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NCAR TN-48

Superpressure Balloon Flights from Christchurch, New Zealand July 1968-December 1969

VINCENT E. LALLY
A. BREWSTER RICKEL
MARCEL A. VERSTRAETE

Send for DRFM

May 1970

NCAR Technical Notes
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH
Boulder, Colorado

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FOREWORD

This report contains flight summaries and analyses of Phase III GHOST balloon flights in the period 1 July 1968 to 31 December 1969. These flights were launched from Christchurch, New Zealand, and from an auxiliary site in the South Pacific. Appendices I and II discuss superpressure balloon flights below the freezing level and flights of balloons equipped with strain gages.

During the 18-month period of Phase III, 79 flights were made under the auspices of the New Zealand Meteorological Service, the Environmental Science Services Administration, the National Aeronautics and Space Administration, and the National Science Foundation. The flight program was conducted by the National Center for Atmospheric Research.

We are grateful to the volunteer tracking stations in the southern hemisphere without whose assistance our flight program would not have been possible. We thank the meteorological services, governmental agencies, and trackers who operated the stations at McMurdo Station, Antarctica; Buenos Aires, Argentina; Melbourne, Australia; Rio de Janeiro, Brazil; San Rafael, California; Plaisance, Mauritius; Huancayo, Peru; and Pretoria, South Africa. Our special thanks go to the New Zealand Meteorological Service and to its staff which mans the tracking station in Christchurch.

Previous flight data and analyses have been published in NCAR Technical Notes TN-28 (June 1967) and TN-38 (February 1969). Both documents are available from the National Center for Atmospheric Research, Boulder, Colorado, 80302.

Analyses of trajectory data for GHOST flights are being performed by Samuel B. Solot and Aubrey Schumann at the National Center for Atmospheric Research.

CONTENTS

ANALYSIS OF FLIGHT RESULTS

1. FLIGHTS AT 30 km (10 mb)

One flight of a polyethylene balloon was made at this level. As reported in NCAR TN-38, the balloon probably suffered ascent damage which caused its descent on the evening of the first day. However, Mylar superpressure spheres have been used successfully at this level by other agencies, demonstrating that GHOST-type packages can be flown without difficulty.

2. FLIGHTS AT 24 km (30 mb)

Five flights were made from Christchurch at this level. One balloon burst during ascent, and two others developed leaks. Of these two, one was probably damaged during ascent and flew for only five days; the other flew for 141 days. The fourth balloon flew without problems for 172 days and then came down abruptly, presumably from sudden balloon failure. The fifth balloon was launched in late December 1969, and was last heard on 23 February 1970, its sixtieth day of flight. Average life for these flights was 81 days, not counting the balloon that burst during ascent.

Flights from Ascension Island at 30 and 50 mb showed that balloons can suffer damage from too-rapid ascent through the tropopause. To control the rate of ascent of high-level balloons a technique of ballasting was developed at Christchurch and used successfully. The four balloons launched from Christchurch, whose average life was 81 days, were equipped with ascent ballast. The balloon that burst during ascent employed only a drag chute.

3. FLIGHTS AT 16 km (100 mb)

Eleven flights were made at this level; eight of these were flown in December 1969 for J. Blamont of France. Of the remaining three, one suffered the only known electronics failure for this period. The

second balloon failed after 89 days. The third balloon, equipped with ascent ballast, had logged 258 days as of 1 April 1970.

4. FLIGHTS AT 12 km (200 mb)

Thirteen flights were made at this level. Two balloons had metalized Mylar top caps and flew for four months each. The remaining eleven were capless; four of these had an average life of 110 days, and one stayed aloft for 225 days. Four others remained aloft for a month or less, one failing two hours after reaching altitude. The remaining two balloons were launched during November-December 1969 and were still flying as of 1 January 1970. Icing appears to be the major obstacle to flight at this level.

5. FLIGHT AT 9 km (300 mb)

Only one flight was made at this level; its termination after 60 days of flight was probably caused by frost accumulation.

6. FLIGHT AT 7.2 km (400 mb)

Major emphasis was placed on flight testing at this level. Twenty-six balloons were flown and the average flight life was 12 days. Only two balloons are known to have failed, one from launch damage. Fourteen of the balloons had metalized Mylar top caps: average life was 12 days, maximum life was 68 days, and minimum life was 3 days. The remaining 12 balloons were not capped: average life was 12 days, maximum life was 53 days and minimum life was 4 days. These figures indicate that icing, rather than frosting under high clouds, was the major cause of flight termination. The use of top caps does not increase flight life at this level.

7. FLIGHT AT 2 km (800 mb)

Eleven flights were made at this level; average life was only four days, and maximum life was nine days. All balloons but one (which floated 500 m higher) were reinforced cylindrical balloons

carrying 12% overpressure. The advantage of the cylindrical shape over the spherical shape is that less water should adhere to the balloon surface. Water or ice were nevertheless the primary causes of flight termination. All balloons were wax-coated and polished. Water repellents for balloon surfaces are discussed in Appendix I.

8. FLIGHTS AT OR BELOW 1 km (900 mb)

Ten flights were made at this level, three from Christchurch and seven from Johnston Island (169°31'W, 16°44'N). All balloons were cylindrical and were treated with water repellents. Their average life was less than two days. One flight terminated when the balloon came inland and was caught in high-country bushes. Another flight (reported in Appendix I) was launched into a heavy rainstorm. Excessive water loading on the balloons terminated all of the other flights, including a 300 m float-altitude flight employing a drag line.

SUMMARY OF FLIGHTS BY LEVEL

Level (mb)	Flight number	Days of flight	Probable cause of termination	Strain gage
	A. Phase II Flights Still Aloft as of 1 December 1968			
200	*145200 J	228	-	
	*148203 G	240	-	
	*149204 Z	207	-	
100	98104 Q	441	Gas diffusion	
	130101 XZ	319	Sudden balloon failure	X
	B. Phase III Flights through 31 December 1969			
970	207974 X	2	Water	
900	195903 L	4	Terrain	
	196903 L	2	Water	
	212902 L	3	Water	
	213905 R	2	Water	
	214905 U	1	Water	
	215903 M	1	Water	
	216901 P	1	Water	
	217906 D	3	Water	
	218908 J	2	Water	
800	154835 K	2	Water	
	176803 NDHU	6	Water	X
	179805 GN	4	Water	X
	180805 NV	7	Water	
	181806 CK	9	Water	
	182802 BG	2	Water	X
	183807 BW	3	Water	X
	184806 FR	2	Water	X
	185801 PU	6	Water	X
	186803 DR	4	Water	X
	225757 F	2	Ice	
400	*166405 CV	68	Ice	X
	*167406 DL	3	Ice	X
	168401 AP	8	Ice	X
	169404 W	12	Ice	
	*170401 B	8	Ice	
	171404 X	12	Ice	
	*172406 C	4	Ice	
	173403 JR	4	Ice	
	*174403 V	5	Ice	
	175401 Y	4	Ice	
	*177405 QU	29	Ice	X

*Top-capped

Level (mb)	Flight number	Days of flight	Probable cause of termination	Strain gage
400	178402 NK	24	Ice	X
	*187404 F	3	Ice	
	*189406 W	8	Launch damage	
	190407 B	5	Ice	
	*192401 K	9	Ice	
	193403 H	53	Ice	
	*194406 J	5	Ice	
	198401 W	8	Ice	
	*199402 C	8	Ice	
	200404 V	8	Ice	
	*201407 I	7	Ice	
	202406 K	4	Ice	
	*203403 M	4	Ice	
	204405 N	4	Ice	
	*205404 Y	7	Ice	
300	188285/2 R/X	60	Frost	
200	*156224 UF	126	Ice	
	*157228 LU	121	Ice	X
	158226 DC	107	Leak	X
	159203 L	107	-	
	160206 BK	118	Ice	X
	161204 AR-H	107	Ice	X
	191225 GL	225	Ice	
	197184/8/2 F/P/U	39	-	
	206223 L	12	-	
	208227 RV	12	-	
	211195 AHDL	2	Balloon failure	
	219211 G	108	Electronics failure	
	229204 H	106	Flying as of 1/4/70	
100	153104 GH	89	Balloon failure	X
	209124/1 Q/JG	258+	Flying as of 1/4/70	
	210105 DMAG	6	Electronics failure	
	22010_ FMVR	Flown for J. Blamont of France		
	22110_ GMVR			
	22210_ KMLR			
	22310_ LMDR			
	22410_ XMZR			
	22610_ LMFR			
	22710_ LMWR			
	22810_ FMGR			
30	162033/6 D/P	172	Balloon failure	X
	163036/2 A/V	141	Balloon failure	X
	164035/6 P/QWXBCA	0	Burst	X
	165031/6 U/FAGKYD	5	Leak	X
	*230037 FRCW	60	Electronics failure	X
10	155017 A	1	Polyethylene balloon ascent damage	

*Top-capped

GHOST BALLOON FLIGHT SUMMARY - NOTES

Balloon # nnn pp f M (Note A)

Frequency _____ MHz

Method of leak test (Note B)

Test results _____

_____

_____

Mfr. balloon # _____

Balloon mass _____ gm

Balloon volume _____ m^3

Balloon diameter _____ m

Film thickness (Note C) mil

Electronics mass _____ gm

Ballast _____ gm

Gross weight less helium _____ gm

Free lift _____ gm

Launch site _____ S

Launch time _____ UT

Ascent rate

0 - 5,000 m _____ m/sec

5,000 - 10,000 m _____ m/sec

Float altitude (Note D) _____ m

Radar (Note E)

Computed (Note F)

Telemetry

Code	Sensor
____	_____
____	_____
____	_____
____	_____

Surface winds ____° _____ m/sec

Cloud cover _____

Flight duration _____ days

Number of orbits _____

Position last heard _____

Probable cause of failure:

_____

Note A: nnn = flight number; pp = pressure altitude in tens of millibars; f = frequency = 15.02f MHz; M = balloon code letters

Note B: Freon test - complete survey of balloon using General Electric Co. halogen detector; balloon overpressurized with air and Freon.

Tent test - balloon pressurized with air and Freon and left under canopy for 24 hr. Canopy tested with halogen detector for escaped gas.

Water test - balloon pressurized with air and placed in wading pool filled with water; leak detected from bubbles.

Note C: 1 mil = 0.001 in. = 25μ.

Note D: Balloon floats at a constant density surface; expressed in kg/m^3, the number would not be meaningful. "Density altitude" is altitude in *U.S. Standard Atmosphere, 1962*, corresponding to the computed or measured density level at float altitude.

Note E: Altitude is measured float altitude from radar, corrected to "density altitude."

Note F: "Density altitude" in meters, computed from balloon volume and gross mass.

Occulting angle is the sun's elevation angle above which the balloon obscures the sun elevation angle sensor. On some flights an occulting disk was used to provide a precise angle for blocking the sun and preventing reflected light from the metalized cap from entering the sun elevation angle sensor.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 98104 Q

Frequency 15.024 MHz

Method of leak test Freon

Test results Leak at inflation fitting detected and repaired

Mfr. balloon # Raven 3

Balloon mass 1996 gm

Balloon volume 14.82 m^3

Balloon diameter 3.05 m

Film thickness 1.5 mil

Electronics mass 160 gm

Ballast 20 gm

Gross weight less helium 2176 gm

Free lift 18.4% 400 gm

Launch site 172°32'E, 43°29'S

Launch time 29/09/67 2118 UT

Ascent rate

0 - 5,000 m 2.3 m/sec

5,000 - 10,000 m m/sec

Float altitude 15,800 m

Radar

Computed x

Telemetry

Code	Sensor
Q	Sun angle

Surface winds 060° 3.6 m/sec

Cloud cover 1/4 Ac at 5500 m

Flight duration 441 days

Number of orbits 25

Position last heard 57710 (12/12/68)

Probable cause of failure:

Gas diffusion

Remarks:

GHOST BALLOON FLIGHT SUMMARY

Balloon # 130101 XZ

Frequency 15.021 MHz

Method of leak test Freon

Test results Five leaks detected and repaired

Mfr. balloon # Schjeldahl 3

Balloon mass 2106 gm

Balloon volume 14.74 m^3

Balloon diameter 3.04 m

Film thickness 1.5 mil

Electronics mass 148 gm

Ballast 35 gm

Gross weight less helium 2289 gm

Free lift 456 gm

Launch site 172°32'E, 43°29'S

Launch time 21/04/68 1930 UT

Ascent rate

0 - 5,000 m 2.1 m/sec

5,000 - 10,000 m 2.1 m/sec

Float altitude 13,900* m

Radar x

Computed

Telemetry

Code	Sensor
X	Sun angle
Z	Strain gage

Surface winds calm m/sec

Cloud cover 1/4 Sc; 1/2 Ac

Flight duration 319 days

Number of orbits 19

Position last heard 62146 (04/03/68)

Probable cause of failure:

Balloon failure

Remarks:

*Design altitude was 15,500 m. After inflation, the defective inflation tube was cut out and replaced by a patch. Apparently 0.3 m^3 of air was sucked into the balloon during the repair operation. This provided a 300 gm increase in effective ballast.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 145200 J

Frequency 15.020 MHz

Method of leak test Freon

Test results One leak around inflation fitting detected and repaired

Mfr. balloon # Raven 101

Balloon mass 1728 gm

Balloon volume 7.037 m^3

Balloon diameter 2.38 m

Film thickness 2 mil

Electronics mass 142 gm

Ballast 80 gm

Gross weight less helium 1950 gm

Free lift 195 gm

Launch site $172^{o}32'E$, $43^{o}29'S$

Launch time 13/06/68 2120 UT

Ascent rate

0 - 5,000 m 1.6 m/sec

5,000 - 10,000 m 2.1 m/sec

Float altitude 11,784 m

Radar

Computed x

Telemetry

Code	Sensor
J	Sun angle

Surface winds calm m/sec

Cloud cover 3/8 Ac

Flight duration 228 days

Number of orbits 17

Position last heard 82563 (26/01/69)

Probable cause of failure:

Unknown

Remarks: The top third of the balloon was covered with a metalized Mylar cap.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 148203 G

Frequency 15.023 MHz

Method of leak test Freon

Test results No leaks detected

Mfr. balloon # Raven 105

Balloon mass 1732 gm

Balloon volume 7.037 m^3

Balloon diameter 2.38 m

Film thickness 2 mil

Electronics mass 135 gm

Ballast 83 gm

Gross weight less helium 1950 gm

Free lift 195 gm

Launch site 172°32'E, 43°29'S

Launch time 18/06/68 2100 UT

Ascent rate

0 - 5,000 m 1.5 m/sec

5,000 - 10,000 m 1.8 m/sec

Float altitude 11,784 m

Radar

Computed x

Telemetry

Code	Sensor
G	Sun angle

Surface winds gusty 4 m/sec

Cloud cover 1/4 Sc

Flight duration 240 days

Number of orbits 20

Position last heard 63679 (12/02/69)

Probable cause of failure:

Unknown

Remarks: The top third of the balloon was covered with a metalized Mylar cap.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 149204 Z
Frequency 15.024 MHz

Method of leak test Freon
Test results No leaks detected

Mfr. balloon # Raven 110
Balloon mass 1716 gm
Balloon volume 7.037 m^3
Balloon diameter 2.38 m
Film thickness 2 mil
Electronics mass 138 gm
Ballast 77 gm
Gross weight less helium 1950 gm
Free lift 195 gm

Launch site 172°32'E, 43°29'S
Launch time 18/06/68 2102 UT
Ascent rate
0 - 5,000 m 1.5 m/sec
5,000 - 10,000 m 1.8 m/sec
Float altitude 11,784 m
Radar
Computed x

Telemetry

Code	Sensor
Z	Sun angle

Surface winds gusty 4 m/sec
Cloud cover 1/4 Sc
Flight duration 207 days
Number of orbits 13
Position last heard 73122 (10/01/69)

Probable cause of failure:
Unknown

Remarks: The top third of the balloon was covered with a metalized Mylar cap.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 153104 GH

Frequency 15.024 MHz

Method of leak test Freon

Test results Three cracks repaired on frangible inflation fitting transition cone; one leak detected and repaired

Mfr. balloon # Schjeldahl 4

Balloon mass 2118 gm

Balloon volume 14.74 m^3

Balloon diameter 3.04 m

Film thickness 1.5 mil

Electronics mass 178 gm

Ballast 33 gm

Gross weight less helium 2329 gm

Free lift 18% 420 gm

Launch site 172°32'E, 43°29'S

Launch time 26/09/68 1801 UT

Ascent rate

0 - 5,000 m 2.08 m/sec

5,000 - 10,000 m 2.32 m/sec

Float altitude 15,150 m

Radar x

Computed

Telemetry

Code	Sensor
G	Sun angle
H	Strain gage

Surface winds 0.26° 5.65 m/sec

Cloud cover 1/4 Sc

Flight duration 89 days

Number of orbits 3

Position last heard 7--50 (23/12/68)

Probable cause of failure:

Sudden balloon failure

Remarks: The balloon was flown with a frangible inflation fitting and hemispherical electronics package with linear sun-angle detector.

80° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 154835 K

Frequency 15.025 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 105

Balloon mass 4872 gm

Balloon volume 5.79 m^3

Balloon diameter 1 × 6.7 m

Film thickness 1 × 1 × 1 mil

Electronics mass 321 gm

Ballast 35 gm

Gross weight less helium 5228 gm

Free lift 12% 625 gm

Launch site 172°32'E, 43°29'S

Launch time 02/10/68 1802 UT

Ascent rate

0 - 5,000 m 2.18 m/sec

5,000 - 10,000 m m/sec

Float altitude 1352 m

Radar x

Computed

Telemetry

Code	Sensor
K	Sun angle

Surface winds 070° 2.6 m/sec

Cloud cover 1/8 Cb; 3/4 Ac

Flight duration 2 days

Number of orbits 0

Position last heard 63167 (03/10/68)

Probable cause of failure:
Excessive water loading

Remarks: The balloon was a 1 × 6.7 cylinder equipped with hemispherical end caps and a 1 × 1 mil sleeve.

The balloon film was waxed to prevent accumulation of water and ice.

85° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 155017 A
Frequency 15.027 MHz

Method of leak test Not tested
Test results

Mfr. balloon # Winzen 4
Balloon mass 69,400 gm
Balloon volume 4419 m^3
Balloon diameter 20.37 m
Film thickness 2 mil
Electronics mass 168 gm
Ballast 2428 gm
Gross weight less helium 71,996 gm
Free lift 5% 3582 gm

Launch site 172°32'E, 43°29'S
Launch time 03/10/68 1753 UT
Ascent rate
0 - 5,000 m 2.32 m/sec
5,000 - 10,000 m 3.09 m/sec
Float altitude 29,500 m
Radar
Computed x

Telemetry

Code	Sensor
A	Sun angle

Surface winds variable, light
Cloud cover 1/8 Cu
Flight duration 1 days
Number of orbits 0
Position last heard 74373 (03/10/68)

Probable cause of failure:
Ascent damage

Remarks: The balloon was fabricated of StratoFilm polyethylene. It was launched with 2866 gm of Freon 11 as an ascent ballast to slow entry into float level, and a 66.9 m^3 volume lifting balloon to aid ascent through the tropopause.

The flight was radar tracked to 16 km; signal was lost at this point due to extreme slant range.

80.2° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 156224 UF

Frequency 15.024 MHz

Method of leak test Saran integrity

Test results Large leak detected within two hours

Mfr. balloon # Schjeldahl 1169-1

Balloon mass 1657 gm

Balloon volume 6.06 m^3

Balloon diameter 2.26 m

Film thickness 1.5 + 0.5* mil

Electronics mass 165 gm

Ballast 58 gm

Gross weight less helium 1880 gm

Free lift 11% 207 gm

Launch site 172°32'E, 43°29'S

Launch time 10/10/68 1429 UT

Ascent rate

0 - 5,000 m 1.89 m/sec

5,000 - 10,000 m m/sec

Float altitude 11,070 m

Radar

Computed x

Telemetry

Code	Sensor
U	Sun angle
F	Electronics temperature

Surface winds 260° 1.5 m/sec

Cloud cover 1/8 Sc

Flight duration 126 days

Number of orbits 8

Position last heard (12/02/69)

Probable cause of failure:

Icing

Remarks: The balloon was equipped with a metalized Mylar cap.

80° occulting disk, 79.3° occulting angle.

*Doubloon with 1.5 mil Mylar outer balloon; 0.5 mil saran inner balloon.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 157228 LU

Frequency 15.028 MHz

Method of leak test Saran integrity

Test results No leaks detected, 48 hr test

Mfr. balloon # Schjeldahl 1169-3

Balloon mass 1702 gm

Balloon volume 6.06 m^3

Balloon diameter 2.26 m

Film thickness 1.5 + 0.5* mil

Electronics mass 170 gm

Ballast 8 gm

Gross weight less helium 1880 gm

Free lift 11% 207 gm

Launch site 172°32'E, 43°29'S

Launch time 10/10/68 1431 UT

Ascent rate

0 - 5,000 m 1.89 m/sec

5,000 - 10,000 m m/sec

Float altitude 11,070 m

Radar

Computed x

Telemetry

Code	Sensor
L	Sun angle
U	Strain gage

Surface winds 260° 1.5 m/sec

Cloud cover 1/8 Sc

Flight duration 121 days

Number of orbits 6

Position last heard 55172 (07/02/69)

Probable cause of failure:

Icing

Remarks: The balloon was equipped with a metalized Mylar cap.

80° occulting disk, 79.3° occulting angle.

*Doubloon with 1.5 mil Mylar outer balloon; 0.5 mil saran inner balloon.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 158226 DC

Frequency 15.026 MHz

Method of leak test Saran integrity

Test results No leaks detected, 48 hr test

Mfr. balloon # Schjeldahl 1169-2

Balloon mass 1641 gm

Balloon volume 6.06 m^3

Balloon diameter 2.26 m

Film thickness 1.5 + 0.5* mil

Electronics mass 168 gm

Ballast 71 gm

Gross weight less helium 1880 gm

Free lift 16% 301 gm

Launch site 172°32'E, 43°29'S

Launch time 10/10/68 1445 UT

Ascent rate

0 - 5,000 m 1.89 m/sec

5,000 - 10,000 m m/sec

Float altitude 11,070 m

Radar

Computed x

Telemetry

Code	Sensor
D	Sun angle
C	Strain gage

Surface winds 260° 1.5 m/sec

Cloud cover 1/8 Sc

Flight duration 107 days

Number of orbits 8

Position last heard 72268 (24/01/69)

Probable cause of failure:

Balloon developed small leak

Remarks: The electronics package was equipped with a linear sun-angle sensor.

80° occulting disk, 79.3° occulting angle.

* Doubloon with 1.5 mil Mylar outer balloon; 0.5 mil saran inner balloon.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 159203 L

Frequency 15.023 MHz

Method of leak test Pressure

Test results Retained Pressure

Mfr. balloon # Raven 145

Balloon mass 1011 gm

Balloon volume 4.19 m^3

Balloon diameter 2.0 m

Film thickness 0.75 × 0.75 mil

Electronics mass 150 gm

Ballast 25 gm

Gross weight less helium 1186 gm

Free lift 12% 142 gm

Launch site 172°32'E, 43°29'S

Launch time 16/10/68 1900 UT

Ascent rate

0 - 5,000 m 1.6 m/sec

5,000 - 10,000 m m/sec

Float altitude 11,650 m

Radar

Computed x

Telemetry

Code	Sensor
L	Sun angle

Surface winds 020° 3.6 m/sec

Cloud cover 3/4 Ac; 1/4 As

Flight duration 107 days

Number of orbits 9

Position last heard 73038 (30/01/69)

Probable cause of failure:

Unknown

Remarks: The electronics package was equipped with a linear sun-angle sensor.

80° occulting disk, 77.8° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 160206 BK

Frequency 15.026 MHz

Method of leak test Pressure

Test results Retained pressure

Mfr. balloon # Raven 148

Balloon mass 960 gm

Balloon volume 4.19 m^3

Balloon diameter 2.0 m

Film thickness 0.5 × 0.5* mil

Electronics mass 160 gm

Ballast 66 gm

Gross weight less helium 1186 gm

Free lift 12% 142 gm

Launch site 172°32'E, 43°29'S

Launch time 16/10/68 1900 UT

Ascent rate

0 - 5,000 m 1.6 m/sec

5,000 - 10,000 m m/sec

Float altitude 11,650 m

Radar

Computed x

Telemetry

Code	Sensor
B	Sun angle
K	Strain gage

Surface winds 020° 3.6 m/sec

Cloud cover 3/4 Ac; 1/4 As

Flight duration 118 days

Number of orbits 9

Position last heard 62976 (10/02/69)

Probable cause of failure:

Icing

Remarks: The electronics package was equipped with a linear sun-angle sensor.

80° occulting disk, 77.8° occulting angle.

*The balloon was 0.5 × 0.5 mil bilam Mylar with a 0.5 mil adhesive layer.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 161204 AR-H
Frequency 15.024 MHz

Method of leak test Pressure
Test results Retained pressure

Mfr. balloon # Raven 146
Balloon mass 945 gm
Balloon volume 4.19 m^3
Balloon diameter 2.0 m
Film thickness 0.5 × 0.5* mil
Electronics mass 177 gm
Ballast 64 gm
Gross weight less helium 1186 gm
Free lift 12% 142 gm

Launch site 172°32'E, 43°29'S
Launch time 16/10/68 1901 UT
Ascent rate
0 - 5,000 m 1.6 m/sec
5,000 - 10,000 m m/sec
Float altitude 11,650 m
Radar
Computed x

Telemetry

Code	Sensor
A	Sun angle
R	Strain gage
H	Electronics temperature

Surface winds 020° 3.6 m/sec
Cloud cover 3/4 Ac; 1/4 As
Flight duration 107 days
Number of orbits 6
Position last heard 64268 (30/01/69)

Probable cause of failure:
Icing

Remarks: The electronics package was equipped with a linear sun-angle sensor. The third letter of the code failed to transmit properly and left a blank in transmission for ~40 sec..

80° occulting disk, 77.8° occulting angle.

*The balloon was 0.5 × 0.5 mil bilam Mylar with a 0.5 mil adhesive layer.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 162033/6 D/P

Frequency 15.023 15.026 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 104

Balloon mass 25,350 gm

Balloon volume 697 m^3

Balloon diameter 11 m

Film thickness 0.75 × 0.75 mil

Electronics mass 321 gm

Ballast 4179 gm

Gross weight less helium 29,850 gm

Free lift 16% 4776 gm

Launch site 172°32'E, 43°29'S

Launch time 23/10/68 1743 UT

Ascent rate

0 - 5,000 m 2.08 m/sec

5,000 - 10,000 m 2.27 m/sec

Float altitude 23,350 m

Radar

Computed x

Telemetry

Code	Sensor
D	Sun angle
P	Strain gage

Surface winds calm m/sec

Cloud cover clear

Flight duration 172 days

Number of orbits 3+

Position last heard (12/04/69)

Probable cause of failure:

Sudden balloon failure

Remarks: The balloon was launched with 3880 gm of Freon 11 as an ascent ballast to slow entry into float level, and a 5.3 m^3 volume lifting balloon to aid ascent through the tropopause.

The flight was radar tracked at altitude for approximately the first 6 hr.

80° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 163036/2 A/V
Frequency 15.026 15.022 MHz

Method of leak test Not tested
Test results

Mfr. balloon # Raven 105
Balloon mass 24,900 gm
Balloon volume 697 m^3
Balloon diameter 11 m
Film thickness 0.75 × 0.75 mil
Electronics mass 525* gm
Ballast 3182 gm
Gross weight less helium 29,850 gm
Free lift 16% 4776 gm

Launch site 172°32'E, 43°29'S
Launch time 29/10/68 1730 UT
Ascent rate
0 - 5,000 m 3.47 m/sec
5,000 - 10,000 m 3.47 m/sec
Float altitude 23,350 m
Radar x
Computed

Telemetry

Code	Sensor
A	Sun angle
V	Strain gage

Surface winds calm m/sec
Cloud cover 1/8 Ac
Flight duration 141 days
Number of orbits 5
Position last heard 63367 (18/03/69)

Probable cause of failure:
Balloon failure

Remarks: The balloon was launched with 4776 gm of Freon 11 as an ascent ballast to slow entry into float level, and a 5.3 m^3 volume lifting balloon to aid ascent through the tropopause.

The flight was radar tracked at altitude for 3½ hr.

80° occulting disk, 82.2° occulting angle.

*Package A = 228 gm;
Package V = 297 gm

GHOST BALLOON FLIGHT SUMMARY

Balloon # 164035/6 P/QWXBCA

Frequency 15.025 15.026 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Schjeldahl 1208-1

Balloon mass 23,683 gm

Balloon volume 691.8 m^3

Balloon diameter 10.97 m

Film thickness 1 + 0.5* mil

Electronics mass 3491** gm

Ballast 1498 gm

Gross weight less helium 28,672 gm

Free lift 16% 4587 gm

Launch site 172°32'E, 43°29'S

Launch time 06/11/68 1718 UT

Ascent rate

0 - 5,000 m 2.38 m/sec

5,000 - 10,000 m 2.87 m/sec

Float altitude 23,760 m

Radar

Computed x

Surface winds 040° 3.6 m/sec

Cloud cover 1/8 Sc; 7/8 As

Flight duration 0 days

Number of orbits 0

Position last heard 74373 (06/11/68)

Probable cause of failure:

Balloon burst

Remarks: After 118 min of flight, the balloon had ascended to 23,940 m, where it burst. Prior to burst (112-114 min) it reached peak ascent rate of 465 m/min.

Flight train employed drag parachute in attempt to reduce ascent rate.

80° occulting angle.

Telemetry

Code	Sensor
P	Sun angle
Q	BIP external temperature, side
W	BIP external temperature, top
X	BIP internal temperature, side
B	Air temperature
C	Strain gage
A	Reference resistor

* Doubloon with 1 mil Mylar outer balloon; 0.5 mil saran/Mylar inner balloon.

** BIP = 2840 gm; Clevite solar cell panel, transmitter and antenna = 439 gm; GHOST package = 212 gm.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 165031/6 U/FAGKYD
Frequency 15.021 15.026 MHz

Method of leak test Not tested
Test results

Mfr. balloon # Schjeldahl 1208-2
Balloon mass 23,462 gm
Balloon volume 691.8 m^3
Balloon diameter 10.97 m
Film thickness 1 + 0.5* mil
Electronics mass 3635** gm
Ballast 1540 gm
Gross weight less helium 28,637 gm
Free lift 12% 3440 gm

Launch site 172°32'E, 43°29'S
Launch time 14/11/68 1140 UT
Ascent rate
0 - 5,000 m 3.2 m/sec
5,000 - 10,000 m 3.34 m/sec
Float altitude 23,765 m
Radar
Computed x

Surface winds 225° 1 m/sec
Cloud cover clear
Flight duration 5 days
Number of orbits 0
Position last heard 74040 (18/11/68)

Probable cause of failure:
Balloon developed small leak, probably during ascent.

Remarks: The balloon was launched with 2864 gm of Freon 11 as an ascent ballast to slow entry into float level, and a 7.4 m^3 volume lifting balloon to aid ascent through the tropopause.

80° occulting angle.

* Doubloon with 1 mil Mylar outer balloon; 0.5 mil saran/Mylar inner balloon.

** BIP = 3000 gm; Clevite solar cell panel, transmitter and antenna = 444 gm; GHOST package = 191 gm.

Telemetry

Code	Sensor
U	Sun angle
F	Strain gage
A	Reference resistor
G	BIP external temperature, side
K	BIP internal temperature, side
Y	Air temperature
D	BIP external temperature, top

GHOST BALLOON FLIGHT SUMMARY

Balloon # 166405 CV

Frequency 15.025 MHz

Method of leak test Freon

Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-3

Balloon mass 1903 gm

Balloon volume 4.446 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 187 gm

Ballast 121 gm

Gross weight less helium 2211 gm

Free lift 15% 332 gm

Launch site 172°32'E, 43°29'S

Launch time 21/11/68 1725 UT

Ascent rate

0 - 5,000 m 1.77 m/sec

5,000 - 10,000 m m/sec

Float altitude 7170 m

Radar x

Computed

Telemetry

Code	Sensor
C	Sun angle
V	Strain gage

Surface winds 210° 3 m/sec

Cloud cover 1/8 Cb; 3/8 Cs

Flight duration 68 days

Number of orbits 1+

Position last heard 85622 (27/01/69)

Probable cause of failure:

Icing

Remarks: The balloon was equipped with a metalized Mylar cap.

The electronics package was equipped with 6 in. occulting disk installed 72.6 cm above sun-angle sensor. Solar cell panel interference from disk begins at 77°.

84° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 167406 DL

Frequency 15.026 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-7

Balloon mass 1915* gm

Balloon volume 4.446 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 190 gm

Ballast 106 gm

Gross weight less helium 2211 gm

Free lift 15% 332 gm

Launch site 172°32'E, 43°29'S

Launch time 26/11/68 1732 UT

Ascent rate

0 - 5,000 m 1.98 m/sec

5,000 - 10,000 m m/sec

Float altitude 7335 m

Radar x

Computed

Telemetry

Code	Sensor
D	Sun angle
L	Strain gage

Surface winds calm m/sec

Cloud cover 1/8 Cu

Flight duration 3 days

Number of orbits 0

Position last heard 64238 (28/11/68)

Probable cause of failure:

Icing

Remarks: The balloon was equipped with a metalized Mylar cap.

The electronics package was equipped with a 15.23 cm occulting disk installed 72.6 cm above sun-angle sensor.

84° occulting angle.

*Includes 89 gm strain gage and wire and 51 gm cap.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 168401 AP

Frequency 15.021 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-8

Balloon mass 1858* gm

Balloon volume 4.446 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 209 gm

Ballast 144 gm

Gross weight less helium 2211 gm

Free lift 15% 332 gm

Launch site 172°32'E, 43°29'S

Launch time 26/11/68 1733 UT

Ascent rate

0 - 5,000 m 1.85 m/sec

5,000 - 10,000 m m/sec

Float altitude 7335 m

Radar x

Computed

Telemetry

Code	Sensor
A	Sun angle
P	Strain gage

Surface winds calm m/sec

Cloud cover 1/8 Cu

Flight duration 8 days

Number of orbits 0

Position last heard 65049 (03/12/68)

Probable cause of failure:

Icing

Remarks: The electronics package was equipped with a 15.23 cm occulting disk installed 72.6 cm above sun angle sensor.

84° occulting angle.

*Includes 90 gm strain gage wire.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 169404 W

Frequency 15.024 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-5

Balloon mass 1779 gm

Balloon volume 4.446 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 184 gm

Ballast 248 gm

Gross weight less helium 2211 gm

Free lift 15% 332 gm

Launch site 172°32'E, 43°29'S

Launch time 28/11/68 2133 UT

Ascent rate

0 - 5,000 m 2.19 m/sec

5,000 - 10,000 m m/sec

Float altitude 7180 m

Radar x

Computed

Telemetry

Code	Sensor
W	Sun angle

Surface winds 090° 4 m/sec

Cloud cover 1/8 Ac; 4/8 Cs

Flight duration 12 days

Number of orbits 0

Position last heard 85822 (09/12/68)

Probable cause of failure:

Icing

Remarks: The electronics package was equipped with a 15.23 cm occulting disk installed 72.6 cm above sun-angle sensor.

84° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 170401 B

Frequency 15.021 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-10

Balloon mass 1797 gm

Balloon volume 4.446 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 190 gm

Ballast 224 gm

Gross weight less helium 2211 gm

Free lift 14% 310 gm

Launch site 172°32'E, 43°29'S

Launch time 01/12/68 1734 UT

Ascent rate

0 - 5,000 m Not measured

5,000 - 10,000 m m/sec

Float altitude 7440 m

Radar x

Computed

Telemetry

Code	Sensor
B	Sun angle

Surface winds 050° 5 m/sec

Cloud cover 1/2 Sc

Flight duration 8 days

Number of orbits 0

Position last heard 63553 (08/12/68)

Probable cause of failure:

Icing

Remarks: The balloon was equipped with a metalized Mylar cap.

84° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 171404 X

Frequency 15.024 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-6

Balloon mass 1777 gm

Balloon volume 4.446 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 185 gm

Ballast 249 gm

Gross weight less helium 2211 gm

Free lift 18% 398 gm

Launch site 172°32'E, 43°29'S

Launch time 01/12/68 1735 UT

Ascent rate

0 - 5,000 m 1.85 m/sec

5,000 - 10,000 m 1.26 m/sec

Float altitude 7340 m

Radar x

Computed

Telemetry

Code	Sensor
X	Sun angle

Surface winds 050° 5 m/sec

Cloud cover 1/2 Sc

Flight duration 12 days

Number of orbits 0

Position last heard 64330 (12/12/68)

Probable cause of failure:

Icing

Remarks: 84° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 172406 C

Frequency 15.026 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-2

Balloon mass 1802 gm

Balloon volume 4.446 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 196 gm

Ballast 213 gm

Gross weight less helium 2211 gm

Free lift 14% 310 gm

Launch site 172°32'E, 43°29'S

Launch time 08/12/68 1733 UT

Ascent rate

0 - 5,000 m 1.77 m/sec

5,000 - 10,000 m 1.92 m/sec

Float altitude 7185 m

Radar x

Computed

Telemetry

Code	Sensor
C	Sun angle

Surface winds 255° 4.4 m/sec

Cloud cover 1/8 Cu; 3/8 Sc

Flight duration 4 days

Number of orbits 0

Position last heard 63668 (11/12/68)

Probable cause of failure:

Icing

Remarks: The balloon was equipped with a metalized Mylar cap.

84° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 173403 JR

Frequency 15.023 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-20

Balloon mass 1740 gm

Balloon volume 4.446 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 206 gm

Ballast 265 gm

Gross weight less helium 2211 gm

Free lift 18% 398 gm

Launch site 172°32'E, 43°29'S

Launch time 08/12/68 1743 UT

Ascent rate

0 - 5,000 m 1.77 m/sec

5,000 - 10,000 m 1.92 m/sec

Float altitude 7185 m

Radar x

Computed

Telemetry

Code	Sensor
J	Sun angle
R	Electronics temperature

Surface winds 255° 4.4 m/sec

Cloud cover 1/8 Cu; 3/8 Sc

Flight duration 4 days

Number of orbits 0

Position last heard 63076 (11/12/68)

Probable cause of failure:

Icing

Remarks: 84° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 174403 V

Frequency 15.023 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-1

Balloon mass 1817 gm

Balloon volume 4.446 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 208 gm

Ballast 186 gm

Gross weight less helium 2211 gm

Free lift 14% 310 gm

Launch site 172°32'E, 43°29'S

Launch time 09/12/68 1711 UT

Ascent rate.

0 - 5,000 m 1.94 m/sec

5,000 - 10,000 m m/sec

Float altitude 7185 m

Radar

Computed x

Telemetry

Code	Sensor
V	Sun angle

Surface winds 280° 1 m/sec

Cloud cover 1/8 St; 1/8 Sc; 1/8 Ac

Flight duration 5 days

Number of orbits 0

Position last heard 64700 (13/12/68)

Probable cause of failure:

Icing

Remarks: The balloon was equipped with a metalized Mylar cap.

84° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 175401 Y
Frequency 15.021 MHz

Method of leak test Overpressure
Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-22
Balloon mass 1753 gm
Balloon volume 4.446 m^3
Balloon diameter 2.04 m
Film thickness 1.5 × 1.5 mil
Electronics mass 216 gm
Ballast 242 gm
Gross weight less helium 2211 gm
Free lift 18% 398 gm

Launch site 172°32'E, 43°29'S
Launch time 09/12/68 1713 UT
Ascent rate
0 - 5,000 m 1.9 m/sec
5,000 - 10,000 m 1.66 m/sec
Float altitude 7185 m
Radar x
Computed

Telemetry

Code	Sensor
Y	Sun angle

Surface winds 280° 1 m/sec
Cloud cover 1/8 St; 1/8 Sc; 1/8 Ac
Flight duration 4 days
Number of orbits 0
Position last heard 63349 (12/12/68)

Probable cause of failure:
Icing

Remarks: 84° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 176803 NDHU

Frequency 15.023 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 6

Balloon mass 5270 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 × 8.38* m

Film thickness 1 × 1 × 1* mil

Electronics mass 373 gm

Ballast 127 gm

Gross weight less helium 5770 gm

Free lift 12% 690 gm

Launch site 172°32'E, 43°29'S

Launch time 10/12/68 1230 UT

Ascent rate

0 - 5,000 m 1.9 m/sec

5,000 - 10,000 m m/sec

Float altitude 1845 m

Radar x

Computed

Telemetry

Code	Sensor
N	Sun angle
D	Strain gage
H	Electronics temperature
U	Air temperature

Surface winds 070° 3.6 m/sec

Cloud cover 4/8 Sc at 2000 ft

Flight duration 6 days

Number of orbits 0

Position last heard 65660 (15/12/68)

Probable cause of failure:
Excessive water load on balloon

Remarks: 84° occulting angle.

*The balloon was a cylinder 8.38 m long, with a 2 mil bilam. Mylar sleeve.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 177405 QU

Frequency 15.025 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-9

Balloon mass 1909 gm

Balloon volume 4.446 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 206 gm

Ballast 96 gm

Gross weight less helium 2211 gm

Free lift 14% 310 gm

Launch site 172°32'E, 43°29'S

Launch time 19/12/68 1728 UT

Ascent rate

0 - 5,000 m 2.2 m/sec

5,000 - 10,000 m 1.56 m/sec

Float altitude 7530 m

Radar x

Computed

Telemetry

Code.	Sensor
Q	Sun angle
U	Strain gage

Surface winds 030° 1.5 m/sec

Cloud cover 7/8 Sc

Flight duration 29 days

Number of orbits 1+

Position last heard 53473 (16/01/69)

Probable cause of failure:

Icing

Remarks: The balloon was equipped with a metalized Mylar cap.

Strain data show decreased strain on three occasions; 27 December, and 2 and 17 January, with the minimum strain dropping to no overpressure on the last two dates, and the maximum strain reaching 0.33 and 0.14%, respectively. This can be attributed to ice forming on the balloon at night (despite the top cap) and melting during the day.

84° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 178402 NK

Frequency 15.022 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Schjeldahl 1204-21

Balloon mass 1815 gm

Balloon volume 4.446 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 177 gm

Ballast 219 gm

Gross weight less helium 2211 gm

Free lift 18% 398 gm

Launch site 172°32'E, 43°29'S

Launch time 19/12/68 1729 UT

Ascent rate

0 - 5,000 m Not measured

5,000 - 10,000 m m/sec

Float altitude 7100 m

Radar x

Computed

Telemetry

Code	Sensor
N	Sun angle
K	Strain gage

Surface winds 030° 1.5 m/sec

Cloud cover 7/8 Sc

Flight duration 24 days

Number of orbits 1

Position last heard 64963 (11/01/69)

Probable cause of failure:

Icing

Remarks: 84° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 179805 GN

Frequency 15.025 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 123

Balloon mass 5376 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 × 8.38* m

Film thickness 1 × 1 × 1 mil

Electronics mass 160 gm

Ballast 234 gm

Gross weight less helium 5770 gm

Free lift 14% 823 gm

Launch site 172°32'E, 43°29'S

Launch time 02/01/69 1748 UT

Ascent rate

0 - 5,000 m ** m/sec

5,000 - 10,000 m m/sec

Float altitude 1950 m

Radar

Computed x

Telemetry

Code	Sensor
G	Sun angle
N	Strain gage

Surface winds 040° 1.5 m/sec

Cloud cover 1/2 Sc; 5/8 Ac

Flight duration 4 days

Number of orbits 0

Position last heard 65774 (05/01/69)

Probable cause of failure:

Excessive water load on balloon

Remarks: 84° occulting angle.

* The balloon was a cylinder 8.38 m long, with a 2 mil bilam Mylar sleeve.

** Due to radar malfunction, ascent rate was not determined.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 180805 NV

Frequency 15.025 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 128

Balloon mass 5384 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 × 8.38 m

Film thickness 1 × 1 × 1* mil

Electronics mass 158 gm

Ballast 228 gm

Gross weight less helium 5770 gm

Free lift 12% 690 gm

Launch site 172°32'E, 43°29'S

Launch time 10/01/69 1730 UT

Ascent rate

0 - 5,000 m 2.05 m/sec

5,000 - 10,000 m m/sec

Float altitude 1995 m

Radar x

Computed

Telemetry

Code	Sensor
N	Sun angle
V	Air temperature

Surface winds 040° 1.5 m/sec

Cloud cover 1/8 Sc; 3/8 As

Flight duration 7 days

Number of orbits 0

Position last heard 76473 (14/01/69)

Probable cause of failure:

Excessive water load on balloon

Remarks: 85.5° occulting angle.

*The balloon was a cylinder 8.38 m long, with a 2 mil bilam Mylar sleeve.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 181806 CK

Frequency 15.026 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 120

Balloon mass 5307 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 × 8.38* m

Film thickness 1 × 1 × 1 mil

Electronics mass 168 gm

Ballast 295 gm

Gross weight less helium 5770 gm

Free lift 12% 690 gm

Launch site 172°32'E, 43°29'S

Launch time 16/01/69 1729 UT

Ascent rate

0 - 5,000 m 2.36 m/sec

5,000 - 10,000 m m/sec

Float altitude 1560 m

Radar x

Computed

Telemetry

Code	Sensor
C	Sun angle
K	Air temperature

Surface winds 270° 2.2 m/sec

Cloud cover 1/8 Sc

Flight duration 9 days

Number of orbits 0

Position last heard 72453 (24/01/69)

Probable cause of failure:

Excessive water load on balloon

Remarks: 84° occulting angle.

*The balloon was a cylinder 8.38 m long, with a 2 mil bilam Mylar sleeve.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 182802 BG

Frequency 15.022 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 117

Balloon mass 5368 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 × 8.38* m

Film thickness 1 × 1 × 1 mil

Electronics mass 190 gm

Ballast 212 gm

Gross weight less helium 5770 gm

Free lift 12% 690 gm

Launch site 172°32'E, 43°29'S

Launch time 24/01/69 1743 UT

Ascent rate

0 - 5,000 m Not measured

5,000 - 10,000 m m/sec

Float altitude 1800 m

Radar x

Computed

Telemetry

Code	Sensor
B	Sun angle
G	Strain gage

Surface winds calm m/sec

Cloud cover 3/8 St; 7/8 Sc

Flight duration 2 days

Number of orbits 0

Position last heard 74178 (25/01/69)

Probable cause of failure:

Excessive water load on balloon

Remarks: The electronics package employed an end-fed full-wave antenna.

84° occulting angle.

*The balloon was a cylinder 8.38 m long, with a 2 mil bilam Mylar sleeve.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 183807 BW
Frequency 15.027 MHz

Method of leak test Not tested
Test results

Mfr. balloon # Raven 127
Balloon mass 5435 gm
Balloon volume 6.62 m^3
Balloon diameter 1.067 × 8.38* m
Film thickness 1 × 1 × 1 mil
Electronics mass 194 gm
Ballast 141 gm
Gross weight less helium 5770 gm
Free lift 12% 690 gm

Launch site 172°32'E, 43°29'S
Launch time 04/04/69 1807 UT
Ascent rate
0 - 5,000 m 3.02 m/sec
5,000 - 10,000 m m/sec
Float altitude 1600 m
Radar x
Computed

Telemetry

Code	Sensor
B	Sun angle
W	Strain gage

Surface winds 070° 4.7 m/sec
Cloud cover 5/8 Ac, As
Flight duration 3 days
Number of orbits 0
Position last heard 74475 (06/02/69)

Probable cause of failure:
Excessive water load on balloon

Remarks: The electronics package employed an end-fed full-wave antenna.

84° occulting angle.

*The balloon was a cylinder 8.38 m long, with a 2 mil bilam Mylar sleeve.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 184806 FR

Frequency 15.026 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 113

Balloon mass 5372 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 × 8.38* m

Film thickness 1 × 1 × 1 mil

Electronics mass 195 gm

Ballast 203 gm

Gross weight less helium 5770 gm

Free lift 12% 690 gm

Launch site 172°32'E, 43°29'S

Launch time 06/02/69 1730 UT

Ascent rate

0 - 5,000 m Not measured

5,000 - 10,000 m m/sec

Float altitude 1660 m

Radar x

Computed

Telemetry

Code	Sensor
F	Sun angle
R	Strain gage

Surface winds 190° 6.2 m/sec

Cloud cover

Flight duration 2 days

Number of orbits 0

Position last heard 74375 (07/02/69)

Probable cause of failure:

Excessive water load on balloon

Remarks: The electronics package employed an end-fed full-wave antenna.

84° occulting angle.

*The balloon was a cylinder 8.38 m long, with a 2 mil bilam Mylar sleeve.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 185801 PU

Frequency 15.021 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 118

Balloon mass 5361 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 × 8.38* m

Film thickness 1 × 1 × 1 mil

Electronics mass 197 gm

Ballast 212 gm

Gross weight less helium 5770 gm

Free lift 12% 690 gm

Launch site 172°32'E, 43°29'S

Launch time 17/02/69 1749 UT

Ascent rate

0 - 5,000 m Not measured

5,000 - 10,000 m m/sec

Float altitude 1620 m

Radar x

Computed

Telemetry

Code	Sensor
P	Sun angle
U	Strain gage

Surface winds 190° 3.6 m/sec

Cloud cover 1/8 St; 3/8 Cu

Flight duration 6 days

Number of orbits 0

Position last heard (22/02/69)

Probable cause of failure:

Excessive water load on balloon

Remarks: The electronics package employed an end-fed full-wave antenna.

84° occulting angle.

*The balloon was a cylinder 8.38 m long, with a 2 mil bilam Mylar sleeve.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 186803 DR

Frequency 15.023 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 125

Balloon mass 5454 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 × 8.38* m

Film thickness 1 × 1 × 1 mil

Electronics mass 213 gm

Ballast 106 gm

Gross weight less helium 5770 gm

Free lift 12% 690 gm

Launch site 172°32'E, 43°29'S

Launch time 18/02/69 1810 UT

Ascent rate

0 - 5,000 m m/sec

5,000 - 10,000 m m/sec

Float altitude 2053 m

Radar x

Computed

Telemetry

Code	Sensor
D	Sun angle
R	Strain gage

Surface winds 260° 2 m/sec

Cloud cover 3/4 Sc

Flight duration 4 days

Number of orbits 0

Position last heard 74175 (21/02/69)

Probable cause of failure:

Excessive water load on balloon

Remarks: Strain data on last day showed a maximum strain of 0.48%; on that day a minimum strain of 0% was reached. There is no indication the balloon had developed a leak.

The electronics package employed an end-fed full-wave antenna.

84.8° occulting angle.

*The balloon was a cylinder 8.38 m long, with a 2 mil bilam Mylar sleeve.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 187404 F
Frequency 15.024 MHz

Method of leak test Pressure comparison
Test results No leaks detected

Mfr. balloon # Schjeldahl 17
Balloon mass 1783 gm
Balloon volume 4.445 m^3
Balloon diameter 2.04 m
Film thickness 1.5 × 1.5 mil
Electronics mass 232 gm
Ballast 196 gm
Gross weight less helium 2211 gm
Free lift 15% 332 gm

Launch site 172°32'E, 43°29'S
Launch time 06/03/69 1830 UT
Ascent rate
0 - 5,000 m 1.94 m/sec
5,000 - 10,000 m 1.67 m/sec
Float altitude 7300 m
Radar x
Computed

Telemetry

Code	Sensor
F	Sun angle

Surface winds calm m/sec
Cloud cover 1/8 Cu
Flight duration 3 days
Number of orbits 0
Position last heard 65857 (08/03/69)

Probable cause of failure:
Icing

Remarks: The balloon was equipped with a metalized Mylar cap.

86.7° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 188285/2 R/X

Frequency 15.025 15.022 MHz

Method of leak test Freon

Test results Four leaks detected and repaired

Mfr. balloon # Schjeldahl 3

Balloon mass 1048 gm

Balloon volume 4.445 m^3

Balloon diameter 2.04 m

Film thickness 0.75 × 0.75 mil

Electronics mass 490* gm

Ballast 138 gm

Gross weight less helium 1676 gm

Free lift 10% 168 gm

Launch site 172°32'E, 43°29'S

Launch time 06/03/69 1951 UT

Ascent rate

0 - 5,000 m 1.3 m/sec

5,000 - 10,000 m 1.83 m/sec

Float altitude 9620 m

Radar x

Computed

Telemetry

Code	Sensor
R	Sun angle
X	Hypsometric pressure

Surface winds calm m/sec

Cloud cover 1/8 Cu

Flight duration 60 days

Number of orbits 4

Position last heard 63345 (04/05/69)

Probable cause of failure:

Frost accumulation on balloon

Remarks: This was the first flight test of the pressure-subtracting hypsometer--a new device for measuring atmospheric pressure.

The balloon was protected against shipping damage by a strippable coating.

87.5° occulting angle.

*Hypsometer = 53 gm;
hypsometer electronics = 232 gm;
sun-angle electronics = 205 gm.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 189406 W

Frequency 15.026 MHz

Method of leak test Pressure comparison

Test results No leaks detected

Mfr. balloon # Schjeldahl 27

Balloon mass 1820 gm

Balloon volume 4.445 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 228 gm

Ballast 163 gm

Gross weight less helium 2211 gm

Free lift 15% 332 gm

Launch site 172°32'E, 43°29'S

Launch time 10/03/69 1855 UT

Ascent rate

0 - 5,000 m 1.74 m/sec

5,000 - 10,000 m 1.94 m/sec

Float altitude 7100 m

Radar x

Computed

Telemetry

Code	Sensor
W	Sun angle

Surface winds 300° 7.7 m/sec

Cloud cover 1/8 Sc; 7/8 Ci

Flight duration 8 days

Number of orbits 0

Position last heard 53132 (17/03/69)

Probable cause of failure:

Leak in balloon, launch damage

Remarks: The balloon was equipped with a metalized Mylar cap.

The balloon was severely damaged at launch when it struck the side of a building.

86.7° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 190407 B

Frequency 15.027 MHz

Method of leak test Pressure comparison

Test results No leaks detected

Mfr. balloon # Schjeldahl 28

Balloon mass 1754 gm

Balloon volume 4.445 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 191 gm

Ballast 266 gm

Gross weight less helium 2211 gm

Free lift 20% 442 gm

Launch site 172°32'E, 43°29'S

Launch time 12/03/69 1958 UT

Ascent rate

0 - 5,000 m 1.89 m/sec

5,000 - 10,000 m 1.67 m/sec

Float altitude 7200 m

Radar x

Computed

Telemetry

Code	Sensor
B	Sun angle

Surface winds 200° 7.2 m/sec

Cloud cover 1/8 St; 7/8 Sc

Flight duration 5 days

Number of orbits 0

Position last heard 62655 (16/03/69)

Probable cause of failure:

Icing

Remarks: 86.7° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 191225 GL

Frequency 15.025 MHz

Method of leak test Freon

Test results No leaks detected

Mfr. balloon # Schjeldahl 1

Balloon mass 1039 gm

Balloon volume 10.65 m^3

Balloon diameter 2.20 m

Film thickness 0.75 × 0.75 mil

Electronics mass 258* gm

Ballast 93 gm

Gross weight less helium 1390 gm

Free lift 10% 139 gm

Launch site 172°32'E, 43°29'S

Launch time 18/03/69 0109 UT

Ascent rate

0 - 5,000 m 1.26 m/sec

5,000 - 10,000 m 1.57 m/sec

Float altitude 11,700 m

Radar x

Computed

Telemetry

Code	Sensor
G	Sun angle
L	Hypsometric pressure

Surface winds 070° 5.1 m/sec

Cloud cover 1/8 Cu

Flight duration 225 days

Number of orbits 9

Position last heard 74075 (28/01/69)

Probable cause of failure:

Icing

Remarks: The balloon was protected against shipping damage by a strippable coating.

81.8° occulting angle.

*Hypsometer = 96 gm.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 192401 K

Frequency 15.021 MHz

Method of leak test Pressure comparison

Test results No leaks detected

Mfr. balloon # Schjeldahl 15

Balloon mass 1803 gm

Balloon volume 4.445 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 198 gm

Ballast 210 gm

Gross weight less helium 2211 gm

Free lift 14% 332 gm

Launch site 172°32'E, 43°29'S

Launch time 19/03/69 1929 UT

Ascent rate

0 - 5,000 m 1.98 m/sec

5,000 - 10,000 m 1.37 m/sec

Float altitude 7300 m

Radar x

Computed

Telemetry

Code	Sensor
K	Sun angle

Surface winds 020° 2.56 m/sec

Cloud cover 3/8 Sc

Flight duration 9 days

Number of orbits 0

Position last heard 63207 (27/03/69)

Probable cause of failure:

Icing

Remarks: The balloon was equipped with a metalized Mylar cap.

87.6° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 193403 H

Frequency 15.023 MHz

Method of leak test Pressure comparison

Test results No leaks detected

Mfr. balloon # Schjeldahl 18

Balloon mass 1734 gm

Balloon volume 4.445 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 248 gm

Ballast 229 gm

Gross weight less helium 2211 gm

Free lift 20% 442 gm

Launch site 172°32'E, 43°29'S

Launch time 27/03/69 2017 UT

Ascent rate

0 - 5,000 m 2.14 m/sec

5,000 - 10,000 m 1.42 m/sec

Float altitude 7300 m

Radar x

Computed

Telemetry

Code	Sensor
H	Sun angle

Surface winds 040° 1.54 m/sec

Cloud cover 1/8 St; 7/8 Sc

Flight duration 53 days

Number of orbits 0

Position last heard (18/05/69)

Probable cause of failure:

Icing

Remarks: 86.7° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 194406 J

Frequency 15.026 MHz

Method of leak test Pressure comparison

Test results One leak detected and repaired

Mfr. balloon # Schjeldahl 1204-19

Balloon mass 1796 gm

Balloon volume 4.445 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 249 gm

Ballast 166 gm

Gross weight less helium 2211 gm

Free lift 14% 332 gm

Launch site 172°32'E, 43°29'S

Launch time 31/03/69 0028 UT

Ascent rate

0 - 5,000 m 2.31 m/sec

5,000 - 10,000 m 1.39 m/sec

Float altitude 7330 m

Radar x

Computed

Telemetry

Code	Sensor
J	Sun angle

Surface winds 060° 6.17 m/sec

Cloud cover 5/8 Sc

Flight duration 5 days

Number of orbits 0

Position last heard 64142 (04/04/69)

Probable cause of failure:

Icing

Remarks: This balloon was equipped with a metalized Mylar cap.

86.7° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 195903 L

Frequency 15.023 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Raven 129

Balloon mass 5384 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067* m

Film thickness 1 × 1 × 1 mil

Electronics mass 262 gm

Ballast 704 gm

Gross weight less helium 6350 gm

Free lift 12% 762 gm

Launch site 172°32'E, 43°29'S

Launch time 16/04/69 2123 UT

Ascent rate

0 - 5,000 m 2.17 m/sec

5,000 - 10,000 m m/sec

Float altitude 1040 m

Radar x

Computed

Telemetry

Code	Sensor
L	Air temperature

Surface winds 040° 1 m/sec

Cloud cover 1/8 Sc; 1/8 Ac

Flight duration 4 days

Number of orbits 0

Position last heard 74472 (19/04/69)

Probable cause of failure:

Payload caught in high-country trees

Remarks: The balloon was recovered and flown again as Flight 196903 L.

86° occulting angle.

*The balloon was a cylinder 8.38 m long, with a 2 mil bilam Mylar sleeve, and hemispherical end caps.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 196903 L

Frequency 15.203 MHz

Method of leak test Overpressure

Test results Small leak detected

Mfr. balloon # Raven 129

Balloon mass 5384 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 m

Film thickness 1 × 1 × 1 mil

Electronics mass 262 gm

Ballast 431 gm

Gross weight less helium 6082 gm

Free lift 12.8% 784 gm

Launch site 172°32'E, 43°29'S

Launch time 23/04/69 0345 UT

Ascent rate

0 - maximum altitude 4.05m/sec

5,000 - 10,000 m m/sec

Float altitude m

Radar x

Computed

Telemetry

Code	Sensor
L	Air temperature

Surface winds 080° 2.57 m/sec

Cloud cover 7/8 Sc; 8/8 As

Flight duration 2 days

Number of orbits 0

Position last heard 74372 (24/04/69)

Probable cause of failure:
Excessive water load on balloon

Remarks: The balloon was launched during a heavy rainstorm. It climbed to 730 m, then descended to 440 m where some of the water load was shed. Thereafter it ranged between 440 and 560 m during the 50 min that it was tracked by radar; target was then lost because of intense radar rain return.

No attempt was made to locate and repair the small leak since, for the purpose of this flight, the balloon life was more than adequate.

86° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 197184/8/2 F/P/U

Frequency 15.024/15.028/15.022 MHz

Method of leak test Overpressure

Test results No leaks detected

Mfr. balloon # Schjeldahl 4

Balloon mass 4184 gm

Balloon volume 28.96 m^3

Balloon diameter 3.81 m

Film thickness 1 × 1 mil

Electronics mass 1328* gm

Ballast 98 gm

Gross weight less helium 5610 gm

Free lift 20% 1122 gm

Launch site 172°32'E, 43°29'S

Launch time 19/05/69 2037 UT

Ascent rate

0 - 5,000 m 2.68 m/sec

5,000 - 10,000 m 2.68 m/sec

Float altitude 12,500 m

Radar x

Computed

Telemetry

Code	Sensor
F	Sun angle
P	Vertical magnetometer
U	Cut-down device

Surface winds 045° 2.6 m/sec

Cloud cover 1/8 Sc; 7/8 Cs

Flight duration 39 days

Number of orbits 0

Position last heard (26/06/69)

Probable cause of failure:

Unknown

Remarks: The cut-down device operates with night/day temperature change. Contacts are wired to measure either electronics temperature or high or low reference resistor. The total cycle for this cut-down device was 180 days.

89.4° occulting angle.

*Package F = 251 gm; package P = 388 gm; package U = 689 gm.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 198401 W

Frequency 15.021 MHz

Method of leak test Freon

Test results No leaks detected

Mfr. balloon # Schjeldahl 24

Balloon mass 1770 gm

Balloon volume 4.44 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 176 gm

Ballast 265 gm

Gross weight less helium 2211 gm

Free lift 20% 442 gm

Launch site 172°32'E, 43°29'S

Launch time 02/06/69 2019 UT

Ascent rate

0 - 5,000 m 2.26 m/sec

5,000 - 10,000 m 1.36 m/sec

Float altitude 7200 m

Radar x

Computed

Telemetry

Code	Sensor
W	Sun angle

Surface winds calm m/sec

Cloud cover clear

Flight duration 8 days

Number of orbits 0

Position last heard 63293 (09/06/69)

Probable cause of failure:

Icing

Remarks: Launched simultaneously with 199402 C, a capped balloon.

80.23° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 199402 C
Frequency 15.022 MHz

Method of leak test Freon
Test results No leaks detected

Mfr. balloon # Schjeldahl 25
Balloon mass 1805* gm
Balloon volume 4.44 m^3
Balloon diameter 2.04 m
Film thickness 1.5 × 1.5 mil
Electronics mass 179 gm
Ballast 227 gm
Gross weight less helium 2211 gm
Free lift 15% 332 gm

Launch site 172°32'E, 43°29'S
Launch time 02/06/69 2019 UT
Ascent rate
0 - 5,000 m 1.89 m/sec
5,000 - 10,000 m 1.48 m/sec
Float altitude 7300 m
Radar x
Computed

Telemetry

Code	Sensor
C	Sun angle

Surface winds calm m/sec
Cloud cover clear
Flight duration 8 days
Number of orbits 0
Position last heard 54172 (09/06/69)

Probable cause of failure:
Icing

Remarks: The balloon was equipped with a metalized Mylar cap; it was launched simultaneously with 198401 W, an uncapped balloon.

80.23° occulting angle.

*Includes 52 gm top cap.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 200404 V

Frequency 15.024 MHz

Method of leak test Freon

Test results No leaks detected

Mfr. balloon # Schjeldahl 23

Balloon mass 1718 gm

Balloon volume 4.44 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 178 gm

Ballast 315 gm

Gross weight less helium 2211 gm

Free lift 20% 442 gm

Launch site 172°32'E, 43°29'S

Launch time 04/06/69 2020 UT

Ascent rate

0 - 5,000 m 2.19 m/sec

5,000 - 10,000 m 1.67 m/sec

Float altitude 7040 m

Radar x

Computed

Telemetry

Code	Sensor
V	Sun angle

Surface winds calm m/sec

Cloud cover clear

Flight duration 8 days

Number of orbits 0

Position last heard (11/06/69)

Probable cause of failure:

Icing

Remarks: Launched simultaneously with 201407 I, a capped balloon.

80.23° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 201407 I

Frequency 15.027 MHz

Method of leak test Freon

Test results Inflation fitting leaked and was repaired. No other leaks detected.

Mfr. balloon # Schjeldahl 26

Balloon mass 1825* gm

Balloon volume 4.44 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 172 gm

Ballast 214 gm

Gross weight less helium 2211 gm

Free lift 15% 332 gm

Launch site 172°32'E, 43°29'S

Launch time 14/06/69 2020 UT

Ascent rate

0 - 5,000 m 1.81 m/sec

5,000 - 10,000 m 1.67 m/sec

Float altitude 7000 m

Radar x

Computed

Telemetry

Code	Sensor
I	Sun angle

Surface winds calm m/sec

Cloud cover clear

Flight duration 7 days

Number of orbits 0

Position last heard (10/06/69)

Probable cause of failure:

Icing

Remarks: The balloon was equipped with a metalized Mylar cap; it was launched simultaneously with 200404 V, an uncapped balloon.

80.23° occulting angle.

*Includes 52 gm top cap.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 202406 K

Frequency 15.026 MHz

Method of leak test Freon

Test results No leaks detected

Mfr. balloon # Schjeldahl 11

Balloon mass 1742 gm

Balloon volume 4.44 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 176 gm

Ballast 293 gm

Gross weight less helium 2211 gm

Free lift 20% 442 gm

Launch site 172°32'E, 43°29'S

Launch time 08/06/69 2019 UT

Ascent rate

0 - 5,000 m 2.32 m/sec

5,000 - 10,000 m 1.33 m/sec

Float altitude 7240 m

Radar x

Computed

Telemetry

Code	Sensor
K	Sun angle

Surface winds 280° 1.5 m/sec

Cloud cover 1/8 St; 1/2 Sc

Flight duration 4 days

Number of orbits 0

Position last heard 62861 (11/06/69)

Probable cause of failure:

Icing

Remarks: Launched simultaneously with 203403 M, a capped balloon.

80.23° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 203403 M

Frequency 15.023 MHz

Method of leak test Freon

Test results No leaks detected

Mfr. balloon # Schjeldahl 12

Balloon mass 1789* gm

Balloon volume 4.44 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 173 gm

Ballast 249 gm

Gross weight less helium 2211 gm

Free lift 15% 332 gm

Launch site 172°32'E, 43°29'S.

Launch time 08/06/69 2019 UT

Ascent rate

0 - 5,000 m 2.32 m/sec

5,000 - 10,000 m 1.32 m/sec

Float altitude 7220 m

Radar x

Computed

Telemetry

Code	Sensor
M	Sun angle

Surface winds 280° 1.5 m/sec

Cloud cover 1/8 St; 1/2 Sc

Flight duration 4 days

Number of orbits 0

Position last heard 62862 (11/06/69)

Probable cause of failure:

Icing

Remarks: The balloon was equipped with a metalized Mylar cap; it was launched simultaneously with 202406 K, an uncapped balloon.

80.23° occulting angle.

*Includes 52 gm top cap.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 204405 N

Frequency 15.025 MHz

Method of leak test Freon

Test results No leaks detected

Mfr. balloon # Schjeldahl 13

Balloon mass 1746 gm

Balloon volume 4.44 m^3

Balloon diameter 2.04 m

Film thickness 1.5 × 1.5 mil

Electronics mass 178 gm

Ballast 287 gm

Gross weight less helium 2211 gm

Free lift 20% 442 gm

Launch site 172°32'E, 43°29'S

Launch time 11/06/69 2016 UT

Ascent rate

0 - 5,000 m 2.08 m/sec

5,000 - 10,000 m 1.90 m/sec

Float altitude 7050 m

Radar x

Computed

Telemetry

Code	Sensor
N	Sun angle

Surface winds calm m/sec

Cloud cover 1/2 Ci

Flight duration 4 days

Number of orbits 0

Position last heard 63065 (14/06/69)

Probable cause of failure:

Icing

Remarks: Launched simultaneously with 205404 Y, a capped balloon.

80.23° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 205404 Y
Frequency 15.024 MHz

Method of leak test Freon
Test results No leaks detected

Mfr. balloon # Schjeldahl 14
Balloon mass 1798* gm
Balloon volume 4.44 m^3
Balloon diameter 2.04 m
Film thickness 1.5 × 1.5 mil
Electronics mass 169 gm
Ballast 244 gm
Gross weight less helium 2211 gm
Free lift 15% 332 gm

Launch site 172°32'E, 43°29'S
Launch time 11/06/69 2016 UT
Ascent rate
0 - 5,000 m 2.08 m/sec
5,000 - 10,000 m 1.90 m/sec
Float altitude 7100 m
Radar x
Computed

Telemetry

Code	Sensor
Y	Sun angle

Surface winds calm m/sec
Cloud cover 1/2 Ci
Flight duration 7 days
Number of orbits 0
Position last heard 65196 (17/06/69)

Probable cause of failure:
Icing

Remarks: The balloon was equipped with a metalized Mylar cap; it was launched simultaneously with 204405 N, an uncapped balloon.

80.23° occulting angle.

*Includes 52 gm top cap.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 206223 L

Frequency 15.023 MHz

Method of leak test Freon

Test results No leaks detected

Mfr. balloon # Schjeldahl 1170

Balloon mass 1030 gm

Balloon volume 4.44 m^3

Balloon diameter 2.04 m

Film thickness 0.75 × 0.75 mil

Electronics mass 297 gm

Ballast none gm

Gross weight less helium 1327 gm

Free lift 14% 185 gm

Launch site 172°32'E, 43°29'S

Launch time 23/06/69 2329 UT

Ascent rate

0 - 5,000 m 1.5 m/sec

5,000 - 10,000 m 2.0 m/sec

Float altitude 11,270 m

Radar

Computed x

Telemetry

Code	Sensor
L	Thermal enclosure

Surface winds calm m/sec

Cloud cover 1/8 Sc; 7/8 Cs

Flight duration 12 days

Number of orbits 0

Position last heard (04/07/69)

Probable cause of failure:

Unknown

Remarks: The flight was made to monitor the internal temperature of a conically shaped "witch's hat" package. This was the third flight of this package; the previous flights were 195903 L and 196903 L.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 207974 X

Frequency 15.024 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 119

Balloon mass 5300 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067* m

Film thickness 1 × 1 × 1 mil

Electronics mass 166 gm

Ballast 1584 gm

Gross weight less helium 6050 gm

Free lift 24% 1450 gm

Launch site 172°32'E, 43°29'S

Launch time 25/06/69 2340 UT

Ascent rate

0 - 5,000 m m/sec

5,000 - 10,000 m m/sec

Float altitude 366 m

Radar

Computed x

Telemetry

Code	Sensor
X	Air temperature

Surface winds 060° 2 m/sec

Cloud cover 1/8 Cu; 7/8 Ac

Flight duration 2 days

Number of orbits 0

Position last heard (26/06/69)

Probable cause of failure:

Excessive water load on balloon

Remarks: The balloon had a plastic hose (9.15 m) on the end of a drag line (305 m) attached to balloon 3.05 m from top end. The purpose of drag line is to decrease ballast mass if balloon is forced down by water load. Plastic hose (100 gm) floats in water. The balloon was treated with water repellent.

*The balloon was a cylinder 8.38 m long, with a 2 mil bilam Mylar sleeve.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 208227 RV

Frequency 15.027 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Schjeldahl 1168-3

Balloon mass 1013 gm

Balloon volume 4.44 m^3

Balloon diameter 2.04 m

Film thickness 0.75 × 0.75 mil

Electronics mass 330 gm

Ballast None gm

Gross weight less helium 1343 gm

Free lift 14% 188 gm

Launch site 172°32'E, 43°29'S

Launch time 02/07/69 2128 UT

Ascent rate

0 - 5,000 m 1.8 m/sec

5,000 - 10,000 m 2.3 m/sec

Float altitude 11,270 m

Radar

Computed x

Telemetry

Code	Sensor
R & V	Thermal enclosure temperatures

Surface winds calm m/sec

Cloud cover 1/8 Sc

Flight duration 12 days

Number of orbits

Position last heard (13/07/69)

Probable cause of failure:

Unknown

Remarks: Retest of "witch's hat" electronics enclosure with an added greenhouse outer cover. Two thermistors monitor internal temperatures; one (R) mounted on the base of the inverted cone, and the other (V) suspended halfway up.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 209124/1 Q/JG
Frequency 15.024 15.021 MHz

Method of leak test Freon
Test results No leaks detected

Mfr. balloon # Schjeldahl 1232-5
Balloon mass 4220 gm
Balloon volume 28.96 m^3
Balloon diameter 3.81 m
Film thickness 1 × 1 mil
Electronics mass 546* gm
Ballast 218 gm
Gross weight less helium 4984 gm
Free lift 18% 897 gm

Launch site 172°32'E, 43°29'S
Launch time 16/07/69 2020 UT
Ascent rate
0 - 5,000 m 2.38 m/sec
5,000 - 10,000 m 2.38 m/sec
Float altitude 14,800 m
Radar x
Computed x

Telemetry

Code	Sensor
Q	Sun angle
J	Magnetometer
G	Reference

Surface winds 045° 2.6 m/sec
Cloud cover Fog
Flight duration 258+ days
Number of orbits
Position last heard still flying as of (01/04/70)

Probable cause of failure:

Remarks: The balloon was flown with an ascent ballast of 400 gm Freon 12, used with two pibals as lifter balloons. The float altitude was corrected for flight level after Freon ballast boiled away.

82.6° occulting angle.

*Package Q = 163 gm; package JG = 383 gm

GHOST BALLOON FLIGHT SUMMARY

Balloon # 210105 DMAG (DIAG)

Frequency 15.025 MHz

Method of leak test Freon

Test results No leaks detected*

Raven 106

Mfr. balloon # Schjeldahl 1222-4

Balloon mass R = 3391; S = 3133 gm

Balloon volume each 28.97 m^3

Balloon diameter each 3.81 m

Film thickness each 0.75 × 0.75 mil

Electronics mass total 1533 gm

Ballast 160 gm

Gross weight less helium 8217 gm

Free lift 18.9% 1553 gm

Launch site 172°32'E, 43°29'S

Launch time 16/06/69 1813 UT

Ascent rate

0 - 5,000 m 1.56 m/sec

5,000 - 10,000 m 1.7 m/sec

Float altitude 15,810** m

Radar x

Computed x

Telemetry

Code	Sensor
D	Sun angle
I	Radio altimeter
A	Air temperature
G	Reference

Surface winds 360° 2.5 m/sec

Cloud cover 5/8 St; 7/8 Sc

Flight duration 6 days

Number of orbits 0

Position last heard (21/09/69)

Probable cause of failure:

Electronics failure

Remarks: Two balloons were required to carry the payload to desired altitude.

The "M" transmitted as "I" and the "G" failed to transmit due to local RF feedback.

79.8° occulting angle.

* 53 cm rip on gore seam of Raven balloon was repaired.

** Float altitude corrected.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 211195 AHDL

Frequency 15.025 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Schjeldahl 1165-5

Balloon mass 7718 gm

Balloon volume 36.47 m^3

Balloon diameter 4.11 m

Film thickness 1.5 × 1.5 Mylar 0.5 saran mil

Electronics mass 1584 gm

Ballast 302 gm

Gross weight less helium 9604 gm

Free lift 20% 1902 gm

Launch site 172°32'E, 43°29'S

Launch time 03/10/69 1933 UT

Ascent rate

0 - 5,000 m 2.87 m/sec

5,000 - 10,000 m 3.2 m/sec

Float altitude 12,130 m

Radar x

Computed x

Telemetry

Code	Sensor
A	Sun angle
H	Reference
D	Air temperature
L	Radio altimeter

Surface winds calm m/sec

Cloud cover 1/8 Sc

Flight duration 2 days

Number of orbits 0

Position last heard 74375 (04/10/69)

Probable cause of failure:

Balloon failure

Remarks: The flight was made with a canniballoon; it ascended 100 m ~ 2 hr after reaching altitude, indicating that it had developed a hole and lost its free-lift gas. During the remainder of the day it lost 50 m.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 212902 L

Frequency 15.022 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 130

Balloon mass 5380 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 m

Film thickness 5 mil

Electronics mass 184 gm

Ballast 670 gm

Gross weight less helium 6234 gm

Free lift 748 gm

Launch site 172°32'E, 43°29'S

Launch time 07/11/69 2016 UT

Ascent rate

0 - 5,000 m m/sec

5,000 - 10,000 m m/sec

Float altitude m

Radar

Computed

Telemetry

Code	Sensor
L	Sun angle

Surface winds 093° 7.7 m/sec

Cloud cover 2/8 Cu

Flight duration 3 days

Number of orbits 0

Position last heard (09/11/69)

Probable cause of failure:

Excessive water load on balloon

Remarks: The balloon was a 3 mil cylinder with 2 mil sleeve and hemispherical end caps. It was launched from Johnston Atoll.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 213905 R

Frequency 15.025 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 114

Balloon mass 5386 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 m

Film thickness 5 mil

Electronics mass 185 gm

Ballast 663 gm

Gross weight less helium 6234 gm

Free lift 748 gm

Launch site 172°32'E, 43°29'S

Launch time 07/11/69 0140 UT

Ascent rate

0 - 5,000 m m/sec

5,000 - 10,000 m m/sec

Float altitude m

Radar

Computed

Telemetry

Code	Sensor
R	Sun angle

Surface winds 097° 8.2 m/sec

Cloud cover 4/8 Cu

Flight duration 2 days

Number of orbits 0

Position last heard (08/11/69)

Probable cause of failure:
Excessive water load on balloon

Remarks: The balloon was a 3 mil cylinder with 2 mil sleeve and hemispherical end caps. It was launched from Johnston Atoll.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 214905 U

Frequency 15.025 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven, 124

Balloon mass 5323 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 m

Film thickness 5 mil

Electronics mass 208 gm

Ballast 703 gm

Gross weight less helium 6234 gm

Free lift 748 gm

Launch site 172°32'E, 43°29'S

Launch time 08/11/69 1921 UT

Ascent rate

0 - 5,000 m m/sec

5,000 - 10,000 m m/sec

Float altitude m

Radar

Computed

Telemetry

Code	Sensor
U	Sun angle

Surface winds 110° 7.2 m/sec

Cloud cover 1/8 Cu; 1/8 Ci St

Flight duration 1 days

Number of orbits 0

Position last heard (08/11/69)

Probable cause of failure:

Excessive water load on balloon

Remarks: The balloon was a 3 mil cylinder with 2 mil sleeve and hemispherical end caps. It was launched from Johnston Atoll.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 215903 M

Frequency 15.023 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 121

Balloon mass 5320 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 m

Film thickness 5 mil

Electronics mass 185 gm

Ballast 729 gm

Gross weight less helium 6234 gm

Free lift 748 gm

Launch site 172°32'E, 43°29'S

Launch time 09/11/69 0101 UT

Ascent rate

0 - 5,000 m m/sec

5,000 - 10,000 m m/sec

Float altitude m

Radar

Computed

Telemetry

Code	Sensor
M	Sun angle

Surface winds 120° 5.7 m/sec

Cloud cover 1/8 Cu; 1/8 Ci

Flight duration 1 days

Number of orbits 0

Position last heard (09/11/69)

Probable cause of failure:

Excessive water load on balloon

Remarks: The balloon was a 3 mil cylinder with 2 mil sleeve and hemispherical end caps. It was launched from Johnston Atoll.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 216901 P

Frequency 15.021 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 112

Balloon mass 5311 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 m

Film thickness 5 mil

Electronics mass 195 gm

Ballast 728 gm

Gross weight less helium 6234 gm

Free lift 748 gm

Launch site 172°32'E, 43°29'S

Launch time 09/11/69 1902 UT

Ascent rate

0 - 5,000 m m/sec

5,000 - 10,000 m m/sec

Float altitude m

Radar

Computed

Telemetry

Code	Sensor
P	Sun angle

Surface winds 140° 3.1 m/sec

Cloud cover 2/8 Cu; 1/8 Ci

Flight duration 1 days

Number of orbits 0

Position last heard (09/11/69)

Probable cause of failure:
Excessive water load on balloon

Remarks: The balloon was a 3 mil cylinder with 2 mil sleeve and hemispherical end caps. It was launched from Johnston Atoll.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 217906 D

Frequency 15.026 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 126

Balloon mass 5384 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 m

Film thickness 5 mil

Electronics mass 196 gm

Ballast 654 gm

Gross weight less helium 6234 gm

Free lift 748 gm

Launch site 172°32'E, 43°29'S

Launch time 09/11/69 2126 UT

Ascent rate

0 - 5,000 m m/sec

5,000 - 10,000 m m/sec

Float altitude m

Radar

Computed

Telemetry

Code	Sensor
D	Sun angle

Surface winds 140° 3.1 m/sec

Cloud cover 6/8 St Cu; 2/8 Cu

Flight duration 3 days

Number of orbits 0

Position last heard (11/11/69)

Probable cause of failure:
Excessive water load on balloon

Remarks: The balloon was a 3 mil cylinder with 2 mil sleeve and hemispherical end caps. It was launched from Johnston Atoll.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 218908 J

Frequency 15.028 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 115

Balloon mass 5257 gm

Balloon volume 6.62 m^3

Balloon diameter 1.067 m

Film thickness 5 mil

Electronics mass 197 gm

Ballast 780 gm

Gross weight less helium 6234 gm

Free lift 748 gm

Launch site $172^{o}32'E$, $43^{o}29'S$

Launch time 10/11/69 2018 UT

Ascent rate

0 - 5,000 m m/sec

5,000 - 10,000 m m/sec

Float altitude m

Radar

Computed

Telemetry

Code	Sensor
J	Sun angle

Surface winds 220^{o} 2.1 m/sec

Cloud cover 6/8 Ci; 2/8 Cu

Flight duration 2 days

Number of orbits 0

Position last heard (11/11/69)

Probable cause of failure:
Excessive water load on balloon

Remarks: The balloon was a 3 mil cylinder with 2 mil sleeve and hemispherical end caps. It was launched from Johnston Atoll.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 219211 G

Frequency 15.021 MHz

Method of leak test Not tested

Test results

Mfr. balloon # Raven 117

Balloon mass 1595 gm

Balloon volume 7.04 m^3

Balloon diameter 2.38 m

Film thickness 0.92 × 0.92 mil

Electronics mass 326 gm

Ballast 125 gm

Gross weight less helium 2046 gm

Free lift 18% 368 gm

Launch site 172°32'E, 43°29'S

Launch time 20/11/69 1701 UT

Ascent rate

0 - 5,000 m 2.16 m/sec

5,000 - 10,000 m 2.66 m/sec

Float altitude 11,375 m

Radar

Computed

Telemetry

Code	Sensor
G	Sun angle with 24¼° cutoff

Surface winds calm m/sec

Cloud cover 1/8 Cu; 1/4 Ac; 3/4 Ci

Flight duration 108 days

Number of orbits

Position last heard (07/03/70)

Probable cause of failure:
Electronics failure

Remarks: The balloon was fabricated from Celenar.

Sun-angle sensor changes from code period of 60 to 18 (approximately) for sun angles of 21¼ to 27¼°. The solar panel occults the sun-angle sensor at 85.6°. The balloon occulting angle is 89°.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 22010-* FMVR

Frequency 15.045** MHz

Method of leak test None

Test results

Mfr. balloon # GTS 1222-5

Balloon mass 3212 gm

Balloon volume 28.9 m^3

Balloon diameter 3.81 m

Film thickness 0.75 × 0.75 Mylar mil

Electronics mass 556 gm

Ballast 190 gm

Gross weight less helium 4005 gm

Free lift 20% 800† gm

Launch site 172°32'E, 43°29'S

Launch time 28/11/69 1431 UT

Ascent rate

0 - 5,000 m 2.08 m/sec

5,000 - 10,000 m 2.2 m/sec

Float altitude 16,170 m

Radar x

Computed x

Telemetry

Code	Sensor
F	Sun angle
M & R	Cosmic-ray geiger counter
V	Air temperature

Surface winds calm m/sec

Cloud cover 7/8 Sc

Flight duration days

Number of orbits

Position last heard

Probable cause of failure:

Remarks: 79.3° occulting angle.

* The balloon was part of a flight series launched for J. Blamont of the French National Science Research Center (CNRS).

** Not regular GHOST frequency.

† 400 gm of Freon 11 ascent ballast was used in balloon.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 22110* GMVR

Frequency 15.0475** MHz

Method of leak test None

Test results

Mfr. balloon # Raven 144

Balloon mass 2841 gm

Balloon volume 25.62 m^3

Balloon diameter 3.66 m

Film thickness 0.75 × 0.75 Mylar mil

Electronics mass 538 gm

Ballast 152 gm

Gross weight less helium 3550 gm

Free lift 20% 710 gm

Launch site 172°32'E, 43°29'S

Launch time 01/12/69 1416 UT

Ascent rate

0 - 5,000 m 2.6 m/sec

5,000 - 10,000 m 2.6 m/sec

Float altitude 16,161 m

Radar x

Computed x

Telemetry

Code	Sensor
G	Sun angle
M & R	Cosmic-ray geiger counter
V	Air temperature

Surface winds calm m/sec

Cloud cover 7/8 St; 5/8 Sc

Flight duration days

Number of orbits

Position last heard

Probable cause of failure:

Remarks: 79.3° occulting angle.

* The balloon was part of a flight series launched for J. Blamont of the French National Science Research Center (CNRS).

** Not regular GHOST frequency.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 22210-* KMLR

Frequency 15.043** MHz

Method of leak test None

Test results

Mfr. balloon # Raven 141

Balloon mass 2835 gm

Balloon volume 25.62 m^3

Balloon diameter 3.66 m

Film thickness 0.75 × 0.75 Mylar mil

Electronics mass 556 gm

Ballast 140 gm

Gross weight less helium 3350 gm

Free lift 20% 710 gm

Launch site 172°32'E, 43°29'S

Launch time 05/12/69 0232 UT

Ascent rate

0 - 5,000 m 3.08 m/sec

5,000 - 10,000 m 2.69 m/sec

Float altitude 16,250 m

Radar x

Computed x

Telemetry

Code	Sensor
K	Sun angle
M & R	Cosmic-ray geiger counter
L	Air temperature

Surface winds calm m/sec

Cloud cover 5/8 Sc

Flight duration days

Number of orbits

Position last heard

Probable cause of failure:

Remarks: 79.3° occulting angle.

* The balloon was part of a flight series launched for J. Blamont of the French National Science Research Center (CNRS).

** Not regular GHOST frequency.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 22310-* LMDR

Frequency 15.037** MHz

Method of leak test None

Test results

Mfr. balloon # Raven 143

Balloon mass 2836 gm

Balloon volume 25.62 m^3

Balloon diameter 3.66 m

Film thickness 0.75 × 0.75 Mylar mil

Electronics mass 554 gm

Ballast 160 gm

Gross weight less helium 3550 gm

Free lift 20% 710 gm

Launch site 172°32'E, 43°29'S

Launch time 07/12/69 1441 UT

Ascent rate

0 - 5,000 m 2.78 m/sec

5,000 - 10,000 m 2.88 m/sec

Float altitude 16,024 m

Radar x

Computed x

Surface winds calm m/sec

Cloud cover clear

Flight duration days

Number of orbits

Position last heard

Probable cause of failure:

Remarks: 79.3° occulting angle.

* The balloon was part of a flight series launched for J. Blamont of the French National Science Research Center (CNRS).

** Not regular GHOST frequency.

Telemetry

Code	Sensor
L	Sun angle
M & R	Cosmic-ray geiger counter
D	Air temperature

GHOST BALLOON FLIGHT SUMMARY

Balloon # 22410-* XMZR

Frequency 15.046** MHz

Method of leak test None

Test results

Mfr. balloon # Raven 142

Balloon mass 2836 gm

Balloon volume 25.62 m^3

Balloon diameter 3.66 m

Film thickness 0.75 × 0.75 Mylar mil

Electronics mass 554 gm

Ballast 160 gm

Gross weight less helium 3550 gm

Free lift 20% 710 gm

Launch site 172°32'E, 43°29'S

Launch time 07/12/69 1448 UT

Ascent rate

0 - 5,000 m 2.60 m/sec

5,000 - 10,000 m 2.78 m/sec

Float altitude 16,024 m

Radar x

Computed x

Telemetry

Code	Sensor
X	Sun angle
M & R	Cosmic-ray geiger counter
Z	Air temperature

Surface winds calm m/sec

Cloud cover clear

Flight duration days

Number of orbits

Position last heard

Probable cause of failure:

Remarks: 79.3° occulting angle.

* The balloon was part of a flight series launched for J. Blamont of the French National Science Research Center (CNRS).

** Not regular GHOST frequency.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 225757 F*

Frequency 15.027 MHz

Method of leak test Freon

Test results One leak detected and repaired

Mfr. balloon # Raven

Balloon mass 1810 gm

Balloon volume 3.37 m^3

Balloon diameter 1.86 m

Film thickness 1.5 × 1.5 Mylar mil

Electronics mass 186 gm

Ballast 802* gm

Gross weight less helium 2798 gm

Free lift 13% 364 gm

Launch site 172°32'E, 43°29'S

Launch time 07/12/69 2230 UT

Ascent rate

0 - Altitude 3 m/sec

5,000 - 10,000 m m/sec

Float altitude m

Radar x

Computed x

Telemetry

Code	Sensor
F	Sun angle

Surface winds 010° 5.65 m/sec

Cloud cover 1/8 Sc; 5/8 Ac; 7/8 Ci

Flight duration 2 days

Number of orbits 0

Position last heard (08/12/69)

Probable cause of failure:

Ice on balloon

Remarks: 82.7° occulting angle.

*790 gm of Freon 11 ascent ballast was used in balloon.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 22610-* LMFR

Frequency 15.048** MHz

Method of leak test None

Test results

Mfr. balloon # Raven 138

Balloon mass 2810 gm

Balloon volume 27.4 m^3

Balloon diameter 3.74 m

Film thickness 0.75 × 0.75 Mylar mil

Electronics mass 549 gm

Ballast 191 gm

Gross weight less helium 3550 gm

Free lift 20% 710 gm

Launch site 172°32'E, 43°29'S

Launch time 09/12/69 1429 UT

Ascent rate

0 - 5,000 m 2.6 m/sec

5,000 - 10,000 m 2.87 m/sec

Float altitude 16,607 m

Radar x

Computed x

Telemetry

Code	Sensor
L	Sun angle
M & R	Cosmic-ray geiger counter
F	Air temperature

Surface winds 045° 2.5 m/sec

Cloud cover 1/8 Sc

Flight duration days

Number of orbits

Position last heard

Probable cause of failure:

Remarks: 79.3° occulting angle.

* The balloon was part of a flight series launched for J. Blamont of the French National Science Research Center (CNRS).

** Not regular GHOST frequency.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 22710-* LMWR

Frequency 15.045** MHz

Method of leak test None

Test results

Mfr. balloon # Raven 139

Balloon mass 2810 gm

Balloon volume 27.4 m^3

Balloon diameter 3.66 m

Film thickness 0.75 × 0.75 Mylar mil

Electronics mass 558 gm

Ballast 182 gm

Gross weight less helium 3550 gm

Free lift 20% 710 gm

Launch site 172°32'E, 43°29'S

Launch time 13/12/69. 1207 UT

Ascent rate

0 - 5,000 m m/sec

5,000 - 10,000 m m/sec

Float altitude 16,200 m

Radar

Computed x

Telemetry

Code	Sensor
L	Sun angle
M & R	Cosmic-ray geiger counter
W	Air temperature

Surface winds calm m/sec

Cloud cover clear

Flight duration days

Number of orbits

Position last heard

Probable cause of failure:

Remarks: 79.3° occulting angle.

* The balloon was part of a flight series launched for J. Blamont of the French National Science Research Center (CNRS).

** Not regular GHOST frequency.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 22810-* FMGR

Frequency 15.047** MHz

Method of leak test None

Test results

Mfr. balloon # Raven 145

Balloon mass 2828 gm

Balloon volume 27.4 m^3

Balloon diameter 3.66 m

Film thickness 0.75 × 0.75 Mylar mil

Electronics mass 538 gm

Ballast 184 gm

Gross weight less helium 3550 gm

Free lift 20% 710 gm

Launch site 172°32'E, 43°29'S

Launch time 13/12/69 1211 UT

Ascent rate

0 - 5,000 m m/sec

5,000 - 10,000 m m/sec

Float altitude 16,200 m

Radar

Computed x

Telemetry

Code	Sensor
F	Sun angle
M & R	Cosmic-ray geiger counter
G	Air temperature

Surface winds calm m/sec

Cloud cover clear

Flight duration days

Number of orbits

Position last heard

Probable cause of failure:

Remarks: 79.3° occulting angle.

* The balloon was part of a flight series launched for J. Blamont of the French National Science Research Center (CNRS).

** Not regular GHOST frequency.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 229204 H

Frequency 15.204 MHz

Method of leak test None

Test results

Mfr. balloon # Raven 118

Balloon mass 1592 gm

Balloon volume 7.04 m^3

Balloon diameter 2.38 m

Film thickness 0.92 × 0.92 Mylar mil

Electronics mass 244 gm

Ballast 119 gm

Gross weight less helium 1955 gm

Free lift 18% 352 gm

Launch site 172°32'E, 43°29'S

Launch time 18/12/69 1530 UT

Ascent rate

0 - 5,000 m 2.2 m/sec

5,000 - 10,000 m 2.6 m/sec

Float altitude 11,800 m

Radar x

Computed x

Telemetry

Code	Sensor
H	Fixed sun angle

Surface winds calm m/sec

Cloud cover 7/8 St

Flight duration 106+ days

Number of orbits

Position last heard still flying as of (01/04/70)

Probable cause of failure:

Remarks: Test flight of New Zealand Department of Scientific and Industrial Research fixed sun-angle sensor.

Package transmits H slowly (50-60 sec) at angles 0-15° and 23-90°.

Between 16 and 22° H is transmitted rapidly (10-15 sec/10 counts).

84.5° occulting angle.

GHOST BALLOON FLIGHT SUMMARY

Balloon # 230037 FRCW

Frequency 15.027 MHz

Method of leak test None

Test results

Mfr. balloon # Rvn 104 Rvn 149*

Balloon mass 25,719 1338* gm

Balloon volume 751.5 4.19* m^3

Balloon diameter 11.28 2.0* m

Film thickness 0.75 × 0.75 Mylar** mil

Electronics mass 817 gm

Ballast 4596 gm

Gross weight less helium 31,146 gm

Free lift 7.9% 2460 gm

Launch site 172°32'E, 43°29'S

Launch time 26/12/69 1423 UT

Ascent rate

0 - 5,000 m 2.3 m/sec

5,000 - 10,000 m 2.6 m/sec

Float altitude 23,757 m

Radar

Computed x

Telemetry

Code	Sensor
F	Sun angle
R	Strain
C	Top cap temperature
W	Skin (gas) temperature

Surface winds 020° 3.5 m/sec

Cloud cover 1/8 Sc

Flight duration 60 days

Number of orbits 1

Position last heard (23/02/70)

Probable cause of failure:

Electronics failure

Remarks: Balloon was equipped with a metalized Mylar cap. Flight equipped with battery pack with water containers. Strain gage band length, 101.6 cm.

81.45° occulting angle.

* Tow balloon.

** The tow balloon film is a trilam of 0.5 mil Mylar, 1 mil saran, and 0.5 mil Mylar.

Appendix I

SUPERPRESSURE FLIGHTS AT LOW ALTITUDES

Superpressure balloons have flown in the stratosphere for periods in excess of one year. From the tropopause down to the freezing level, icing in supercooled clouds, frost formation at night, and accretion of ice particles can all cause balloon failure. Evidence to date indicates that the primary causes of failure are: ice-particle accretion in cirrus clouds at 200 mb (average life of five months); frost formation at night at 300 mb (average life of 40 days); supercooled water droplet icing at altitudes from 400 mb down to the freezing level (average life of 20 days).

Below the freezing level a balloon may fail because it accumulates a weight of liquid water that exceeds the free lift of the balloon. Wax treatment of the balloon surface can reduce water accumulation to below a critical mass, allowing flight to continue.

RAINFALL ON A BALLOON

Effective Pressure of Raindrops

A balloon flying below the freezing level may be subject to extremely heavy rainfall for short periods of time. The instantaneous rainfall rate will rarely exceed 10 in./hr over a 1 min interval. During a two-week period the probability of rainfall at this intensity is less than 2% for the rainiest area in the United States* and should be even less over tropical ocean areas. The mass concentration of water in a rain of this intensity is ~ 10 gm/m^3, and the average fall velocity of the droplets is 7 m/sec. Hence, a 10 in./hr rainfall would deposit 70 gm/m^{2}sec on a horizontal surface. The effective pressure exerted by rebounding raindrops on the surface of a balloon with 1 m radius

*Yarnell, D. L.: Rainfall intensity frequency data. U.S. Dept. of Agriculture *Miscellaneous Publication No. 204*, August 1935.

would be 49 gm/m^2. For spherical balloons with radii > 1 m and for all cylindrical balloons the effect of rebounding raindrops can be neglected for rainfall rates < 10 in./hr.

Mass Increase Due to Raindrops

The following analysis pertains to spherical and long cylindrical balloons. Assume the water adhering to the balloon surface to be W gm/m^2. For a spherical balloon the loss of lift is $4\pi r^2 W$, and the percent loss of lift is

$$\text{sphere:} \quad \frac{4\pi r^2 W \times 100}{4/3\pi r^3 \rho} = \frac{300W}{r\rho}$$

$$\text{cylinder:} \quad \frac{2\pi r \ell W \times 100}{\pi r^2 \ell \rho} = \frac{200W}{r\rho}$$

At low altitudes a 1% loss of lift corresponds to a 90 m loss of altitude. Assuming $\rho = 1100$ gm/m^3, the loss of altitude in meters can be approximated as

$$\text{sphere:} \quad 90 \times \frac{300W}{r\rho} = \frac{27 \times 10^3 W}{1100\ r} \sim \frac{25W}{r}$$

$$\text{cylinder:} \quad 90 \times \frac{200W}{r\rho} = \frac{18 \times 10^3 W}{1100\ r} \sim \frac{17W}{r}$$

REQUIREMENTS FOR WAX SURFACES

A reasonable criterion for low-level flight through clouds or rain is that the altitude loss should not be > 300 m under conditions of heavy rain. It is not necessary for the balloon to survive the severest rainfall conditions since an average life of two weeks in the tropical ocean areas is considered acceptable.

Even in a light rainfall or in flight through clouds a balloon can accumulate a water load that will force it to the earth's surface unless the balloon skin is treated with water repellents. Since a spherical balloon of 1 m radius will lose 25 m of altitude for each gm/m^2 of surface water, the maximum permissible accumulation of surface water is 12 gm/m^2. A 1 m radius balloon is very large for low-level flights. Larger spheres would have better water-carrying capabilities, but would need thicker walls to withstand flight stresses.

Since a cylindrical balloon of 0.5 m radius will lose 34 m for each gm/m^2 of surface water, the maximum permissible surface water is 9 gm/m^2. Surface coatings must thus maintain water accumulations below this value in order to permit flights by cylinders and prolate spheroids for periods of two weeks or longer. A coating with poor repellency will result in too large an altitude drop in clouds and rain. A coating which allows accumulations > 30 gm/m^2 will result in balloon descent to the earth's surface (see Table 1).

TESTS OF WATER-SHEDDING COATINGS

In 1966 a number of balloon surface coatings were tested to determine their water- and ice-shedding capabilities. No coatings were able to prevent severe accumulations of ice particles formed in a supercooled water droplet environment. The new silicone-base waxes shed water poorly. A household aerosol used for polishing furniture (Pledge Wax, manufactured by S. C. Johnson & Son) gave the best test results when used on a number of flights from Christchurch, but was unable to prolong average balloon life beyond three to four days. A retesting showed that the wax deteriorated or was leached from the surface by several hours of continuous rain. After a few months of storage, it also lost its effectiveness on the surfaces of factory-treated balloons.

Subsequently, a careful testing program was initiated using the most promising water repellents. One meter lengths of Mylar were wax coated, tested, exposed to sun and rain, and then retested. The

Table 1

HEIGHT LOSS IN METERS CAUSED BY WATER ON BALLOON SURFACE

W (gm/m^2)	Spherical Balloon				Cylindrical Balloon			
	Radius (m)				Radius (m)			
	0.8	1.0	1.2	1.4	0.4	0.5	0.6	0.7
10	310	250	210	180	420	330	280	240
20	620	500	420	360	840	660	560	480
30	930	750	630	540	1260	1000	840	720
40	1240	1000	840	720	--	1330	1120	960
50	--	1250	1050	900	--	--	1400	1200

Table 2

TEST OF WATER REPELLENTS

Sample panels*	Before Aging		After Aging**	
	Water adhesion 1 min after spraying (gm/m^2)	Water adhesion 3 min after spraying (gm/m^2)	Water adhesion 1 min after spraying (gm/m^2)	Water adhesion 3 min after spraying (gm/m^2)
A	50.3	47.5	45.9	44.3
B	42.1	40.2	44.0	41.7
C	12.4	8.8	40.7	37.5
D	22.3	20.6	40.8	38.4
E	25.2	24.5	4.4	3.9
F	46.2	44.0	53.0	51.5
X	9.2	8.3	41.2	36.6
Y	20.8	14.1	61.0	59.9

*A--Not washed, not waxed

B--Not waxed, washed with detergent

C--Pledge Wax (S. C. Johnson & Son)

D--Fluo-kem (Bel-Art Products)

E--Lockheed water repellent (Lockheed-Georgia Company)

F--Cleaning and polishing compound, plastic, Type 1 GSA

X--Commercial grade polyethylene (wax-like surface as a result of manufacturing process)

Y--Rain-Boe Type 3 water repellent (Boeing Company)

**48 hr rain
5 days sunshine
5 nights heavy frost

results are listed in Table 2. After extensive tests, the only acceptable water repellent found was one under development for the U.S. Navy by Lockheed-Georgia; this coating improved with age for several days before beginning to deteriorate. All others failed to meet minimum standards under any conditions or deteriorated rapidly after exposure.

FLIGHT TEST 196903 L

On 23 April 1969, a cylindrical balloon coated with Pledge Wax was flown in moderate to heavy rain. Radar track was maintained for 64 min; the radar oscilloscope showed moderate to heavy precipitation throughout this period. A plot of the first 50 min of flight is shown in Fig. 1. The balloon rose to an altitude of ~ 750 m, 5 min after launch. Theoretical altitude was 1424 m. As water accumulated, the balloon descended to an average altitude of 470 m; as water was shed, it oscillated 30-40 m. The average float altitude of 470 m corresponds to a water accumulation of 596 gm (i.e., 21.2 gm/m^2 of balloon surface).

JOHNSTON ISLAND TESTS (FLIGHTS 212902 L THROUGH 218908 J)

Seven balloons identical to the one flown on 23 April 1969 were flown from Johnston Island in November 1969. Average flight duration was two days--an unsatisfactory performance since these balloons were treated with a current sample of the Lockheed-Georgia water repellent. Before aging, the repellent gave values of 32 gm/m^2; after two weeks of aging it gave values from 22 to 29 gm/m^2. These results were well above the maximum permissible value of 9 gm/m^2.

SUMMARY

A cylindrical balloon with an adequate long-life wax coating will survive conditions of intense rainfall with only a slight loss of altitude. A development program will be required to produce a wax capable of consistent performance. Since one entirely satisfactory sample has been produced, development should be readily accomplished.

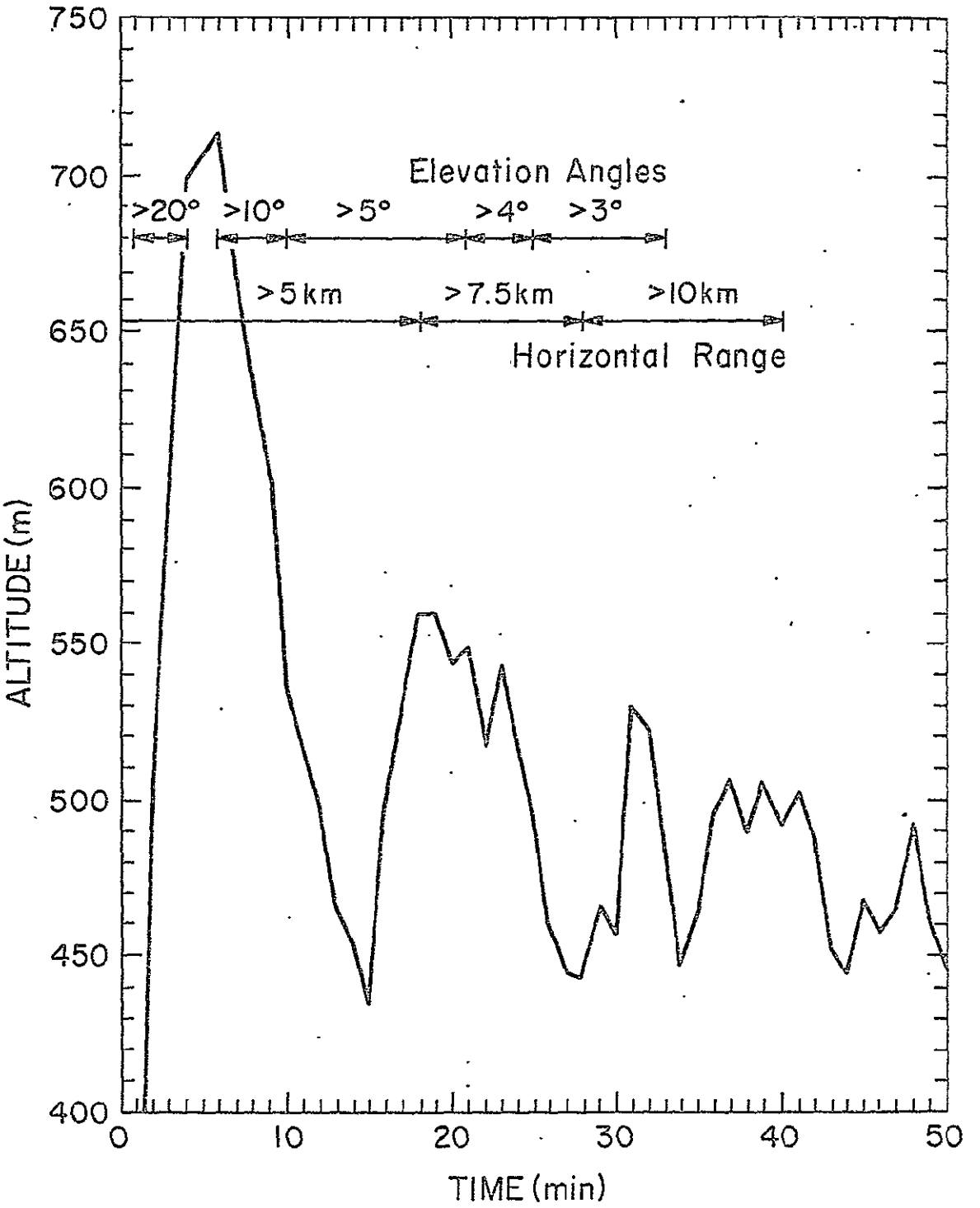

Fig. 1 Flight test 196903 L.

Appendix II

BALLOON STRAIN DATA ANALYSES

PHASE II FLIGHT ALOFT AS OF 1 DECEMBER 1968

Flight 130101 XZ was launched 21 April 1968 and flew for 319 days. Initially the balloon maintained a strain of 0.4%. No data were obtained for a four-week period while the balloon was too far south in the Antarctic night (14 July to 11 August 1968). When it was heard again, the strain had decreased to 0.25%, where it remained until the beginning of November, and then began a slow increase. By mid-January 1969, the strain had increased to $\sim 0.53\%$; it then began a gradual decrease, and by mid-April had reached the value recorded at launch. During the last several weeks of flight, the strain slowly increased to $\sim 0.6\%$.

Maximum strain during the flight was slightly in excess of 1.0% and was attained at the end of the first month. The minimum strain occasionally went to $< 0.1\%$. At the end of this flight the average maximum and minimum strains were 0.68 and 0.5%, respectively.

Strain data showed a marked seasonal variation but showed no evidence of leakage or electronics failure. Flight termination was apparently caused by sudden balloon failure.

PHASE III FLIGHTS TO 31 DECEMBER 1969 (30 mb)

Flight 162033/6 D/P was launched on 23 October 1968, and remained aloft for 172 days. The data show a slow increase in average strain from $\sim 0.6\%$ at launch to $\sim 0.64\%$ in early December. A slow decrease to $\sim 0.54\%$ occurred by the end of March when the flight terminated. Maximum strain exceeded 0.9% in the ninth week of flight

and again in the eighteenth week. Minimum strain seldom fell below 0.2%. Flight termination was apparently caused by sudden balloon failure.

Flight 163036/2 A/V was launched on 29 October 1968, and remained aloft for 141 days. Strain data were scanty and erratic, although average strain seems to have been 0.5%. One month before the flight ended, the strain data indicated nearly 0% strain for three consecutive days (18-20 February). The next data received showed an increase to 0.95% (27 February) and a decrease to 0.6% the next day. Insufficient data exist to draw firm conclusions about balloon performance.

Flight 164035/6 P/QWXBCA burst on reaching float altitude. The balloon was a doubloon with a 1 mil Mylar outer balloon, and a 0.5 mil saran inner balloon. The flight train employed a drag parachute which was unsuccessful in slowing the ascent rate; just below float altitude the ascent rate was 465 m/min.

Flight 165031/6 U/FAGKYD flew for five days. The strain fell from 0.45% for the first two days of flight to 0.15% on the fourth day. Strain data show that the balloon developed a leak on the second day of flight.

100 mb FLIGHT

Flight 153104 GH was launched on 27 September 1968, and remained aloft for 89 days. Strain data through the end of November showed an average strain of $\sim 0.4\%$ with no indication of leakage. The most likely cause of flight termination was sudden balloon failure.

200 mb FLIGHTS

Flight 157228 LU, equipped with a top cap and a strain gage, was launched on 10 October 1968, and remained aloft for 121 days. It was launched simultaneously with flights 156224 UF and 158226 DC.

The 156224 UF balloon, also equipped with a top cap but without a strain gage, stayed aloft for 126 days. The 158226 DC balloon, equipped with a strain gage but without a top cap, flew for 107 days.

Data for flight 157228 LU, although somewhat sketchy, indicate an average strain of 0.95%. On one occasion, toward the end of November, the strain fell to 0.15%, then rose to 0.6%. This may have been due to ice accumulation despite the top cap. The last data received showed a strain of 0.95%. Flight termination was probably caused by sudden balloon failure or by icing.

Flight 158226 DC flew for 107 days. For the first five weeks strain remained between 0.5 and 0.6%. It then fell at the rate of 0.05% per week until 4 December. Transmissions were not heard again until 23 January 1969, when minimum strain was 0% and maximum strain was 0.21%; the flight ended the next day. Flight termination was probably caused by a small leak which appears to have developed in the sixth week.

Flights 160206 BK and 161204 AR-H were the second and third of three flights launched on 16 October 1968. Both balloons had strain gages but no top caps; the first balloon (159203 L), which flew for 107 days, had neither strain gage nor top cap. The initial average strain on 160206 BK was 0.9%, but it decreased to 0.75% by the end of the second week. Thereafter, it slowly increased to 0.95% by the end of flight. On one occasion, minimum strain fell to 0.2%, but returned to 0.9%, probably because of icing. The balloon flew for 118 days. Probable causes of flight termination were sudden failure or excessive ice-particle accretion. Average strain on 161204 AR-H was 0.8%, with one wide excursion in maximum to minimum strain recorded in the second week of flight (0-0.8%). This strain variation was due to excessive ice accumulation overnight. The balloon flew 107 days. Probable causes of flight termination were sudden balloon failure or excessive ice-particle accretion.

400 mb FLIGHTS

Flight 166405 CV, equipped with a metalized Mylar top cap, was launched 22 November 1968, and remained aloft for 68 days. Average strain was ~0.8%; however, during the first three days, maximum strain increased from 0.74% to 0.9% to 1.5%, and the minimum strain was ~0.62%. Since there was no indication of leakage, the probable cause of flight termination was severe icing.

Flights 167406 DL and 168401 AP were launched on 26 November 1968. The first balloon was equipped with a top cap but flew only three days; the second balloon had no top cap and flew for eight days. Icing was the probable cause of termination for both flights.

Flights 177405 QU and 178402 NK were launched on 19 December 1968. Balloon 177405 QU was equipped with a top cap and flew for 29 days. Average strain was ~ 0.85% with three marked departures: on the seventh day the strain decreased from a 0.15% minimum to 0.5% maximum; on the thirteenth day, the strain was 0-0.33%, and on the last day, 0-0.14%. Despite the warmer gas temperature maintained by the top cap, the balloon iced at night when exposed to a great number of supercooled water droplets. The third time icing occurred, the accumulation was so great that the top cap was unable to shed ice sufficiently during the day to warm and de-ice the balloon; consequently it came down that night. Minor icing was indicated on three other occasions during this flight.

Flight 178402 NK provided only seven days of usable strain data. It had an average strain of slightly under 0.6% since there was no top cap. On the seventh day of flight there was some indication of icing, but not as severe as that experienced by 177405 QU on the same day. On the twenty-fourth day (when 177405 QU experienced minor icing) 178402 NK was forced down because of excessive icing.

800 mb FLIGHTS

Flight 176803 NDHU was launched on 10 December 1968 and flew for six days. Average strain was ~ 0.35%. Since there was no indication of leakage or sudden balloon failure, the probable cause of flight termination was excessive water accumulation during a storm.

Flight 179805 GN was launched on 2 January 1969 and flew for four days. Average strain was ~ 0.6%. Probable cause of termination was excessive water accumulation.

Flight 182802 BG was launched on 24 January 1969 and flew only two days. Average strain was ~ 0.7%. Probable cause of termination was excessive water accumulation.

Flight 183807 BW was launched on 4 February 1969 and flew for three days. Average strain was ~ 0.45%. Probable cause of termination was excessive water accumulation.

Flight 185801 PU was launched on 17 February 1969 and flew for five days. Average strain was 0.3%. Probable cause of termination was excessive water accumulation.

Flight 186803 DR was launched on 18 February 1969 and flew for four days. It produced the best strain data for the series. Average strain for the first three days was 0.4%, with a maximum strain of 0.48% occurring on the last day. On the same day, the strain fell to 0%, indicating that a hole developed or excessive water accumulated on the balloon. Data for previous flights in this series indicate that the latter difficulty was the probable cause of flight termination.

SUMMARY

Of the six balloons flying at 30 and 10 mb, one burst because of too-rapid ascent, one developed a leak, and four indicated no problems.

Of the four balloons flying at 200 mb, one developed a leak, while the other three provided evidence that ice-particle accretion in cirrus clouds can cause flight termination despite the protection of a metalized Mylar top cap. While the number of flights was too small to yield firm conclusions, it appears that a top cap is nevertheless advantageous in all but the most severe icing conditions.

Of the five balloons flying at 400 mb, one developed a leak, the others provided evidence that ice accumulation from supercooled water droplets is the major problem at 400 mb as it is at 200 mb. Again, as with the 200 mb flights, the top cap helped in all but the most severe conditions.

All six balloons flying at 800 mb indicated that excessive water accumulation was the cause of flight termination. This problem is discussed in Appendix I.