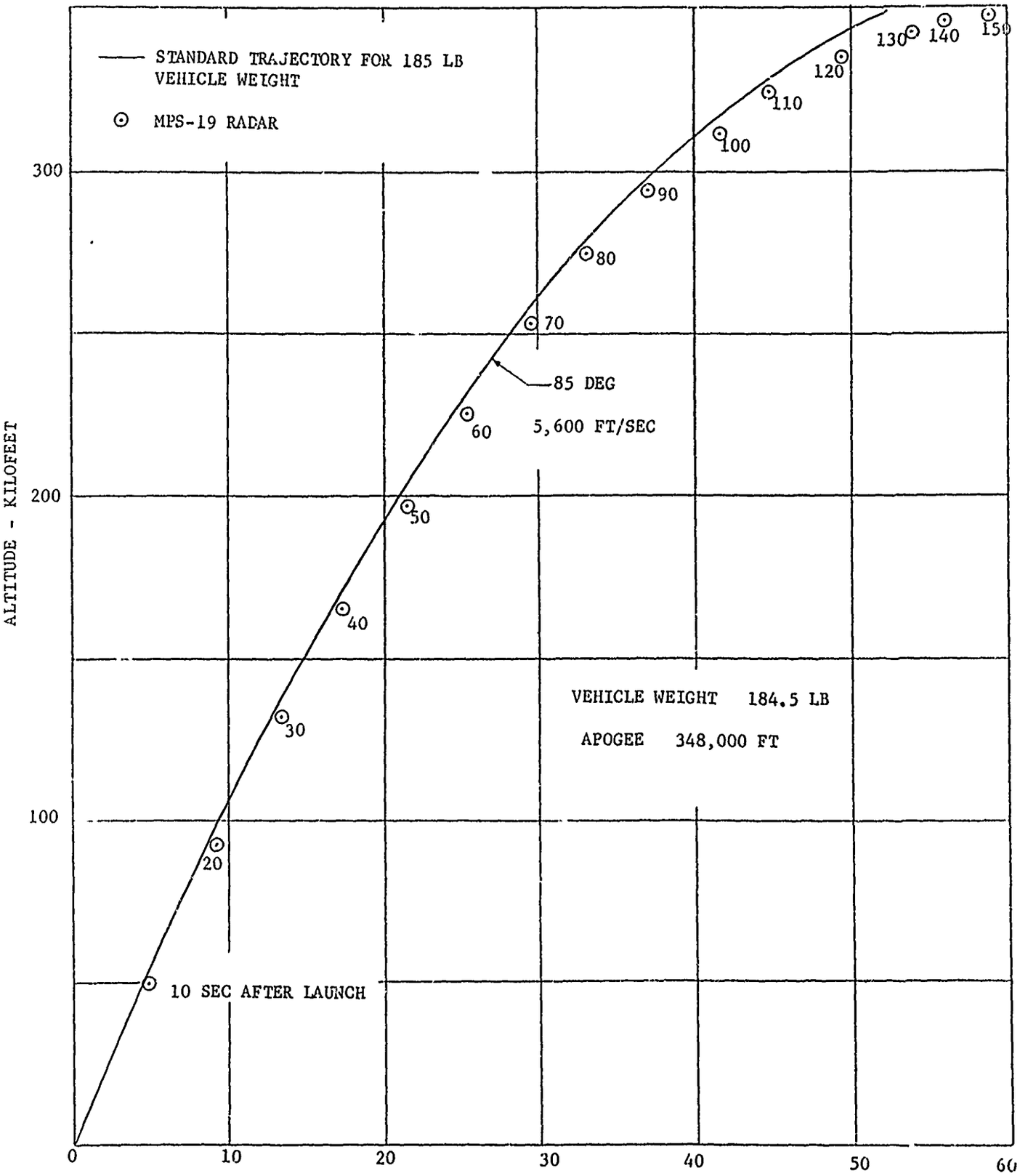


FIG. 2.28a MARTLET 2C INDEPENDENCE 1

ALTITUDE VS RANGE

Round No. 215 - INDEPENDENCE 2

Date: 14 December 1966 - 1709 AST

Vehicle Description: Martlet 2G Vehicle without payload.

Purpose of Test: Engineering Test (structural performance).

Weights: Shot Weight 475 lb

Centre of Gravity: Not available

Launch Data:

Charge Weight	800 lb WMM.225 (11 bags)
Spacing of Charge	One 9" Spacer at breech
Swedish Additive	7 sheets
Igniter	Multi-point ignition
Gun Elevation	85 deg
Crusher Gauges	Not available
Ram Distance	184 in
Ram Load	100 tons
Chamber Volume	39,100 in^3
Recoil	42 in
Breech Pressure	Strain: 45,000 (Fig. 2.29)
Muzzle Velocity (Probe)	Not available
Gun Evacuation	None

Camera Records:

Front and rear smear cameras aimed at the vehicle and Fastax cameras aimed at the gun muzzle were used in this round. The smear photographs indicated a structural failure in the rear section of the vehicle, with approximately 54 inches front section of the vehicle intact and flying ahead of a cloud of debris.

Radar Data and Trajectory:

The MPS-19 radar located a target at T + 10 seconds and tracked it through an apogee of 11,000 ft at T + 20 seconds to impact at T + 55 seconds. This was presumably the intact body section seen

on the smear photographs. The target veered to the right and flew a path approximately 15 deg clockwise from the gun.

Breech and Muzzle Pressure Records:

The muzzle pressure trace (upper curve of Figure 2.29) did not show any significant pressure rise, probably owing to the loss of obturation in the barrel. The breech pressure trace showed a maximum of 45,000 psi at approximately T + 50 seconds; there was a large noise content superimposed on the pressure trail not seen on previous rounds.

Summary:

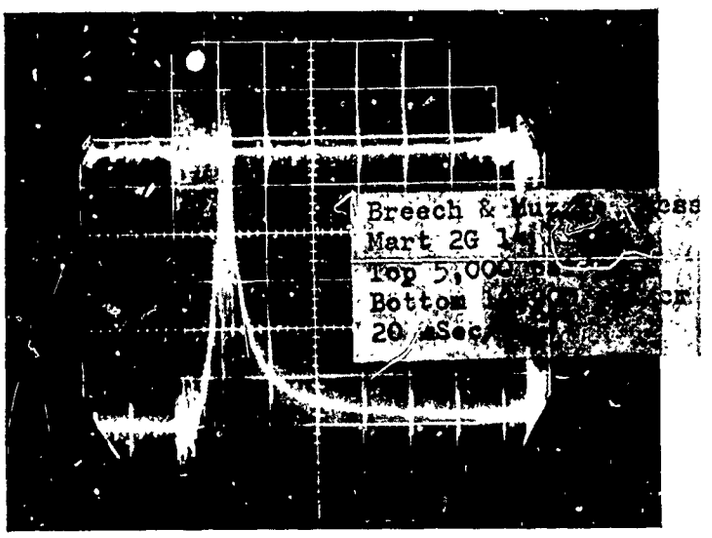
The round was not successful since the vehicle failed in the gun.

INDEPENDENCE 2

14 DECEMBER 1966 - 1709 AST

BREECH PRESSURE (Bottom) 10,000 psi/div.

MUZZLE PRESSURE (Top) 5,000 psi/div



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 45,000 psi

CHARGE: 800 lb WMM.225

FIG. 2.29 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND INDEPENDENCE 2

Round No. 216 - TEST SLUG

Date: 18 January 1967 - 1500 AST

Vehicle Description: Wood Slug

Purpose of Test: Firing intended for seating of obturator seals only.

Weights: Shot Weight 350 lb

Launch Data:

Charge Weight	550 lb Pyro
Gun Elevation	80 deg
Ram Distance	189 in
Ram Load	12.5 tons
Chamber Volume	40,150 in^3
Recoil	14 in
Breech Pressure	Strain: 8000 psi
Gun Evacuation	Nor

Camera Records:

Both the rear and front smear camera were operated, but there was no Fastax coverage. No velocity measurements were obtained.

Radar Records:

There was no target for the MPS-19 to track.

Summary:

The slug disintegrated in the barrel.

Round No. 217 - ANTRIM

Date: 15 February 1967 - 1937 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	134.0 lb
	Pusher and Obturator	132.0 lb
	Sabot	97.5 lb
	Shot Weight	413.5 lb

Centre of Gravity: 22.25 inches from base.

Launch Data:

Charge Weight	1290 lb Pyro (10 bags)
Swedish Additive	Rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	40 tons
Chamber Volume	39,700 in^3
Recoil	44 in
Breech Pressure	M11: 46,400 psi Strain: 46,000 psi (Fig. 2.30)
Muzzle Velocity (Probe)	Not available
Gun Evacuation	27 in of Mercury

Camera Records:

Smear camera coverage was attempted, by painting the vehicle white. Although adequate density was obtained on the films, no images of the vehicles were seen. This agreed with previous experience in photographing Martlet 2C vehicles at night when the pusher plate shadows the vehicle. The front smear photograph showed the pusher plate partially obscured by gases; no photograph of the vehicle was obtained. The

vehicle was apparently barely separated from the pusher as the stream pattern originating from the four fins were seen.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 3 sec to T + 105 sec. An azimuth change of -2 to -3 degrees was recorded.

Trajectory:

The radar results agree well with a standard trajectory for a muzzle velocity of 5750 ft/sec (Fig. 2.30a). The apogee derived from the radar data was 376,000 ft = 115 km and the range was estimated to be 127,000 ft.

TMA Trail Results:

The cameras and the TMA payload performed satisfactorily, and good trail photographs were obtained.

Summary:

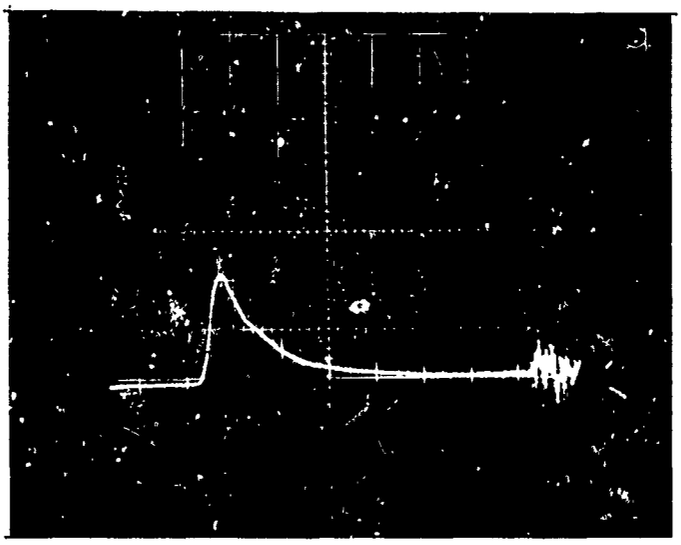
The round was successful.

ANTRIM

15 FEBRUARY 1967 - 1937 AST

20,000 psi/division

BREECH PRESSURE



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 46,000 psi

CHARGE: 1290 lb Pyro

FIG. 2.30 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND ANTRIM

II-129

ANTRIM

15 FEBRUARY 1967 - 1937 AST

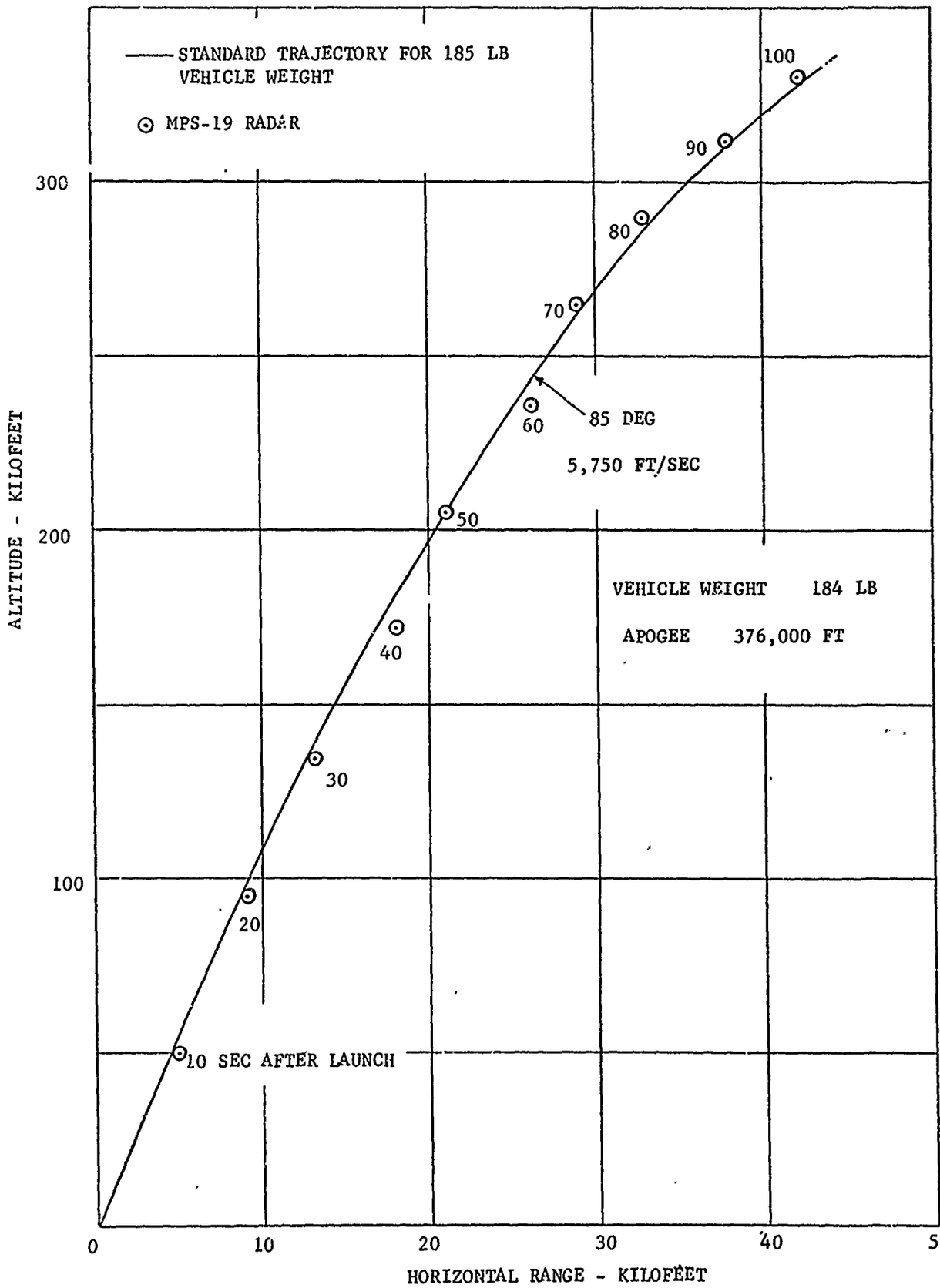


FIG. 2.30a MARTLET 2C (MOD 2) ANTRIM
ALTITUDE VS RANGE

Round No. 218 - BELFAST

Date: 15 February 1967 - 2117 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	184 lb
	Pusher and Obturator	133 lb
	Sabot	101 lb
	Shot Weight	418 lb

Centre of Gravity: 22.25 inches from base.

Launch Data:

Charge Weight	1320 lb Pyro (10 bags)
Swedish Additive	Rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	40 tons
Chamber Volume	39,700 in^3
Recoil	45 in
Breech Pressure	M11: 53,500 psi Strain: 53,000 psi (Fig. 2.31)
Muzzle Velocity (Probe)	Not available
Gun Evacuation	25 inches of Mercury

Camera Records:

One smear camera (rear) was operated in this round. The photograph showed only gun gases. (See also comment in Round ANTRIM)

Radar Records:

The MPS-19 radar tracked the vehicle from T + 3 sec to T + 80 sec. An azimuth change of -2 degrees was recorded.

Trajectory:

The radar results agree well with a standard drag trajectory for a muzzle velocity of 5900 ft/sec (Fig. 2.31a). The apogee derived from the radar data was 399,000 ft = 122 km, and the range was estimated to be 135,000 ft.

TMA Trail Results:

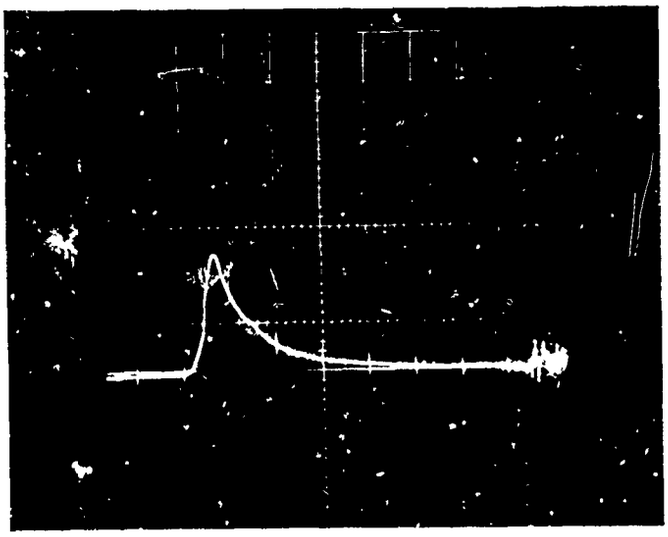
The cameras and the TMA payload performed satisfactorily, and good trail photographs were obtained.

Summary:

The round was successful. There was the expected increase with charge weight of muzzle velocity and apogee, and the results suggested a further increase of the charge weight.

BELFAST

15 FEBRUARY 1967 - 2117 AST



Maximum Breech Pressure: P_{max} = 53,000 psi

CHARGE: 1320 lb Pyro

FIG. 2.31 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND BELFAST

BELFAST

15 FEBRUARY 1967 - 2117 AST

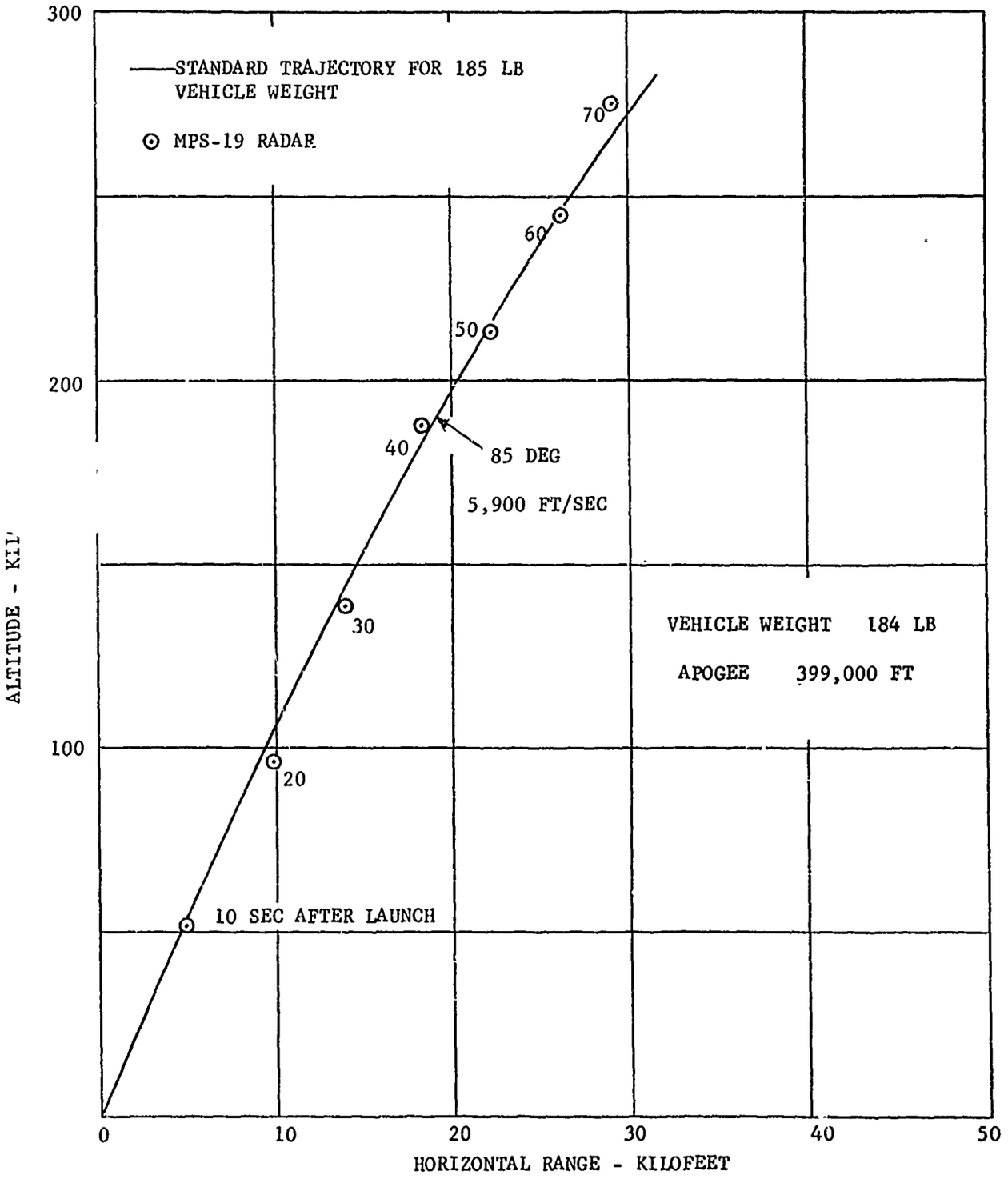


FIG. 2.31a MARTLET 2C (MOD 2) BELFAST
ALTITUDE VS RANGE

Round No. 219 - CORK

Date: 15 February 1967 - 2245 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	184.5 lb
	Pusher and Obturator	132.0 lb
	Sabot	107.0 lb
	Shot Weight	423.5 lb

Centre of Gravity: 22.25 inches from base.

Launch Data:

Charge Weight	1330 lb Pyro (10 bags)
Swedish Additive	Rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	40 tons
Chamber Volume	39,700 in^3
Recoil	45 in
Breech Pressure	M11: 46,400 psi Strain: 47,000 psi (Fig. 2.32)
Muzzle Velocity (Probe)	5680 ft/sec
Gun Evacuation	25 in of Mercury

Camera Records:

Only the smear camera was operated. The photograph shows only gun gases. (See also comments in Round ANTRIM.)

Radar Records:

The MPS-19 radar tracked the vehicle from T + 3 sec to T + 120 sec. The azimuth change was -5 degrees from the gun line.

Trajectory:

The data were plotted in Figure 2.32a in comparison with standard trajectories for a muzzle velocity of 5700 ft/sec at 85 and 85.5 degree launch elevation. It appears that the effective elevation was 85.5 degrees. The apogee derived from the radar data was 367,600 ft = 112.0 km and the range was estimated to be 124,000 ft.

TMA Trail Results:

The cameras and the TMA payload performed satisfactorily, and good trail photographs were obtained. A slight TMA leak, however, was reported in this round.

Summary:

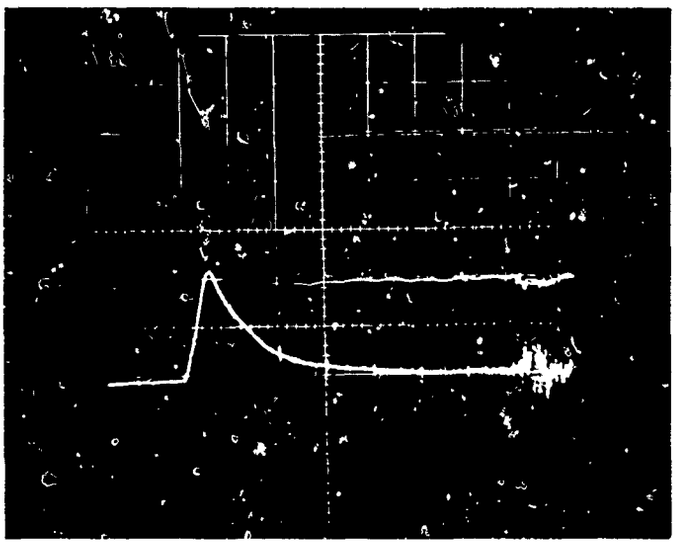
The round was successful. The large change in azimuth (5 deg) with the increase in charge weight might indicate a partial failure of the pusher plate.

CORK

15 FEBRUARY 1967 - 2245 AST

20,000 psi./division

BREECH PRESSURE



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 47,000 psi

CHARGE: 1330 lbs Pyro

FIG. 2.32 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND CORK

CORK

15 FEBRUARY 1967 - 2245 AST

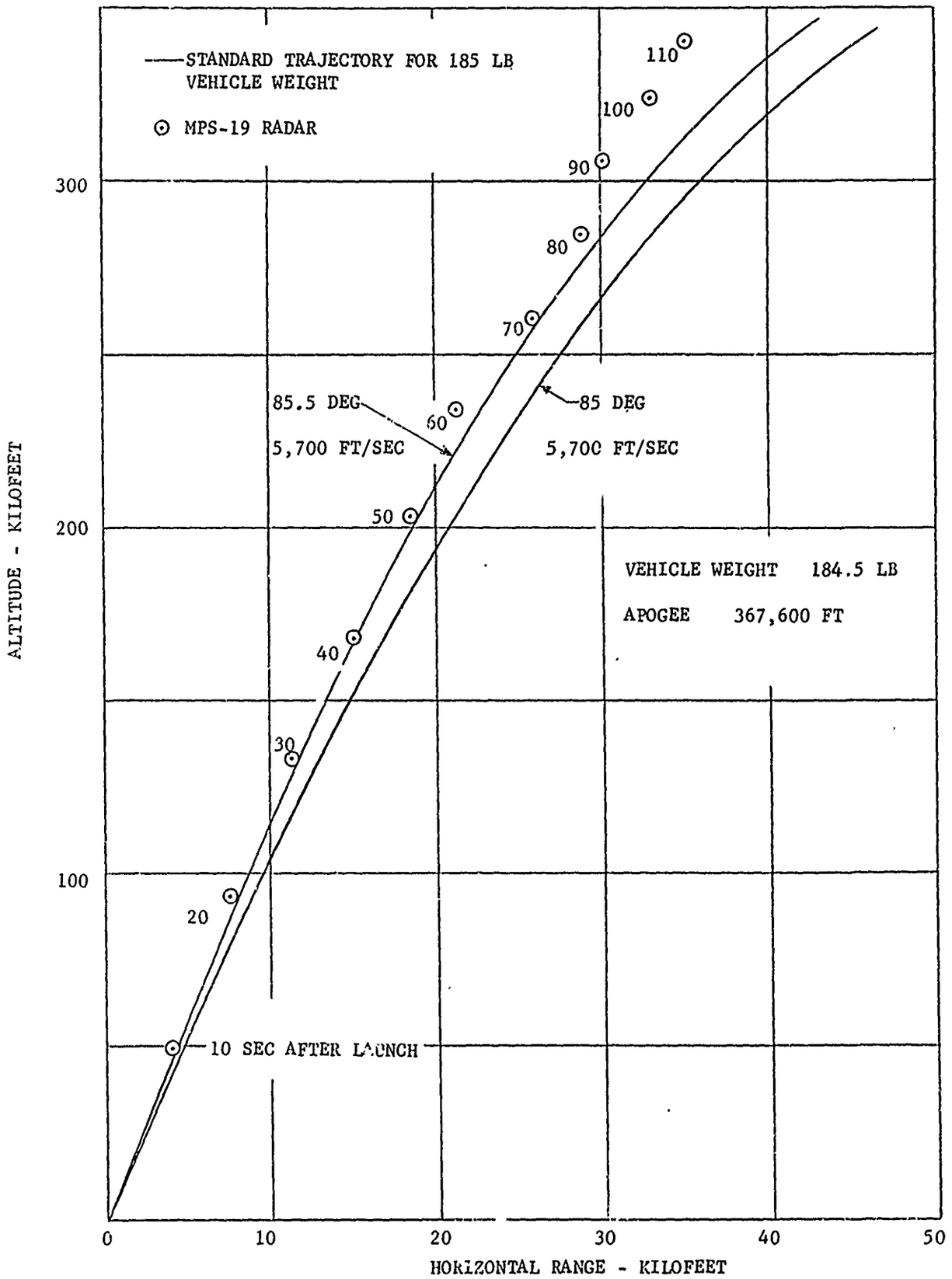


FIG. 2.32a MARTLET 2C (MOD 2) CORK

ALTITUDE VS RANGE

Round No. 220 - DUBLIN

Date: 15 February 1967 - 2356 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	185.0 lb
	Pusher and Obturator	132.5 lb
	Sabot	101.5 lb
	Shot Weight	419.0 lb

Centre of Gravity: 22.25 inches from base.

Launch Data:

Charge Weight	1320 lb Pyro (10 bags)
Swedish Additive	Rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	40 tons
Chamber Volume	39,700 in^3
Recoil	45 in
Breech Pressure	M11: 43,600 psi Strain: 42,500 psi (Fig. 2.33)
Muzzle Velocity (Probe)	5490 ft/sec
Gun Evacuation	27 in of Mercury

Camera Records:

No smear camera coverage was attempted on this round.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 4 sec to T + 80 sec; the azimuth change was -5 degrees.

Trajectory:

The radar results agree well with a standard drag trajectory for a muzzle velocity of 5700 ft/sec (Fig. 2.33a). The measured velocity of only 5490 ft/sec, indicated that the drag was probably smaller than standard in this round. The apogee derived from the radar data was 371,400 ft = 113 km and the range was estimated to be 125,000 ft.

TMA Trail Results:

The camera and the TMA payload performed satisfactorily, and good trail photographs were obtained.

Summary:

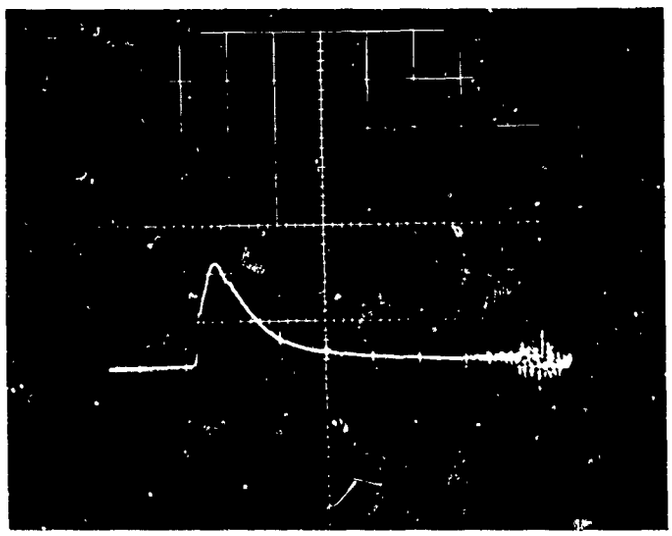
The round was successful.

DUBLIN

15 FEBRUARY 1967 - 2356 AST

20,000 psi/division

BREECH PRESSURE



TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 42,500 psi

CHARGE: 1320 lb PYRO

FIG. 2.33 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND DUBLIN

DUBLIN

15 FEBRUARY 1967 - 2356 AST

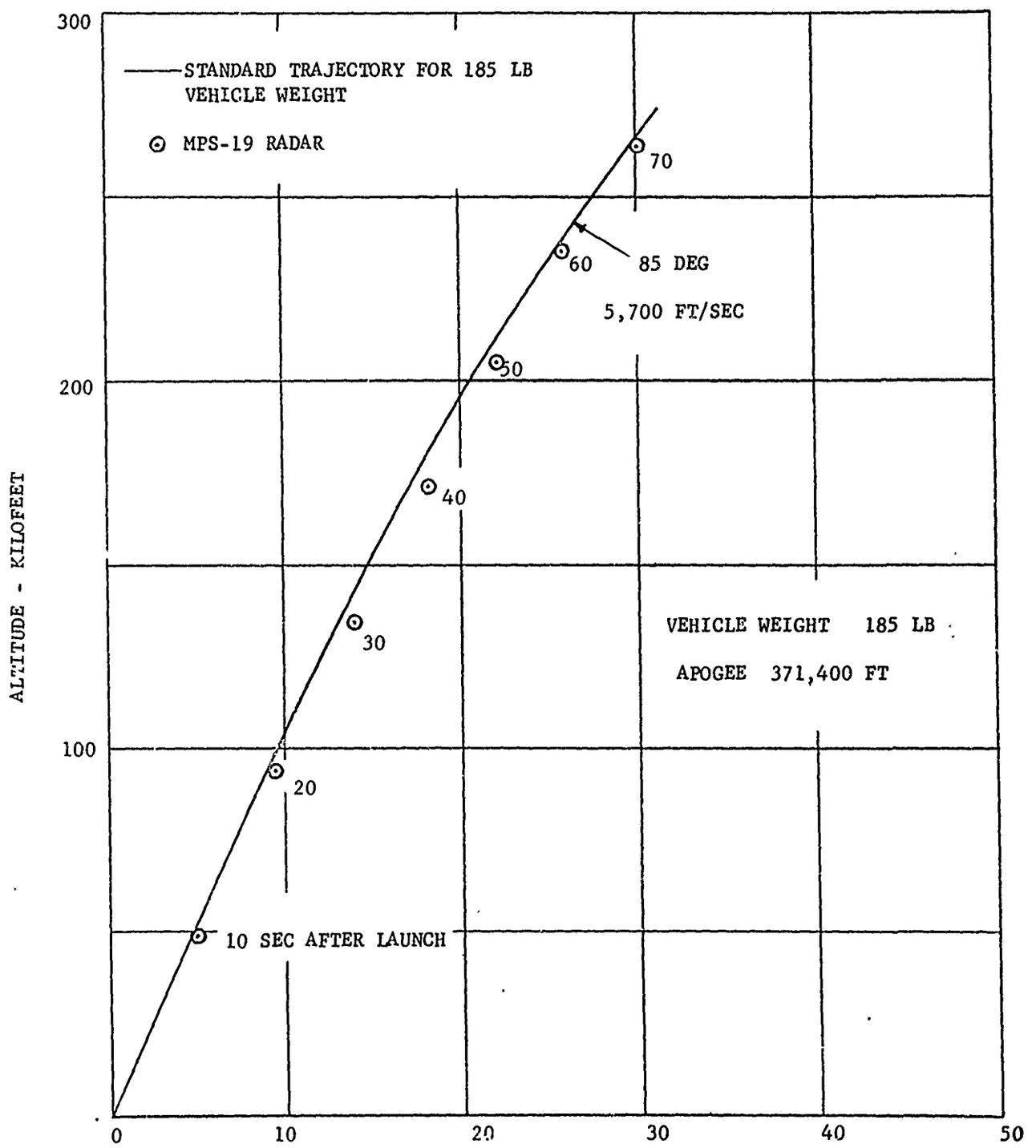


FIG. 2.33a MARTLET 2C (MOD 2) DUBLIN

ALTITUDE VS RANGE

Round No. 221 - GARVAGH

Date: 16 February 1967 - 0105 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	185.0 lb
	Pusher and Obturator	132.0 lb
	Sabot	100.0 lb
	Shot Weight	417.0 lb

Centre of Gravity: 22.25 inches from base.

Launch Data:

Charge Weight	1320 lb Pyro (10 bags)
Swedish Additive	Rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	40 tons
Chamber Volume	39,700 in^3
Recoil	45 in
Breech Pressure	M11: 44,300 psi Strain: 44,000 psi (Fig. 2.34)
Muzzle Velocity (Probe)	Left: 5710 ft/sec
Gun Evacuation	25 in of Mercury

Camera Records:

No smear camera coverage was attempted on this round.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 3 sec to T + 130 sec. The azimuth change was -5 degrees.

Trajectory:

The radar results agree well with a standard trajectory for a muzzle velocity of 5800 ft/sec (Fig. 2.34a). The apogee derived from the radar data was 380,000 ft = 116 km and the range was estimated to be 125,000 ft.

TMA Trail Results:

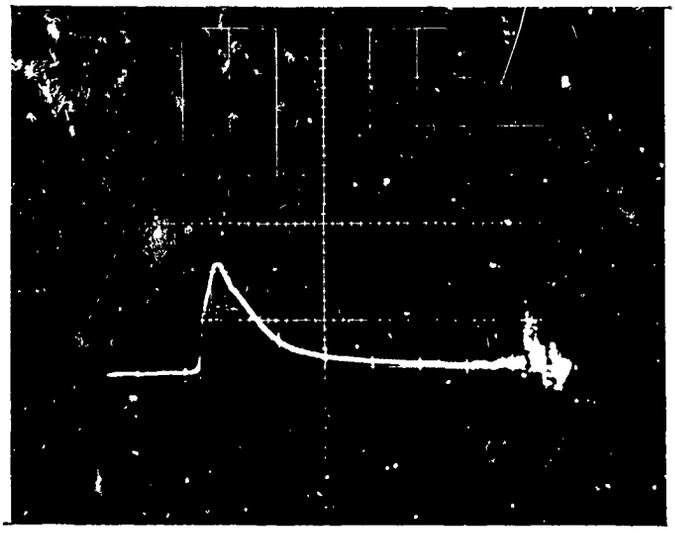
The cameras and the TMA payload performed satisfactorily, and good trail photographs were obtained.

Summary:

The round was successful.

GARVAGH

16 FEBRUARY 1967 - 0105 AST



20,000 psi/division

BREECH PRESSURE

TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 44,000 psi

CHARGE: 1320 lbs PYRO

FIG. 2.34 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND GARVAGH

II-145

GARVACH

16 FEBRUARY 1967 - 0105 AST

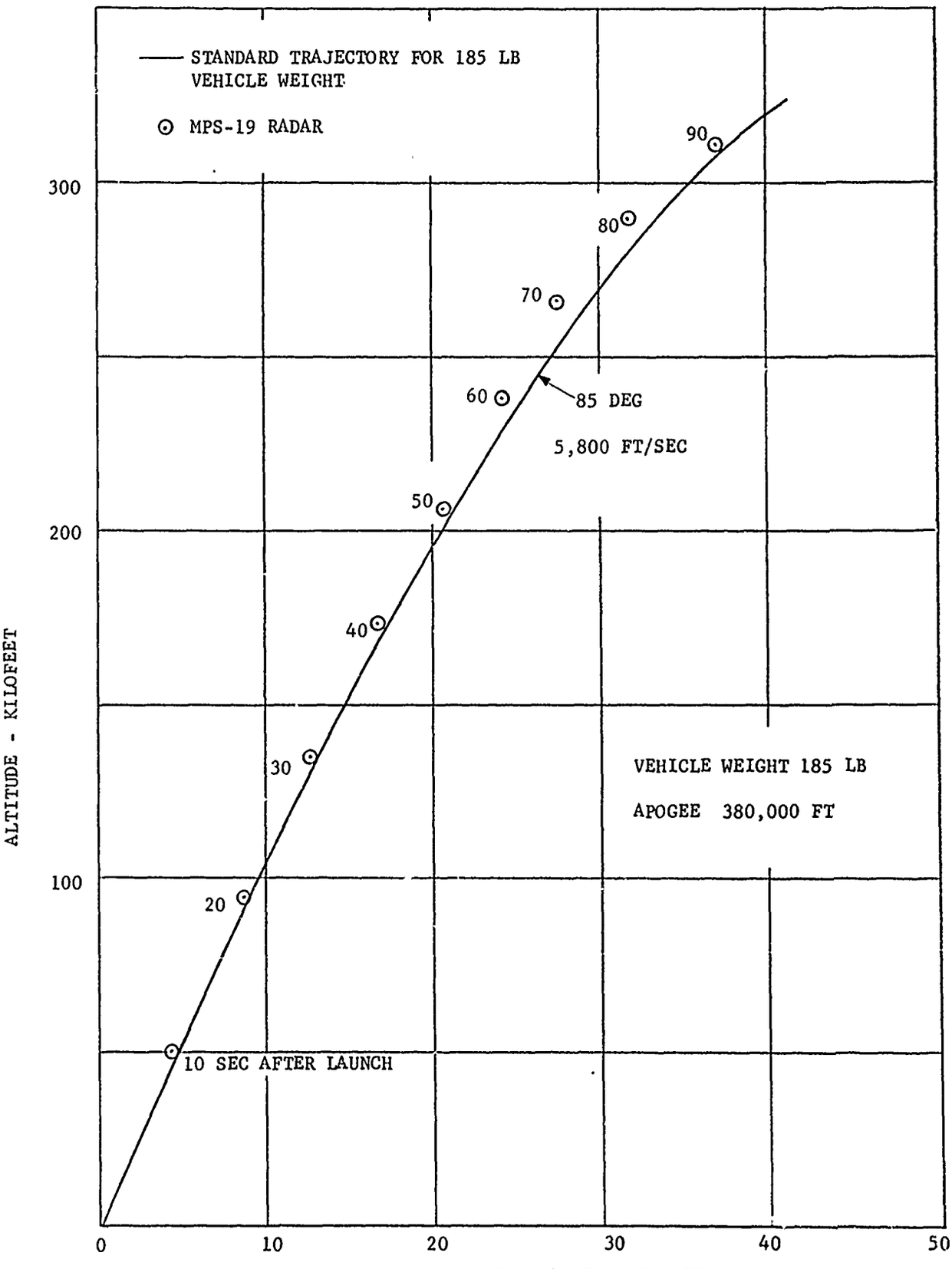


FIG. 2.34a MARTLET 2C (MOD 2) GARVAGH

ALTITUDE VS RANGE

Round No. 222 - HOLLYWOOD

Date: 16 February 1967 - 0210 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	184.5 lb
	Pusher and Obturator	133.0 lb
	Sabot	103.0 lb
	Shot Weight	420.5 lb

Centre of Gravity: 22.25 inches from base.

Launch Data:

Charge Weight	1320 lb Pyro (10 bags)
Swedish Additive	Rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	20 tons
Chamber Volume	39,700 in^3
Recoil	45 in
Breech Pressure	M11: 47,000 psi Strain: 46,000 psi (Fig. 2.35)
Muzzle Velocity (Probe)	5730 ft/sec
Gun Evacuation	27 in of Mercury

Camera Records:

No smear camera coverage was attempted on this round.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 4 sec to T + 140 sec. The azimuth change was + 3.8 deg.

Trajectory:

The radar results agree well with a standard trajectory for a muzzle velocity of 5700 ft/sec (Fig. 2.35a). The apogee derived from the radar data was 376,000 ft = 115 km and the range was estimated to be 126,000 ft.

TMA Trail Results:

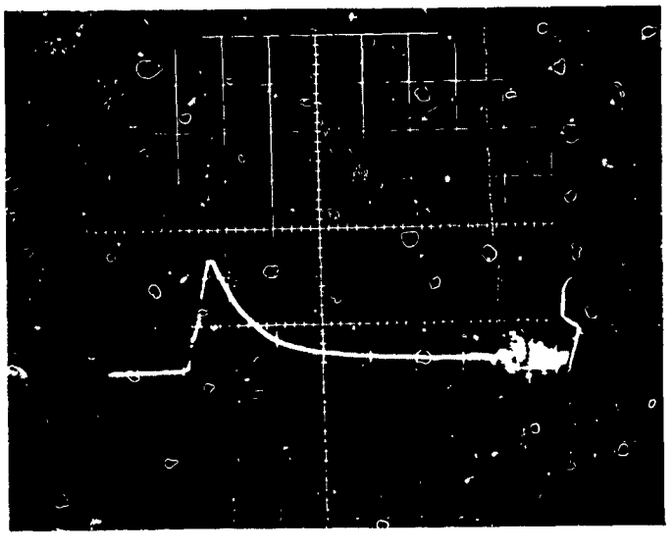
The cameras and the TMA payload performed satisfactorily, and trail photographs were taken. All stations, however, reported hazy to cloudy weather.

Summary:

The round was successful.

HOLLYWOOD

16 FEBRUARY 1967 - 0210 AST



20,000 psi/division

BREECH PRESSURE

TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 46,000 psi

CHARGE: 1320 LB PYRO

FIG. 2.35 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND HOLLYWOOD

HOLLYWOOD

16 FEBRUARY 1967 - 0210 AST

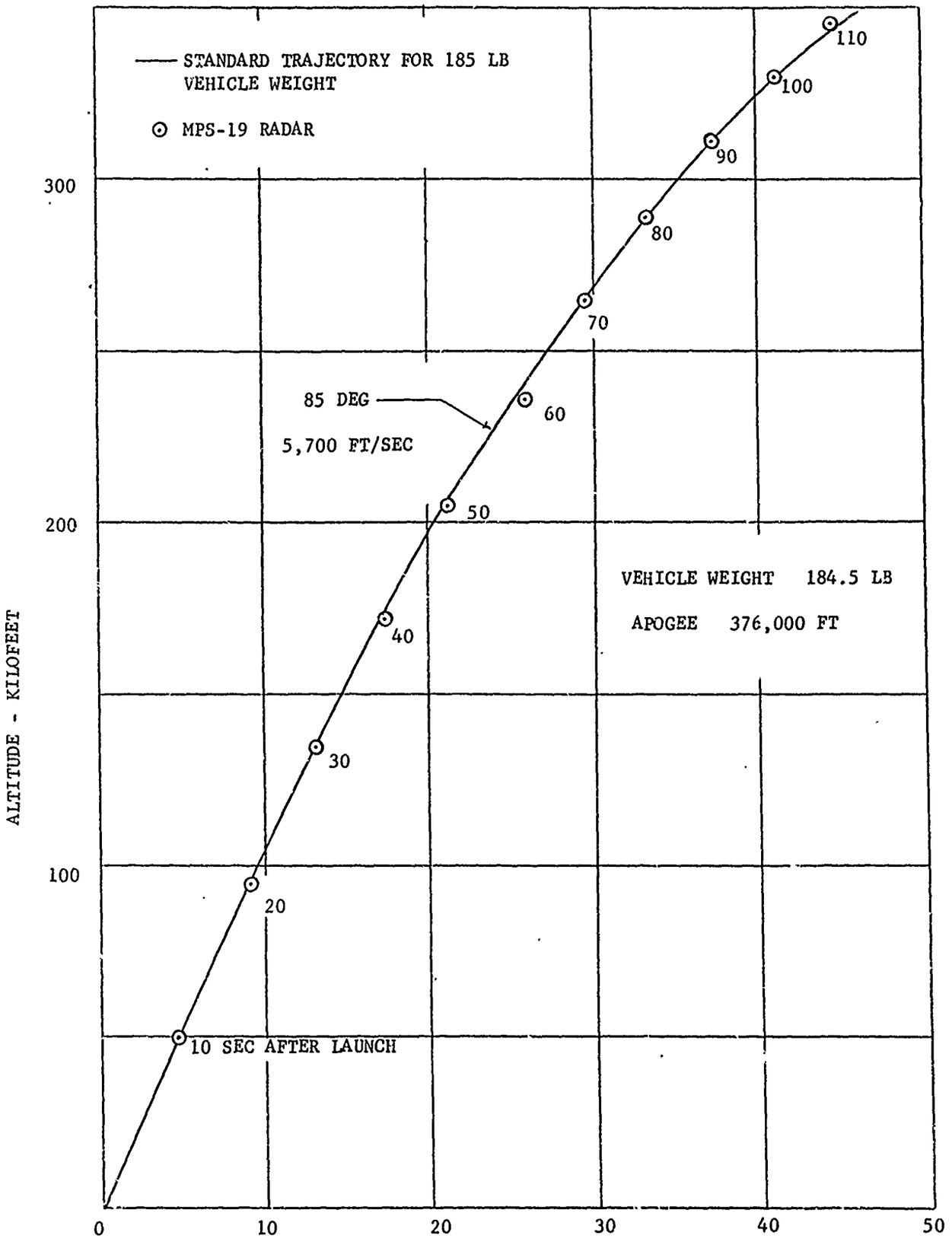


FIG. 2.35a MARTLET 2C (MOD 2) HOLLYWOOD
ALTITUDE VS RANGE

Round No. 223 - KERRY

Date: 16 February 1967 - 0323 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	184.5 lb
	Pusher and Obturator	133.0 lb
	Sabot	105.0 lb
	Shot Weight	422.5 lb

Centre of Gravity: 22.25 inches from base.

Launch Data:

Charge Weight	1330 lb Pyro (10 bags)
Swedish Additive	Rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	18 tons
Chamber Volume	39,700 in^3
Recoil	45 in
Breech Pressure	M11: 47,000 psi Strain: 46,000 psi (Fig. 2.36)
Muzzle Velocity (Probe)	Not available
Gun Evacuation	27 in of Mercury

Camera Records:

No smear camera coverage was attempted on this round.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 3 sec beyond apogee. There was no azimuth change.

Trajectory:

The radar data were plotted in Figure 2.36a in comparison with a standard drag trajectory for a muzzle velocity of 5700 ft/sec. The range data indicated that the effective launch elevation was higher than 85 deg. The measured apogee was 373,000 ft = 144 km, and the range was estimated to be 125,000 ft.

TMA Trail Results:

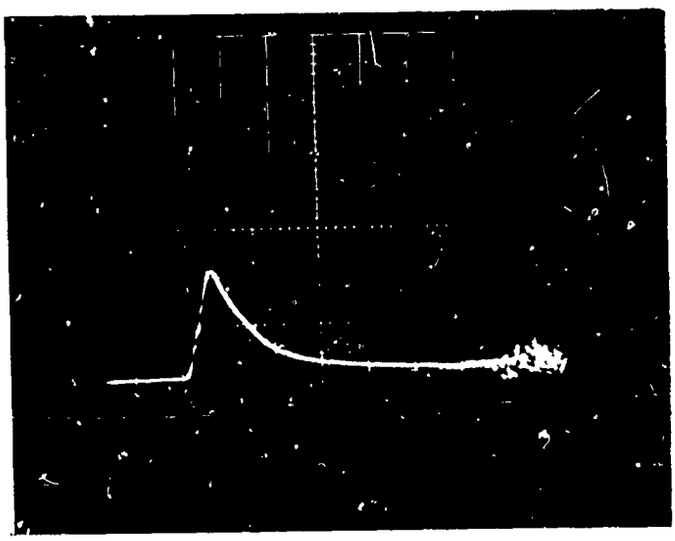
The cameras and the TMA payload performed satisfactorily and good trail photographs were obtained from the St. Vincent and Grenada sites. Rain interrupted photography at Barbados.

Summary:

The round was successful.

KERRY

16 FEBRUARY 1967 - 0323 AST



20,000 psi/division

BREECH PRESSURE

TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 46,000 psi

CHARGE: 1330 LB PYRO

FIG. 2.36 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND KERRY

KERRY

16 FEBRUARY 1967 - 0323 AST

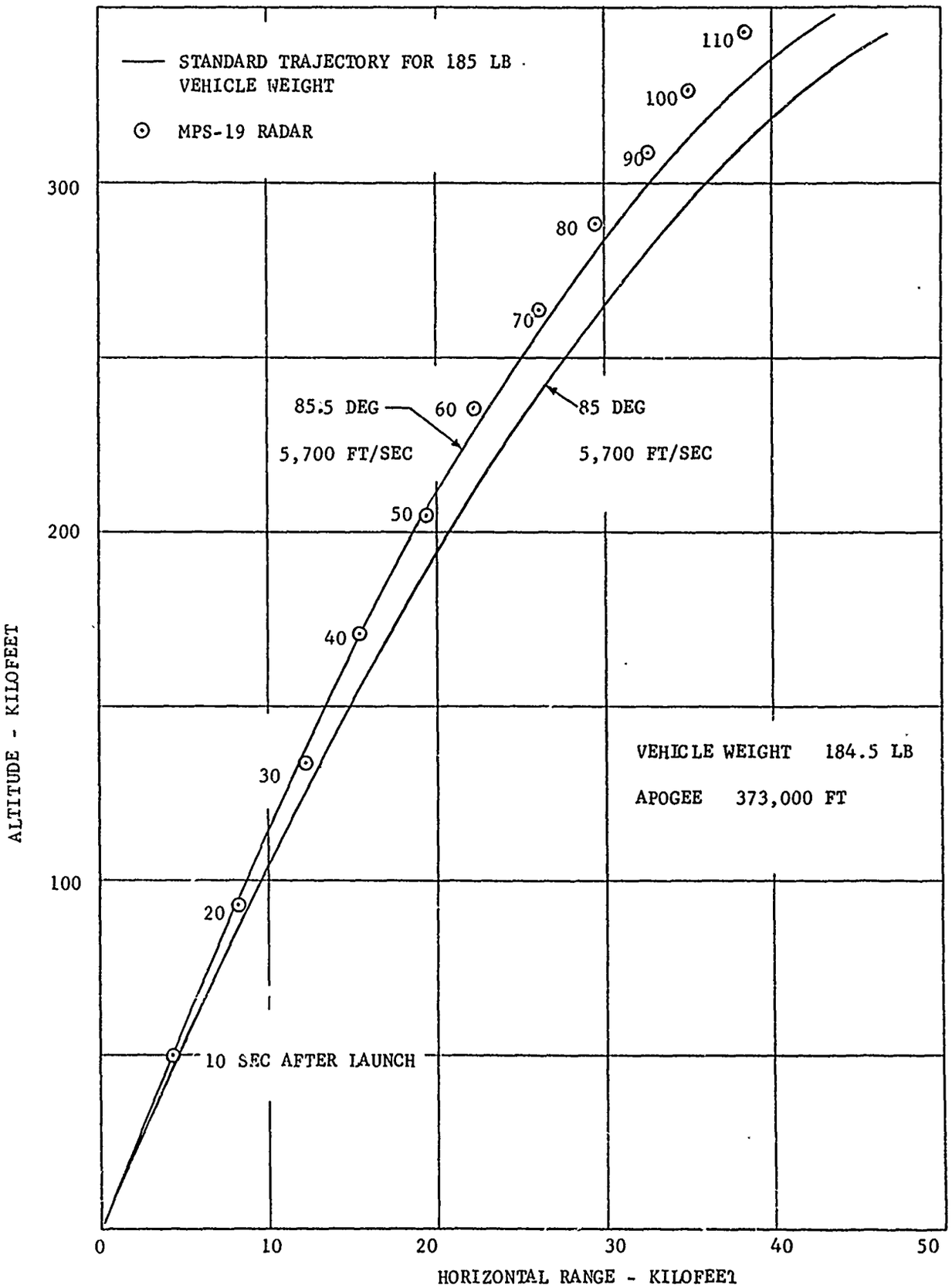


FIG. 2.36a MARTLET 2C (MOD 2) KERRY

ALTITUDE VS RANGE

Round No. 224 - LIMERICK

Date: 16 February 1967 - 0417 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	185.0 lb
	Pusher and Obturator	132.5 lb
	Sabot	101.0 lb
	Shot Weight	418.5 lb

Centre of Gravity: 22.25 inches from base.

Launch Data:

Charge Weight	1340 lb Pyro (10 bags)
Swedish Additive	Rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	22 tons
Chamber Volume	39,700 in^3
Recoil	45 in
Breech Pressure	M11: 48,300 psi Strain: 47,000 psi (Fig. 2.37)
Muzzle Velocity (Probe)	Not available
Gun Evacuation	None

Camera Records:

No smear camera coverage was attempted on this round.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 3 sec to beyond the apogee at T + 150 sec. The azimuth change was -3 degrees.

Trajectory:

The radar data were plotted in comparison with a standard

drag trajectory for a muzzle velocity of 5700 ft/sec (Fig. 2.37a). The range data indicated that the effective launch elevation was higher than 85 deg. The measured apogee was 364,000 ft = 111 km and the range was estimated to be 122,000 ft.

TMA Trail Results:

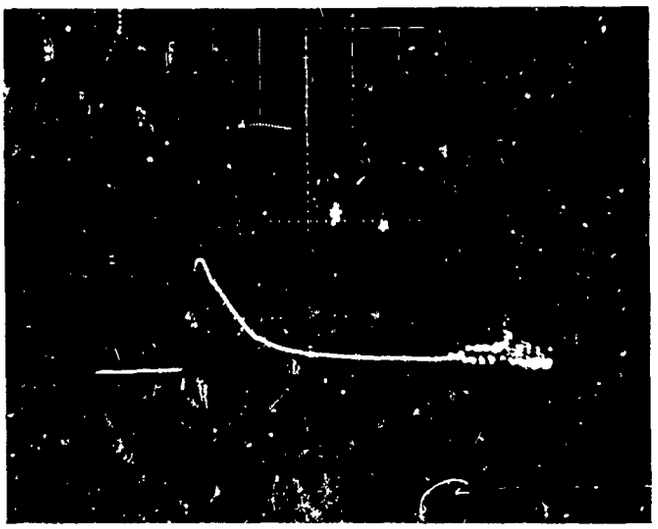
The cameras and the TMA payload performed satisfactorily and good trail photographs were obtained from the St. Vincent and Grenada sites whereas the trail was obscured by a heavy haze at the Barbados station.

Summary:

The round was successful. The increase in charge weight over that of the preceding shot resulted in an increase in breech pressure but not in apogee; it must be noted, however, that the bore was not evacuated in this round.

LIMERICK

16 FEBRUARY 1967 - 0417 AST



20,000 psi/division

BREECH PRESSURE

TIME

.. 20 milliseconds/division

Maximum Breech Pressure: P_{max} = 47,000 psi

CHARGE: 1340 LB PYRO

FIG. 2.37 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND LIMERICK

LIMERICK

16 FEBRUARY 1967 - 0417 AST

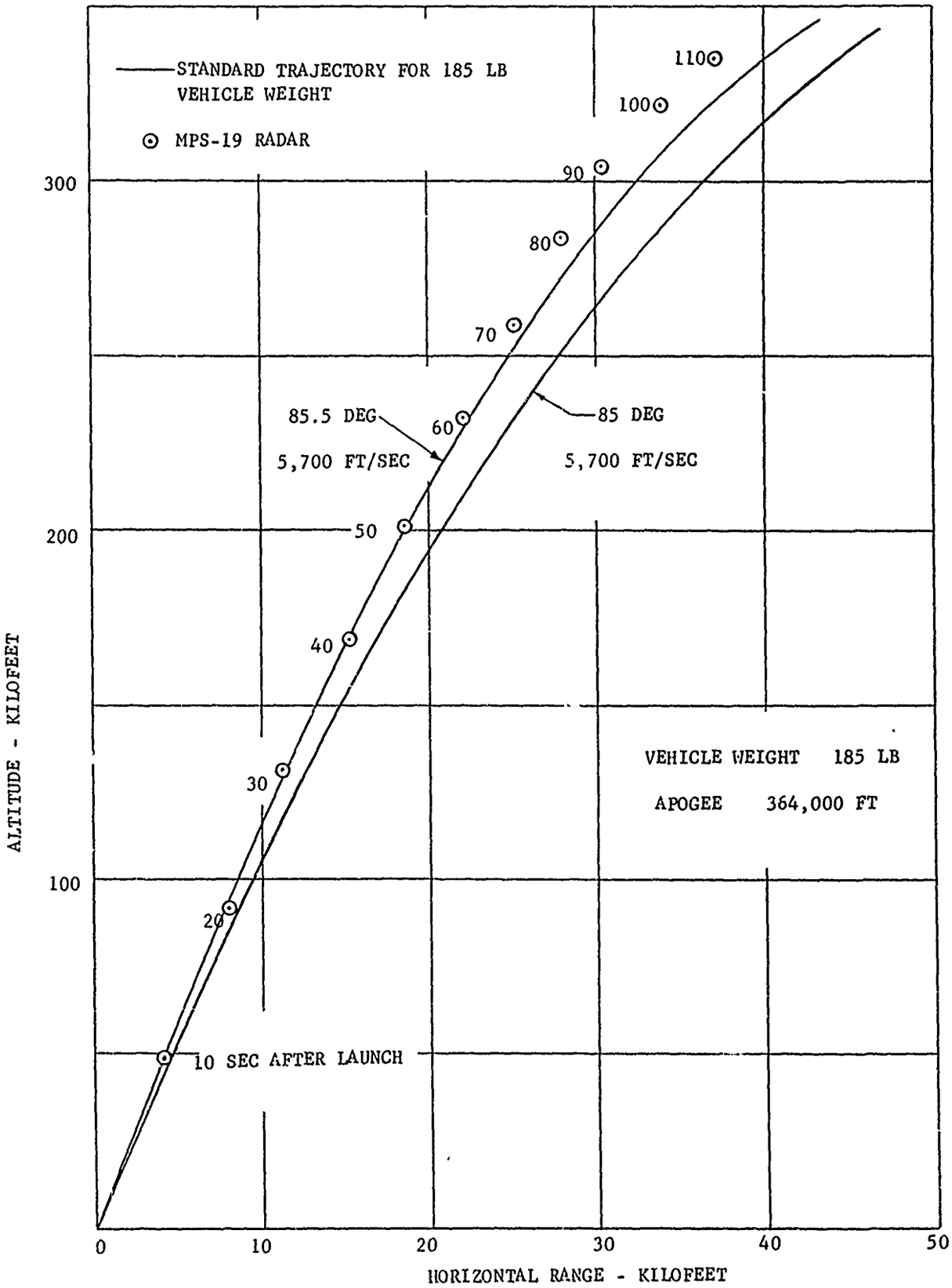


FIG. 2.37a MARTLET 2C (MOD 2) LIMERICK
ALTITUDE VS RANGE

Round No. 225 - NEWRY

Date: 16 February 1967 - 0520 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a payload of 5.5 lb TMA with delay release mechanism.

Purpose of Test: Synoptic measurements of wind profiles.

Weights:		
	Vehicle	184.5 lb
	Pusher and Obturator	131.0 lb
	Sabot	107.0 lb
	Shot Weight	422.5 lb

Centre of Gravity: 22.25 inches from base.

Launch Data:

Charge Weight	1350 lb Pyro (10 bags)
Swedish Additive	Rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	18 tons
Chamber Volume	39,700 in^3
Recoil	45 in
Breech Pressure	M11: 51,600 psi Strain: 52,000 psi (Fig. 2.38)
Muzzle Velocity (Probe)	Not available
Gun Evacuation	None

Camera Records:

No smear camera coverage was attempted on this round.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 10 sec to T + 116 sec. The azimuth change was -9 degrees.

Trajectory:

The radar data were plotted in Figure 2.38a in comparison with a standard drag trajectory for a muzzle velocity of 5800 ft/sec. The range data indicated that the effective launch elevation was smaller than 85 deg. The apogee derived from the radar data was 381,000 ft = 116 km and the range was estimated to be 128,000 ft.

TMA Trail Results:

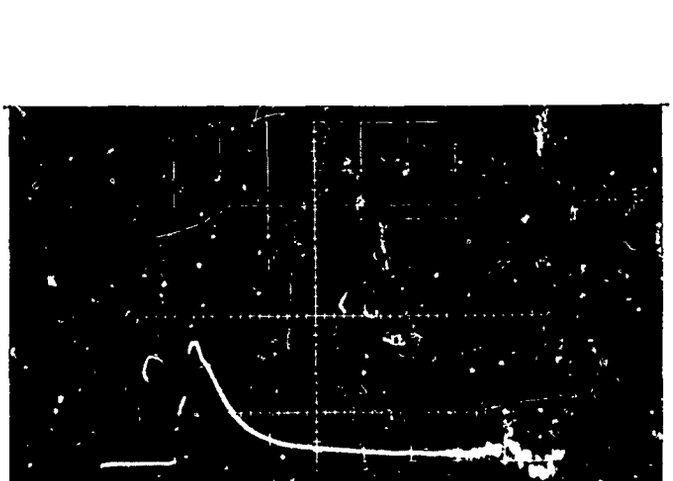
The cameras and the TMA payload performed satisfactorily and good trail photographs were obtained from the Grenada North and Barbados South stations.

Summary:

The round was successful. The further increase in charge weight over that of the previous round resulted in a further increase in pressure. The rather large azimuth change of 9 deg indicated that the pusher plate was probably cocked in the sleeve.

NEWRY

16 FEBRUARY 1967 - 0520 AST



20,000 psi/division

BREECH PRESSURE

TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 52,000 psi

CHARGE: 1350 LB PYRO

FIG. 2.38 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND NEWRY

NEWRY

16 FEBRUARY 1967 - 0520 AST

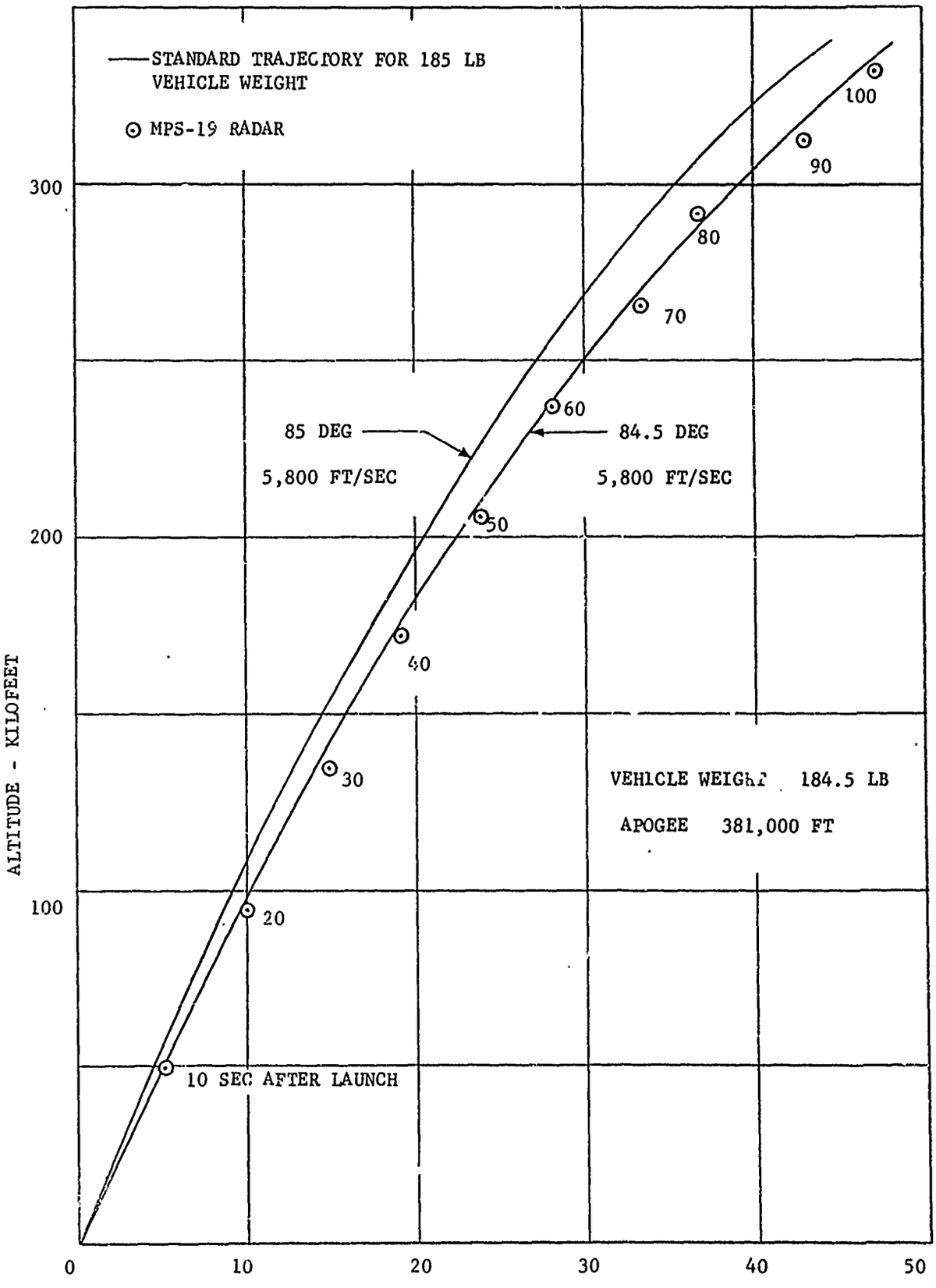


FIG. 2.38a MARTLET 2C (MOD 2) NEWRY

ALTITUDE VS RANGE

Round No. 226 - SHANKILL

Date: 17 February 1967 - 1654 AST

Vehicle Description: Martlet 2G carrying a kerosene payload and a dummy release valve but no piston.

Purpose of Test: Engineering Test

Weights:		
	Vehicle	333.0 lb
	Sabot	213.5 lb
	Shot Weight	546.5 lb

Centre of Gravity: 22 1/8 inches from base.

Launch Data:

Charge Weight	775 lb WMM.225 (8 bags)
Swedish Additive	18 sheets rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	80 deg
Crusher Gauges	M11: 3
Ram Distance	188 in
Ram Load	18 tons
Chamber Volume	39,950 in^3
Recoil	39 in
Breech Pressure	M11: 31,800 psi Strain: 32,000 psi (Fig. 2.39)
Muzzle Velocity (Probe)	5200 ft/sec
Gun Evacuation	None

Camera Records:

Two smear cameras were operated in this round, one in front of the gun at a distance of 300 ft, and one behind the gun at a distance of 250 ft, both on the gun line. The intercept point for both cameras was 150 ft ahead of the muzzle. The films from the two cameras showed the intact vehicle. Figure 2.39b shows the photograph from the front smear camera.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 2 sec through the apogee (at T + 120 sec) to T + 156 sec and further from T + 254 sec to impact (at T + 291 sec). The AGC record indicated that at initial lock-on the the voltage was slightly higher than for the 2C vehicles. Signal appearance and loss on the descent leg indicated tumbling. The azimuth record pointed to a perfect flight.

Trajectory:

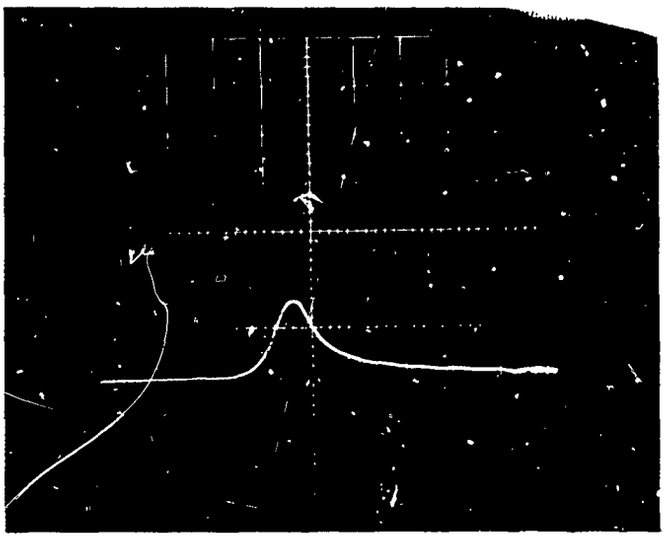
The radar data were plotted in Figure 2.39a indicating an apogee of 228,700 ft = 70 km, and a total range of 162,000 ft.

Summary:

The round was successful, resulting in a perfect flight of the vehicle.

SHANKILL

17 FEBRUARY 1967 - 1654 AST



20,000 psi/division

BREECH PRESSURE

TIME

20 milliseconds/division

Maximum Breech Pressure: P_{max} = 32,000 psi

CHARGE: 775 LB WMM.225

FIG. 2.39 STRAIN GAUGE RECORD OF BREECH PRESSURE
ROUND SHANKILL

SHANKILL

17 FEBRUARY 1967 - 1654 AST

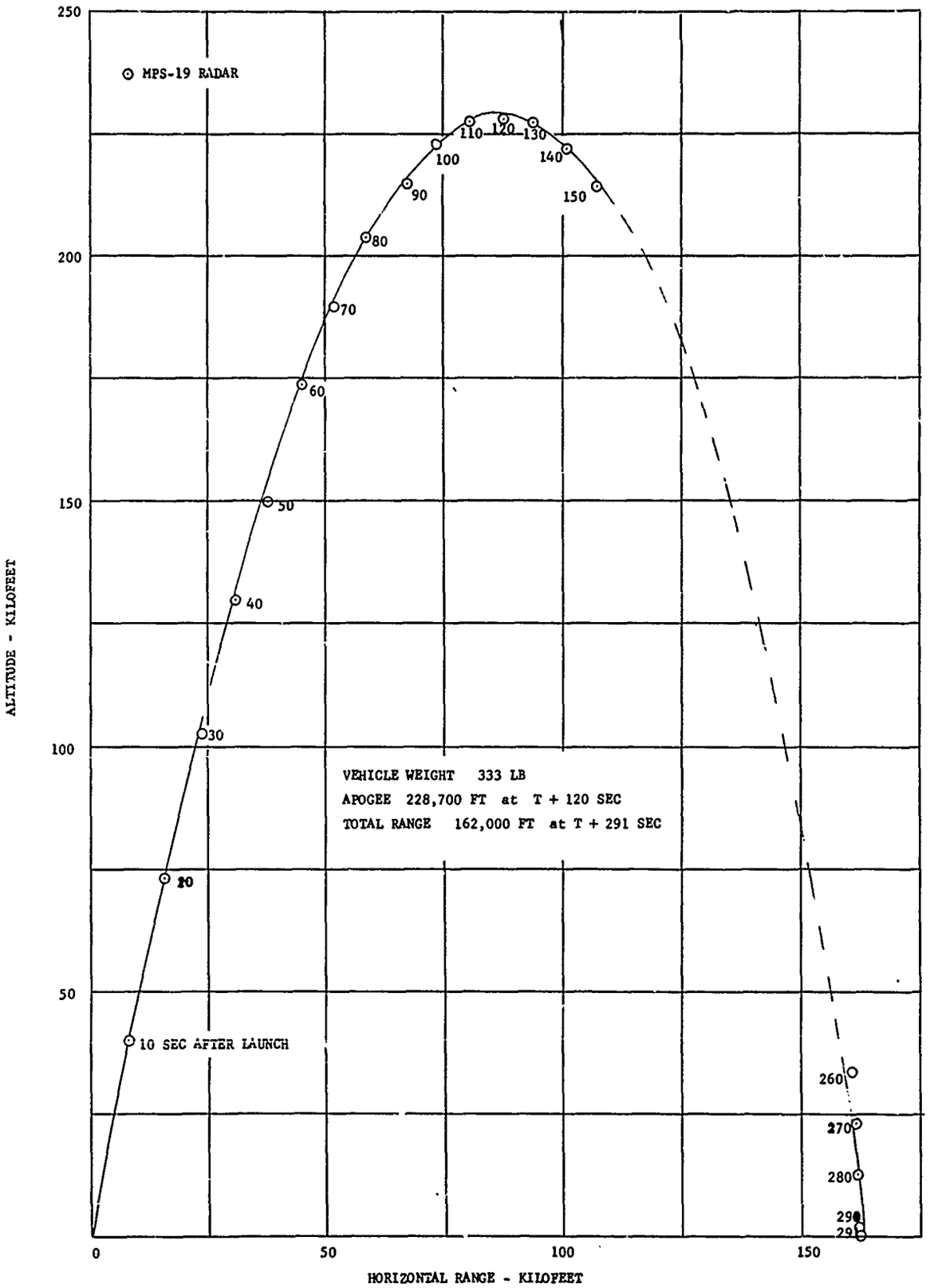


FIG. 2.39a MARTLET 2G SHANKILL

ALTITUDE VS RANGE

FIG. 2.39b
FRONT SMEAR PHOTOGRAPH
of SHANKILL
150 ft ahead of
gun muzzle

Round No. 227 - BANGOR

Date: 22 March 1967 - 1315 AST

Vehicle Description: Martlet 2C (Mod 2) with a CDC telemetry package.

Purpose of Test: Test of telemetry package.

Weights:		
	Vehicle	185.0 lb
	Pusher and Obturator	132.5 lb
	Sabot	100.0 lb
	Shot Weight	417.5 lb

Launch Data:

Charge Weight	1110 lb Pyro (10 bags)
Swedish Additive	rubbed inside chamber
Gun Elevation	85 deg
Crusher Gauges	Mil: 3
Ram Distance	187.5 in
Ram Load	18 tons
Chamber Volume	39,850 in^3
Recoil	40 in
Breech Pressure	Mil: 27,700 psi Strain: Not available
Muzzle Velocity (Probe)	Not available
Gun Evacuation	None

Camera Records:

Front smear photographs of the vehicle were obtained at a point of the trajectory 150 ft ahead of the muzzle.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 3 sec to T + 172 sec and again from T + 243 to impact at T + 252 sec.

Trajectory:

The radar data plotted in Figure 2.40a were compared with a standard drag trajectory for a muzzle velocity of 4700 ft/sec and

a launch elevation of 86 deg since the horizontal range data indicated an effective elevation of 86 deg instead of the recorded 85 deg. The apogee was 232,000 ft = 71 km, and the total range 63,000 ft.

Telemetry Records:

Not available.

Summary:

The round was successful.

BANGOR

22 MARCH 1967 - 1315 AST

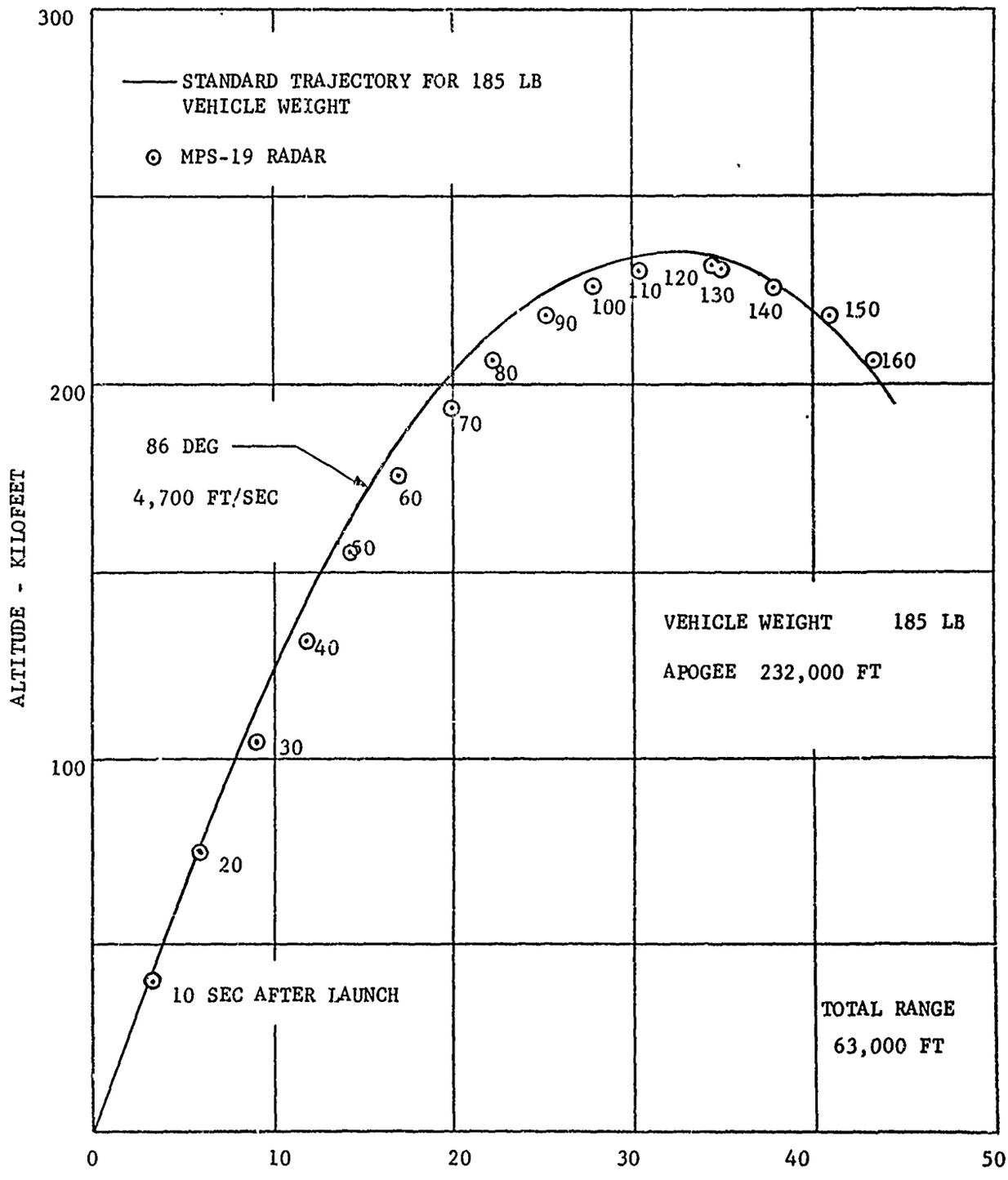


FIG. 2.40a MARTLET 2C (MOD 2) BANGOR ALTITUDE VS RANGE

Round No. 228 - DONAGHADEE

Date: 25 March 1967 - 1030 AST

Vehicle Description: Martlet 2C (Mod 2) with a CDC telemetry package.

Purpose of Test: Test of the telemetry package.

Weights:		
	Vehicle	185 lb
	Pusher and Obturator	132 lb
	Sabot	100 lb
	Shot Weight	417 lb

Centre of Gravity: 22 1/8 inches from base.

Launch Data:

Charge Weight	660 lb Pyro (6 bags)
Swedish Additive	Rubbed inside chamber
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187.5 in
Ram Load	14 tons
Chamber Volume	39,850 in^3
Recoil	27 in
Breech Pressure	M11: 9,000 psi Strain: 9,000 psi (Fig. 2.41)
Muzzle Velocity (Probe)	Not available
Gun Evacuation	None

Camera Records:

Front and rear smear photographs of the vehicle were obtained at a point on the trajectory 150 ft ahead of the muzzle.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 6 sec to T + 157 sec.

Trajectory:

The radar data plotted in Figure 2.41a show that the apogee

of 97,000 ft = 29.6 km was reached at T + 76 sec; the total range was 28,100 ft.

Telemetry Records:

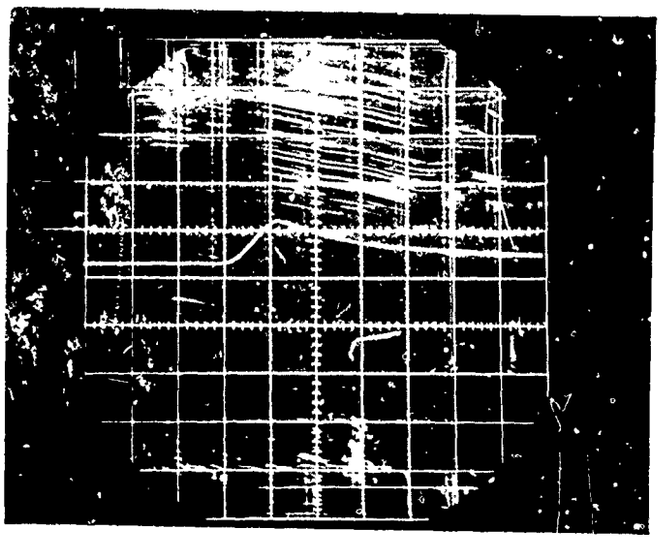
Not available.

Summary:

The round was successful.

DONAGHADEE

25 MARCH 1967 - 1030 AST



10,000 psi/division

BREECH PRESSURE

TIME

20 milliseconds/division

Maximum Breech Pressure: $P_{max} \approx 9{,}000$ psi

CHARGE: 660 LB PYRO

FIG. 2.41 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND DONAGHADEE

DONAGHADEE

25 MARCH 1967 - 1030 AST

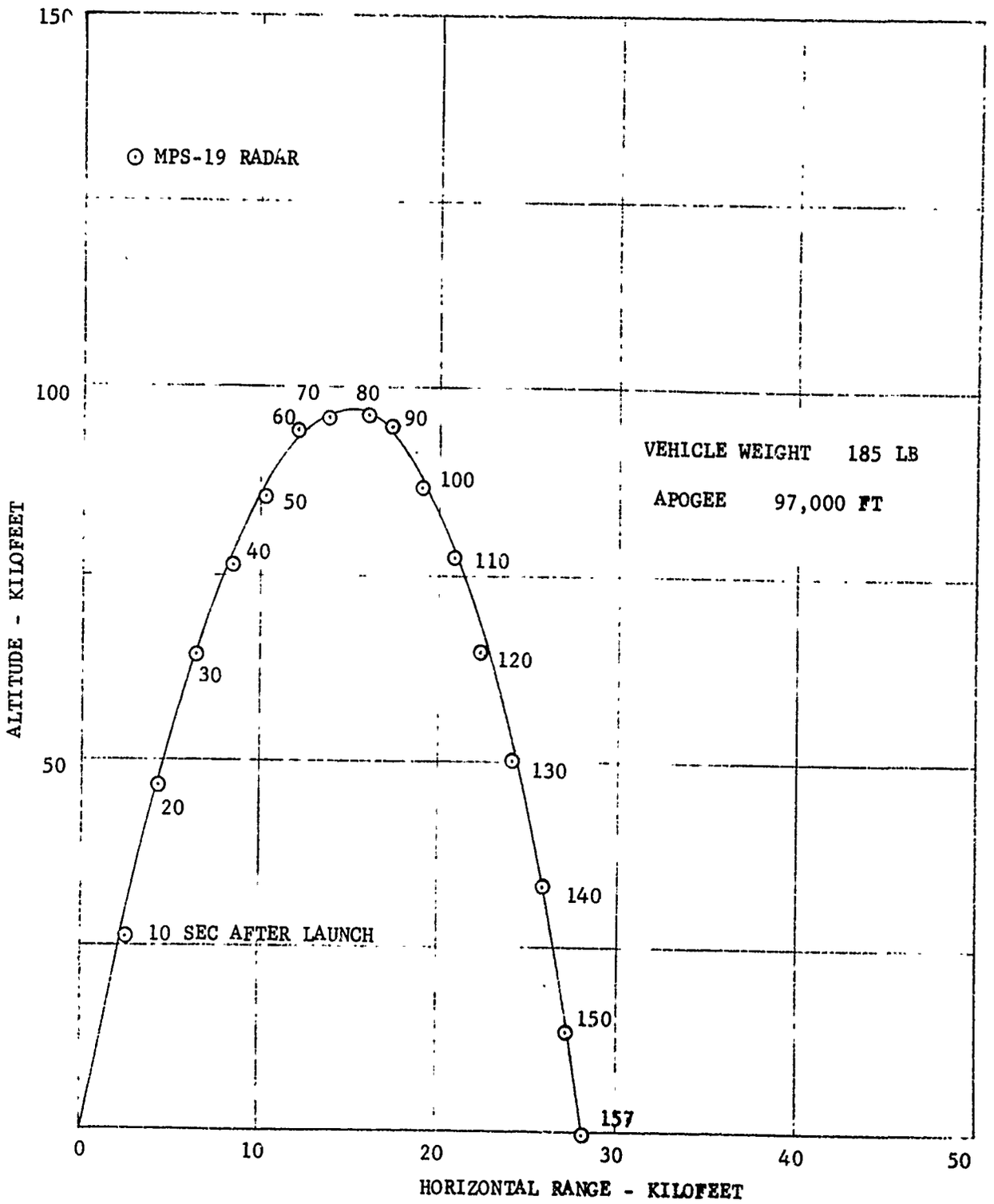


FIG. 2.41a MARTLET 2C (MOD 2) DONAGHADEE
ALTITUDE VS RANGE

Round No. 229 - TEST SLUG 25

Date: 23 May 1967 - 1227 AST

Vehicle Description: METAL TEST SLUG

Purpose of Test: Simulation of weight and charge for Martlet 2G1 to observe the performance of the instrumentation and the behaviour of the gun.

Weights: Shot Weight 1545 lb

Launch Data:

Charge Weight	1120 lb Pyro (9 bags)
Spacing of Charge	56 x 266 x 532 x 266 (Fig. 2.42b)
Swedish Additive	Rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	80 deg
Crusher Gauges	M11: 3
Ram Distance	221 in
Ram Load	12 tons
Chamber Volume	46,900 in^3
Recoil	46.75 in
Breech Pressure	M11: 39,100 psi Strain: Not available
Muzzle Velocity (Probe)	3750 ft/sec
Gun Evacuation	27 in of Mercury

Camera Records:

Seven cameras were used in this round: one Fastax and one Photo-Theodolite at the West Fastax station, two Mitchell cameras (one at Paragon and one at the radar site), the front smear and the rear smear camera, and one Bolex camera on the screen at the radar.

Good photographs were obtained from the rear smear, Fastax, Mitchell at radar and Photo-Theodolite cameras.

Radar Records:

The MPS-19 radar tracked the target from T + 9 seconds to impact at T + 88 seconds. An azimuth change of two to three degrees was recorded.

Trajectory:

The radar data are plotted in Figure 2.42a. The apogee was 30,600 ft = 9.3 km, and the total range 14,000 ft.

Summary:

The flight was satisfactory, and muzzle velocity and breech pressure were as expec ' The measuring equipment gave satisfactory results. Exceptions were the strain gauge the time base of which (20 milliseconds per cm) was probably too fast for recording the pressure; the front smear which was out of focus, and the Mitchell camera at the Paragon because of a jammed film. With these shortcomings eliminated the round has shown that the same propellant and recording arrangement could be used for the following Martlet 2G-1 shot.

TEST SLUG No. 25

23 MAY 1967 - 1227 AST

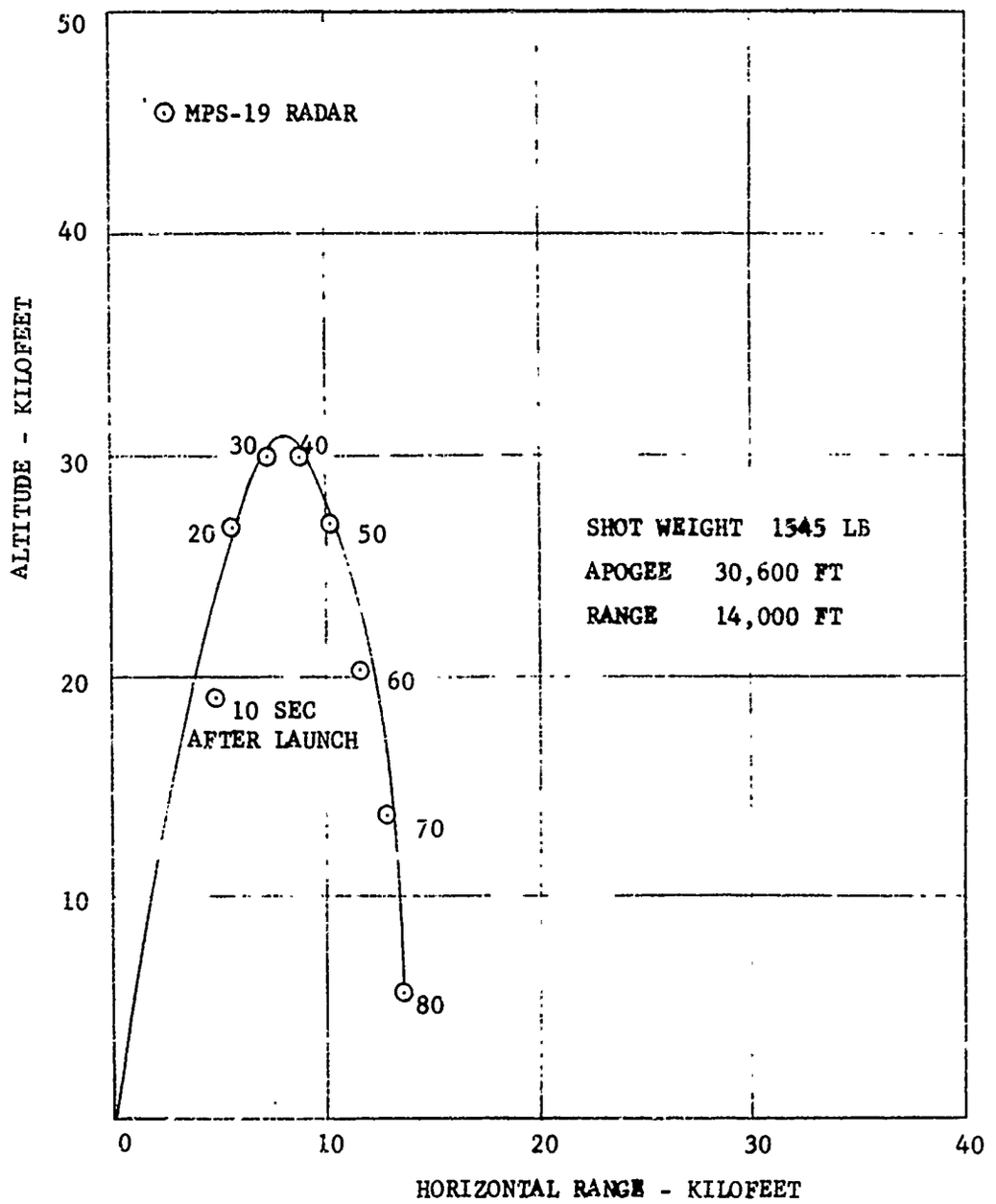
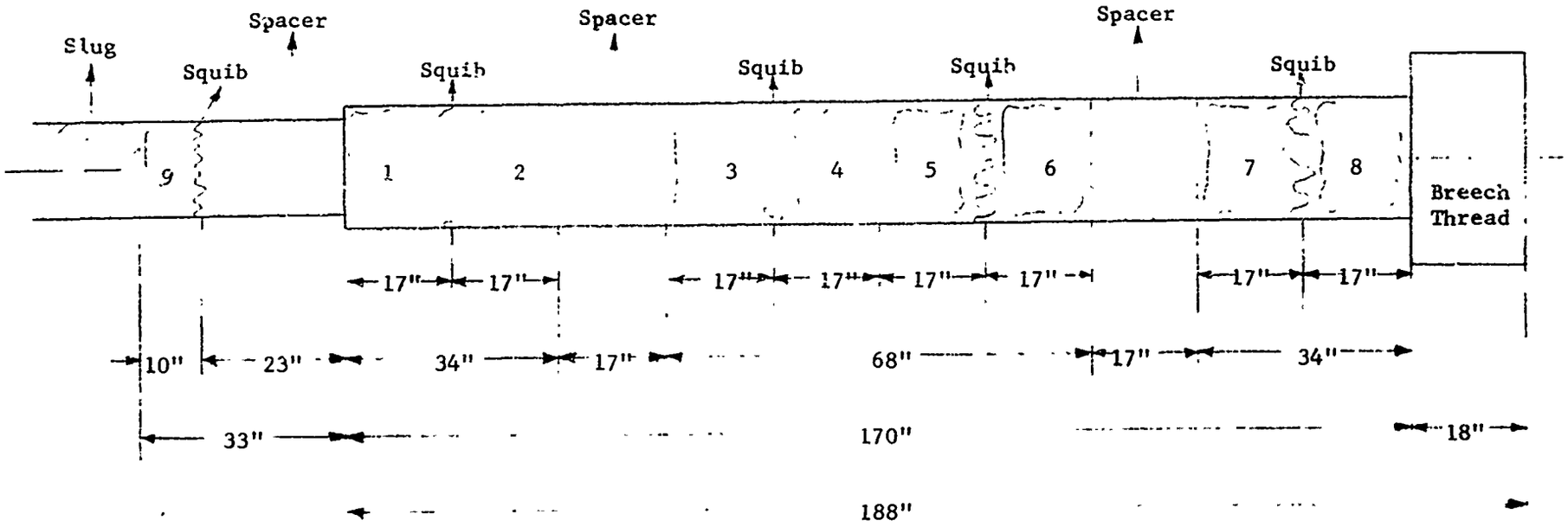


FIG. 2.42a METAL TEST SLUG TEST SLUG No. 25

ALTITUDE VS RANGE

TEST SLUG NO. 25

23 MAY 1967 - 1227 AST



Propellant: Pyro
Igniter: Multiple pyro-technic squibs

1-8, 8 bags @ 133 lbs = 1064 lbs
9, 1 bag @ 56 lbs = 56 lbs

TOTAL CHARGE WT. = 1120 lbs

FIG. 2.42b ARRANGEMENT OF PROPELLANT BAGS

Round No. 230 - BRONSON

Date: 28 May 1967 - 1703 AST

Vehicle Description: Prototype Martlet 2G1, Series B configuration, carrying a dummy rocket, a BRL 1780 MHz 200 milliwatt transmitter feeding a slotted-loop antenna, and BRL/SRI telemetry equipment consisting of two transmitters of 1 watt at 223 and 235 MHz, and a module containing an accelerometer, thermistor, calibrator, sun and earth sensor S.C.O., and an S.C.O. mixer.

Purpose of Test: Engineering Test of vehicle and payload.

Weights:

Total empty vehicle weight	859 lb
Rocket and payload weight	492 lb
Total Flight Weight	1351 lb
Sabot and Obturator	285 lb
Shot Weight	1636 lb

Centre of Gravity: 89.25 inches from tail fin edge.

Launch Data:

Charge Weight	1120 lb SPD 10311-Pyro (12 bags)
Spacing of Charge	See Figure 2.43
Swedish Additive	Rubbed inside chamber
Igniter	Multiple Pyrotechnic Squibs
Gun Elevation	80 deg
Crusher Gauges	M11: 3
Ram Distance	260 in
Ram Load	40 tons
Recoil	47.75 in
Breech Pressure	M11: 47,170 psi Strain: Not available
Muzzle Velocity (Probe)	Not available
Gun Evacuation	26 in of Mercury

Camera Records:

Paragon Mitchell	:	no pulse
Radar Mitchell	:	no pulse

West Fastax 10" lens	:	good image of flying fragments of vehicle
West Fastax 35 mm lens	:	good image of barrel and gas cloud
Rear Smear	:	flying fragments of vehicle
Front Smear	:	
Photo-Theodolite (West Fastax)	:	did not start
Bolex (radar screen)	:	image of scopes weak

Radar Records:

No track of vehicle or any target, either from the Barbados MPS-19 radar or the Trinidad radar.

Trajectory:

No trajectory obtained since the vehicle failed in the gun barrel.

Telemetry Records:

No telemetry signals were received. All electronic units from the recovered broken payload canister were found to have survived in operable condition except for the back-up event timer which had been sliced; the fracture of the canister, however, was such that the BRL transmitter was lost.

Summary:

The breech pressure of over 47,000 psi which exceeded the intended pressure and that of the preceding slug shot by 30% resulted evidently in launch stresses which exceeded the strength limitations of the body section in the region of the sabot. A break-up of the vehicle followed, probably before muzzle exit although the gun was found to be undamaged.

The cause for the overpressure could not positively be established; contributing factors were probably the following:

(i) The performance of the Pyro propellant used is thought to be somewhat unpredictable for large charge and shot weights.

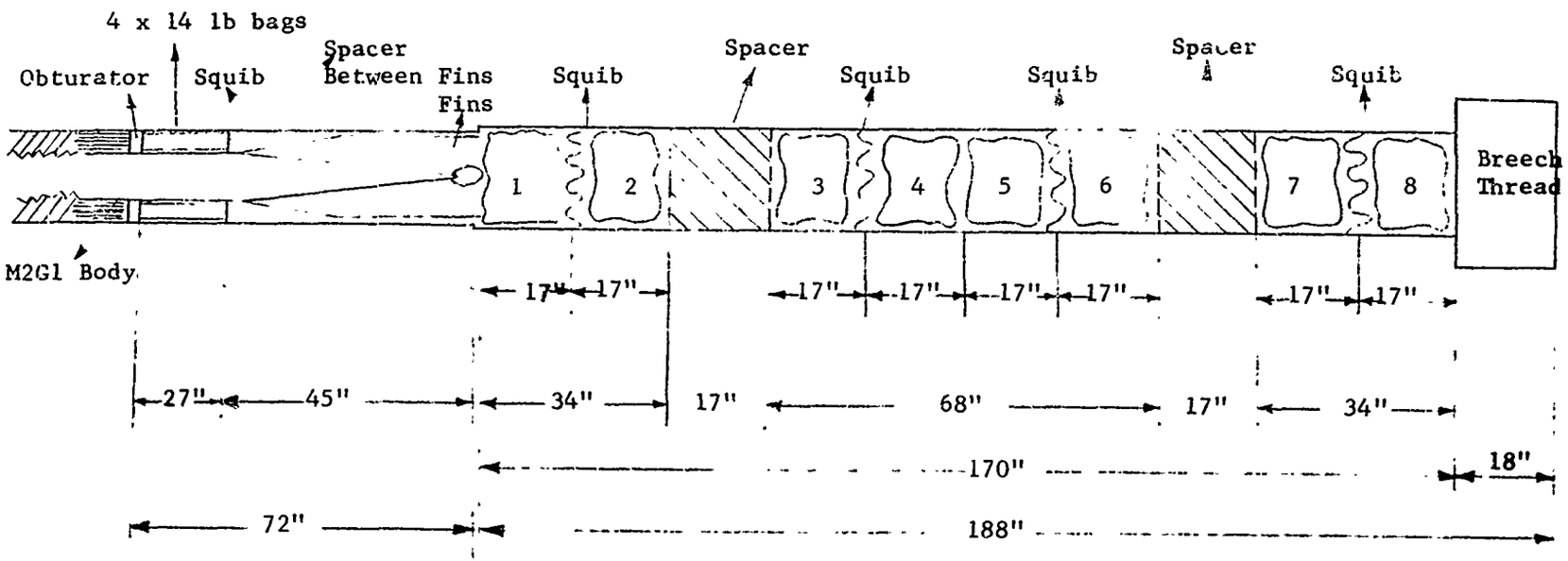
(ii) The ram pressure was much higher than that required for the test slug used to verify the propellant charge weight..

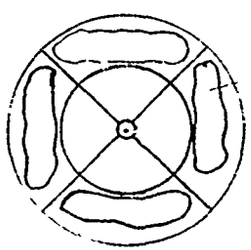
(iii) The weight of the Martlet 2G1-B1 was 91 lb, i.e. 6% heavier than the slug.

With the exception of the Mitchell cameras which failed to trigger, and Photo-Theodolite which did not start, the cameras gave satisfactory results. The recovered electronic units also demonstrated their ability to survive the launch accelerations intact.

BRONSON

28 MAY 1967 - 1703 AST





Plan view of Sleeve

Propellant Bag

Propellant Type: SPD 10311-39

Lot Number: ALN-1K-4-HA53

1-8, 8 bags	@	133 lbs	=	1064 lbs
9-12, 4 bags	@	14 lbs	=	56 lbs
TOTAL CHARGE WT.				1120 lbs

TOTAL RAM DISTANCE = 260"

FIG. 2.43 ARRANGEMENT OF PROPELLANT BAGS
ROUND BRONSON - MARTLET 2G1-B1

Round No. 231 - BANNOCK

Date: 30 May 1967 - 1040 AST

Vehicle Description: LAHIVE FLARE BODY

Purpose of Test: Structural and flight test of vehicle.

Weights:		
	Vehicle	127 lb
	Pusher and Obturator	86 lb
	Sabot	106 lb
	Shot Weight	319 lb

Launch Data:

Charge Weight	885 lb M8M.22 (9 bags)
Spacing of Charge	200 x 200 x 200 x 285
Swedish Additive	Wrapped around bags
Igniter	5 point ignition
Gun Elevation	80 deg
Crusher Gauges	M11: 3
Ram Distance	188 in
Ram Load	18 tons
Chamber Volume	39,950 in^3
Recoil	39.5 in
Breech Pressure	M11: 39,630 psi Strain: 38,000 psi (Fig. 2.44)
Muzzle Velocity (Probe)	Spurious readings
Gun Evacuation	None

Camera Records:

Front Smear	:	Vehicle seen with a bright burning sabot
Rear Smear	:	Glow of burning sabot, precluding the vehicle
Mitchell (Paragon)	:	Vehicle seen as a bright streak
Theodolite (West Fastax)	:	Good results for barrel whip studies
Fastax (West Fastax)	:	Good photographs; their evaluation gave a muzzle velocity of 6000 ft/sec as an average over the first 150 ft from the muzzle.

Radar Records and Trajectory:

No records available.

Summary:

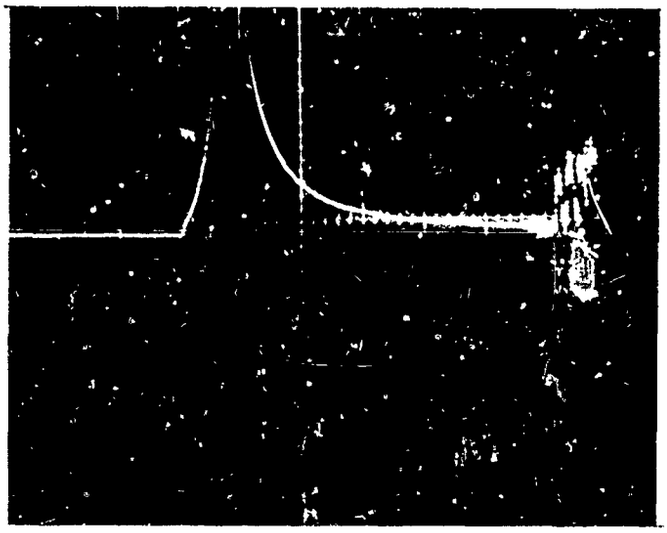
The round was successful. A recovered sabot piece indicated that the sabot was severely gas washed and damaged which would explain the spurious probe readings.

BANNOCK

30 MAY 1967 - 1040 AST

10,000 psi/division

BREECH PRESSURE



TIME

10 milliseconds/division

Maximum Breech Pressure: P_{max} = 38,000 psi

CHARGE: 885 LB M8M.22

FIG. 2.44 STRAIN CAUGE RECORD OF BREECH PRESSURE
ROUND BANNOCK

Round No. 232 - CAMERON

Date: 30 May 1967 - 1350 AST

Vehicle Description: LAHIVE 15 deg cone

Purpose of Test: Structural and flight test of vehicle.

Weights:		
	Vehicle	71 lb
	Pusher Plate	125 lb
	Sabot	28 lb
	Shot Weight	224 lb

Launch Data:

Charge Weight	970 lb M8M.22 (10 bags)
Spacing of Charge	400 x 400 x 170
Swedish Additive	Wrapped around bags
Igniter	5 point ignition
Gun Elevation	80 deg
Crusher Gauges	M11: 3
Ram Distance	189 in
Ram Load	9 tons
Chamber Volume	40,150 in^3
Recoil	39.75 in
Breech Pressure	M11: 41,300 psi Strain: 41,000 psi (Fig. 2.45)
Muzzle Velocity (Probe)	Spurious readings
Gun Evacuation	None

Camera Records:

Front Smear	:	Tip of cone visible
Rear Smear	:	Glow only seen
West Fastax	:	Good photographs obtained; their evaluation gave 6820 ft/sec over the first 150 ft of the trajectory.

Radar Records:

The MPS-19 tracked the vehicle for T + 2.5 sec on to impact. The apogee of 17,500 ft = 5.3 km was reached at T + 20 sec, and the impact occurred at T + 69 sec at a range of 4800 ft.

Trajectory:

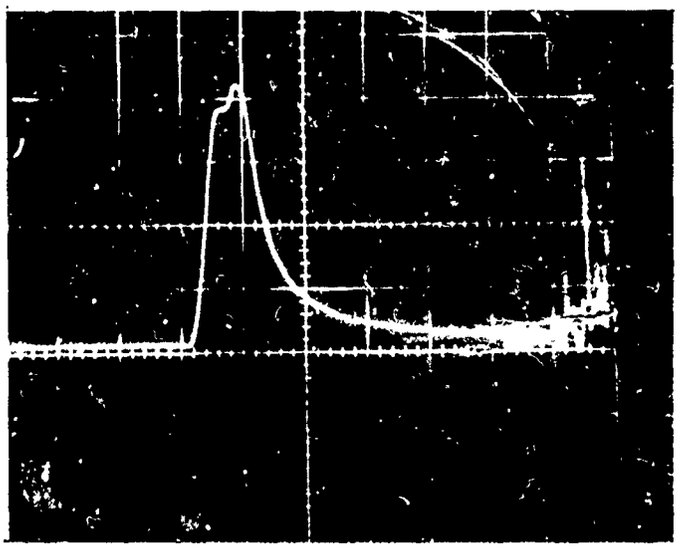
The radar data are plotted in Figure 2.45a.

Summary:

The round was successful. The spurious readings from the muzzle velocity probes suggest again some sabot degradation.

CAMERON

30 MAY 1967 - 1350 AST



10,000 psi/division

BREECH PRESSURE

TIME

10 milliseconds/division

Maximum Breech Pressure: P_{max} = 41,000 psi

CHARGE: 970 LB M8M.22

FIG. 2.45 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND CAMERON

CAMERON

30 MAY 1967 - 1350 AST

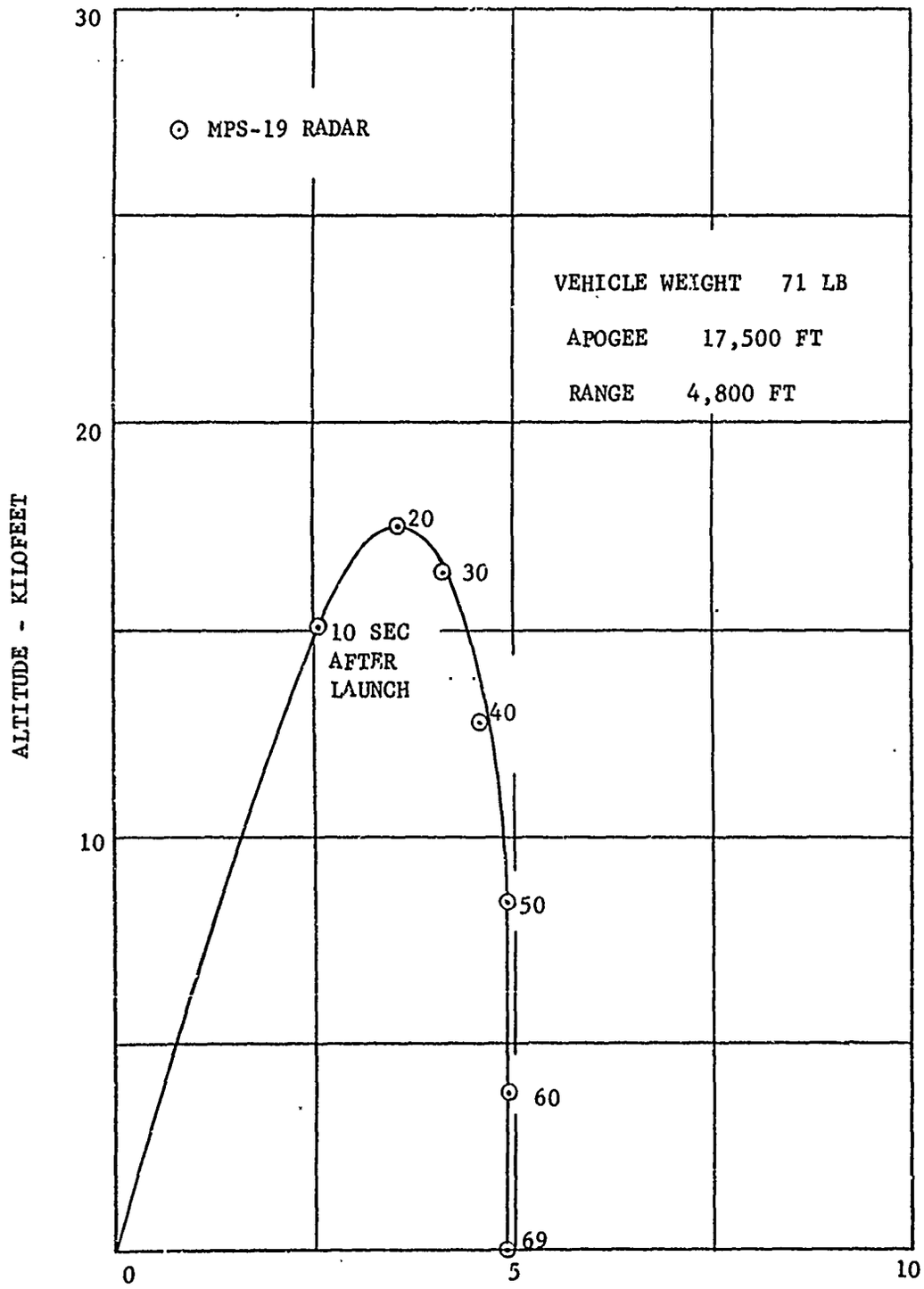


FIG. 2.45a LAHIVE 15 DEG CONE CAMERON
ALTITUDE VS RANGE

Round No. 233 - DUNOON

Date: 30 May 1967 - 1626 AST

Vehicle Description: LAHIVE 10 deg cone with a short sabot and carrying a pyrotechnic payload.

Purpose of Test: Structural and flight test of vehicle.

Weights:		
	Vehicle	121.0 lb
	Pusher Plate	121.0 lb
	Sabot	28.5 lb
	Shot Weight	270.5 lb

Launch Data:

Charge Weight	1000 lb M8M.22 (10 bags)
Spacing of Charge	400 x 400 x 200
Swedish Additive	Wrapped around bags
Igniter	5 point ignition
Gun Elevation	80 deg
Crusher Gauges	M11: 3
Ram Distance	188.5 in
Ram Load	18 tons
Chamber Volume	40,050 in^3
Recoil	41.75 in
Breech Pressure	M11: 56,100 psi Strain: Pre-triggered
Muzzle Velocity (Probe)	Pre-triggered
Gun Evacuation	25 in. of Mercury

Camera Records:

Front Smear	:	Vehicle faintly visible in glow
Rear Smear	:	Only glow visible
Mitchell (Radar)	:	The glowing vehicle visible in five consecutive frames
Mitchell (Paragon)	:	Film jammed
Theodolite and Fastax	:	Good results obtained

The average velocity over the first 150 ft calculated from the smear and Fastax film was 5560 ft/sec.

Radar Records:

The MPS-19 obtained only a track of the pusher plate which was recovered between the gun and the West Fastax station.

Trajectory:

No trajectory data available.

Summary:

The recovered pusher plate was buckled and gas washed possibly indicating a failure of the pyrotechnic payload in the gun barrel.

The pre-triggering of the strain gauge and muzzle probes was found to have been caused by a line voltage surge when the vacuum pump was turned off.

Round No. 234 - ACCRA

Date: 21 June 1967 - 1900 AST

Vehicle Description: Martlet 2D carrying a 10 lb payload of TMA with puff-puff release.

Purpose of Test: Engineering test.

Weights:		
	Vehicle	227.0 lb
	Pusher and Obturator	146.0 lb
	Sabot	91.0 lb
	Shot Weight	464.0 lb

Centre of Gravity: 22.5 inches from base.

Launch Data:

Charge Weight	800 lb M8M.22 (8 bags)
Spacing of Charge	200 x 200 x 200 x 200
Swedish Additive	15 sheets, wrapped around bags
Igniter	4 point ignition squibs equally spaced
Gun Elevation	80 deg
Crusher Gauges	M11: 3
Ram Distance	186.5 in
Ram Load	18 tons
Chamber Volume	39,600 in^3
Recoil	39 in
Breech Pressure	M11: 40,000 psi Strain: Pre-triggered
Muzzle Velocity (Probe)	5500 ft/sec
Gun Evacuation	27 in of Mercury

Camera Records:

Rear smear and West Fastax photographs showed only gun gases.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 4 seconds to impact at T + 165 seconds. The azimuth during flight was around 130 degrees.

Trajectory:

The radar data plotted in Figure 2.46a show a low trajectory with an apogee of 73,600 ft = 22.4 km at T + 50 seconds and a total range of 21,300 ft at T + 165 seconds.

TMA Trail Results:

The puff-puff release valve operated satisfactorily throughout the flight. The apogee, however, was not high enough for the usual trail.

Summary:

The trajectory, reaching only a very low apogee, indicated a high drag flight. One broken fin of the vehicle was later discovered in the launch area.

A C C R A

21 JUNE 1967 - 1900 AST

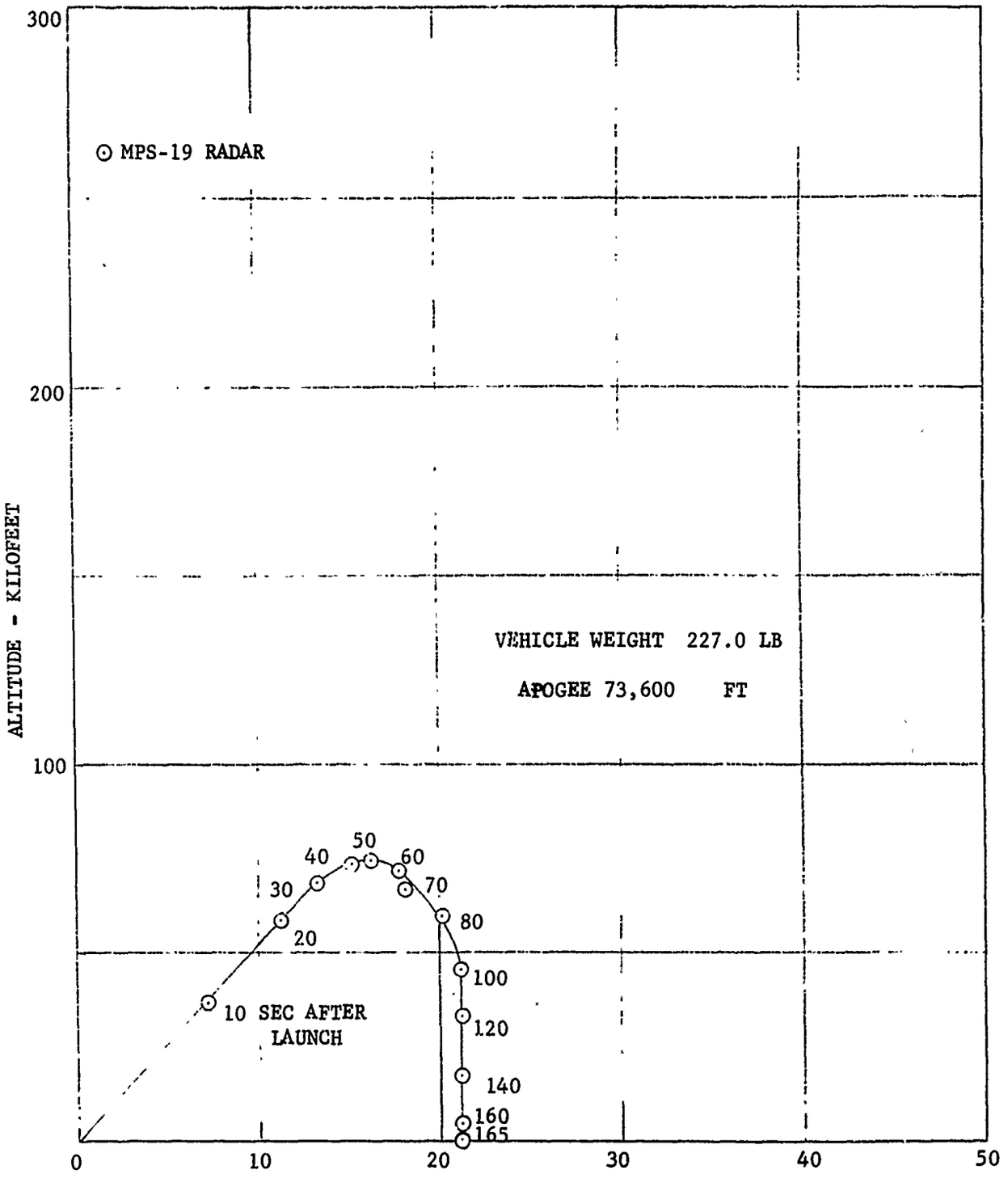


FIG. 2.46a MARTLET 2C (MOD 2) ACCRA
ALTITUDE VS RANGE

Round No. 235 - CAIRO

Date: 21 June 1967 - 2248 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a 5 lb payload of TMA with delay release mechanism.

Purpose of Test: Measurement of wind profile.

Weights:		
	Vehicle	185.0 lb
	Pusher and Obturator	132.0 lb
	Sabot	101.5 lb
	Shot Weight	418.5 lb

Centre of Gravity: 22 1/8 inches from base.

Launch Data:

Charge Weight	1320 lb Pyro (9 bags)
Swedish Additive	rubbed inside chamber
Igniter	5 point ignition (squibs)
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	14 tons
Chamber Volume	39,700 in^3
Recoil	44.5 in
Breech Pressure	M11: 43,100 psi Strain: 40,000 psi
Muzzle Velocity (Probe)	No results
Gun Evacuation	28 in of Mercury

Camera Records:

No coverage.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 3 seconds to T + 263 seconds.

Trajectory:

The radar data are plotted in Figure 2.47a in comparison with standard drag trajectories for a muzzle velocity of 5600 ft/sec and launch elevation of 85 deg and 86 deg. It appears from the horizontal range data that the effective elevation was higher than the recorded 85 degrees. The vehicle reached an apogee of 355,000 ft = 108 km, and the total range was estimated as approximately 95,000 ft.

TMA Trail Records:

The cameras and the payload performed satisfactorily, and a bright trail resulted. Photographs were obtained from the Barbados North and South, Grenada North and South, and Tobago North stations.

Summary:

The round was successful.

CAIRO

21 JUNE 1967 - 2248 AST

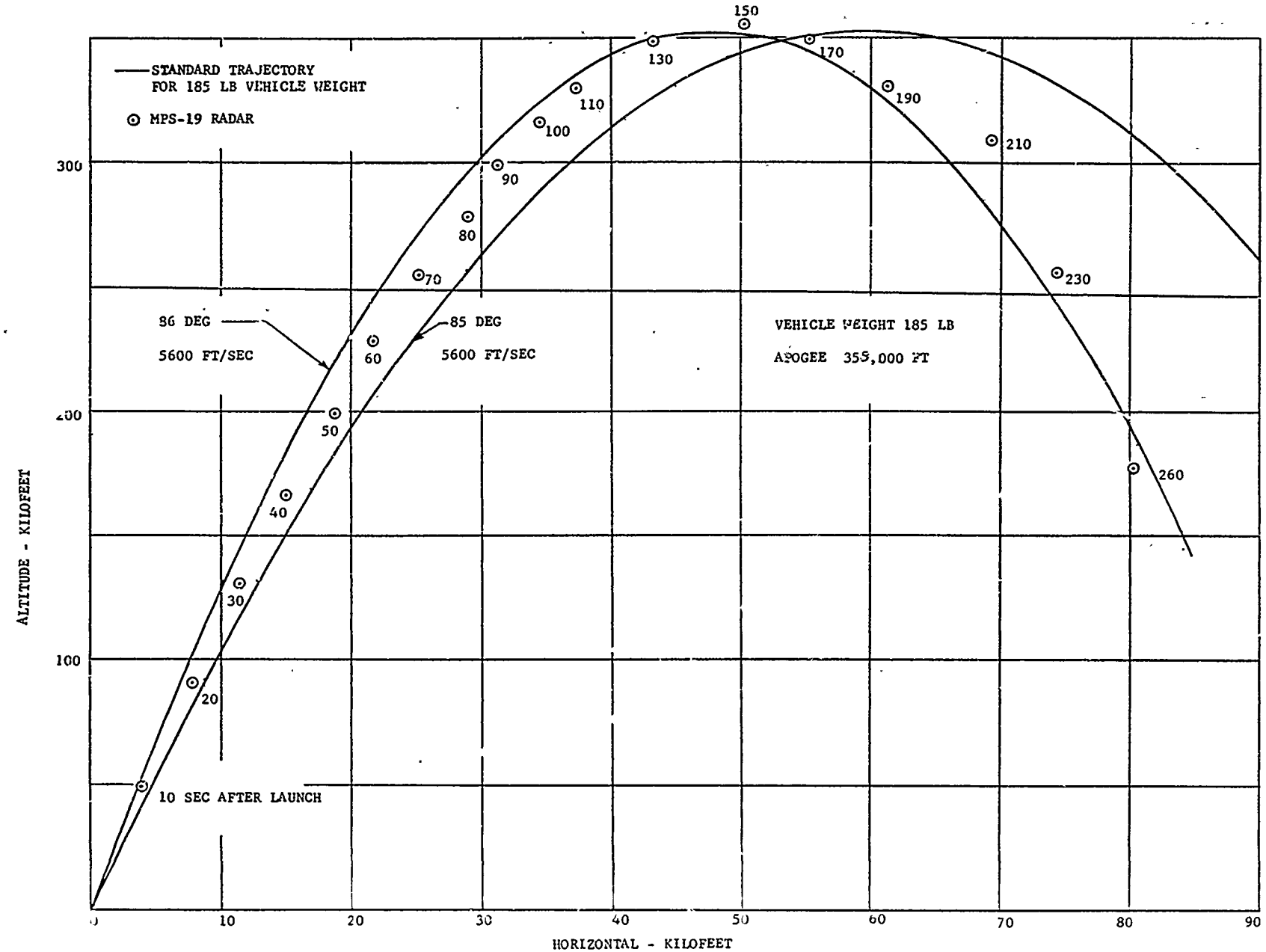


FIG. 2.47a MARTLET 2C (MOD 2) CAIRO
ALTITUDE VS RANGE

Round No. 236 - DURBAN

Date: 22 June 1967 - 1951 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a 5 lb payload of TMA with delay release mechanism.

Purpose of Test: Measurement of wind profile.

Weights:		
	Vehicle	184.0 lb
	Pusher and Obturator	132.5 lb
	Sabot	102.0 lb
	Shot Weight	418.5 lb

Centre of Gravity: 22 1/8 inches from base.

Launch Data:

Charge Weight	1360 lb Pyro (10 bags)
Swedish Additive	rubbed inside chamber
Igniter	5 point ignition (squibs)
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	14 tons
Chamber Volume	39,700 in^3
Recoil	45.25 in
Breech Pressure	M11: 46,700 psi Strain: 41,000 psi (Fig. 2.48)
Muzzle Velocity (Probe)	5770 ft/sec
Gun Evacuation	26 in of Mercury

Camera Records:

No coverage.

Radar Records:

The MPS-19 radar tracked from T + 3 seconds to T + 260 seconds and again from T + 299 seconds to impact at T + 311 seconds.

Trajectory:

The radar data were compared in Figure 2.48a with standard

drag trajectories for a muzzle velocity of 5700 ft/sec and launch elevations of 85 and 86 degrees. The horizontal range data indicated that the effective launch elevation was higher than the recorded 85 degree elevation. The apogee was 362,000 ft = 110 km which was reached at T + 150 seconds, and the total range was 88,300 ft.

TMA Trail Records:

The M-24 cameras and the payload worked satisfactorily; a long and bright trail was photographed from the Barbados, Grenada, and St. Vincent stations.

Summary:

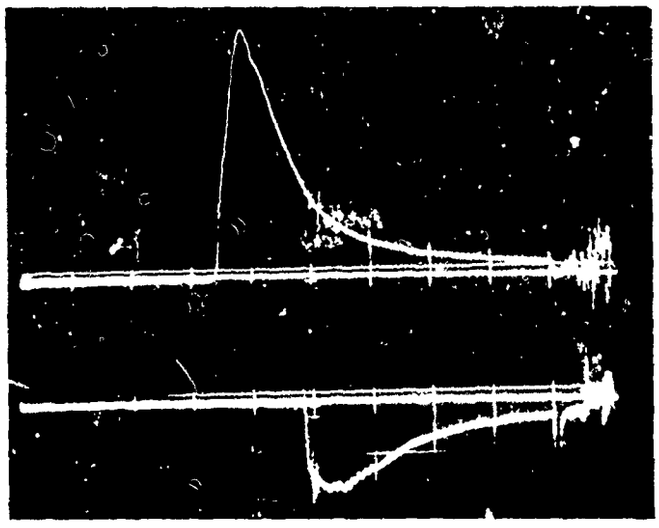
The round was successful.

DURBAN

22 June 1967 - 1951 AST

10,000 psi/division

BREECH PRESSURE



TIME

10 milliseconds/division

Maximum Breech Pressure: $P_{max} \approx 41{,}000$ psi

Charge: 1360 lb Pyro

FIG. 2.48 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND DURBAN

DURBAN

22 JUNE 1967 - 1951 AST

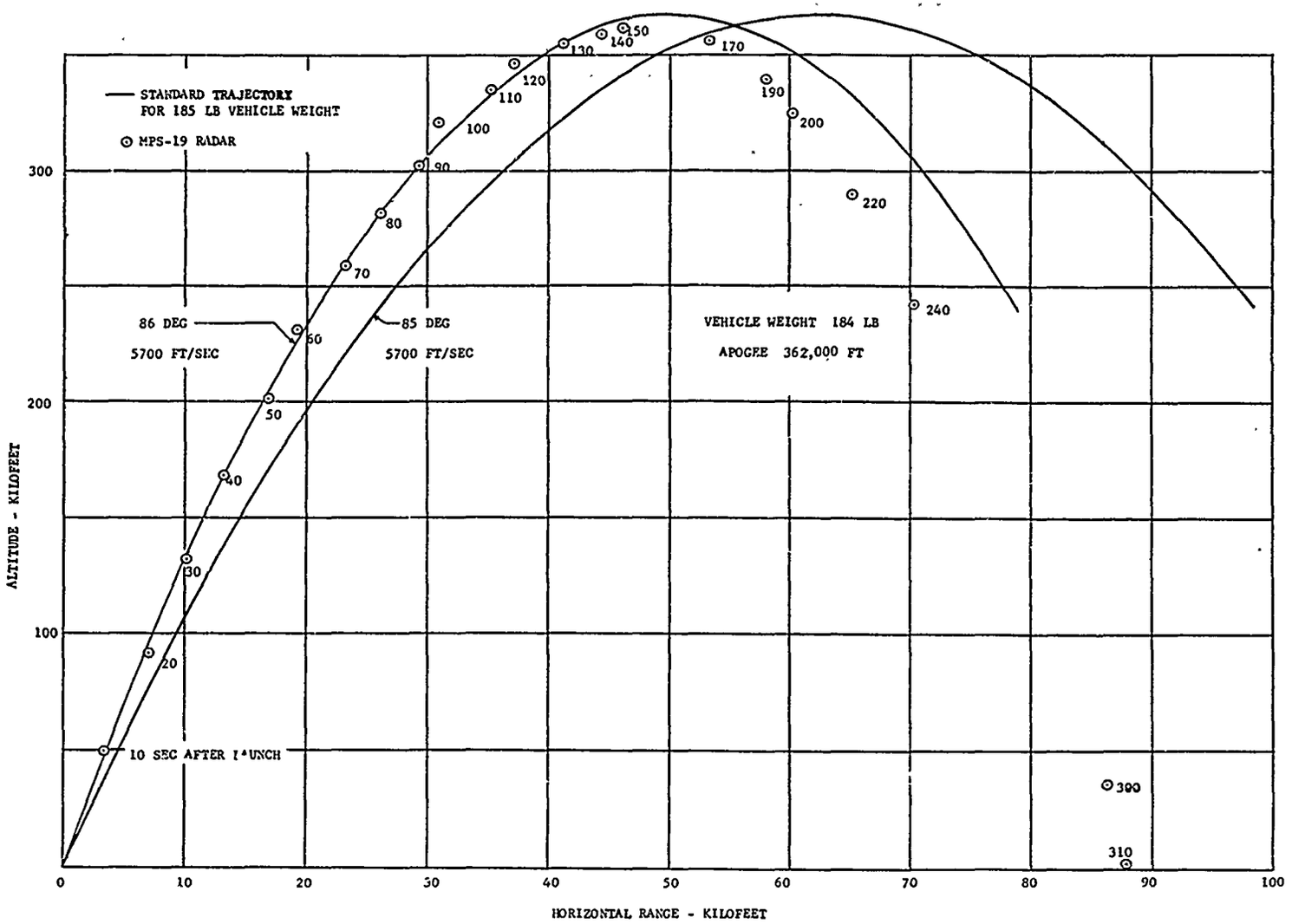


FIG. 2.48a MARTLET 2C (MOD 2) DURBAN
ALTITUDE VS RANGE

Round No. 237 - ENTEBBE

Date: 22 June 1967 - 2120 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a 5 lb payload of TMA with delay release mechanism.

Purpose of Test: Measurement of wind profile.

Weights:		
	Vehicle	184.0 lb
	Pusher and Obturator	132.5 lb
	Sabot	99.0 lb
	Shot Weight	415.5 lb

Centre of Gravity: 22 1/8 inches from base.

Launch Data:

Charge Weight	1380 lb Pyro (10 bags)
Swedish Additive	rubbed inside chamber
Igniter	5 point ignition (squibs)
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	14 tons
Chamber Volume	39,700 in^3
Recoil	45.25 in
Breech Pressure	M11: 50,900 psi Strain: 43,000 psi (Fig. 2.49)
Muzzle Velocity (Probe)	Inconsistent results
Gun Evacuation	27 in. of Mercury

Camera Records:

No coverage.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 4 sec to T + 100 sec and again from T + 320 sec to impact at T + 326 sec.

Trajectory:

The radar data are plotted in Figure 2.49a in comparison with

a standard drag trajectory for a muzzle velocity of 5900 ft/sec. The horizontal range data suggest that the effective launch elevation was somewhat higher than the recorded 85 degrees. The apogee as derived from the radar data was 393,000 ft = 120 km and a total range of 103,000 ft was measured.

TMA Trail Results:

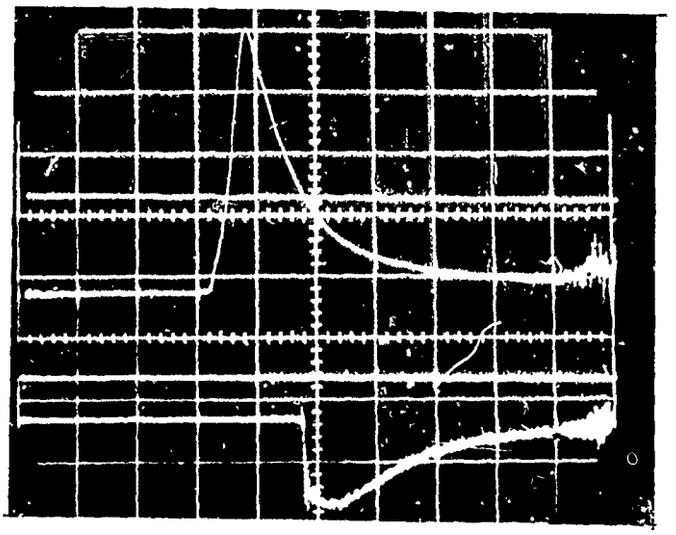
No trail was visible. Apparently the TMA release valve failed to function.

Summary:

The trajectory was normal but no wind data were obtained since the release mechanism failed.

ENTEBBE

22 June 1967 - 2120 AST



Maximum Breech Pressure: P_{max} = 43,000 psi

Charge: 1380 lb Pyro

FIG. 2.49 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND ENTEBBE

E N T E B B E

22 JUNE 1967 - 2120 AST

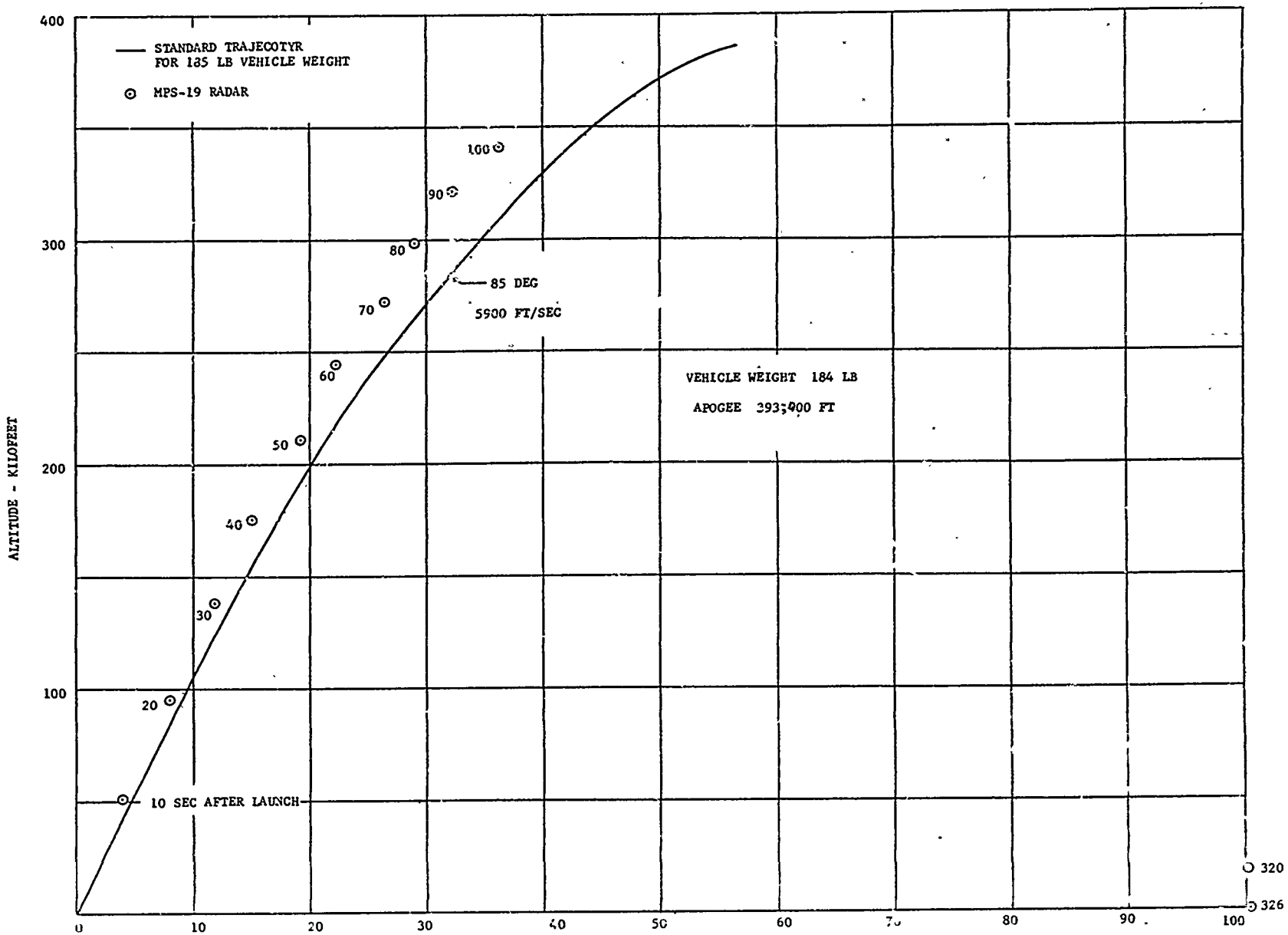


FIG. 2.49a MARTLET 2C (MOD 2) ENTEBBE
ALTITUDE VS RANGE

Round No. 238 - FREETOWN

Date: 24 June 1967 - 2120 AST

Vehicle Description: Martlet 2C (Mod 2) carrying a 5 lb payload of TMA with delay release mechanism.

Purpose of Test: Measurement of wind profile.

Weights:		
	Vehicle	181.0 lb
	Pusher and Obturator	132.0 lb
	Sabot	105.0 lb
	Shot Weight	418.0 lb

Centre of Gravity: 22 1/8 inches from base.

Launch Data:

Charge Weight	860 lb M8M.22 (9 bags)
Swedish Additive	rubbed inside chamber
Igniter	5 point ignition (squibs)
Gun Elevation	85 deg
Crusher Gauges	M11: 3
Ram Distance	187 in
Ram Load	11 tons
Chamber Volume	39,700 in^3
Recoil	45.5 in
Breech Pressure	M11: 44,600 psi Strain: 38,000 psi (Fig. 2.50)
Muzzle Velocity (Probe)	Inconsistent Result
Gun Evacuation	28 in. of Mercury

Camera Records:

No coverage.

Radar Records:

The MPS-19 radar tracked the vehicle from T + 3 sec to T + 100 sec and from T + 338 sec to impact at T + 346 sec.

Trajectory:

The radar data were plotted in Figure 2.50a in comparison with a standard drag trajectory for muzzle velocity of 6100 ft/sec. The apogee derived from the radar data was 440,000 ft = 134 km, and a total range of 117,000 ft was measured.

TMA Trail Results:

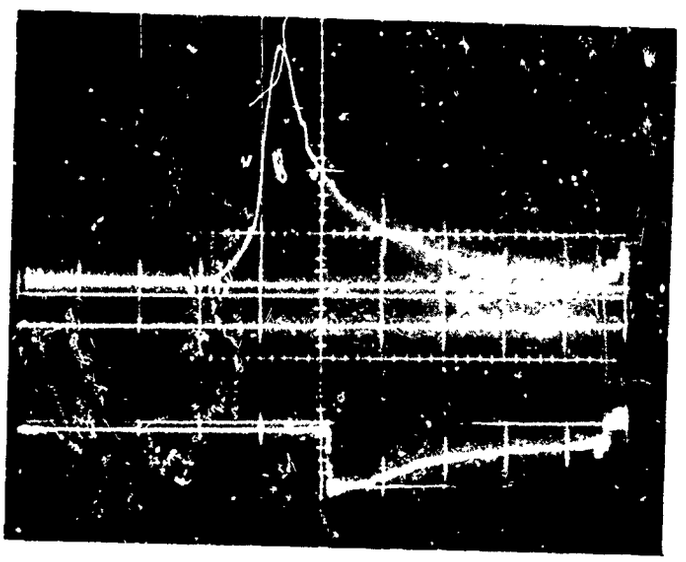
The trail was weak and dim but photographs could be obtained from the Barbados, Grenada, and St. Vincent stations.

Summary:

The round was successful. Examination of the gun after the shot showed that the entire sleeve had been launched with the vehicle but the gun was not otherwise damaged.

FREETOWN

24 June 1967 - 2120 AST



10,000 psi/division

BREECH PRESSURE

TIME

10 milliseconds/division

Maximum Breech Pressure: P_{max} = 38,000 psi

Charge: 860 lb M8M.22

FIG. 2.50 STRAIN GAUGE RECORD OF BREECH PRESSURE ROUND FREETOWN

F R E E T O W N

24 JUNE 1967 - 2120 AST

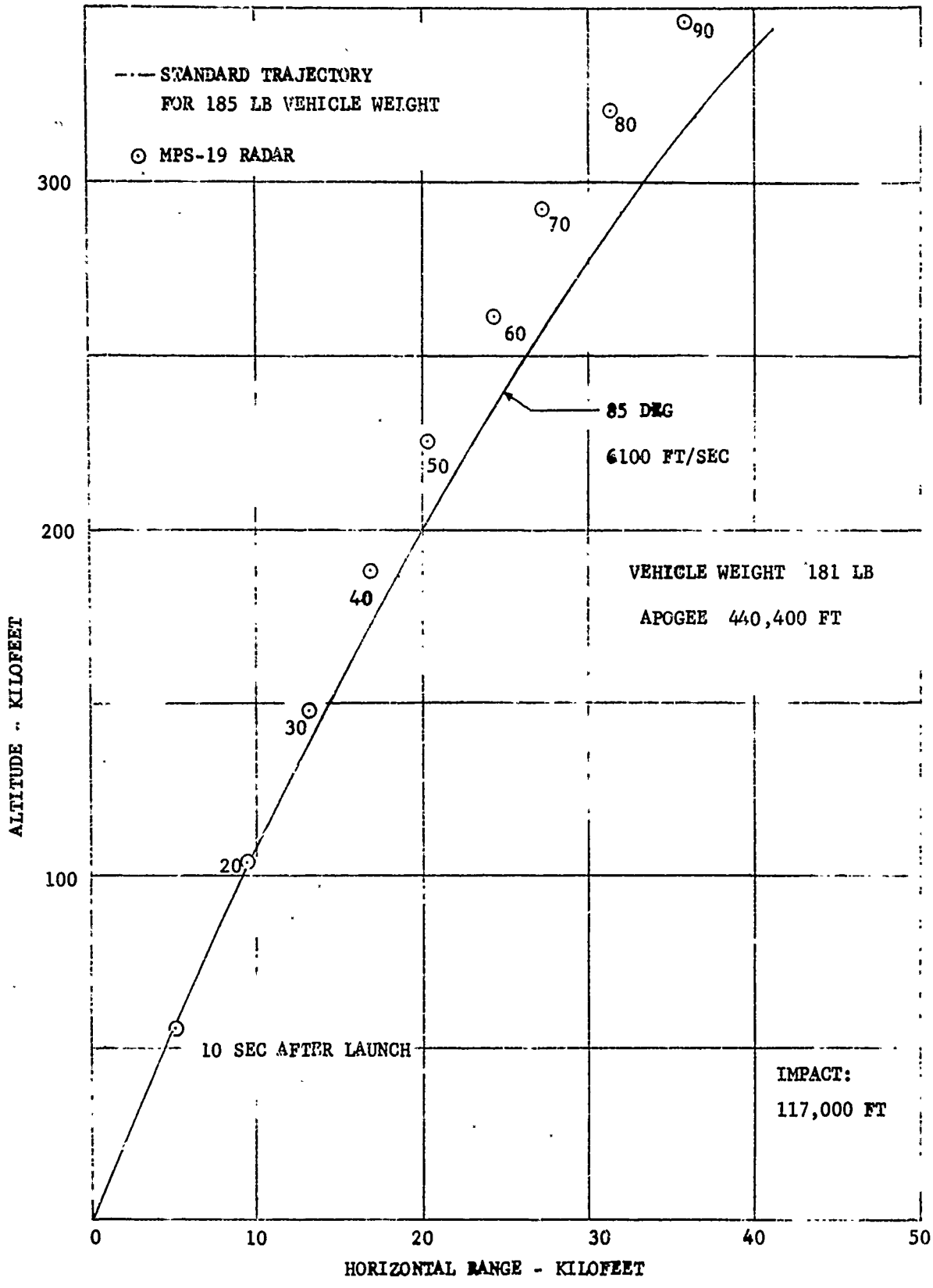


FIG. 2.50a MARTLET 2C (MOD 2) FREETOWN
ALTITUDE VS RANGE

PART III

TABLE OF RADAR DATA

Round No.	Name	Radar MPS-19	Radar M-33	Comments
180	ANTIGUA			
181	INAUGUA	X	X	
182	CUBA	X	X	
183	MURPHIUS			
184	DOMINICA			
185	TS 1			
186	TS 2			
187	TS 3			
188	JAMAICA	X	X	
189	ST. KITTS	X	X	
190	ST. LUCIA	X	X	
191	MONTSERRAT	X	X	Synoptic Series
192	NEVIS	X		
193	OCHO RIOS			
194	PUERTO RICO	X		
195	LA RAIZET	X		
196	ST. THOMAS	X		
197	TS 4			
198	ELEUTHERA	X	X	
199	FLAMINGO	X	X	
200	DONNA	X	X	
201	TS			
202	FERNANDE			
203	TS			
204	ALPHA	X		
205	BETA	X		
206	GAMMA	X		
207	DELTA	X		
208	EPSILON	X		Synoptic Series
209	ZETA	X		
210	ETA	X		
211	THETA	X		
212	IOTA	X		
213	KAPPA	X		
214	INDEPENDENCE 1	X		
215	INDEPENDENCE 2	X		
216	TS			
217	ANTRIM	X		
218	BELFAST	X		
219	CORK	X		
220	DUBLIN	X		Synoptic Series
221	GARVAGH	X		
222	HOLLYWOOD	X		
223	KERRY	X		
224	LIMERICK	X		
225	NEWRY	X		

TABLE OF RADAR DATA (Cont'd)

Round No.	Name	Radar MPS-19	Radar M-33	Comments
226	SHANKILL	X		
227	BANGOR	X		
228	DONAGHADEE	X		
229	TS No. 25	X		
230	BRONSON			
231	BANNOCK			
232	CAMERON	X		
233	DUNOON			
234	ACCRA	X		
235	CAIRO	X		
236	DURBAN	X		
237	ENTEBBE	X		
238	FREETOWN	X		

181 - INAUGUA						182 - CUBA					
	MPS-19			M-33			MPS-19			M-33	
Time	Altitude	Range	T	Altitude	Range	Time	Altitude	Range	T	Altitude	Range
10	52,000	5,300	7	41,600	4,450	10	30,000	5,800	7	27,220	5,000
20	97,100	10,300	10	50,800	4,500	20	52,500	10,300	10	31,780	5,800
30	139,100	15,300	15	76,500	7,800	30	70,000	15,100	15	44,700	8,000
40	178,000	19,700	20	97,400	10,500	40	85,000	19,300	20	54,200	10,100
50	214,000	24,300	25	119,800	13,700	50	96,000	23,300	25	64,000	12,300
60	246,000	29,300	30	139,000	16,300	60	104,000	27,300	30	71,600	14,700
70	275,000	33,300				70	109,000	32,300	35	79,000	16,700
80	302,000	36,700				80	110,500	36,300	40	85,900	19,200
90	322,000	39,300				90	109,000	40,300			

188 - JAMAICA						189 - ST. KITTS					
	MPS-19			M-33			MPS-19			M-33	
Time	Altitude	Range	T	Altitude	Range	Time	Altitude	Range	T	Altitude	Range
10	50,000	5,100	10	48,000	3,900	10	52,200	4,300	5	35,000	3,550
20	95,000	9,900	15	74,600	7,150	20	100,000	8,700	10	53,800	4,200
30	136,000	14,300	20	97,100	9,000	30	144,000	12,900	15	73,000	6,000
40	174,000	18,300	25	119,300	11,600	40	184,000	16,300	20	98,000	7,900
50	209,500	22,700	30	138,000	13,700	50	222,000	20,100	25	124,900	10,100
60	241,000	26,100	35	157,100	15,900	60	256,000	22,800	30	144,900	13,200
70	270,000	29,600	40	175,200	18,000	70	287,000	26,300			
80	295,500	32,300				80	315,500	29,300			
90	318,000	35,300				90	340,000	31,500			
100	338,000	38,300									

190 - ST. LUCIA					
MPS-19			M-33		
Time	Altitude	Range	T	Altitude	Range
10	54,000	4,300	5	27,700	2,500
20	98,000	8,300	10	48,500	3,100
30	139,000	11,300	15	74,400	5,900
40	176,000	14,300			
50	210,500	17,500			
60	242,000	20,500			
70	270,000	23,900			
80	294,500	26,500			
90	316,500	29,300			
100	335,000	31,100			
110	351,000	33,800			

191 - MONTSERRAT					
MPS-19			M-33		
Time	Altitude	Range	T	Altitude	Range
10	55,000	5,100	5	31,880	2,760
20	102,000	9,300	10	54,900	4,740
30	146,000	13,900	15	85,900	7,700
40	187,000	18,300	20	105,700	10,000
50	224,000	22,300	25	125,500	12,200
60	259,000	26,300	30	145,000	14,700
70	290,000	29,800			
80	319,000	33,300			
90	344,000	36,900			
100	366,000	40,300			

192 - NEVIS					
MPS-19			M-33		
Time	Altitude	Range	T	Altitude	Range
				Not available	
251,600		25,900			
287,000		29,300			
319,000		33,300			
348,000		36,300			

194 - PUERTO RICO					
MPS-19			M-33		
Time	Altitude	Range	T	Altitude	Range
10	52,000	4,300			
20	98,000	7,300		Not available	
30	140,000	11,300			
40	179,000	14,800			
50	215,000	18,300			
60	247,000	21,300			
70	277,000	23,900			
80	296,000	25,500			

195 - LA RAIZET					196 - ST. THOMAS				
MPS-19			M-33		MPS-19			M-33	
Time	Altitude	Range	T	Altitude Range	Time	Altitude	Range	T	Altitude Range
10	55,000	4,800			10	49,000	3,300		
20	102,000	9,300		Not available	20	93,000	7,100		Not available
30	145,000	14,300			30	134,000	10,300		
40	186,000	19,300			40	172,000	13,700		
50	223,000	24,300			50	206,000	16,300		
60	258,000	28,300			60	238,000	19,900		
70	289,000	32,300			70	267,000	21,700		
80	317,000	36,000			80	292,000	26,300		
90	340,000	41,300			90	314,000	31,300		
					100	333,000	34,300		
					110	349,000	38,300		
					120	361,000	43,300		

198 - ELEUTHERA					199 - FLAMINGO				
MPS-19			M-33		MPS-19			M-33	
Time	Altitude	Range	T	Altitude Range	Time	Altitude	Range	T	Altitude Range
10	51,500	9,300	4	30,200 5,350	10	54,500	5,300	6	29,300 3,400
20	99,000	17,800	10	55,460 9,100	20	103,500	10,900	10	52,100 4,800
30	142,500	26,300	15	79,850 13,900	30	148,000	15,900	15	80,100 7,800
40	183,000	35,300	20	99,800 17,900	40	190,000	20,800	20	103,100 10,200
50	220,000	43,800			50	229,000	25,800	25	128,000 13,200
60	255,000	51,800			60	265,000	31,100	30	150,100 15,800
70	285,500	59,300			70	297,500	35,900		
80	313,000	67,300			80	327,000	40,300		
					90	351,000	44,300		

200 - DONNA					
MPS-19			M-33		
Time	Altitude	Range[x)]	Time	Altitude	Range
10	37,500	11,000	7	34,600	6,600
20	71,500	19,000	25	90,000	18,400
30	102,000	27,000	30	104,500	21,700
40	128,000	33,000	35	118,700	25,000
50	153,000	40,000	40	131,000	28,300
60	170,000	45,500	45	144,000	31,300
70	188,000	52,000			
80	202,000	58,000			
90	212,000	64,000			
100	219,000	71,000			
110	224,500	78,000			
120	226,000	86,000			
130	223,500	92,000			
140	214,000	100,000			
230	50,000	150,000			
240	22,000	155,000			

x) The range data of MPS-19 as shown above were corrected by -5000 ft in order to obtain agreement with M-33 data, and since the given data do not appear to have the gun as reference point.

204 - ALPHA			205 - BETA			206 - GAMMA		
MPS-19			MPS-19			MPS-19		
Time	Altitude	Range	Time	Altitude	Range	Time	Altitude	Range
10	51,600	5,800	10	54,600	4,300	10	55,000	5,300
20	94,000	11,200	20	101,000	8,900	20	103,200	9,700
30	125,600	16,300	30	144,000	13,100	30	148,000	14,700
40	156,800	21,700	40	183,500	16,900	40	189,500	19,500
50	185,400	26,700	50	219,600	20,300	50	227,600	24,300
60	210,000	32,100	60	252,800	24,300	60	260,600	29,300
70	232,000	36,900	70	279,600	27,300	70	294,400	33,500
80	251,000	42,200	80	308,800	34,300			
90	267,000	46,900						
100	279,000	52,200						

207 - DELTA			208 - EPSILON			209 - ZETA		
MPS-19			MPS-19			MPS-19		
Time	Altitude	Range	Time	Altitude	Range	Time	Altitude	Range
10	53,400	4,700	10	51,000	5,300	10	52,800	4,500
20	98,000	8,500	20	93,800	10,100	20	96,200	8,700
30	139,000	12,500	30	133,000	14,700	30	136,200	13,000
40	176,200	16,500	40	169,200	19,300	40	173,700	16,700
50	211,400	20,300	50	201,800	23,500	50	207,400	20,300
60	242,000	23,700	60	231,200	27,700	60	237,600	24,100
70	271,000	27,300	70	257,600	32,100	70	265,000	27,300
80	296,000	30,300	80	281,400	36,300	80	289,500	30,100
90	318,000	32,900	90	299,400	39,300	90	310,000	32,500
100	337,600	35,300						
110	353,600	37,300						
120	366,000	39,300						

210 - ETA			211 - THETA			212 - IOTA		
MPS-19			MPS-19			MPS-19		
Time	Altitude	Range	Time	Altitude	Range	Time	Altitude	Range
10	54,400	5,500	10	54,600	5,900	10	53,600	5,700
20	100,000	10,300	20	101,000	11,300	20	99,400	10,300
30	142,000	15,100	30	144,000	16,300	30	141,200	15,300
40	180,400	19,100	40	183,600	21,300	40	180,200	19,700
50	217,400	22,200	50	220,000	25,900	50	218,100	24,100
			60	253,600	30,900	60	248,800	29,300
			70	283,300	35,300	70	276,000	37,900
			80	311,200	41,700			
			90	335,000	44,300			

213 - KAPPA			214 - INDEPENDENCE 1			215 - INDEPENDENCE 2		
MPS-19			MPS-19			MPS-19		
Time	Altitude	Range	Time	Altitude	Range	Time	Altitude	Range
10	50,400	5,500	10	50,000	4,800	10	10,300	2,300
20	93,400	10,300	20	92,000	9,300	20	11,000	2,800
30	132,400	15,300	30	131,000	13,500	30	8,300	4,800
40	168,200	19,700	40	165,500	17,300	40	4,500	5,100
50	201,000	24,300	50	197,600	21,600	50	1,000	5,300
60	230,000	28,300	60	226,800	25,300	55	0	5,300
70	257,000	32,700	70	252,500	29,300			
80	280,000	36,500	80	275,500	32,800			
90	300,000	39,500	90	295,000	36,800			
100	317,700	41,900	100	311,500	41,800			
110	327,000	43,100	110	325,000	44,300			
			120	335,000	49,300			
			140	347,000	55,800			
			150	348,500	58,300			

217 - ANTRIM			218 - BELFAST			219 - CORK		
MPS-19			MPS-19			MPS-19		
Time	Altitude	Range	Time	Altitude	Range	Time	Altitude	Range
10	50,000	4,700	10	51,200	4,800	10	49,800	4,000
20	94,000	9,100	20	96,800	9,700	20	93,000	7,700
30	134,800	13,300	30	139,000	13,900	30	133,000	11,300
40	172,000	18,100	40	187,800	18,300	40	169,700	15,000
50	206,200	21,100	50	213,400	22,300	50	203,300	18,500
60	237,200	26,300	60	245,800	26,100	60	233,700	21,300
70	265,200	29,100	70	275,400	29,100	70	260,500	25,900
80	290,000	32,900				80	284,800	28,700
90	311,800	38,000				90	306,300	30,100
100	330,200	42,300				100	324,200	33,000
						110	339,800	35,100
						120	351,000	37,000

220 - DUBLIN			221 - GARVAGH			222 - HOLLYWOOD		
MPS-19			MPS-19			MPS-19		
Time	Altitude	Range	Time	Altitude	Range	Time	Altitude	Range
10	48,800	4,700	10	50,200	4,300	10	50,000	4,500
20	93,600	9,300	20	94,400	8,500	20	94,000	9,100
30	134,000	13,900	30	135,000	12,500	30	134,600	13,100
40	171,200	18,100	40	172,800	16,600	40	172,000	17,300
50	205,200	22,300	50	206,800	20,600	50	206,000	21,100
60	235,400	25,900	60	237,000	24,100	60	236,800	25,900
70	263,800	30,300	70	266,000	27,500	70	264,800	29,500
			80	290,600	31,700	80	289,700	33,300
			90	312,400	36,900	90	311,600	37,300
			100	331,600	38,800	100	330,000	41,100
			110	347,400	39,900	110	345,600	44,700
			120	360,000	41,300	120	358,000	47,900
			130	369,800	42,300	130	367,200	50,900

223 - KERRY			224 - LIMERICK			225 - NEWRY		
MPS-19			MPS-19			MPS-19		
Time	Altitude	Range	Time	Altitude	Range	Time	Altitude	Range
10	50,000	4,300	10	49,000	4,100	10	50,000	5,300
20	93,700	8,100	20	92,000	8,000	20	94,200	10,100
30	133,900	12,100	30	132,000	11,300	30	135,200	14,900
40	171,000	15,300	40	168,600	15,100	40	172,800	19,300
50	204,800	19,300	50	201,800	18,500	50	207,200	23,900
60	235,600	22,300	60	231,800	22,100	60	238,300	28,300
70	263,200	26,100	70	259,000	25,100	70	266,600	33,300
80	287,800	29,500	80	283,000	27,900	80	292,000	36,700
90	309,200	32,500	90	304,000	30,600	90	313,300	42,900
100	327,600	35,100	100	321,800	33,900	100	332,400	47,300
110	342,800	38,300	110	336,000	37,100	110	348,400	50,500
130	364,000	45,700	130	356,000	42,900			
150	373,000	49,300	150	364,000	48,300			

226 - SHANKILL			227 - BANGOR			228 - DONAGHADEE		
MPS-19			MPS-19			MPS-19		
Time	Altitude	Range	Time	Altitude	Range	Time	Altitude	Range
10	40,000	8,300	10	40,500	3,300	10	26,300	2,300
20	73,600	15,800	20	74,500	5,800	20	47,000	4,300
30	10[illegible],500	23,800	30	104,600	9,100	30	63,500	6,300
40	130,200	30,700	40	131,500	11,800	40	76,600	8,300
50	153,300	38,000	50	155,000	14,300	50	86,300	10,100
60	173,600	45,300	60	175,500	17,000	60	93,000	11,900
70	190,600	52,100	70	193,000	19,900	70	96,400	13,600
80	204,400	59,100	80	207,000	22,300	80	96,600	15,700
90	215,000	66,700	90	218,000	25,300	90	93,700	17,300
100	222,800	73,600	100	225,700	27,800	100	87,500	18,900
110	227,300	80,600	110	230,000	30,300	110	78,000	20,700
120	228,700	87,300	120	232,000	34,300	120	65,700	22,300
130	227,000	94,100	130	231,000	34,800	130	50,400	24,100
140	222,300	100,900	140	226,000	37,800	140	32,600	25,700
150	214,800	107,000	150	218,000	40,800	150	13,200	27,100
260	33,800	160,700	160	207,000	43,300	157	- 600	28,000
270	23,000	161,200	246	17,000	61,800			
280	12,000	161,500	250	- 700	62,800			
290	1,500	161,700						
291	0	161,800						

229 - TEST SLUG #25			232 - CAMERON		
MPS-19			MPS-19		
Time	Altitude	Range	Time	Altitude	Range
10	19,000	4,800	10	15,100	2,550
20	26,800	5,600	20	17,500	3,550
30	30,200	7,300	30	16,300	4,100
40	30,200	8,800	40	12,800	4,550
50	27,200	10,300	50	8,400	4,900
60	21,200	11,700	60	3,800	4,900
70	13,800	12,800	69	0,000	4,900
80	5,700	13,600			

234 - ACCRA			238 - FREETOWN		
MPS-19			MPS-19		
Time	Altitude	Range	Time	Altitude	Range
10	37,200	7,300	10	55,000	5,100
20	58,000	11,300	20	103,000	9,300
30	68,000	13,300	30	147,500	13,100
40	72,500	15,300	40	188,000	16,800
50	73,600	16,300	50	226,000	20,300
60	71,300	17,800	60	261,000	24,300
70	66,400	19,300	70	292,500	27,300
80	59,400	20,300	80	321,000	31,300
100	45,300	21,300	90	346,500	35,800
120	32,700	21,300	340	9,000	116,600
140	17,400	21,300	346	-3,000	117,300
160	4,000	21,300			
165	-5,000	21,300			

235 - CAIRO			236 - DURBAN			237 - ENTEBBE		
MPS-19			MPS-19			MPS-19		
Time	Altitude	Range	Time	Altitude	Range	Time	Altitude	Range
10	49,000	3,800	10	49,300	3,300	10	51,000	3,800
20	91,500	7,800	20	92,000	7,300	20	96,000	8,000
30	130,200	11,300	30	132,000	10,300	30	138,000	11,700
40	166,400	15,000	40	168,000	13,300	40	176,500	15,000
50	199,000	18,700	50	201,300	17,100	50	211,000	19,300
60	228,500	21,800	60	231,000	19,300	60	243,400	22,300
70	255,000	25,300	70	258,000	23,300	70	272,000	26,500
80	278,000	29,000	80	282,000	26,300	80	298,000	29,000
90	298,500	31,300	90	303,000	29,300	90	321,000	32,300
100	315,500	34,700	100	320,500	30,800	100	340,400	36,800
110	329,800	37,300	110	335,000	35,300	110	357,000	39,000
130	348,400	43,300	120	346,500	37,300	120	371,000	39,600
150	355,000	50,300	130	354,800	41,300	130	382,000	40,300
170	348,800	55,300	140	359,500	44,300	320	17,500	102,300
190	330,400	61,300	150	362,000	46,300	326	0	103,300
210	299,000	69,300	170	356,500	53,300			
230	256,000	74,300	190	339,500	58,000			
260	177,000	82,800	200	326,000	60,800			
			220	290,000	65,300			
			240	242,000	70,300			
			300	36,600	86,300			
			310	2,800	87,800			

PART IV

TABLES AND GRAPHS OF WIND DATA

Trail No.	Round No.	Name	Date	Page
43	181	INAUGUA	17 Feb 66	IV-3
44	189	ST. KITTS		[illegible]-8
45	190	ST. LUCIA		IV-12
46	191	MONTSERRAT	23/24 Feb 66	IV-16
47	192	NEVIS		IV-20
48	194	PUERTO RICO		IV-24
49	196	ST. THOMAS		IV-28
50	199	FLAMINGO	25 Feb 66	IV-34
51	205	BETA		IV-38
52	206	GAMMA		IV-43
53	207	DELTA		IV-48
54	208	EPSILON	19/20 Sep 66	IV-53
55	209	ZETA		IV-57
56	210	ETA		IV-62
57	211	THETA		IV-66
58	212	IOTA		IV-71
59	218	BELFAST		IV-75
60	219	CORK		IV-80
61	220	DUBLIN		IV-84
62	221	GARVAGH		IV-89
63	222	HOLLYWOOD	15/16 Feb 67	IV-93
64	223	KERRY		IV-98
65	224	LIMERICK		IV-102
66	225	NEWRY		IV-107
67	235	CAIRO	21 June 67	IV-111
68	236	DURBAN	22 June 67	IV-116

For each of these rounds a data table and graphs are given.*)

The wind speed plot shows the speed of the wind vector in meters per second as a function of altitude in kilometers above sea level. For the wind direction plot the wind vector is considered to point in the direction towards which the wind is moving, and the direction is given in degrees clockwise from North, over East, South, West, to North. The wind components plots give the North/South, and East/West velocities, with direction towards North and East positive. The components are plotted in meters per second versus altitude in kilometers.

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*) Taken from References Nos. 12 to 15, pp I-63/64.
(See also Bibliography, Appendix A-3, p. A-11.)

The wind direction and components as given in the plots are referenced to true North. Components relative to magnetic North have also been calculated for comparison with other ionospheric phenomena. These components are not plotted, but are listed in the data tables.

TRAIL NO. 843 INAUGUA

BARBADOS
UP TRAIL

17 FEBRUARY 1966 21-03-00 AST

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
92.0	299.8	97.9	48.7	-85.0	64.9	-73.4
93.0	312.0	112.3	75.2	-83.5	90.5	-66.(
94.0	324.7	111.4	90.9	-64.4	102.0	-44.7
95.0	337.4	112.7	104.0	-43.4	110.6	-21.5
96.0	345.6	117.0	113.3	-29.0	116.8	-5.5
97.0	345.5	136.8	132.4	-34.1	136.6	-6.(
98.0	344.2	143.9	138.5	-39.1	143.5	-10.3
99.0	344.4	143.5	138.2	-38.7	143.2	-10.(
100.0	353.7	113.7	113.0	-12.5	113.2	10.6
101.0	6.4	105.7	105.0	11.8	100.5	32.8
102.0	13.7	100.2	97.3	23.8	90.5	43.(
103.0	23.0	75.2	69.2	29.4	61.8	42.8
104.0	31.0	62.8	53.8	32.4	46.1	42.6
105.(	44.2	44.2	31.7	30.8	24.8	36.6
106.(	105.0	21.6	-5.6	20.9	-9.7	19.3
107.(	161.4	17.3	-16.4	5.5	-17.2	2.1
108.0	248.5	22.6	-8.3	-21.0	-3.9	-22.2
109.0	265.1	14.9	-1.3	-14.8	1.7	-14.8
110.0	336.6	18.1	16.6	-7.2	17.7	-3.7
111.0	43.5	20.2	14.6	13.9	11.5	16.6
112.0	49.0	35.9	23.5	27.1	17.5	31.3
113.0	63.6	53.6	23.8	48.0	13.6	51.8
114.0	68.9	66.4	23.9	62.0	10.9	65.5
115.0	69.8	72.2	24.9	67.8	10.7	71.4
116.0	71.2	79.5	25.7	75.3	10.0	78.9
117.0	71.9	87.9	27.3	83.5	9.9	87.3
118.0	77.6	87.0	18.7	85.0	1.2	87.0
119.0	88.1	81.8	2.7	81.7	-13.9	80.6
120.0	96.4	76.6	-8.5	76.1	-23.7	72.8
121.0	99.(	74.9	-12.7	73.8	-27.3	69.7
122.0	102.7	75.1	-16.5	73.3	-31.0	68.5
123.0	101.4	73.8	-14.6	72.3	-28.9	67.9

TRAIL NO. B43 INAUGUA

BARBADOS 17 FEBRUARY 1966 21-03-00 AST

DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
107.0	212.4	7.5	-6.3	-4.0	-5.4	-5.2
108.0	221.6	20.9	-15.6	-13.9	-12.5	-16.8
109.0	261.7	19.7	-2.8	-19.5	1.2	-19.7
110.0	328.7	16.2	13.6	-8.4	15.2	-5.4
111.0	19.0	16.7	15.8	5.5	14.4	8.6
112.0	62.4	39.6	18.3	35.1	10.8	38.1
113.0	72.2	59.4	18.2	56.6	6.4	59.1
114.0	76.2	67.0	16.0	65.1	2.5	67.0
115.0	77.3	86.9	19.2	84.8	1.7	86.9
116.0	78.4	99.8	20.0	97.7	-0.1	99.7
117.0	80.9	101.6	16.0	100.3	-4.6	101.5
118.0	84.2	100.6	10.1	100.1	-10.3	100.1
119.0	91.4	93.7	-2.2	93.7	-21.1	91.3
120.0	94.8	94.4	-8.0	94.1	-26.8	90.5
121.0	97.3	97.5	-12.3	96.7	-31.6	92.2

WIND COMPONENTS

TRAIL NO. B43 INAUGUA

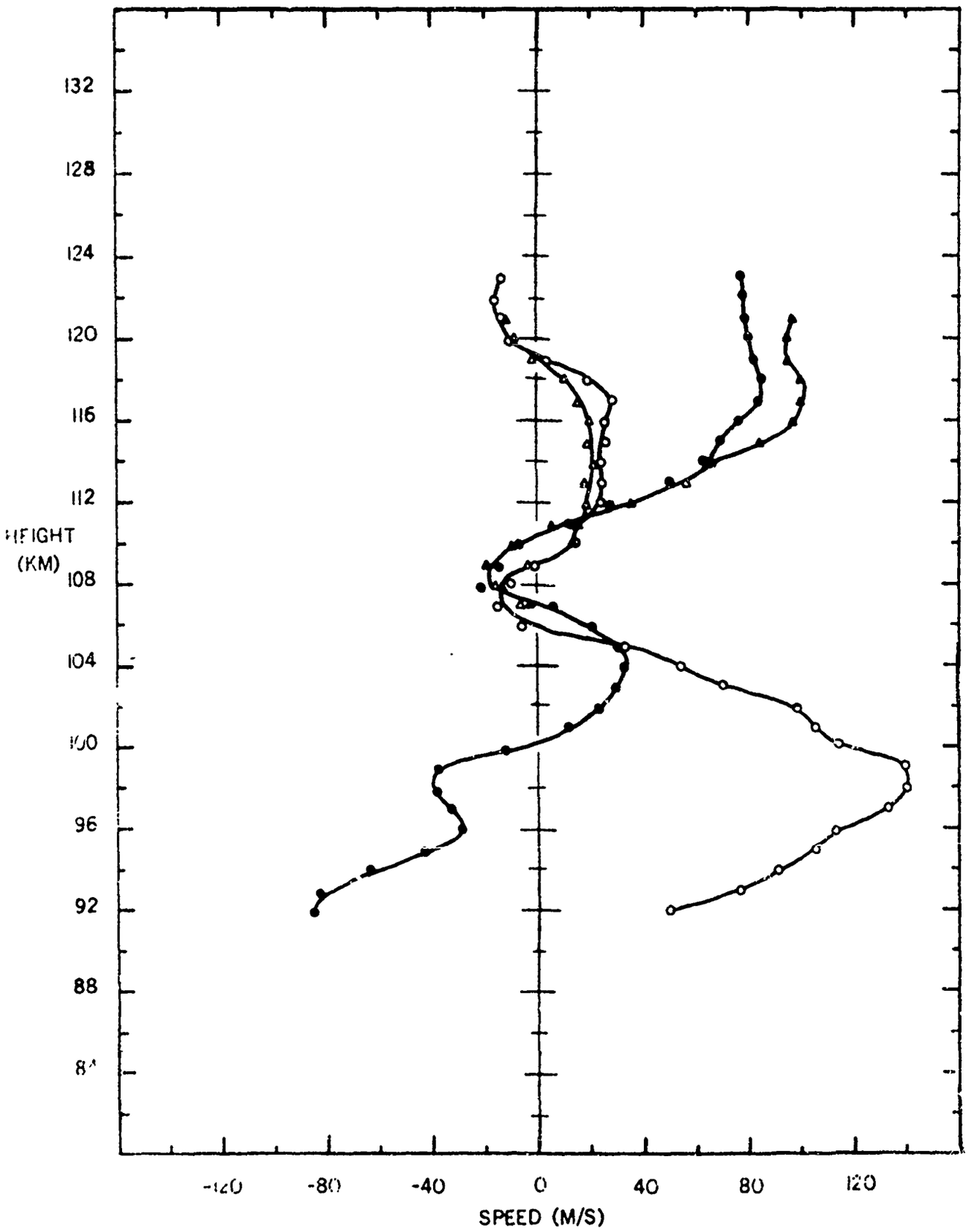
UP DOWN

17 FEBRUARY 1966 21:03:00

○ △ NORTH- SOUTH

● ▲ EAST-WEST

H.A.R.P. BARBADOS



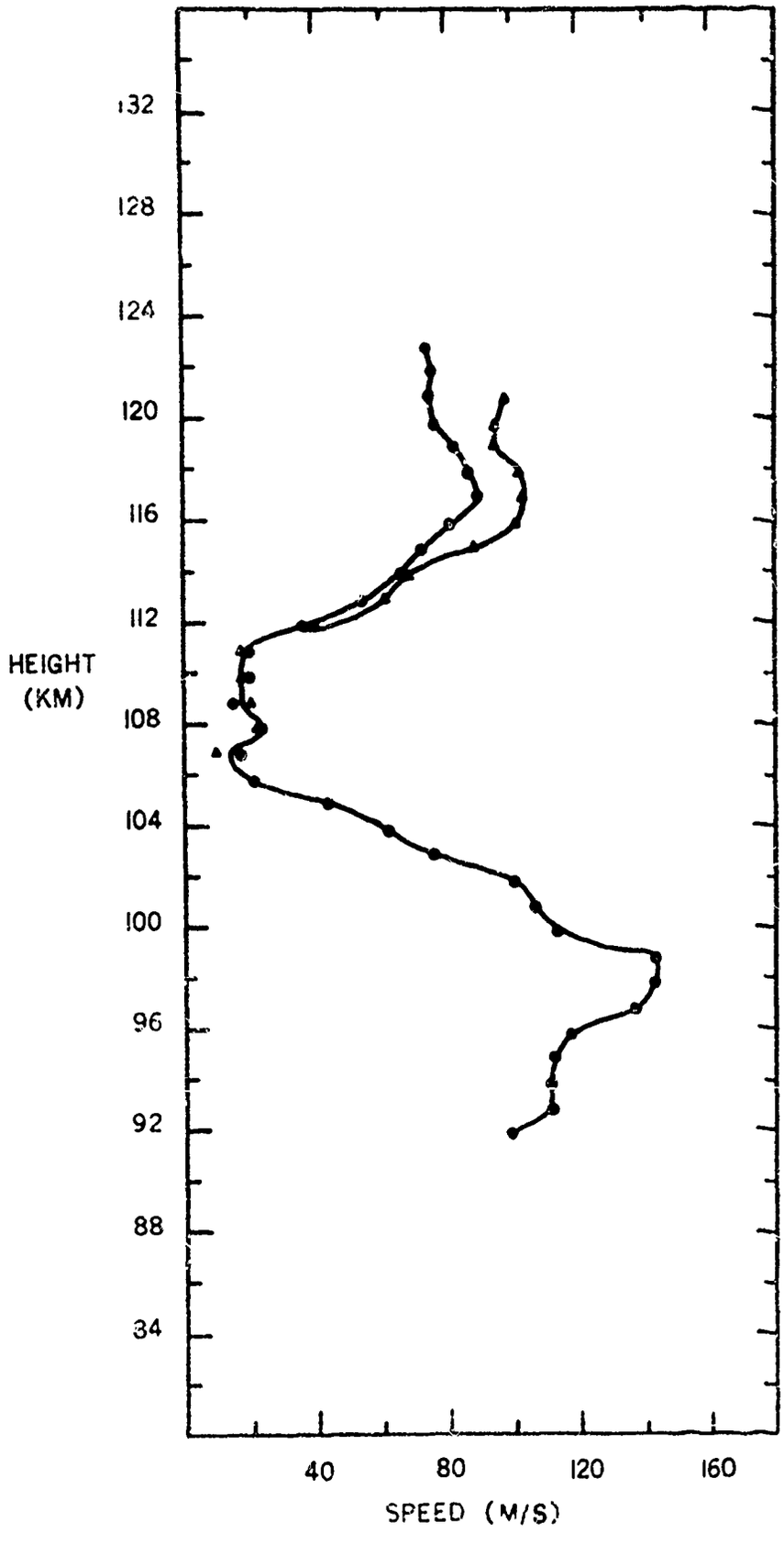
WIND SPEED

TRAIL NO. B43 INAUGUA

17 FEBRUARY 1966 21:03:00

H.A.R.P. BARBADOS

● UP TRAIL
▲ DOWN TRAIL



WIND DIRECTION

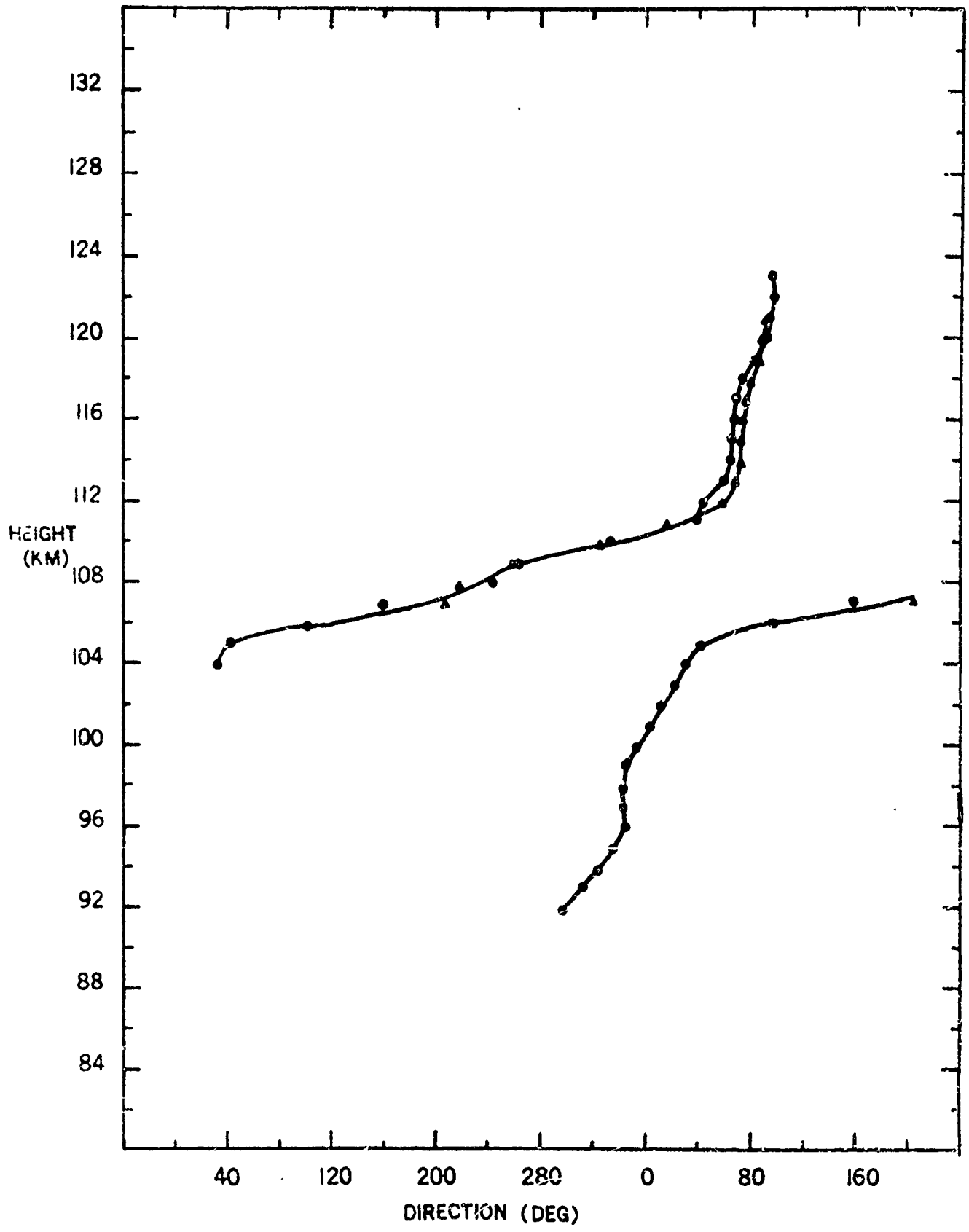
● UP TRAIL

▲ DOWN TRAIL

TRAIL NO. B43 INAUGUA

17 FEBRUARY 1966 21:03:00

H.A.R.P. BARBADOS



TRAIL NO. B44 ST. KITTS

BARBADOS 23 FEBRUARY 1966 20-46-00 AST

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
87.0	195.8	92.5	-89.0	-25.1	-82.1	-42.6
88.0	197.7	66.9	-63.7	-20.4	-58.3	-32.8
89.0	206.5	79.7	-71.4	-35.5	-62.8	-49.2
90.0	210.2	74.7	-64.6	-37.6	-55.7	-49.9
91.0	229.2	61.4	-40.2	-46.5	-30.0	-53.7
92.0	224.1	60.3	-43.4	-42.0	-34.0	-49.9
93.0	234.6	62.2	-36.1	-50.7	-25.1	-56.9
94.0	265.7	81.5	-6.1	-81.2	10.4	-80.8
95.0	297.5	78.9	36.5	-70.0	49.9	-61.2
96.0	296.1	69.8	30.7	-62.7	42.7	-55.2
97.0	304.5	62.1	35.2	-51.1	44.8	-42.9
98.0	311.5	85.3	56.5	-63.9	68.2	-51.2
99.0	316.7	85.0	61.8	-58.3	72.3	-44.6
100.0	321.9	82.6	65.0	-50.9	73.9	-36.7
101.0	327.1	79.7	66.9	-43.2	74.2	-28.8
102.0	328.2	87.6	74.4	-46.2	82.2	-30.2
103.0	323.5	103.4	83.2	-61.5	93.9	-43.4
104.0	323.1	109.8	87.7	-65.9	99.2	-46.8
105.0	323.3	114.1	91.5	-68.2	103.4	-48.3
106.9	316.4	95.6	69.2	-66.0	81.1	-50.7
107.0	263.2	41.0	-4.9	-40.7	3.4	-40.9
108.0	262.1	28.8	-4.0	-28.5	1.8	-28.7
109.0	278.7	15.0	2.3	-14.8	5.2	-14.0
110.0	18.0	10.4	9.8	3.2	9.0	5.1
111.0	55.1	28.6	16.3	23.5	11.2	26.3
112.0	57.5	39.8	21.4	33.6	14.2	37.2
113.9	64.1	42.7	18.7	38.4	10.6	41.4
114.0	73.5	41.7	11.9	40.0	3.6	41.6
115.0	79.3	82.5	15.2	81.1	-1.5	82.5
116.0	78.5	88.7	17.6	87.0	-0.3	88.8
117.0	77.3	90.2	19.9	88.0	1.7	90.2
118.0	76.4	91.5	21.5	88.9	3.1	91.4
119.0	76.9	89.3	20.3	87.0	2.3	89.2
120.0	82.2	80.8	11.0	80.0	-5.4	80.6
121.0	83.7	76.4	8.3	76.0	-7.2	76.1
122.0	84.4	76.6	7.5	76.3	-8.1	76.2
123.0	83.5	77.1	8.2	76.7	-7.0	76.9
124.0	82.5	77.6	10.1	77.0	-5.7	77.5
125.0	85.8	70.9	5.1	70.7	-9.3	70.3
126.0	91.1	62.1	-1.2	62.0	-13.7	60.5
127.0	92.9	57.7	-3.0	57.6	-14.6	55.8
128.0	95.3	53.0	-4.9	52.8	-15.5	50.7
129.0	96.1	49.5	-5.3	49.3	-15.1	47.0
130.0	104.7	43.4	-11.0	42.0	-19.3	38.9
131.0	119.9	35.1	-17.5	30.4	-23.3	26.4

WIND COMPONENTS

TRAIL NO. B44 ST. KITTS

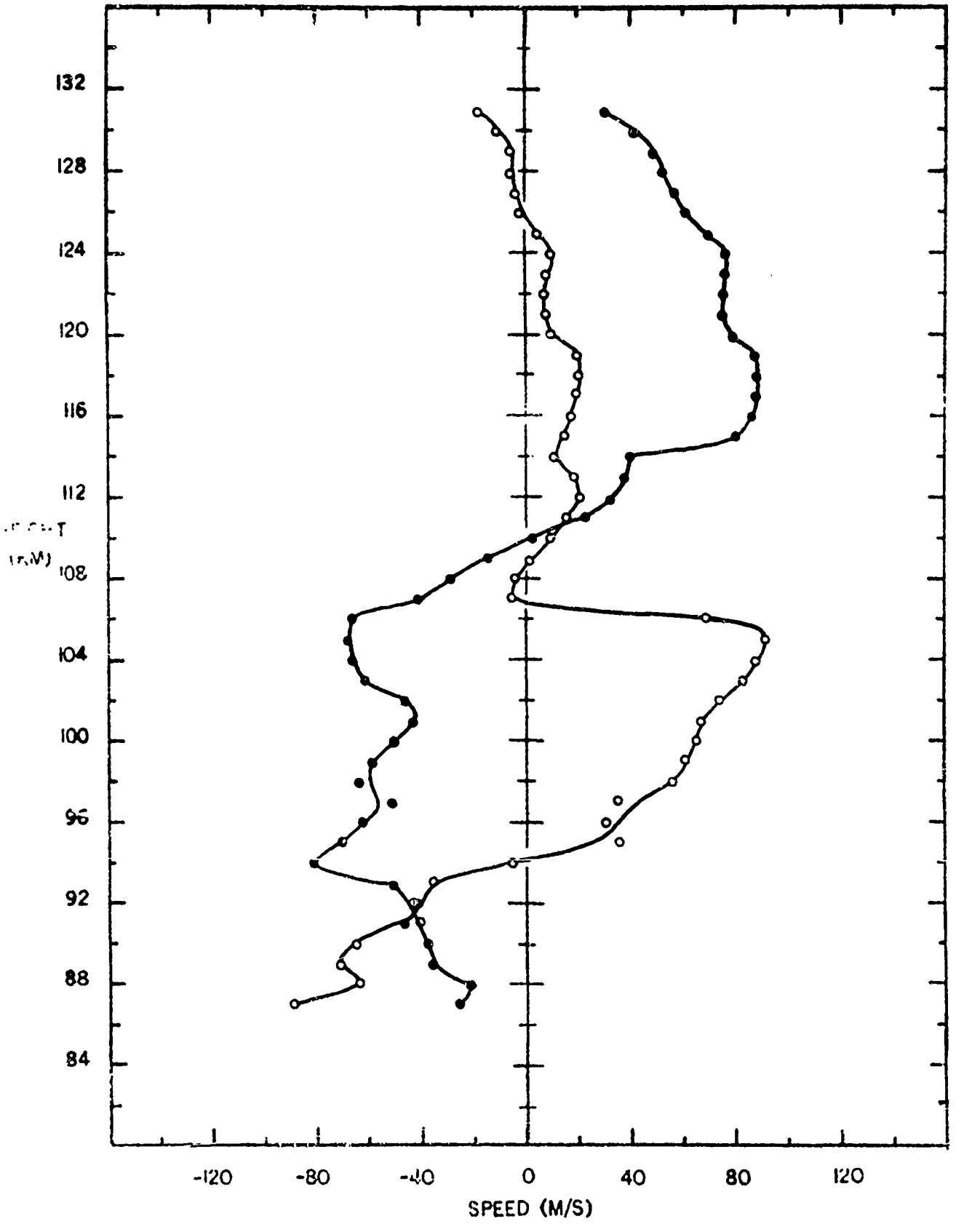
UP DOWN

○ △ NORTH- SOUTH

● ▲ EAST-WEST

23 FEBRUARY 1966 20:46:00

H.A.R.P. BARBADOS



WIND SPEED

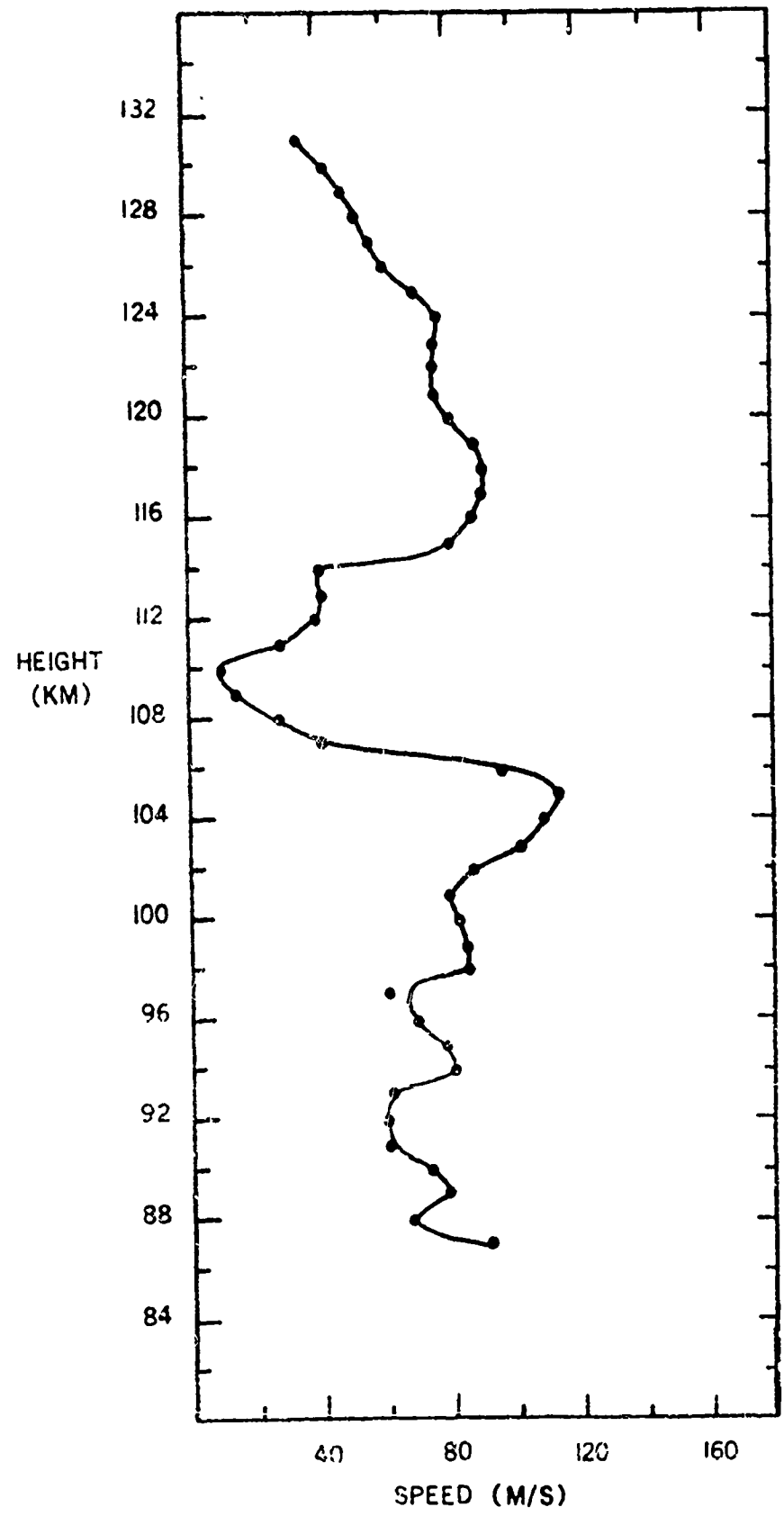
TRAIL NO. B44 ST. KITTS

● UP TRAIL

▲ DOWN TRAIL

23 FEBRUARY 1966 20:46:00

H.A.R.P. BARBADOS



WIND DIRECTION

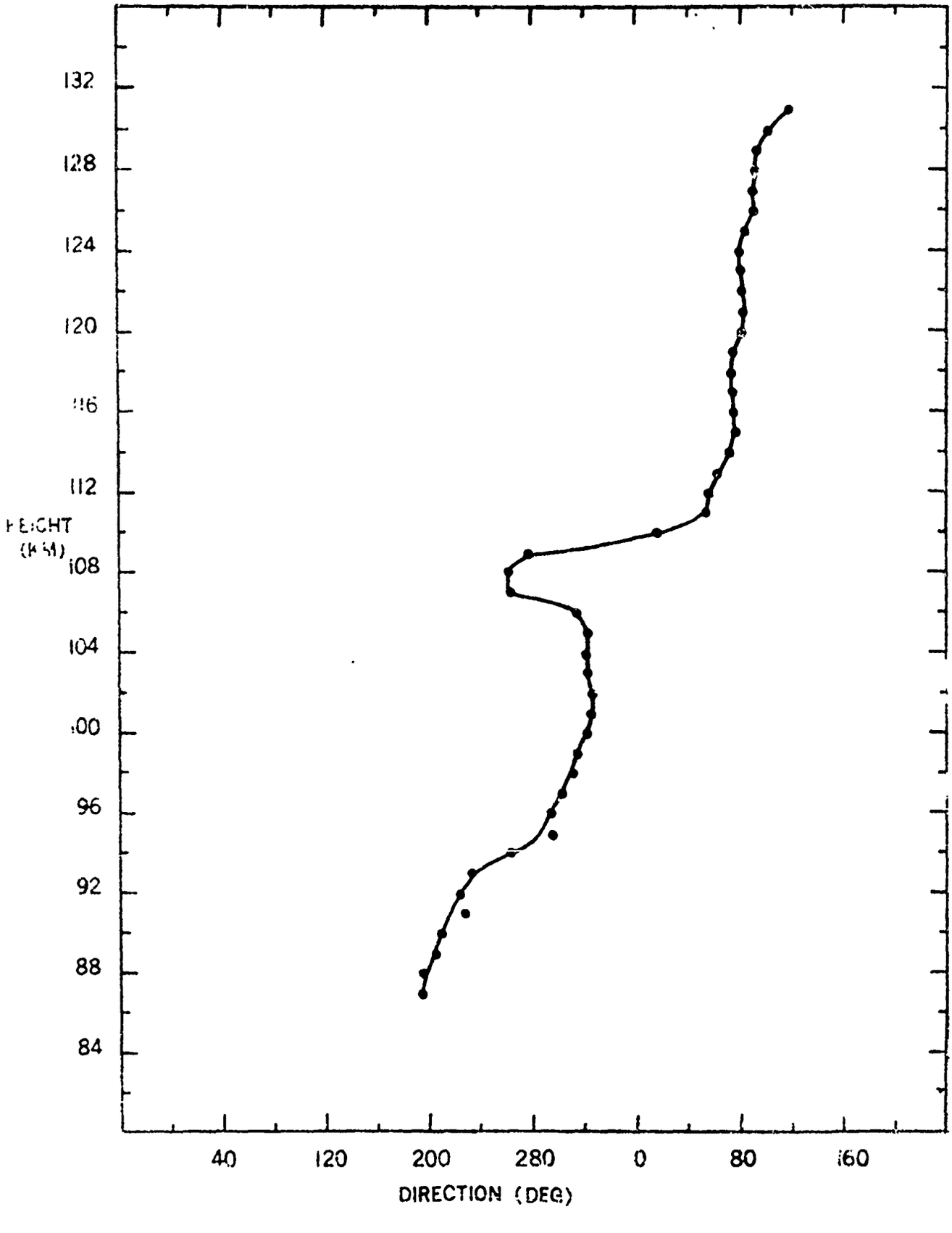
● UP TRAIL

▲ DOWN TRAIL

TRAIL NO. B44 ST. KITTS

23 FEBRUARY 1966 20:46:00

H.A.R.P. BARBADOS



TRAIL NO. B45 ST. LUCIA

BARBADOS 23 FEBRUARY 1966 22-03-00 AST

ALTITUDE	WIND HEADING	WIND VELOCITY	WIND COMPONENTS (M/S) GEOGRAPHIC		MAGNETIC	
(KM)	(DEG)	(M/S)	N-S	E-W	N-S	E-W
95.0	300.6	78.4	39.9	-67.5	52.7	-58.1
96.0	308.6	86.4	53.9	-67.5	66.4	-55.2
97.0	318.6	90.6	68.0	-59.9	78.7	-44.9
98.0	322.1	92.9	73.2	-57.1	83.2	-41.1
99.0	321.9	95.5	75.2	-58.9	85.5	-42.5
100.0	321.7	95.0	74.6	-58.9	85.0	-42.6
101.0	323.6	93.9	75.6	-55.7	85.3	-39.3
102.0	319.5	90.6	68.9	-58.9	79.4	-43.8
103.0	313.0	89.4	60.9	-65.4	72.9	-51.8
104.0	290.8	55.4	19.7	-51.8	29.8	-46.8
105.0	244.6	39.7	-17.0	-35.9	-9.4	-38.6
106.0	229.5	34.6	-22.5	-26.3	-16.7	-30.3
107.0	209.1	30.3	-26.4	-14.7	-22.9	-19.7
108.0	168.4	26.3	-25.8	5.3	-26.3	0.0
109.0	140.3	38.9	-29.9	24.9	-34.3	18.3
110.0	126.1	53.8	-31.7	43.5	-39.8	36.2
111.0	117.4	68.8	-31.7	61.1	-43.4	53.4
112.0	120.4	69.2	-35.0	59.7	-46.3	51.4
113.0	115.4	69.1	-29.6	62.4	-41.6	55.1
114.0	117.1	65.4	-29.8	58.2	-40.9	51.0
115.0	115.3	62.2	-26.6	56.2	-37.4	49.7
116.0	99.9	62.7	-10.8	61.8	-23.1	58.3
117.0	87.0	77.3	4.0	77.2	-11.7	76.4

WIND COMPONENTS

TRAIL NO. B45 ST LUCIA

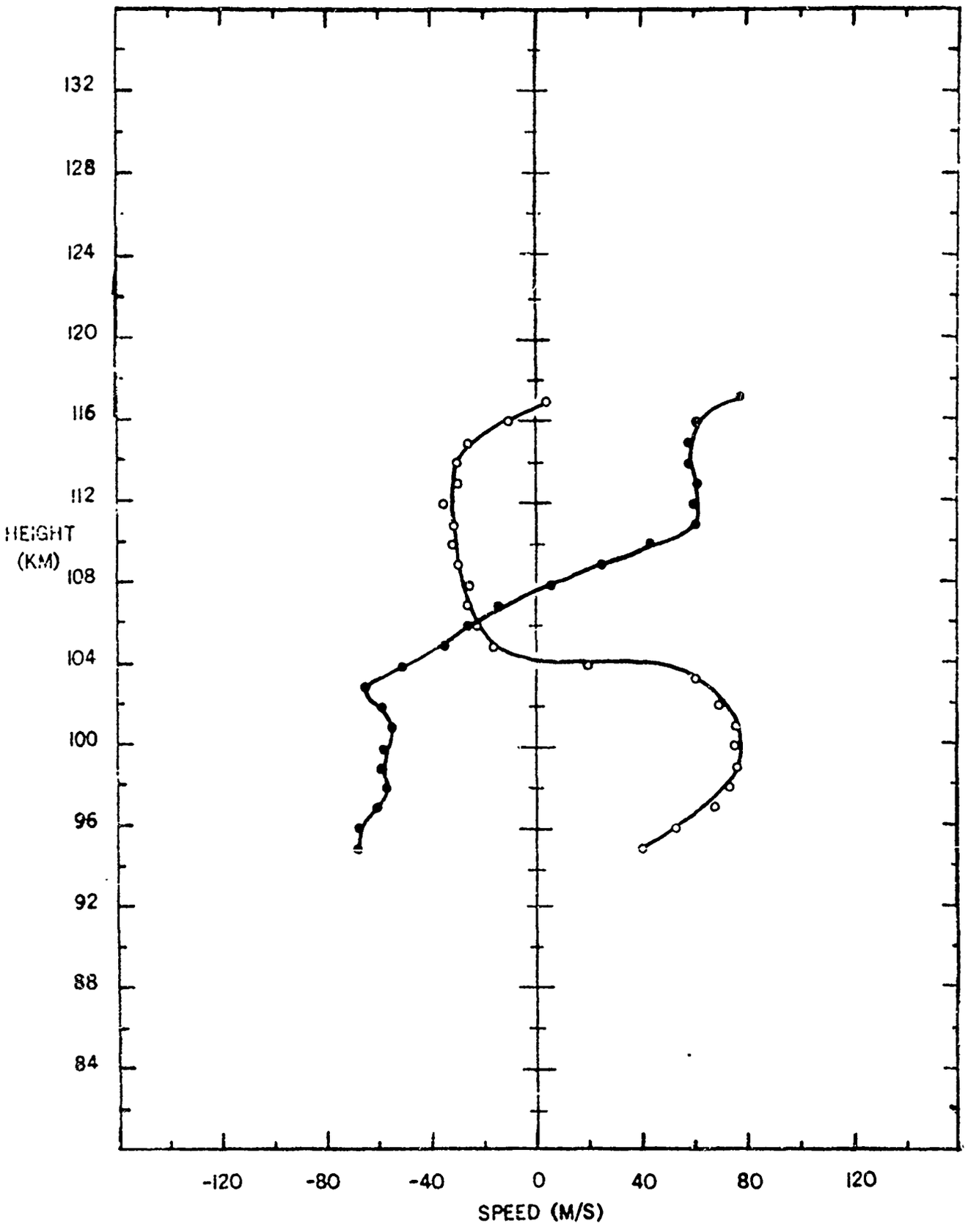
UP DOWN

23 FEBRUARY 1966 23:03:00

○ △ NORTH- SOUTH

● ▲ EAST-WEST

H.A.R.P. BARBADOS



WIND SPEED

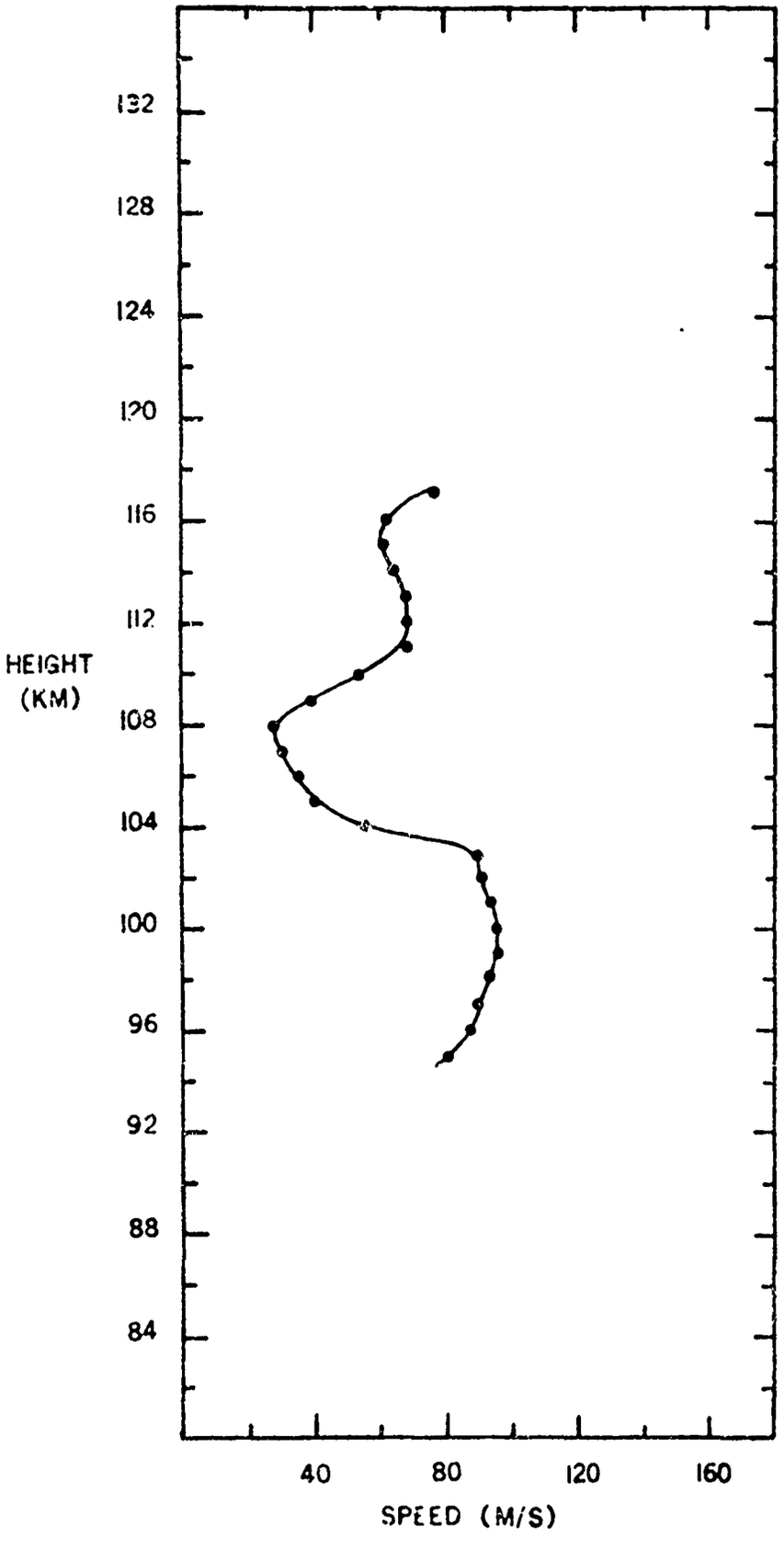
TRAIL NO. B 45 ST. LUCIA

23 FEBRUARY 1966 23:03:00

H.A.R.P. BARBADOS

● UP TRAIL

▲ DOWN TRAIL



WIND DIRECTION

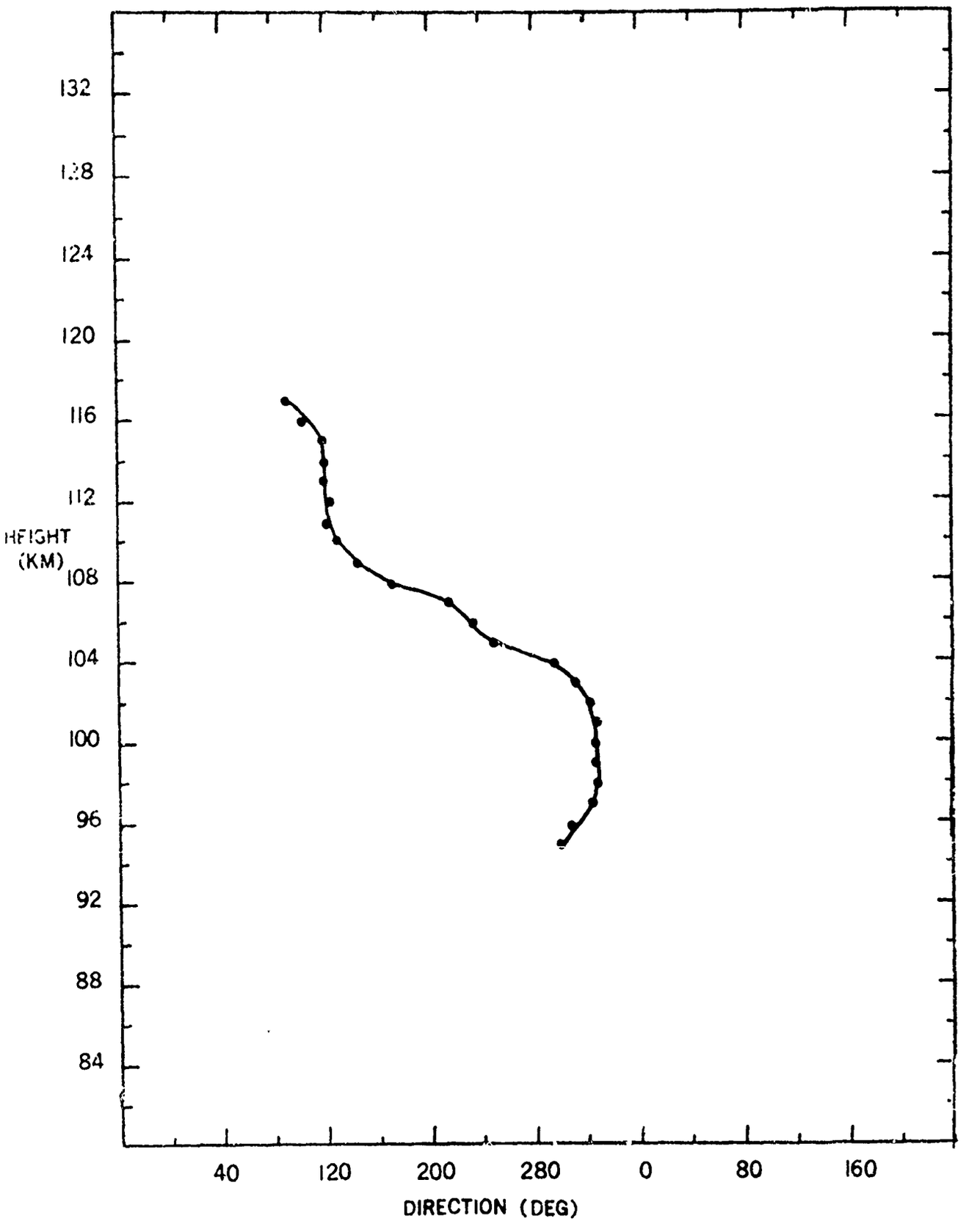
● UP TRAIL

▲ DOWN TRAIL

TRAIL NO. B45 ST. LUCIA

23 FEBRUARY 1966 23:03:00

H.A.R.P. BARBADOS



TRAIL NO. B46 MONTSERRAT

BARBADOS 23 FEBRUARY 1966 23-21-00 AST

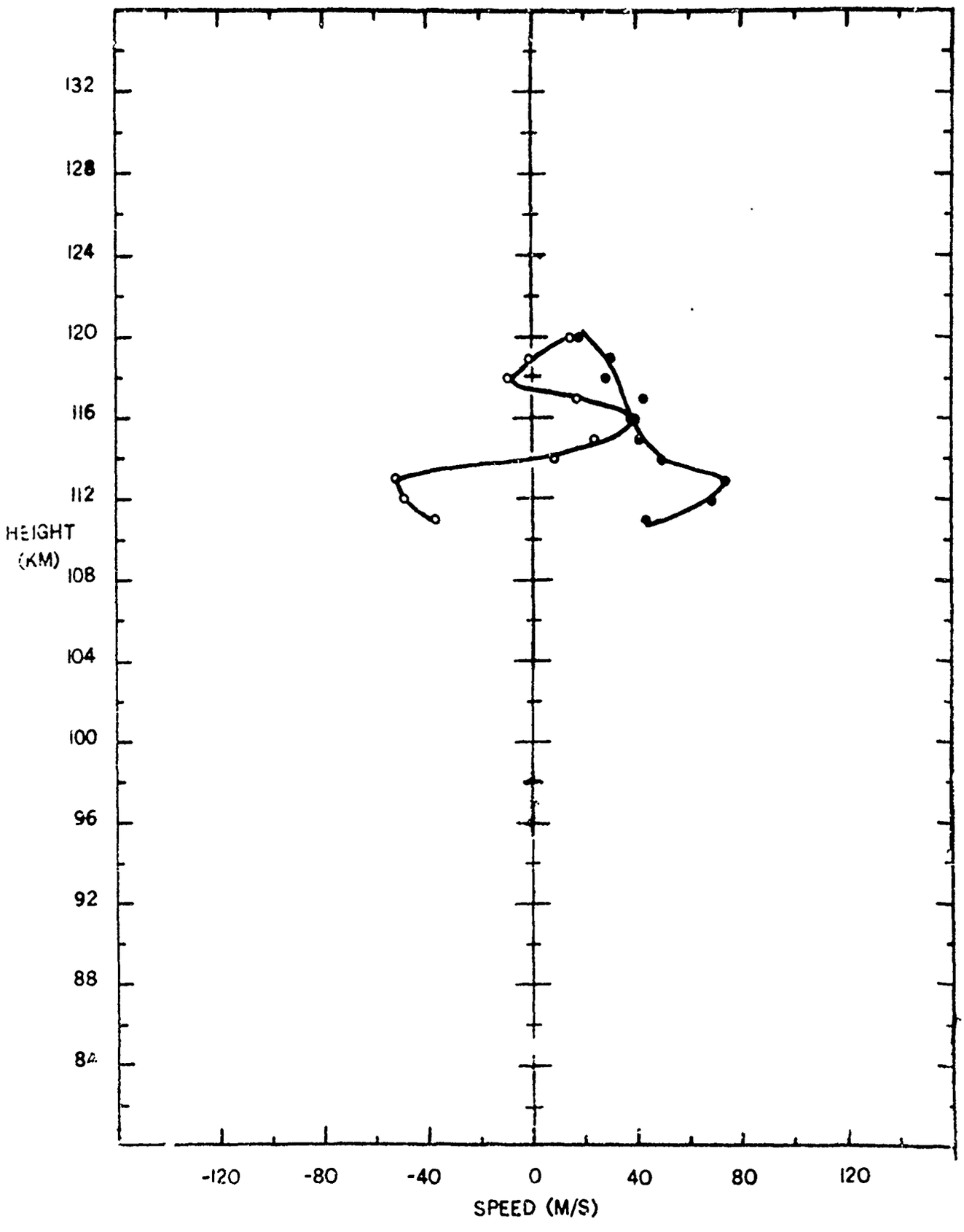
ALTITUDE	WIND HEADING	WIND VELOCITY	WIND COMPONENTS (M/S) GEOGRAPHIC		MAGNETIC	
(KM)	(DEG)	(M/S)	N-S	E-W	N-S	E-W
111.0	128.9	57.4	-36.0	44.7	-44.3	36.5
112.0	124.7	84.8	-48.3	69.7	-61.4	58.5
113.0	125.2	91.2	-52.6	74.5	-66.6	62.3
114.0	80.2	51.0	8.7	50.3	-1.6	51.0
115.0	59.6	48.6	24.6	41.9	15.6	46.0
116.0	45.2	54.8	38.6	38.9	29.9	45.9
117.0	67.9	46.7	17.6	43.3	8.5	46.0
118.0	105.8	30.2	-8.2	29.1	-13.9	26.8
119.0	91.2	31.5	-0.7	31.4	-7.0	30.6
120.0	50.3	23.4	15.0	18.0	11.1	20.7

WIND COMPONENTS TRAIL NO. B46 MONTSERRAT

UP DOWN 23 FEBRUARY 1966 23:21:00

○ △ NORTH-SOUTH

● ▲ EAST-WEST H.A.R.P. BARBADOS



WIND SPEED

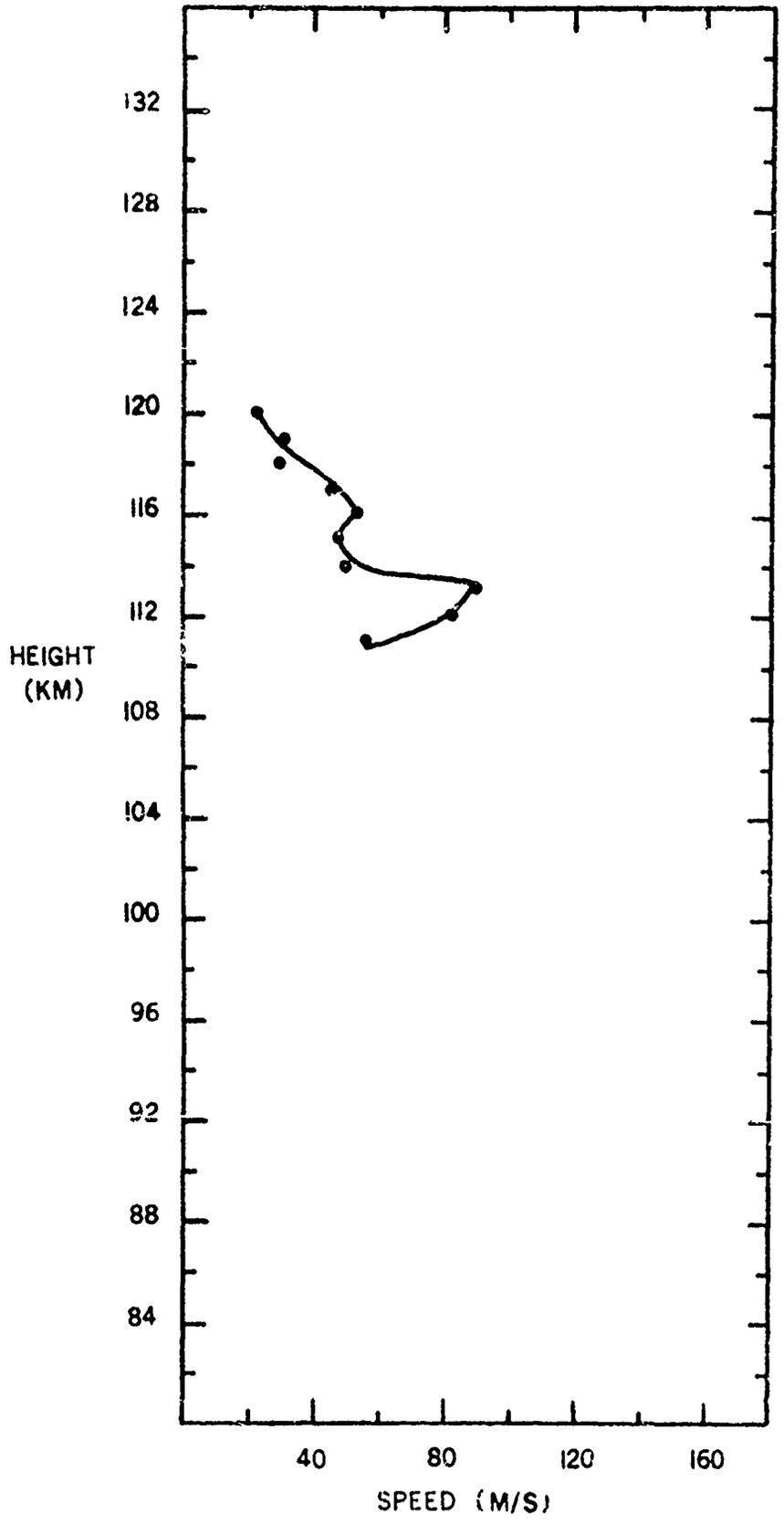
TRAIL NO. B46 MONTSERRAT

● UP TRAIL

▲ DOWN TRAIL

23 FEBRUARY 1966 23:21:00

H.A.R.P. BARBADOS



WIND DIRECTION

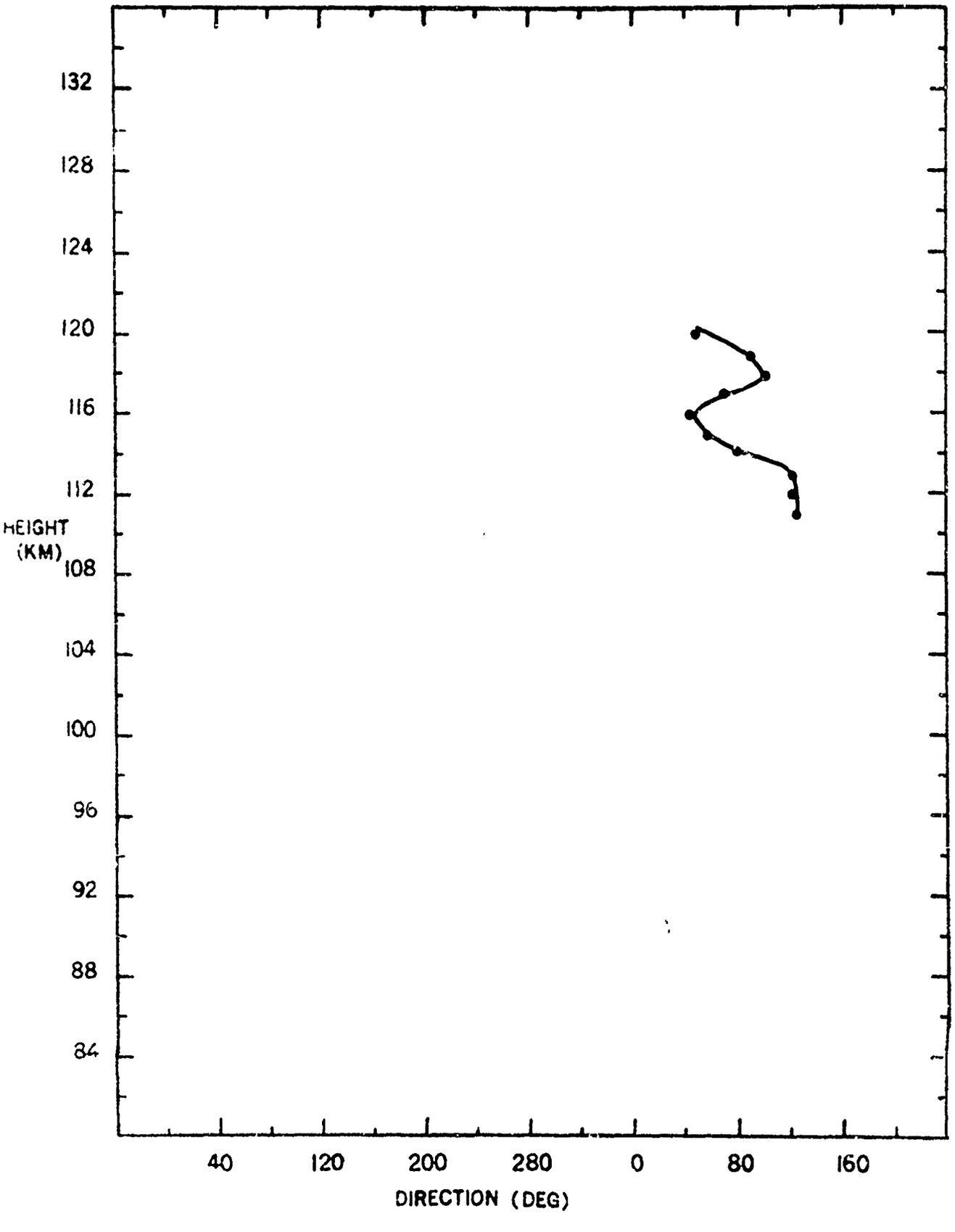
● UP TRAIL

▲ DOWN TRAIL

TRAIL NO. B46 MONTSERRAT

23 FEBRUARY 1966 23:21:00

H.A.R.P. BARBADOS



TRAIL NO. 847 NEVIS

BARBADOS 24 FEBRUARY 1966 00-25-00 AST

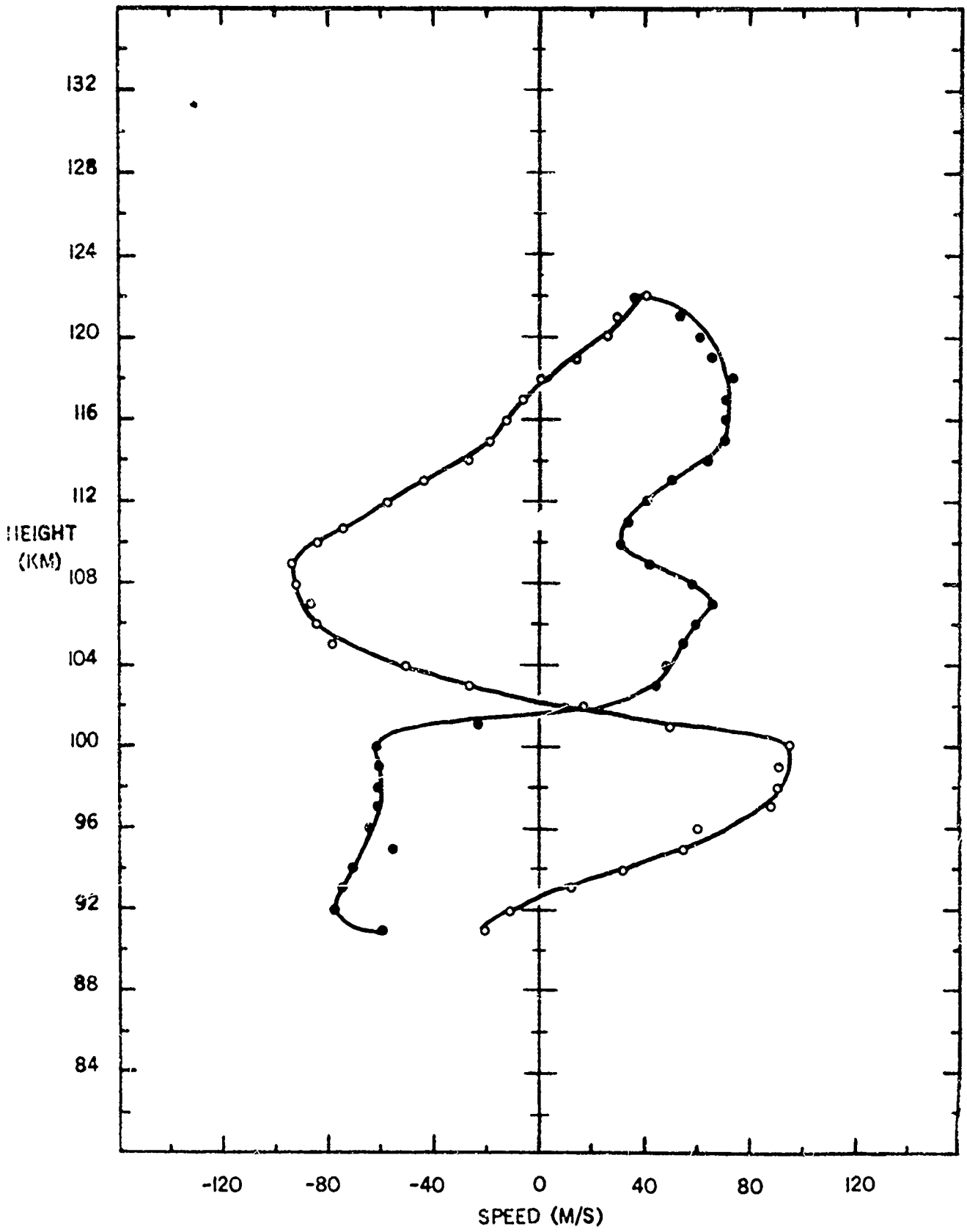
ALTITUDE	WIND HEADING	WIND VELOCITY	WIND COMPONENTS (M/S) GEOGRAPHIC		MAGNETIC	
(KM)	(DEG)	(M/S)	N-S	E-W	N-S	E-W
91.0	250.5	64.4	-21.5	-60.7	-8.8	-63.8
92.0	261.0	80.0	-12.6	-79.0	3.6	-79.9
93.0	279.1	76.1	12.1	-75.1	27.0	-71.1
94.0	294.2	78.4	32.1	-71.5	45.9	-63.5
95.0	313.4	77.8	53.5	-56.5	63.8	-44.5
96.0	312.6	88.6	60.0	-65.2	71.9	-51.7
97.0	325.0	107.9	88.4	-61.9	99.1	-42.8
98.0	324.9	108.9	89.2	-62.6	100.0	-43.3
99.0	325.6	109.6	90.4	-62.0	101.1	-42.5
100.0	326.3	114.5	95.2	-63.6	106.1	-43.1
101.0	334.8	53.9	48.8	-22.9	52.4	-12.6
102.0	27.3	17.8	15.8	8.1	13.8	11.1
103.0	122.3	51.4	-27.5	43.4	-35.7	37.0
104.0	138.5	69.6	-52.1	46.2	-60.4	34.7
105.0	145.2	94.5	-77.6	53.9	-86.9	37.1
106.0	146.1	103.6	-86.0	57.8	-95.9	39.2
107.0	143.5	108.9	-87.5	64.8	-98.8	45.8
108.0	148.4	108.9	-92.8	57.0	-102.4	37.1
109.0	156.8	103.0	-94.6	40.6	-100.8	20.7
110.0	160.6	91.1	-85.9	30.3	-90.2	12.3
111.0	156.7	83.0	-76.3	32.9	-81.4	16.8
112.0	145.1	70.7	-58.0	40.5	-65.0	28.0
113.0	131.7	66.4	-44.2	49.6	-53.3	39.7
114.0	113.0	69.2	-27.1	63.7	-39.4	56.9
115.0	105.2	72.2	-19.0	69.7	-32.7	64.4
116.0	101.0	71.9	-13.7	70.5	-27.7	66.3
117.0	95.7	70.9	-7.1	70.5	-21.2	67.6
118.0	89.5	73.7	0.6	73.7	-14.3	72.3
119.0	78.5	66.3	13.3	65.0	-0.1	66.3
120.0	66.9	65.8	25.9	60.5	13.1	64.5
121.0	61.6	59.8	28.5	52.6	17.3	57.3
122.0	41.2	53.9	40.5	35.5	32.5	42.9

WIND COMPONENTS TRAIL NO. B47 NEVIS

UP DOWN 24 FEBRUARY 1966 00:25:00

○ △ NORTH-SOUTH

● ▲ EAST-WEST H.A.R.P. BARBADOS



WIND SPEED

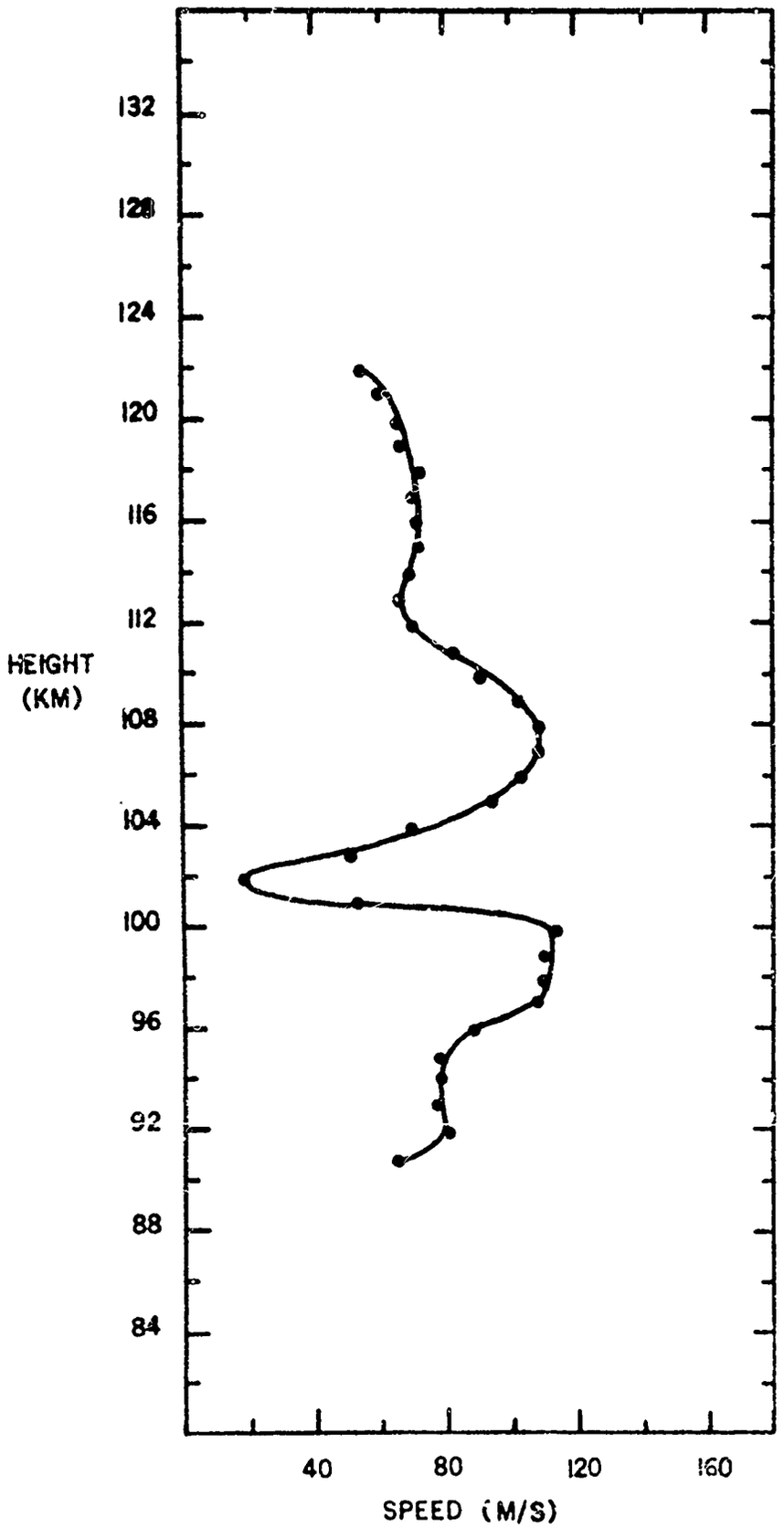
TRAIL NO. B47 NEVIS

● UP TRAIL

▲ DOWN TRAIL

24 FEBRUARY 1968 00:25:06

H.A.R.P. BARBADOS



WIND DIRECTION

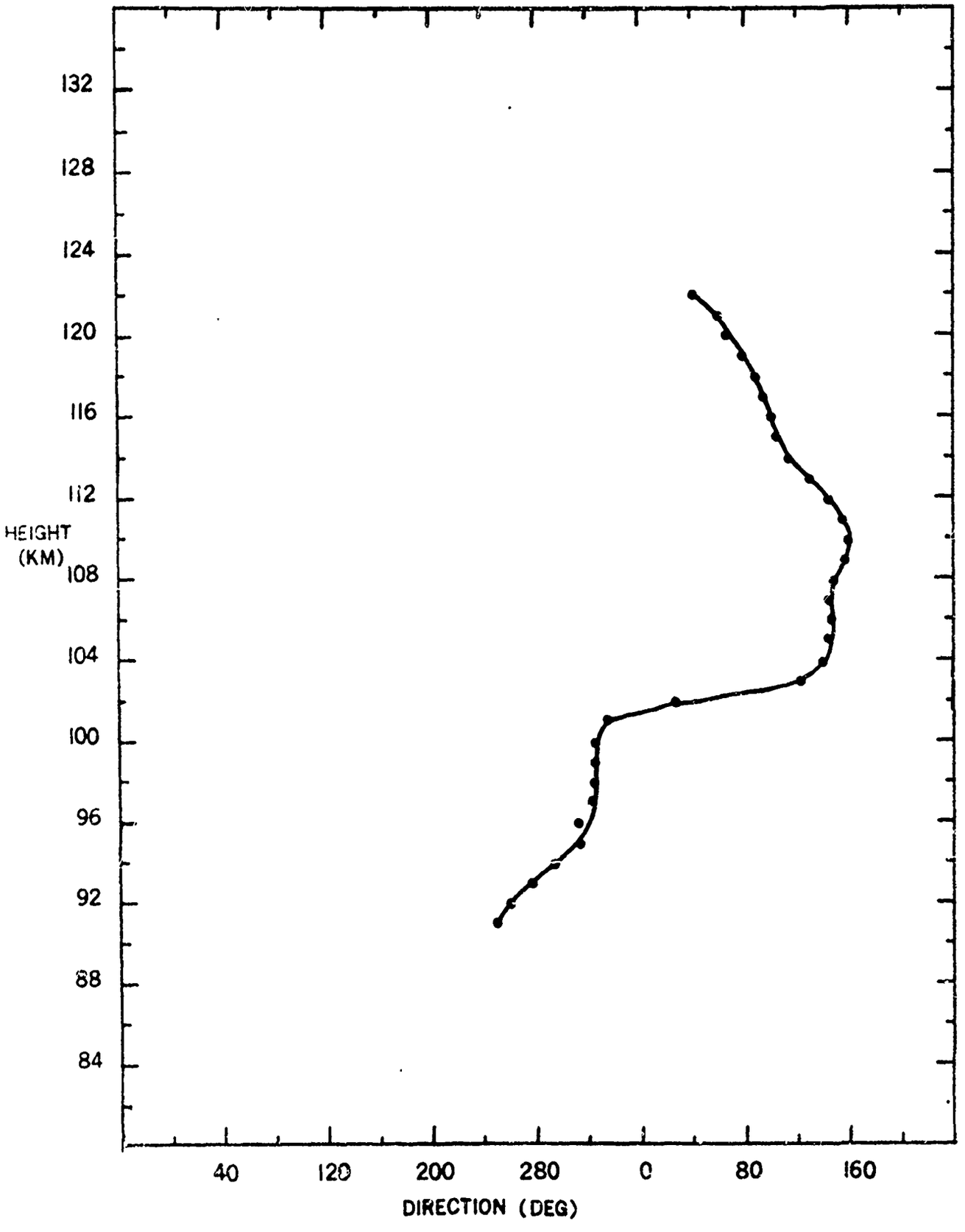
● UP TRAIL

▲ DOWN TRAIL

TRAIL NO. B47 NEVIS

24 FEBRUARY 1966 00:25:00

H.A.R.P. BARBADOS



TRAIL NO. B48 PUERTO RICO

BARBADOS 24 FEBRUARY 1966 03-27-00 AST

ALTITUDE	WIND HEADING	WIND VELOCITY	WIND COMPONENTS (M/S) GEOGRAPHIC		MAGNETIC	
(KM)	(DEG)	(M/S)	N-S	E-W	N-S	E-W
90.0	320.1	53.7	41.2	-34.4	47.3	-25.4
91.0	324.6	52.7	43.0	-30.5	48.3	-21.2
92.0	338.2	62.2	57.8	-23.1	61.3	-11.6
93.0	337.4	71.6	66.1	-27.6	70.3	-13.7
94.0	339.2	70.3	65.7	-25.0	69.4	-11.2
95.0	349.5	58.1	57.2	-10.6	58.2	1.2
96.0	1.1	43.9	43.9	0.9	42.8	9.7
97.0	357.9	43.2	43.2	-1.6	42.6	7.2
98.0	0.2	46.6	46.6	0.1	45.6	9.5
99.0	355.8	49.8	49.7	-3.7	49.4	6.4
100.0	137.7	27.1	-20.0	18.2	-23.3	13.8
101.0	164.8	60.4	-58.3	15.8	-60.3	3.7
102.0	162.0	67.2	-64.0	20.6	-66.8	7.3
103.0	168.6	67.6	-66.3	13.3	-67.6	-0.4
104.0	176.2	74.7	-74.5	5.0	-74.0	-10.1
105.0	184.3	78.8	-78.6	-6.0	-75.8	-21.7
106.0	145.9	58.8	-48.7	32.9	-54.3	22.4
107.0	129.0	66.2	-41.7	51.4	-51.2	41.9
108.0	128.7	66.9	-41.9	52.2	-51.6	42.7
109.0	135.9	54.7	-39.3	38.1	-46.2	29.4
110.0	139.5	29.2	-22.2	18.9	-25.6	14.0
111.0	96.4	1.3	-0.1	1.2	-0.3	1.2
112.0	352.7	12.2	12.1	-1.5	12.2	1.0
113.0	352.5	18.5	18.4	-2.4	18.5	1.4
114.0	333.8	38.4	34.5	-17.0	37.2	-9.7
115.0	333.2	45.4	40.6	-20.5	43.9	-11.9
116.0	331.1	58.2	51.0	-28.2	55.6	-17.3
117.0	331.0	65.8	57.6	-31.9	62.9	-19.6
118.0	335.7	71.1	64.8	-29.3	69.4	-15.6
119.0	334.8	77.0	69.7	-32.8	74.9	-18.0
120.0	337.1	80.8	74.4	-31.4	79.2	-15.7
121.0	336.9	80.6	74.2	-31.7	79.1	-16.1
122.0	340.3	79.9	75.3	-26.9	79.2	-11.1
123.0	339.8	86.1	80.8	-29.7	85.1	-12.8

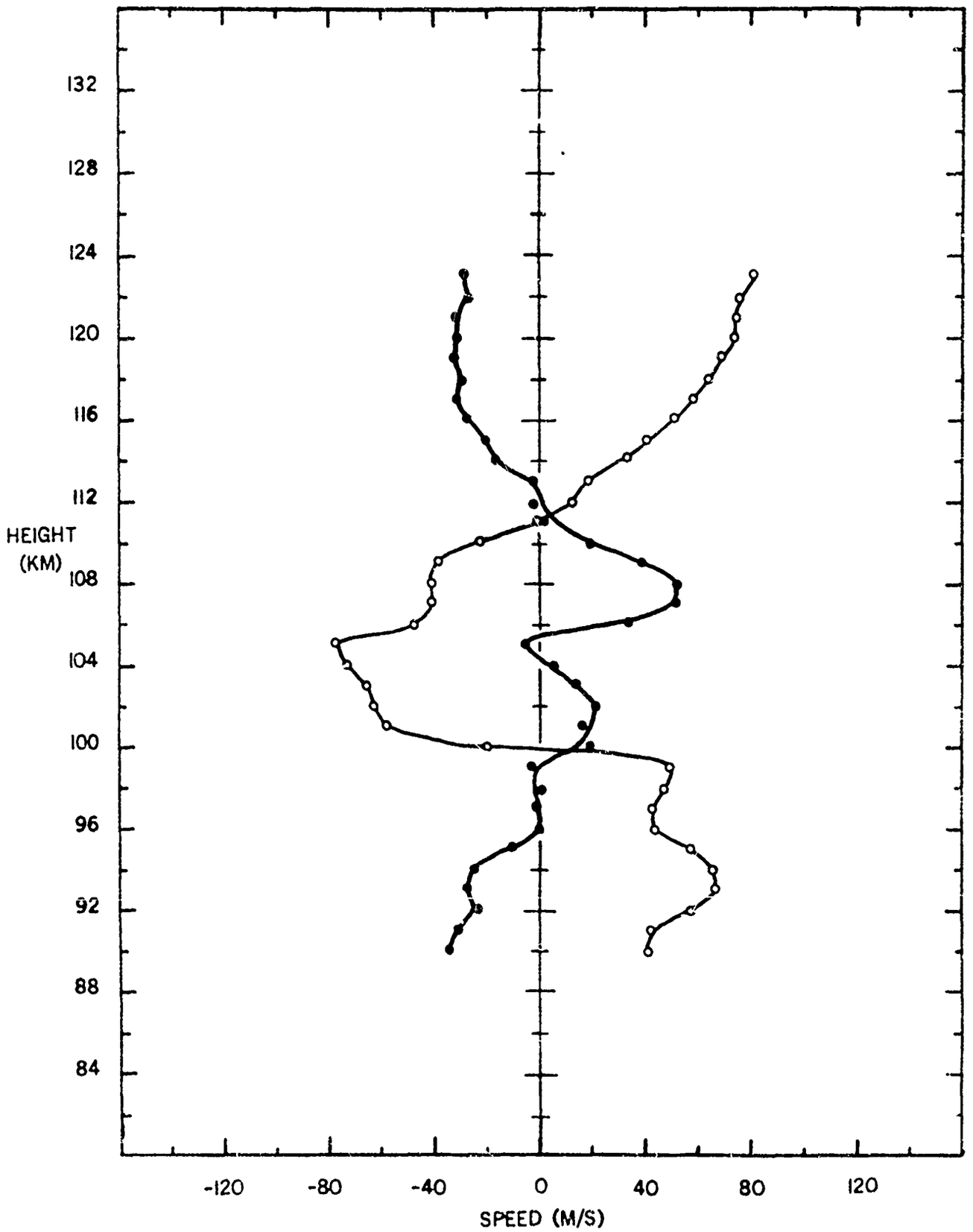
WIND COMPONENTS TRAIL NO. B48 PUERTO RICO

UP DOWN 24 FEBRUARY 1966 03:27:00

○ △ NORTH-SOUTH

● ▲ EAST-WEST

H.A.R.P. BARBADOS

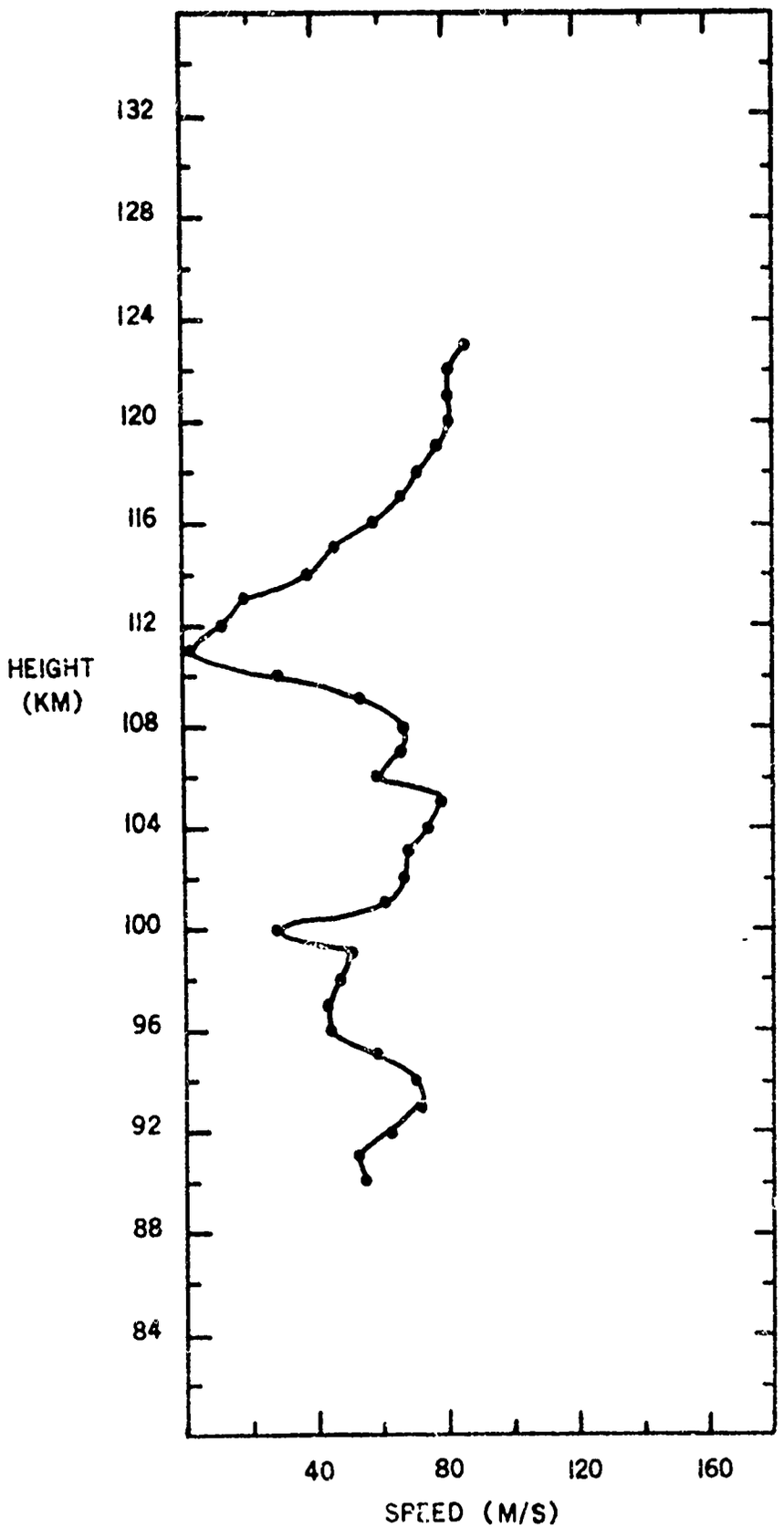


WIND SPEED TRAIL NO. B48 PUERTO RICO

● UP TRAIL
▲ DOWN TRAIL

24 FEBRUARY 1966 03:27:00

H.A.R.P. BARBADOS



WIND DIRECTION

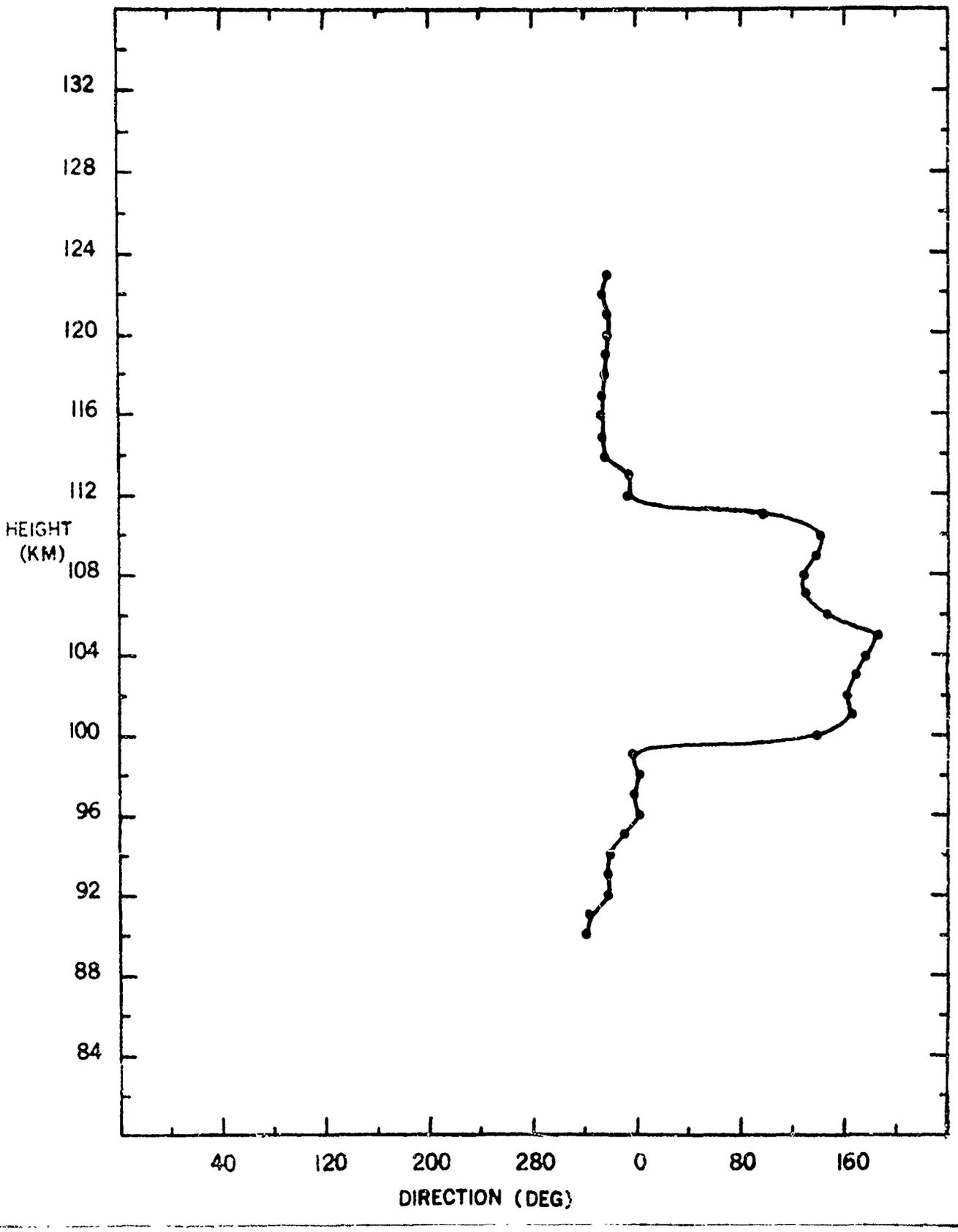
● UP TRAIL

▲ DOWN TRAIL

TRAIL NO. 848 PUERTO RICO

24 FEBRUARY 1966 03:27:00

H.A.R.P. BARBADOS



TRAIL NO. B49 ST. THOMAS
BARBADOS 24 FEBRUARY 1966 05-23-30 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
96.0	282.3	38.9	8.3	-38.0	15.8	-35.5
97.0	256.8	32.0	-7.3	-31.1	-0.9	-31.9
98.0	226.2	38.7	-26.8	-27.9	-20.6	-32.7
99.0	205.1	119.1	-107.9	-50.5	-95.5	-71.2
100.0	206.7	131.2	-117.2	-58.9	-102.9	-81.4
101.0	213.0	126.4	-106.0	-68.8	-89.9	-88.8
102.0	219.5	111.4	-86.0	-70.9	-69.9	-86.8
103.0	224.1	86.4	-62.1	-60.1	-48.7	-71.4
104.0	225.8	58.3	-40.6	-41.8	-31.3	-49.1
105.0	224.9	34.7	-24.6	-24.5	-19.1	-29.0
106.0	201.8	12.7	-11.8	-4.7	-10.6	-7.0
107.0	86.6	16.5	1.0	16.5	-2.4	16.4
108.0	78.4	36.2	7.3	35.5	0.0	36.2
109.0	72.3	41.7	12.7	39.7	4.4	41.4
110.0	64.7	44.2	18.9	39.9	10.5	42.9
111.0	52.1	44.3	27.2	35.0	19.6	39.8
112.0	35.5	52.5	42.7	30.5	35.7	38.5
113.0	23.2	64.3	59.1	25.4	52.8	36.8
114.0	22.9	79.9	73.6	31.1	65.8	45.3
115.0	33.9	89.3	74.1	49.8	62.5	63.7
116.0	18.9	67.3	63.7	21.8	58.0	34.2
117.0	4.9	49.0	48.8	4.2	46.9	14.0

TRAIL NO. B49 ST. THOMAS

BARBADOS 24 FEBRUARY 1966 05-23-30 AST

DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
101.0	220.2	121.7	-93.0	-78.5	-75.2	-95.7
102.0	222.8	99.2	-72.8	-67.4	-57.7	-80.7
103.0	226.1	70.5	-48.9	-50.8	-37.6	-59.6
104.0	224.3	56.8	-40.7	-39.7	-31.8	-47.1
105.0	224.6	43.4	-30.9	-30.5	-24.1	-36.1
106.0	223.8	19.5	-14.0	-13.5	-11.0	-16.0
107.0	66.5	32.5	13.0	29.8	6.7	31.8
108.0	62.4	46.3	21.6	41.3	12.8	44.8
109.0	64.2	46.4	20.2	41.8	11.3	45.0
110.0	62.1	47.8	22.3	42.2	13.3	45.8
111.0	55.9	43.1	24.1	35.7	16.4	39.8
112.0	43.9	48.4	34.9	33.5	27.4	39.9
113.0	32.8	47.1	39.6	25.5	33.6	33.0
114.0	20.3	47.9	44.9	16.6	40.6	25.3
115.0	33.8	57.2	47.5	31.8	40.1	40.7
116.0	34.9	59.9	49.1	34.3	41.2	43.5
117.0	26.6	46.4	41.5	20.7	36.5	28.7
118.0	347.1	24.6	24.0	-5.5	24.6	-0.5

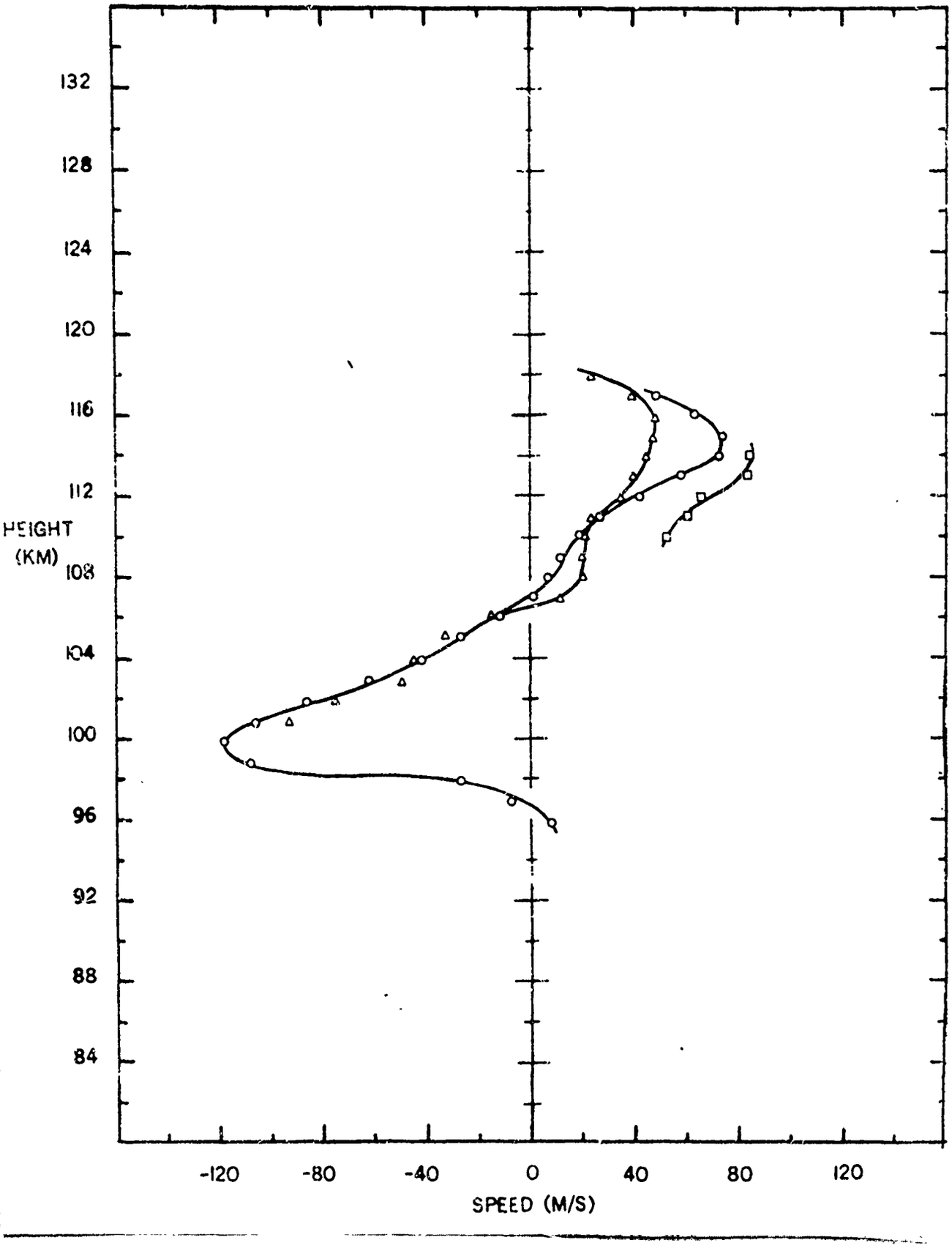
TRAIL A

DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
110.0	10.9	54.4	53.4	10.2	50.2	20.8
111.0	19.9	65.4	61.5	22.3	55.7	34.3
112.0	16.4	68.4	65.6	19.3	60.4	32.1
113.0	359.3	85.0	85.0	-1.0	83.5	16.2
114.0	355.2	85.6	85.3	-7.2	85.0	10.2

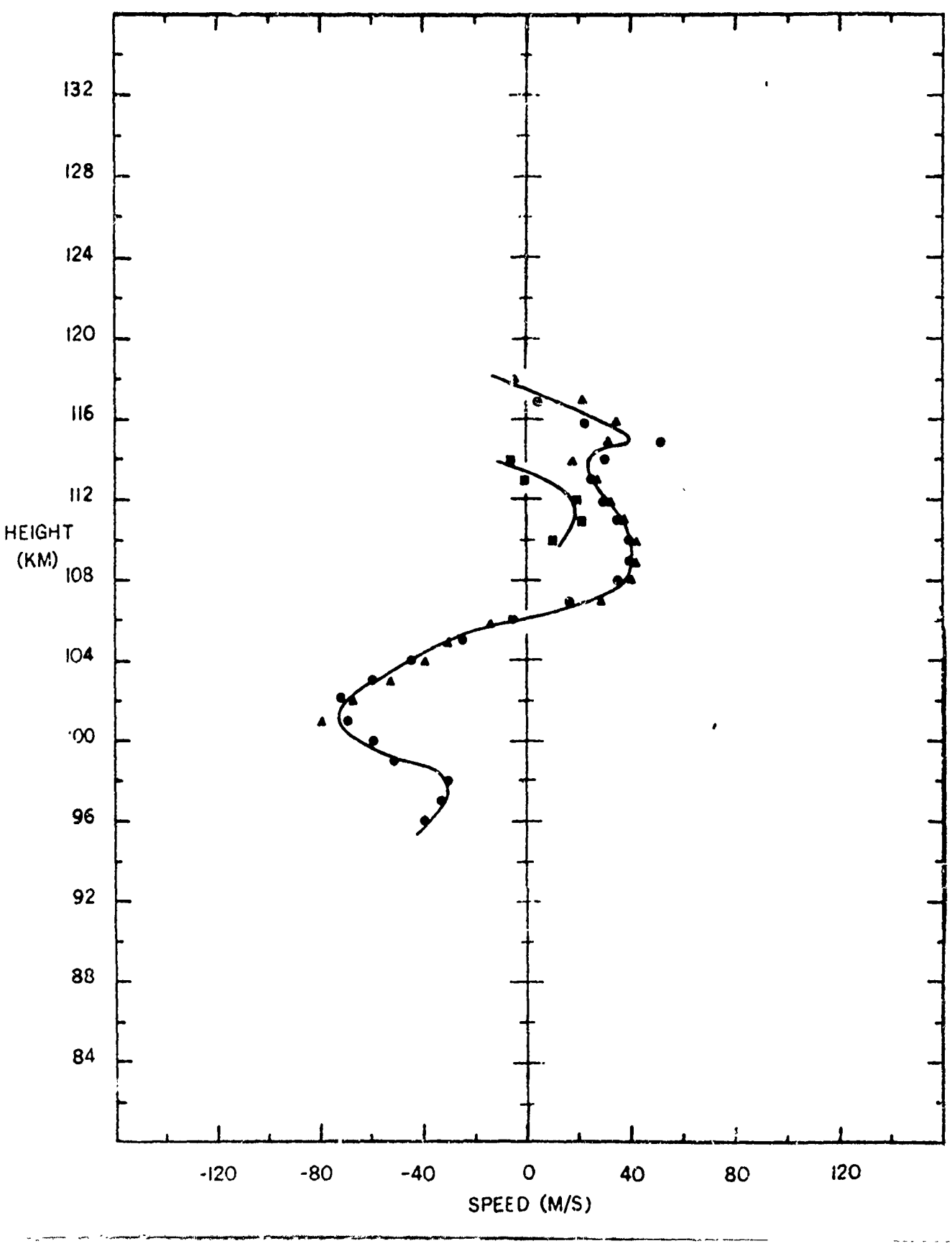
WIND COMPONENTS
NORTH- SOUTH ONLY
TRAIL "A"
UP DOWN DOWN
○ △ □

TRAIL NO. B49 ST THOMAS
24 FEBRUARY 1966 05:23:30
H.A.R.P. BARBADOS



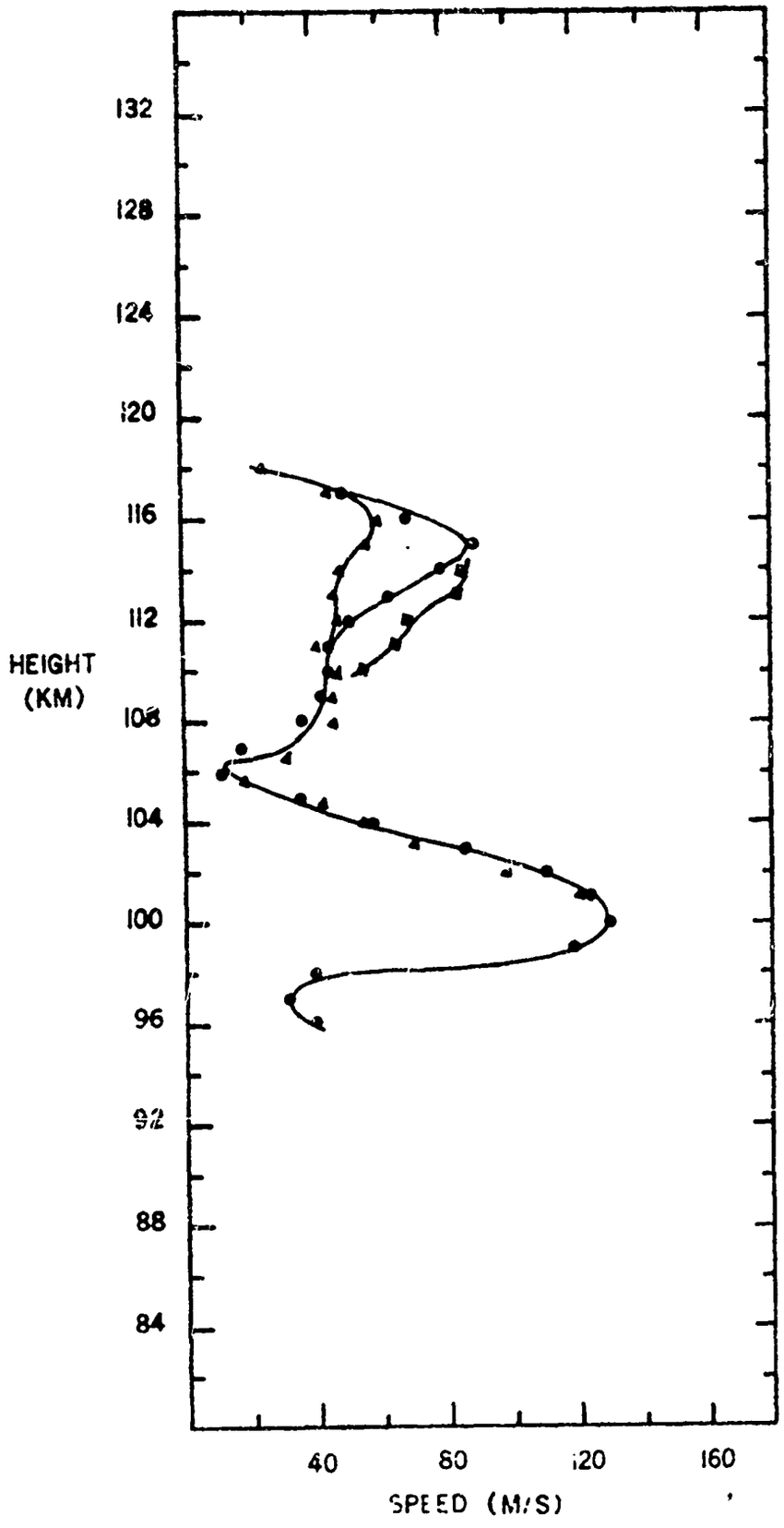
WIND COMPONENTS
EAST-WEST ONLY
TRAIL "A"
UP DOWN DOWN

TRAIL NO. B49 ST THOMAS
24 FEBRUARY 1966 05:23:30
H.A.R.P. BARBADOS



WIND SPEED
● UP TRAIL
▲ DOWN TRAIL
■ DOWN TRAIL "A"

TRAIL NO. B49 ST THOMAS
26 FEBRUARY 1966 05:23:30
H.A.R.P. BARBADOS



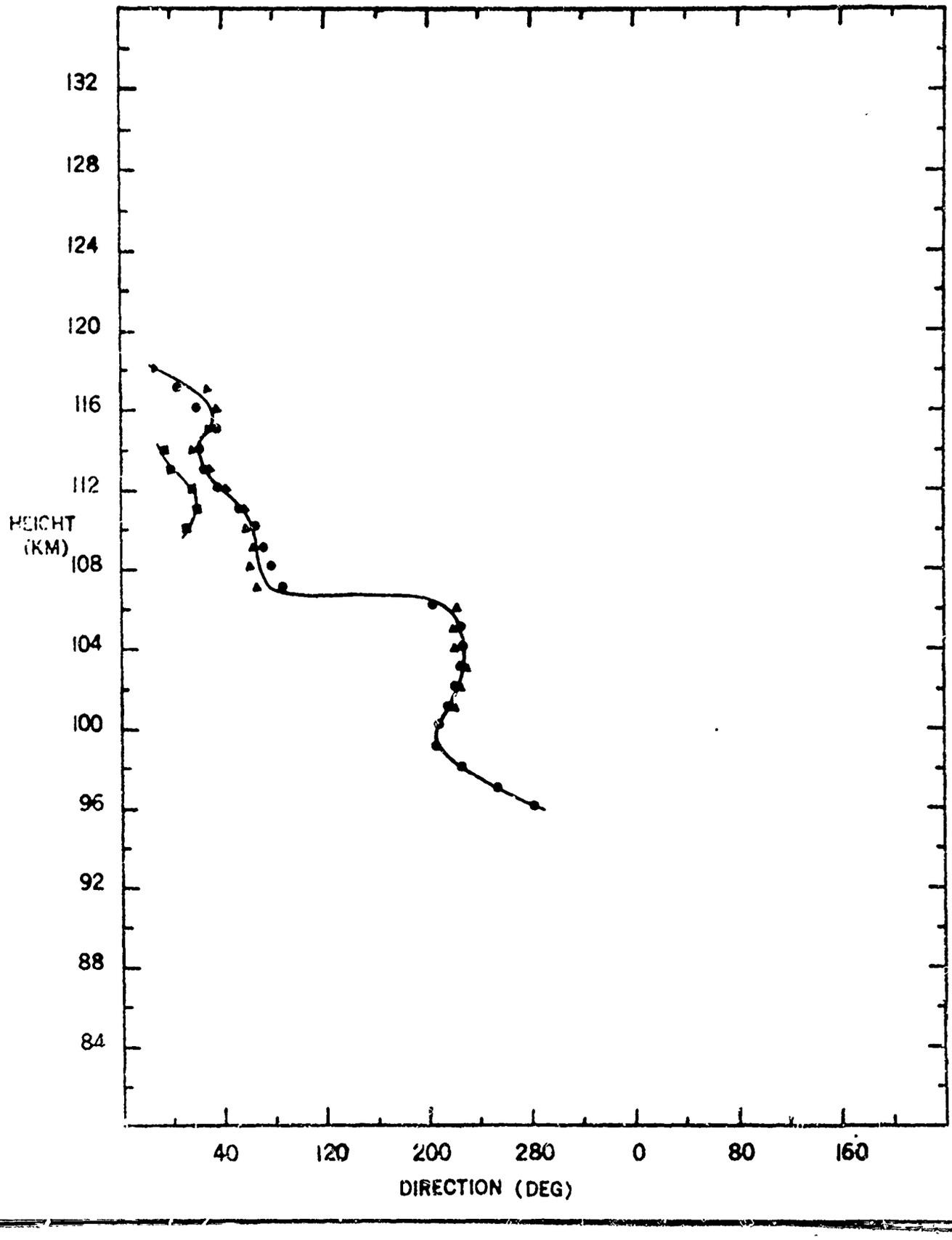
WIND DIRECTION

● UP TRAIL
▲ DOWN TRAIL
■ DOWN TRAIL "A"

TRAIL NO. B49 ST. THOMAS

24 FEBRUARY 1966 05:23:30

H.A.R.P. BARBADOS



BARBADOS

TRAIL NO. B50 FLAMINGO
25 FEBRUARY 1966 18-43-00 AST

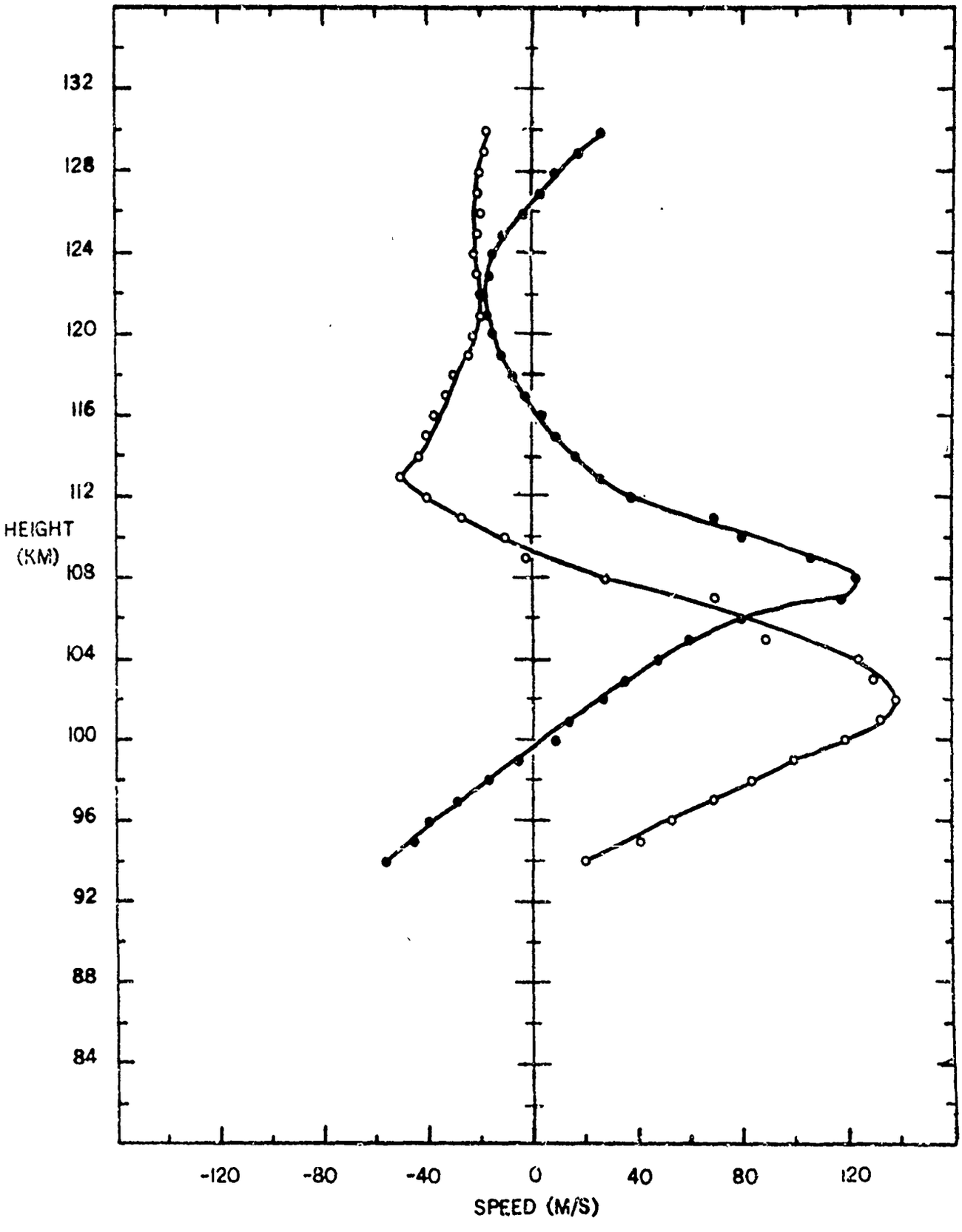
ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
94.0	289.6	59.6	20.0	-56.2	30.9	-51.[illegible]
95.0	312.0	61.4	41.1	-45.6	49.5	-3[illegible].4
96.0	323.1	65.8	52.6	-39.5	59.[illegible]	-2[illegible].[illegible]
97.0	337.6	74.7	69.1	-28.4	73.4	-1[illegible].[illegible]
98.0	348.7	85.1	83.5	-16.7	85.[illegible]	[illegible].[illegible]
99.0	356.9	99.8	99.6	-5.3	98.6	14.[illegible]
100.0	3.8	119.4	119.1	8.0	115.0	31.9
101.0	5.8	133.3	132.6	13.6	127.1	40.1
102.0	11.3	141.9	139.2	27.7	130.7	55.2
103.0	15.5	135.2	130.3	36.1	120.3	61.7
104.0	20.5	133.6	125.1	47.0	113.0	71.3
105.0	34.9	103.2	84.7	59.1	71.0	75.0
106.0	44.5	114.7	81.9	80.3	64.0	95.2
107.0	63.0	132.7	60.3	118.2	35.2	127.9
108.0	77.0	126.8	28.5	123.6	3.0	126.8
109.0	92.0	106.7	-3.8	106.6	-25.2	103.6
110.0	97.4	80.7	-10.4	80.0	-26.3	76.3
111.0	111.1	74.7	-27.0	69.7	-40.5	62.8
112.0	136.9	54.9	-40.1	37.6	-46.9	28.7
113.0	153.2	56.1	-50.0	25.3	-54.1	14.7
114.0	159.4	47.2	-44.2	16.6	-46.6	7.3
115.0	166.5	41.9	-40.7	9.8	-41.8	1.4
116.0	173.4	37.3	-37.1	4.3	-37.2	-3.3
117.0	183.8	34.0	-33.9	-2.2	-32.8	-9.0
118.0	193.5	30.7	-29.9	-7.2	-27.8	-13.1
119.0	204.5	26.7	-24.3	-11.1	-21.6	-15.8
120.0	212.0	27.3	-23.1	-14.5	-19.7	-18.9
121.0	220.6	26.0	-19.7	-16.9	-15.9	-20.5
122.0	221.7	27.1	-20.3	-18.0	-16.2	-21.7
123.0	216.5	26.6	-21.4	-15.8	-17.8	-19.8
124.0	214.1	26.9	-22.3	-15.1	-18.8	-19.3
125.0	207.5	24.0	-21.3	-11.1	-18.6	-15.2
126.0	190.9	19.9	-19.6	-3.8	-18.4	-7.7
127.0	170.2	20.4	-20.1	3.5	-20.4	-0.6
128.0	154.5	22.0	-19.9	9.5	-21.4	5.3
129.0	135.5	25.5	-18.2	17.8	-21.4	13.8
130.0	123.7	31.5	-17.5	26.2	-22.4	22.1

WIND COMPONENTS TRAIL NO. B50 FLAMINGO

UP DOWN 25 FEBRUARY 1966 18:43:00

○ △ NORTH-- SOUTH

● ▲ EAST-WEST H.A.R.P. BARBADOS



WIND SPEED

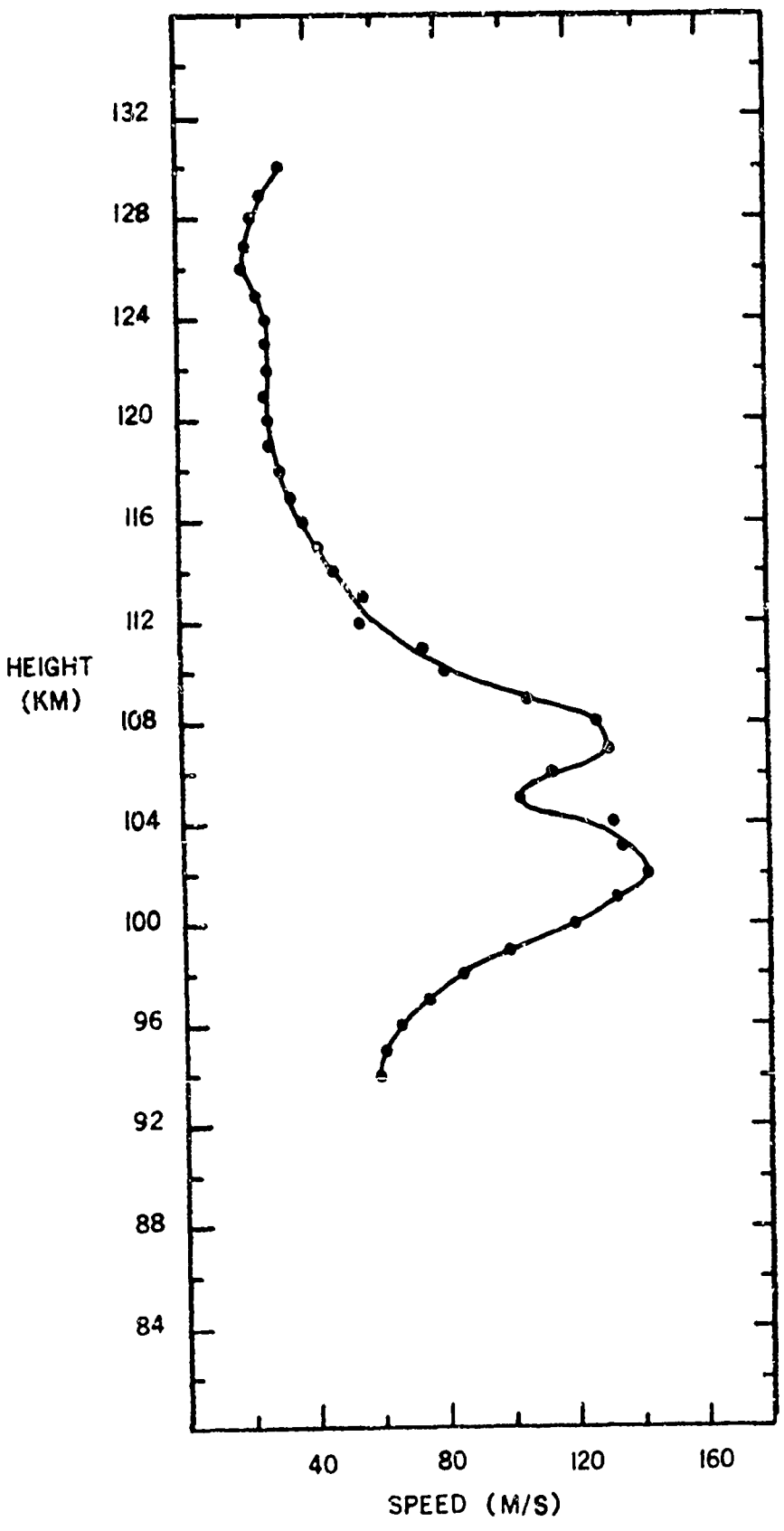
TRAIL NO. B50 FLAMINGO

25 FEBRUARY 1966 18:43:00

H.A.R.P. BARBADOS

● UP TRAIL

△ DOWN TRAIL



WIND DIRECTION

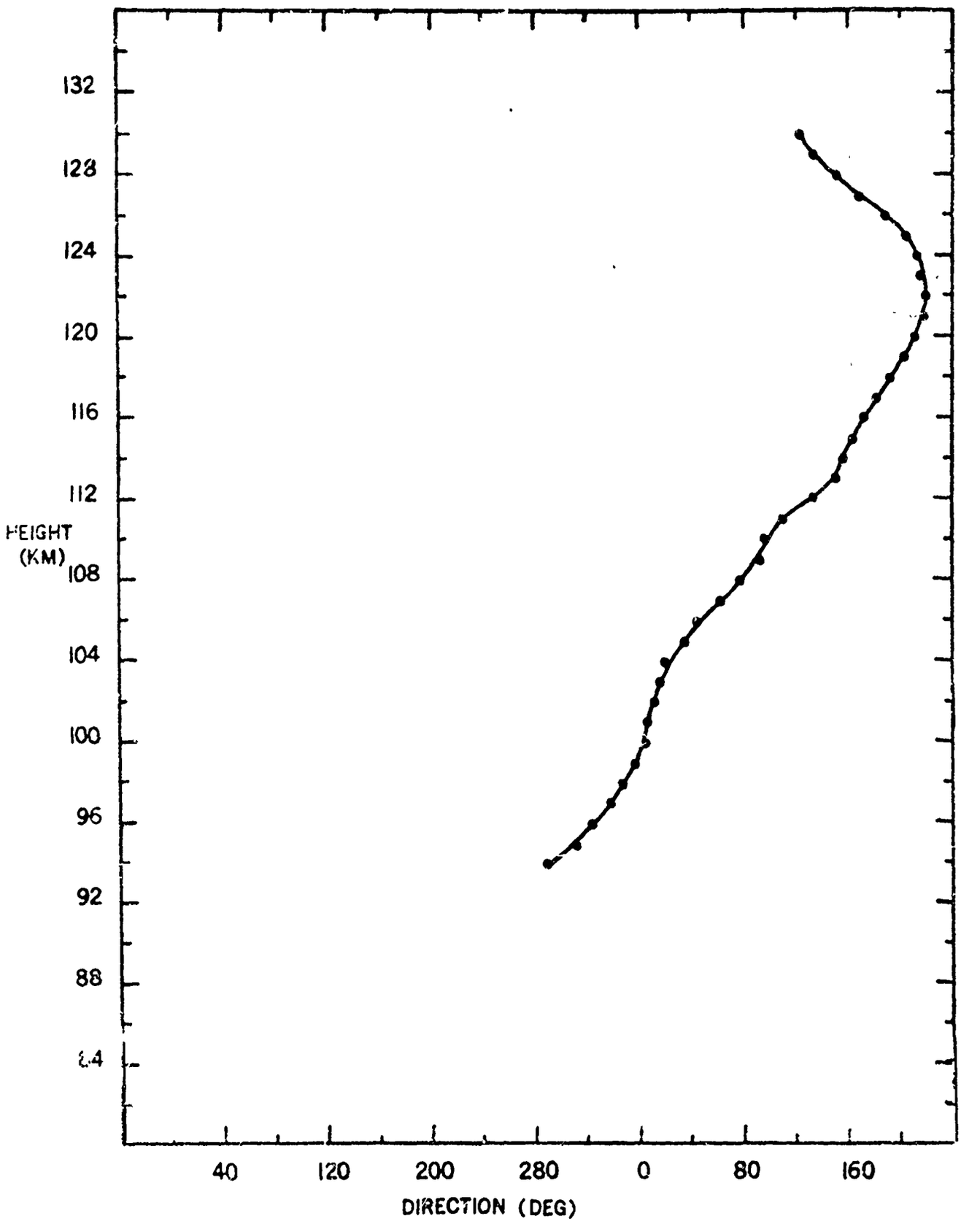
● UP TRAIL

▲ DOWN TRAIL

TRAIL NO. B50 FLAMINGO

25 FEBRUARY 1966 18:43:00

H.A.R.P. BARBADOS



TRAIL NO. B51 BETA
BARBADOS 19 SEPTEMBER 1966 20-55-09 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
105.0	54.2	24.6	14.4	19.9	10.1	22.4
106.0	45.7	21.6	15.1	15.5	11.6	18.2
107.0	26.5	22.0	19.7	9.8	17.3	13.6
108.0	0.8	28.9	28.9	0.4	28.2	6.3
109.0	351.7	44.0	43.6	-6.4	44.0	2.6
110.0	344.3	50.1	48.2	-13.6	50.0	-3.5
111.0	338.8	50.3	46.9	-18.2	49.6	-8.3
112.0	306.5	43.5	25.9	-35.0	32.5	-29.0
113.0	230.6	57.2	-36.3	-44.2	-26.6	-50.7
114.0	215.0	90.8	-74.4	-52.1	-62.3	-66.1
115.0	212.2	112.9	-95.5	-60.2	-81.3	-78.3
116.0	210.8	130.9	-112.5	-67.0	-96.5	-88.5
117.0	209.5	147.0	-127.9	-72.3	-110.5	-96.8
118.0	206.3	151.4	-135.7	-67.2	-119.2	-93.4
119.0	202.3	154.8	-143.3	-58.7	-128.4	-86.6
120.0	200.3	155.5	-145.9	-53.8	-131.9	-82.3
121.0	196.8	153.0	-146.5	-44.3	-134.4	-73.1
122.0	195.2	147.6	-142.5	-38.6	-131.7	-66.7
123.0	192.5	137.6	-134.3	-29.7	-125.5	-56.4
124.0	190.8	130.2	-127.9	-24.5	-120.3	-50.0
125.0	190.9	126.5	-124.2	-23.9	-116.8	-48.6
126.0	194.2	121.9	-118.2	-29.9	-109.7	-53.3
127.0	191.9	106.3	-104.0	-22.0	-97.4	-42.7

TRAIL NO. B51 BETA
BARBADOS 19 SEPTEMBER 1966 20-55-09 AST
DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
94.0	306.5	33.5	19.9	-26.9	24.9	-22.3
95.0	316.8	65.2	47.5	-44.6	55.6	-34.0
96.0	330.2	75.6	65.6	-37.6	71.9	-23.5
97.0	347.5	80.2	78.3	-17.4	80.2	-1.1
98.0	0.6	85.2	85.2	0.9	83.2	18.2
99.0	11.6	83.2	81.5	16.7	76.4	32.9
100.0	18.1	54.6	51.9	16.9	47.4	27.1
101.0	34.1	47.3	39.2	26.6	33.0	34.0
102.0	40.8	47.0	35.6	30.7	28.6	37.3
103.0	47.7	35.3	23.7	26.1	17.9	30.4
104.0	48.3	30.6	20.4	22.9	15.3	26.6
105.0	51.1	30.6	19.2	23.8	14.0	27.2
106.0	44.8	28.6	20.3	20.1	15.8	23.8
107.0	26.7	30.9	27.6	13.9	24.2	19.2
108.0	20.9	34.8	32.5	12.4	29.3	18.7
109.0	354.9	53.0	52.8	-4.7	52.7	6.1
110.0	346.4	53.7	52.2	-12.6	53.7	-1.7
111.0	328.5	48.7	41.6	-25.5	45.9	-16.5
112.0	283.9	27.0	6.5	-26.2	11.7	-24.3
113.0	223.7	39.0	-42.7	-40.8	-33.5	-48.6
114.0	214.0	90.3	-74.8	-50.5	-63.0	-64.6
115.0	213.2	121.1	-101.3	-66.3	-85.7	-85.5
116.0	211.5	126.9	-108.2	-66.3	-92.5	-86.9
117.0	209.9	137.3	-119.0	-68.5	-102.6	-91.2
118.0	207.7	145.0	-128.4	-67.3	-112.1	-92.0
119.0	205.5	154.0	-139.0	-66.3	-122.6	-93.2
120.0	203.0	158.1	-145.5	-61.9	-129.9	-90.2
121.0	202.3	158.4	-146.5	-60.1	-131.2	-88.6
122.0	200.5	152.2	-142.6	-53.2	-128.8	-81.1
123.0	197.1	143.5	-137.2	-42.1	-125.8	-69.1
124.0	195.8	137.4	-132.2	-37.4	-121.8	-63.5
125.0	194.2	131.4	-127.4	-32.3	-118.2	-57.5
126.0	192.1	121.0	-118.3	-25.4	-110.7	-48.9
127.0	193.1	114.5	-111.5	-25.9	-103.9	-48.0
128.0	190.4	116.2	-114.3	-20.9	-107.7	-43.7

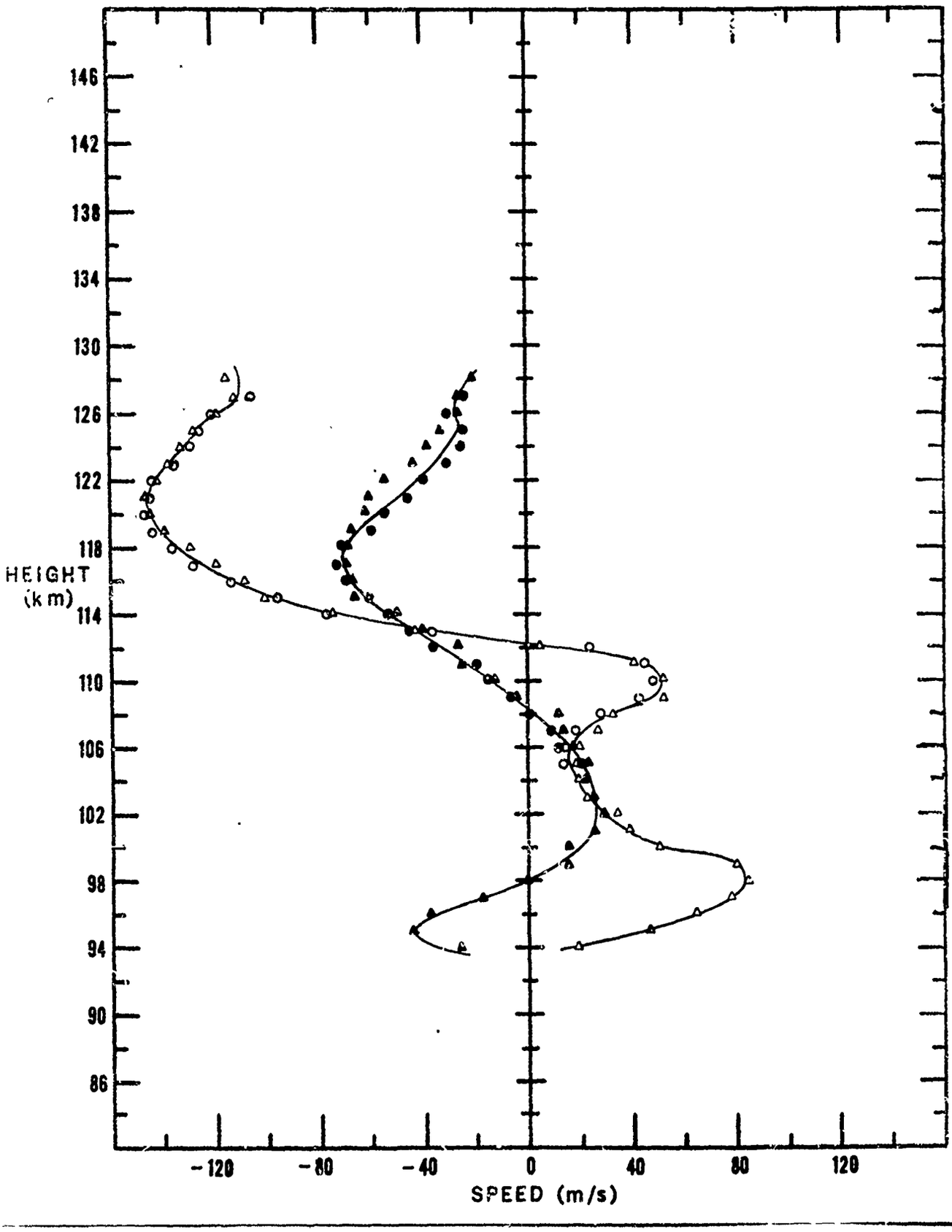
WIND COMPONENTS

	UP	DOWN
N-S	o	△
E-W	●	▲

TRAIL NO. B51 BETA

19 SEPTEMBER 1966 20:55:09 AST

H.A.R.P. BARBADOS



WIND SPEED

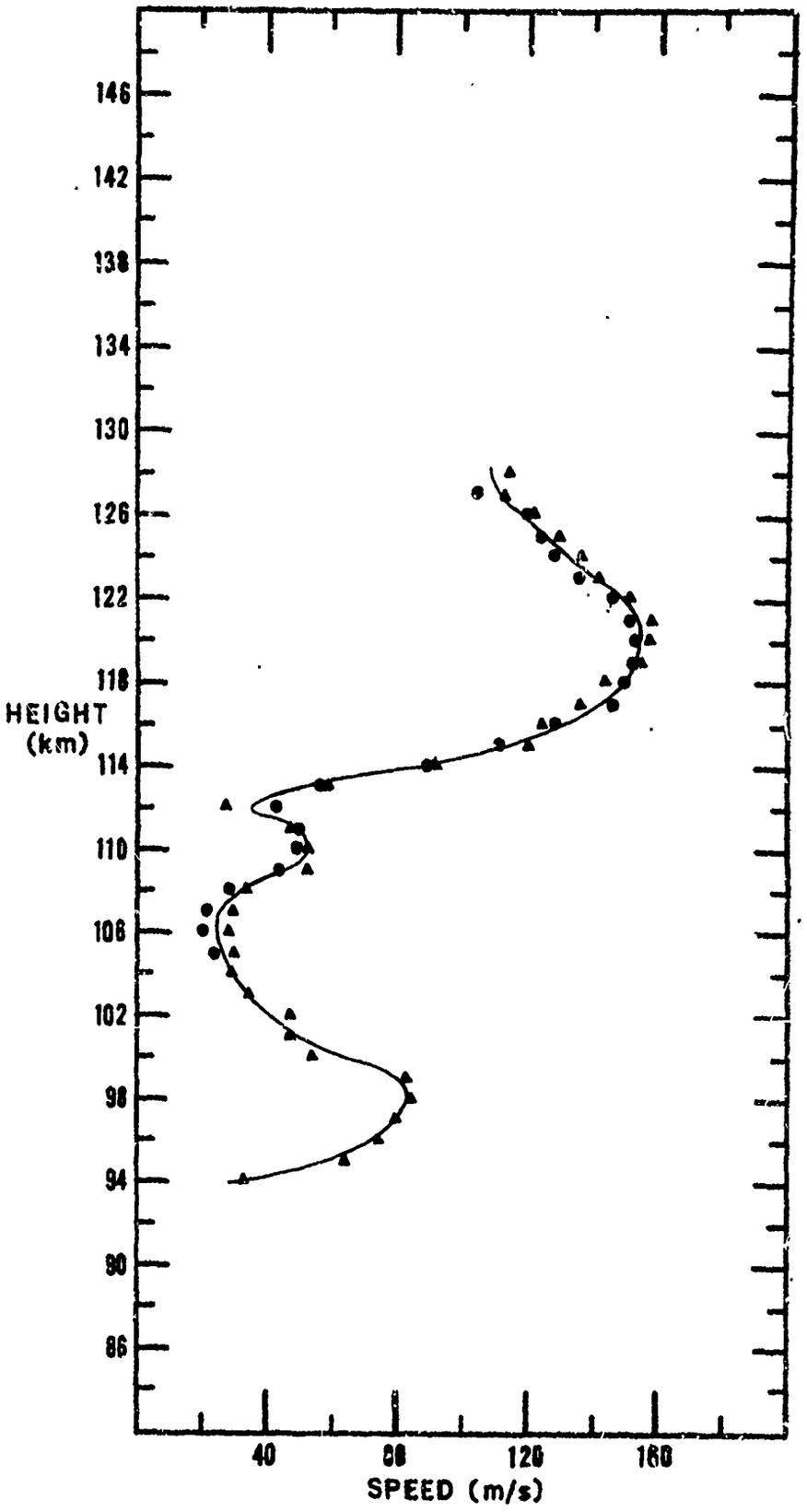
● UP

▲ DOWN

TRAIL NO. B51 BETA

19 SEPTEMBER 1966 20:55:09 AST

H.A.R.P. BARBADOS



WIND DIRECTION

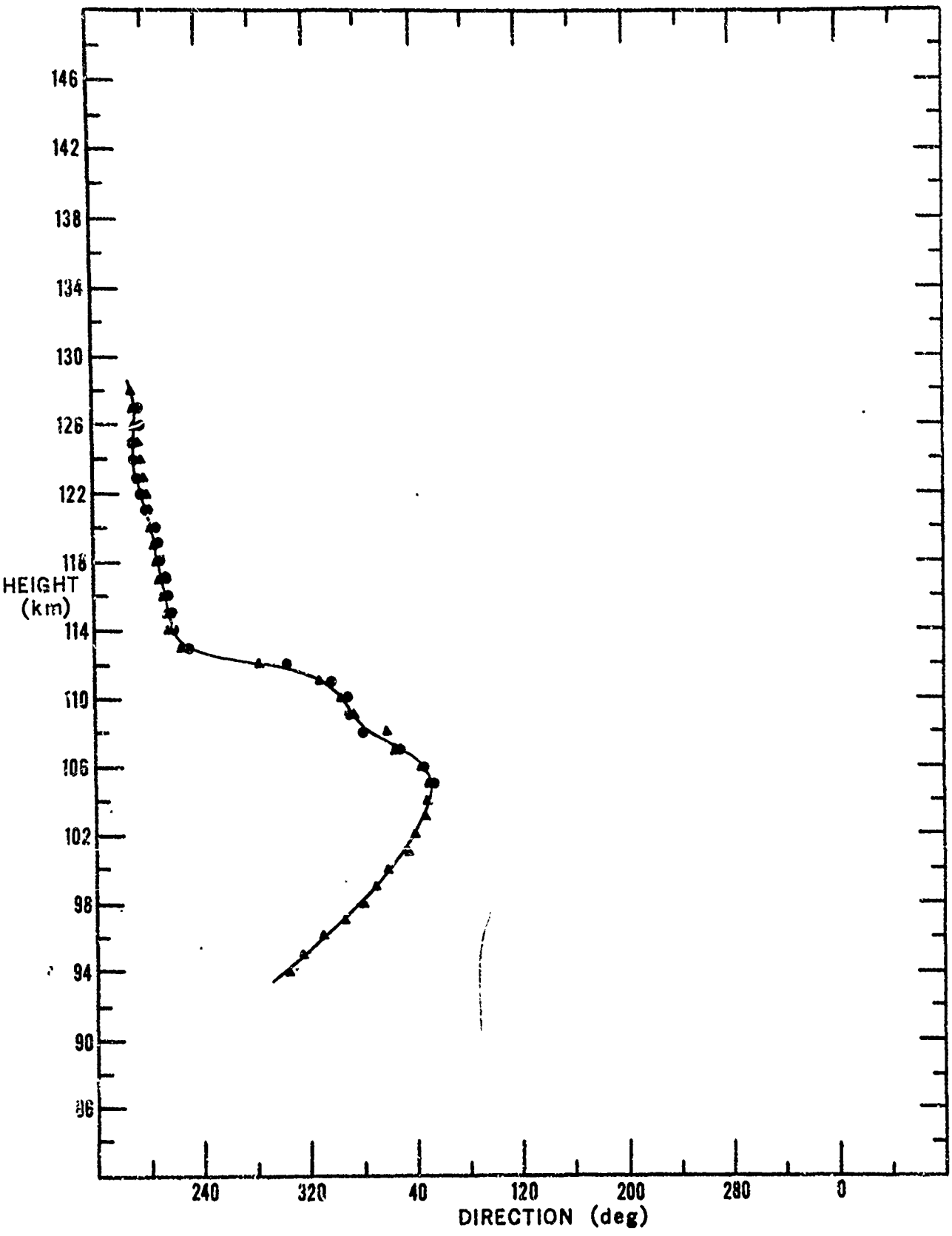
• UP

▲ DOWN

TRAIL NO. B51 BETA

19 SEPTEMBER 1966 20:55:09 AST

H.A.R.P. BARBADOS



TRAIL NO. B52 GAMMA
BARBADOS 19 SEPTEMBER 1966 22-24-06 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
89.0	138.2	52.1	-38.8	34.7	-45.0	26.1
90.0	136.0	66.0	-47.5	45.9	-55.8	35.3
91.0	156.4	56.4	-51.7	22.6	-55.2	11.6
92.0	178.6	38.7	-38.7	0.9	-38.1	-7.0
93.0	291.8	37.6	14.0	-34.9	20.8	-31.3
94.0	316.4	55.0	39.8	-37.9	46.7	-29.0
95.0	334.7	79.4	71.8	-33.9	77.2	-18.6
96.0	341.9	89.9	85.5	-27.9	89.4	-10.0
97.0	347.3	96.4	94.0	-21.1	96.3	-1.6
98.0	356.9	93.5	93.4	-5.1	92.5	14.0
99.0	2.7	93.1	93.0	4.4	90.2	23.2
100.0	3.3	84.6	84.4	4.8	81.7	21.8
101.0	3.8	70.5	70.4	4.7	68.0	18.9
102.0	357.9	44.6	44.6	-1.7	44.0	7.4
103.0	0.1	29.4	29.4	0.0	28.8	6.0
104.0	10.8	19.0	18.7	3.6	17.6	7.3
105.0	336.0	12.2	11.1	-4.9	11.9	-2.5
106.0	317.0	10.6	7.7	-7.2	9.0	-5.5
107.0	239.5	55.9	-28.3	-48.2	-17.9	-52.9
108.0	219.4	108.0	-83.4	-68.6	-67.7	-84.1
109.0	210.8	130.8	-112.4	-66.9	-96.5	-88.3
110.0	207.9	147.3	-130.2	-68.9	-113.5	-93.9
111.0	206.9	161.7	-144.1	-73.2	-126.2	-100.9
112.0	206.9	168.8	-150.5	-76.3	-131.9	-105.3
113.0	207.9	175.9	-155.4	-82.3	-135.4	-112.2
114.0	207.8	172.1	-152.3	-80.3	-132.8	-109.6
115.0	208.3	170.9	-150.6	-80.9	-131.0	-109.8
116.0	208.1	163.6	-144.4	-76.9	-125.8	-104.6
117.0	206.5	151.7	-135.7	-67.7	-119.1	-93.9
118.0	203.8	135.1	-123.6	-54.6	-109.9	-78.6
119.0	202.0	117.3	-108.8	-43.9	-97.6	-65.1
120.0	199.7	103.2	-97.2	-34.8	-88.1	-53.8
121.0	196.6	92.5	-88.7	-26.4	-81.5	-43.9
122.0	192.2	88.0	-81.1	-17.6	-75.8	-33.7
123.0	186.3	74.7	-70.3	-7.7	-67.3	-21.8
124.0	180.7	57.7	-57.7	-0.7	-56.4	-12.4
125.0	173.0	49.9	-49.5	6.0	-49.7	-4.2
126.0	171.6	40.8	-40.3	5.9	-40.7	-2.4
127.0	169.9	24.3	-23.9	4.2	-24.3	-0.7
128.0	180.7	11.8	-11.8	-0.1	-11.5	-2.5
129.0	314.6	7.0	4.9	-5.0	5.8	-3.9
130.0	334.4	20.4	18.4	-8.8	19.8	-4.9
131.0	337.0	31.1	28.6	-12.2	30.5	-6.1
132.0	335.0	36.2	32.8	-15.3	35.2	-8.3
133.0	342.1	40.7	38.7	-12.5	40.4	-4.4

TRAIL NO. B52 GAMMA
BARBADOS 19 SEPTEMBER 1966 22-24-06 AST
DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
107.0	223.3	132.1	-96.2	-90.6	-75.8	-108.3
108.0	217.7	154.9	-122.6	-94.8	-100.8	-117.7
109.0	214.0	161.9	-134.3	-90.5	-113.1	-115.9
110.0	210.6	168.3	-144.8	-85.7	-124.4	-113.3
111.0	208.5	171.7	-150.9	-81.8	-131.1	-110.7
112.0	207.6	172.7	-153.8	-80.2	-134.3	-109.8
113.0	208.2	167.9	-148.0	-79.3	-128.8	-107.7
114.0	207.6	158.4	-140.4	-73.3	-122.6	-100.3
115.0	206.4	149.8	-134.1	-66.6	-117.8	-92.5
116.0	203.1	138.8	-127.7	-54.4	-114.0	-79.2
117.0	200.9	129.1	-120.6	-46.0	-108.7	-69.5
118.0	198.1	119.1	-113.2	-36.9	-103.3	-59.1
119.0	195.3	106.6	-102.8	-28.1	-94.9	-48.?
120.0	193.0	94.4	-92.0	-21.2	-85.8	-39.4
121.0	187.3	82.8	-82.1	-10.6	-78.2	-27.1
122.0	183.0	71.3	-71.2	-3.7	-69.0	-18.1
123.0	176.5	61.4	-61.3	3.8	-60.8	-8.7
124.0	174.1	47.9	-47.7	5.0	-47.7	-4.8
125.0	170.2	39.1	-38.5	6.7	-39.1	-1.3
126.0	175.3	24.3	-24.2	2.0	-24.1	-3.0
127.0	178.3	16.2	-16.2	0.5	-16.0	-2.8
128.0	204.8	6.7	-6.1	-2.8	-5.4	-4.0
129.0	304.3	12.8	7.2	-10.6	9.2	-8.9
130.0	318.7	25.4	19.0	-16.7	22.0	-12.5
131.0	322.7	46.2	36.8	-28.0	41.7	-19.9
132.0	322.6	72.6	57.7	-44.1	65.5	-31.5
133.0	323.3	76.4	61.2	-45.7	69.2	-32.3
134.0	326.7	93.3	78.0	-51.2	86.8	-34.3
135.0	329.4	95.0	81.8	-48.4	89.9	-30.8

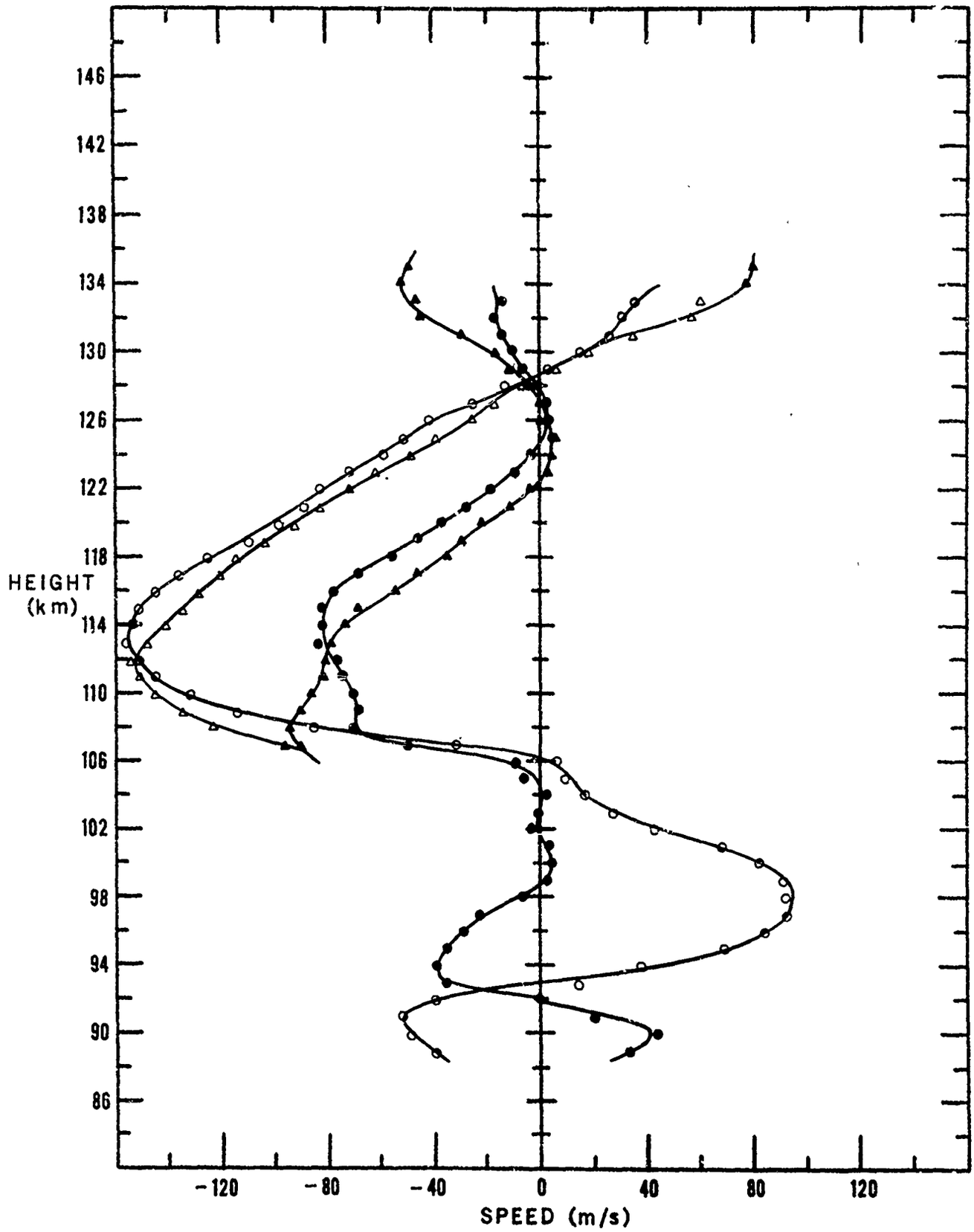
WIND COMPONENTS

	UP	DOWN
N-S	o	▲
E-W	●	▲

TRAIL NO. B52 GAMMA

19 SEPTEMBER 1966 22:24:06 AST

H.A.R.P. BARBADOS



WIND SPEED

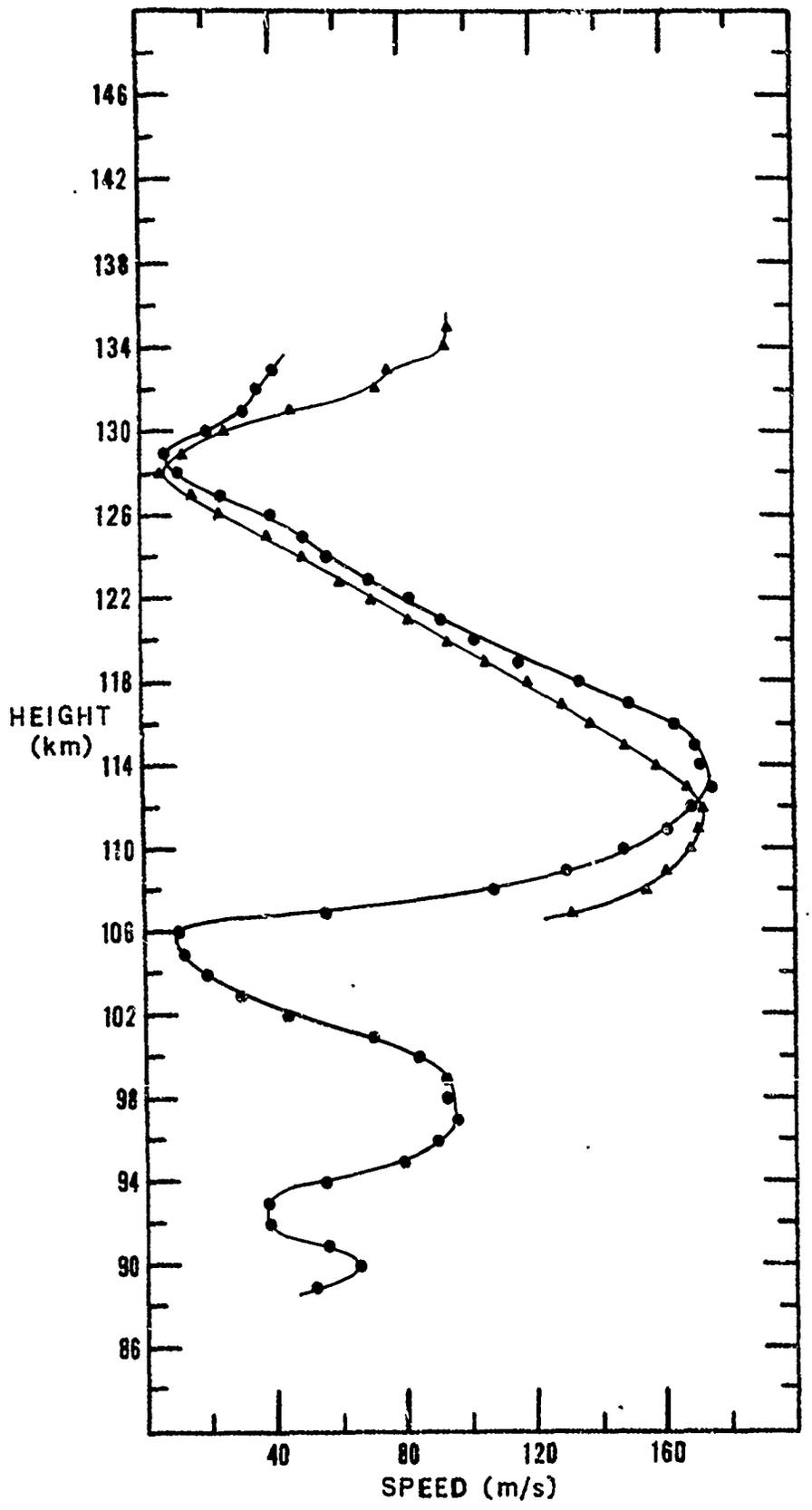
● UP

▲ DOWN

TRAIL NO. B52 GAMMA

19 SEPTEMBER 1966 22:24:06 AST

H.A.R.P. BARBADOS



WIND DIRECTION

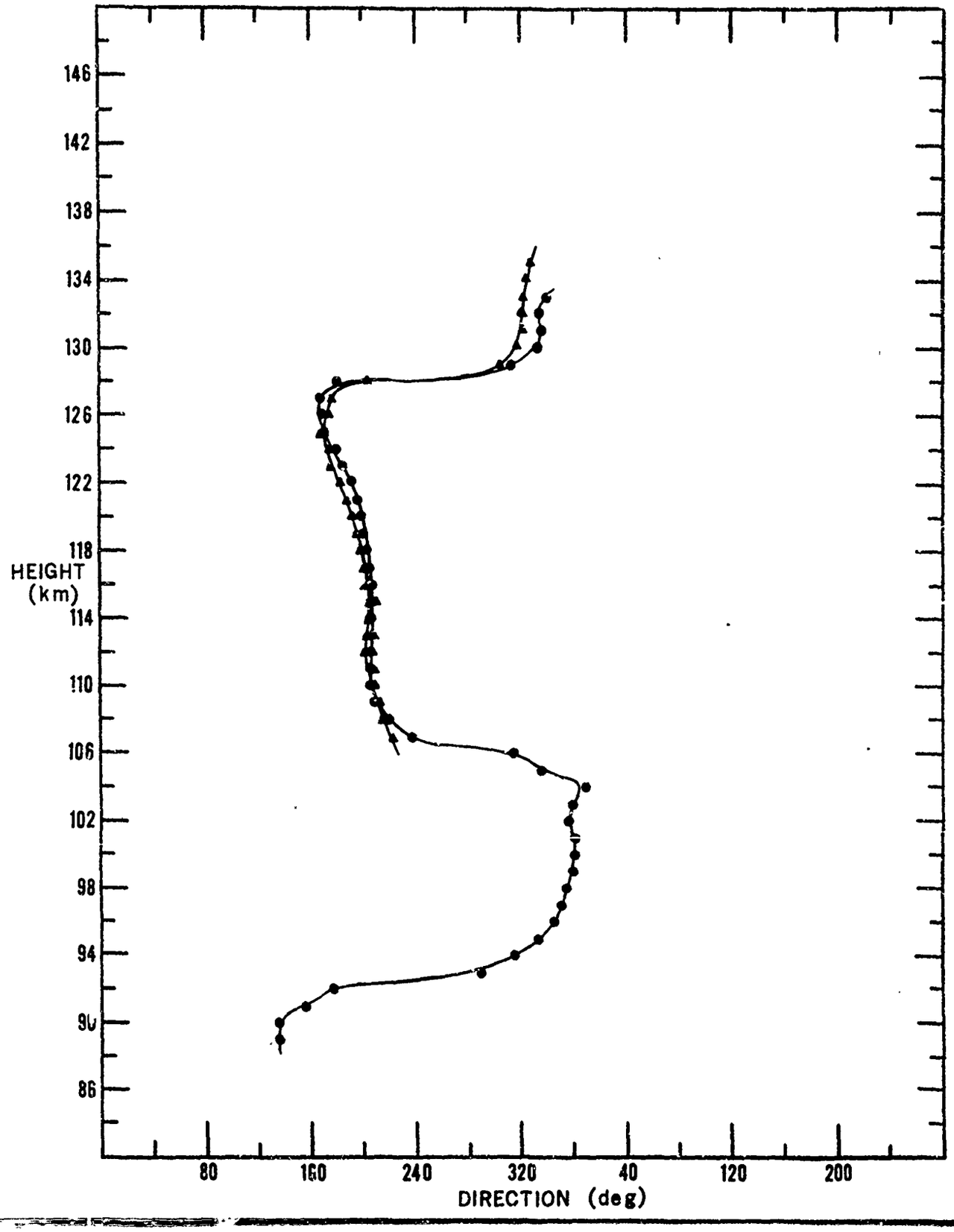
• UP

▲ DOWN

TRAIL NO. B 52 GAMMA

19 SEPTEMBER 1966 22:24:06 AST

H.A.R.P. BARBADOS



TRAIL NO. B53 DELTA

BARBADOS 20 SEPTEMBER 1966 00-10-00 AST

UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
91.0	197.7	41.3	-39.3	-12.6	-35.9	-20.3
92.0	214.2	37.8	-31.3	-21.2	-26.3	-27.1
93.0	299.3	23.2	11.3	-20.2	15.2	-17.5
94.0	335.2	43.4	39.4	-18.2	42.3	-9.8
95.0	359.2	62.2	62.2	-0.9	61.1	11.8
96.0	19.3	64.6	60.9	21.4	55.3	33.3
97.0	28.7	68.0	59.6	32.7	51.7	44.1
98.0	35.3	61.7	50.4	35.6	42.1	45.1
99.0	44.5	44.8	31.9	31.4	24.9	37.2
100.0	69.5	24.0	8.4	22.4	3.7	23.6
101.0	171.4	53.7	-53.1	8.0	-53.6	-3.0
102.0	177.5	72.9	-72.9	3.1	-72.0	-11.8
103.0	175.9	78.0	-77.8	5.6	-77.3	-10.3
104.0	174.7	86.7	-86.4	8.0	-86.2	-9.7
105.0	177.3	90.7	-90.6	4.3	-89.6	-14.2
106.0	196.1	108.8	-104.6	-30.1	-96.3	-50.7
107.0	216.2	114.9	-92.7	-67.8	-77.0	-85.2
108.0	229.5	93.1	-60.5	-70.8	-44.9	-81.6
109.0	232.9	96.1	-58.0	-76.6	-41.2	-86.8
110.0	234.3	87.7	-51.2	-71.2	-35.7	-80.1
111.0	234.3	75.7	-44.2	-61.5	-30.8	-69.2
112.0	240.3	53.8	-26.6	-46.7	-16.6	-51.1
113.0	240.2	44.0	-21.8	-38.1	-13.6	-41.7
114.0	241.1	37.7	-18.2	-33.0	-11.1	-36.0
115.0	249.2	27.8	-9.9	-26.0	-4.4	-27.5
116.0	268.4	19.9	-0.6	-19.9	3.5	-19.6
117.0	287.3	18.8	5.6	-18.0	9.1	-16.5
118.0	297.9	16.1	7.5	-14.2	10.2	-12.4
119.0	336.1	18.3	16.7	-7.4	17.9	-3.9
120.0	359.0	20.0	20.0	-0.3	19.6	3.8
121.0	350.0	28.4	27.9	-4.9	28.3	0.9
122.0	352.0	26.9	26.6	-3.7	26.8	1.8

TRAIL NO. B53 DELTA

BARBADOS 20 SEPTEMBER 1966 00-10-00 AST

DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
106.0	193.7	111.2	-108.1	-26.3	-100.4	-47.7
107.0	218.1	116.7	-91.9	-72.0	-75.4	-89.2
108.0	229.1	93.3	-61.1	-70.5	-45.5	-81.4
109.0	230.1	83.4	-53.5	-64.0	-39.4	-73.5
110.0	235.3	76.7	-43.6	-63.1	-29.9	-70.6
111.0	240.7	67.7	-33.1	-59.1	-20.4	-64.6
112.0	244.2	57.3	-25.0	-51.6	-14.0	-55.6
113.0	248.1	46.3	-17.3	-43.0	-8.2	-45.6
114.0	255.6	35.1	-8.7	-34.0	-1.6	-35.1
115.0	268.6	26.4	-0.6	-26.4	4.8	-26.0
116.0	286.7	21.9	6.3	-21.0	10.4	-19.3
117.0	300.9	23.8	12.3	-20.5	16.2	-17.6
118.0	319.1	23.5	17.7	-15.4	20.5	-11.5
119.0	327.4	24.3	20.5	-13.1	22.7	-8.7
120.0	331.1	27.4	24.0	-13.2	26.2	-8.0
121.0	8.2	23.4	23.2	3.3	22.0	7.9
122.0	355.5	36.9	36.8	-2.9	36.6	4.6

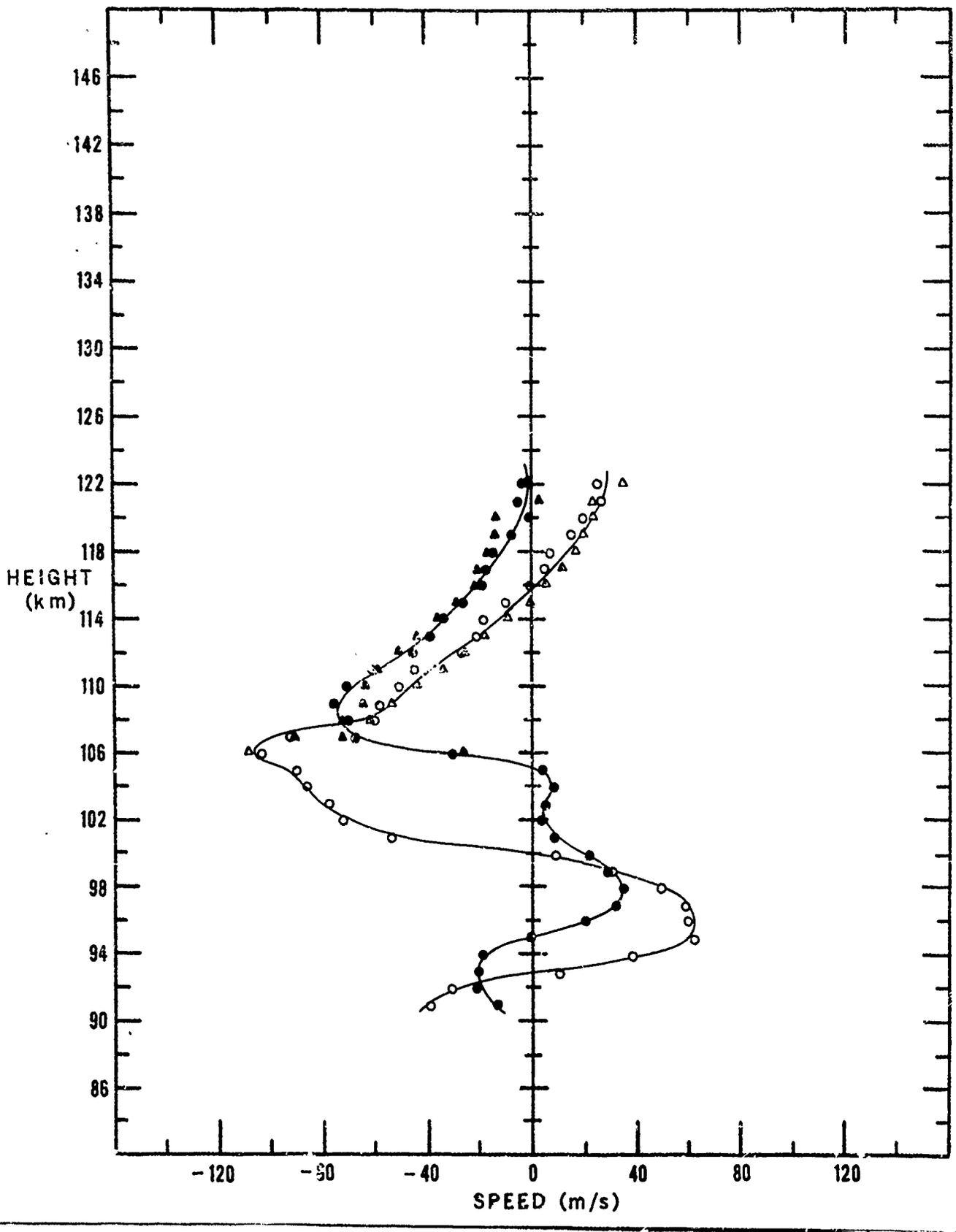
WIND COMPONENTS

	UP	DOWN
N-S	o	△
E-W	●	▲

TRAIL NO. B53 DELTA

20 SEPTEMBER 1966 00:10:00 AST

H.A.R.P. BARBADOS



WIND SPEED

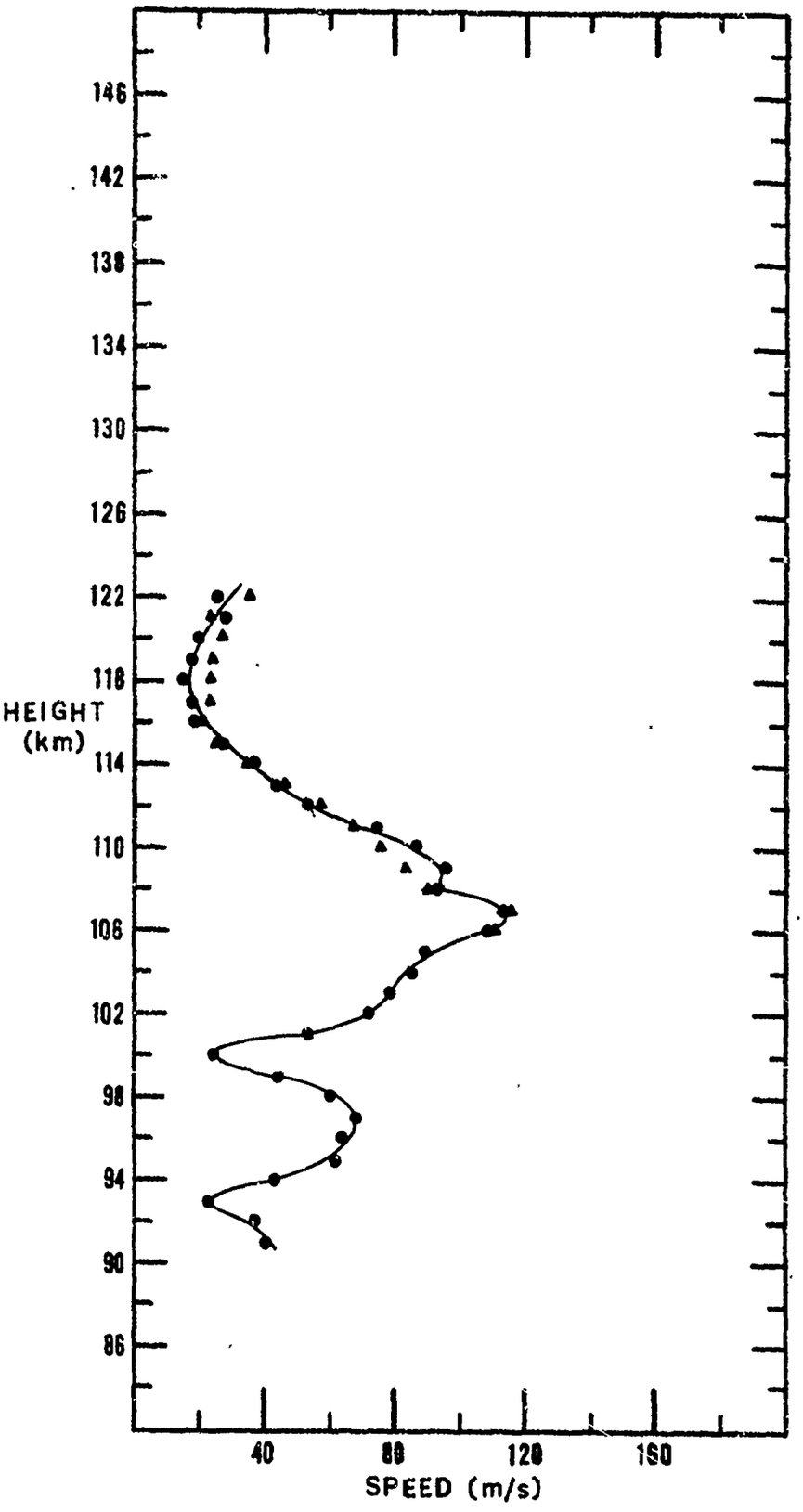
• UP

▲ DOWN

TRAIL NO. B53 DELTA

20 SEPTEMBER 1966 00:10:00 AST

H.A.R.P. BARBADOS



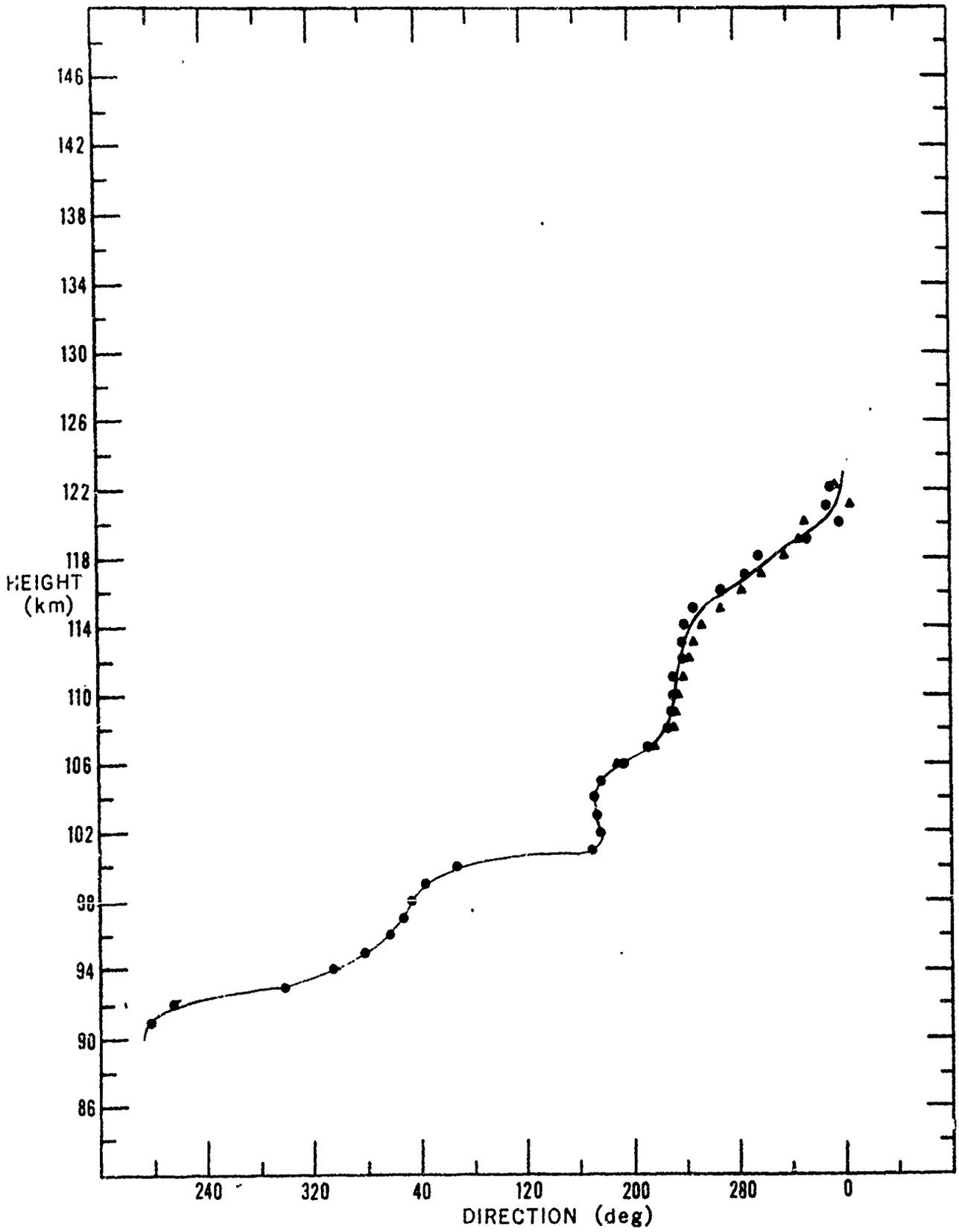
TRAIL NO. B53 DELTA

20 SEPTEMBER 1966 00:10:00 AST

H.A.R.P. BARBADOS

WIND DIRECTION

- • UP
- ▲ DOWN



TRAIL NO. B54 EPSILON
BARBADOS 20 SEPTEMBER 1966 02-24-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
90.0	106.5	10.5	-3.0	10.1	-5.0	9.3
91.0	341.7	28.8	27.4	-9.0	28.7	-3.2
92.0	352.6	45.2	44.8	-5.8	45.0	3.4
93.0	0.3	64.4	64.4	0.3	63.0	13.4
94.0	15.4	75.9	73.2	20.1	67.6	34.6
95.0	28.3	81.3	71.6	38.5	62.3	52.2
96.0	33.2	86.9	72.7	47.6	61.5	61.4
97.0	33.2	82.2	68.8	45.0	58.2	58.0
98.0	61.4	50.4	24.1	44.2	14.6	48.2
99.0	146.3	51.3	-42.7	28.5	-47.6	19.2
100.0	170.3	98.9	-97.5	16.7	-98.9	-3.5
101.0	174.5	99.0	-98.6	9.5	-98.5	-10.7
102.0	177.9	99.2	-99.1	3.6	-97.8	-16.6
103.0	187.0	80.5	-79.9	-9.8	-76.2	-25.8
104.0	184.1	69.3	-69.2	-5.0	-66.7	-19.0
105.0	200.4	44.6	-41.8	-15.5	-37.8	-23.7
106.0	248.9	41.1	-14.8	-38.4	-6.7	-40.6
107.0	274.1	50.7	3.6	-50.6	13.8	-48.8
108.0	289.8	66.9	22.6	-62.9	34.9	-57.0
109.0	294.1	86.8	35.4	-79.2	50.7	-70.4

TRAIL NO. B54 EPSILON

WIND COMPONENT

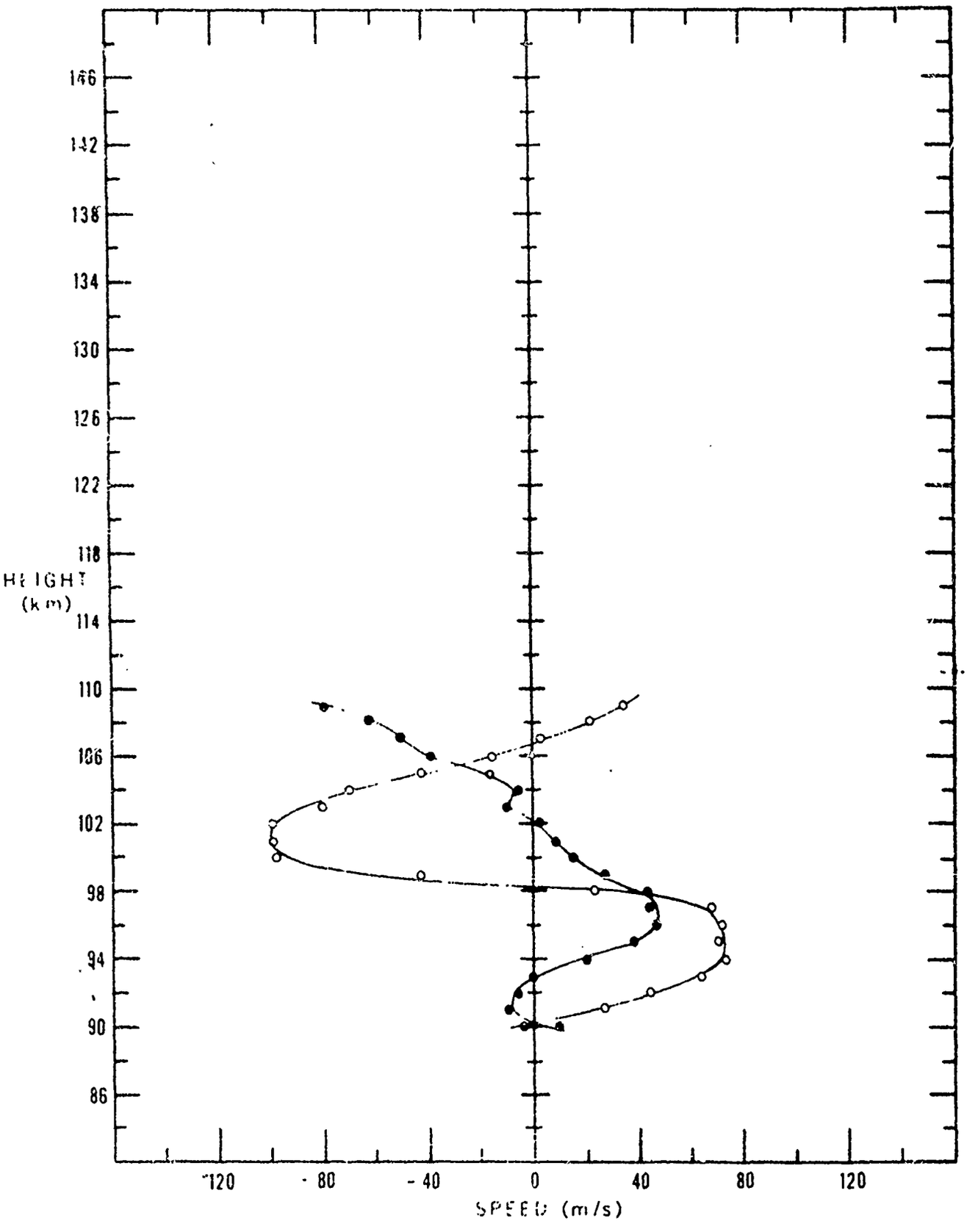
UP

N-S o

E-W •

20 SEPTEMBER 1966 01:23:00 AST

H.A.R.P. BARBADOS

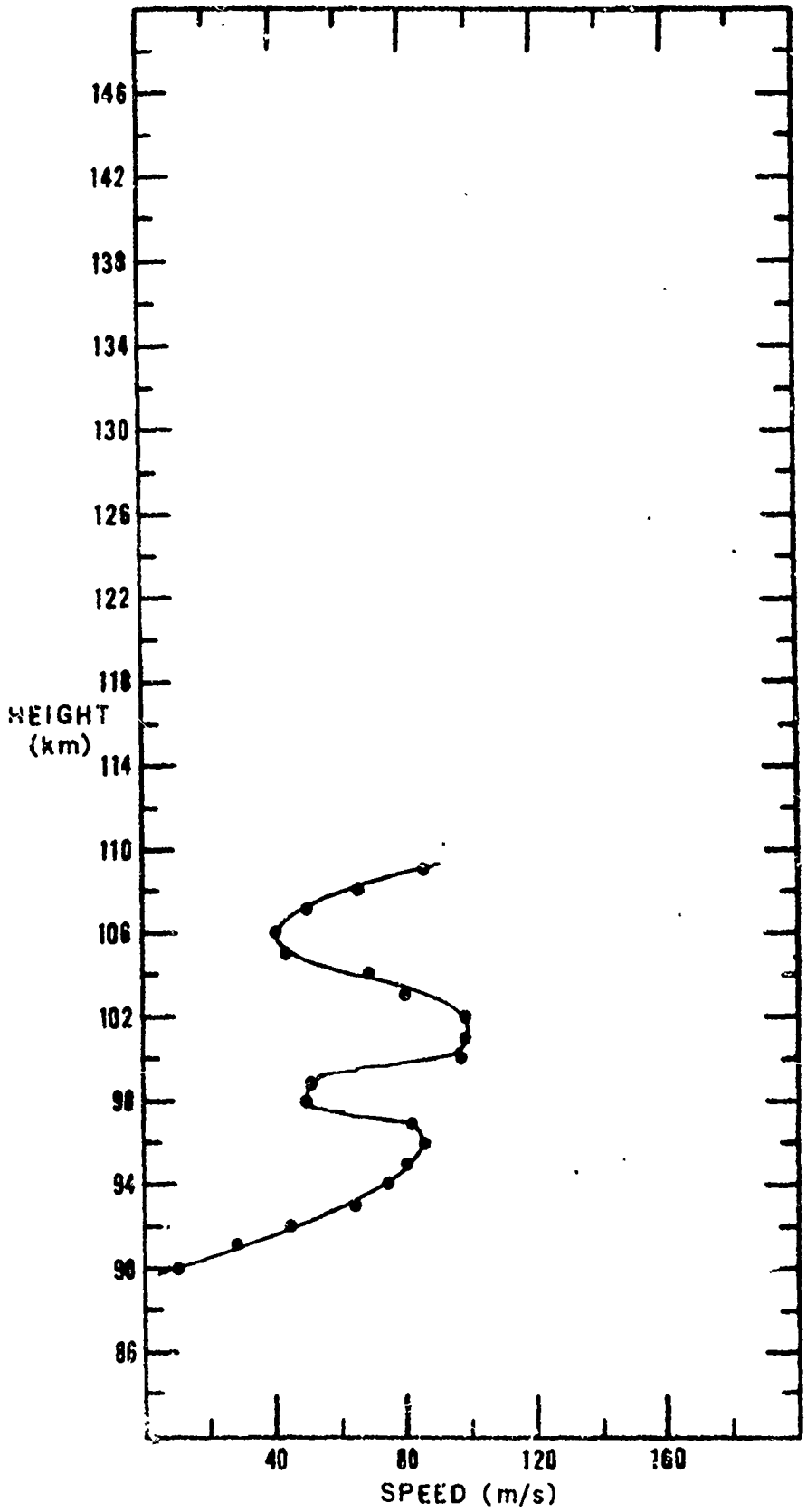


WIND SPEED
• UP

TRAIL NO. B54 EPSILON

20 SEPTEMBER 1966 01:23:00 AST

H.A.R.P. BARBADOS

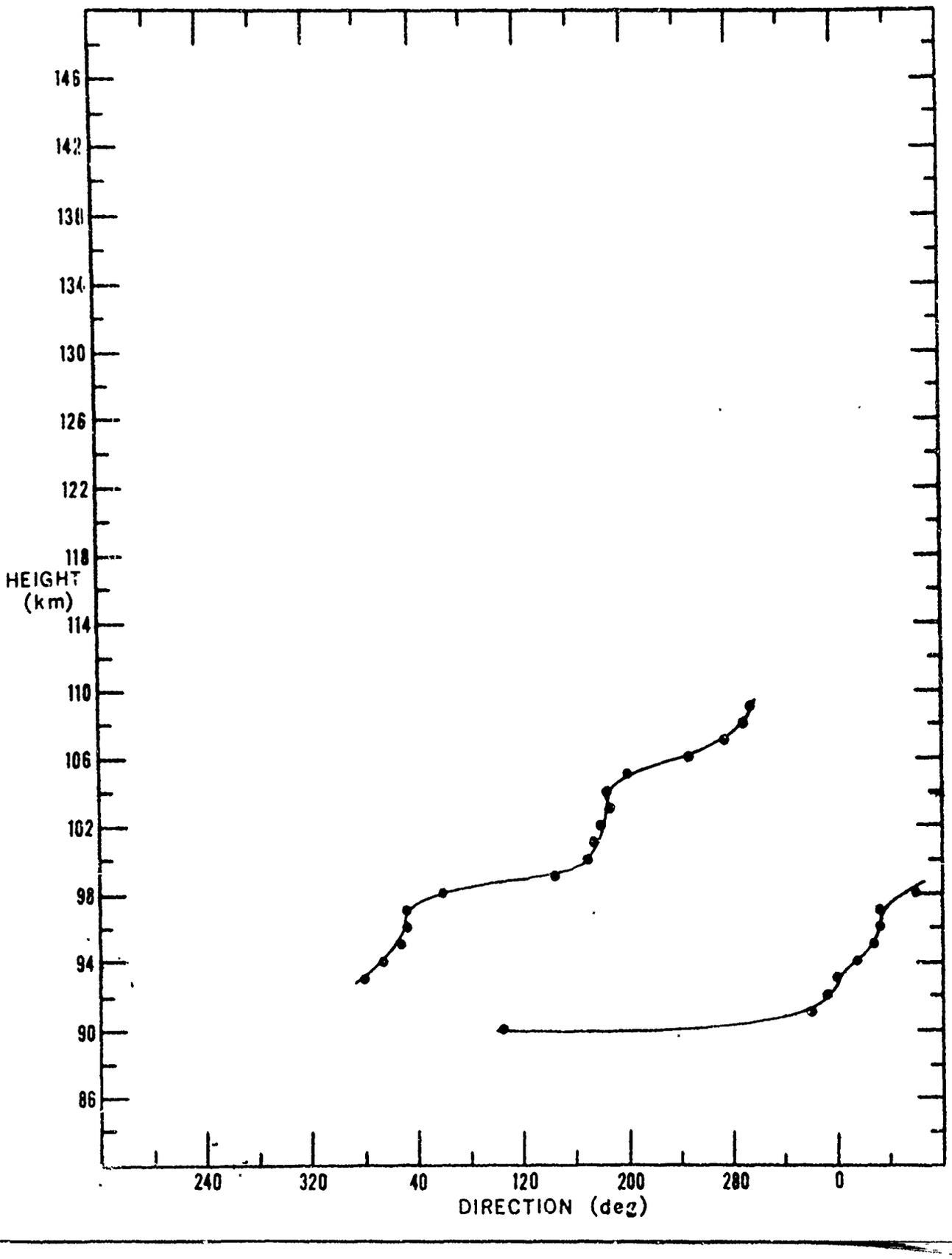


TRAIL NO. B54 EPSILON

WIND DIRECTION
• UP

20 SEPTEMBER 1966 01:23:0C AST

H.A.R.P. BARBADOS

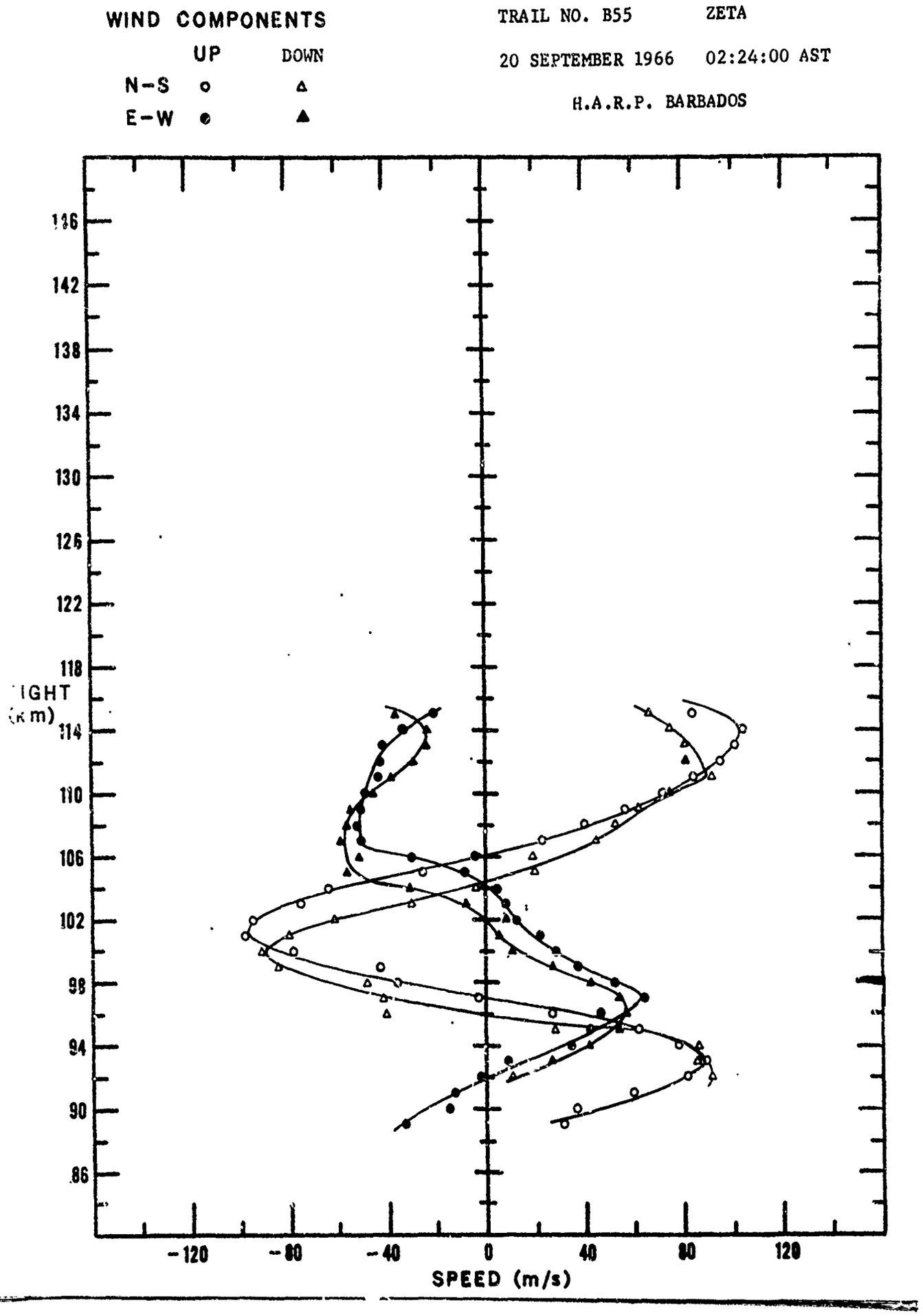


TRAIL NO. B55 ZETA
BARBADOS, 20 SEPTEMBER 1966 02-24-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
89.0	314.6	45.4	31.8	-32.3	37.7	-25.2
90.0	339.0	40.2	37.6	-14.4	39.7	-6.5
91.0	348.5	61.2	60.0	-12.1	61.2	0.3
92.0	358.6	82.3	82.3	-2.0	81.0	14.8
93.0	5.9	90.1	89.7	9.3	85.9	27.3
94.0	24.6	86.2	78.4	35.9	69.5	51.1
95.0	34.9	76.7	62.9	43.9	52.7	55.8
96.0	60.1	55.3	27.5	47.9	17.2	52.5
97.0	93.5	64.8	-3.9	64.6	-16.9	62.5
98.0	123.7	64.2	-35.7	53.4	-45.8	45.0
99.0	138.2	57.6	-42.9	38.4	-49.8	28.9
100.0	159.6	83.6	-78.3	29.1	-82.6	12.6
101.0	166.9	100.3	-97.7	22.8	-100.3	2.5
102.0	171.7	95.0	-94.0	13.7	-94.8	-5.7
103.0	173.1	75.0	-74.5	9.0	-74.8	-6.3
104.0	174.3	63.4	-63.1	6.3	-63.1	-6.6
105.0	197.0	26.5	-25.3	-7.7	-23.2	-12.7
106.0	262.4	29.5	-3.9	-29.3	2.1	-29.5
107.0	295.6	55.5	24.0	-50.1	33.7	-44.2
108.0	308.9	66.0	41.4	-51.4	51.0	-41.9
109.0	319.2	76.3	57.8	-49.8	66.7	-37.0
110.0	326.5	87.1	72.6	-48.1	80.9	-32.3
111.0	333.0	95.8	85.3	-43.5	92.4	-25.3
112.0	336.5	105.5	96.7	-42.1	103.2	-21.6
113.0	337.8	110.2	102.1	-41.6	108.4	-20.0
114.0	342.9	110.2	105.4	-32.4	109.8	-10.3
115.0	346.6	86.7	84.3	-20.2	86.6	-2.7

TRAIL NO. B55 ZETA
BARBADOS 20 SEPTEMBER 1966 02-24-00 AST
DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
92.0	7.2	93.5	92.7	11.7	88.4	30.3
93.0	17.1	93.0	88.9	27.4	81.5	44.9
94.0	25.6	98.7	89.0	42.6	78.5	59.8
95.0	62.8	61.7	28.2	54.9	16.5	59.5
96.0	124.4	70.7	-39.9	58.4	-50.9	40.1
97.0	127.2	69.3	-41.9	55.2	-52.2	45.5
98.0	143.8	72.7	-58.6	43.0	-66.1	30.2
99.0	162.3	88.9	-84.6	27.1	-88.3	9.4
100.0	172.8	91.8	-91.0	11.6	-91.5	-7.1
101.0	175.2	79.7	-79.4	6.7	-79.1	-9.6
102.0	171.0	62.5	-61.7	9.8	-62.4	-2.9
103.0	193.9	30.8	-29.9	-7.4	-27.8	-13.3
104.0	261.8	30.1	-4.3	-29.8	1.8	-30.1
105.0	290.3	60.0	20.8	-56.3	31.8	-50.9
106.0	290.8	54.7	19.4	-51.1	29.4	-46.1
107.0	307.8	74.2	45.4	-58.6	56.4	-48.2
108.0	314.0	76.8	53.4	-55.3	63.5	-43.3
109.0	320.6	81.7	63.1	-51.9	72.3	-38.0
110.0	328.9	88.0	75.3	-45.4	83.0	-29.2
111.0	337.5	100.5	92.8	-38.4	98.7	-18.7
112.0	341.2	86.9	82.3	-28.1	86.3	-10.8
113.0	344.2	85.5	82.3	-23.2	85.3	-6.0
114.0	343.2	79.6	76.2	-23.0	79.3	-7.0
115.0	331.7	77.2	67.9	-36.6	73.9	-22.0


WIND COMPONENTS
UP
DOWN
N-S
E-W
TRAIL NO. B55
ZETA
20 SEPTEMBER 1966
02:24:00 AST
H.A.R.P. BARBADOS
146
142
138
134
130
126
122
118
114
110
106
102
98
94
90
86
IGHT
(K m)
-120
-80
-40
0
40
80
120
SPEED (m/s)

WIND SPEED

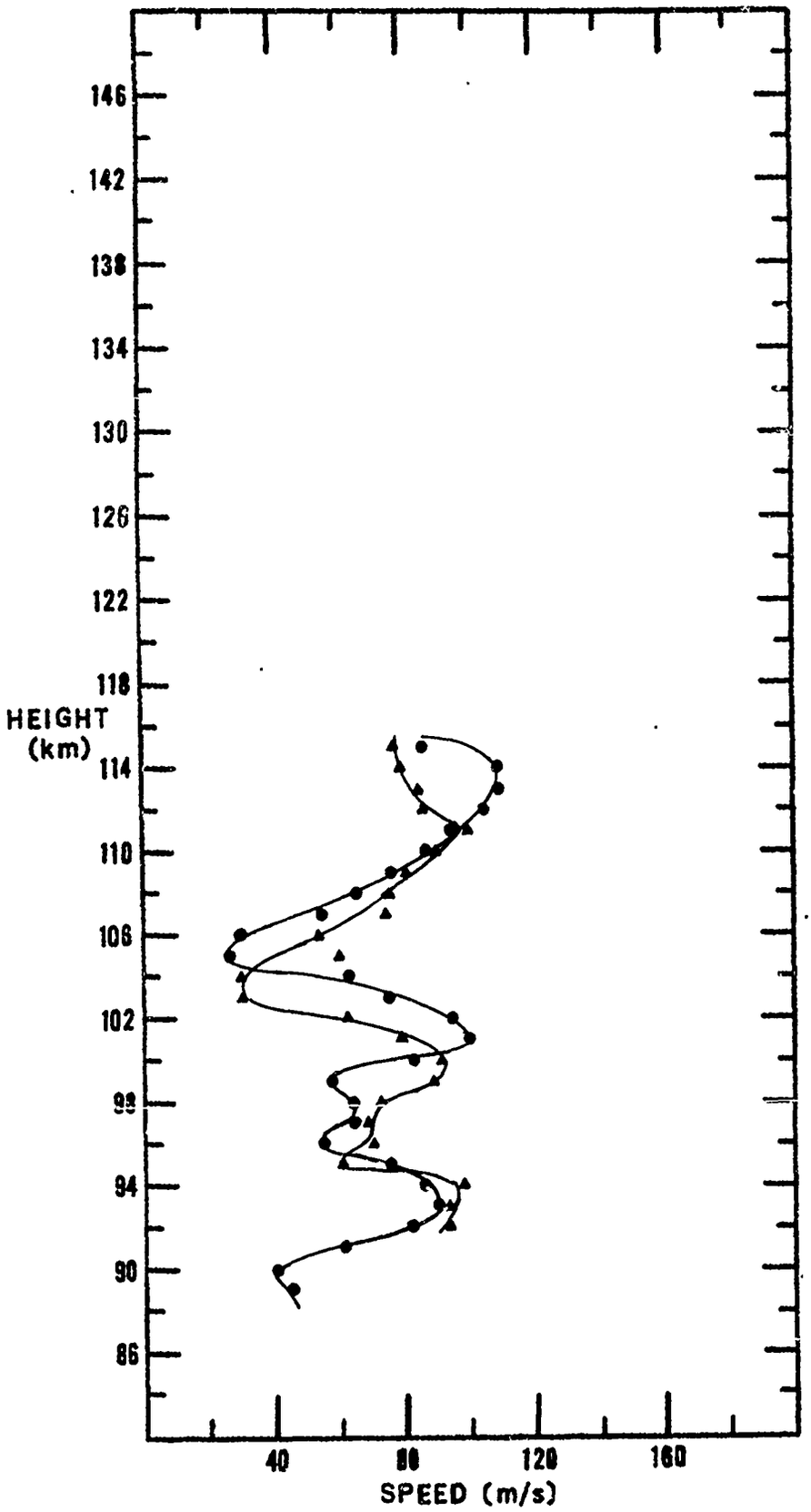
• UP

▲ DOWN

TRAIL NO. B55 ZETA

20 SEPTEMBER 1966 02:24:00 AST

H.A.R.P. BARBADOS



WIND DIRECTION

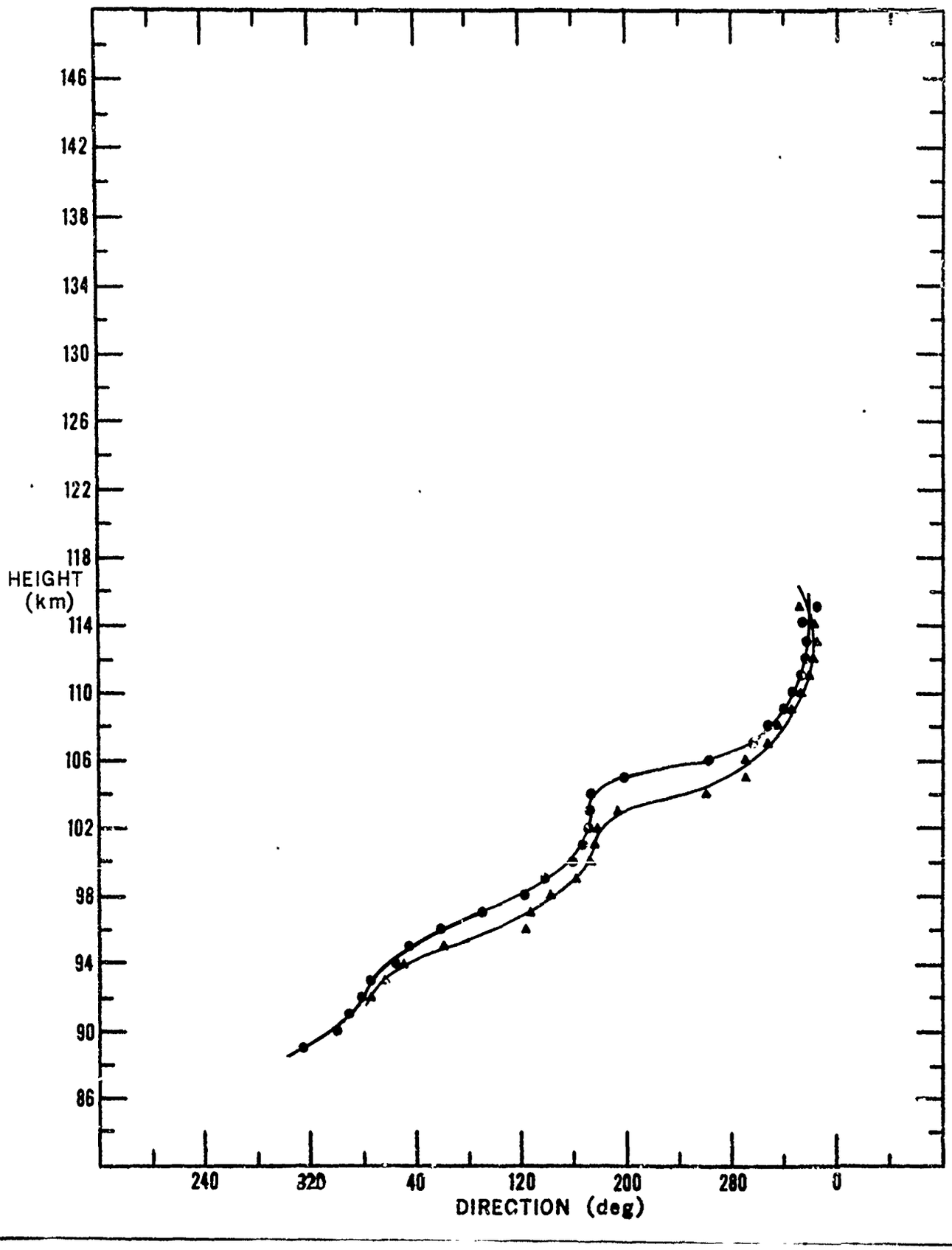
• UP

▲ DOWN

TRAIL NO. B55 ZETA

20 SEPTEMBER 1966 02:24:00 AST

H.A.R.P. BARBADOS



TRAIL NO. B56 ETA
BARBADOS 20 SEPTEMBER 1966 02-24-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
88.0	69.7	10.4	3.6	9.7	1.6	10.2
89.0	99.8	5.3	-0.9	5.2	-1.9	4.9
90.0	3.5	60.3	60.2	3.7	58.2	15.9
91.0	10.1	70.3	69.3	12.3	65.4	26.1
92.0	13.0	83.8	81.6	18.9	76.1	35.1
93.0	17.4	98.3	93.8	29.4	85.9	47.8
94.0	29.8	84.9	73.7	42.2	63.6	56.3
95.0	52.5	66.3	40.4	52.6	28.9	59.7
96.0	70.5	72.6	24.3	68.4	9.9	71.9
97.0	93.3	72.9	-4.1	72.8	-18.8	70.4
98.0	128.3	81.8	-50.7	64.2	-62.7	52.6
99.0	143.4	87.3	-70.0	52.1	-79.1	36.8
100.0	142.1	103.1	-81.4	63.3	-92.6	45.4
101.0	140.8	109.8	-85.1	69.4	-97.4	50.7
102.0	145.9	106.4	-88.1	59.7	-98.4	40.6
103.0	162.4	73.0	-69.6	22.0	-72.6	7.4
104.0	196.3	35.9	-34.5	-10.1	-31.7	-16.9
105.0	261.3	38.8	-5.9	-38.3	2.0	-38.7
106.0	283.5	53.9	12.6	-52.4	23.0	-48.7
107.0	301.3	67.1	34.9	-57.3	45.8	-49.0
108.0	319.1	80.0	60.4	-52.4	69.8	-39.0
109.0	328.4	91.7	78.1	-48.1	86.2	-31.2
110.0	333.5	97.1	86.9	-43.2	93.9	-24.6
111.0	340.1	96.2	90.4	-32.8	95.2	-13.8
112.0	345.8	93.1	90.2	-22.9	93.0	-4.1
113.0	352.1	88.5	87.6	-12.1	88.2	5.9
114.0	358.0	90.4	90.3	-3.2	89.1	15.2
115.0	5.4	89.2	88.8	8.4	85.2	26.3
116.0	11.3	87.4	85.8	17.1	80.5	34.2
117.0	15.8	89.7	86.3	24.4	79.5	41.4
118.0	20.0	90.3	84.8	30.9	76.8	47.5
119.0	22.5	89.7	82.9	34.3	74.2	50.4
120.0	22.9	90.0	82.9	35.0	74.1	51.1
121.0	21.3	91.9	85.7	33.4	77.1	50.1
122.0	16.8	100.6	96.3	29.1	88.4	48.1
123.0	21.5	91.5	85.2	33.5	76.6	50.1
124.0	14.3	116.1	112.5	28.7	104.3	51.0

TRAIL NO. B56 ETA

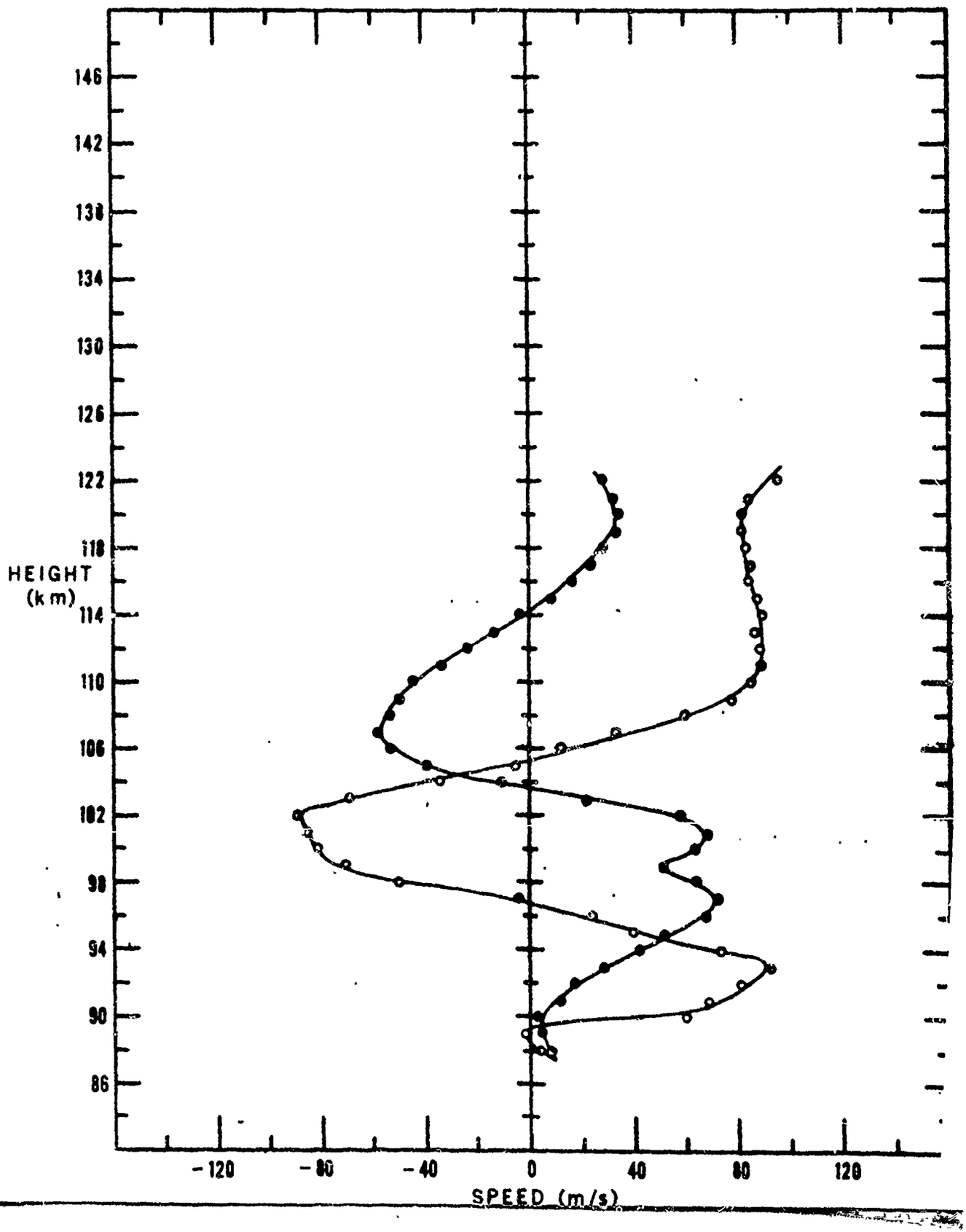
WIND COMPONENTS 20 SEPTEMBER 1966 03:18:00 AST

UP

N-S o

E-W •

H.A.R.P. BARBADOS

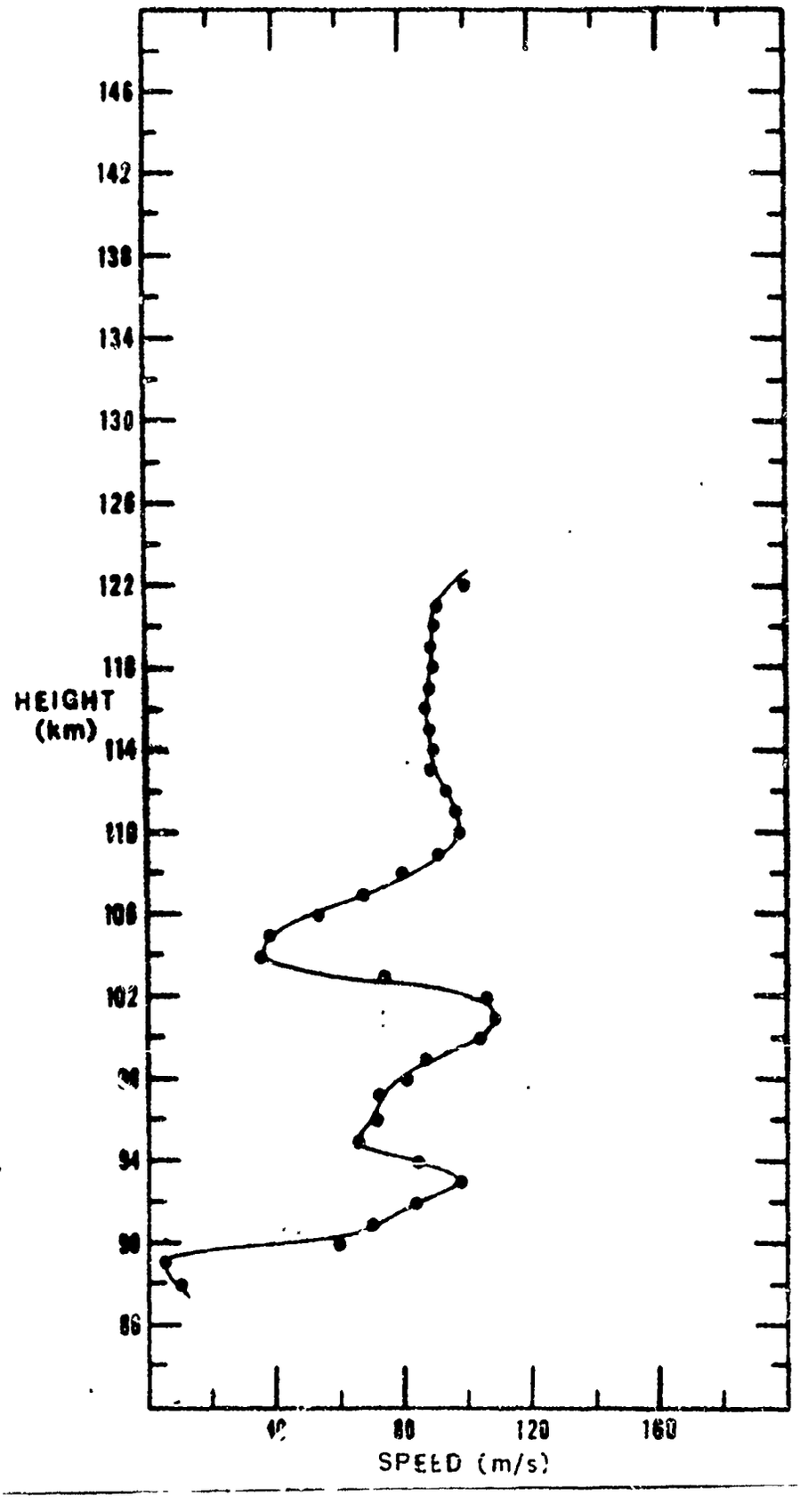


WIND SPEED
• UP

TRAIL NO. B56 ETA

20 SEPTEMBER 1966 03:18:00 AST

H.A.R.P. BARBADOS

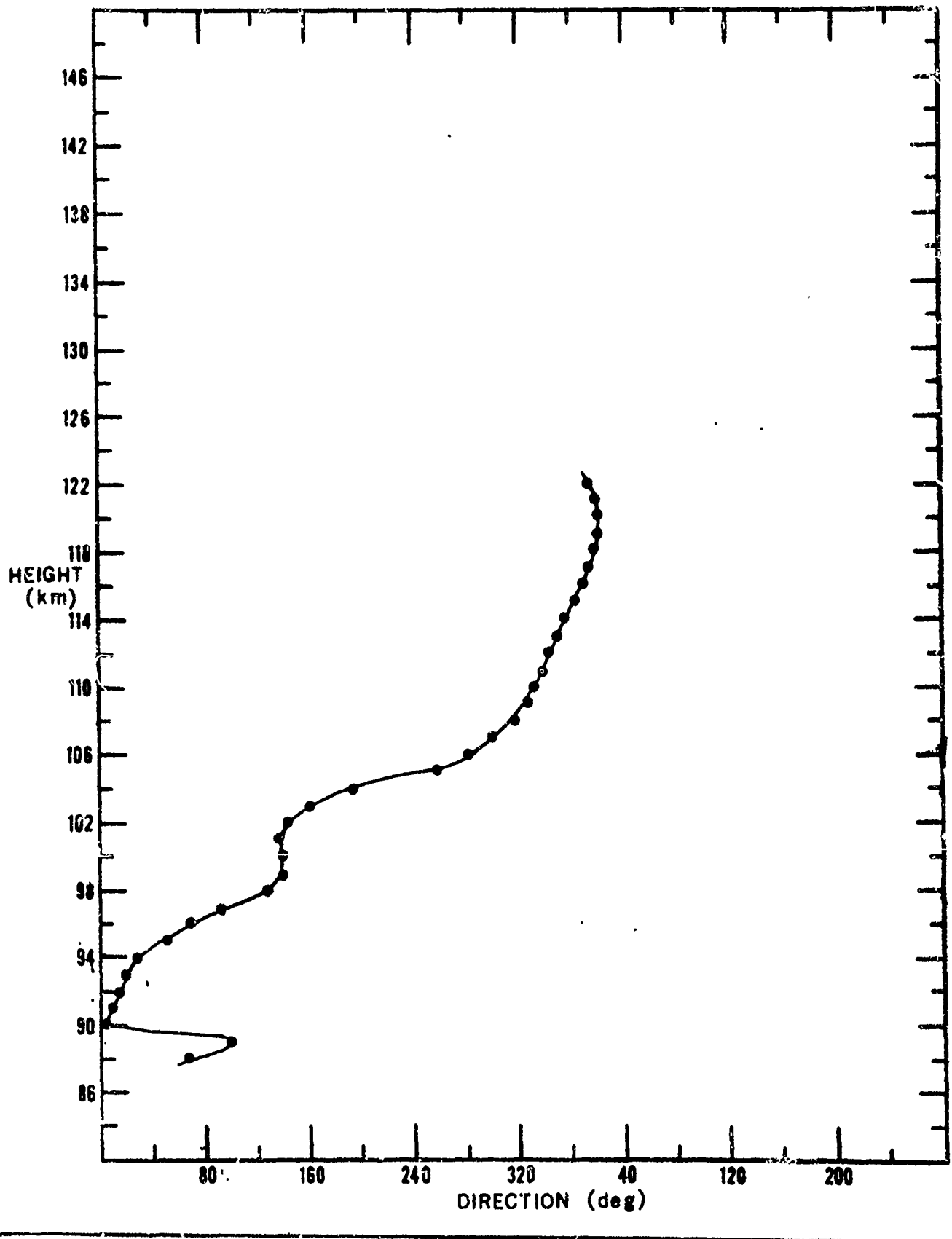


TRAIL NO. 356 ETA

WIND DIRECTION
• UP

20 SEPTEMBER 1966 03:18:00 AST

H.A.R.P. BARBADOS



TRAIL NO. B57 THETA
BARBADOS 20 SEPTEMBER 1966 02-24-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
87.0	39.7	24.3	18.7	15.5	15.2	19.0
88.0	239.0	2.9	-1.5	-2.5	-1.0	-2.8
89.0	338.1	22.5	20.8	-8.4	22.1	-4.0
90.0	3.3	43.2	43.2	2.5	41.8	11.2
91.0	358.0	71.1	71.1	-2.5	70.1	12.0
92.0	6.6	83.9	83.3	9.6	79.6	26.3
93.0	20.1	92.5	86.9	31.8	78.6	48.8
94.0	51.7	73.3	45.5	57.5	32.9	65.5
95.0	69.4	75.9	26.7	71.0	11.7	74.9
96.0	84.1	80.0	8.2	79.6	-8.1	79.6
97.0	106.0	84.8	-23.3	81.5	-39.4	75.1
98.0	128.0	87.7	-54.0	69.1	-66.9	56.7
99.0	137.9	97.5	-72.3	65.4	-84.1	49.4
100.0	147.2	111.2	-93.5	60.2	-103.8	40.0
101.0	155.0	107.2	-97.2	45.2	-104.4	24.5
102.0	158.1	64.6	-60.0	24.1	-63.6	11.4
103.0	165.4	44.3	-42.9	11.1	-44.3	2.2
104.0	194.0	33.1	-32.1	-8.0	-29.8	-14.4
105.0	243.6	35.2	-15.7	-31.5	-9.0	-34.0
106.0	290.9	40.5	14.5	-37.8	21.9	-34.1
107.0	318.3	68.7	51.2	-45.7	59.4	-34.3
108.0	325.0	82.4	67.4	-47.3	75.6	-32.6
109.0	333.1	91.5	81.6	-41.5	88.3	-24.1
110.0	340.4	93.2	87.8	-31.3	92.3	-12.8
111.0	348.3	94.1	92.2	-19.1	94.2	0.0
112.0	357.1	93.8	93.7	-4.8	92.7	14.3
113.0	4.9	94.7	94.3	8.1	90.7	27.1
114.0	10.7	95.1	93.4	17.6	87.9	36.2
115.0	14.9	95.6	92.4	24.6	85.5	42.9
116.0	16.9	98.2	94.0	28.5	86.3	47.0
117.0	16.6	102.7	98.4	29.3	90.4	48.7
118.0	17.5	104.1	99.3	31.3	90.9	50.8
119.0	16.4	114.7	110.0	32.4	101.1	54.1
120.0	15.9	139.2	133.8	38.2	123.3	64.6
121.0	15.9	141.1	135.7	38.6	125.0	65.4
122.0	21.7	121.7	113.0	45.1	101.5	67.1
123.0	29.3	84.6	73.8	41.4	63.9	55.5
124.0	41.4	52.2	39.2	34.5	31.4	41.7
125.0	63.0	33.0	15.0	29.4	8.7	31.8
126.0	106.4	25.3	-7.1	24.3	-11.9	22.4
127.0	141.3	30.0	-23.4	18.8	-26.7	13.7

TRAIL NO. B57 THETA
BARBADOS 20 SEPTEMBER 1966 02-24-00 AST
DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
89.0	351.0	55.4	54.7	-8.6	55.3	2.7
90.0	0.7	63.1	63.1	0.8	61.6	13.6
91.0	2.4	66.8	66.7	2.8	64.7	16.3
92.0	12.8	87.1	85.0	19.3	79.3	36.2
93.0	25.1	93.6	84.8	39.8	74.9	56.2
94.0	39.7	82.5	63.5	52.7	51.5	64.5
95.0	79.3	72.4	13.4	71.1	-1.3	72.3
96.0	90.5	84.9	-0.7	84.9	-17.9	83.0
97.0	109.9	90.9	-31.0	85.5	-47.7	77.4
98.0	134.9	91.8	-64.8	65.0	-76.7	50.5
99.0	142.8	105.6	-84.1	63.9	-95.3	45.5
100.0	156.7	114.3	-105.0	45.2	-112.0	22.9
101.0	158.5	94.9	-88.3	34.8	-93.5	16.1
102.0	158.2	71.0	-65.9	26.4	-69.9	12.5
103.0	180.6	40.3	-40.3	-0.4	-39.4	-8.6
104.0	241.0	41.2	-20.0	-36.0	-12.3	-39.3
105.0	256.7	37.9	-8.7	-36.9	-1.0	-37.9
106.0	290.4	41.4	14.4	-38.8	22.0	-35.1
107.0	319.3	72.5	54.9	-47.3	63.4	-39.2
108.0	330.8	88.4	77.2	-43.2	84.4	-26.6
109.0	336.4	92.9	85.1	-37.3	90.9	-19.2
110.0	342.1	94.8	90.2	-29.1	94.2	-10.2
111.0	348.5	95.0	93.1	-18.9	95.0	0.4
112.0	358.1	94.5	94.4	-3.1	93.1	16.1
113.0	5.2	98.7	98.3	9.0	94.4	28.8
114.0	12.1	96.8	94.7	20.3	88.6	39.1
115.0	16.9	96.7	92.5	28.1	84.9	46.3
116.0	19.2	102.2	96.5	33.6	87.7	52.5
117.0	22.4	103.5	95.7	39.4	85.7	58.0
118.0	24.7	109.9	99.9	46.0	88.5	65.3
119.0	24.9	117.2	106.3	49.3	94.1	69.9
120.0	25.1	124.0	112.3	52.6	99.3	74.3
121.0	26.0	128.0	115.0	56.2	101.2	78.4
122.0	31.0	77.6	66.5	40.0	57.0	52.7
123.0	39.4	60.0	46.3	38.1	37.6	46.7
124.0	51.6	45.0	28.0	35.3	20.2	40.3
125.0	98.4	28.6	-4.2	28.3	-9.9	26.9
126.0	119.8	30.8	-15.3	26.7	-20.4	23.0

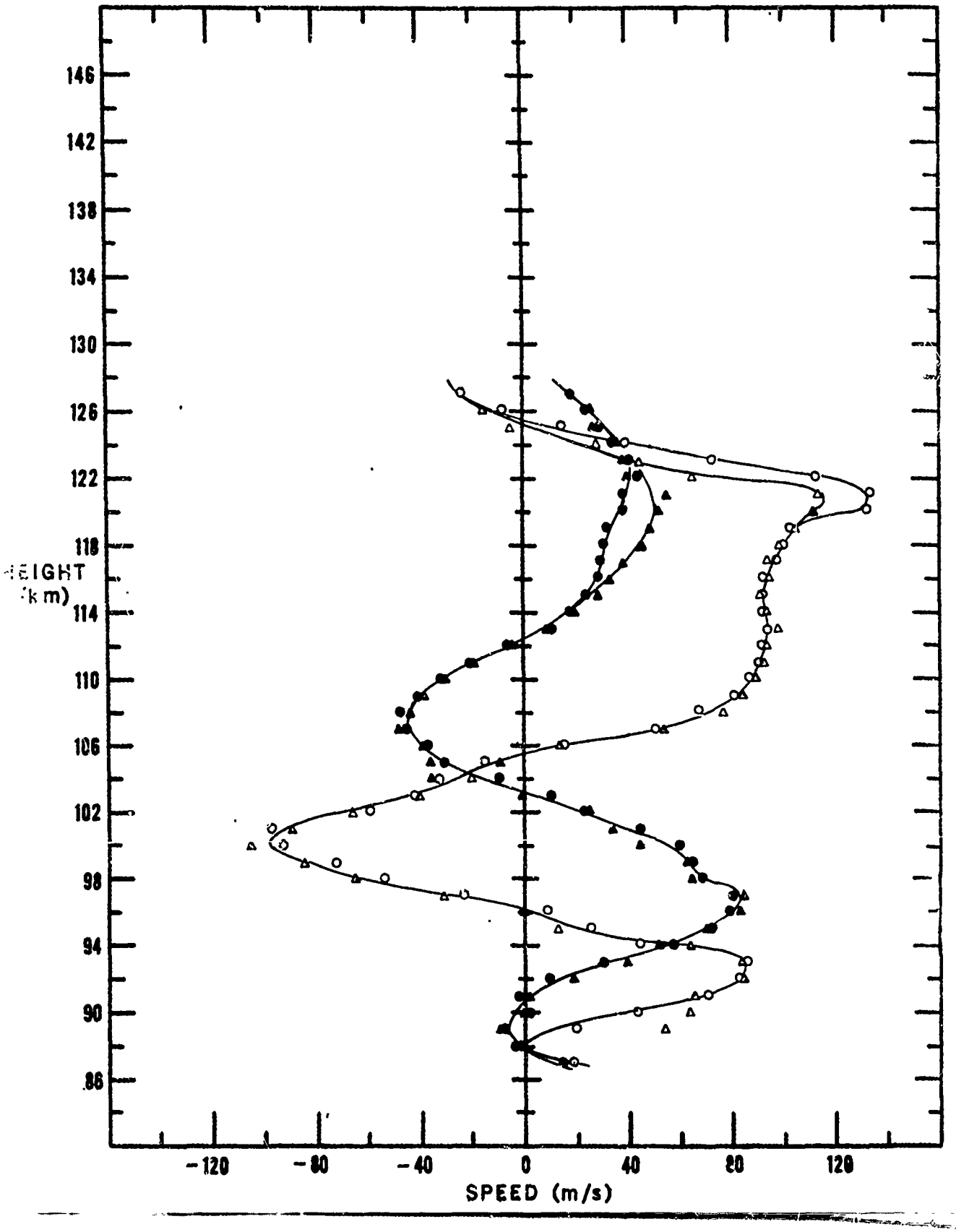
WIND COMPONENTS

	UP	DOWN
N–S	o	△
E–W	●	▲

TRAIL NO. B57 THETA

20 SEPTEMBER 1966 04:03:00 AST

H.A.R.P. BARBADOS



WIND SPEED

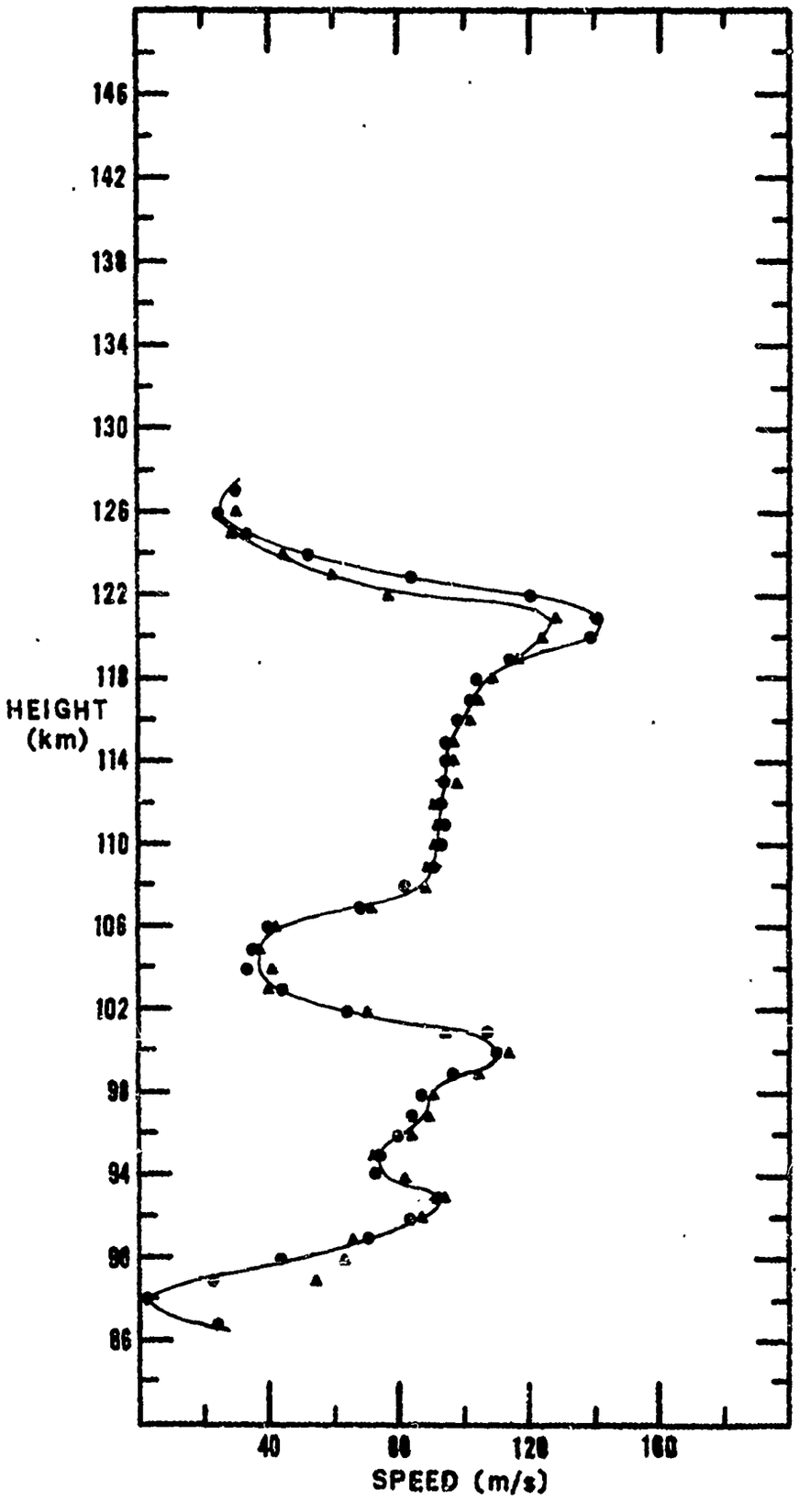
● UP

▲ DOWN

TRAIL NO. B57 THETA

20 SEPTEMBER 1966 04:03:00 AST

H.A.R.P. BARBADOS



WIND DIRECTION

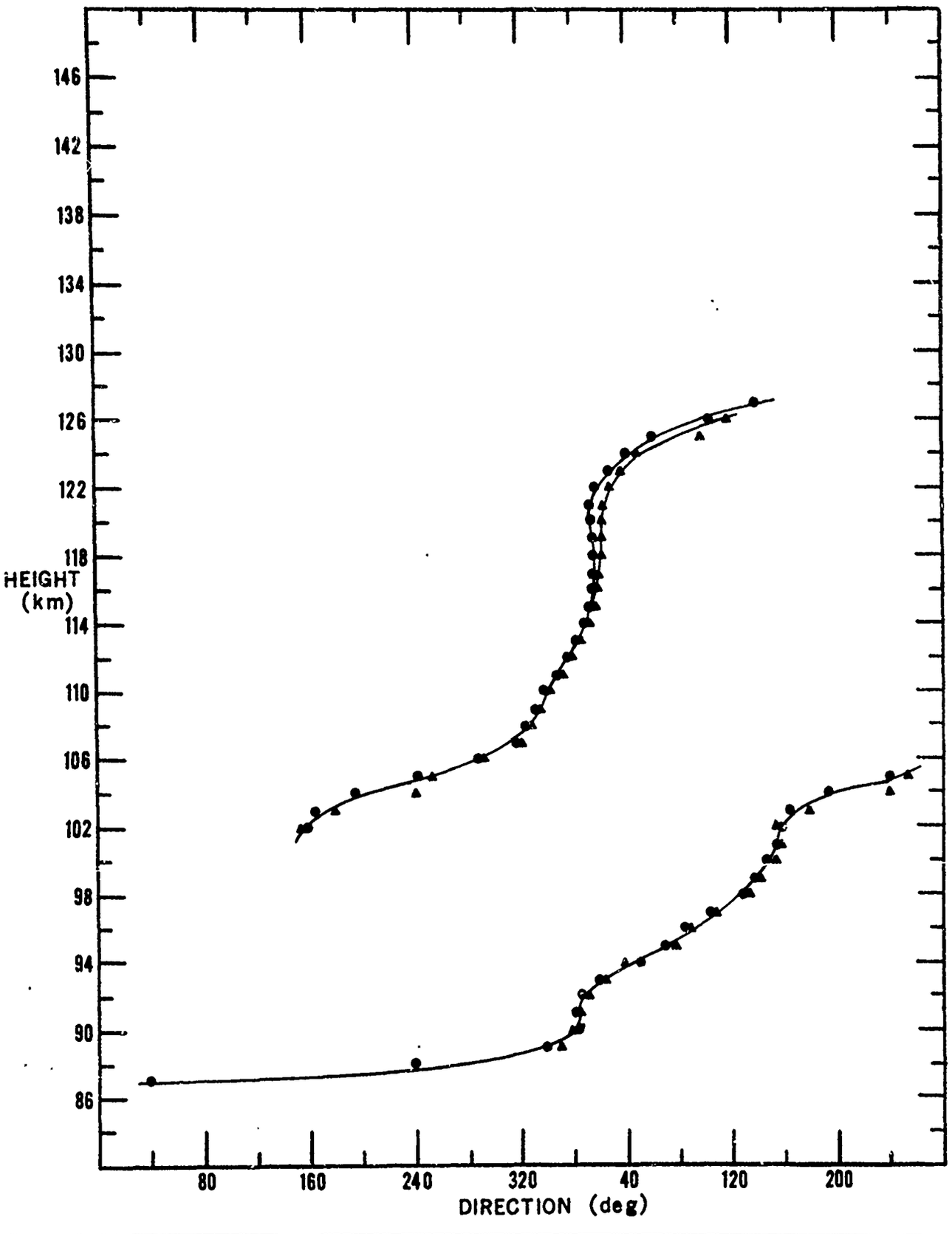
• UP

▲ DOWN

TRAIL NO. B57 THETA

20 SEPTEMBER 1966 04:03:00 AST

H.A.R.P. BARBADOS



TRAIL NO. B58 IOTA
BARBADOS 20 SEPTEMBER 1966 02-24-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
86.0	336.3	36.4	33.4	-14.7	35.7	-7.6
87.0	334.8	40.5	36.6	-17.2	39.3	-9.4
88.0	341.2	45.9	43.5	-14.8	45.6	-5.7
89.0	356.5	50.5	50.4	-3.1	50.0	7.2
90.0	357.0	55.0	54.9	-2.8	54.3	8.4
91.0	10.2	63.0	62.0	11.2	58.4	23.6
92.0	10.4	70.7	69.6	12.7	65.6	26.6
93.0	40.6	62.6	47.5	40.7	38.2	49.5
94.0	67.9	71.0	26.8	65.8	12.9	69.9
95.0	82.1	78.6	10.7	77.9	-5.3	78.4
96.0	98.8	82.0	-12.5	81.0	-28.7	76.8
97.0	122.9	101.6	-55.2	85.2	-71.4	72.2
98.0	131.0	122.8	-80.5	92.7	-97.7	74.4
99.0	137.1	135.0	-98.9	92.0	-115.5	70.0
100.0	140.5	139.0	-107.3	88.4	-123.0	64.8
101.0	144.6	125.4	-102.2	72.7	-114.8	50.4
102.0	149.0	75.4	-64.6	38.9	-71.2	25.0
103.0	122.9	31.9	-17.3	26.8	-22.4	22.7
104.0	102.6	17.8	-3.8	17.4	-7.3	16.3
105.0	350.3	11.5	11.4	-1.9	11.5	0.5
106.0	342.2	33.6	32.0	-10.3	33.4	-3.6
107.0	354.6	53.0	52.8	-5.0	52.7	5.8
108.0	7.4	80.6	80.0	10.3	76.2	26.3
109.0	20.4	96.3	90.2	33.5	81.5	51.1
110.0	29.1	94.2	82.3	45.8	71.3	61.6
111.0	32.0	94.9	80.5	50.3	68.6	65.6
112.0	34.8	94.6	77.7	54.0	65.1	68.7
113.0	33.2	105.6	88.4	57.8	74.8	74.6
114.0	27.6	126.8	112.4	58.7	98.1	80.3
115.0	22.2	139.0	128.7	52.6	115.3	77.6
116.0	18.4	154.2	146.3	48.5	133.4	77.2
117.0	19.2	161.8	152.9	53.1	138.9	83.1
118.0	20.2	171.0	160.5	59.1	145.1	90.5
119.0	24.6	155.6	141.5	64.7	125.4	92.1
120.0	34.0	123.6	102.4	69.1	86.2	88.5
121.0	43.8	100.5	72.6	69.5	57.0	82.8
122.0	50.6	79.2	50.2	61.2	36.7	70.1
123.0	63.0	54.6	24.8	48.7	14.4	52.7
124.0	104.9	28.0	-7.2	27.0	-12.5	25.0

TRAIL NO. B58 IOTA

20 SEPTEMBER 1966 04:46:00 AST

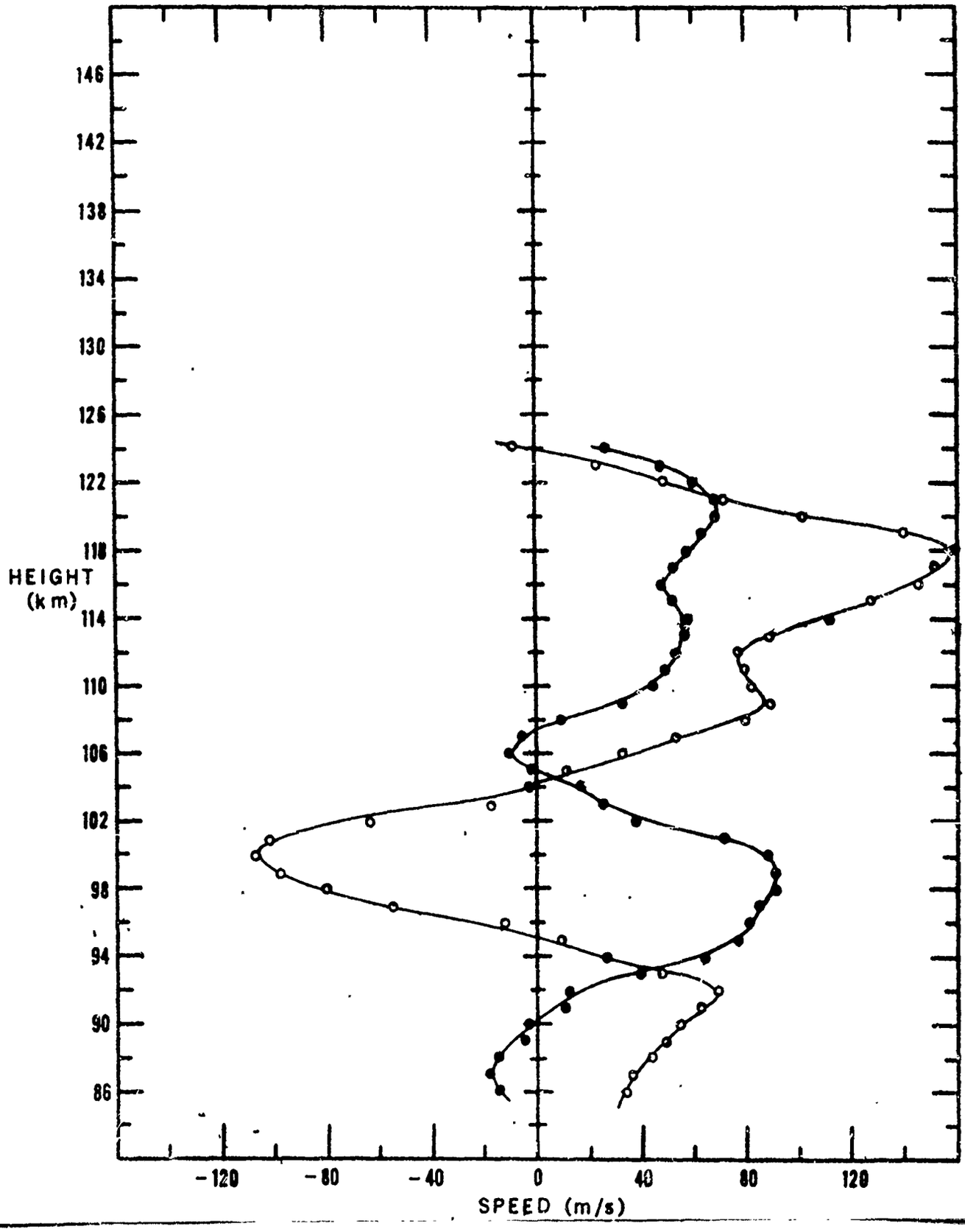
H.A.R.P. BARBADOS

WIND COMPONENTS

UP

N-S o

E-W •



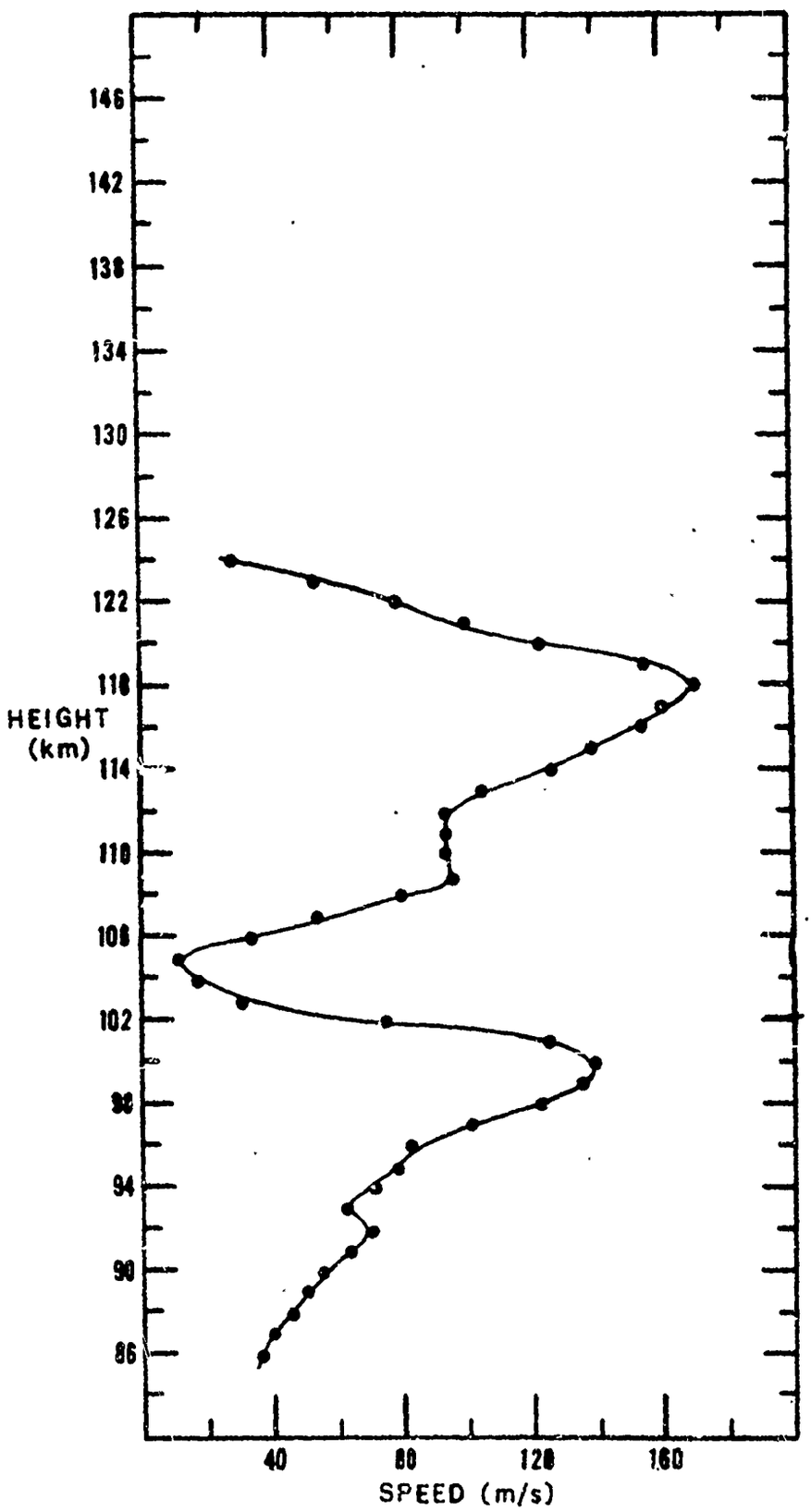
WIND SPEED

• UP

TRAIL NO. B58 IOTA

20 SEPTEMBER 1966 04:46:00 AST

H.A.R.P. BARBADOS

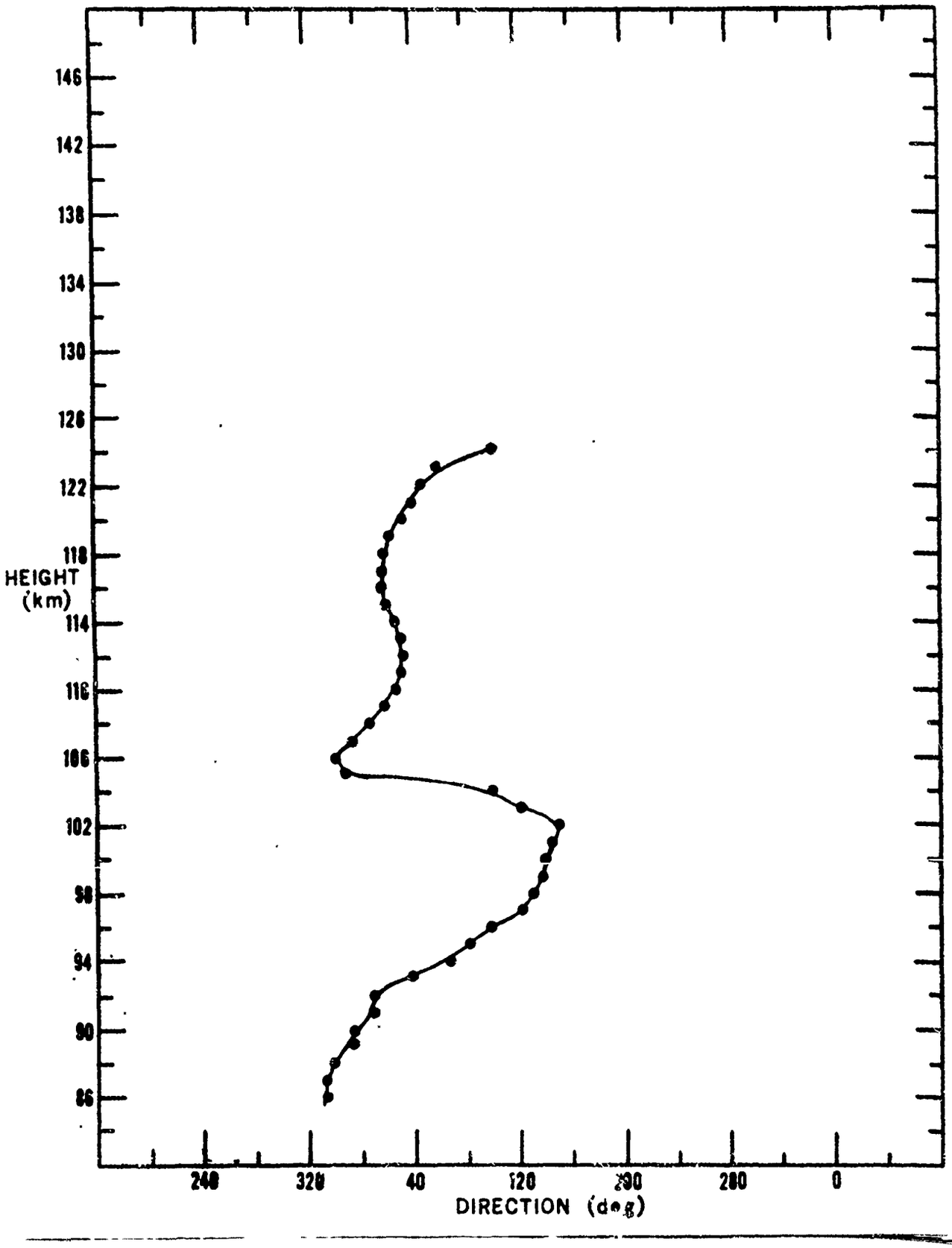


TRAIL NO. B58 IOTA

WIND DIRECTION
• UP

20 SEPTEMBER 1966 04:46:00 AST

H.A.R.P. BARBADOS



TRAIL NO. B59 BELFAST
BARBADOS 15 FEBRUARY 1967 22-45-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
89.0	295.4	20.8	8.9	-18.8	12.5	-16.6
90.0	274.4	37.5	2.9	-37.4	10.4	-36.0
91.0	259.0	61.3	-1.7	-60.2	0.8	-61.3
92.0	244.9	48.8	-20.7	-44.2	-11.3	-47.5
93.0	237.3	43.6	-23.6	-36.7	-15.7	-40.7
94.0	237.8	42.2	-22.5	-35.7	-14.8	-39.5
95.0	245.5	43.6	-18.1	-39.6	-9.7	-42.5
96.0	258.3	37.6	-7.6	-36.8	0.0	-37.6
97.0	270.3	36.1	0.2	-36.1	7.5	-35.3
98.0	278.7	33.8	5.1	-33.4	11.8	-31.7
99.0	281.5	35.3	7.0	-34.5	13.9	-32.4
100.0	285.5	37.4	10.0	-36.0	17.1	-33.2
101.0	291.6	36.1	13.3	-33.6	19.8	-30.2
102.0	300.7	37.4	19.1	-32.2	25.2	-27.6
103.0	321.2	49.6	38.6	-31.1	44.1	-22.6
104.0	344.5	42.6	41.1	-11.4	42.6	-2.8
105.0	343.8	31.4	30.2	-8.7	31.3	-2.4
106.0	317.3	32.8	24.1	-22.2	28.1	-16.8
107.0	321.6	44.8	35.1	-27.9	40.0	-20.2
108.0	338.1	39.0	36.2	-14.5	38.4	-6.8
109.0	3.2	42.9	42.8	2.4	41.4	11.0
110.0	45.9	44.6	31.0	32.0	23.9	37.6
111.0	87.1	57.9	3.0	57.9	-8.8	57.3
112.0	99.9	77.9	-13.4	76.7	-28.7	72.4
113.0	106.3	96.3	-27.1	92.4	-45.3	85.0
114.0	108.4	111.3	-35.1	105.6	-55.8	96.3
115.0	112.3	117.1	-44.5	108.4	-65.6	97.1
116.0	112.4	121.9	-46.4	112.7	-68.3	100.9
117.0	115.3	118.8	-50.8	107.5	-71.6	94.9
118.0	123.7	113.0	-62.7	94.0	-80.5	79.3
119.0	122.9	121.5	-66.0	102.0	-85.3	86.5
120.0	122.0	130.5	-69.2	110.7	-90.2	94.3
121.0	122.0	137.5	-72.9	116.6	-95.1	99.4
122.0	125.7	139.9	-81.7	113.5	-103.1	94.5
123.0	129.0	143.0	-90.0	111.2	-110.7	90.6

TRAIL NO. B59 BELFAST

BARBADOS 15 FEBRUARY 1967 22-45-00 AST

DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
88.0	63.3	12.8	5.7	11.4	3.3	12.3
89.0	283.6	36.0	8.5	-35.0	15.4	-32.5
90.0	274.2	39.9	2.9	-39.8	10.9	-38.4
91.0	269.0	30.1	-0.5	-30.1	5.6	-29.6
92.0	253.2	23.4	-6.8	-22.4	-2.1	-23.3
93.0	239.6	42.1	-21.3	-36.3	-13.5	-39.9
94.0	240.3	41.6	-20.6	-36.2	-12.8	-39.6
95.0	242.6	37.9	-17.5	-33.7	-10.3	-36.6
96.0	260.0	40.5	-7.0	-39.9	1.3	-40.5
97.0	271.6	40.0	1.1	-39.9	9.2	-38.8
98.0	280.5	38.4	7.0	-37.8	14.5	-35.6
99.0	282.0	42.8	8.9	-41.8	17.2	-39.1
100.0	287.7	43.7	13.3	-41.6	21.5	-38.0
101.0	298.8	44.1	21.3	-38.7	28.7	-33.6
102.0	308.9	54.8	34.4	-42.6	42.3	-34.7
103.0	323.0	61.4	49.1	-36.9	55.6	-26.2
104.0	336.1	50.2	45.9	-20.4	49.1	-10.7
105.0	335.9	32.1	29.3	-13.1	31.4	-6.9
106.0	303.7	35.0	19.4	-29.1	24.9	-24.6
107.0	304.9	43.4	24.9	-35.6	31.6	-29.8
108.0	326.9	48.7	40.8	-26.6	45.4	-17.8
109.0	353.1	43.5	43.2	-5.2	43.4	3.7
110.0	39.9	37.7	28.9	24.2	23.4	29.6
111.0	86.6	63.6	3.7	63.5	-9.3	62.9
112.0	97.8	77.4	-10.5	76.7	-25.9	73.0
113.0	106.9	95.6	-27.8	91.5	-45.8	83.9
114.0	108.6	112.4	-36.0	106.5	-56.9	97.0
115.0	115.3	119.1	-50.9	107.7	-71.7	95.1
116.0	114.6	123.0	-51.2	111.9	-72.9	99.2
117.0	114.8	126.2	-52.9	114.6	-75.1	101.5

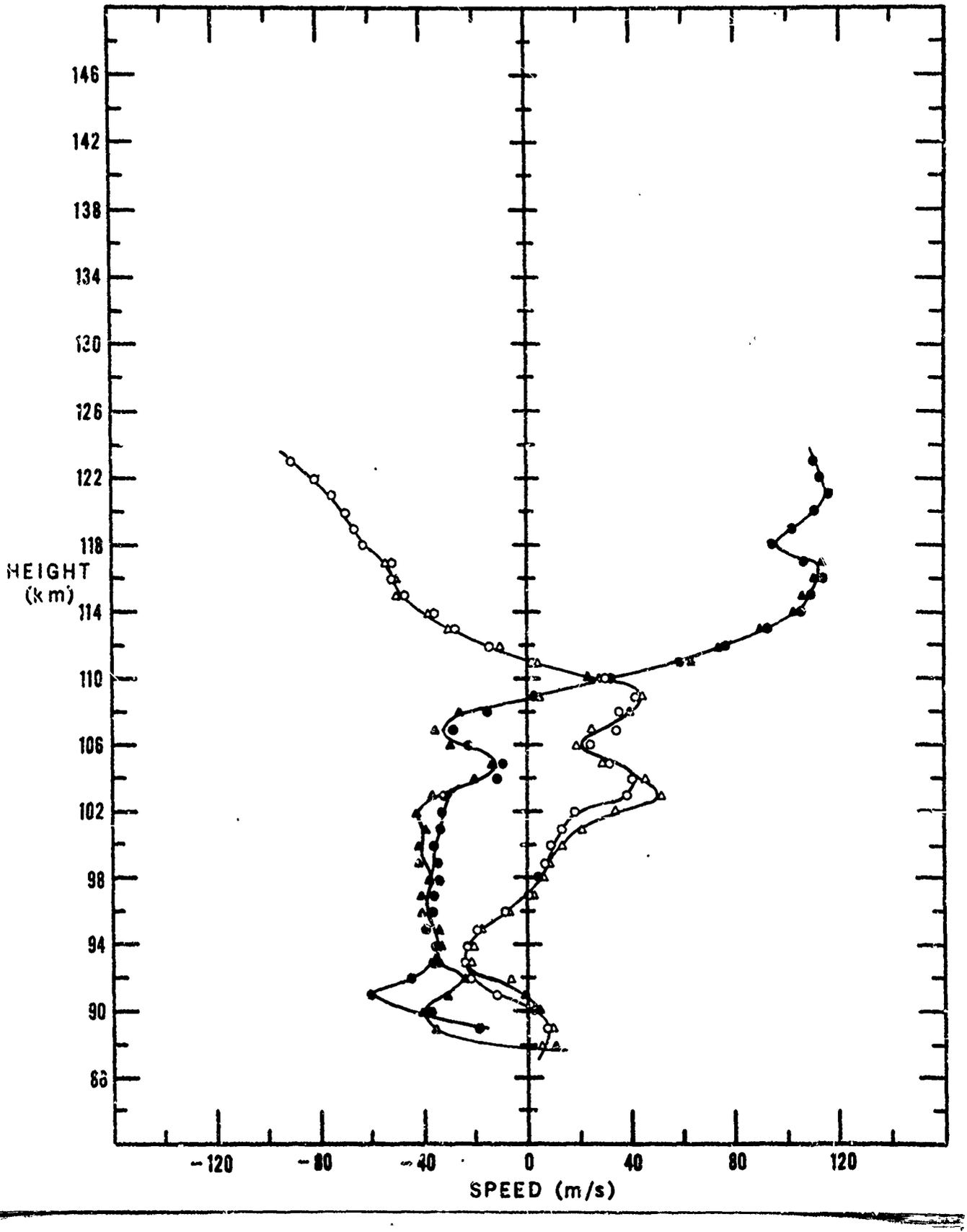
WIND COMPONENTS

	UP	DOWN
N-S	o	Δ
E-W	•	▲

TRAIL NO. B59 BELFAST

15 FEBRUARY 1967 21:17:00 AST

H.A.R.P. BARBADOS



WIND SPEED

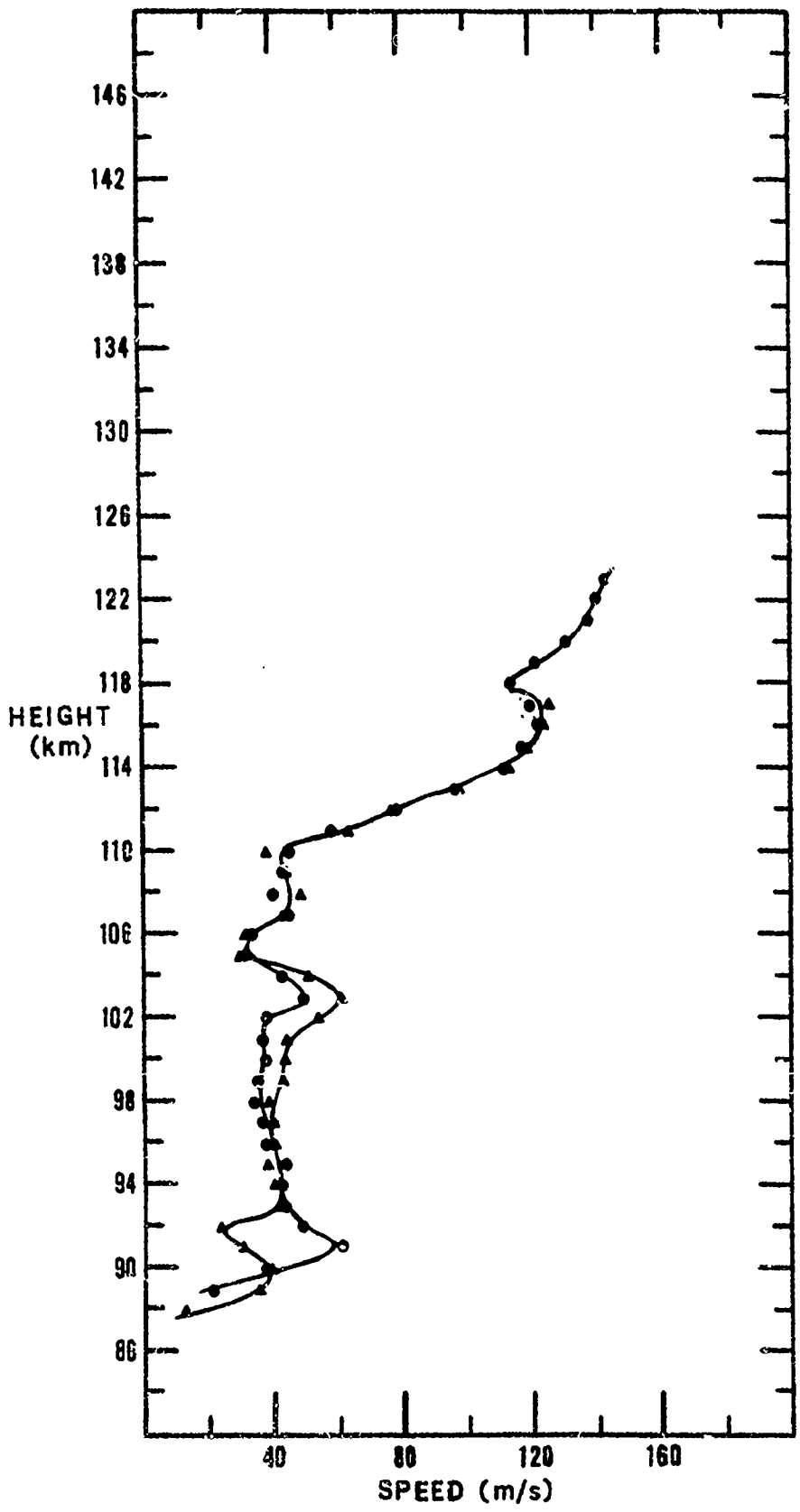
• UP

▲ DOWN

TRAIL NO. B59 BELFAST

15 FEBRUARY 1967 21:17:00 AST

H.A.R.P. BARBADOS



WIND DIRECTION

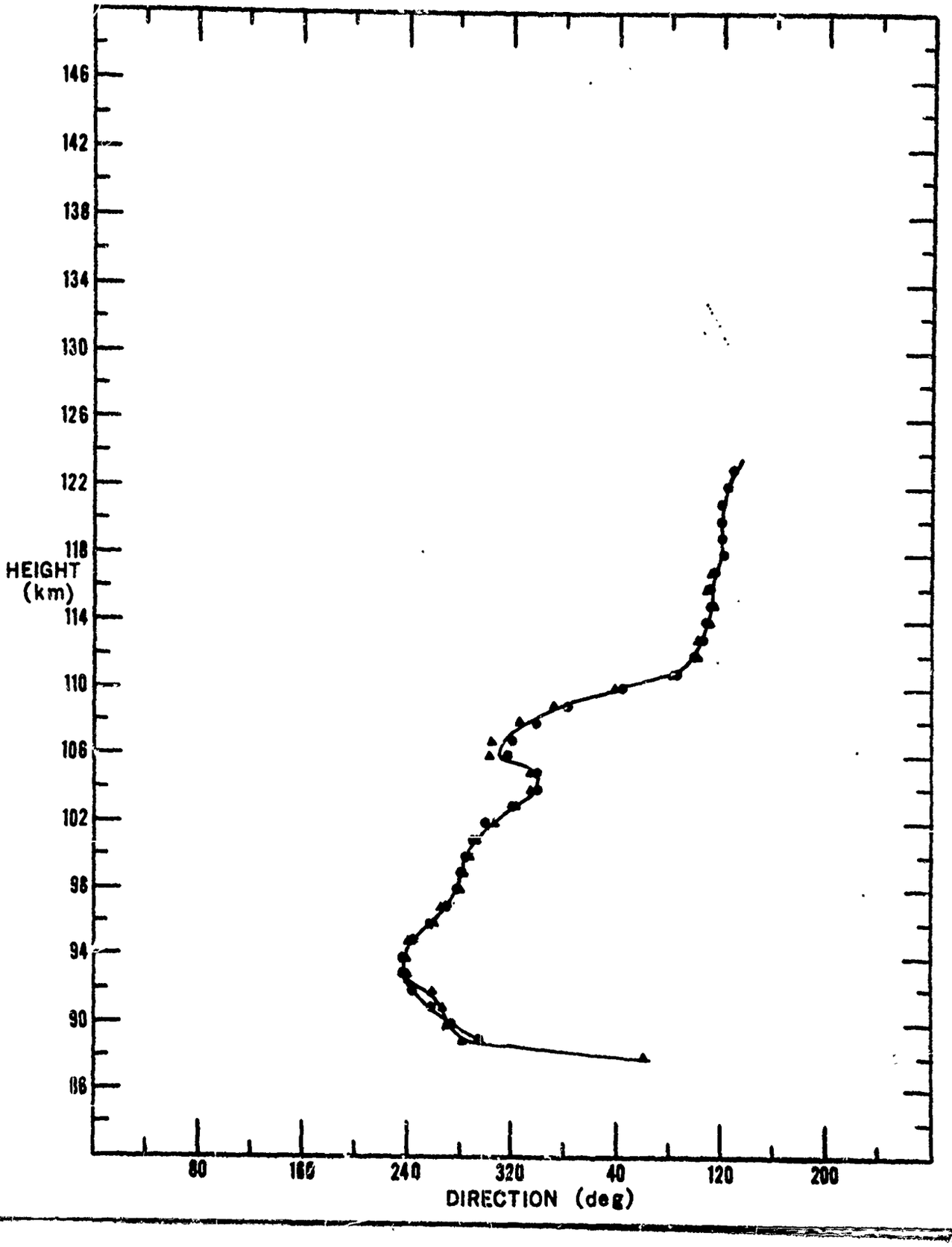
• UP

▲ DOWN

TRAIL NO. B59 BELFAST

15 FEBRUARY 1967 21:17:00 AST

H.A.R.P. BARBADOS



TRAIL NO. 860 CORK
BARBADOS 15 FEBRUARY 1967 22-45-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
89.0	357.8	12.1	12.1	-0.5	11.9	2.0
90.0	8.3	16.2	16.0	2.3	15.2	5.5
91.0	325.0	42.3	34.6	-24.2	38.8	-16.7
92.0	326.3	65.9	54.8	-36.5	61.1	-24.6
93.0	327.0	68.4	57.3	-37.2	63.7	-24.8
94.0	321.7	63.6	49.9	-39.4	56.9	-28.4
95.0	315.3	57.9	41.2	-40.7	48.6	-31.5
96.0	305.0	44.9	25.7	-36.7	32.6	-30.7
97.0	303.3	45.4	24.9	-38.0	32.1	-32.1
98.0	307.0	50.9	30.6	-40.6	38.2	-33.5
99.0	310.0	55.3	35.6	-42.4	43.5	-34.3
100.0	317.7	57.2	42.3	-38.6	49.3	-29.2
101.0	320.7	63.1	48.8	-40.0	55.9	-29.3

IV-81

TRAIL NO. B60 CORK

15 FEBRUARY 1967 22:45:00 AST

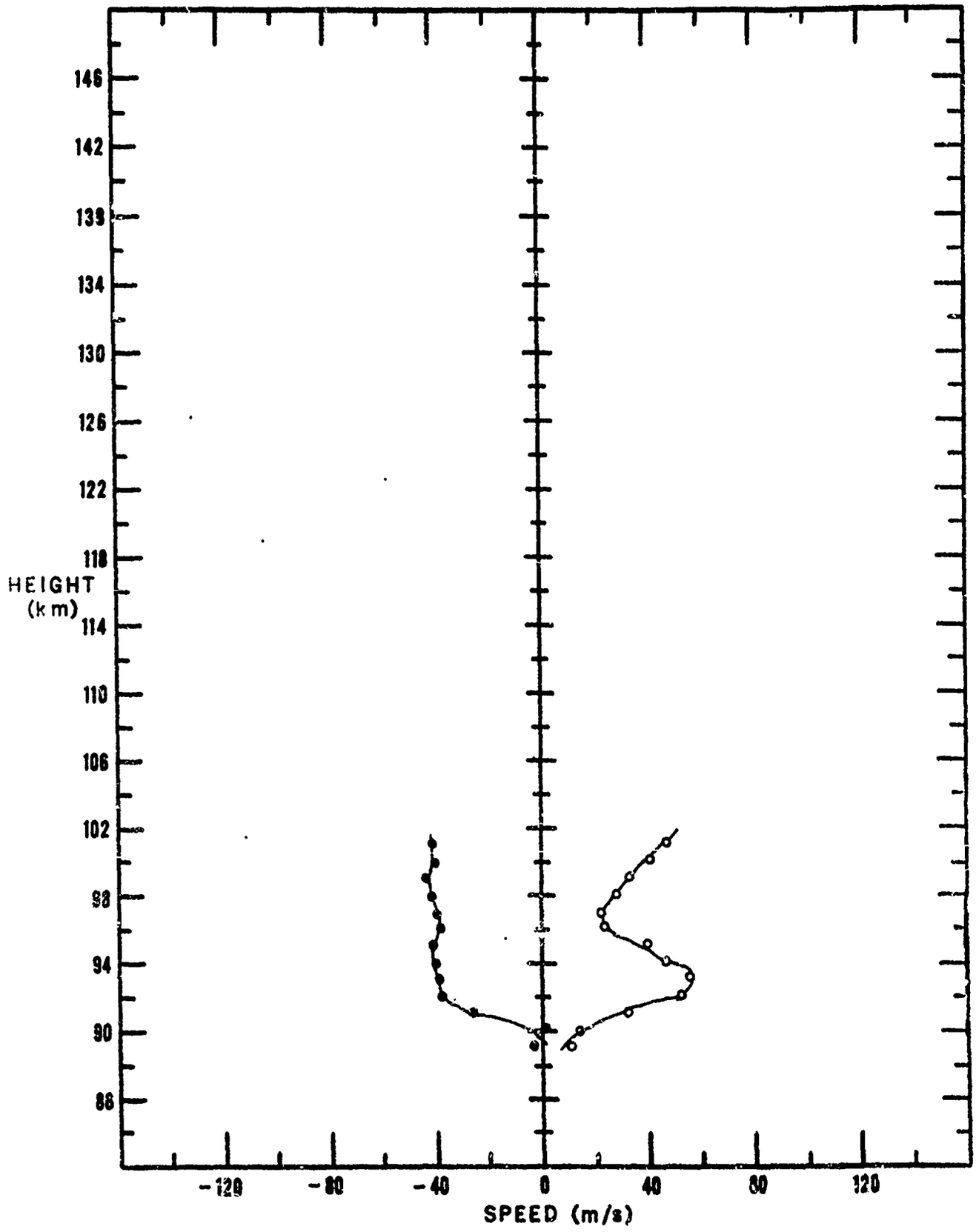
H.A.R.P. BARBADOS

WIND COMPONENTS

UP

N-S o

E-W •



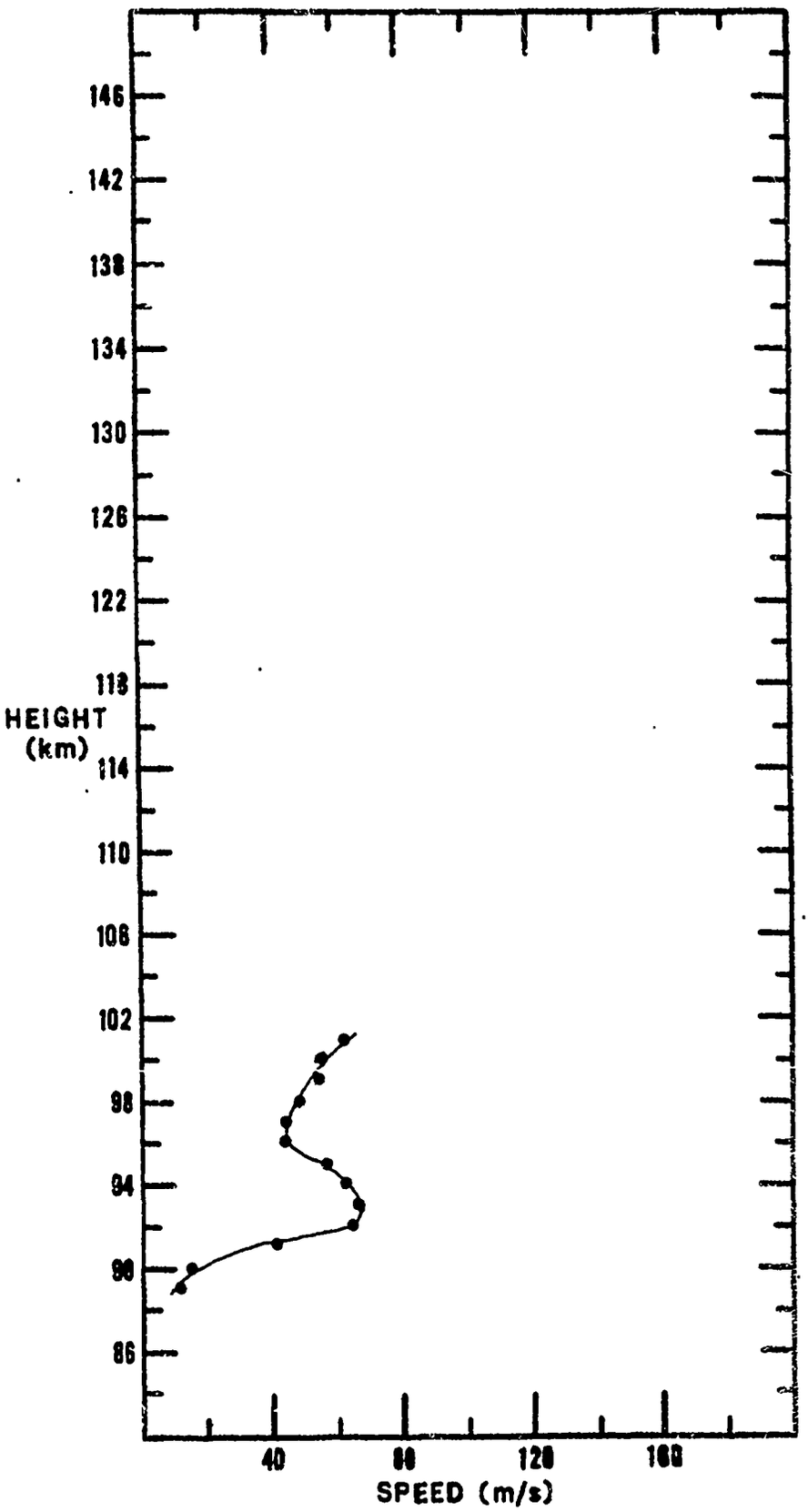
WIND SPEED

• UP

TRAIL NO. B60 CORK

15 FEBRUARY 1967 22:45:00 AST

H.A.R.P. BARBADOS



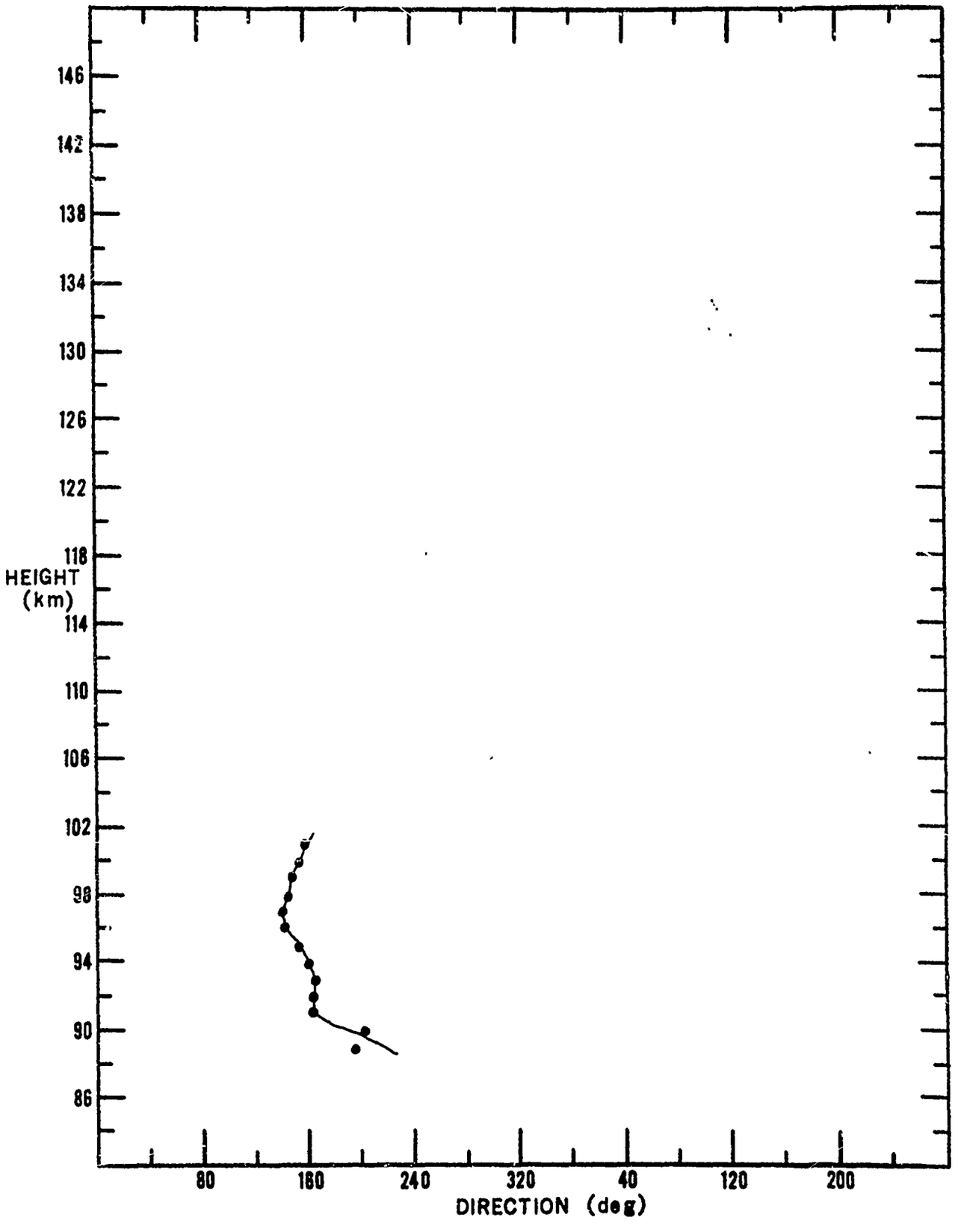
TRAIL NO. B60 CORK

15 FEBRUARY 1967 22:45:00 AST

H.A.R.P. BARBADOS

WIND DIRECTION

• UP



TRAIL NO. B61 DUBLIN
BARBADOS 15 FEBRUARY 1967 22-45-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
88.0	49.2	34.0	22.2	25.7	16.5	29.7
89.0	34.0	35.4	29.4	19.8	24.8	25.4
90.0	12.7	34.1	33.3	7.5	31.1	14.1
91.0	348.2	32.4	31.7	-6.6	32.4	0.0
92.0	324.0	39.0	31.6	-23.0	35.6	-16.1
93.0	313.2	47.3	32.3	-34.5	38.6	-27.2
94.0	310.4	52.7	34.2	-40.2	41.7	-32.4
95.0	265.6	78.9	34.5	-71.0	48.2	-62.5
96.0	294.9	75.2	31.6	-68.3	44.8	-60.5
97.0	279.1	71.1	11.3	-70.2	25.3	-66.4
98.0	268.3	64.6	-1.9	-64.6	11.3	-63.6
99.0	268.8	62.0	-1.2	-62.0	11.4	-61.0
100.0	280.8	63.0	11.8	-61.9	24.1	-58.2
101.0	277.4	75.5	9.7	-74.9	24.7	-71.4
102.0	265.9	72.1	-5.1	-71.9	9.6	-71.4
103.0	262.6	28.9	-3.7	-28.6	2.2	-28.8
104.0	282.9	7.6	1.7	-7.4	3.2	-6.9
105.0	36.1	13.4	10.8	7.9	9.0	9.9
106.0	52.1	21.1	12.9	16.6	9.3	18.9
107.0	60.2	28.2	14.0	24.5	8.7	26.8
108.0	65.6	35.0	14.4	31.9	7.6	34.2
109.0	68.2	43.1	16.0	40.0	7.5	42.4
110.0	70.4	51.0	17.1	48.0	7.0	50.5
111.0	73.1	57.7	16.7	55.2	5.1	57.4
112.0	74.2	65.7	17.9	63.2	4.7	65.5
113.0	77.5	69.7	15.1	68.1	1.0	69.7
114.0	77.6	75.8	16.2	74.0	0.8	75.7
115.0	78.7	71.9	14.1	7 .5	-0.5	71.9
116.0	80.4	75.0	12.5	74.0	-2.8	75.0
117.0	76.7	75.3	17.3	73.3	2.0	75.3

TRAIL NO. B61 DUBLIN
BARBADOS 15 FEBRUARY 1967 22-45-00 AST
DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
88.0	37.9	37.6	29.7	23.1	24.4	28.7
89.0	62.5	41.4	36.7	19.1	32.1	26.2
90.0	342.3	34.7	33.1	-10.6	34.6	-3.7
91.0	335.5	34.7	31.6	-14.4	33.9	-7.7
92.0	318.4	42.2	31.5	-28.0	36.5	-21.0
93.0	306.6	52.9	31.5	-42.5	39.5	-35.2
94.0	306.6	56.4	33.6	-45.3	42.1	-37.5
95.0	297.9	68.2	31.9	-60.2	43.5	-52.5
96.0	284.7	85.1	21.5	-82.3	37.8	-76.2
97.0	284.6	74.7	18.8	-72.3	33.1	-67.0
98.0	267.9	66.7	-2.4	-66.7	11.2	-65.8
99.0	266.6	64.6	-3.9	-64.4	9.3	-63.8
100.0	269.3	62.0	-0.8	-62.0	11.8	-60.9
101.0	275.6	77.1	7.5	-76.7	22.9	-73.6
102.0	269.7	74.0	-0.4	-74.0	14.6	-72.5
103.0	266.0	34.5	-2.4	-34.4	4.6	-34.2
104.0	339.5	12.4	11.6	-4.3	12.2	-1.9
105.0	41.8	19.8	14.8	13.2	11.8	15.9
106.0	56.5	27.6	15.2	23.1	10.2	25.7
107.0	65.9	31.7	12.9	28.9	6.8	30.9
108.0	72.0	34.7	10.7	33.0	3.8	34.5
109.0	77.0	47.7	10.8	46.5	1.1	47.7
110.0	75.4	56.3	14.2	54.5	2.8	56.2
111.0	77.2	66.6	14.7	65.0	1.2	66.6
112.0	79.6	66.9	12.0	65.8	-1.6	66.9
113.0	84.3	73.0	7.3	72.6	-7.6	72.6
114.0	87.8	74.3	2.8	74.3	-12.4	73.3
115.0	92.2	81.9	-3.2	81.8	-19.7	79.4
116.0	93.9	86.8	-5.9	86.6	-23.4	83.6
117.0	96.8	85.2	-10.0	84.6	-27.0	80.8

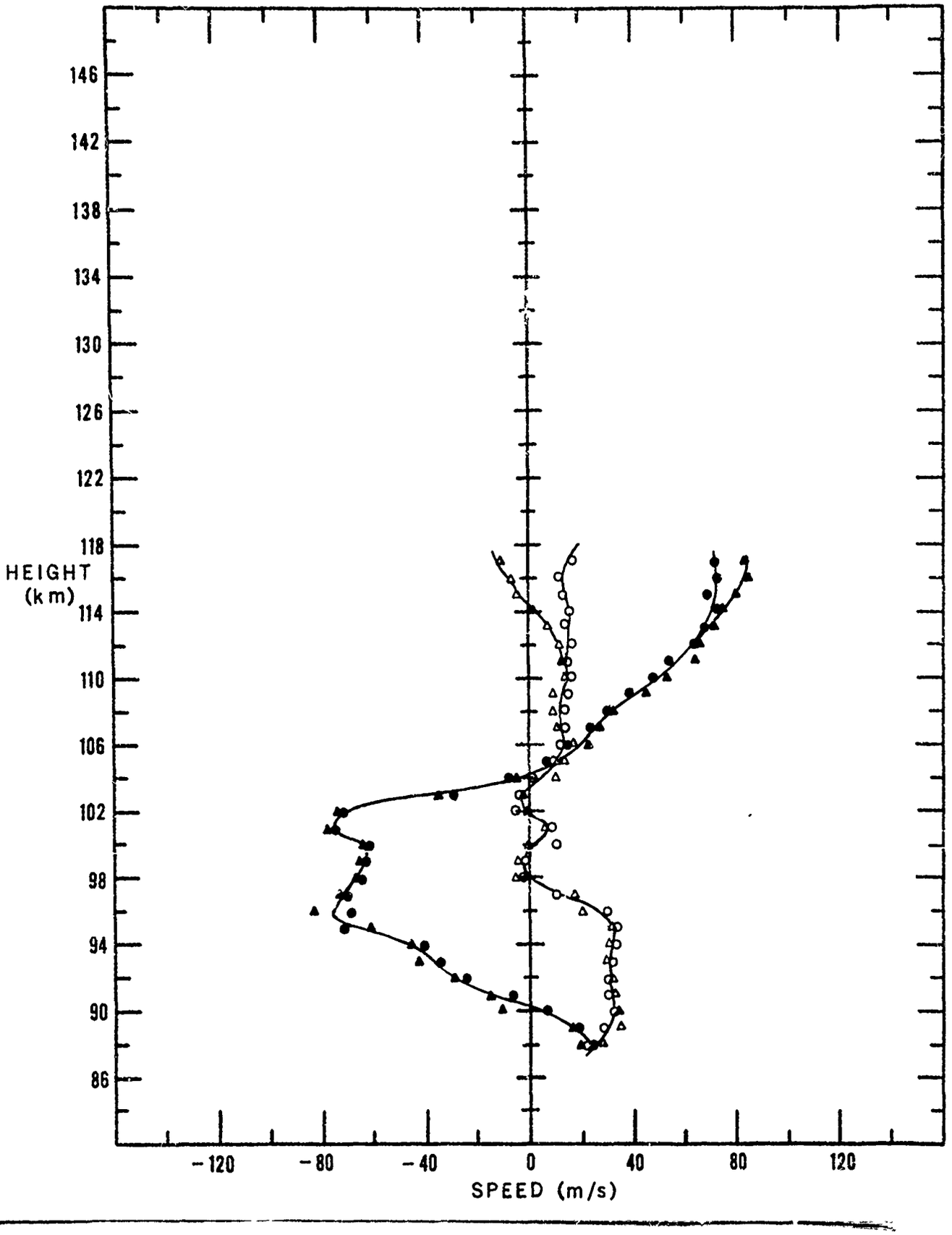
WIND COMPONENTS

	UP	DOWN
N-S	○	△
E-W	●	▲

TRAIL NO. B61 DUBLIN

15 FEBRUARY 1967 23:56:00 AST

H.A.R.P. BARBADOS



WIND DIRECTION

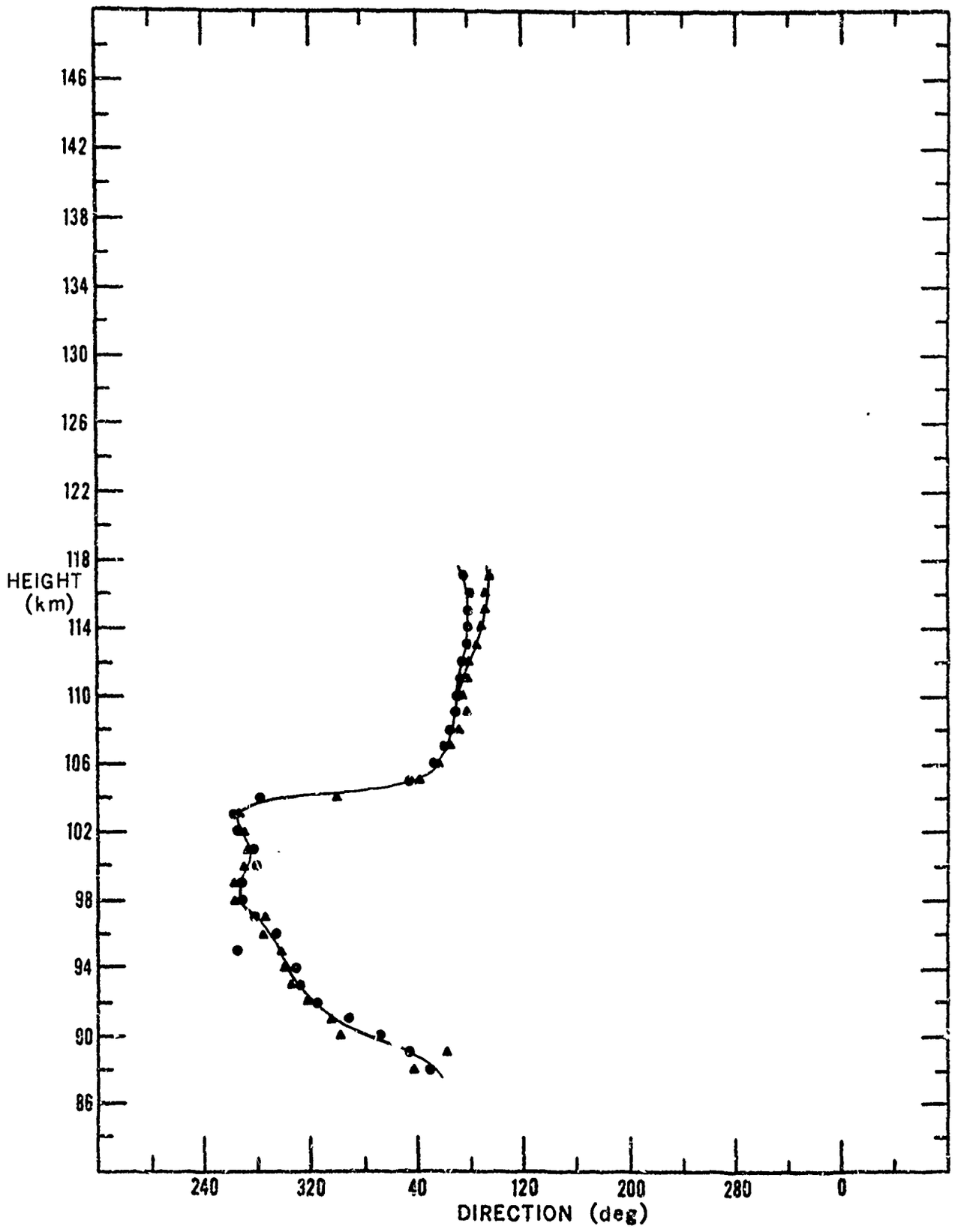
• UP

▲ DOWN

TRAIL NO. B61 DUBLIN

15 FEBRUARY 1967 23:56:00 AST

H.A.R.P. BARBADOS



WIND SPEED

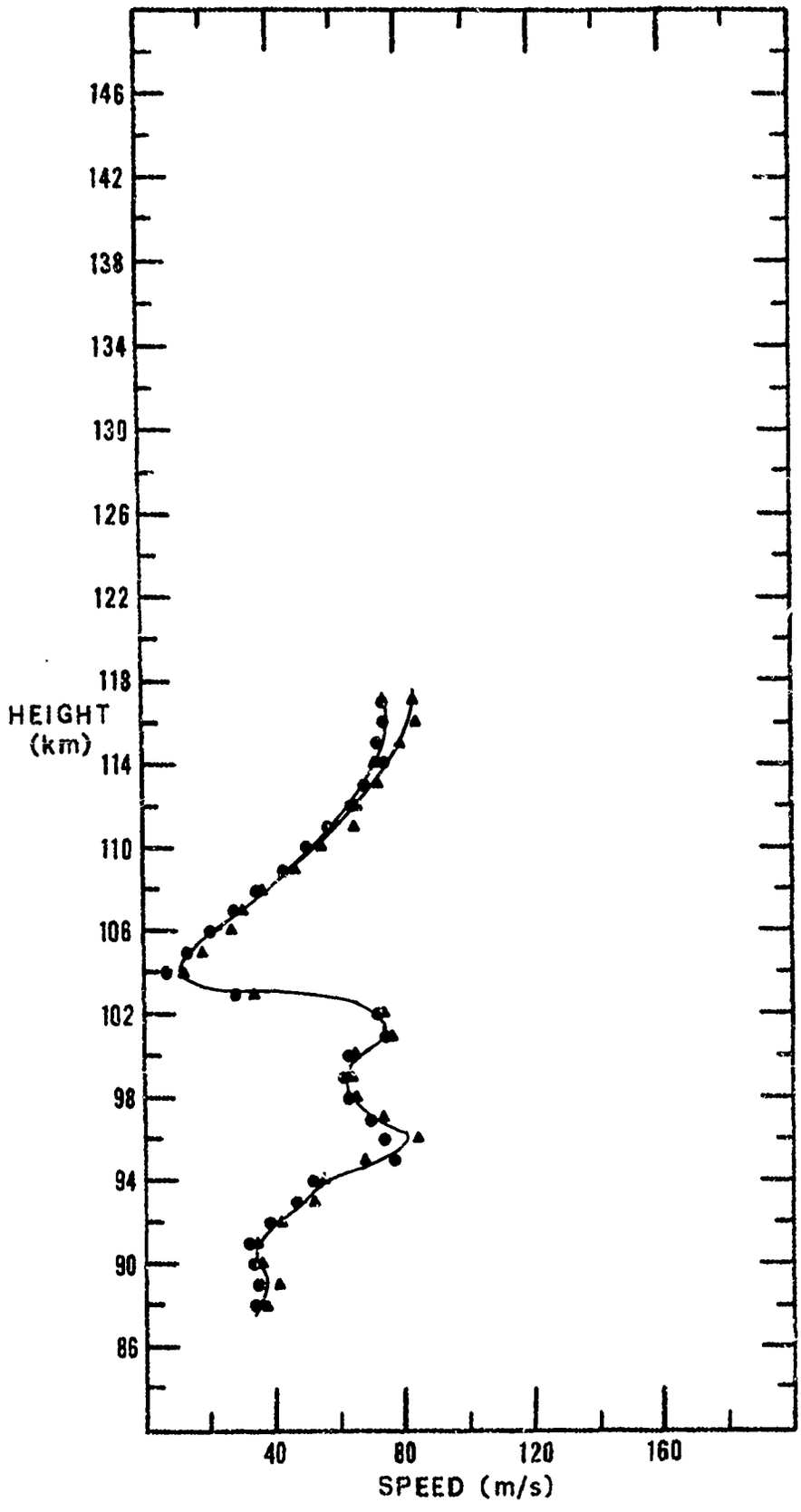
● UP

▲ DOWN

TRAIL NO. B61 DUBLIN

15 FEBRUARY 1967 23:56:00 AST

H.A.R.P. BARBADOS



TRAIL NO. B62 GARVAGH

BARBADOS 15 FEBRUARY 1967 22-45-00 AST

DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
89.0	305.1	56.2	32.3	-46.0	41.0	-38.5
90.0	276.1	51.2	5.5	-50.9	15.7	-48.7
91.0	275.3	46.2	4.3	-46.0	13.6	-44.2
92.0	275.6	39.8	3.9	-39.6	11.9	-38.0
93.0	277.4	46.5	6.0	-46.2	15.3	-44.0
94.0	282.9	53.9	12.0	-52.5	22.4	-49.0
95.0	286.9	58.7	17.1	-56.2	28.2	-51.6
96.0	283.8	63.0	15.0	-61.2	27.1	-56.9
97.0	269.8	70.7	-0.2	-70.7	14.2	-69.3
98.0	258.9	66.3	-12.7	-65.0	0.8	-66.2
99.0	249.3	61.6	-21.8	-57.6	-9.6	-60.8
100.0	269.5	58.3	-0.5	-58.3	11.4	-57.2
101.0	287.9	33.7	10.3	-32.0	16.6	-29.2
102.0	302.6	11.2	6.0	-9.4	7.8	-8.0
103.0	346.1	4.4	4.3	-1.1	4.4	-0.2
104.0	51.3	14.1	8.8	11.0	6.4	12.6
105.0	65.1	19.5	8.2	17.7	4.4	19.0
106.0	69.4	28.7	10.1	26.9	4.4	28.4
107.0	68.0	40.5	15.2	37.6	7.2	39.9
108.0	75.7	47.5	11.7	46.0	2.1	47.4
109.0	71.9	56.2	17.4	53.4	6.2	55.8
110.0	77.6	44.5	9.6	43.5	0.6	44.5
111.0	74.6	39.6	10.5	38.2	2.5	39.5
112.0	61.7	32.5	15.5	28.6	9.4	31.2
113.0	45.8	30.9	21.5	22.1	16.6	26.0
114.0	354.3	33.1	32.9	-3.3	32.9	3.5
115.0	354.6	32.1	32.0	-3.0	31.9	3.6
116.0	354.1	33.1	33.0	-3.4	33.0	3.4

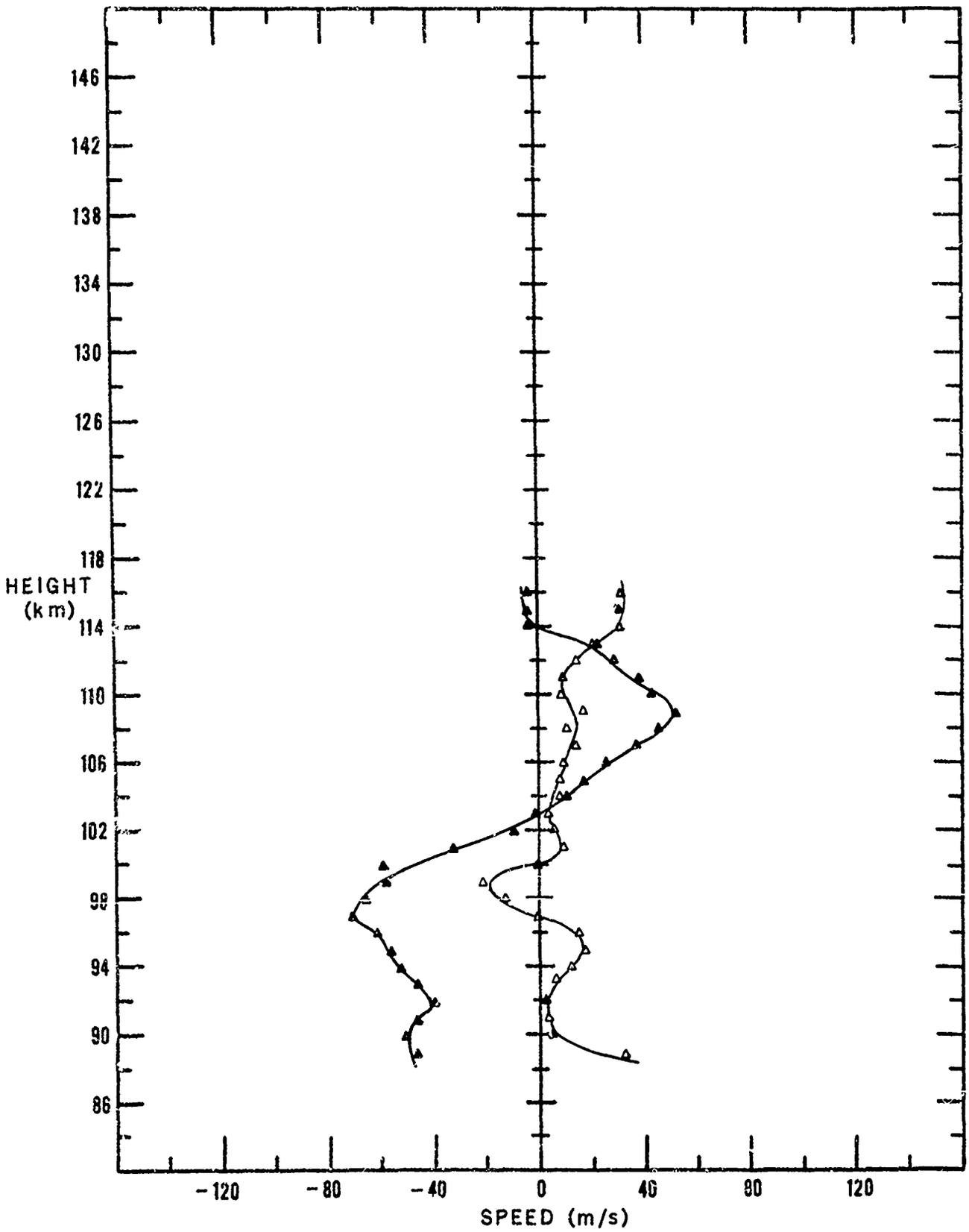
WIND COMPONENTS

	UP	DOWN
N-S	o	△
E-W	●	▲

TRAIL NO. B62 GARVAGH

16 FEBRUARY 1967 01:05:00 AST

H.A.R.P. BARBADOS



WIND SPEED

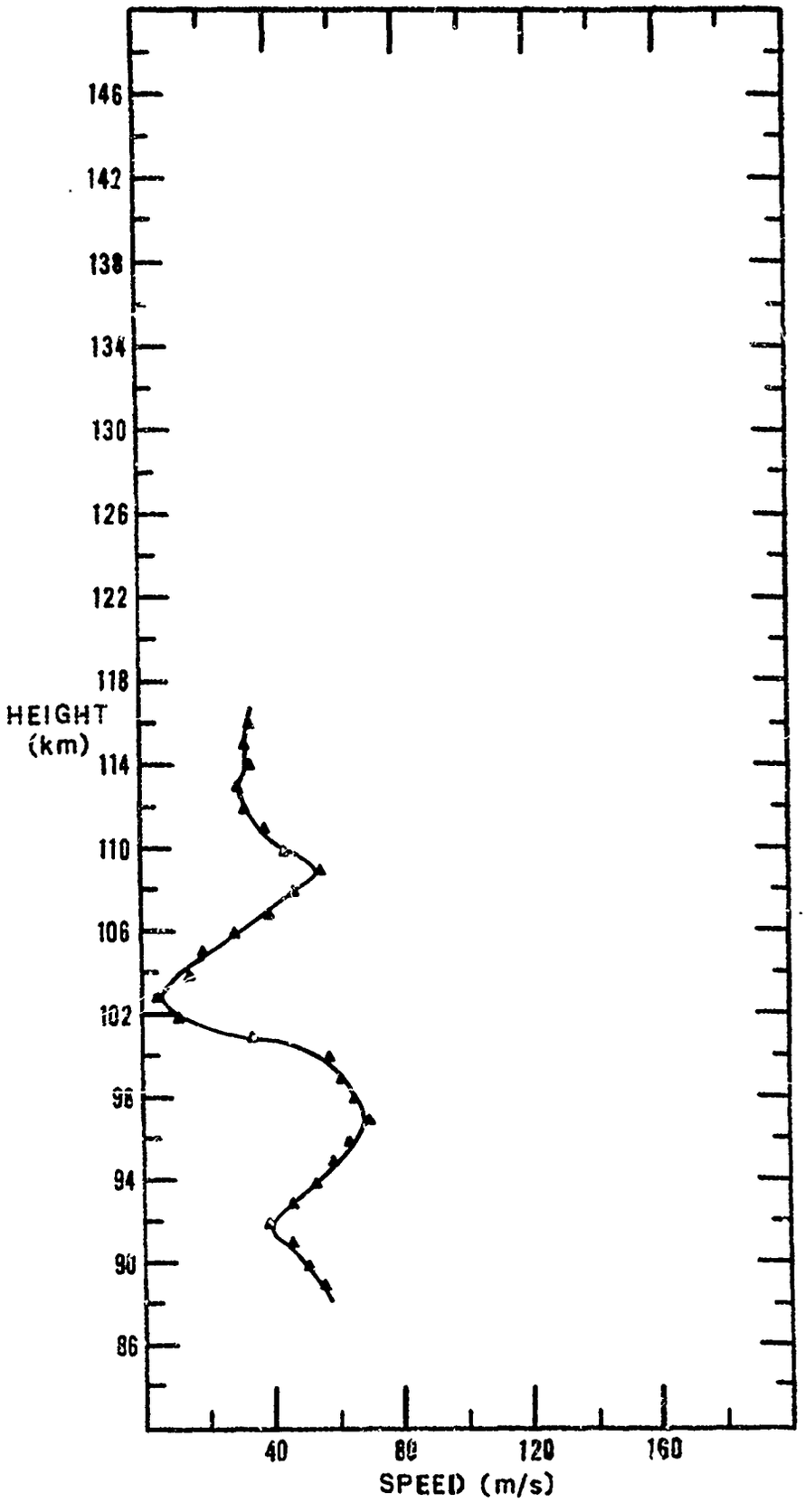
● UP

▲ DOWN

TRAIL NO. B62 GARVAGH

16 FEBRUARY 1967 01:05:00 AST

H.A.R.P. BARBADOS



WIND DIRECTION

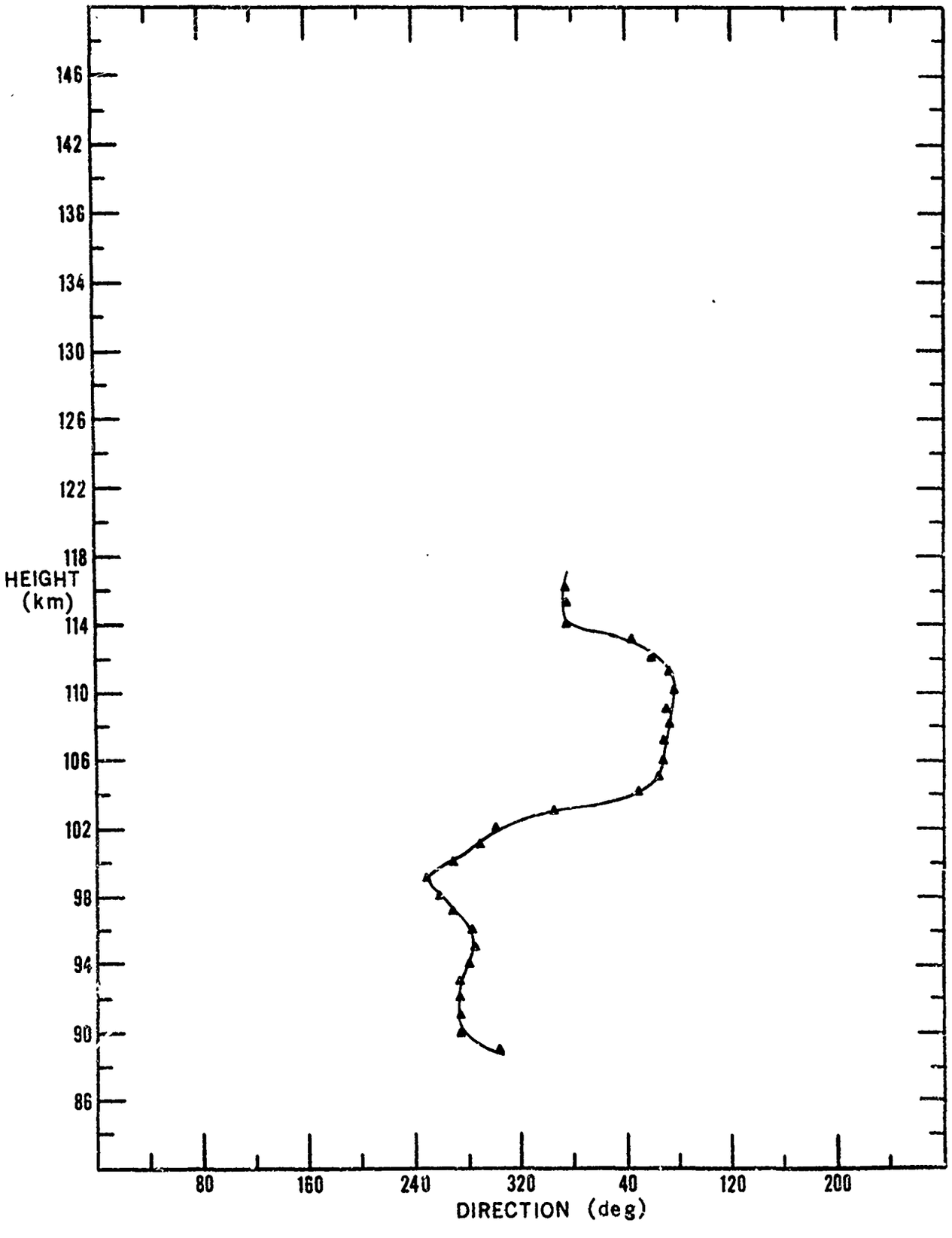
• UP

▲ DOWN

TRAIL NO. B62 GARVAGH

16 FEBRUARY 1967 01:05:00 AST

H.A.R.P. BARBADOS



TRAIL NO. B63 HOLLYWOOD
BARBADOS 15 FEBRUARY 1967 22-45-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
88.0	352.1	62.6	62.1	-8.6	62.6	4.2
89.0	347.5	81.8	79.9	-17.7	81.8	-1.1
90.0	312.2	78.2	52.5	-58.0	63.2	-46.1
91.0	311.3	54.5	36.0	-41.0	43.6	-32.8
92.0	304.2	45.5	25.6	-37.6	32.7	-31.6
93.0	296.0	45.6	20.0	-41.0	27.9	-36.1
94.0	306.2	40.4	23.9	-32.6	30.0	-27.1
95.0	322.4	41.4	32.8	-25.3	37.3	-18.1
96.0	321.2	55.8	43.5	-34.9	49.7	-25.3
97.0	308.3	61.7	38.2	-48.4	47.2	-39.6
98.0	303.6	63.2	35.0	-52.6	45.0	-44.4
99.0	297.1	52.6	24.0	-46.8	33.0	-40.9
100.0	282.0	49.2	10.3	-48.1	19.9	-45.0
101.0	283.4	43.9	10.2	-42.7	18.7	-39.7
102.0	310.3	36.7	23.8	-28.0	29.0	-22.6
103.0	353.2	40.4	40.2	-4.8	40.3	3.5
104.0	10.7	52.0	51.1	9.7	48.1	19.9
105.0	19.1	54.0	51.0	17.7	46.3	27.7
106.0	30.3	57.8	49.9	29.2	42.9	38.7
107.0	43.6	65.1	47.1	44.9	37.0	53.5
108.0	56.1	64.3	35.8	53.4	24.2	59.6
109.0	43.9	29.6	21.4	20.5	16.8	24.4

TRAIL NO. B63 HOLLYWOOD
BARBADOS 15 FEBRUARY 1967 22-45-00 AST
DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
102.0	348.1	43.2	42.3	-8.9	43.2	-0.1
103.0	18.6	44.9	42.5	14.3	38.7	22.6
104.0	35.7	54.3	44.1	31.7	36.7	40.0
105.0	50.5	70.0	44.5	54.1	32.6	62.0
106.0	62.9	67.2	30.6	59.8	17.8	64.8
107.0	69.0	50.1	18.0	46.8	8.1	49.5
108.0	73.7	39.8	11.2	38.2	3.2	39.7
109.0	72.0	31.8	9.8	30.2	3.5	31.6
110.0	12.0	21.1	20.6	4.4	19.3	8.5
111.0	329.3	51.0	43.9	-26.0	48.3	-16.5
112.0	333.9	64.1	57.6	-28.2	62.1	-15.9

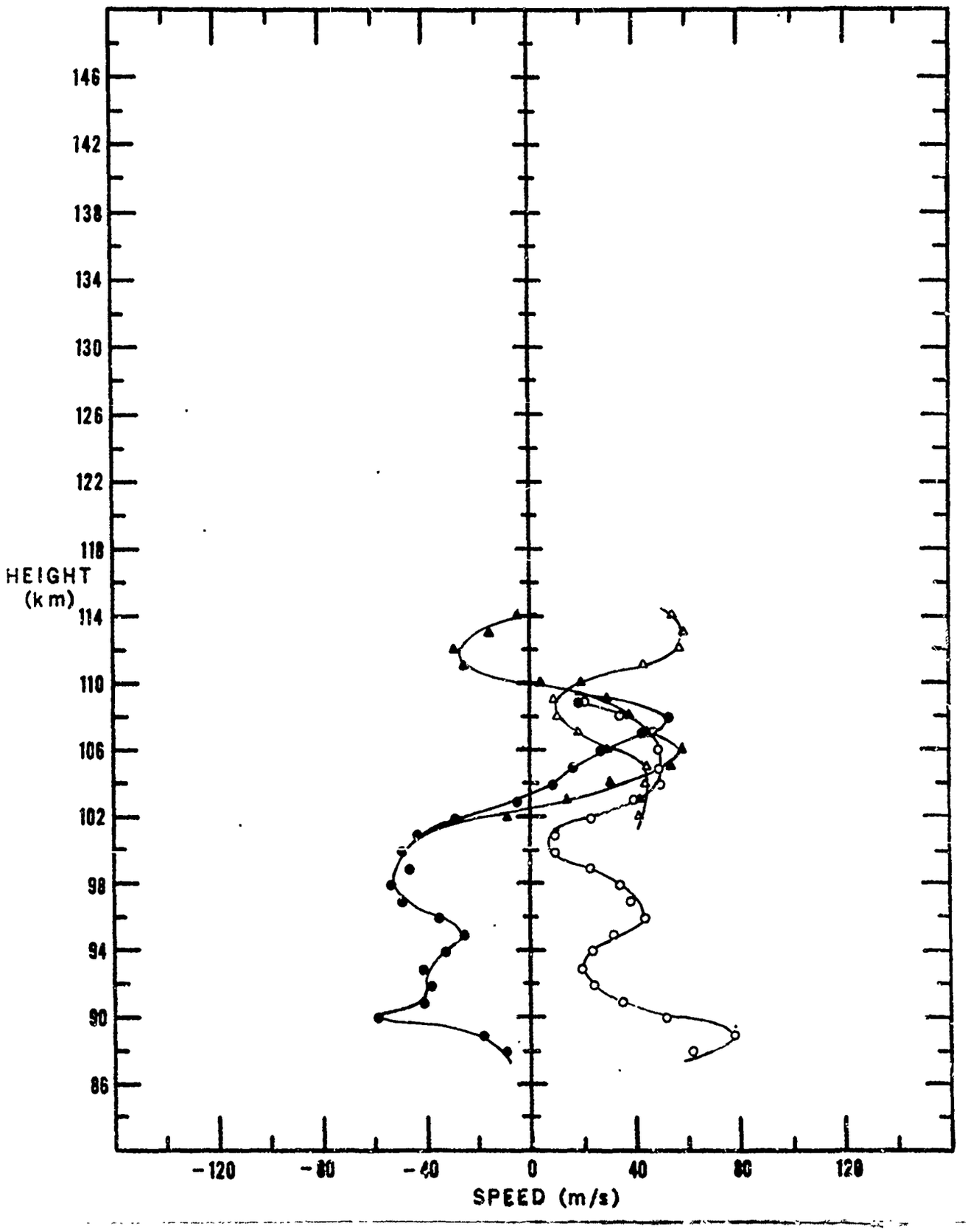
WIND COMPONENTS

	UP	DOWN
N-S	o	△
E-W	•	▲

TRAIL NO. B63 HOLLYWOOD

16 FEBRUARY 1967 02:10:00 AST

H.A.R.P. BARBADOS



WIND SPEED

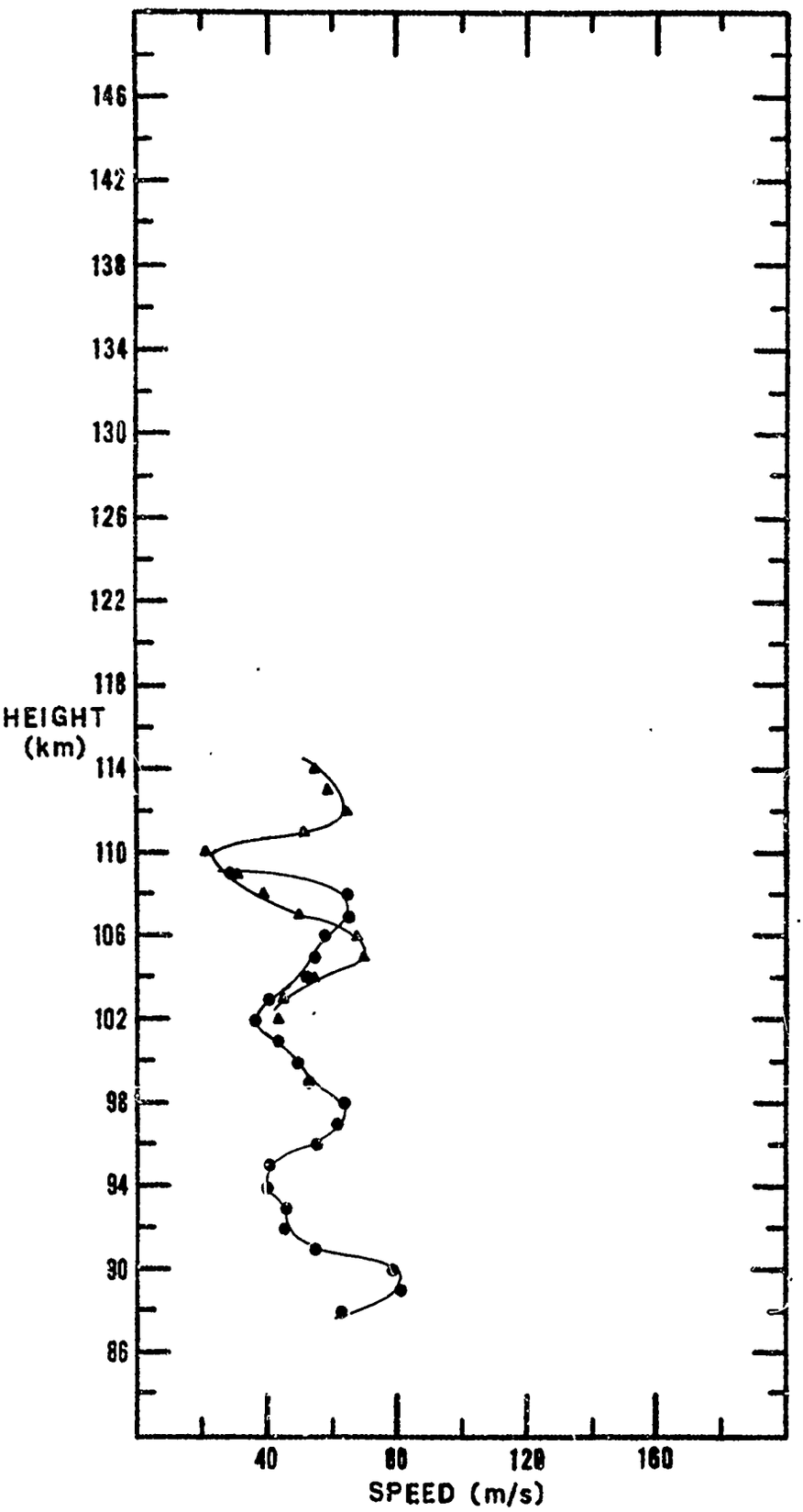
● UP

▲ DOWN

TRAIL NO. B63 HOLLYWOOD

16 FEBRUARY 1967 02:10:00 AST

H.A.R.P. BARBADOS



WIND DIRECTION

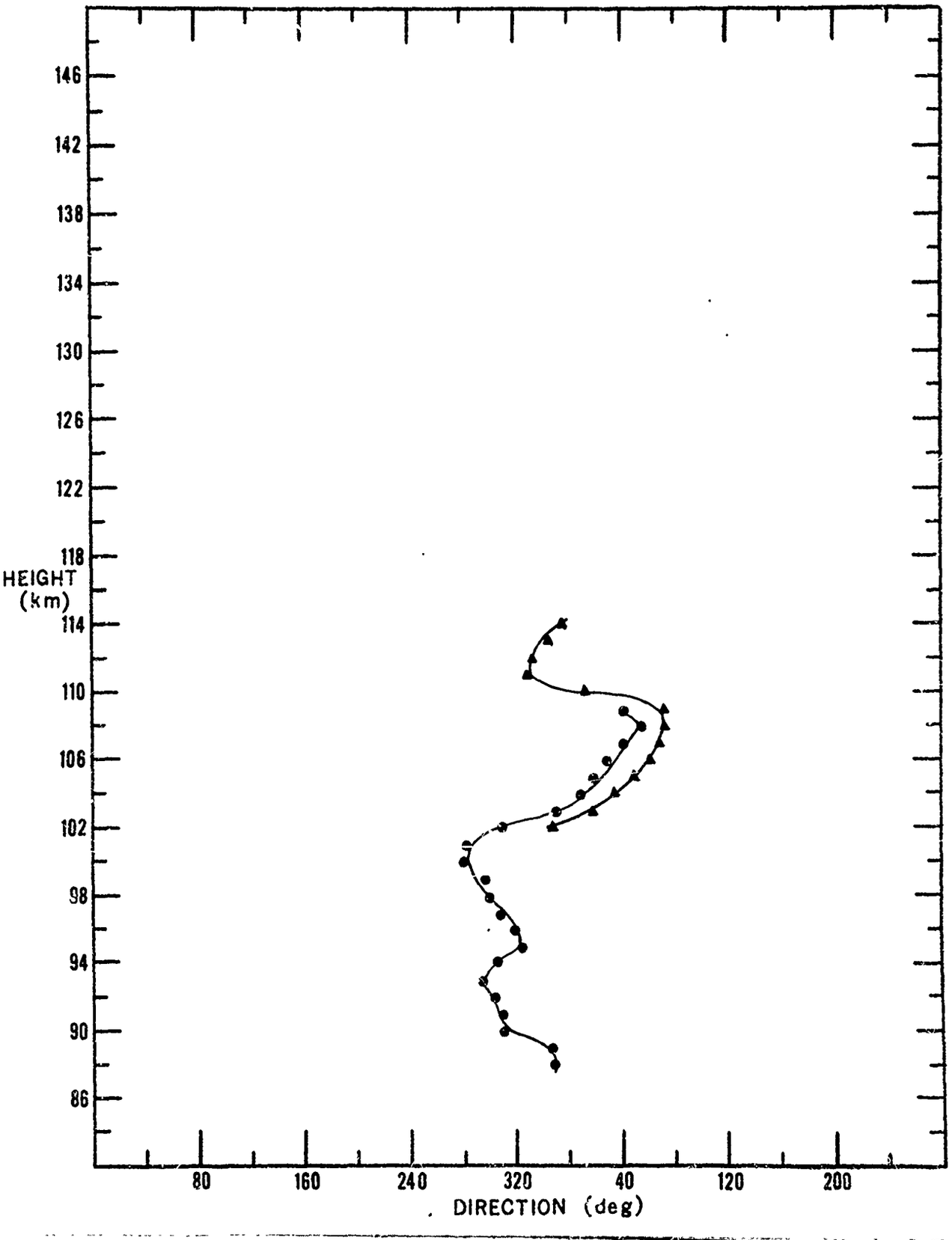
• UP

▲ DOWN

TRAIL NO. B63 HOLLYWOOD

16 FEBRUARY 1967 02:10:00 AST

H.A.R.P. BARBADOS



TRAIL NO. B64 KERRY 65 LIMERICK
BARBADOS 15 FEBRUARY 1967 22-45-00 AST
UP TRAIL

..TITUDE	WIND HEADING	WIND VELOCITY	WIND COMPONENTS (M/S) GEOGRAPHIC		MAGNETIC	
(KM)	(DEG)	(M/S)	N-S	E-W	N-S	E-W
93.0	293.9	61.3	24.8	-56.0	35.7	-49.8
94.0	298.6	71.8	34.4	-63.0	46.5	-54.7
95.0	289.7	84.0	28.3	-79.1	43.8	-71.7
96.0	285.6	89.8	24.1	-86.5	41.2	-79.8
97.0	291.2	78.0	28.2	-72.8	42.4	-65.6
98.0	300.3	64.2	32.4	-55.4	43.0	-47.7
9.0	317.3	54.3	39.9	-36.8	46.5	-27.9
10.0	11.8	48.6	47.5	10.0	44.5	19.4
.1.0	30.7	57.5	49.4	29.3	42.4	38.7
12.0	35.8	62.9	51.1	36.8	42.6	46.4
13.0	33.3	70.6	59.0	38.8	49.9	50.0
14.0	43.1	78.4	57.2	53.6	45.1	64.1
15.0	46.4	83.4	57.5	60.4	44.0	70.6
16.0	47.9	85.2	57.2	63.2	43.2	73.5
07.0	47.4	86.3	58.4	63.5	44.3	74.0
.08.0	46.7	90.4	62.0	65.8	47.3	77.0
09.0	34.0	77.7	64.1	43.9	53.8	56.0
10.0	356.1	76.7	76.5	-5.2	76.0	10.4
11.0	359.2	86.8	86.8	-1.2	85.2	16.5
.2.0	358.9	104.5	104.4	-2.0	102.6	19.2
13.0	349.3	89.6	88.0	-16.6	89.5	1.6
14.0	345.3	91.6	88.6	-23.2	91.5	-4.7
15.0	341.3	90.1	85.3	-28.8	89.4	-10.9
16.0	338.0	89.5	83.0	-33.5	88.1	-15.9

TRAIL NO. B 64 KERRY

WIND COMPONENTS

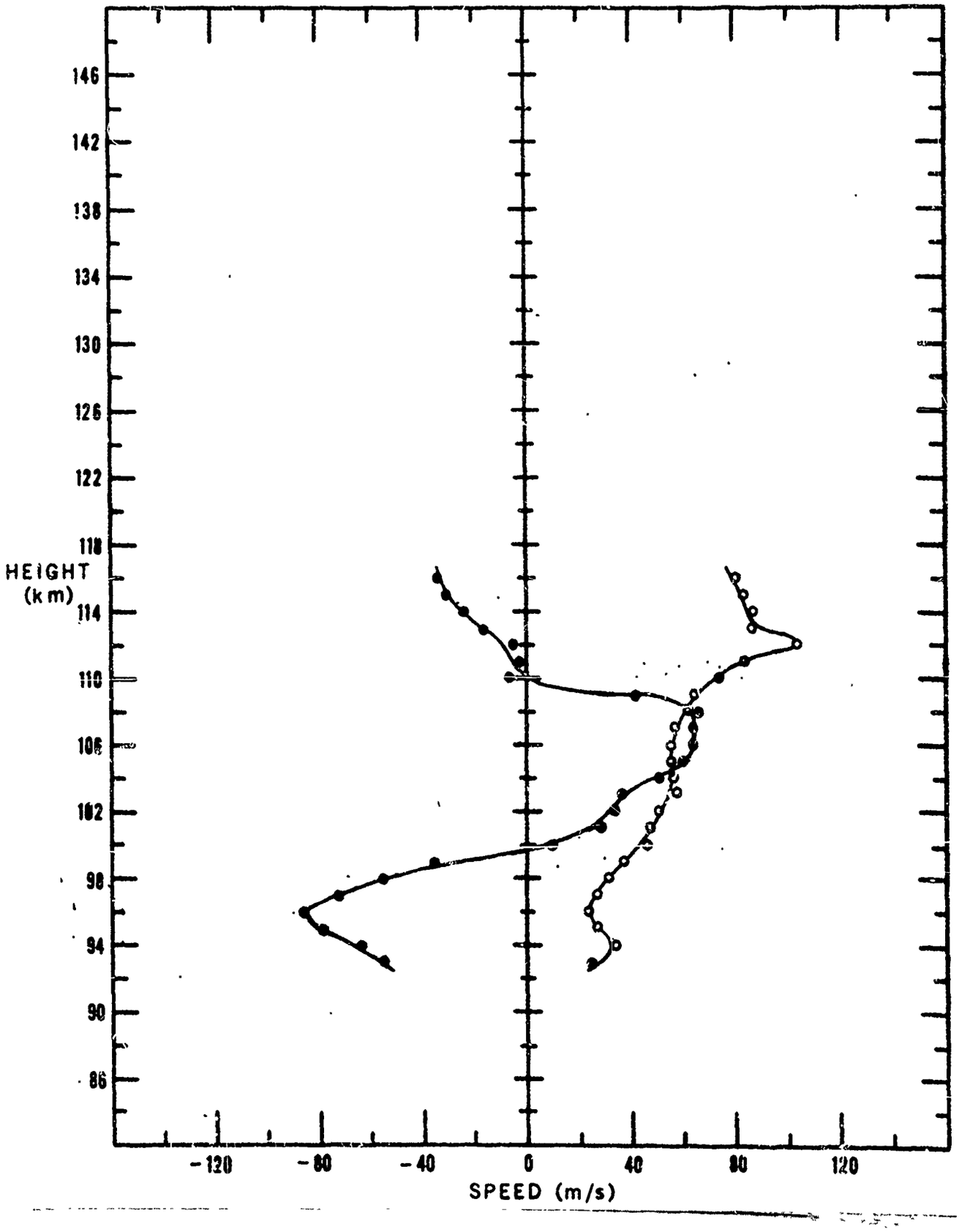
UP

N-S o

E-W ●

16 FEBRUARY 1967 03:23:00 A S T

H.A.R.P. BARBADOS

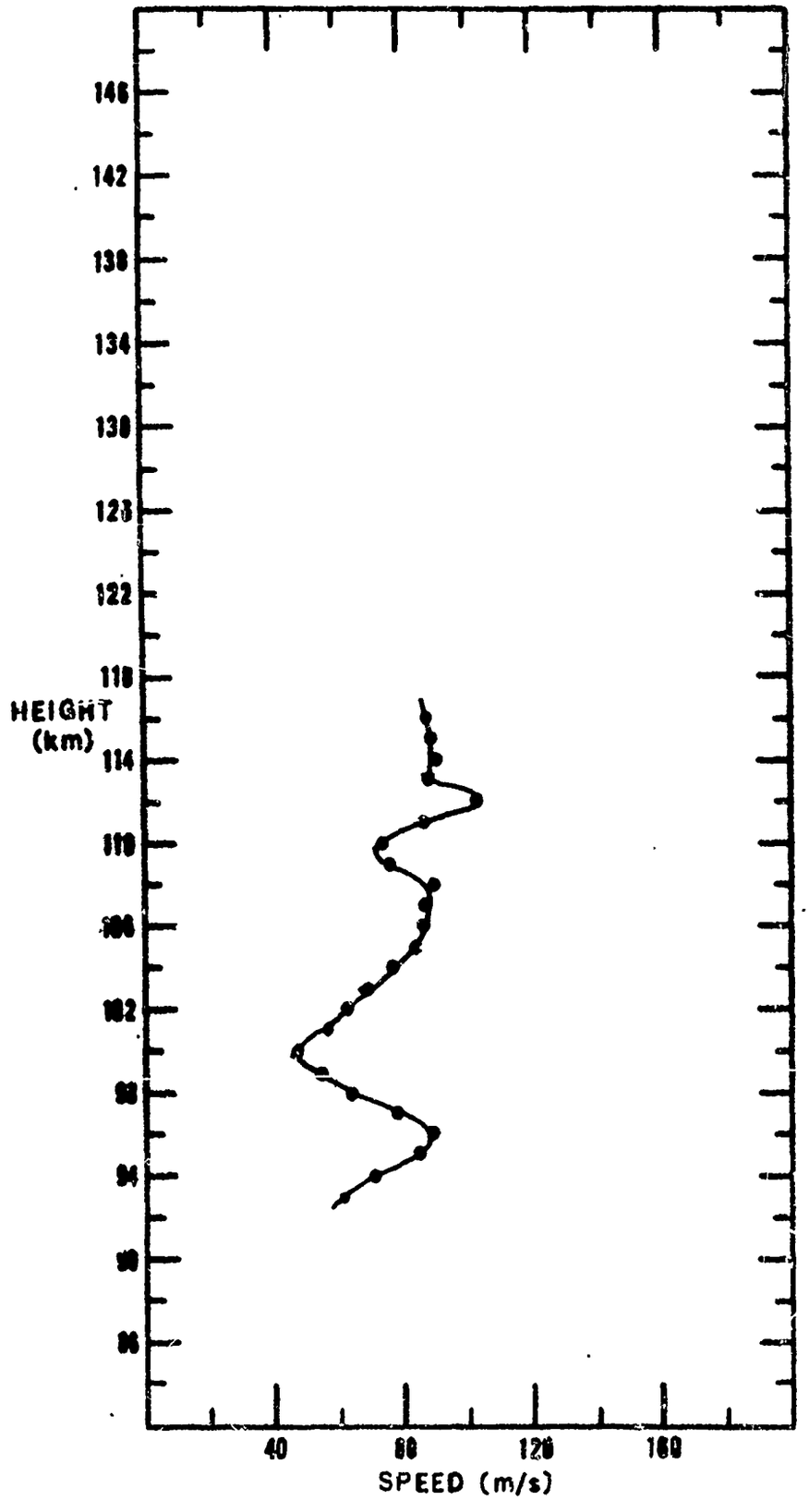


TRAIL NO. B 64 KERRY

WIND SPEED
• UP

16 FEBRUARY 1967 03:23:00 A S T

H.A.R.P. BARBADOS

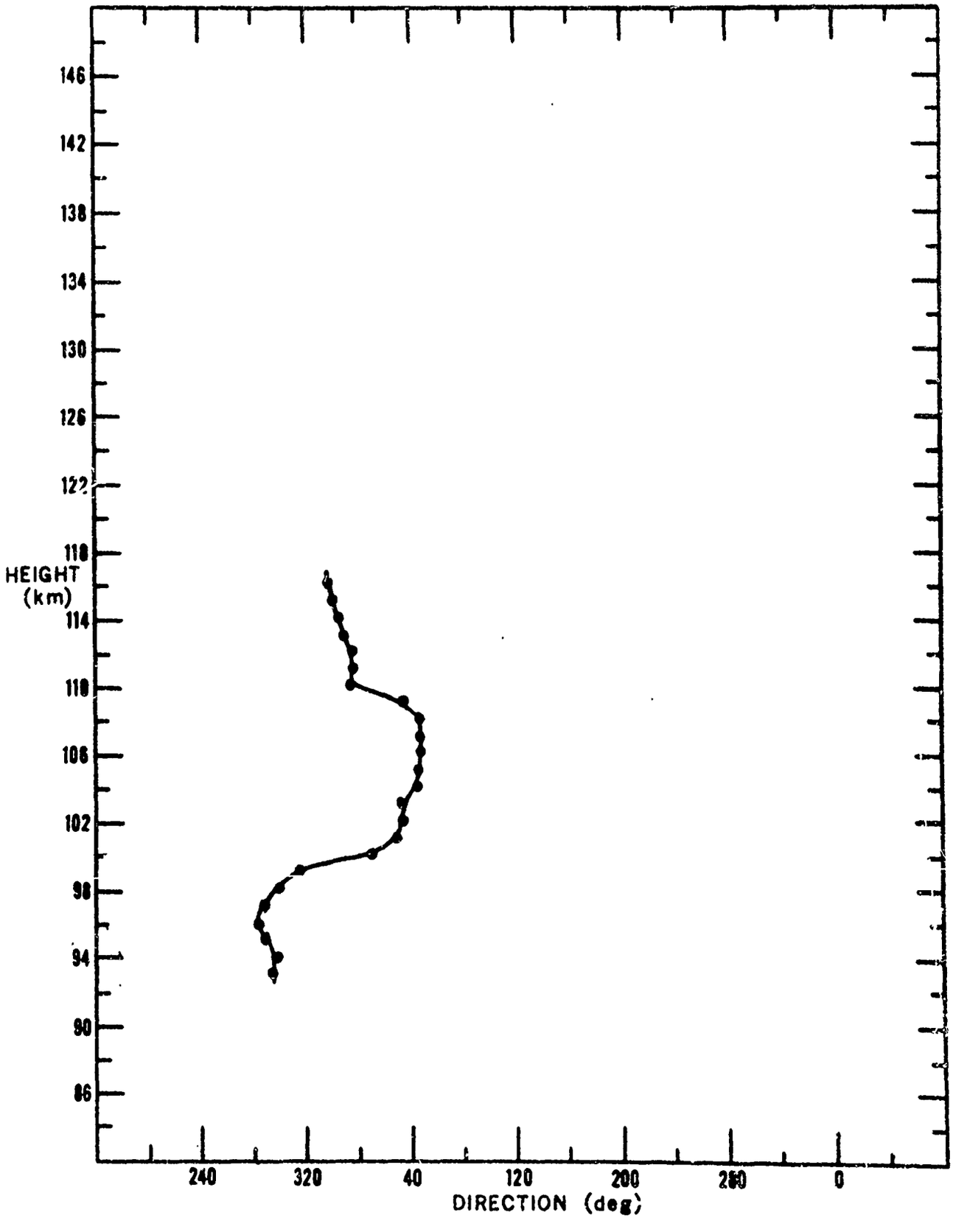


TRAIL NO. B 64 KERRY

WIND DIRECTION
• UP

16 FEBRUARY 1967 03:23:00 A S T

H.A.R.P. BARBADOS



TRAIL NO. B65 LIMERICK
BARBADOS 15 FEBRUARY 1967 22-45-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
95.0	302.6	106.7	57.5	-89.9	74.6	-76.3
96.0	326.9	79.4	66.5	-43.4	73.9	-29.0
97.0	342.7	64.7	61.8	-19.2	64.4	-6.2
98.0	356.4	60.7	60.6	-3.8	60.1	8.6
99.0	2.8	65.0	65.0	3.2	63.0	16.3
00.0	11.8	74.0	72.5	15.1	67.9	29.5
01.0	19.6	80.3	75.7	27.0	68.6	41.8
02.0	31.8	86.5	73.5	45.6	62.7	59.6
03.0	47.1	90.4	61.5	66.2	46.8	77.3
04.0	52.7	96.0	58.2	76.4	41.5	86.6
05.0	53.8	82.3	48.6	66.4	34.1	74.9
106.0	32.9	51.2	43.0	27.8	36.5	36.0
107.0	359.4	61.7	61.7	-0.6	60.5	11.9
08.0	331.2	78.4	68.7	-37.8	74.9	-23.1
09.0	343.1	97.7	93.5	-28.4	97.3	-8.8
10.0	352.0	107.1	106.1	-14.8	106.9	7.1

TRAIL NO. B65 LIMERICK

BARBADOS 15 FEBRUARY 1967 22-45-00 AST

DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
95.0	333.0	66.0	58.8	-30.0	63.7	-17.4
96.0	335.0	71.0	64.3	-29.9	69.0	-16.2
97.0	346.7	65.4	63.6	-15.1	65.3	-1.9
98.0	1.0	63.0	63.0	1.1	61.5	13.9
99.0	25.2	60.0	54.3	25.5	48.0	36.0
100.0	32.8	66.6	55.9	36.1	47.4	46.7
101.0	38.8	74.0	57.7	46.4	47.1	57.2
102.0	45.3	83.9	59.0	59.6	45.7	70.3
103.0	48.3	92.4	61.5	69.0	46.2	80.1
104.0	52.3	91.4	55.9	72.3	40.0	82.1
105.0	54.4	83.3	48.5	67.7	33.7	76.1
106.0	43.7	61.1	44.2	42.2	34.7	50.3
107.0	11.9	57.7	56.5	11.9	52.9	23.1

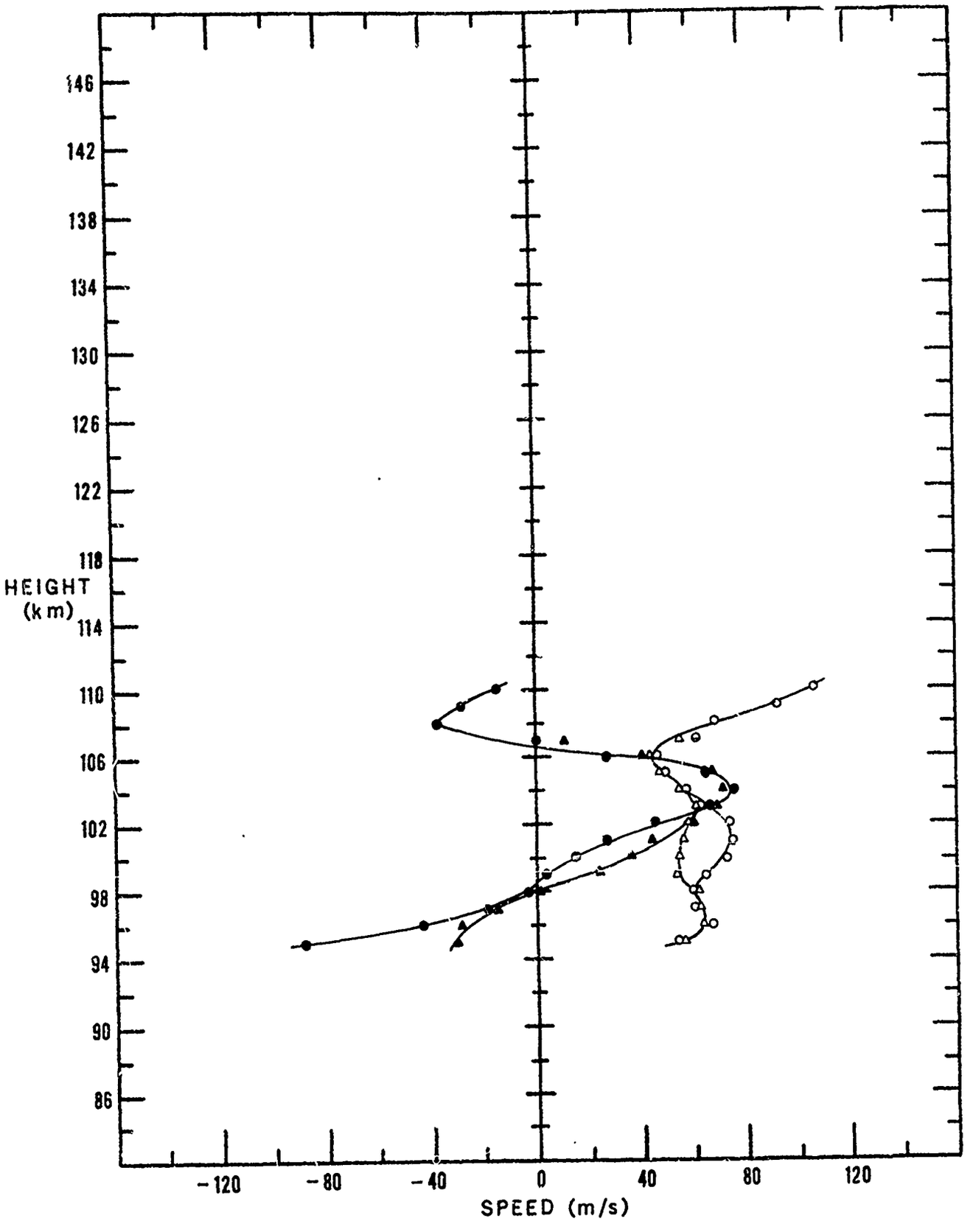
WIND COMPONENTS

	UP	DOWN
N-S	o	△
E-W	●	▲

TRAIL NO. B65 LIMERICK

16 FEBRUARY 1967 04:17:00 AST

H.A.R.P. BARBADOS



WIND SPEED

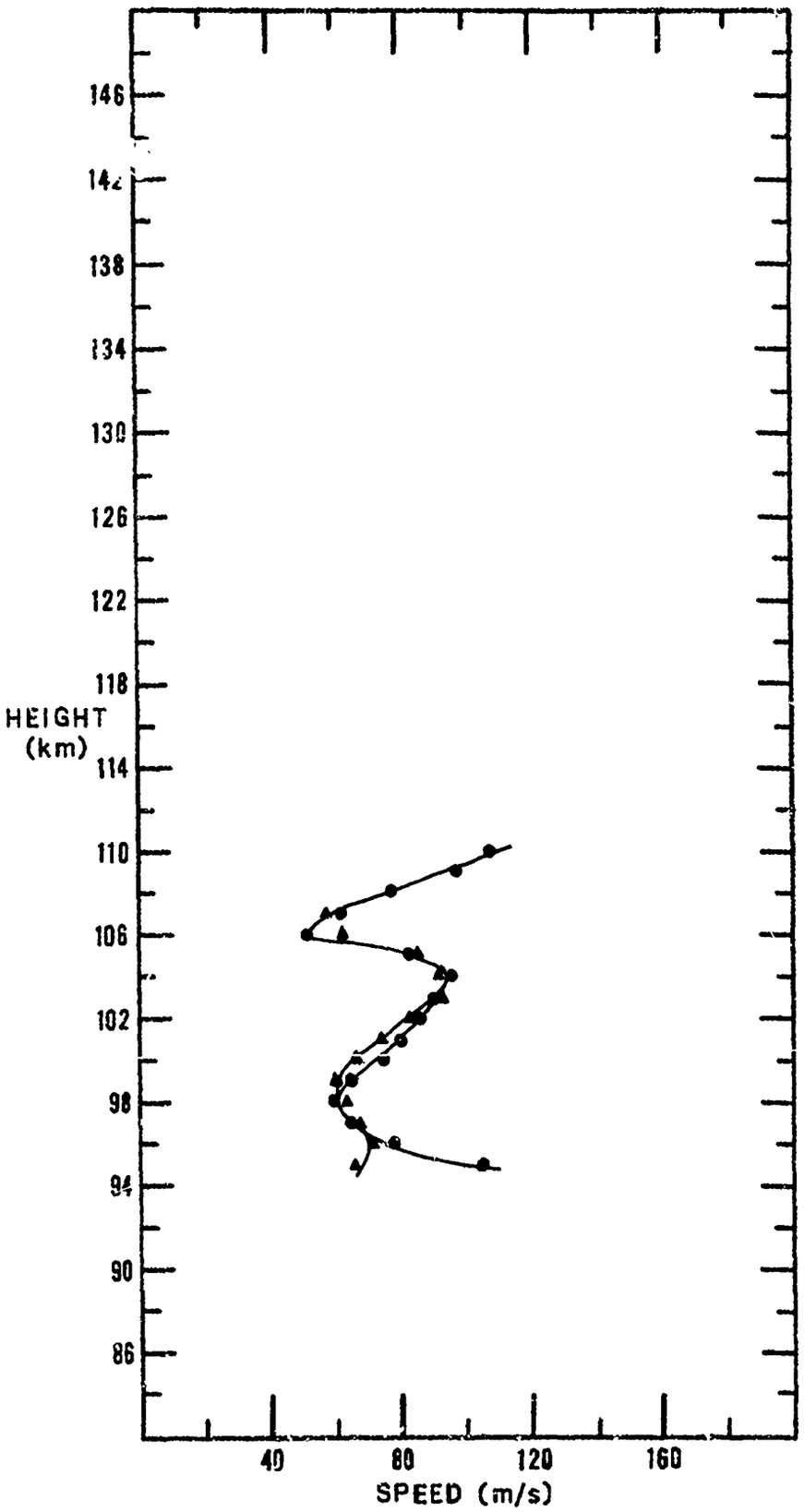
• UP

▲ DOWN

TRAIL NO. B65 LIMERICK

16 FEBRUARY 1967 04:17:00 AST

H.A.R.P. BARBADOS



WIND DIRECTION

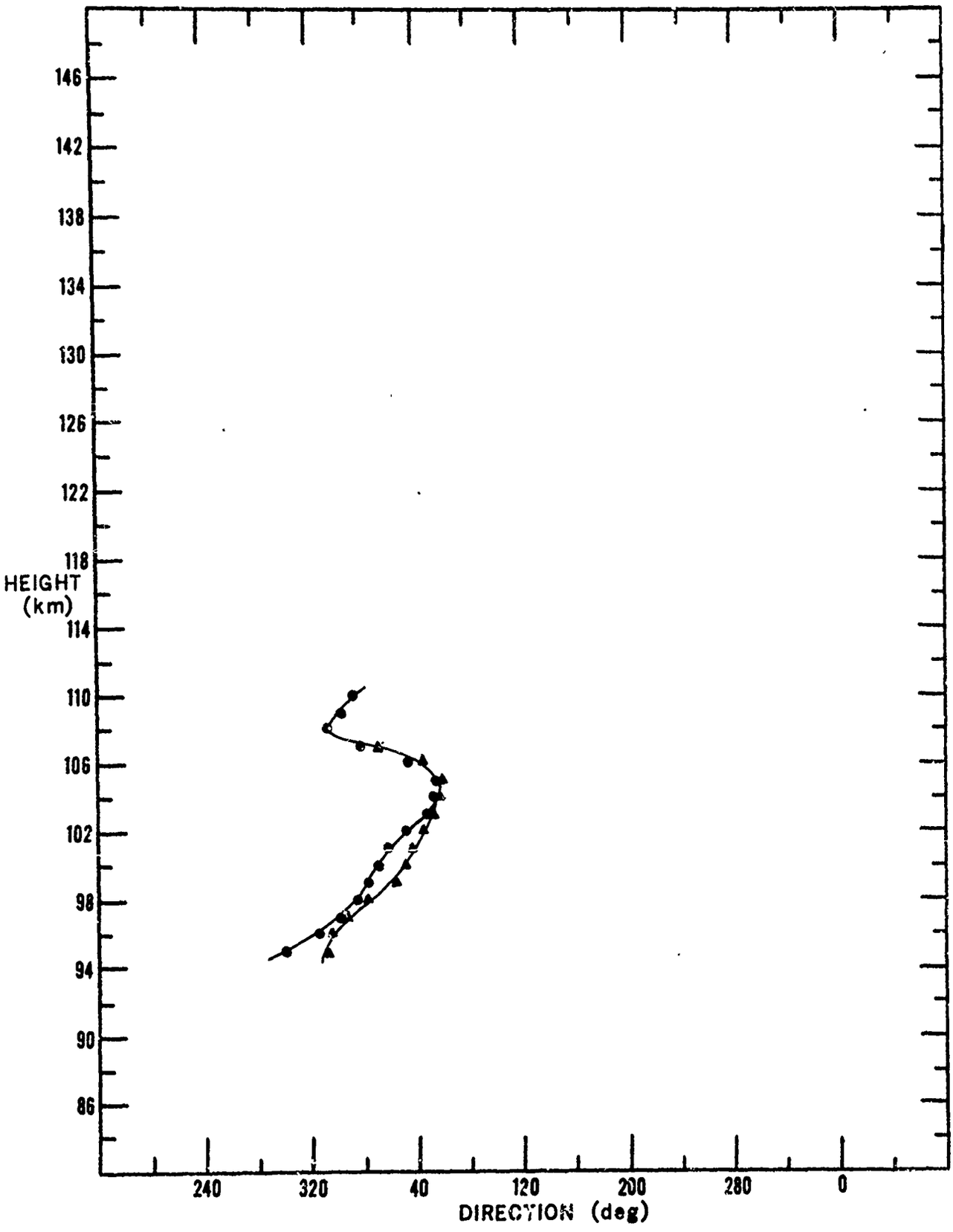
• UP

▲ DOWN

TRAIL NO. B65 LIMERICK

16 FEBRUARY 1967 04:17:00 AST

H.A.R.P. BARBADOS



TRAIL NO. B66 NEWRY
BARBADOS 15 FEBRUARY 1967 22-45-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
106.0	52.5	12.6	7.7	10.0	5.5	11.4
107.0	27.8	18.7	16.5	8.7	14.4	11.9
108.0	320.3	53.1	40.8	-33.9	46.8	-24.9
109.0	337.0	70.8	65.2	-27.7	69.5	-13.9
110.0	352.1	81.9	81.1	-11.2	81.7	5.5
111.0	3.5	103.5	103.3	6.4	8.2	0
112.0	19.3	115.2	108.8	38.1	8.7	0

TRAIL NO. B 66 NEWRY

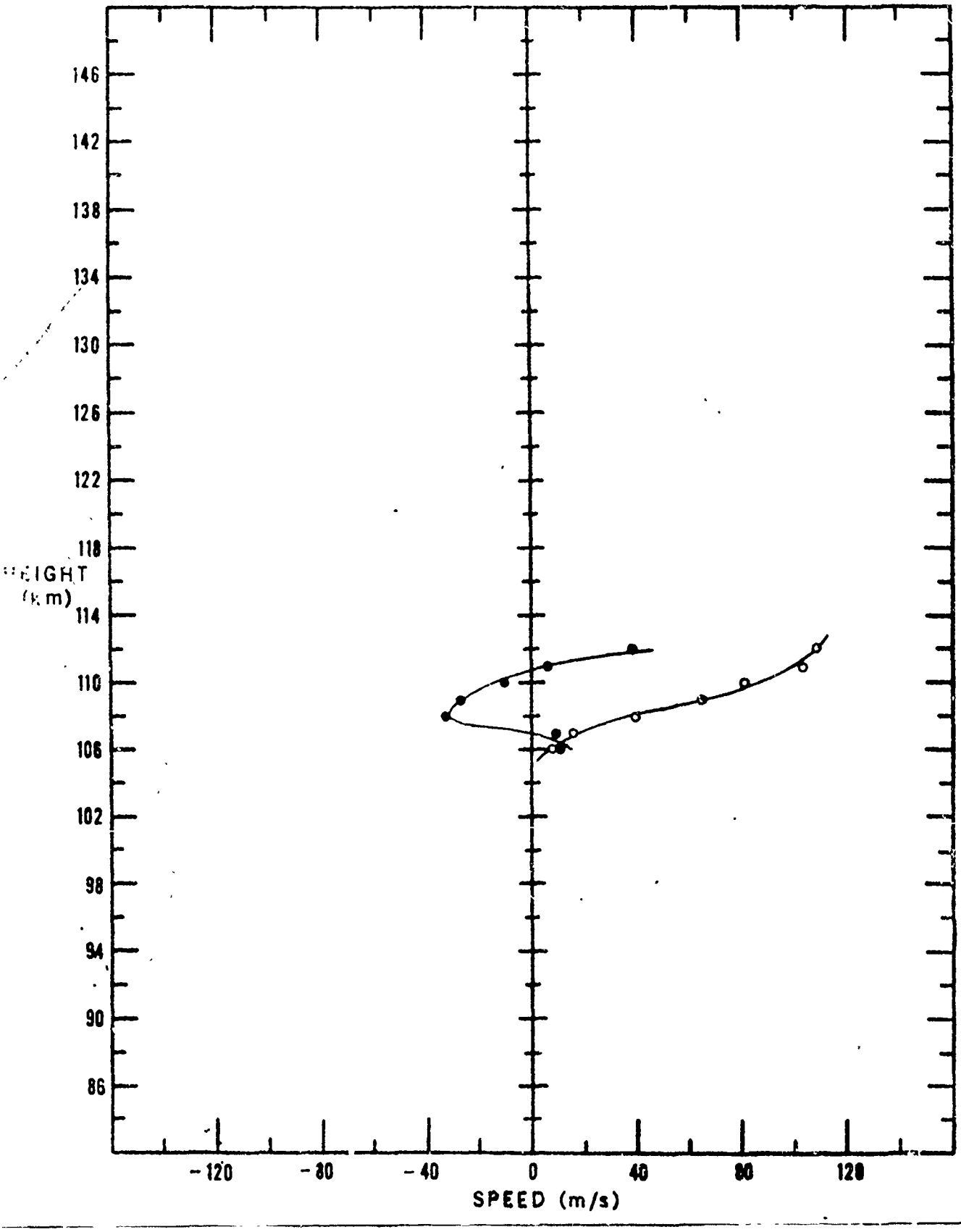
16 FEBRUARY 1967 05:20:00 A S T

H.A.R.P. BARBADOS

WIND [illegible]

N-S ○

E-W ●



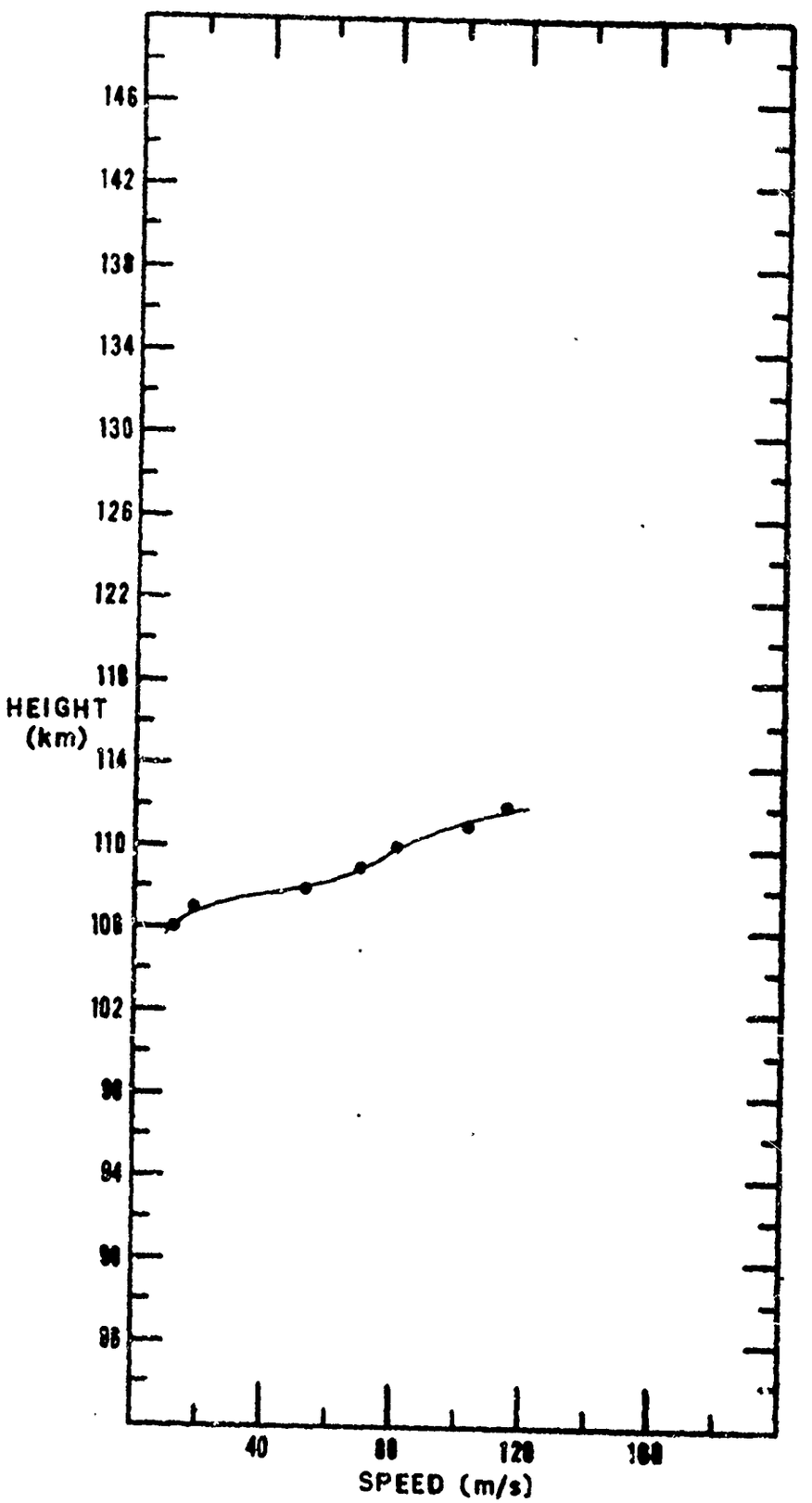
WIND SPEED

• UP

TRAIL NO. B 66 NEWRY

16 FEBRUARY 1967 05:20:00 AST

H.A.R.P. BARBADOS



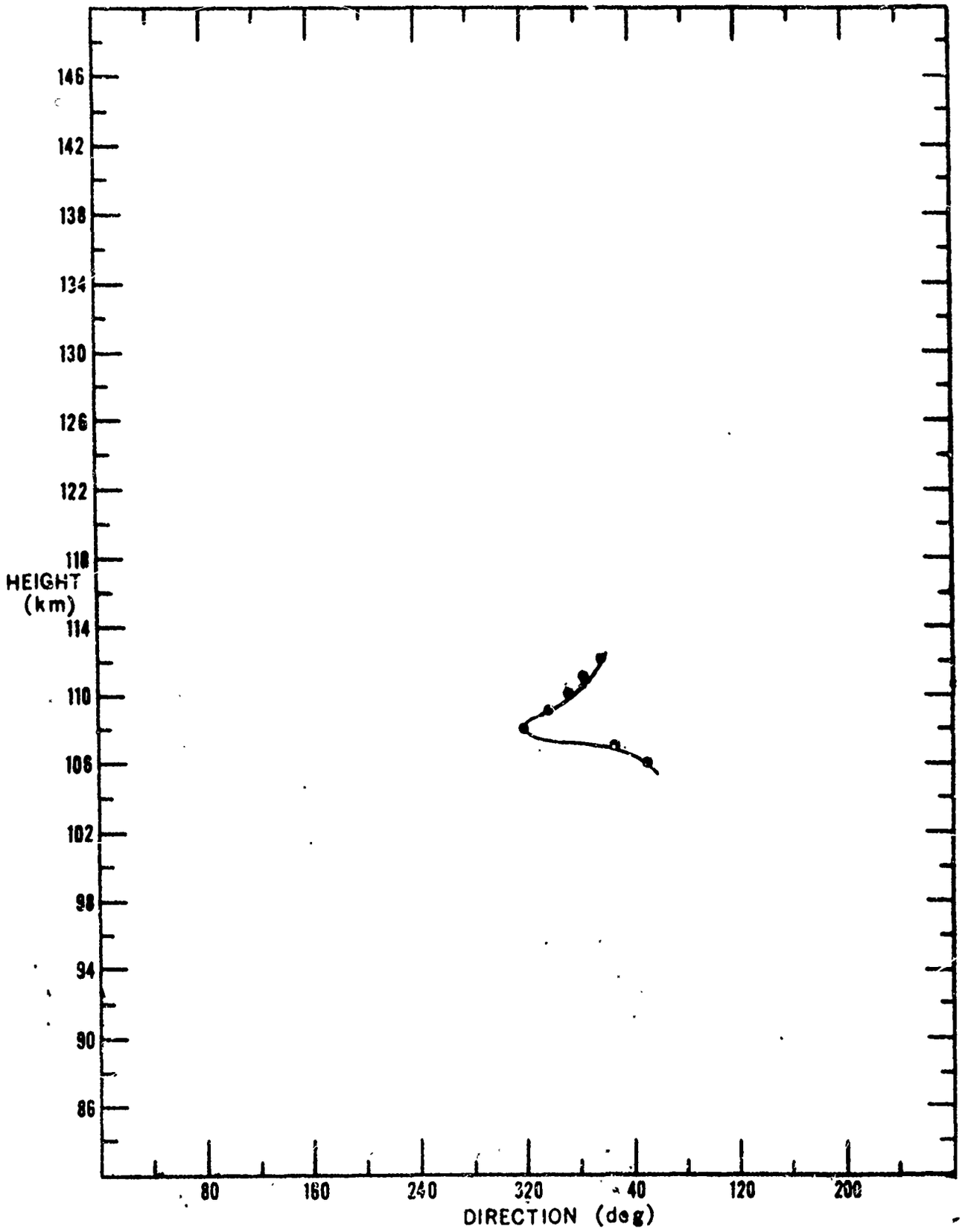
TRAIL NO. B 66 NEWRY

16 FEBRUARY 1967 05:20:00 AST

H.A.R.P. BARBADOS

WIND DIRECTION

• UP

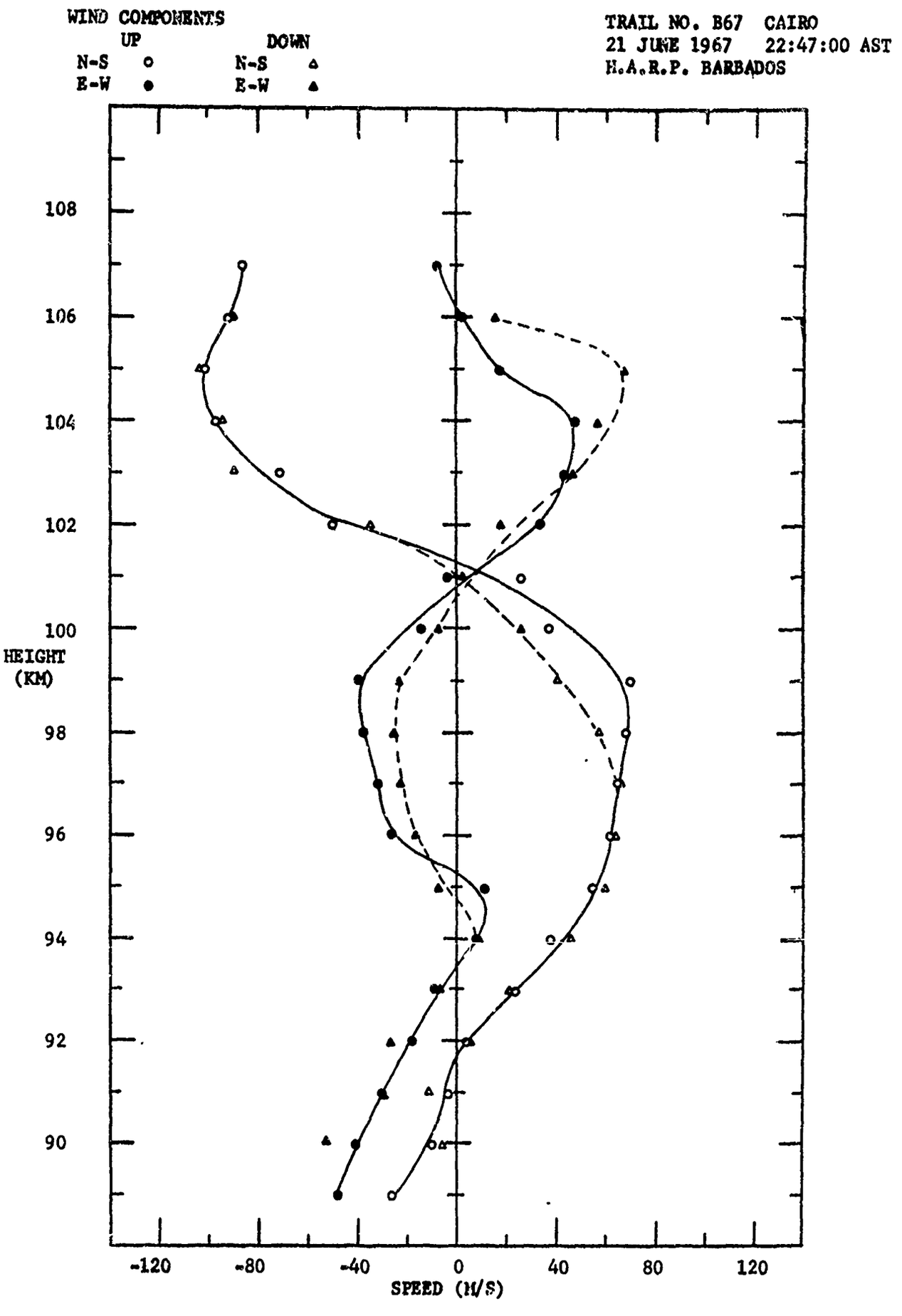


TRAIL NO. B67 CAIRO
BARBADOS 21 JUNE 1967 22-47-00 AST
UP TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
89.0	241.5	53.7	-25.6	-47.2	-15.3	-51.5
90.0	256.4	41.6	-9.8	-40.4	-1.3	-41.6
91.0	264.2	30.0	-3.0	-29.9	3.2	-29.9
92.0	285.1	17.2	4.5	-16.7	7.8	-15.4
93.0	339.5	25.8	24.2	-9.0	25.5	-3.8
94.0	13.3	39.1	38.1	9.0	35.4	16.7
95.0	12.5	58.1	56.7	12.5	52.9	23.9
96.0	337.0	67.5	62.2	-26.3	66.3	-12.9
97.0	334.3	72.3	65.1	-31.4	70.2	-17.3
98.0	331.0	78.4	68.5	-38.0	74.9	-23.1
99.0	330.9	80.2	70.1	-39.0	76.6	-23.7
100.0	339.9	39.6	37.2	-13.6	39.2	-5.6
101.0	352.6	26.4	26.2	-3.4	26.3	2.1
102.0	145.5	60.2	-49.6	34.1	-55.6	23.1
103.0	146.1	86.3	-71.6	48.1	-80.0	32.3
104.0	153.5	108.1	-96.7	48.3	-104.6	27.3
105.0	170.0	102.1	-100.6	17.8	-102.1	-3.3
106.0	178.5	91.0	-91.0	2.4	-89.5	-16.4
107.0	184.7	85.6	-85.3	-7.0	-82.0	-24.4

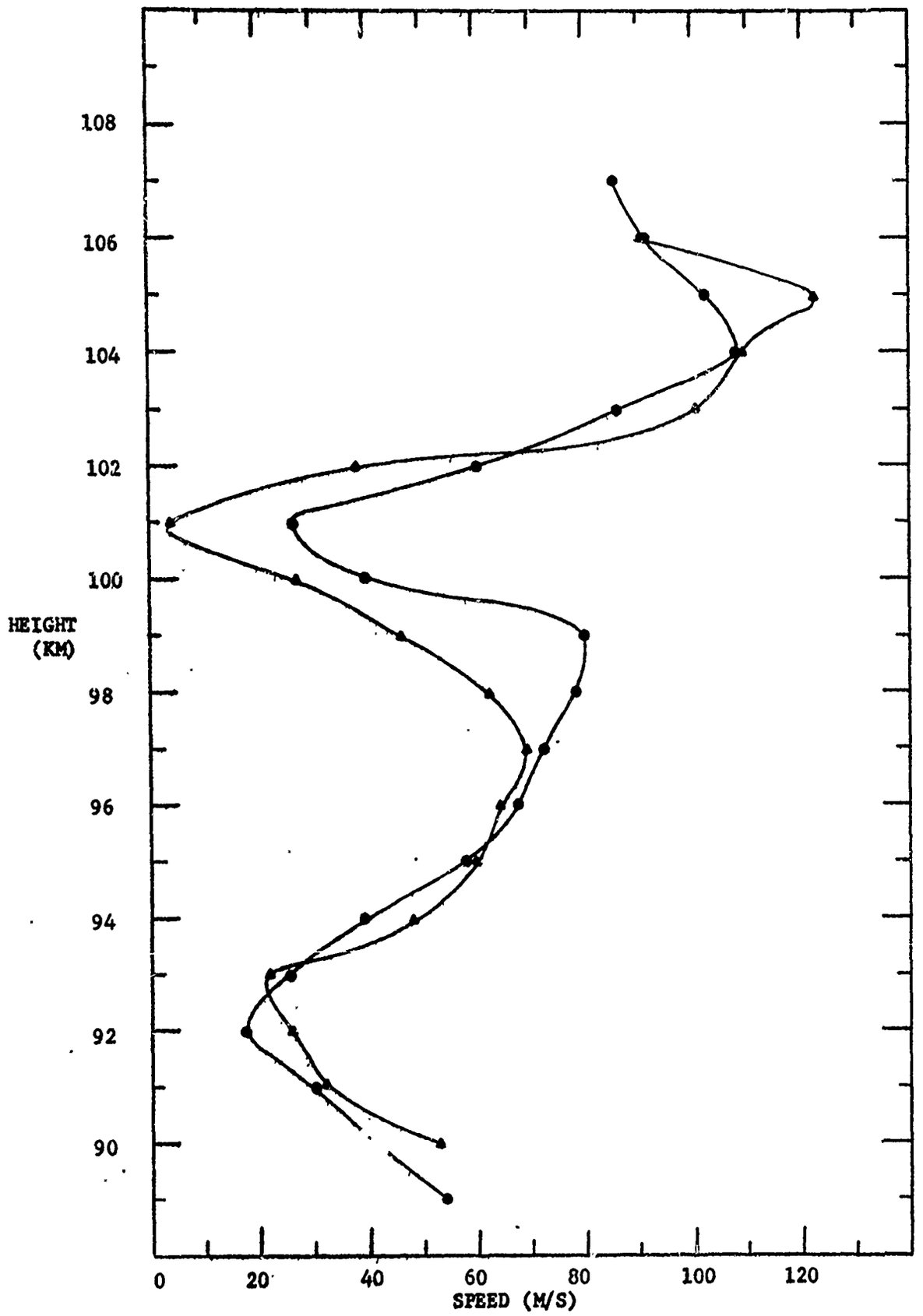
TRAIL NO. B67 CAIRO
BARBADOS 21 JUNE 1967 22-47-00 AST
DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
90.0	263.5	52.6	-5.9	-52.2	5.0	-52.3
91.0	250.5	31.5	-10.5	-29.7	-4.2	-31.2
92.0	279.4	26.0	4.3	-25.7	9.5	-24.3
93.0	343.0	21.9	20.9	-6.4	21.8	-2.0
94.0	10.8	48.1	47.3	9.0	44.4	18.6
95.0	353.7	59.9	59.5	-6.6	59.6	5.8
96.0	345.6	64.3	62.3	-16.0	64.3	-2.8
97.0	341.1	69.0	65.3	-22.3	68.5	-8.4
98.0	336.1	62.5	57.2	-25.3	61.2	-13.0
99.0	329.7	46.3	40.0	-23.3	43.9	-14.6
100.0	343.1	27.2	26.0	-7.9	27.1	-2.4
101.0	36.9	4.0	3.2	2.4	2.6	3.0
102.0	152.7	38.3	-34.1	17.6	-37.0	10.2
103.0	152.3	100.6	-89.1	46.8	-96.8	27.4
104.0	148.9	108.9	-93.2	56.3	-102.8	35.9
105.0	146.8	122.7	-102.7	67.1	-114.3	44.5
106.0	170.1	90.9	-89.5	15.6	-90.8	-3.2


WIND COMPONENTS
UP
N-S
E-W
DOWN
N-S
E-W
TRAIL NO. B67 CAIRO
21 JUNE 1967 22:47:00 AST
H.A.R.P. BARBADOS
108
106
104
102
100
98
96
94
92
90
HEIGHT (KM)
-120
-80
-40
0
40
80
120
SPEED (M/S)

WIND SPEED
UPTRAIL ●
DOWNTRAIL ▲

TRAIL NO. 867 CAIRO
21 JUNE 1967 22:47:00 AST
H.A.R.P. BARBADOS

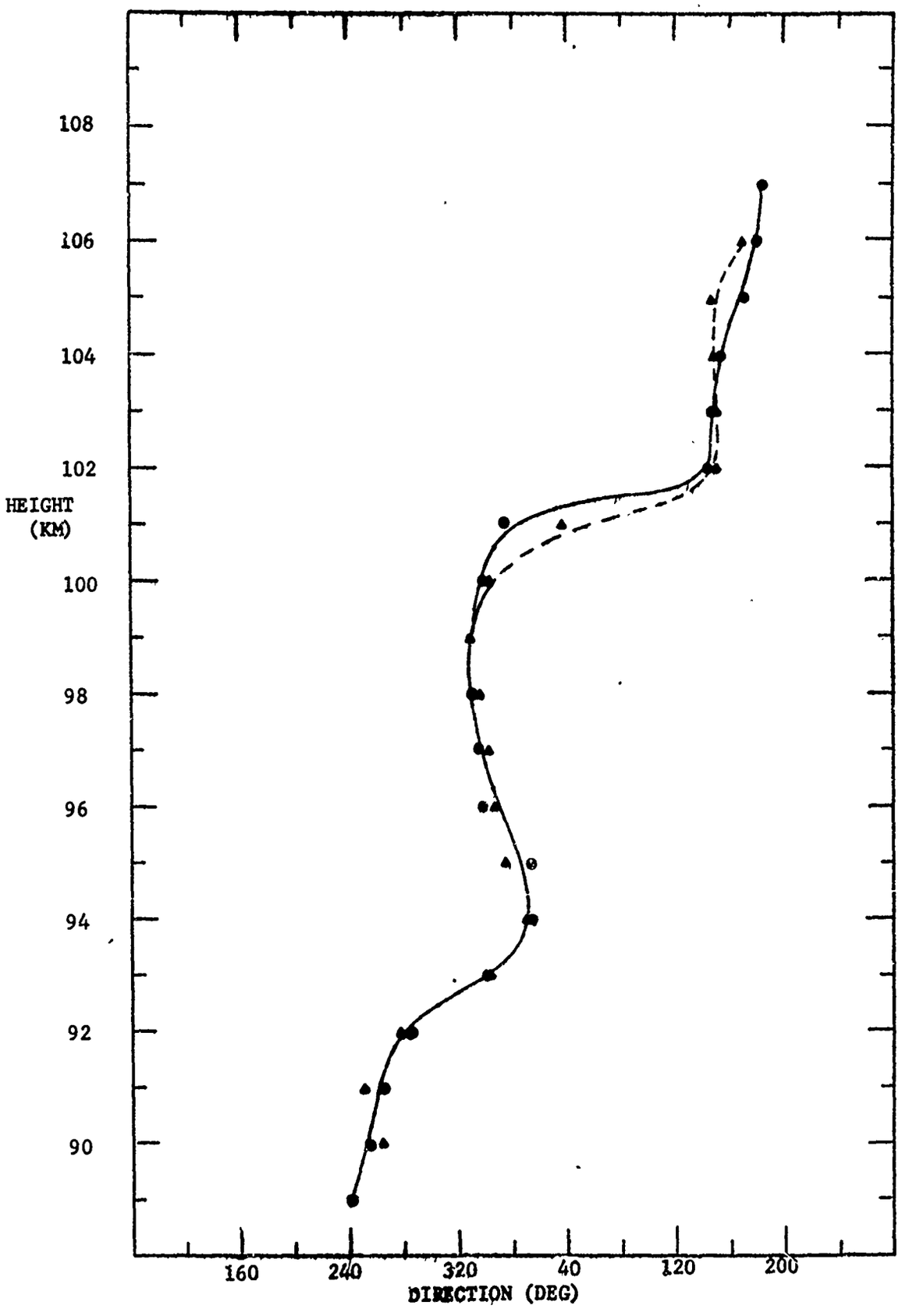


WIND DIRECTION

UPTRAIL ●

DOWNTRAIL ▲

TRAIL NO. B67 CAIRO
21 JUNE 1967 22:47:00 AST
H.A.R.P. BARBADOS



TRAIL NO. B68 DURBAN
BARBADOS 22 JUNE 1967 19-51-00 AST
UP TRAIL

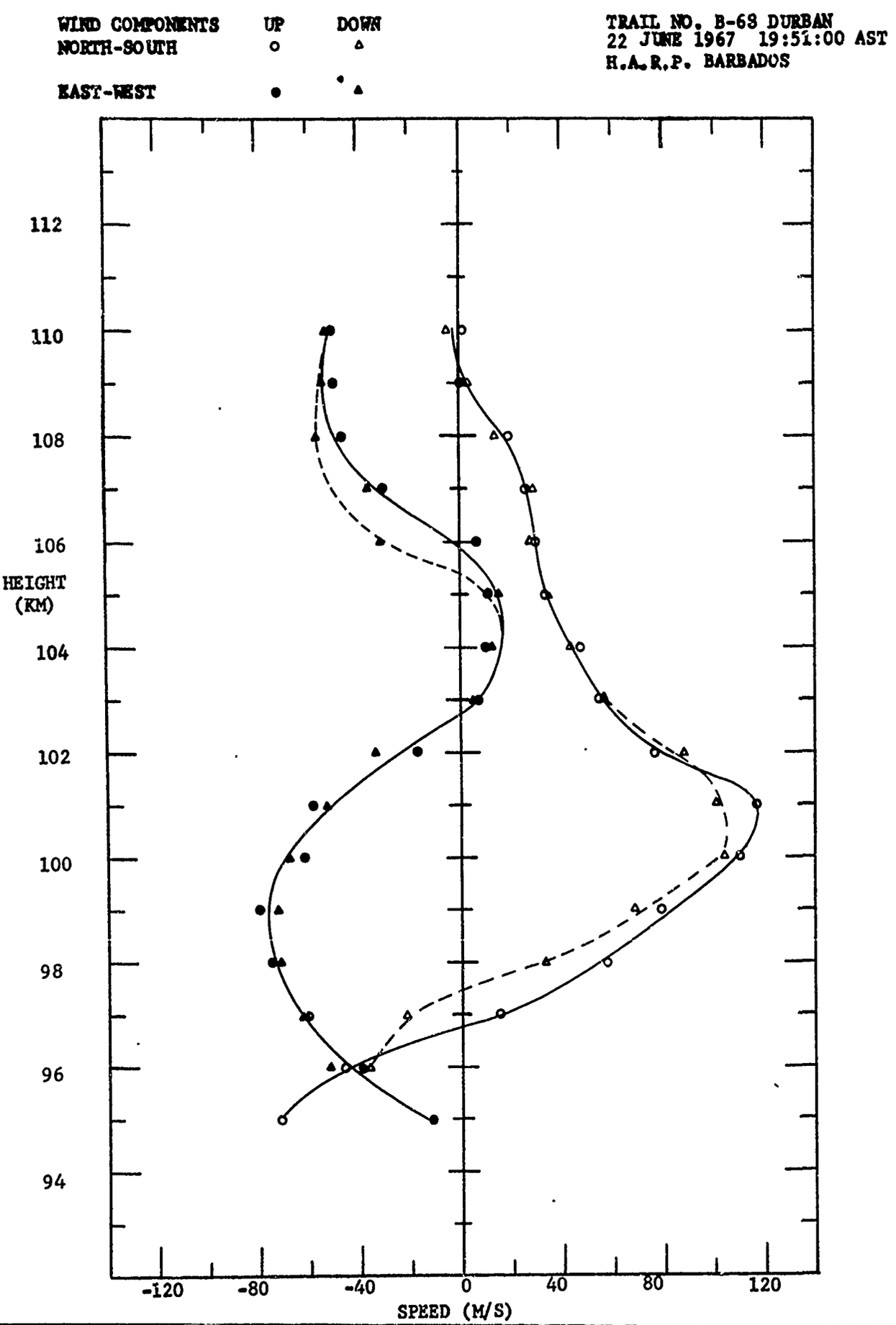
ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
95.0	189.3	72.0	-71.1	-11.6	-67.2	-26.0
96.0	220.1	60.0	-45.9	-38.6	-37.0	-47.2
97.0	283.8	62.1	14.8	-60.3	26.9	-56.0
98.0	307.7	94.4	57.7	-74.7	71.9	-61.2
99.0	318.6	105.6	79.2	-69.9	91.9	-52.1
100.0	330.7	126.7	110.5	-62.0	120.9	-37.9
101.0	332.5	124.0	117.0	-58.3	124.0	-46.6
102.0	347.5	78.7	76.8	-17.1	78.7	-0.9
103.0	7.8	55.3	54.8	7.5	52.1	18.6
104.0	12.0	48.5	47.4	10.1	44.3	19.7
105.0	17.5	35.4	33.8	10.7	30.9	17.4
106.0	13.1	30.7	29.9	6.9	27.8	12.9
107.0	311.5	40.0	26.5	-30.0	32.1	-23.9
108.0	292.6	49.6	19.1	-45.8	28.1	-40.9
109.0	270.8	49.1	0.7	-49.1	10.8	-47.9
110.0	272.1	50.1	1.8	-50.1	12.1	-48.7

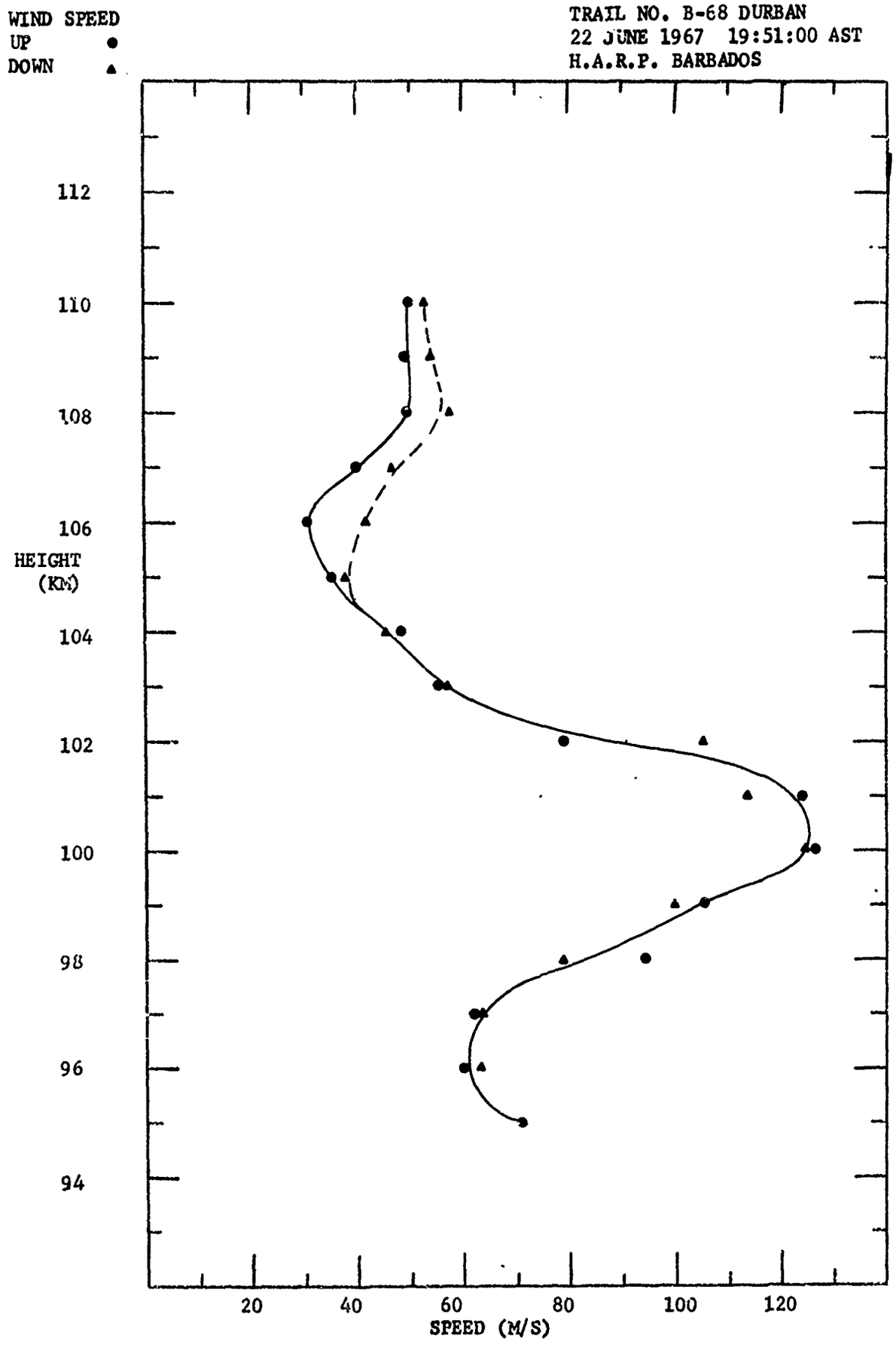
TRAIL NO. B68 DURBAN

BARBADOS 22 JUNE 1967 19-51-00 AST

DOWN TRAIL

ALTITUDE (KM)	WIND HEADING (DEG)	WIND VELOCITY (M/S)	WIND COMPONENTS (M/S) GEOGRAPHIC N-S	GEOGRAPHIC E-W	MAGNETIC N-S	MAGNETIC E-W
96.0	235.2	63.4	-36.2	-52.0	-24.7	-58.3
97.0	259.7	63.5	-11.3	-62.5	1.8	-63.5
98.0	295.3	78.7	33.6	-71.2	47.6	-62.7
99.0	313.8	99.7	69.0	-72.0	82.4	-56.2
100.0	327.0	124.4	104.4	-67.7	116.1	-44.7
101.0	332.7	113.8	101.1	-52.2	109.7	-30.2
102.0	339.2	95.2	89.0	-33.7	94.0	-14.6
103.0	5.5	57.1	56.8	5.5	54.4	17.1
104.0	16.0	45.6	43.8	12.6	40.3	21.4
105.0	24.0	37.9	34.6	15.4	30.7	22.2
106.0	312.4	41.7	28.1	-30.8	33.8	-24.3
107.0	309.0	46.5	29.3	-36.1	36.1	-29.3
108.0	284.3	57.8	14.3	-56.0	25.5	-51.8
109.0	274.4	53.7	4.2	-53.6	15.2	-51.6
110.0	265.1	52.6	-4.5	-52.4	6.4	-52.2


WIND COMPONENTS
NORTH-SOUTH
EAST-WEST
UP
DOWN
TRAIL NO. B-68 DURBAN
22 JUNE 1967 19:51:00 AST
H.A.R.P. BARBADOS
112
110
108
106
HEIGHT (KM)
104
102
100
98
96
94
-120
-80
-40
0
40
80
120
SPEED (M/S)

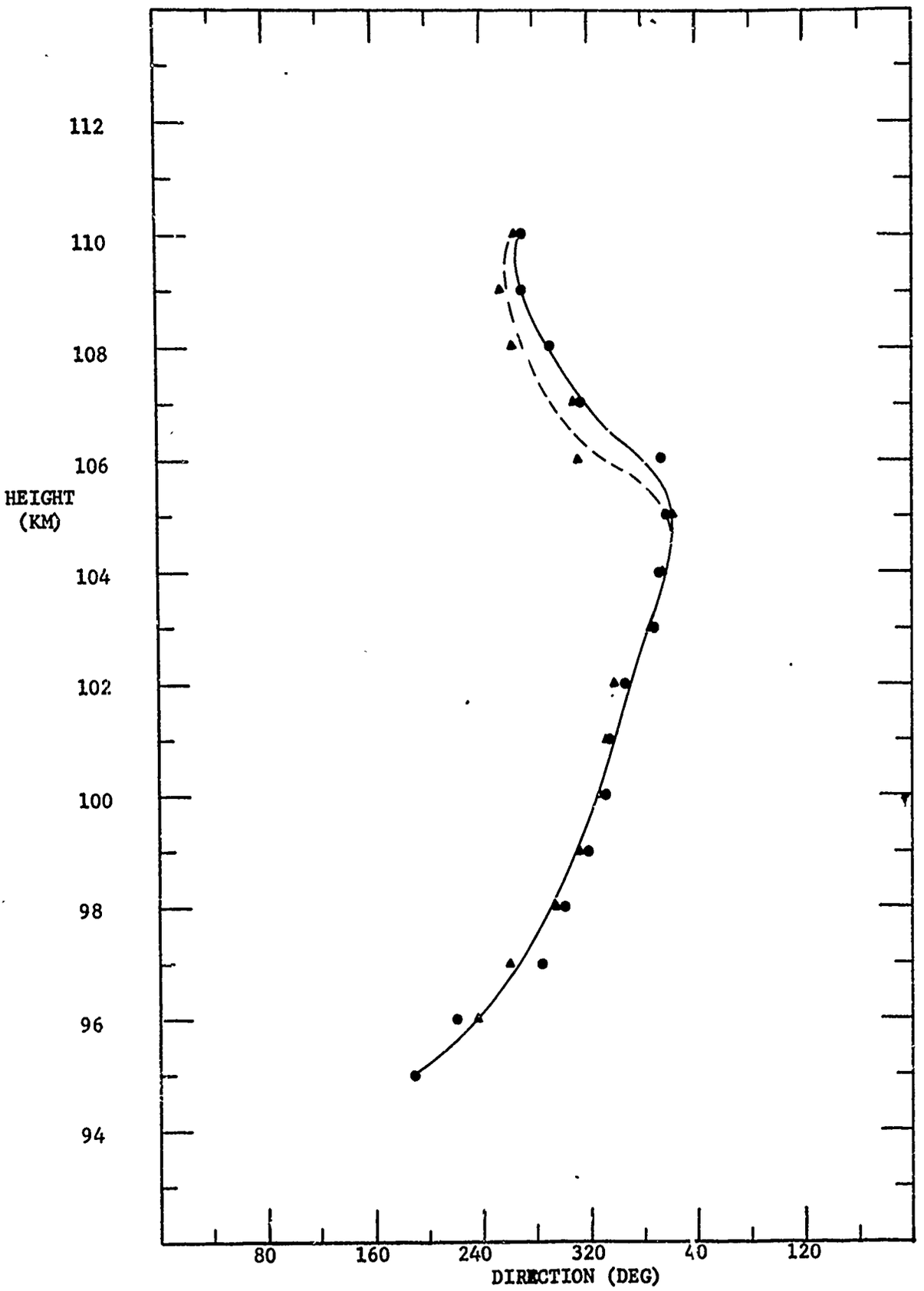

WIND SPEED
UP ●
DOWN ▲
TRAIL NO. B-68 DURBAN
22 JUNE 1967 19:51:00 AST
H.A.R.P. BARBADOS
112
110
108
106
HEIGHT (KM)
104
102
100
98
96
94
20
40
60
80
100
120
SPEED (M/S)

WIND DIRECTION

UP ●

DOWN ▲

TRAIL NO. B-68 DURBAN
22 JUNE 1967 19:51:00 AST
H.A.R.P. BARBADOS



APPENDICES

APPENDIX A-1

LIST OF ALL TEST FIRING SERIES

with the 16 inch Barbados Gun

SERIES	NOS.	DATE	SLUGS	MARTLET										LAHIVE	TOTAL
				1A	1B	2A	2B	2C	2D	2G	2G1	3A	3B		
I	1-4	Jan 25-Feb 1/63	2	1	1										4
II	5-12	June 5-June 19/63	4			4									8
III	13-18	Aug 28-Sept 5/63					2					4			6
IV	19-34	Jan 4-Jan 15/64				9						7			16
V	35-38	June 23-June 26/64				4									4
VI	39-72	July 6-July 25/64	1			23							10		34
VII	73-76	Sept 8-Sept 9/64											4		4
VIII	77-79	Nov 5-Nov 6/64	3												3
IX	80-93	Dec 8-Dec 14/64	3			4		4					3		14
X	94-107	Mar 23-Mar 29/65				4		6	1				3		14
XI	108-127	May 31-June 12/65				3		15					2		20
XII	128-130	Aug 4-Aug 6/65						3							3
XIII	131-152	Sept 14-Sept 25/65	2			2		18							22
XIV	153-179	Nov 10-Nov 23/65	2					22					3		27
XV	180-199	Feb 17-Feb 25/66	6					13	1						20
XVI	200-203	Aug 15-Aug 25/66	2					1		1					4
XVII	204-213	Sept 19-Sept 20/66						10							10
XVIII	214-215	Dec 5-Dec 14/66						1		1					2
	216	Jan 18/67	1												1
XIX	217-226	Feb 15-Feb 17/67						9		1					10
XX	227-228	Mar 22-Mar 25/67						2							2
XXI	229-233	May 23-May 30/67	1								1			3	5
XXII	234-238	June 21-June 24/67						4	1						5
	TOTAL 1963 - JUNE 1967		27	1	1	53	2	108	3	3	1	11	25	3	238

APPENDIX A-2

LIST OF TMA TRAILS (Nos. 1-68)

Trail No.	Name	Shot No.	Date	Time AST	Altitude km
1	IRIS	42	7 Jul 64	1902	94 - 109
2	JANET	43	7 Jul 64	2110	86 - 95
3	SHARON	62	22 Jul 64	1900	95 - 98
4	QUEENIE	67	24 Jul 64	1945	30 - 96
5	LUPACA	97	23 Mar 65	2124	92 - 114
6	MIAMI	98	24 Mar 65	0103	101 - 110
7	NOOTKA	103	27 Mar 65	0220	92 - 111
8	OTTAWA	104	28 Mar 65	2002	105 - 119
9	PUEBLO	105	28 Mar 65	2220	90 - 117
10	MARIUS	112	3 June 65	1957	102 - 114
11	NERO	113	3 June 65	2241	88 - 94
12	ELAGABULUS	114	4 June 65	0135	91 - 121
13	FABIUS	115	5 June 65	0317	92 - 107
14	OVID	122	9 June 65	2157	95 - 103
15	CICERO	123	9 June 65	2358	91 - 103
16	PLINY	125	10 June 65	2107	97 - 108
17	TIBERIUS	129	5 Aug 65	2020	95 - 107
18	UMBRIA	130	6 Aug 65	0244	94 - 106
19	BELAIR	133	20 Sep 65	1930	90 - 132
20	CONOWINGO	134	20 Sep 65	2052	88 - 136
21	EDGEWOOD	136	21 Sep 65	0024	90 - 123
22	FOUNTAIN GREEN	137	21 Sep 65	0221	88 - 128
23	GALENA	138	21 Sep 65	0335	91 - 138
24	HAVRE DE GRACE	139	21 Sep 65	0500	90 - 123
25	LINTHICUM	142	22 Sep 65	1924	91 - 127
26	MAGNOLIA	144	23 Sep 65	0150	94 - 126
27	NANTICOKE	145	23 Sep 65	0315	98 - 133
28	OLNEY	146	23 Sep 65	0407	88 - 126
29	PERRYMAN	147	23 Sep 65	0505	98 - 124
30	YORKSHIRE	157	16 Nov 65	1815	101

APPENDIX A-2 (Cont'd)

Trail No.	Name	Shot No.	Date	Time AST	Altitude km
31	CHRISTCHURCH	160	17 Nov 65	1815	92 - 119
32	DOVER	161	17 Nov 65	1934	91 - 122
33	FOUL BAY	163	17 Nov 65	2315	93 - 127
34	GUN HILL	164	18 Nov 65	0045	96 - 127
35	INDIAN GROUND	166	18 Nov 65	0330	98 - 117
36	JAMESTOWN	167	18 Nov 65	0508	93 - 119
37	MAXWELL	173	22 Nov 65	1809	94 - 120
38	NEEDHAM'S POINT	174	22 Nov 65	1930	93 - 134
39	PARAGON	176	22 Nov 65	2259	99 - 126
40	QUEEN'S FORT	177	23 Nov 65	0131	100 - 133
41	ROCKLEY	178	23 Nov 65	0328	95 - 138
42	SEAWELL	179	23 Nov 65	0516	91 - 130
43	INAUGUA	181	17 Feb 66	2103	92 - 123
44	ST. KITTS	189	23 Feb 66	2046	87 - 131
45	ST. LUCIA	190	23 Feb 66	2203	95 - 117
46	MONTSERRAT	191	23 Feb 66	2321	111 - 120
47	NEVIS	192	24 Feb 66	0025	91 - 122
48	PUERTO RICO	194	24 Feb 66	0327	90 - 123
49	ST. THOMAS	196	24 Feb 66	0523	96 - 118
50	FLAMINGO	199	25 Feb 66	1843	94 - 130
51	BETA	205	19 Sep 66	2055	94 - 128
52	GAMMA	206	19 Sep 66	2224	89 - 135
53	DELTA	207	20 Sep 66	0010	91 - 122
54	EPSILON	208	20 Sep 66	0130	90 - 109
55	ZETA	209	20 Sep 66	0224	89 - 115
56	ETA	210	20 Sep 66	0318	88 - 122
57	THETA	211	20 Sep 66	0403	87 - 127
58	IOTA	212	20 Sep 66	0446	86 - 124
59	BELFAST	218	15 Feb 67	2117	88 - 123
60	CORK	219	15 Feb 67	2245	89 - 101
61	DUBLIN	220	15 Feb 67	2356	88 - 117
62	GARVAGH	221	16 Feb 67	0105	89 - 116
63	HOLLYWOOD	222	16 Feb 67	0210	88 - 114
64	KERRY	223	16 Feb 67	0323	93 - 116
65	LIMERICK	224	16 Feb 67	0417	95 - 110
66	NEWRY	225	16 Feb 67	0520	106 - 112
67	CAIRO	235	21 June 67	2248	89 - 107
68	DURBAN	236	22 June 67	1951	95 - 110

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
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13. ABSTRACT

This report is a review and analysis of results of the test firings of Project HARP from the Barbados 16-inch gun during 1966 and 1967 until the 30th of June.

Fifty-nine rounds were fired during the report period. Thirty-five of these (i.e. the majority of shots) carried TMA release payloads on Martlet 2C (Mod. 2) vehicles. Five further rounds with Martlet 2C vehicles had the purpose of testing the sea impact device, telemetry packages, and Langmuir probes, whereas nine rounds were vehicle development tests. The remaining ten rounds were launch engineering test firings of slugs.

The test objectives were generally achieved. The gun performance was satisfactory, and the usefulness of inserting spacers between the propellant bags was again confirmed. In December 1966 the multipoint ignition method was successfully introduced, reducing the maximum pressure for the same charge weight considerably and increasing the muzzle velocity at the same pressure. Tests were also made with gun liners in order to reduce the barrel taper caused by extensive wear near the breech. These tests finally led to the installation of a permanent liner which gave satisfactory results.

The Martlet 2C vehicles performed with the usual reliability. Two surplus Martlet 2D vehicles were used for structural test firings in connection with tests on a gun liner and a TMA puff-puff release system, respectively. Tests of the Martlet 2G, a model replacing the Martlet 2D design, proved successful in one round in which a perfect flight trajectory was obtained.

The tests during the report period have shown a further progress in the development of instrumentation capable of withstanding the high launch accelerations. Furthermore, wind data were obtained in synoptic firings during three nights and in several single rounds.

The present report discusses the general results of the firings, and gives the detailed performance data of all rounds, the radar trajectory data, and the wind data. It concludes the series of reports on Project HARP firings from the Barbados 16-inch gun carried out by the Space Research institute of McGill University.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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HARP						
High Altitude Research Project						
Vertical-fired Gun Probes						
Gun Launched Projectiles						
Gun Boosted Rockets						
Ionospheric Winds						