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■ **RESEARCH**

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SUPPORT SERVICES

R-1866



FINAL REPORT
SKYHOOK CHURCHILL 1966
Performed Under Contract Nonr 3390(14)
for
Office of Naval Research
Washington 25, D. C.

Report No. 1866

Date: 1 November 1966

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ABSTRACT

Contract Nonr 3390(14) dated 21 February 1966 was awarded to Raven Industries, Inc. on 13 April 1966. The contract originally specified furnishing facilities and personnel necessary to conduct thirty (30) high altitude SKYHOOK balloon flights, involving not more than thirty-eight (38) launchings, from Fort Churchill, Manitoba, Canada. Amendment Number 1, dated 13 May 1966, however, increased these numbers to thirty-five (35) flights involving not more than forty-three (43) launchings.

Raven Industries, Inc. provided the following services:

1. Fabrication and supply of balloon safety, destruct, and flight control instrumentation.
2. Tracking and communication network between Fort Churchill, Lynn Lake, and Uranium City.
3. Launching, down-range and aircraft tracking and recovery of payloads.
4. Rigging, and advice and assistance, as necessary, to the scientific investigator.
5. Establish and maintain liaison with scientific investigators, base officials, and Canadian authorities.

This report describes individual flights, equipment used, altitude and trajectory data, and an analysis, where applicable, of all program functions.

I. INTRODUCTION

The SKYHOOK Churchill program originated in 1959 when Dr. J. Earl of the University of Minnesota flew five high altitude balloons. At that time, Fort Churchill was under the auspices of the Canadian Army. In July of 1962, Churchill Research Range (CRR) was established by the Office of Aerospace Research, USAF, who subcontracted its management, operation, and maintenance to Pan American Airways. Subsequent departure of the U. S. Air Force in 1965 found the site being turned over to the National Research Council of Canada who, in conjunction with NASA, now jointly sponsors the range.

The 1966 program "officially" started in early June with the arrival of the Raven Industries Flight Operations crew; Office of Naval Research, University of Chicago; and the California Institute of Technology personnel. Flights 1148 and 1149 on 9 June began the schedule which ended with the flight of 1179 on 6 August.

Assistance and cooperation from the Canadian base authorities was excellent. Churchill Research Range (CRR), headed by Dr. James H. Brandy, extended every courtesy to all groups associated with the SKYHOOK program. The Canadian Department of Transport provided weather services, hanger facilities, and the launch site while the Department of Public Works furnished housing, messing, and vehicle transportation and service. In addition, all flight clearances were conducted under the terms of NOTAM (209-A) issued by the Department of Transport. The Pan American Airway's helicopter was used, on occasion, for recovery operations in the vicinity of Fort Churchill.

SUMMARY AND RESULTS

During SKYHOOK 1966, 32 balloons were inflated and launched. No balloons were classified as leakers and no balloons burst. Types of balloons flown and rates of rise from Surface to Tropopause and Tropopause to Ceiling are presented in Table 1.

Table 1

Balloon Types and Rates of Rise

Balloon Volume	Number Flown	Rate of Rise (Average fpm)	
		Surface to Trop	Trop to Ceiling
10.6	18	895	543
6.0	3	917	689
0.25	2	1055	1158
2.9	1	892	768
4.0	1	1045	739
0.33	3	898	801
5.25	2	849	617
1.0	2	761	673

Table 2 represents the flight summary of all SKYHOOK balloons launched at Fort Churchill in 1966. Pertinent flight data is given for each balloon system.

All payloads were recovered with the exception of Flight No. 1157 which was lost in Hudson Bay after a combination of unfavorable winds and a misset termination timer caused the payload to descend, from a point over land to a water landing.

Figure 1, Calendar of Operations Fort Churchill 1966, presents "availability" information including weather and scientific equipment standby and flight time. Payload recovery time is also included in the top line of the figure.

Total program time for tracking and recovery aircraft is presented in Table 3. (Data for 1965 and 1964 was taken from the SKYHOOK program reports for those years.)

Table 3

Total Aircraft Time

Aircraft	1966 (hours)	1965 (hours)	1964 (hours)
Douglas C-47	218.6	321.2	211
Cessna 206	120	202.5	(185) 112
Cessna 185	84	224.3	100

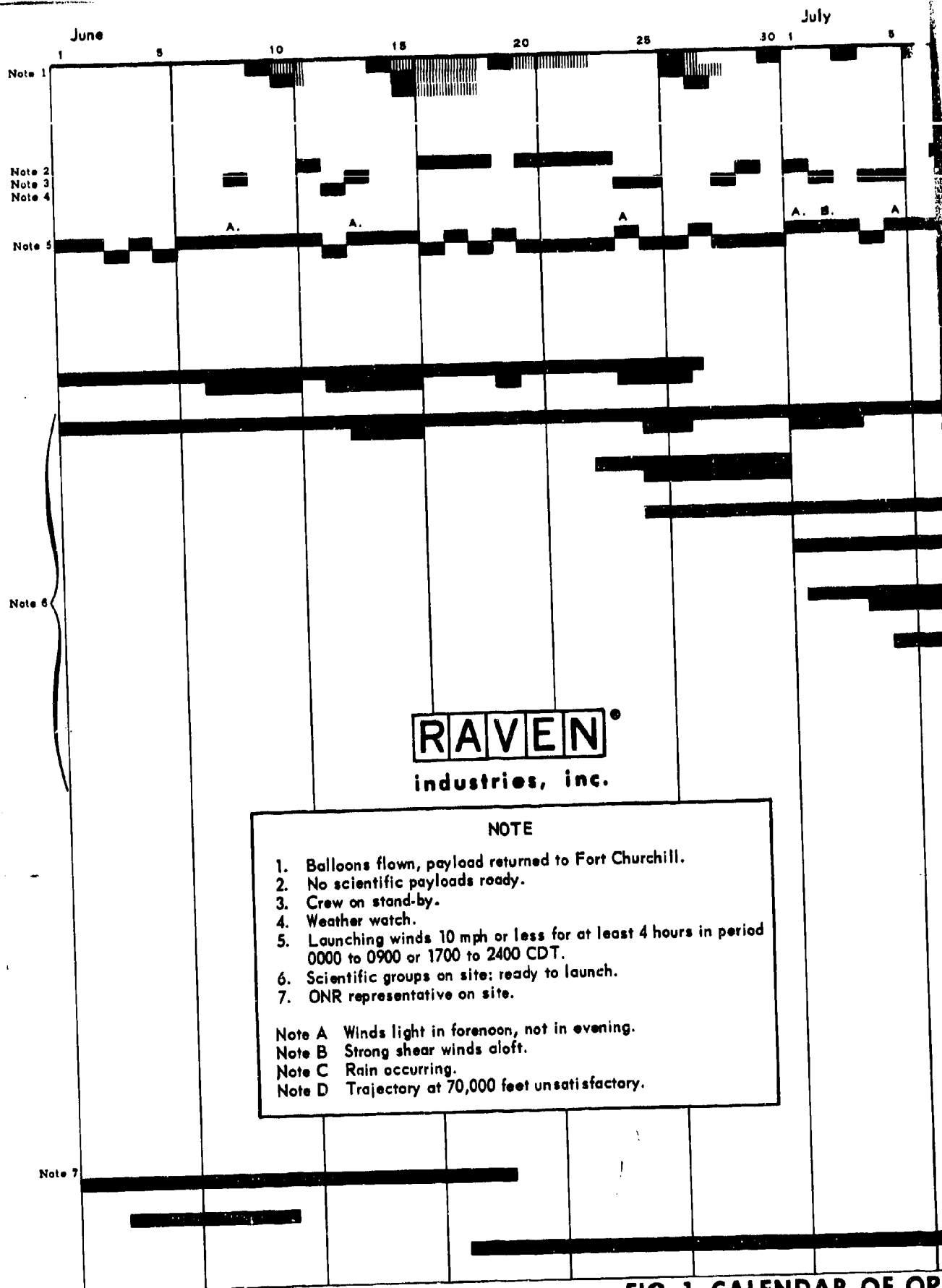


FIG. 1. CALENDAR OF OPERATIONS

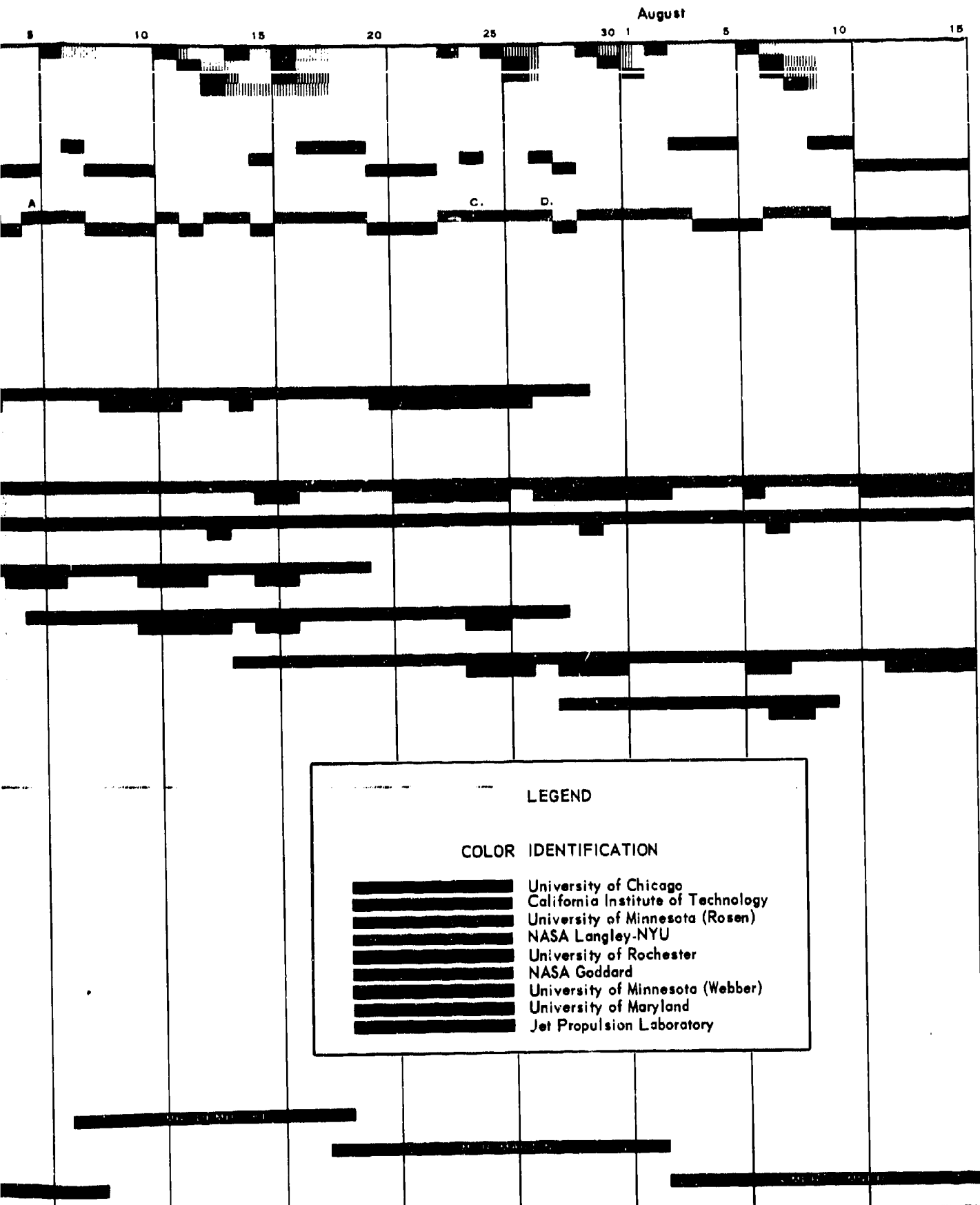


TABLE 2

FLIGHT SUMMARY

GENERAL				ALTITUDE		Vol. 10 ⁶ ft ³	V
Flight Number	University - Scientist	Duration (Hrs)		x 1000 Feet			
		Proposed	Actual	Theoret.	Actual		
1148	Chicago: Meyer-Fanselow	21.0	19.1	135.0	133.2	10.6	1
1149	Chicago: Meyer-Fanselow	18.0	17.1	135.0	135.0	6.0	
1150	Chicago: Meyer-Fanselow	22.0	21.9	135.0	132.6	10.6	1
1151	Chicago: Meyer-L'Heureux	20.0	16.5	135.0	135.0	6.0	
1152	Cal Tech: Vogt	20.0	17.6	145.5	148.0	10.6	1
1153	Chicago: Meyer-L'Heureux	22.0	20.8	135.0	136.5	6.0	
1154	Chicago: Meyer-Fanselow	22.0	16.4	135.0	136.0	10.6	1
1155	Cal Tech: Vogt	22.0	15.0	145.0	144.8	10.6	1
1156	Minnesota: Ney-Rosen	3.0	3.7	106.4	107.1	0.25	
1157	Minnesota: Ney-Rosen	3.0	3.9	106.5	107.7	0.25	
1158	Cal Tech: Vogt	20.0	10.4	145.2	143.8	10.6	1
1159	NASA Goddard: Balasubrahmanyam	Max	16.4	147.2	145.1	10.6	
1160	Cal Tech: Vogt	15.0	15.5	145.0	144.6	10.6	1
1161	NASA Goddard: Balasubrahmanyam	20.0	20.0	146.0	142.5	10.6	
1162	Minnesota: Webber	15.0	12.7	149.5	151.3	10.6	
1163	Rochester: Kaplon-Deney	17.0	18.8	144.0	139.2	10.6	
1164	Cal Tech: Vogt	22.0	21.4	147.2	147.2	10.6	
1165	NASA Goddard: Balasubrahmanyam	22.0	21.0	145.5	143.4	10.6	
1166	NASA Lang/NYU: Foelsche-Mendel	22.0	18.0	122.9	125.0	2.94	
1167	Minnesota: Webber	16.0	11.3	134.0	133.2	4.0	
1168	Cal Tech: Vogt	21.0	15.5	148.3	142.6	10.6	
1169	NASA Lang/NYU: Foelsche-Mendel	20.0	21.0	72.0	74.0	0.33	
1170	NASA Lang/NYU: Foelsche-Mendel	20.0	5.1	69.0	69.0	0.33	
1171	Maryland: Earl	18.0	17.9	117.0	118.2	1.0	
1172	Minnesota: Webber	22.5	18.4	141.8	145.1	10.6	
1173	Rochester: Kaplon-Deney	20.0	19.3	144.0	143.0	10.6	
1174	Maryland: Earl	18.0	14.3	116.0	116.2	1.0	
1175	NASA Lang/NYU: Foelsche-Mendel	22.0	19.4	143.0	137.5	10.6	
1176	Rochester: Kaplon-Deney	Max	18.9	143.5	141.4	10.6	
1177	Jet Prop. Lab: McDonald	10.0	15.2	132.2	132.0	5.25	
1178	Maryland: Earl	17.0	15.8	135.0	130.6	5.25	
1179	NASA Lang/NYU: Foelsche-Mendel	20.0	19.4	75.0	76.6	0.33	

SUMMARY FORT CHURCHILL 1966										
UDE	BALLOON DATA						SUSPENSION			
Feet	Vol.	Wt.	Thickness(Mils)		Gross	Helium	Payload	Ballast	Chute	Total Sus-
Actual	10 ⁶ ft ³	Lbs.	Balloon	Cap	Inflation	Used-ft ³	Weight	Lbs.	Dia-Ft.	pended Wt.
133.2	10.6	1216	0.7	0.7	2396	38544	629	200	48	962
135.0	6.0	684	0.5	0.5	1317	14000	220	150	32	491
132.6	10.6	1231	0.7	0.7	2410	38560	631	200	48	960
135.0	6.0	672	0.5	0.5	1276	20416	224	150	32	488
148.0	10.6	1108	0.6	0.7	1625	26000	111	150	28	369
136.5	6.0	678	0.5	0.5	1295	20720	240	150	32	499
136.0	10.6	1213	0.7	0.7	2390	38256	625	200	46	960
144.8	10.6	1095	0.6	0.7	1615	25840	119	150	28	374
107.1	0.25	56.0	0.5	-	228.7	3664	80	None	28	130
107.7	0.25	57.0	0.5	-	183.5	3520	81	None	28	126
143.8	10.6	1095	0.6	0.7	1628	26048	126	150	28	385
145.1	10.6	978	0.5	0.7	1484	23744	66	150	28	370
144.6	10.6	1073	0.6	0.7	1589	25440	115	150	28	371
142.5	10.6	959	0.5	0.7	1549	24800	153	150	32	450
151.3	10.6	938	0.5	0.5	1437	22992	122	150	28	368
139.2	10.6	949	0.5	0.7	1647	26352	293	150	32	548
147.2	10.6	961	0.5	0.7	1481	23696	127	150	28	385
143.4	10.6	977	0.5	0.7	1567	25072	149	150	32	447
125.0	2.94	470	0.7	-	1117	17872	252	150	38	537
133.2	4.0	577	0.7	-	1022	16352	105	150	28	352
142.6	10.6	917	0.5	0.7	1426	22816	123	150	28	279
74.0	0.33	219	1.5	-	1067	17072	321	150	38	751
69.0	0.33	221	1.5	-	1280	20464	462	150	46	936
118.2	1.0	181	0.5	-	547	8752	181	100	28	312
145.1	10.6	944	0.5	0.5	1752	28160	276	150	32	648
143.0	10.6	945	0.5	0.5	1637	26192	295	150	32	543
116.2	1.0	173	0.5	-	590	9408	156	100	28	349
137.5	10.6	950	0.5	0.7	1691	27056	255	150	38	587
141.4	10.6	941	0.5	0.7	1645	26280	300	150	32	554
132.0	5.25	671	0.7	-	1508	24128	430	150	38	675
130.6	5.25	760	0.8	-	1244	19904	113	155	28	371
76.6	0.33	224	1.5	-	1228	19632	168	300	46	816

Bell 47G3B1	148.6	162.8	154
Bell 204	1.8	--	--
(Chartered-1164)			
Bell 47G	5.0	--	--
(Chartered-1169)			
Total	578.0	910.8	576

If local Pan American helicopter recoveries are excluded, contractor and GFE Aircraft-Time-Per-Recovery averaged:

1966 - 19.3 hours
 1965 - 33.8 hours
 1964 - 36.6 hours

A considerable savings is seen between previous years and this year's aircraft operation. Although experienced helicopter and recovery aircraft personnel accounted for some of this savings, a large share of it is attributed by the pilots to down-range tracking. If, in the future, longer duration flights are desired, another tracking station located in the Peace River region would be extremely helpful. When a balloon reaches the radio horizon from Churchill, Uranium City, Lynn Lake, and a Peace River station could cross-fix position.

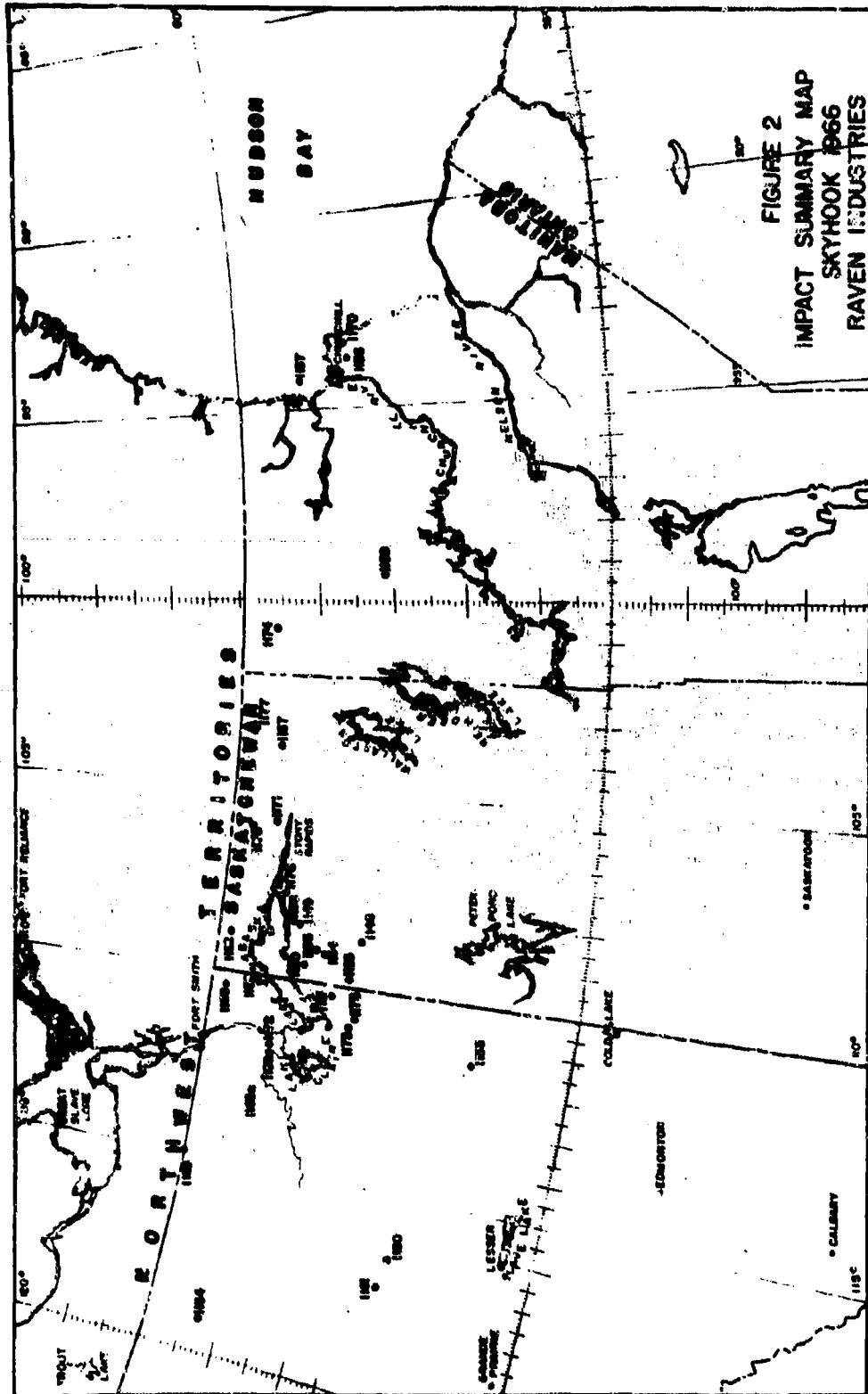
An Impact Summary Map marking all impact locations of the 32 flights is shown in Figure 2. As can be seen, the majority of all landings occurred in the proximity of Lake Athabaska. A few longer flights such as 1150, 1161, and 1164 required considerably more effort from the recovery and helicopter pilots. Flights 1156 and 1170 in the Fort Churchill area were recovered by a Pan American Airways H-21 helicopter.

Of the 28 flights recovered by aircraft other than Pan American helicopter, an average time from impact to return of equipment to Fort Churchill was 32 hours, 10 minutes. The longest time required was 95 hours and 20 minutes while the shortest was 4 hours and 52 minutes. For the same 28 flights, average time from launch to cut-down was 17 hours and 33 minutes. The shortest flight was 10 hours, 25 minutes, and the longest was 21 hours and 50 minutes. Including the three short Churchill area impact flights, a total of 521 hours and 2 minutes was accumulated on balloon-borne equipment during this program.

The capability of three monitoring radio stations to plot balloon positions by cross-vectoring enhances recovery efforts, especially during periods of marginal weather. This capability was manifested by a considerable savings in expended flight time by the recovery aircraft for the number of loads carried.

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Table 4 represents a listing of all balloon-borne failures and their associated reliability based on the number of times used for each item. Total reliability of an entire Raven instrumentation package due to all malfunctions from the time it was taken out of storage until impact is the multiplication of individual reliabilities as in Table 4 or,

$$R_T = \prod_{i=1}^n R_i = 0.51$$

$$i = 1$$

This figure is the probability that every cable, every instrument, and every battery taken as a whole, will perform with no failures from the time it is put in service until impact after parachute descent. It is not the probability that a malfunction indicates a total failure of the instrumentation package.

As can be noted in the Flight Histories, Section V, equipment performance was satisfactory. It is difficult to put a total "system" reliability on balloon flight and balloon instrumentation without setting guidelines such as absolute minimum and maximum flight times, maximum deviation from requested altitude (using accurate sensors), and, in general, what constitutes a satisfactory flight.

One ground station failure occurred due to a wiring malfunction between the command encoder and ground transmitter at Uranium City. Termination was satisfactorily performed from a tracking aircraft.

All of these problems are fully discussed under the individual Flight Descriptions in Section V and, if a recommendation is appropriate, under Section IV, Conclusions and Recommendations.

Table 5 presents a summary of radio-frequency usage for Fort Churchill during the 1966 program. Type of emission, power in watts, and total transmit hours are given.

Two one-half ton trucks, one launch truck and a helium trailer were used for vehicular transportation. One pick-up was left at Fort Churchill at the request of ONR. Total mileage on the three Raven-shipped vehicles was:

Launch truck	225
Helium trailer tractor	380
One-half ton pickup	2733

Table 4

Balloon-borne Equipment Reliability

Item	Flt. Failure Number	Cause	No. Flts Used	Reli- ability
TR-20 Transmitter	None		30	1.00
0-18 VCO	None		12	1.00
R/C Receiver	None		32	1.00
R/C Decoder	1165	Faulty resonant reed in ballast channel	30 (3 each)	0.99
Main Termin- ation Timer	None		30	1.00
Brailsford Top Timer	1161 1167	Faulty governor; ran fast Faulty governor; ran fast	17	0.88
Dribble Ballaster	None		30	1.00
Barocoders	1152 1155 1173	Audio osc. low output due to cold temp. Mechanical binding of code drum Altitude error due to loose mechanism	30	0.90
Silvercells [®]	1171 1172	Insufficient charging Insufficient charging	30	0.93
Dry Batteries	1164 1171	Decoder Open Cell Decoder Open Cell	32	0.94
R/C Antennas	1159	Center conductor opened after launch	32	0.97
Ant. RF Cables	1149 1151	Intermittent. Replaced before launch Intermittent in mid- flight. Operated dur- ing ascent & descent.	32	0.94

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Table 4 (cont)

Photobarograph	1151	Defective lens	21	0.86
	1165	Faulty motor		
	1168	Photoflash circuit defective		
Ballast Valves	1163	Launch damage on one valve.	30	0.97

Table 5
 Radio Frequency Useage-Fort Churchill
 June 1966

Frequency	Emission	Power (Watts)	Total Hrs Transmit
1710 kHz (Minnesota)	2A2	1	13
4015 kHz	3A3j	100	19
7465 kHz	3A3j	100	31
149.4 MHz	30F9	80	26
232.9 MHz (Chicago)	300F9	2	65
251.5 MHz	46F9	4	88
253.1 MHz	46F9	4	61
255.1 MHz	46F9	4	22

July 1966

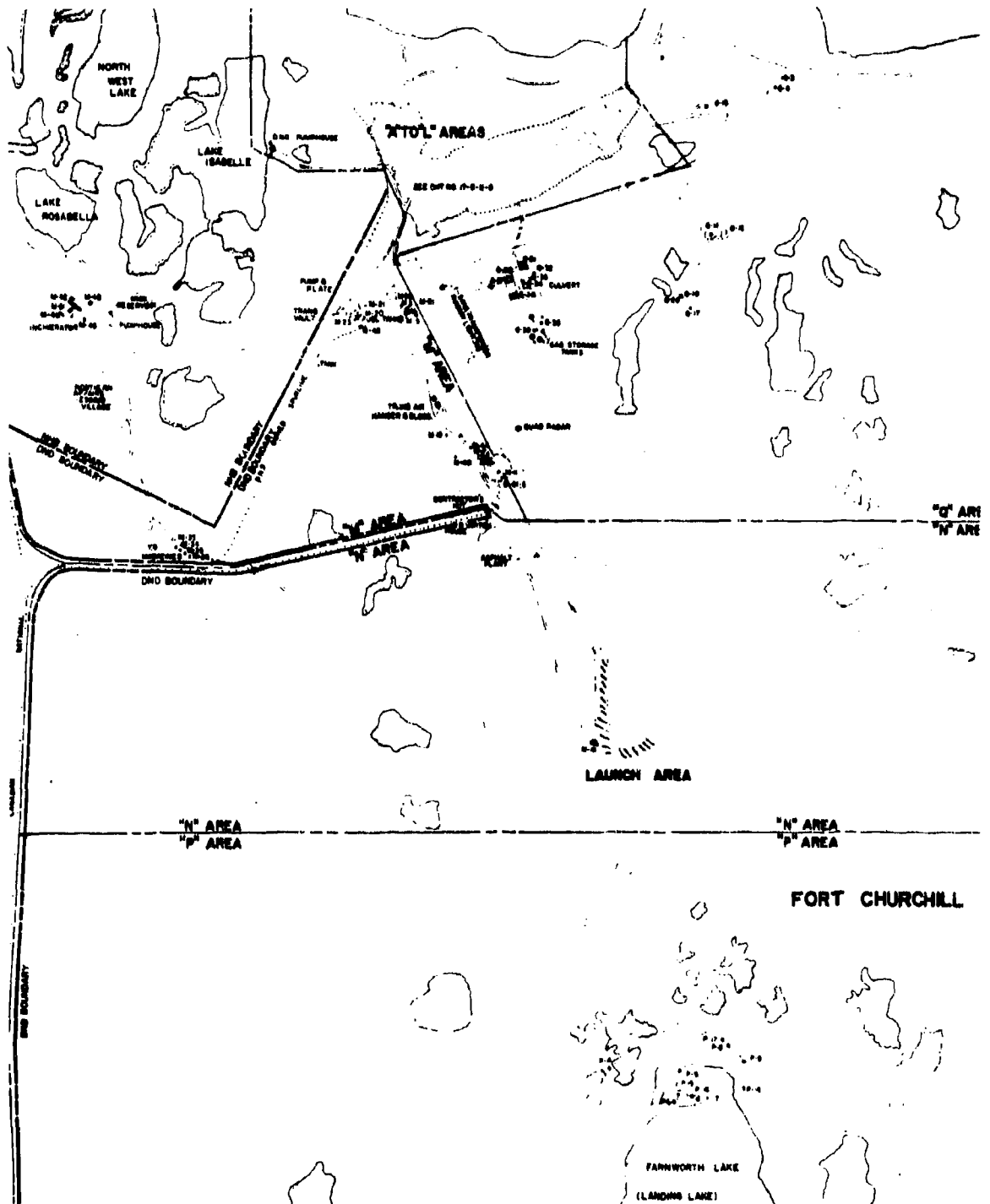
Frequency	Emission	Power (Watts)	Total Hrs Transmit
4015 kHz	3A3j	100	17
7465 kHz	3A3j	100	28
149.4 MHz	30F9	80	30
251.5 MHz	46F9	4	105
253.1 MHz	46F9	4	114
255.1 MHz	46F9	4	69
227.7 MHz	300F9	2	51

August 1966

Frequency	Emission	Power (Watts)	Total Hrs Transmit
4015 kHz	3A3j	100	5
7465 kHz	3A3j	100	12
149.4 MHz	30F9	80	6
251.5 MHz	46F9	4	47
253.1 MHz	46F9	4	22
255.1 MHz	46F9	4	39

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United States Air Force Map, Office of Aerospace Research,
Churchill Research Range. Prepared by Pan American Airways
Inc. (February 1964).



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III. PROGRAM DESCRIPTION

A. Personnel

For the conduct of the 1966 Fort Churchill SKYHOOK program, Raven Industries, Inc. supplied a crew of 21 people, distributed as follows:

At Fort Churchill, Manitoba

- 1 Program Manager
- 2 Launch Directors
- 4 Launch Specialists
- 3 Instrumentation and Communication Specialists
- 1 Administrative Assistant
- 1 Chief Tracking Pilot (C-47)
- 1 Co-pilot (C-47)

At Lynn Lake, Manitoba

- 1 Communications Specialist

At Uranium City, Saskatchewan

- 1 Chief Recovery Pilot (float planes)
- 3 Recovery Pilots (float planes)
- 1 Helicopter Pilot
- 1 Helicopter Mechanic
- 1 Communications Specialist

A roster of the individual Raven crew members is provided in Appendix A. During the course of the program, two individuals were replaced by other members of the Raven organization.

A crew of this size, so deployed, handled the operation without undue hardship, although it was necessary to plan for relief to watch-standers and communicators on those occasions when two or more flights were made on the same day. It is believed that the successful execution of three or more flights in a given night could not have been achieved with a smaller crew without requiring critical decisions to be made by over-tired personnel. On the other hand, with a crew of this size, more balloon flights could have been made in the same ten-week period if more scientific payloads had been available for multiple launchings. Of the 32 flights made, twelve were flown on nights when only one flight was made.

As assessment of the value of the communications man stationed at Lynn Lake cannot readily be made in quantitative terms, but it is clear that the successful use of crossed-azimuth radio fixes (from Fort Churchill, Lynn Lake and Uranium City) gave more frequent in-flight positioning data and a better overall determination of trajectory than could be obtained from the C-47 flying as escort, without greatly increasing the total flying effort for that aircraft. The number of flying hours for the C-47 was reduced to 219 hours, as compared with 321 in 1965. Accordingly, the use of a man at Lynn Lake in future programs appears to be well justified.

B. Operational Procedures

In the 1966 Churchill SKYHOOK program, management was a joint function, shared by Office of Naval Research representatives and the Raven Industries program manager. Although operating procedures and decisions were the responsibility of Raven personnel, two specific management tasks were reserved to ONR:

1. Assignment of flight priorities on the occasions when the number of scientific users ready to be flown exceeded the launch capability (occurred only once).
2. Assignment of balloon vehicles to scientific users.

In addition, ONR representatives were able, from time to time, to make valuable contributions to general planning, and as indeed did several of the more experienced scientists.

Upon arrival at Fort Churchill, each scientific user group was provided with appropriate space for equipment preparation and checkout. Separate work areas were also provided for the Raven Industries crew, and for the personnel of the Office of Naval Research. A project office was set up in the room shared by the Raven administrative assistant and the ONR representatives. This office was the scene of daily project meetings attended by the Raven manager, ONR personnel, representatives of each of the scientific user groups, and the Liaison Officer and the Safety Officer assigned to the program by the Churchill Research Range.

These meetings were held in the afternoon, following a weather briefing presented daily by forecasters at the Department of Transport weather office. Based on



the weather forecasts and the readiness of scientific user groups, a flight plan was worked out for the ensuing evening and night. Three conditions were recognized:

1. No scientists ready to fly.
2. Scientists ready for one or more flights; weather forecast for good weather within the launching period established by the the NOTAM, and the individual flight requirements. Crew scheduled to commence launching preparations at a specified hour.
3. Scientists ready for one or more flights; weather unsatisfactory and forecast to remain so. Flight requirements were analyzed and a "launch window" time period established for each potential flight. Working from this schedule and allowing for equipment preparation, a period of time was set up within which a weather watch was to be maintained.

Although DOT meteorologists were extremely cooperative and dedicated, forecasting in the Churchill area remains difficult. This is due to the sparcity of weather reporting stations in the vicinity (nearest one over 200 miles away), and to the erratic local weather resulting from the influence of Hudson Bay. Accordingly, maintaining a weather watch was found to be a very important part of the SKYHOOK program. Flights were made on 20 calendar days (using Greenwich time standards). Bad weather was predicted on seven of these days, and a crew call was issued after normal working hours as a direct result of the weather watch. Nine flights (1154, 1157 - 1160, 1165 - 1167 and 1170) were made on these nights, following crew calls at local times extending from 2120 to 0440. Weather watching was generally done by the program manager or the administrative assistant.

Once the decision to initiate a flight was taken by the Raven program manager, the Raven crew and the scientific users would mate the experimental payload to the command and control instrumentation, and complete the rigging necessary for launch. This final integration followed the preparation of individual package elements. Most of the scientific payloads were mounted in special frameworks, custom made to fit the individual package needs. Final assembly was done in the DOT hanger after which the flight train was transported to the launching area...the SAC alert apron and approach taxiways. Most of the integrated



loads were reduced to a single physical unit capable of being supported from a load ring attached to the base of the recovery parachute. Exceptions to this general rule were seen on the five NASA Langley NYU flights (1166, 1169, 1170, 1175, and 1179) where three payload elements were deployed in a vertical train, and on flight 1174 where a magnetically oriented emulsion stack flown for Dr. Kim of the University of Saskatchewan was carried at some distance below the main payload of the University of Maryland.

Prior to the beginning of the flight program, plans called for the near-simultaneous inflation and launch of two balloons at a time, whenever more than one payload was ready. In practice this was not done. On the first flight night, a situation was encountered which was repeated on several other occasions. Wind direction dictated the use of one of the two approach taxiways in the launch (oriented 360-180 Deg and 334-154 Deg). This taxiway was too narrow to accommodate side-by-side layouts, such as could be accomplished on the main hardstand (oriented 244-64 Deg). When simultaneous inflations had been proposed, it was expected that one load would be carried on the M-36 truck launcher while the second would be launched with an anchor line technique. On the first flight, the truck launcher was used and then rerigged for use on the following flight. This machine was so satisfactory that ONR personnel, Raven crewmen and scientists alike concurred in its use for all flights. On several flights, notably 1149, 1154, and 1163, it is believed that no other launching technique could have successfully launched a balloon of the size involved (10.6 million cubic feet), under the existing conditions of wind shear and increase at the height of the extended balloon. With this launching technique in use, no balloons were lost after the commencement of inflation. As the season progressed, time-saving techniques were developed to cut down time needed to rerig the truck launcher for sequential flights.

On the NASA Langley-NYU flights, a combination launching technique was used. The heaviest payload element and the Raven command and control instrumentation were supported from the truck launching pin. The next lighter load, extended below, was carried on a launch cart moving as in an anchor-line launch, while the third package was hand-held. On the first of these flights (1166), the wind was at an angle to the taxistrip at launch time and the truck moved nearly to the edge of the runway as it released the upper package. The second load was picked off the launch cart in a satisfactory manner but

the hand-held load dragged on the ground for several feet, without apparent damage.

Another cross-wind launching caused a crush pad to scrape the runway on Flight 1163. Here the Raven command and control instrument package, hung beneath the scientific payload, scraped on the gravel at the edge of the taxiway. Although no damage was done to the scientific equipment, or to the Raven radio command or telemetry units, one of the dual ballast containers was rendered inoperative. This reduced the quantity of ballast released during ascent and seriously increased the time required to reach floating altitude.

During inflation of the balloons, gas was metered from the helium trailer. A secondary check was made using a calibrated dynamometer attached to the inflation spool. On most occasions this gauge indicated properly, agreeing with metering data. On one flight, however, (number 1172), dynamometer readings were high, although the wind was approximately 10 mph...not unusual.

In order to reduce requirements for helium tank cars, a special effort was made to drain the helium trailer tubes on numerous occasions, so that low pressure tubes of the tank car could also be emptied. The fact that only one flight was made on many nights aided this practice. Although the time required to inflate was approximately doubled, this was not of such consequence as it would have been if two or more flights were to be flown. As a matter of precaution against wind increase or shift, each flight of this sort was planned with both a "high pressure" and a "drain" calculation, so that the inflation time could be cut short if wind conditions threatened to deteriorate.

Once the flight train was launched, in-flight control was established at the project communications center in the DOT hanger. This center was equipped to receive information telemetered from the balloon and to take direction bearings from it; to send radio-command signals to the balloon, to communicate by radio and telephone with the tracking stations at Lynn Lake and Uranium City; to communicate by intercom with the Churchill Research Range radar tracking station; and to communicate by radio with the C-47 escort and tracking aircraft.

Data obtained from the balloon-borne altitude telemeter were plotted together with heights obtained from the CRR radar station. Radar data were taken for ranges often exceeding 100 miles, and appeared to be more accurate

than either of the altitude sensing systems employed by Raven Industries. From the altitude profile, balloon behavior was evaluated, and ballast was released by radio command as needed to drive the Stratofilm balloons up to ceiling within a reasonable period of time. Balloons launched at night were especially prone to slow down from the initial rates of about 1000 feet per minute to half that figure or less. A serious and continuous effort was required to keep the balloon ascending at an even 500 fpm, with a minimum...but still large... expenditure of ballast.

Radar position fixes were plotted and when the balloon signal was received by the communications station at Lynn Lake, positions determined by crossed bearings from that station and Fort Churchill were added to the trajectory plot. Still later, bearings were obtained from the Uranium City station and triangulation fixes were maintained with single sideband equipment, rated at 100 watts PEP at Fort Churchill, Uranium City, and Lynn Lake.

As each flight progressed and the balloon moved west, the speed at the floating level was determined (see individual flight trajectory plots). Depending on this trajectory, and other considerations, such as desired flight duration, the C-47 was dispatched to verify the positions reported, and to coordinate cut-down and recovery operations with the recovery team based at Uranium City.

Generally, balloon payloads were cut loose on a parachute by radio command from one of the tracking aircraft, or from one of the base stations*, at a time when:

1. The balloon flight duration was approaching the maximum desired or permitted with recovery still in daylight.
2. The balloon was passing out of the primary recovery area, bounded on the west by the Athabaska River.

Based at Uranium City, Saskatchewan, the recovery crew was equipped with two float planes; a Cessa 206 and a Cessna 185, and an amphibious Bell 47-G helicopter. For most flights, payload recovery procedure followed a standard pattern. The C-47 escort aircraft and one of the float planes would rendezvous at a point along the balloon's trajectory. They would both

*As a matter of note, radio command cutdowns were initiated successfully from all three ground stations and from all four of the aircraft involved in tracking and recovery-

observe the payload release and parachute descent. If the payload impacted in a lake large enough for the float plane to land, it would do so, with the C-47 observing.

On most occasions the payload would impact in an area where float planes could not get to it directly. The impact position would be spotted and the helicopter would be brought into the program. In cases where a ready-made clearing was not available, the recovery crew would cut open a suitable landing area in the brush. The helicopter would then land and carry out the payload to a beach on a lake where a float plane could approach it. The float plane or helicopter would then return the payload to Uranium City, or to Stony Rapids, where a final transfer was made to the C-47 which would bring the load back to Fort Churchill. When multiple flights were in the air, one float plane might work alone, or with the C-47, or as a team with the helicopter, depending on the location and number of flights.

Several other exceptions to this pattern may be noted. Because of the short trajectories, three of the payloads were scheduled to be recovered in the Fort Churchill area by helicopters operated by Pan American Airways for the Churchill Research Range (Flights 1156, 1157, and 1170). One of these...Flight 1157...impacted in Hudson Bay and was lost (See Flight Report in Section V. The other two were brought back without difficulty in 34 and 94 minutes, respectively. A fourth flight (1179) was recovered by the float plane and returned directly to Fort Churchill.

On two occasions, an especially fast wind was encountered at the balloon's floating level. Flight 1150 and Flight 1161 both were approaching the limit of generally good recovery country at about local noon. Had they been cut down then, so that the float planes would be able to effect recovery in areas where terrain features are distinctive, and also where float plane operations are made possible by an abundance of usable lakes, the total flight duration would have been relatively short. Since they were both crossing the traditional Athabaska River boundary at a point near Fort McMurray, Alberta, and moving at speeds in excess of 60 mph toward the cultivated farm area along the Peace River, decisions were taken to let these two flights continue. One of them reached the open country before cut-down, and was recovered by the C-47 crew with the aid of a local truck. The other slowed down and fell short of the Peace River valley when it was cut down by the backup timer. It was necessary to bring in the Bell helicopter, escorted by one of the

float planes carrying reserves of fuel. A straightforward recovery was then made.

In addition to the regularly used float plane helicopter combination, it was expeditious on three occasions to rent other aircraft. On Flight 1169, a local helicopter was rented at Lynn Lake to save bringing the Bell 47-G all the way from Uranium City to the impact site. Likewise, for Flights 1164 and 1165, a Beaver and a Bell 204 helicopter were hired locally to bring the payloads to rendezvous points at Hay River, NWT, and High Level, Alberta, where the C-47 could land.

Flight 1164 was one of four where termination was not made at the discretion of the control crew. Flights 1157 and 1167 were cut down earlier than desired due to backup timers running too fast. Flights 1159 and 1164 were cases where the radio command unit did not operate, and the flight remained aloft until the timer acted.

C. Meteorological Considerations

The existence of satisfactory weather conditions is a prerequisite for any balloon program. In Fort Churchill, the most important factor was the surface wind. Other weather elements were considered, including:

1. Precipitation at the launching site.
2. Weather conditions which would preclude the operation of escort or recovery aircraft.
3. High shear winds aloft.
4. Trajectory of the balloon at floating level.

The existence of precipitation or unsatisfactory flying weather was generally committant with strong surface winds. On only one occasion was it necessary to cancel a flight because of precipitation when winds were light (see Figure 1). No launchings were cancelled because of enroute flight weather. The existence of high shear winds, in the vicinity of a jet stream near the tropopause was noted on several days in July. One flight was cancelled because of this condition. Trajectory considerations established the time for the program to end. Throughout the summer season, stratospheric winds were easterly,

blowing toward the west (See data in Appendix B). The diminution of wind speed and excursions from a generally east-to-west direction herald the fall reversal of winds. These indications were noted during the last week of the program, and contributed to the decision to close out the operation on 15 August. After the wind reversal, payloads are carried eastward across Hudson Bay, and are not recoverable.

Several flights for NASA Langley-NYU were scheduled to float at 70,000 feet. A summary of wind velocity readings at that altitude obtained from the Department of Transport Weather Office at Fort Churchill, is also included in Appendix B. Winds experienced in July, when the NASA Langley equipment was to be flown, were generally from the east but always quite light and almost completely unpredictable. When reversals were experienced, from easterly to westerly, they came without warning. This means that a flight made at that altitude was essentially made with a random probability of less than 10% of being carried out over Hudson Bay.

The most important weather element was the surface wind. An arbitrary value of 10 mph, recorded at the Department of Transport hanger in Fort Churchill was chosen as the dividing line for balloon flights. If speeds were in excess of that figure, balloon launch procedures were not started. When a steady wind of less than 10 mph was observed, generally for a minimum of one hour, the crew proceeded to lay out and inflate.

The reading of one anemometer, at a point two miles from the actual launching site, was an excellent indicator of the general wind field in the area. However, an anemometer was also erected on a mast in the launch area. It is clear that local terrain and drainage effects result in different wind conditions between these two sites, but the "acrovane" instrument provided at the launch site was not properly calibrated and was considered unreliable. Additional indicators of wind were a 15 knot wind sock on the main runway (near the launch site) and, most important, the use of several tethered pilot balloons. These tethered balloons provided data at elevations other than the mast height, and show shear winds...direction and velocity...which were not otherwise detectable. The observation of such "pibals" was indispensable in judging how to lay out the balloon train, and on several occasions "pibal" behavior dictated the cancellation of proposed flights.

Line 5 of the calendar (Figure 1) presents a record of surface winds indicated at the DOT hanger. This log

simply separates those days when winds were 10 mph or less for four consecutive hours from the "bad" days. It may be seen that balloons were flown on four days (June 26, June 30, July 12, and August 5) when winds did not meet this criterion. On these four days, surface winds increased after inflation had commenced, but launching was completed in all instances without losing the balloon. This was in large measure due to the skill of the crew and to the use of the M-35 launch truck. Winds at the top of the extended balloon train were between 15 and 25 mph on numerous occasions. In fact, the existence of a "low-level" jet stream within the lowest 1,000 foot stratum of the atmosphere was observed on several nights in July. This is not generally observable from either surface anemometer readings or pilot balloon data. The calendar shows that no flights were made on eight separate days when a satisfactory period of light winds was encountered, even though scientific payloads were ready to be flown. One day was lost for rain, another for high shear winds in the tropopause area and a third was not used because of the trajectory (over the bay) reported at 70,000 feet, where the only load ready to fly was scheduled to float. On the remaining five days the winds were light in the early morning hours, not in the evening. Balloons launched then would not have been allowed to remain at altitude for as long as the scientists desired, since cut-down was generally scheduled for the evening to allow the recovery crew time to spot payloads down before dark. It was possible to fly through the nighttime period, if: (a) a loss of altitude could be accepted; or (b) a significantly larger amount of ballast were carried on board to compensate for loss of buoyancy at sunset. Only one flight, number 1172 for Dr. Webber (University of Minnesota) was flown through a sunset.

The summary of surface wind observations (Appendix B) shows that over 40% of the time winds were 10 mph or less. Nevertheless, there were many days when no flights could be made. The Department of Transport NOTAM 209-A established launching hours from 1700 to 0900 each night. Thus, one-third of the time was unusable except during the period from 25 July to 31 July when a special NOTAM was in effect, permitting flights 24 hours a day. In addition, some experimenters required a launching after sunrise, to preclude temperature problems; while others desired long flights and did not want to launch late in the morning. Still other days were lost because no scientific packages were ready to fly (See calendar, Figure 1). The observation is that many more flights might have been made, if only meteorological factors were considered. For example, 12 flights were made on

days when only one balloon was flown, fourteen were launched two at a time, and three flights were made on each of two nights. More balloons could have been flown on most of the days when only single or double flights were made.

Two sources of meteorological data at Fort Churchill were extremely cooperative. The Department of Transport Weather Office provided daily observational data for the surface, pilot balloon data, and two rawinsonde reports from Fort Churchill, together with synoptic upper air data for the entire Arctic area. Daily weather briefings with special forecasts for the SKYHOOK program were provided. Unless rocket-firing programs or high winds interfered, the Churchill Research Range provided three Arcas rocket soundings each week. Data from these firings gave the only indication of winds at the floating level for most of the balloons.

D. Instrumentation

Command, communication, and control of balloons this year at Fort Churchill consisted of Raven Industries' primary VHF system which performed in an exemplary manner. Several problem areas did appear, however, and are described under the individual flight histories in Section V. If these problems were serious enough to point out reliability deficiencies or warrant further discussion, their analysis will be found under Section IV, Conclusions and Recommendations.

The beacon transmitter, for tracking and altitude telemetry, radiates from 3 to 4 watts on one of four frequencies in the 250 MHz range assigned to Raven by the U. S. Navy. Originally these four frequencies were: 251.5 MHz, 253.1 MHz, 254.1 MHz, and 255.1 MHz. Almost immediately, after arrival at Fort Churchill, ONR made the request that we not use 254.1 MHz, but 254.4 MHz instead. Since our telemetry transmitters are fixed-frequency devices requiring factory tuning, it was necessary to return the two transmitters on this frequency to the factory. In addition, aircraft telemetry receivers had to have new crystals. The request was made to Collins Radio-Canada for these items and Raven was promised a two to three week delivery. They never did arrive. The transmitters, retuned to 254.4 MHz arrived at Fort Churchill in the middle of July. About this same time, ONR said we could use the original 254.1 MHz frequency on a

limited basis. The result of these changes, requiring factory alterations, new crystals, etc., limited us to three usable frequencies for the entire program. Fortunately, the balloon schedule was not affected.

Altitude data was obtained from an aneroid operated barocoder which keyed a 1 kHz tone oscillator for modulation of the beacon transmitter. Altitude was then read out at the ground station by receiving the altitude-coded Morse characters.

The command receiver was a modified Motorola Handie-Talkie with a tone operated, resonant reed controlled, decoder. A tone operated squelch system provided additional safety against inadvertant or spurious signals. With this system two different and unique tones must be present to perform any command. Accidental operation is further guarded against through the use of a preset variable time delay following application of the correct tones to the decoder. Twelve command channels (frequencies) and two squelch frequencies (Private Lines) were available which resulted in a 24-command capability. With this system, it is possible for four balloons to be flown at the same time using up to six command channels for each balloon.

Command channel and private line selection was made on the basis of the number of flights anticipated to be in the air at the same time. Even though there was ample separation between channels, an effort was made to avoid using channels adjacent to a cut-down channel on any other flight. Also, the same channel was never used with a different Private Line on simultaneous flights. These extra precautions were possible because no more than three channels were ever necessary on any one flight. Had more been required, the number of channels on each of four flights, for maximum safety, would be four in addition to a completely separate cut-down channel for each balloon. This would prevent accidental cutdown in the event of a Private Line squelch failure.

Because of the increased number of flights and the possibility of having four balloons flying simultaneously, Raven increased the original channel capability from six to twelve as noted previously. New command modulators were then designed containing twelve tuning fork controlled oscillators. The modulators were distributed so that all active participants in tracking and recovery had command capability. Two units were used at Churchill (one at the control center and one at the flight line), and one each for Lynn Lake, Uranium City, C-47, Cessna 185 and Cessna 206 aircraft.

The primary cut-down timer consisted of dual chronometrically governed DC motors driving screws attached to a moving block. After a preset time, the moving block activates a microswitch which, in turn, fires termination squibs. The timer can be set to within ± 10 minutes and has a maximum period of twenty-four hours.

The dribble ballaster was a governed DC motor activating a microswitch for approximately 8 seconds every 15 minutes. This occurred throughout the flight, dropping from 0.5 to 1.0 pounds of ballast for each time interval through a magnetically controlled valve.

A photobarograph was included on some flights when requested by the scientific investigator. This device photographs a Wallace and Tiernan absolute pressure gauge every 2.5 minutes. Photobarographs, however, are not as reliable as one would like. For example, no data was obtained on one flight due to a defective lens, another's motor wouldn't start at altitude, and water landings destroyed much of what would be usable data on other flights.

Better and more accurate pressure sensing units are definitely needed which can telemeter data to ground stations. Accuracy is the keynote here. As the Time-Altitude curves indicate (Section IV), the photobarograph is the most accurate of the pressure sensing units which is, in itself, lacking precision. The barocoder should only be used for relative measurement of ascent or descent if the float altitude is above 12 millibars.

FM-FM telemetry was available on a limited basis this year through in-house development by Raven Industries. This system was used on several flights to provide telemetry for up to eight different functions such as voltages, temperatures, and scientific data. This system used a mechanical commutator working into a sub-carrier oscillator to the beacon transmitter.

The power supply consisted of a 20 amp-hour, nominal 24 volt, Silvercell[®] pack and separate dry batteries to power cut-down timers and command equipment. The complete power source was connected to the instruments by inserting a plug on the outside of the instrumentation container prior to flight. A junction box placed inside the container served as a power distribution point. Each sub-unit was plugged into the junction box with its own cable to facilitate quick replacement in the event of a unit failure. The box also provided easy access when modifications were required to meet the needs of each scientific group.

Due to the frequency of water landings when flying from Fort Churchill, an attempt was made to provide water-tight containers for the flight control equipment. This was a welded aluminum box with a rubber gasket on the cover and a built-in water trap. Hermetically sealed power and RF connectors provided power and signal entrance and exit into the container.

Data from the barocoder on the first few flights appeared to indicate "leakers" although contradicted by other altitude measuring devices. Post-flight analysis showed that battery "outgassing" was giving false pressure environment data to the barocoder. Venting of these gasses through the water trap was inadequate using a 1/32 in. hole. Upon increasing the water trap to 3/16 in diameter, satisfactory performance was obtained.

The telemetry beacon antenna system was a quarter-wave ground plane connected to the instrument package by coaxial cable. Placement of the antenna was determined by gondola configuration but was usually slung under the bottom one or two feet or taped to an insulating rod strapped to the side of the gondola. Command receiving was accomplished through a coaxial vertical dipole antenna.

Intersite communication was conducted using Collins KWM-2 Transceivers and 30L-1 Linear Amplifiers. Antennas for all SSB communication were multiband verticals which performed satisfactorily on the two assigned frequencies of 4.015 MHz and 7.465 MHz. Even with this frequency spread, communication was not possible on at least several occasions during the program due to atmospheric conditions. In future years, this will become increasingly more noticeable as we progress into the period of maximum sunspots. A recommendation for circumventing this condition is presented in Section IV, Conclusions and Recommendations.

VHF tracking worked out remarkably well although minor modifications should be considered for next year's operation (Section IV, Conclusions and Recommendations). Initial setup of antennas indicated varying degrees of error at the three sites. Comparison with Fort Churchill radar was difficult when the balloons were within a 100 mile radius of Churchill since half power beamwidth of the antenna main lobe was 40°...preventing accurate azimuth pointing. Later fixes with tracking aircraft confirmed the azimuth errors at all three sites. Initial correction procedure was to estimate the error and add or subtract this factor from the antenna rotor dial readings. After flights 1148 and 1149, Churchill and Uranium City were both receiving and tracking with a much higher degree of accuracy. Lynn Lake still experienced



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some difficulty in obtaining good bearings because of an unusual antenna-receiver combination and inexperience. A post-flight analysis indicated a ± 5 degree bearing accuracy was possible after making a minor antenna azimuth correction. It was then decided to leave the Lynn Lake station as it was until additional flights could be made to thoroughly verify system errors.

On subsequent flights, position data became more accurate but several problems still remained. The Nems-Clarke receivers purchased for use in 1966 had a poor RF amplifier section and consequently the signal strength meter would give little indication of maximum signal unless the balloon distance was under 300 miles. Initially, one of these receivers (Model 1674) was placed at Lynn Lake and one at Fort Churchill as a secondary receiver.

What was considered to be the best tracking antenna was placed at Lynn Lake...two 12 element Yagis stacked horizontally, vertically polarized and fed in phase. With this arrangement, it was not possible for the Lynn Lake station to determine a signal peak within 30 to 40 degrees.

Since the Lynn Lake station was considered to be the most important site for azimuth bearings, the receiver from Uranium City (Nems Clarke Model 1502) was exchanged with the Model 1674 after Flight 1153. Following this move, bearings from Lynn Lake improved considerably. A power line fluctuation, however, introduced a probable error of as much as 10 degrees in the readout dial of the antenna rotor.

The original setup at Uranium City consisted of a single five element Yagi antenna, and a Nems Clarke 1502A receiver. After Flight 1160, a second 5 element Yagi antenna was stacked with the first and fed 180 degrees out of phase to produce a tracking null. This method was chosen so that a sharp null would appear when the array was pointed directly at the signal source. In practice, this was not correct although it did improve the situation. An experienced operator could obtain a repeatability of 2 degrees with this combination.

The secondary receiver at Fort Churchill (Nems Clarke 1674) was used with a single 5 element Yagi and a rotor head which could not be used to read azimuth but provided a monitor for the balloon and for telemetry. The primary antenna (10 element Yagi) worked well in its tracking function.

E. Tracking and Recovery

Based at Uranium City, Saskatchewan, Raven had a Cessna 206 and Cessna 185 on floats and a supercharged Bell 47G3B1 to handle recovery operations. A GFE Douglas C-47 was used to track and assist in recovery and was based at Fort Churchill.

Method of operation consisted of having the C-47 maintain a standby alert immediately following a launch. Position reports obtained by cross-vectoring from the three tracking and monitoring stations plus radar surveillance were then utilized to determine departure time of the C-47 on its tracking mission. In the event of multiple launches, take-off would be delayed when possible to allow for "fly-under" fixes of all balloons during their flight. Times and coordinates of these fixes were reported by radio to the nearest monitoring station which, in turn, passed the data on to the Uranium City recovery station.

Uranium City used aircraft position and radio fixes to plot the probable track and drift speed of the balloon into the recovery area. As the flight neared termination, additional data from recovery aircraft was available.

Dispatch time of the float equipped aircraft for descent monitoring and recovery was primarily determined by weather conditions in the recovery area, the number of balloons approaching termination, and the distance to the probable impact area. When possible, recovery aircraft would rendezvous with the balloon an hour before cut-down to allow time for two fly-under fixes.

Having determined probable impact time and location, the float aircraft, or C-47, maintaining constant radio liaison with the recovery station, would call for a helicopter departure timed to bring it into the area prior to impact. The helicopter pilot was then directed to a point which would bring the descending parachute and payload within his view just prior to impact. Following impact, the fixed wing aircraft relayed impact time and coordinates to the recovery station.

A nearby lake was then selected to provide float plane docking and helicopter landing space in order to prepare for the actual recovery. The helicopter, carrying one or two personnel to the impact site landed in the nearest available spot, seldom more than a half mile from the parachute and its payload. Proceeding on foot,

the recovery crew, maintaining contact with the helicopter via portable transceivers, prepared a landing area adjacent to the payload for the helicopter. If necessary, the payload was disassembled and flown out piecemeal to the float aircraft for transport to the recovery station. Payloads too large for the float aircraft were slung beneath the helicopter and flown to the recovery station for ultimate transport back to Fort Churchill via C-47. A number of smaller loads were also transported this season by this method.

In the event of multiple balloon flights, all fixed wing aircraft including the C-47 were used to monitor descending payloads. The recovery of multiple flights was managed in accordance with geographical deployment in the most expedient manner possible.

Out of thirty-one recovered payloads, twenty-two were brought back the same day they were cut down, seven the following morning (due to near sunset terminations), and two loads were in the bush for two days before recovery.

Of the three flights flown for the University of Chicago (numbers 1148, 1150, and 1154) involving the 800 pound sphere, two flights were recovered and deposited at Uranium City on the same day terminated. Although a similar payload has been flown for a number of years in the SKYHOOK program, this marks the first time, an intact recovery has been accomplished (no disassembly of the load) on the same day of termination.

Recoveries such as Chicago's gondola are difficult and time consuming in that an intermediary point of rendezvous must be selected on the return trip to allow refueling of the helicopter from the float plane. The fixed wing aircraft must arrive at this point first to allow its crew to direct the helicopter pilot, by radio and hand signals, in setting down the payload slung under his craft. Such intermediate points are often difficult to locate.

A major share of our recovery record this year should go to our helicopter crew whose willingness and skill was largely responsible for the excellent record.

Weather in the recovery area was predominantly good this season with only seven of the thirty-one loads being recovered in marginal visibility. Periodic, general rains over the entire recovery area eliminated spurious forest fires of previous years.

Unprecedented drift speeds of balloons during the 1966 season gave some concern and ultimately necessitated allowing several flights to pass beyond the western boundary of the recovery area in order to accumulate desired flight time at altitude.

The boundary formed by the Athabaska and Slave Rivers offers little potential in the way of recovery terrain. The few lakes are nearly all swampy and too marginal to permit safe float plane operation necessary to support the helicopter. The southern portion of this same area is somewhat better providing the balloons have sufficient time to make it across the two-hundred mile area west of the Athabaska River to a comparatively narrow strip of agricultural lands lying parallel to the road running north of Peace River, Alberta. This area intermittently parallels the road for approximately 150 miles north of the town of Peace River and constitutes a small target for a balloon flight.

The region lying west of the Slave River has little or nothing to offer recovery aircraft. Here, vast areas are totally lacking in any readily identifiable feature which would permit accurate marking of impact points permitting a later return and recovery...even under excellent visibility.

If subsequent programs will require recovery in this area, serious thought should be given to the problems involved. One means would employ a larger helicopter, such as the Bell 204 capable of carrying enough fuel to extend its range to six hundred miles at 120 knots. This would allow flight tracking and immediate recovery following impact.

Another problem inherent in operations in this area is the fact that with the present setup, only Uranium City tracking station is capable of monitoring the flight, eliminating radio position fixes. The recommendation in Section IV, Conclusions and Recommendations, provides for increased radio range and position fixes through the use of a balloon transponder. Such extension would allow communication for the prolonged flight situation described above and also increase the present safety factor and radio limitations. Another tracking station in the Peace River area is also recommended.

IV. CONCLUSIONS AND RECOMMENDATIONS

From an operational aspect, personnel and techniques which Raven Industries now employs forms an efficient and effective team. The program was not without problems however, and the following "Problem-Solution/Recommendation" is designed to help ourselves or other parties interested in a task the magnitude of SKYHOOK Churchill.

A. Preparation

1. Problem: Although cooperation and assistance from the Churchill Research Range, Department of Transport, and Department of Public Works is excellent, problems occur after arrival at Churchill taking up time which could be more gainfully used in preparing for operations.

Solution: A trip to Fort Churchill with an ONR representative several weeks before the season begins is recommended to check, inspect, and complete arrangements for housing, messing, transportation, work areas, radar support, etc.

2. Problem: Time involved in changing rigging, different instrumentation requirements, and special requests after a group arrives at Fort Churchill often delay launch of a payload.

Solution: Fund sufficient money for at least one or two trips of an electronics technician and a launch technician to most investigators prior to start of the launch season. Suggested times for these trips would be within several weeks after contact award and then again two to four weeks before start of summer program. This would be particularly helpful in those instances where relatively new groups to balloon flying are involved. It would be beneficial to both the contractor and to the investigator to exchange knowledge and advice before any equipment is in its final construction stage.

B. Personnel

1. Problem: Preparation for multiple flights within a short time span tax the abilities of instrumentation personnel. Varying requirements of the investigator

almost always makes some modification to instrumentation necessary and it was, on occasion, necessary to work twenty-four hours a day.

Recommendation: Provide a minimum of four (4) electronic technicians at the Fort Churchill location.

C. Scheduling

1. Problem: A large percentage of available launch time was lost this year because no investigator was ready to fly. Minimum amount of on-site time before the first launch was two days for three groups while four other groups took nine, ten, eleven and twenty days before they were ready. Average time prior to the first launch was 7.9 days.

Solution: Schedule most groups to arrive within two to three weeks after start of program to eliminate "slack time" later on in the season.

2. Problem: Variable and unpredictable winds in the region of 70,000 to 80,000 feet increases the risk of weather cancellations if these flights are scheduled towards the end of July or the beginning of August.

Solution: Although winds at 70,000 to 80,000 feet are, for the most part, unpredictable throughout the summer season, early scheduling would allow more time to wait for satisfactory flight conditions.

Investigators flying at these altitudes should be prepared, at any time, to risk losing their payloads in Hudson Bay.

D. Operations

1. Problem: The anemometer provided at the SAC Alert Apron was not working satisfactorily.

Solution: Either take along, or have CRR furnish a good, calibrated anemometer. Primary determination of wind direction and velocity is, however, obtained through the use of pibals before layout and before launch.

2. Problem: On several occasions, recovery pilots have reported violent oscillation of payloads during parachute descent. Raven provides crush pads, designed to

absorb landing shock, for a normal descent, but these are useless for an oscillating load.

Solution: Present parachutes should be modified or a stable chute be provided to allow a controlled descent. It does not seem prudent to let an expensive package break itself up on landing if it can be avoided.

3. **Problem:** Increasing requests for longer duration flights jeopardize recovery operations and the possibility of ever getting the payloads back.

Solution: Cut-down should be at the discretion of the tracking or recovery pilot after consultation with the scientist prior to launch. It must be stressed that the risk of recovery greatly increases when the balloon is over unmarkable terrain or in a region where aircraft cannot safely operate. The use of an increased speed, range, and load carrying helicopter is discussed in Part III, Program Description, Section E.

E. Equipment

1. **Problem:** The possibility of having to use two helium trucks for large balloons is present if the tank car is at low pressure.

Solution: Four helium trailers should be provided at Fort Churchill each with a minimum of 30 tubes.

2. **Problem:** Multiple balloon flights during a "short launch window" poses turn-around problems for the M-36 launch truck. Since most investigators desire as little movement as possible when transporting their payload from the hanger to the launch area, the trip takes approximately 45 minutes at a speed of five miles an hour. Inflation itself can be completed within 15 to 30 minutes. If rapid launches are desired, other or additional means must be employed for payload transportation or storage be provided at the Alert Apron.

Solution: Use two launch vehicles at Fort Churchill.

3. Problem: Pressure measuring devices presently used throughout the balloon-flying industry lack precision. Barocoders are satisfactory up to 70,000 feet but then rapidly drop off in accuracy. Photobarographs, while more accurate than the barocoder, still leave something to be desired and are prone to malfunction or destruction in a water landing.

Solution: Provide a new pressure sensing device which would telemeter its data back to the ground station, is rugged, inexpensive, and accurate.

4. Problem: Yardney Silvercells[®] (LR 21) with a nominal capacity of 20 amp-hours were used throughout the season. The battery pack consisted of 16 cells producing a nominal voltage of 24 volts. Eleven complete packs were purchased, filled, and used for the 32 flights. The maximum number of flights obtained from a battery pack was six although from manufacturers specifications, ten to forty complete charge-discharge cycles should be expected. Failure modes left unanswered questions since packs exposed to the same service exhibited completely different characteristics, and some cells within the same pack reacted in an unlike manner. Discharge cycles were conducted on the bench in an attempt to determine failure causes, but no pattern could be discerned. Cell failure appeared to be completely random.

Most bad cells were found during the charge cycle; indicating full charge (2.05 volts) long before sufficient amp-hours had been put back into them. Here, however, we used a manual charging process; increasing or decreasing the current as required. A constant current charger would be of considerable help in accurately monitoring cell input and thus giving a better picture of battery condition. (Raven Industries is presently building such a device.)

Because of the difficulty in determining battery condition, two flights (1171 and 1172) were flown with battery packs that had not been sufficiently charged. Flight 1172 apparently lost one or two cells about an hour prior to cut-down while flight 1171 lost three or more cells two hours before cut-down. Compounding the problem when any cell fails during flight is the fact that the cell then reverse charges to about -1.5 volts and, in effect, subtracts 3 volts from the total supply voltage. If three cells expire and reverse voltage, the total supply drops from a nominal 24 volts to around 15 volts which is too low to operate a telemetry transmitter.

A nominal 20 amp-hour Silvercell- when new, will produce approximately 30 amp-hours at a 1 ampere rate. The Raven package draws 0.7 to 0.8 amps, so an adequate supply is considered to be a 20 amp-hours battery. When any cell does not take at least 24 amp-hours of charging from a completely discharged state, it is considered defective. Of the initial eleven battery packs, only four were considered flyable at the completion of the program.

Solution: In view of the high initial cost and the short service life of a Silvercell it is recommended that in the future, Silver Cadmium batteries be used. Some sacrifice in watt-hours per pounds has to be accepted, but the ruggedness and long life would be well worth a few additional pounds.

Watt-hours/pound for Silvercell[®] (LR 21) = 47
Watt-hours/pound for SilCap[®] (20 amp-hour) = 30

If Silvercells are to be used, it is strongly recommended that an accurate charger be used to monitor, time and cut-off the charge cycle.

F. Tracking

1. **Problem:** Although positional data obtained by radio cross-fixing was better than initially expected (and increased as the season progressed), it is obvious that better equipment will produce superior performance.

Solution:

1. Investigate and purchase stacked antenna arrays to determine which system will give the sharpest nulls.
2. Purchase or build a transistor or nuvistor preamplifier for the Nems Clarke 1674 receivers.
3. Purchase better antenna rotors and readout heads with higher accuracy and greater insensitivity to power line voltage fluctuations.

G. Communications

1. Problem: Increase of solar flare activity this year caused communication "blackouts" on several occasions. This problem is expected to increase in severity during the next few years and then gradually decrease again, in an eleven year cycle. If reliable communication between all sites is to be maintained, means will have to be employed in addition to 3-30 MHz SSB communication.

Solution: Raven Industries, aware of the above problem, designed and tested a balloon "transponder" during several of the later flights at Churchill this year.

The purpose of these tests was to prove the feasibility of using existing balloon instrumentation as a voice transponder to make possible long-range ground-to-ground and ground-to-air communications.

The method was to voice modulate a command transmitter by adding a second Private Line tone and then adding a second "Private Line" squelch deck to the balloon command receiver. Some minor modification to the receiver and telemetry transmitter were necessary. When the proper squelch circuit was operated at the balloon receiver, a relay was energized to remove the barocoder oscillator input from the telemetry transmitter and inject the audio from the receiver. Any FM receiver tuned to the telemetry frequency (approximately 250 MHz) within a 400 mile radius of the balloon could then receive the voice retransmission.

The operation of the command receiver was in no way impaired since the audio and squelch circuits driving the command decoder are not modified. The selection of the "Private Line" determines whether the incoming signal is fed into the command decoder or to the input of the telemetry transmitter.

On Flight 1176, this system was used entirely for inter-station communication instead of SSB. All stations (Churchill, Lynn Lake, Uranium City) reported excellent reception throughout the flight. In-flight fixes were obtained from the C-47 aircraft via re-transmission when the plane was out of direct radio range of any ground station. Unfortunately, the 250 MHz aircraft receiver only operates in the AM mode, so voice

transmission from the balloon telemetry transmitter was unreadable. This would be corrected by the addition of an FM detector to the aircraft receiver so that all active participants in tracking and recovery would be in continuous contact.

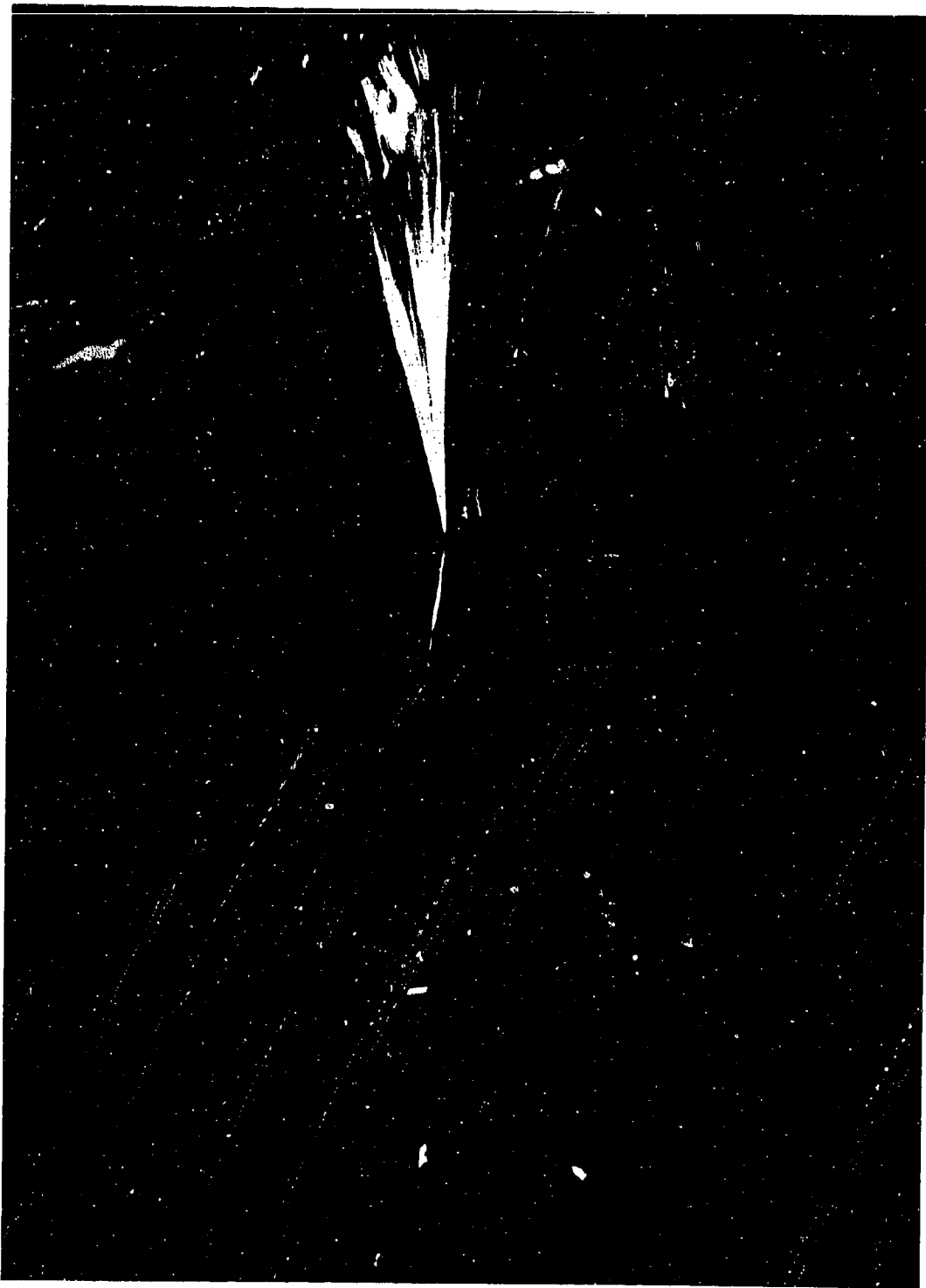
H. Balloons

Since the Stratofilm balloons all performed in a satisfactory manner, and Raven Industries did not participate in their design or construction, comments are inappropriate. No problems were experienced with any balloon throughout the season.

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V. FLIGHT HISTORIES

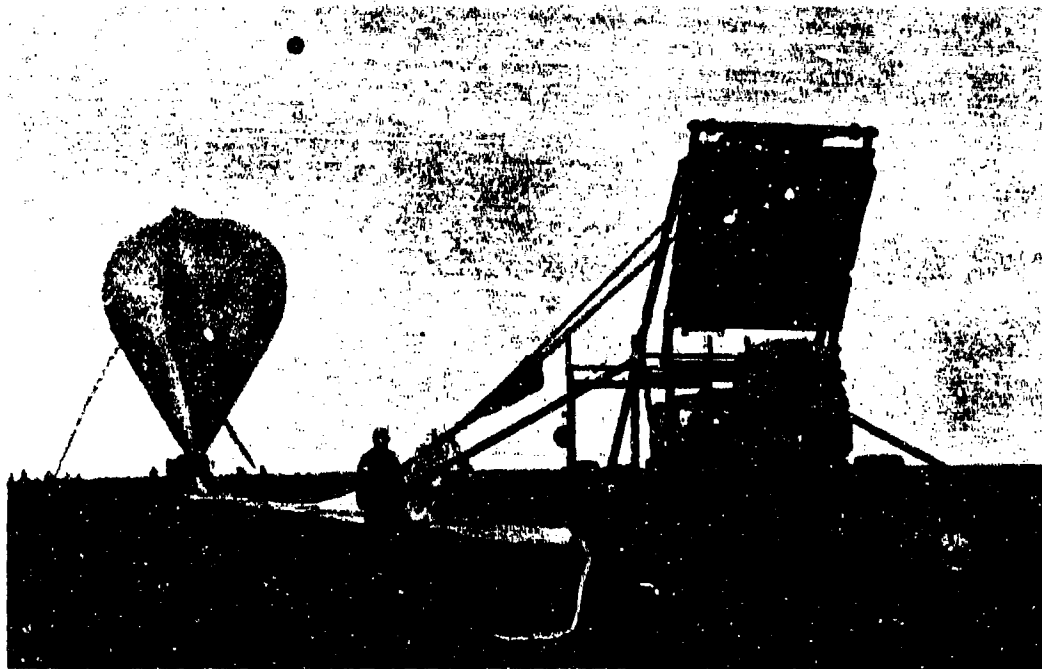


1148 - FLIGHT DESCRIPTION

Flight 1148 was launched at 0241Z on 10 June 1966 under the direction of R. Keuser. After 19.2 hours, termination was successfully performed from our Cessna 206 recovery aircraft.

The University of Chicago "sphere" was designed to measure the ratio of positrons to electrons in the primary cosmic radiation ranges of 100 Mev to 6 Bev. Concurrently, it was able to obtain an energy spectrum for electrons in the energy interval between 100 Mev to approximately 4 Bev. Principal investigators at Fort Churchill with this load were Dr. Peter Meyer and Mr. John Fanselow.

Raven modified its instrumentation package slightly to accommodate a gondola power turn-on by providing a latching relay which could be operated either by radio command or by a back-up timer. The modified back-up timer produced a pulse four hours after launch to accomplish the turn on. With either radio command or the timer a momentary tone shift on the barocder oscillator provided an indication to the ground station that the latching function (power turn-on) had been performed. As it turned out, the scientist decided to leave the power on from the time of launch, so this mechanism was not used.



Balloon train layout with University of Chicago sphere on M-36 launch truck.

1148 - Flight Description (con't.)

The altitude barocoder read approximately 15,000 feet lower than radar although it had been calibrated and functioned well on the ground. Photobarograph data looked considerably better but was still lacking in accuracy. One of the major problems with the barocoder turned out to be too small of a vent hole in the water-tight instrumentation container. Outgassing of batteries created a pressure within the box which caused the barocoder to read a higher pressure than ambient.

Telemetry signals throughout the flight were excellent. Fort Churchill tracking lost the beacon when the balloon was 475 miles away. A Brailsford back-up timer on top of the parachute provided the extra outdown precaution.

All equipment performed satisfactorily although setting up problems caused some difficulties with tracking. Only two radio fixes were obtained; each considerably off of actual track. The major reason for this, as discussed in Sections III. and IV. , were: unsatisfactory antenna and tracking receiver at Lynn Lake, power line fluctuations at Lynn Lake affecting the antenna readout unit, and uncalibrated tracking antennas at all three stations. As the season progressed, equipment changes and experience considerably improved tracking performance.

Telemetry channels and transmitter frequency were as follows:

Transmitter Frequency:	251.5 MHz
Command Channels:	Cutdown 7
	Ballast 8
	Gondola Turn-on 9
	Private Line 1

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LAUNCH LOG, SKYHOOK FLIGHT 1148

University of Chicago (Meyer-Fanselow) sphere
Balloon: 10.6 x 10⁶ cubic foot Stratofilm
all times in CDT 9 June 1966

1930 Full crew in hanger area; helium truck already in launch area.
1950 NOTAM activated for 2200 launch; radar tracking crews called.
1955 Advance crew left hanger for launch area.
2000 Launch truck carrying suspended payload left hanger.
2005 Advance crew arrived in launch area.
2025 Payload and launch truck arrived in launch area. Balloon laid out perpendicular for wind from 060°.
2045 Wind indicated on mast in launch area; 090°, 2 knots. Inflation started, using two tubes, one helium trailer.
2048 Bubble up. Full crew involved in inflation and preparation:
Diffusers: Fulkerson and Pappas, relieved by Hanson and Vandersnick.
Instruments: Oliver, Rupp and Minor
Flight Director: Keuser
Assistant Flight Director: Mancuso
Pilots: Tomnitz and Johnson
Log-Keeper: Smith
Hanger Telemetry: Kerschmann
ONR Observer: Evanick
Balloon Safety Officer: Worth
CRR Technical Officer: Uhrich
2100 Wind reading 090° 3-4 knots.
2117 Inflation completed; wind reading 030°-050°, 4-6 knots.
2132 Instrument package on gondola, wind reading 070°, 2-3 knots.
2135 Final instrument check.
2140 Launch. (Following Control approval of launch ahead of NOTAM schedule.)
Very smooth truck launch; no cross wind.
2200 Weather at DOT: Temperature 46°F, SLP 1008.5; scattered clouds at 4000 feet, broken at 9000, and overcast at 22,000 feet; wind ESE 7.

Range Test Number: 76.6 SB165-A IL.

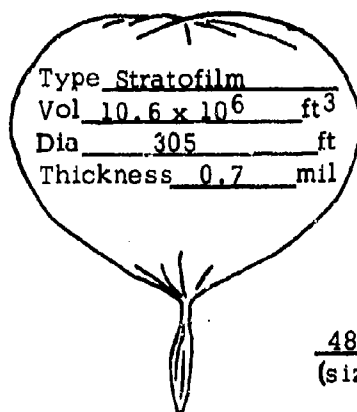
Tropopause at 0000Z, 10 June, -57°C, at 274 Mb, (32,303 ft.).

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

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1. Company Raven Flight Number 1148-N Director Keuser, Mancuso
2. Scientist Meyer Group II. of Chicago Date/Time 6/10 / 0241 Z
3. Launch: Site Churchill Technique/Launch Veh. M-36 Truck
4. Wx: High Overcast, 8°C, 3 mph, 1010 MB Cross Wind Angle None
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 32,000 ft Temp -57 °C Inflation Start 0145 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 500 ft.
5. Balloon Theoretical 2.94 Mbs 135,000 ft. How Determined?
 Ceiling: Actual 3.28 Mbs 133,200 ft. Last Radar Altitude
6. Ascent: Surface to Trop. 979 fpm Trop. to Ceiling 316 fpm.
7. Flight Duration: Total 19 hrs 10 min. At Ceiling 15 hrs. 21 min.
8. Termination: Time 2151 Z Altitude 130,500 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 6/10 / 2227 Z Location 58° 03' N 108° 50' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time

<u>251.5</u>	<u>Altitude telemetry</u>	<u>19.5 hours</u>
<u>149.4</u>	<u>Communication & Command</u>	<u>19.5 hours</u>
12. Balloon: Code Number SF-305.86-070-NSC-02 Serial Number 46



WEIGHTS

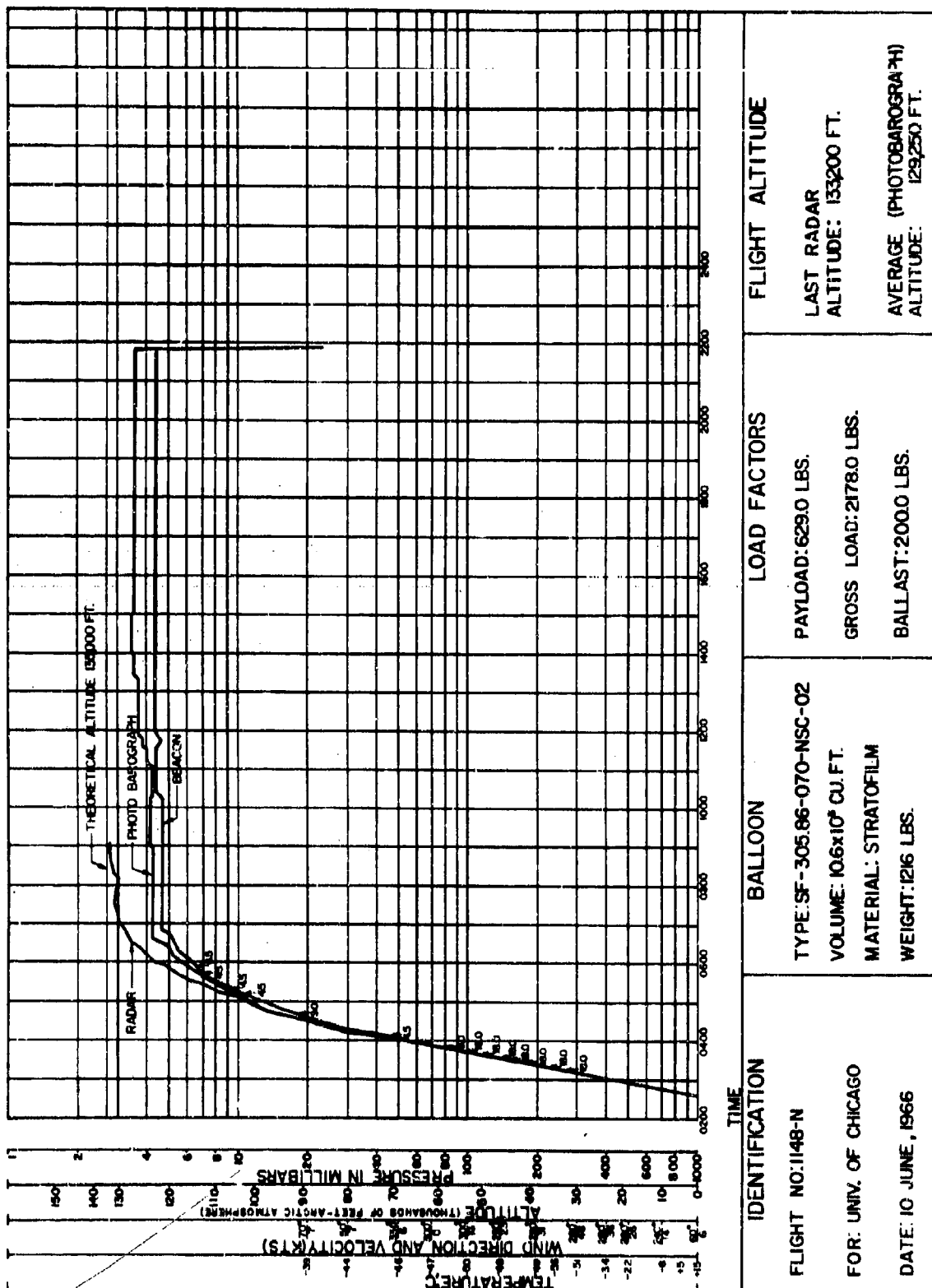
Balloon.....	1216.0
Parachute.....	50.0
Instrumentation.....	50.0
Ballast.....	200.0
Scientific Package.....	629.0
Other. Ballast and Container..	25.0
Other. Photo Barograph.....	8.0
Gross Weight.....	2178.0
Free Lift.....	218.0
Gross Inflation.....	2396.0
Helium used (cu. ft.).....	38544

13. Flight Failures None
 (Nature of flight failures - if any)
14. Comments Theoretical altitude probably attained. Lost radar at 0905 Z.
 (Significant factors concerning the operation)

Copy to:
 ONR/Fld Rep/Minn
 ONR/Code 421

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FLIGHT ALTITUDE

LAST RADAR
ALTITUDE: 133200 FT.
AVERAGE (PHOTOBAROGRAPH)
ALTITUDE: 129250 FT.

LOAD FACTORS

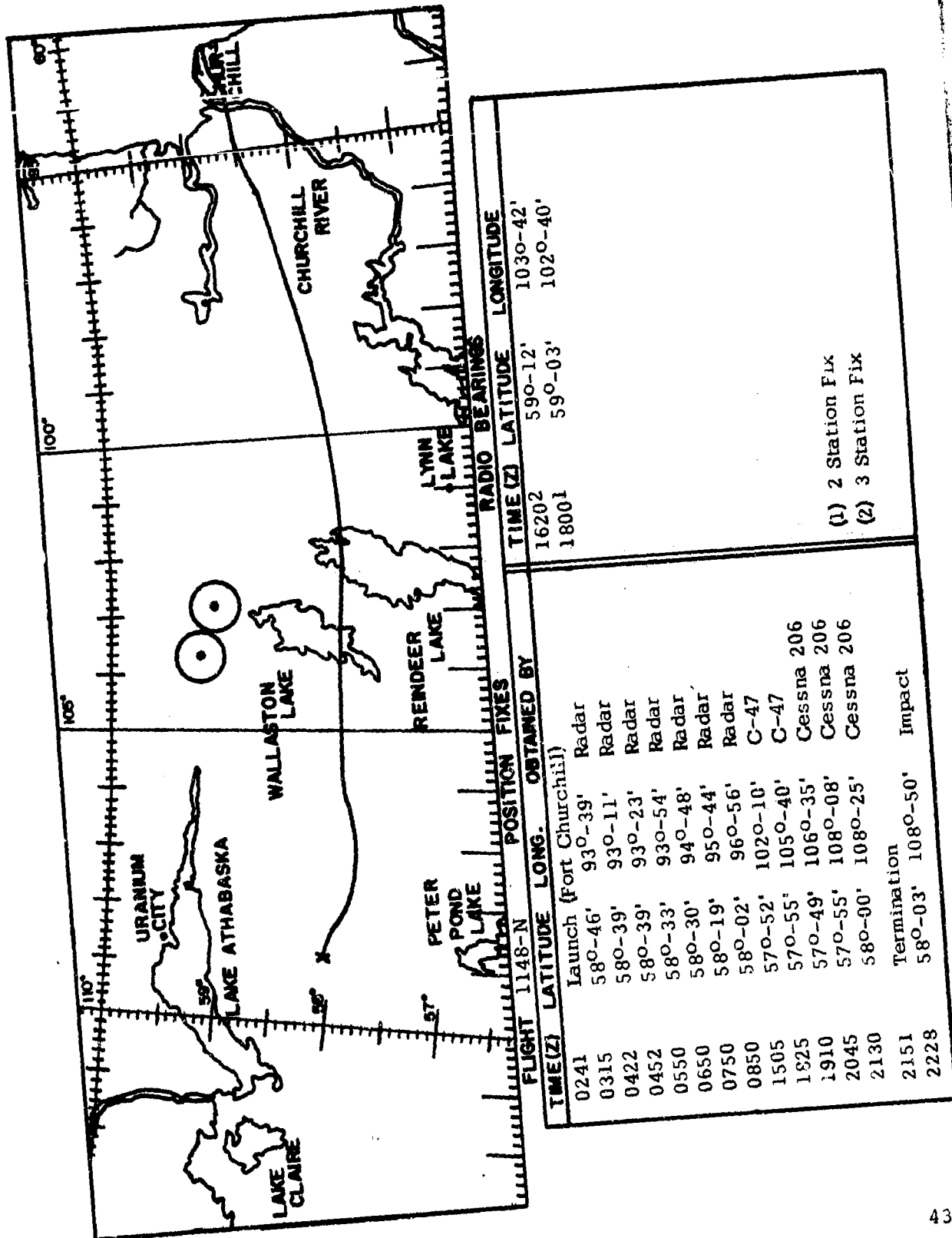
PAYLOAD: 629.0 LBS.
GROSS LOAD: 2178.0 LBS.
BALLAST: 200.0 LBS.

BALLOON

TYPE: SF-305.86-070-NSC-02
VOLUME: 10.6x10³ CU. FT.
MATERIAL: STRATOFILM
WEIGHT: 126 LBS.

IDENTIFICATION

FLIGHT NO: 1148-N
FOR: UNIV. OF CHICAGO
DATE: 10 JUNE, 1966



Flight 1148 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1148 launched on 10 June 1966. Initial ballast on board at the time of launch was 200 pounds. Between 0245Z and 1245Z (termination), 30 pounds of ballast was automatically dropped at the rate of 3.0 pounds per hour. No problems were experienced with the ballasting system during this flight.

Table I
Ballast Data-Flight 1148

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
0321	18.0	182.0
0326	18.0	164.0
0330	18.0	146.0
0333	18.0	128.0
0336	18.0	110.0
0340	18.0	92.0
0346	18.0	74.0
0351	9.0	63.0
0412	4.5	58.5
0444	9.0	47.5
0515	4.5	43.0
0523	4.5	38.5
0543	4.5	34.0
0557	4.5	29.5

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

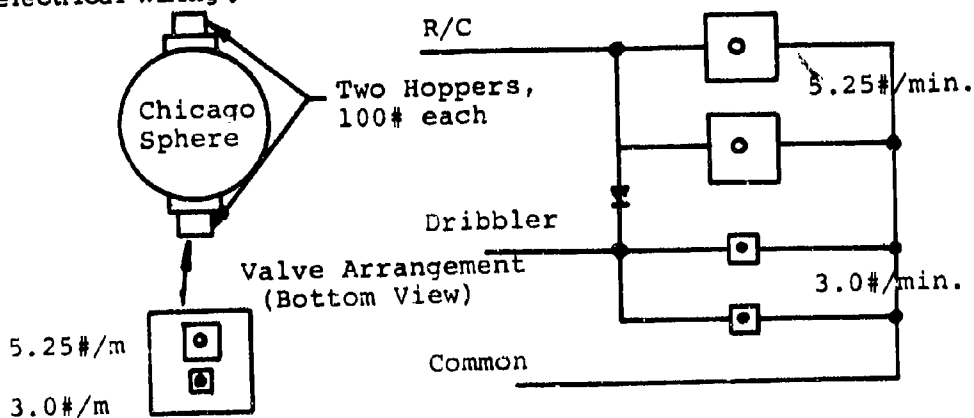


Figure 1

PHOTOBAROGRAPH DATA
 Flight 1148-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0359.5	55.2	67,020	0539.5	7.0	113,497
0402	50.5	69,016	0542	6.9	113,841
0404.5	46.0	71,045	0544.5	6.5	115,271
0407	42.3	72,868	0547	6.5	115,271
0409.5	39.0	74,635	0549.5	6.3	116,023
0412	36.9	75,838	0552	6.3	116,023
0414.5	32.8	78,408	0554.5	6.3	116,023
0417	30.6	79,929	0557	5.9	117,608
0419.5	28.5	81,492	0559.5	5.9	117,608
0422	26.5	83,097	0602	5.5	118,876
0424.5	25.0	84,386	0604.5	5.5	119,315
0427	23.5	85,759	0607	5.3	120,220
0429.5	22.2	87,025	0609.5	5.2	120,687
0432	20.9	88,371	0612	5.2	120,687
0434.5	19.8	89,580	0614.5	5.2	120,687
0437	18.3	91,348	0617	5.2	120,687
0439.5	17.5	92,353	0619.5	5.1	121,163
0442	16.7	93,409	0622	5.0	121,650
0444.5	16.0	94,376	0624.5	4.9	122,147
0447	15.0	95,838	0627	4.8	122,656
0449.5	14.2	97,083	0629.5	4.4	124,813
0452	13.2	98,746	0632	4.3	125,386
0454.5	12.9	99,271	0634.5	4.2	125,974
0457	12.3	100,360	0637	4.2	125,974
0459.5	12.0	100,926	0639.5	4.2	125,974
0502	11.7	101,507	0647	4.2	125,974
0504.5	10.9	103,135	0652	4.2	125,974
0507	10.6	103,778	0657	4.2	125,974
0509.5	10.2	104,665	0702	4.2	125,974
0512	9.7	105,828	0707	4.2	125,974
0514.5	9.3	106,805	0712	4.2	125,974
0517	9.0	107,568	0722	4.2	125,974
0519.5	8.8	108,093	0729.5	4.2	125,974
0522	8.5	108,905	0737	4.2	125,974
0524.5	8.3	109,464	0744.5	4.2	125,974
0527	8.1	110,038	0752	4.2	125,974
0529.5	7.9	110,627	0757	4.2	125,974
0532	7.7	111,233	0802	4.2	125,974
0534.5	7.6	111,542	0807	4.2	125,974
0537	7.3	112,498	0812	4.2	125,974

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Photobarograph Data
1148-N
Page 2

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Time (Z)	Press (MB)	Alt. (ft.)	Time (Z)	Press (MB)	Alt. (ft.)
0817	4.2	125,974	1214	3.7	129,160
0822	4.2	125,974	1232	3.7	129,160
0824.5	4.2	125,974	1245.5	3.7	129,160
0829.5	4.2	125,974	1303.5	3.7	129,160
0834.5	4.2	125,974	1313	3.7	129,160
0839.5	4.2	125,974	1328	3.6	129,854
0844.5	4.2	125,974	1338	3.6	129,854
0849.5	4.2	125,974	1348	3.6	129,854
0854.5	4.2	125,974	1403	3.5	130,569
0859.5	4.1	126,577	1413	3.5	130,569
0904.5	4.1	126,577	1429.5	3.5	130,569
0909.5	4.1	126,577	1440.5	3.5	130,569
0914.5	4.1	126,577	1458	3.5	130,569
0919.5	4.1	126,577	1506	3.6	129,854
0924.5	4.1	126,577	1518	3.6	129,854
0929.5	4.1	126,577	1536.5	3.6	129,854
0934.5	4.1	126,577	1543	3.6	129,854
0942	4.1	126,577	1556	3.6	129,854
0949.5	4.1	126,577	1609	3.6	129,854
0958	4.1	126,577	1622	3.6	129,854
1007	4.1	126,577	1635	3.6	129,854
1016	4.1	126,577	1648.5	3.6	129,854
1022	4.2	125,594	1701.5	3.6	129,854
1028.5	4.2	125,974	1711.5	3.6	130,569
1035.5	4.2	125,974	1725.5	3.6	129,854
1042.5	4.2	125,974	1743.5	3.6	129,854
1049.5	4.2	125,974	1753.5	3.6	129,854
1107.5	4.1	126,577	1816.5	3.6	129,854
1111.5	4.1	126,577	1829	3.6	129,854
1115.5	4.0	127,196	1843	3.6	129,854
1123.5	4.0	127,196	1905	3.6	129,854
1135.5	4.0	127,196	1943.5	3.6	129,854
1139.5	3.8	128,487	2111	3.6	129,854
1151.5	3.8	128,487	2151		Terminated
1156	3.7	129,160	2153.5	23.8	85,477

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1148-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0241	1010	Launch	0315	265	33,000
0246.6	822	5,600	0325	201	39,000
0256.5	554	15,800	0335	152	45,000
0301.1	468	20,000	0346	98	54,600
0311.3	304	30,000	0356	66.5	63,000
0317.4	235	35,600	0406	46	71,100
0325.0	192	40,000	0416	33	78,300
0333.7	147	45,800	0426	25.1	84,300
0345.5	95.2	55,200	0436	19.2	90,300
0351.1	75.7	60,200	0446	15.5	95,100
0403.6	48.2	70,000	0456	12.1	100,800
0422.3	29.5	80,700	0506	10.05	105,000
0430.0	23.8	85,500	0515	8.29	109,500
0437.8	19.2	90,300	0525	7.3	112,500
0448.2	15.4	95,300	0535	6.53	115,200
0457.2	12.5	100,000	0545	5.55	119,100
0512.4	10.1	105,000	0555	5.15	120,900
0523.9	8.65	108,500	0605	4.73	123,000
0532.0	8.1	110,000	0620	4.19	126,000
0545.5	7.15	113,000	0635	3.86	128,100
0602.0	6.53	115,200	0650	3.71	129,100
0611.0	6.17	116,500	0705	3.59	129,900
0617.5	5.87	117,700	0720	3.43	131,100
0647.0	5.35	120,000	0735	3.3	132,000
0650.0	4.88	122,000	0750	3.35	131,700
0700	4.88	122,000	0810	3.51	130,500
0715	4.88	122,000	0820	3.3	132,000
0730	4.88	122,000	0835	3.3	133,000
0800	4.88	122,000	0850	3.3	133,000
0830	4.88	122,000	0905	3.3	133,000
0900	4.88	122,000			
0930	4.88	122,000			
1000	4.88	122,000			
1030	4.45	124,500			
1045	4.45	124,500			
1115	4.45	124,500			
1130	4.45	124,500			
1145	4.88	122,200			
1200	4.55	124,000			
1400	4.55	124,000			
1500	4.55	124,000			
1800	4.55	124,000			
2000	4.55	124,000			
2151	4.55	124,000			

R-1866

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Flight 1148
Upper Air Data for 0000Z, June 10

Standard Levels

Pressure (MB)	T, °C	Wind Kts.
1000	+15	60° 6
850	+ 5	250° 11
700	- 8	240° 14
500	-22	280° 26
400	-34	280° 36
300	-51	280° 48
250	-56	280° 46
200	-49	290° 31
150	-49	290° 23
100	-50	300° 16
70	-47	300° 8
50	-46	330° 6
30	-44	50° 7
20	-39	70° 7

Significant Levels

994	+16
704	- 8
626	-15
619	-14
563	-16
468	-25
366	-40
274	-57
212	-50
40	-47
18	-40
15	-34
13	-34

Wind Data

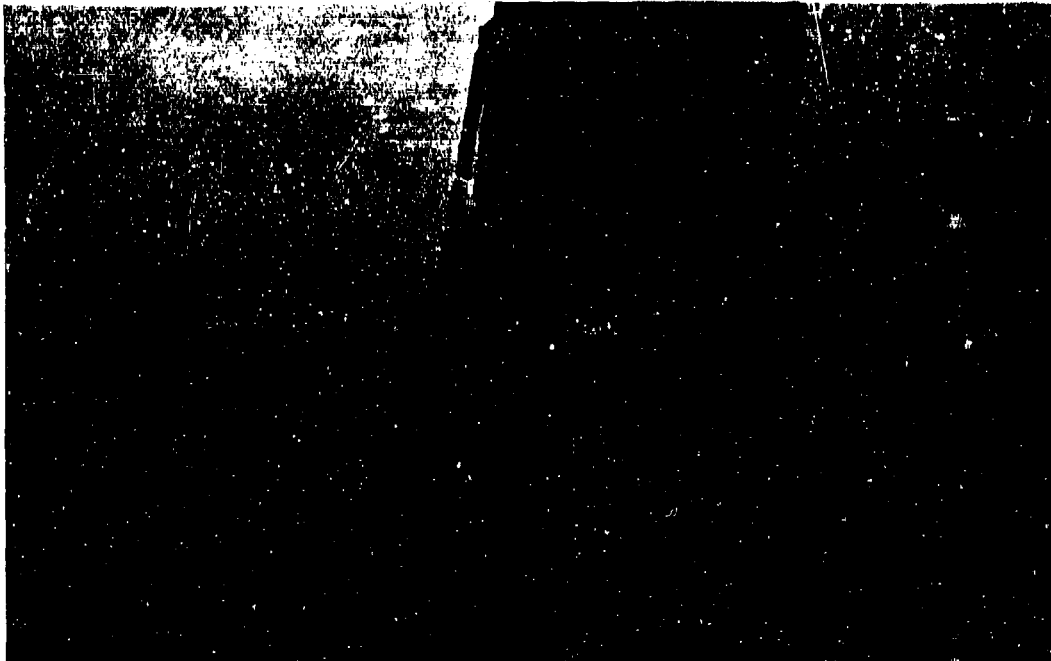
Thousands of Feet	Direction	Knots
1	30	5
2	320	5
4	250	11
10	240	14
14	250	18
20	280	26
25	280	27
30	280	48
35	280	38
40	290	27
50	290	16
60	300	10
70	330	6
80	40	7
90	80	10
97	50	13

1149 - FLIGHT DESCRIPTION

Flight 1149 for the University of Chicago was launched at 0604Z on 10 June 1966 under the direction of R. Keuser and G. Mancuso. After 17.1 hours, the flight was successfully terminated by radio command from Uranium City, although originally attempted by the C-47 tracking aircraft. Cause of the C-47 command failure was later found to be a bad relay in the aircraft's Motrac transmitter. It was repaired with no further problems.

The University of Chicago's "cylinder" was designed to study flux and energy spectrum of primary cosmic ray electrons in the range of 10 Mev to 5 Bev. The detector system used plastic scintillation counters as well as Cerenkov devices. Data was automatically recorded on board the gondola as well as simultaneously transmitted to the ground. Primary investigators for this flight were Dr. Peter Meyer and Mr. J. L'Heureux.

Launch of Flight 1149 was held up for the launch of Flight 1148 about three hours earlier. The M-36 launch truck was rerigged rather than use the anchor line technique since the former provides more freedom in layout and launch. Two simultaneous layouts were not possible due to a 60 degree wind over the relatively small taxiway. The entire lay-out, launch, and flight went smoothly with no problems.



University of Chicago cylinder, ballast
circuit being checked.

1149 - Flight Description (cont.)

As in the previous flight (1148), the barocoder read approximately 10,000 feet under radar observations and indicated a balloon descent at the rate of 2,300 feet per hour throughout float (see time-altitude curve). Photobarograph and University of Chicago pressure sensors both indicated a nearly level flight. At this time, the idea that the water-tight instrument box with a too small vent tube in the water trap became apparent. It was decided to enlarge the vent hole and fly the same box again to check out the theory.

Pre-flight checkout of the instrumentation package indicated that the transmitter was apparently not working. After replacing an RF cable to the antenna, all instruments performed well throughout the flight. Raven monitored battery voltages and temperatures inside the instrumentation container using thermistors and a voltage controlled oscillator (VCO) to modulate an FM-FM transmitter. Reception and decoding at the ground station was accomplished with subcarrier discriminators. No functions were requested or performed for the investigators. Radio command ballasting worked well twenty times out of twenty attempts. Tone-shift reception at the ground station provided indication of command performance. As in Flight 1148, a Brailsford back-up timer was used on top of the parachute.

Tracking and position fixing improved considerably on this flight although only four fixes were taken (see Position Fix Map). Tracking signals were received at Fort Churchill until the balloon was 470 miles out. Lynn Lake acquired the signals at 0721 Z while Uranium City locked on at 1113Z.

Telemetry channels and transmitter frequency were as follows:

Transmitter Frequency: 253.1 MHz

Command Channels:	Cutdown	1
	Ballast	2
	Private Line	1

LAUNCH LOG, SKYHOOK 1149

University of Chicago (Meyer L'Heureux) cylinder
 Balloon: 6 x 10⁶ cubic foot Stratofilm
 all times in CDT 9-10 June 1966

1930 Full crew in hanger area; helium truck in launch area.
 1950 NOTAM activated for 2230 launch; radar tracking crews called.
 1955 Advance crew left hanger for launch area.
 2000 Payload and launch truck left hanger.
 2005 Advance crew arrived in launch area.
 2025 Payload and launch truck arrived in launch area. Flight 1149 held for launch of 1148, then launch truck rerigged, rather than using anchor line. With only one taxi-way usable with a 060° wind, it was not possible to make two simultaneous inflations.
 2309 Balloon laid out per pibal for wind from 240°.
 2320 Wind indicated on mast in launch area; 280°, 7 knots. NOTAM revised for 0010 launch.
 2332 Instrument package on gondola; working, but not closed up.
 2350 Wind 210°, 10 knots gusting to 12. Operations held up, for
 (a) incoming aircraft
 (b) wind to become more steady
 0004 NOTAM changed to 0045 launch, wind reading 225°, 9 knots.
 0040 Wind 210°, 8 knots. Inflation started, using 2 tubes, one helium trailer.
 0043 Bubble up.
 0058 Inflation completed.
 0107 Launch. Wind indicated on mast 240°, 7 knots. Truck moved straight ahead, in a smooth but fast launch. Wind at extended bubble height estimated 15 to 20 mph.
 0100 Weather at DOT: Temperature 56° F; SLP 1008.4; wind 3W 15; clouds scattered at 4000 feet, broken at 9000, and over cast at 22,000 feet.

Tropopause at 1200 Z, 10 June, -52° C, at 257 Mb (33,691 feet).
 Range Test Number: 77.6 SB165-A IL.

R-1966

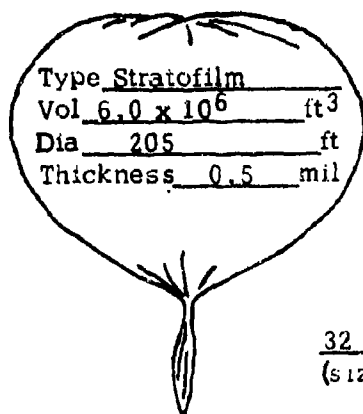
SKYHOOK BALLOON FLIGHT INFORMATION

NAVEXOS 3900/2 (Rev. 8-66)

RAVEN[®]

industries, inc.

1. Company Raven Flight Number 1149-N Director Keuser, Mancuso
2. Scientist Meyer Group U. of Chicago Date/Time 6/10 / 0604 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: High Overcast, 14°C, 10 mph, 1008 Mb Cross Wind Angle None
(Sky-Temp-Wind-Pressure)
Trop (Coldest) Ht. 32,000 ft Temp -57 °C Inflation Start 0540 Z
Hrs Sunshine on Bubble None Train Length (Layout) 425 ft.
5. Balloon Theoretical 2.94 Mbs. 135,000 ft. How Determined?
Ceiling: Actual 2.94 Mbs 135,000 ft. Lost Radar Fix
6. Ascent: Surface to Trop. 944 fpm Trop. to Ceiling 840 fpm.
7. Flight Duration: Total 17 hrs 7 min. At Ceiling 14 hrs. 11 min.
8. Termination: Time 2311 Z Altitude 133,500 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 6/10/2350 Z Location 58° 55' N 108° 35' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
253.1 Altitude Telemetry 17.5 hours
149.4 Communication & Command 17.5 hours
12. Balloon: Code Number SF-250.2-050-NSC-02 Serial Number 2



WEIGHTS

Balloon.....	684.0
Parachute.....	30.0
Instrumentation.....	50.0
Ballast.....	150.0
Scientific Package.....	20.0
Other Photobarograph.....	8.0
Other.....	33.5
Gross Weight.....	1175.5
Free Lift.....	142.0
Gross Inflation.....	1317.5
Helium used (cu. ft.).....	14000

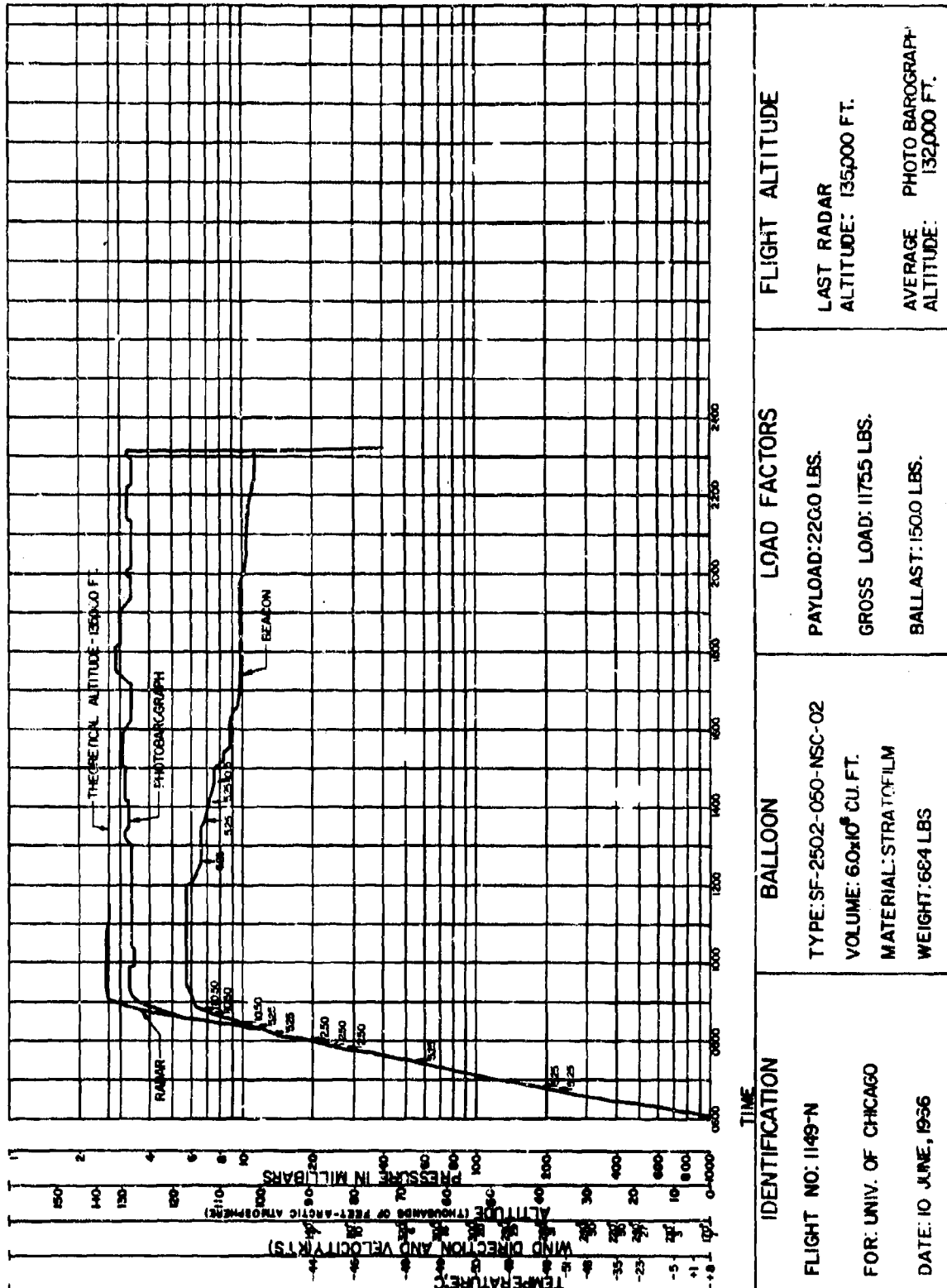
13. Flight Failures None
(Nature of flight failures - if any)
14. Comments Battery outgassing and small vent tube gave indication of leaking balloon on barocoder.
(Significant factors concerning the operation)

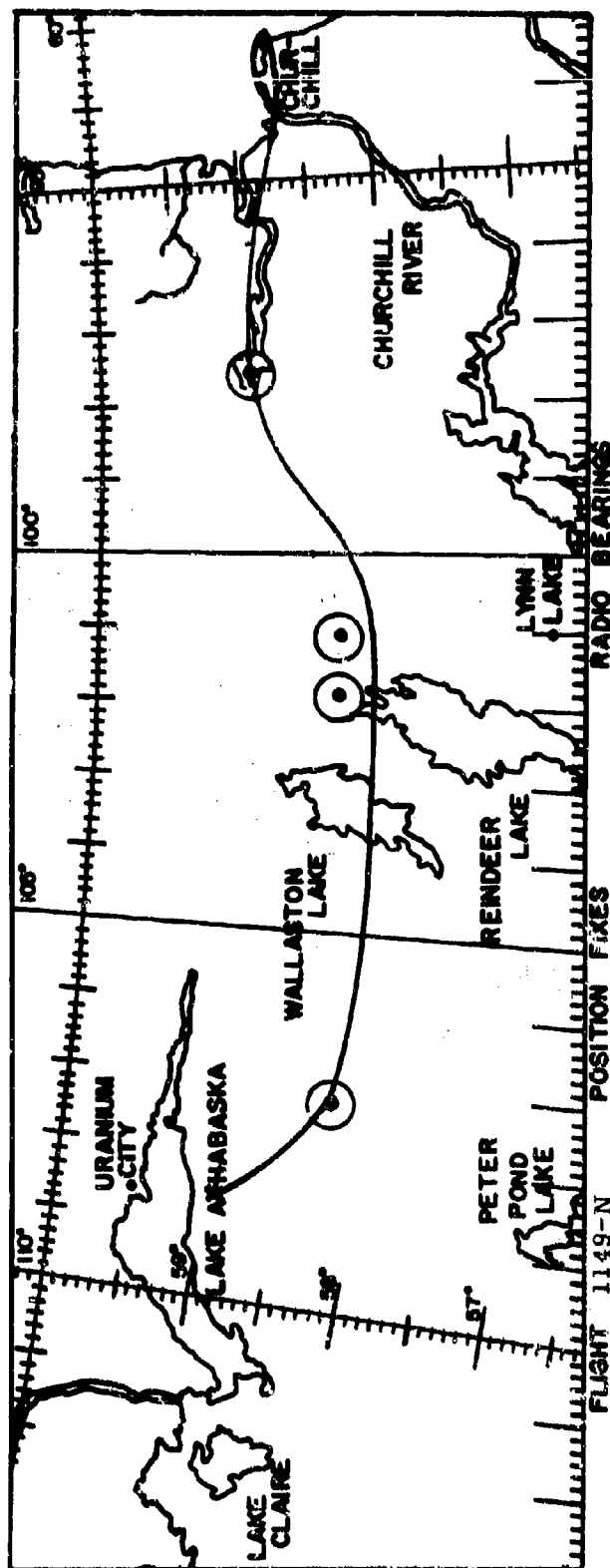
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TIME(Z) LATITUDE LONG.		OBTAINED BY		TIME(Z) LATITUDE LONGITUDE	
0604.5	Fort Churchill	Launch		13521	58°-46' 97°-35'
0625	58°-47' 93°-55'	Radar		16302	58°-29' 102°-25'
0645	58°-50' 93°-31'	Radar		18001	58°-29' 101°-54'
0655	58°-49' 93°-22'	Radar		22321	58°-15' 107°-10'
0715	58°-47' 93°-12'	Radar			
0745	58°-44' 93°-10'	Radar			
0815	58°-43' 93°-22'	Radar			
0855	58°-40' 93°-52'	Radar			
1005	58°-47' 95°-07'	Radar			
1035	58°-53' 95°-27'	Radar			
1120	58°-55' 95°-51'	Radar			
1352	58°-46' 97°-35'	C-47			
1732.2	58°-05' 101°-05'	C-47			
2311	Termination				
2350	58°-55' 108°-35'	Impact			

(1) 2 Station Fix
 (2) 3 Station Fix

Flight 1149 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1149 launched on 10 June 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0545Z and 1815Z (termination), 35 pounds of ballast was automatically dropped at the rate of 2.8 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I
Ballast Data-Flight 1149

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
0646	5.25	144.75
0652	5.25	139.50
0731	5.25	134.25
0751	2.50	131.75
0756	2.50	129.25
0800	5.25	124.00
0805	5.25	118.75
0816	5.25	113.50
0825	5.25	108.25
0832	10.50	97.75
0842	10.50	87.25
0853	10.5	76.75
1238	5.25	71.50
1340	5.25	66.25
1408	5.25	61.00
1440	10.50	50.50
1714	5.25	45.25
1716	5.25	40.00
1718	5.25	34.75

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

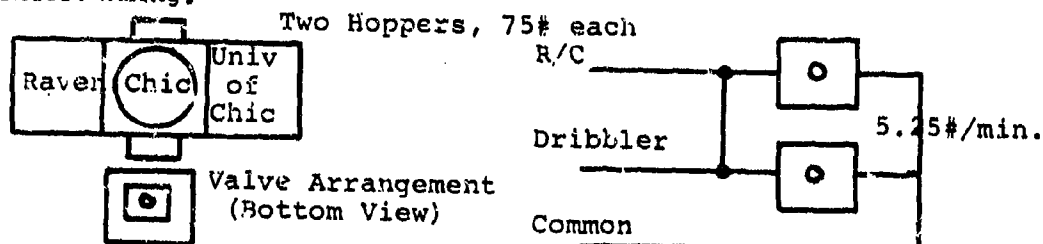


Figure 1

R-1866

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 PHOTOBAROGRAPH DATA
 Flight 1149-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0729	51.4	69,100	0914	3.45	130,935
0731.5	47.4	70,360	0916.5	3.45	130,935
0734	44.2	71,913	0919	3.4	131,307
0736.5	39.8	74,193	0929	3.4	131,307
0739	37.2	75,662	0936.5	3.45	130,935
0741.5	34.2	77,495	0939	3.45	130,935
0744	31.4	79,363	0941.5	3.45	131,307
0746.5	29.2	80,958	0949	3.45	130,935
0749	26.0	83,518	0954	3.5	130,569
0751.5	25.1	84,298	1001.5	3.5	130,569
0754.5	23.5	85,759	1006.5	3.45	130,935
0757.5	21.7	87,533	1011.5	3.45	130,935
0759	20.2	89,133	1016.5	3.45	130,935
0801.5	19.2	90,270	1021.5	3.4	131,307
0804	18.6	90,982	1029	3.4	131,307
0806.5	16.8	93,274	1036.5	3.4	131,307
0809	15.6	94,949	1044	3.4	131,307
0811.5	14.7	96,296	1054	3.4	131,307
0814	12.8	99,449	1104	3.4	131,307
0821.5	10.3	104,440	1114	3.4	131,307
0824	9.7	105,828	1119	3.4	131,307
0826.5	9.1	107,311	1129	3.4	131,307
0829	8.4	109,183	1139	3.4	131,307
0831.5	7.7	111,233	1149	3.4	131,307
0834	7.0	113,497	1154	3.4	131,307
0836.5	6.0	117,201	1204	3.4	131,307
0839	5.5	119,315	1214	3.4	131,307
0841.5	5.1	121,163	1224	3.4	131,307
0844	4.8	122,656	1229	3.4	131,307
0846.5	4.6	123,709	1239	3.4	131,307
0849	4.5	124,255	1244	3.4	131,307
0851.5	4.3	125,386	1249	3.4	131,307
0854	4.0	127,196	1254	3.3	132,069
0856.5	4.0	127,196	1259	3.4	132,069
0859	3.7	129,160	1301.5	3.3	132,069
0901.5	3.6	129,854	1304	3.4	131,307
0904	3.55	130,209	1306.5	3.3	132,069
0906.5	3.5	130,569	1314	3.3	132,069
0909	3.45	130,935	1316.5	3.2	132,856
0911.5	3.4	131,307	1326.5	3.2	132,856

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Photobarograph Data
1149-N
Page 2

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1329	3.3	132,069	1811.5	3.0	134,515
1334	3.4	131,307	1829	3.0	134,515
1344	3.4	131,307	1839	3.1	133,671
1354	3.4	131,307	1849	3.0	134,515
1359	3.3	132,069	1904	3.1	133,671
1404	3.3	132,069	1909	3.2	132,856
1409	3.3	132,069	1916.5	3.3	132,069
1411.5	3.2	132,856	1929	3.3	132,069
1419	3.1	133,671	1944	3.3	132,069
1421.5	3.2	132,856	1949	3.3	132,069
1429	3.1	133,671	1959	3.2	132,856
1436.5	3.2	132,856	2009	3.3	132,069
1439	3.3	132,069	2019	3.3	132,069
1449	3.1	133,671	2029	3.3	132,069
1459	3.2	132,856	2039	3.3	132,069
1506.5	3.1	133,671	2046.5	3.3	132,069
1514	3.1	133,671	2056.5	3.2	132,856
1519	3.1	133,671	2104	3.3	132,069
1539	3.1	133,671	2111.5	3.3	132,069
1541.5	3.0	134,515	2124	3.2	132,856
1549	3.1	133,671	2136.5	3.1	133,671
1559	3.2	132,856	2141.5	3.1	133,671
1606.5	3.3	132,069	2149	3.2	132,856
1611.5	3.4	131,307	2159	3.2	132,8562204
1624	3.4	131,307	2204	3.2	132,856
1649	3.4	131,307	2209	3.2	132,856
1709	3.4	131,307	2216.5	3.3	132,069
1714	3.3	132,069	2224	3.3	132,069
1719	3.2	132,856	2234	3.3	132,069
1721.5	3.1	133,671	2241.5	3.3	132,069
1729	3.0	134,515	2249	3.3	132,069
1731.5	2.9	135,390	2256.5	3.2	132,856
1744	2.9	135,390	2304	3.2	132,856
1759	2.9	135,390	2309	3.1	133,671
1809	2.9	135,390	2314	41.5	73,283

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1149-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0604.5	-	Launch	0604.5	-	Launch
0609.8	840	5,000	0625	495	18,600
0619.9	572	15,000	0635	273	32,400
0630.9	379	25,000	0645	218.5	37,200
0636.2	304	30,000	0655	159	44,100
0649.3	192	40,000	0705	111	51,900
0702.6	119	50,300	0715	78.5	59,400
0714.7	76.5	60,000	0725	57.3	66,300
0731.2	47.6	70,300	0735	41.1	73,500
0745.1	30.5	80,000	0745	29.5	80,700
0801.2	19.3	90,100	0755	21.6	87,600
0810.4	15.6	94,900	0805	16.55	93,600
0820.3	12.5	100,000	0815	12.05	100,800
0831.0	9.88	105,400	0825	8.95	107,700
0842.5	7.8	110,900	0835	6.27	116,100
0853.0	6.7	114,500	0845	4.45	124,500
0901.3	6.3	116,000	0855	3.84	129,600
0928.0	5.98	117,300	0905	2.94	135,000
1000	5.98	117,300	0920	2.81	136,200
1100	5.98	117,300	0935	2.84	135,900
1200	5.98	117,300	0950	2.87	135,600
1205	6.3	116,000	1005	2.94	135,000
1236	6.7	114,500	1020	2.98	134,700
1300	6.7	114,500	1050	2.98	134,700
1330	6.7	114,500	1105	3.01	134,400
1337	7.08	113,200	1120	2.94	135,000
1345	7.08	113,200	1135	2.94	135,000
1407	7.43	112,100			
1430	7.43	112,100			
1439	7.8	110,900			
1500	7.8	110,900			
1512	8.18	109,800			
1535	8.18	109,800			
1550	8.54	108,800			
1557	8.84	107,900			
1637	9.55	106,200			
1709	9.88	105,400			
1728	10.15	104,800			
1930	10.15	104,800			
1930	10.15	104,800			
2005	10.5	104,000			
2032	10.8	103,300			
2130	11.15	102,600			
2245	11.85	101,200			
2311	11.85	Terminate			

R-1866

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Flight 1149
 Upper Air Data for 1200Z, 10 June (RAWIN)
 and 1600Z, 10 June (ROCOB)

Standard Levels (RAWIN)

Pressure (MB)	T, °C	Wind Knots
1000	+ 8	170° 7
850	+ 1	140° 19
700	- 5	210° 3
500	-23	240° 27
400	-35	220° 50
300	-48	240° 50
250	-51	260° 43
200	-49	280° 31
150	-49	290° 29
100	-50	300° 20
70	-49	300° 16
50	-48	320° 6
30	-46	80° 10
20	-44	140° 7

Significant Levels (RAWIN)

661MB	- 8°C
551	-18
534	-21
487	-24
449	-30
436	-30
369	-40
329	-46
257	-52
40	-48
13	-42
10	-37

Wind Data (RAWIN)

Thousands

of Feet	Direction	Knots
1	180°	11
2	170°	11
5	140°	18
10	210°	12
14	250°	17
20	240°	40
23	220°	51
25	210°	45
30	240°	50
35	260°	40
40	280°	30
45	290°	28
50	300°	23
60	300°	15
70	330°	7
80	90°	6
90	90°	7
100	60°	14
103	60°	28

ROCOB Data

24KM	-47	10° 3
25	-45	60° 11
26	-41	90° 14
28	-39	100° 22
30	-36	100° 14
32	-30	90° 16
34	-27	80° 22
35	-25	80° 26
36	-19	100° 28
38	-15	90° 31
40	-10	90° 35
42	- 1	100° 37
44	+ 3	100° 37
45	+ 3	100° 36
46	+ 4	90° 41

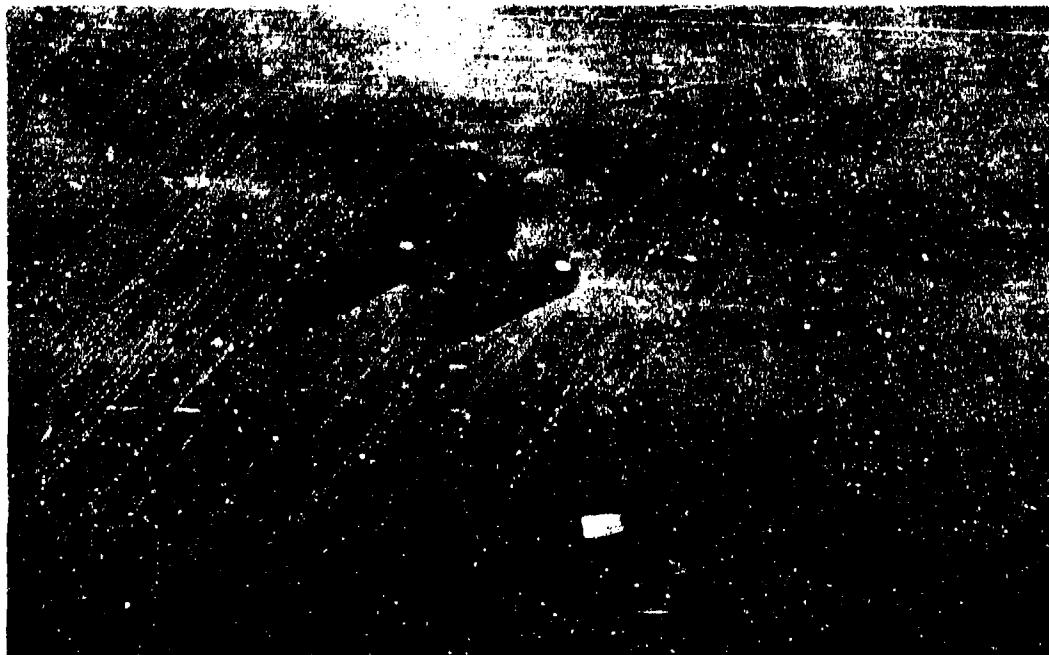
1150 - FLIGHT DESCRIPTION

Flight 1150 for the University of Chicago was launched under the direction of G. Mancuso and R. Keuser at 0351Z on 15 June 1966. This was the first of three flights in as many hours. As in Flight 1148, Raven provided the capability of remote and back-up turn on of Chicago's gondola power and, again, it was not used.

Following a smooth launch and equally faultless flight, the balloon was allowed to float to main timer termination. This occurred nine minutes short of the programmed 22 hours. Timer back-up was provided by using a Brailsford termination timer.

The University of Chicago's "sphere" was used for the second time and consisted of the same experiment; being designed to measure the ratio of positrons to electrons in the energy interval between 100 Mev and 4 Bev was obtained. Principal investigators for this flight were Dr. Peter Meyer and Mr. John Fanselow.

Radio position fixing was improving but inexperience and perhaps lack of confidence at this stage of the program contributed to taking only four fixes, two of which were still quite inaccurate. Lynn Lake acquired the signal when the balloon was at 65,000 feet (0518Z).



Raven helicopter lowering University of Chicago sphere into stake truck after recovery near Peace River, Alberta.

R-1866



1150 - Flight Description (cont.)

Ballasting performance was satisfactory, operating 14 times out of 14 attempts. No failures were recorded for any Raven-provided equipment. Transmitter frequency and command channels are as follows:

Transmitter Frequency:	251.5 MHz	
Command Channels:	Cutdown	7
	Ballast	8
	Gondola Turn-on	9
	Private Line	1

R-1866

RAVEN[®]
industries, inc.

LAUNCH LOG, SKYHOOK FLIGHT 1150

University of Chicago (Meyer-Fanselow) sphere
Balloon: 10.6×10^6 cubic foot Stratofilm
all times in CDT 14 June 1966

2000 Full crew at hanger area, NOTAM activated for 2300 launch.
2020 Sphere ready to tie on launch truck.
2107 Advance crew left hanger.
2120 Winds indicated on launch site mast 360° , 2 knots. Advance crew arrived at launch site.
2111-2128 Launch truck moved from hanger to launch site.
2140-2147 Balloon laid out along taxi-way, 360° , per pibal.
2150 Winds at 360° , 2 knots.
2158 Inflation started; using two tubes, one trailer.
2215 Winds 310° , 1 knot.
2223-2228 Sunset below a deck of low clouds. Sun on balloon.
2245 Winds 315° , cups barely turning.
2250 Winds 280° , cups barely turning.
2251 Launch. Truck moved ahead 30 feet. Surface wind calm, upper wind in line.
2253 Radar acquired. balloon gondola.
2300 DOT weather: broken clouds 1500 feet, Temperature 41.5° , SLP 1014.0 Mb.
Wind WSW, 2 mph.
AURORA noted 0100 to 0200, June 15

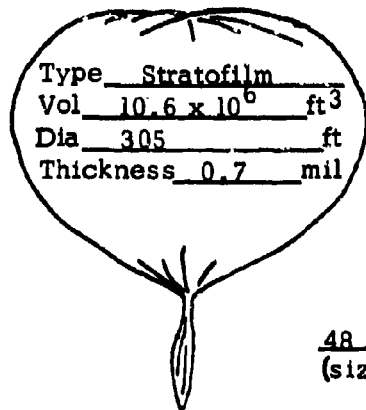
Range Test Number 826 SB165-A IL.
Tropopause at 0000Z, 15 June: -55°C , at 276 Mb (32,144 ft.).

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

RAVEN
 industries, inc.

1. Company Raven Flight Number 1150-N Director Mancuso, Keuser
2. Scientist Meyer Group Univ of Chicago Date/Time 6/15 / 0351 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 150 41.5°F, 3MPH, 1014.0 MB Cross Wind Angle None
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 42,200 ft Temp -59 °C Inflation Start 0228 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 480 ft.
5. Balloon Theoretical 2.94 Mbs. 135,000 ft. How Determined?
 Ceiling: Actual 3.23 Mbs. 132,600 ft. Radar-0854Z
6. Ascent: Surface to Trop. 770 fpm Trop. to Ceiling 358 fpm.
7. Flight Duration: Total 21 hrs 50 min. At Ceiling 17 hrs. 36 min.
8. Termination: Time 0141 Z Altitude 132,600 ft. Cause Timer
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 6/16 / 0220 Z Location 57° 00' N 116° 36' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time

<u>251.5</u>	<u>Altitude Telemetry</u>	<u>22.5 hrs.</u>
<u>149.4</u>	<u>Communication & Cmd</u>	<u>22.0 hrs.</u>
12. Balloon: Code Number SF-305.86-070-NSC-02 Serial Number 47



48 Ft. chute
 (size)

WEIGHTS

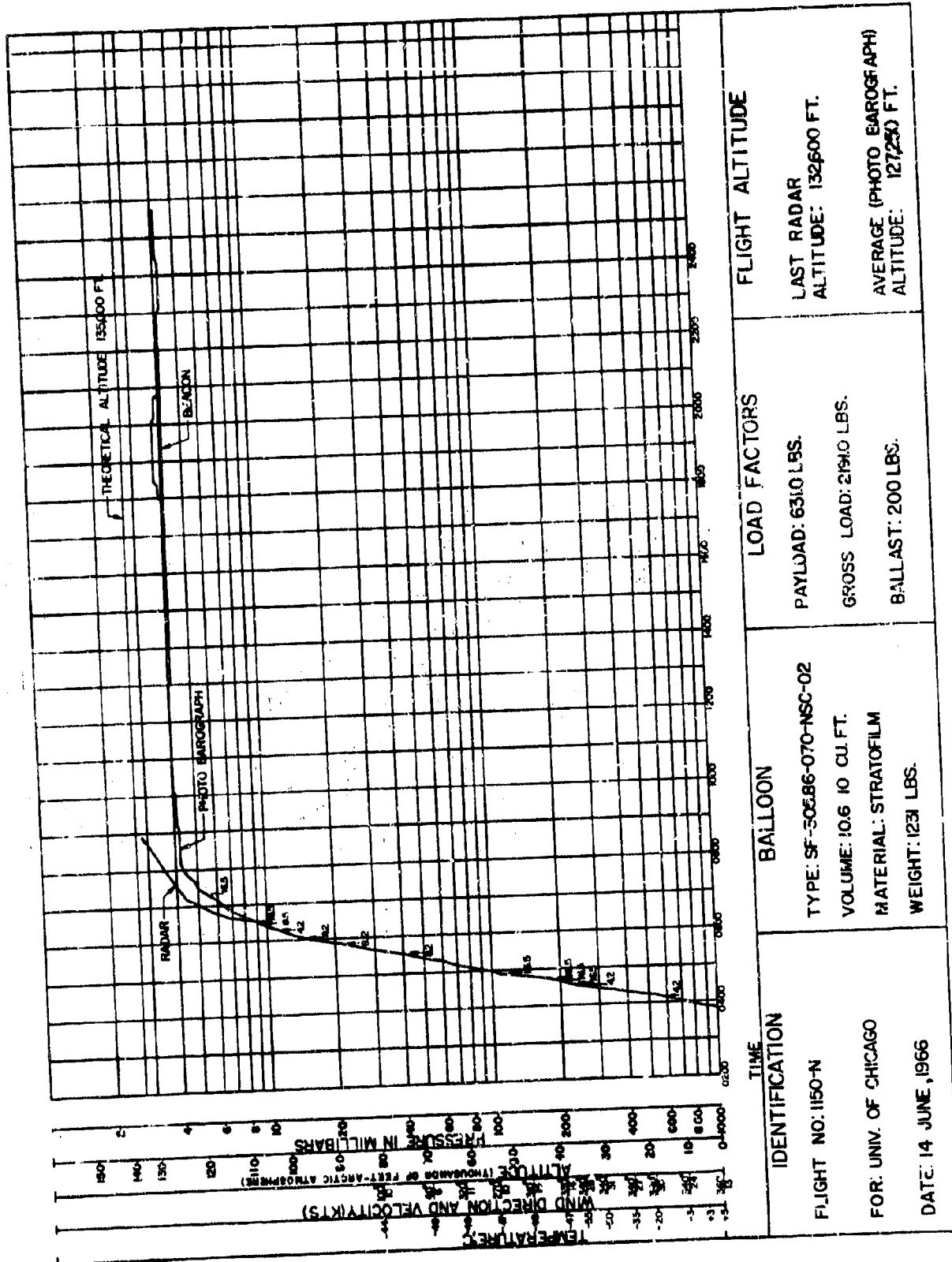
Balloon.....	1231.0
Parachute.....	49.0
Instrumentation.....	50.0
Ballast.....	200.0
Scientific Package.....	632.0
Other Photobarograph.....	8.0
Other Misc.....	22.0
Gross Weight.....	2191.0
Free Lift.....	219.0
Gross Inflation.....	2410.0
Helium used (cu. ft.).....	38560

13. Flight Failures None
 (Nature of flight failures - if any)
14. Comments None
 (Significant factors concerning the operation)

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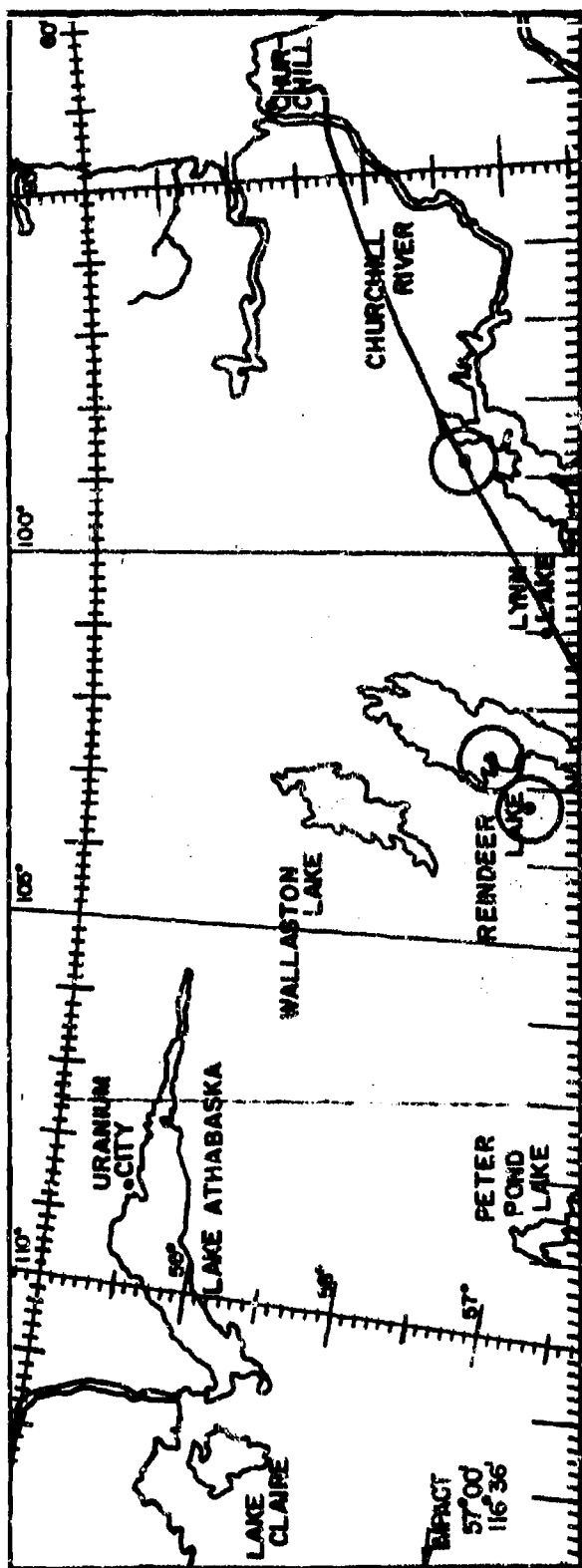
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TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0351	Fort Churchill		Launch	1200 ¹	57°-25'	98°-48'
0410	58°-37'	93°-58'	Radar	1349 ¹	57°-13'	102°-38'
0426	58°-28'	93°-58'	Radar	1430 ¹	57°-02'	103°-19'
0434	58°-24'	93°-59'	Radar	1600 ¹	56°-28'	105°-29'
0454	58°-20'	93°-55'	Radar			
0520	58°-17'	93°-51'	Radar			
0600	58°-15'	94°-03'	Radar			
0630	58°-13'	94°-27'	Radar			
0700	58°-10'	94°-53'	Radar			
0854	57°-49'	96°-52'	Radar			
1610	56°-17'	106°-30'	C-47			
1915	56°-08'	111°-25'	C-47			
0138	57°-06'	116°-38'	C-47			
0141	Termination					
0219	57°-00'	116°-36'	Impact			

(1) 2 Station Fix
(2) 3 Station Fix

R-1866

RAVEN
industries, inc.

Flight 1150 Ballasting Information.

Table I below presents Radio Controlled ballast data for Flight 1150 launched on 15 June 1966. Initial ballast on board at the time of launch was 200 pounds. Between 0345Z and 0141Z (termination), 51 pounds of ballast was automatically dropped at the rate of 2.4 pounds per hour. No problems were encountered with the ballasting system during this flight

Table I
Ballast Data-Flight 1150

Time	Amount Dropped By Radio Command	Amount Re maining (pounds)
0410	4.2	195.8
0435	4.2	191.6
0437	4.2	187.4
0438	16.5	170.9
0441	16.5	154.4
0445	16.5	137.9
0457	16.5	121.4
0534	8.2	113.2
0553	8.2	105.0
0604	8.2	96.8
0619	4.2	92.6
0630	8.5	84.1
0634	16.5	67.6
0720	16.5	51.1

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

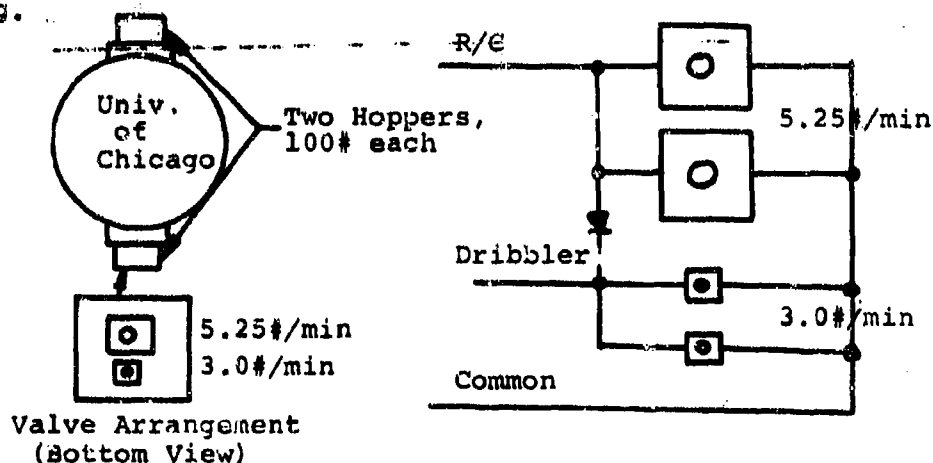


Figure 1

R-1866

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PHOTOBAROGRAPH DATA
Flight 1150-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0521	-	-	0701	6.35	115,833
0523.5	54.9	67,180	0703.5	6.3	116,023
0526	50.0	69,233	0706	6.25	116,215
0528.5	46.6	70,763	0708.5	6.2	116,409
0531	42.4	72,817	0711	6.2	116,409
0533.5	39.4	74,413	0713.5	6.05	117,001
0536	36.1	76,315	0716	6.05	117,031
0538.5	33.9	77,687	0718.5	5.8	118,023
0541	30.5	80,001	0721	5.6	118,876
0543.5	28.4	81,570	0723.5	5.5	119,315
0546	25.9	83,603	0726	5.4	119,763
0548.5	24.3	85,016	0728.5	5.3	120,220
0551	22.7	86,529	0731	5.2	120,697
0553.5	21.2	88,053	0733.5	5.1	121,163
0556	19.9	89,467	0736	5.1	121,163
0558.5	18.3	91,348	0738.5	5.0	121,750
0601	16.9	93,140	0741	4.9	122,147
0603.5	16.2	94,095	0743.5	4.7	123,177
0606	15.4	95,241	0746	4.7	123,177
0608.5	14.4	96,765	0748.5	4.6	123,709
0611	13.4	98,403	0753.5	4.5	124,255
0613.5	12.7	99,628	0758.5	4.4	124,813
0616	12.2	100,547	0803.5	4.3	125,386
0618.5	11.7	101,507	0811	4.3	125,386
0621	11.5	101,903	0818.9	4.2	125,974
0623.5	10.8	103,347	0821.6	4.3	125,386
0626	10.5	103,996	0824.3	4.2	125,974
0628.5	10.0	105,123	0827	4.3	125,386
0631	9.6	106,068	0833	4.3	125,386
0633.5	9.1	107,311	0839	4.3	125,386
0636	8.8	108,093	0842	4.2	125,974
0638.5	8.3	109,464	0848	4.3	125,386
0641	7.9	110,627	0900	4.3	125,386
0643.5	7.5	111,856	0903	4.2	125,974
0646	7.3	112,498	0909	4.1	126,577
0648.5	7.2	112,826	0930	4.1	126,577
0651	7.0	113,497	0942	4.1	126,577
0653.5	6.9	113,841	0954	4.1	126,577
0656	6.7	114,544	1000	4.1	126,577
0658.5	6.5	115,271	1009	4.0	127,196

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Photobarograph Data

1150 N

Page 2

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1024	4.0	127,196	1817	3.9	127,832
1036	4.0	127,196	1825	3.9	127,832
1045	4.0	127,196	1829.5	3.8	128,487
1057	4.0	127,196	1847.5	3.8	128,487
1109	4.0	127,196	1852	3.7	129,160
1121	4.0	127,196	1905.5	3.7	129,160
1130	4.0	127,196	1910	3.8	128,487
1142	4.0	127,196	1946	3.8	128,487
1200	4.0	127,196	2004	3.8	128,487
1215	4.0	127,196	2008.5	3.9	127,832
1230	4.0	127,196	2027	3.9	127,832
1245	4.0	127,196	2041	3.9	127,832
1300	4.0	127,196	2046	4.0	127,196
1303.5	4.1	126,577	2106	4.0	127,196
1328	4.1	126,577	2116	4.0	127,196
1403	4.0	127,196	2136	4.0	127,196
1410	4.1	126,577	2147	4.0	127,196
1431	4.1	126,577	2158	4.0	127,196
1438	4.0	127,196	2203.5	4.1	126,77
1448.5	4.1	126,577	2220	4.1	126,577
1506	4.1	126,577	2242	4.1	126,577
1520	4.1	126,577	2303	4.1	126,577
1534	4.1	126,577	2308	4.2	125,974
1544.5	4.2	125,974	2318	4.2	125,974233
1548	4.0	127,196	2332	4.2	125,974
1558.5	4.1	126,577	2345	4.2	125,974
1616	4.1	126,577	2353	4.2	125,974
1630	4.1	126,577	0001	4.2	125,974
1644	4.1	126,577	0015	4.2	125,974
1712	4.1	126,577	0025	4.2	125,974
1726	4.1	126,577	0030	4.1	126,577
1729.5	4.0	127,196	0045	4.1	126,577
1745	4.0	127,196	0100	4.1	126,577
1757	4.0	127,196	0121.4	4.1	126,577
1801	3.9	127,832	0140.5	4.1	126,577

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PRESSURE AND ALTITUDE DATA
Flight 1150-N

Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0351.0	1014	Launch	0351	1014	Launch
0403.6	696	10,000	0356	866	4,200
0416.8	468	20,000	0402	690	10,200
0422.6	379	25,000	0412	546	16,200
0427.6	304	30,000	0424	359	26,250
0433.5	242	35,000	0430	284	31,500
0443.7	194	39,800	0436	237	35,400
0451.3	151.5	45,100	0444	188	40,500
0458.9	120.5	50,100	0456	117	50,700
0511.7	76	60,100	0510	74.5	60,600
0518.5	60.7	65,000	0530	44	72,000
0526.0	48.2	70,000	0550	22.8	86,400
0534.4	38.3	75,000	0610	13.05	99,000
0547.7	24.1	85,200	0630	8.85	108,000
0556.4	19.4	90,000	0640	6.95	113,700
0615.0	12.55	99,900	0700	5.4	119,200
0626.6	10.18	104,600	0710	4.97	121,800
0642.6	8.1	110,100	0854	3.23	132,600
0653.5	6.9	113,800			
0707.5	6.2	116,400			
0717.5	6.0	117,300			
0726.5	5.45	119,500			
0739.0	5.05	121,500			
0749.2	4.79	122,700			
0812.5	4.45	124,500			
1000	4.45	124,500			
1100	4.45	124,500			
1200	4.45	124,500			
1400	4.45	124,500			
1500	4.45	124,500			
1600	4.45	124,500			
1700	4.45	124,500			
1800	4.45	124,500			
1900	4.45	124,500			
2000	4.45	124,500			
2100	4.45	124,500			
2200	4.45	124,500			
2300	4.45	124,500			
0000	4.45	124,500			
0100	4.45	124,500			
0141		Terminate			
0149	59.5	65,400			
0200	271	32,500			

R-1866

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Flight 1150 and 1152
Upper Air Data for 0000Z, June 15

Standard Levels

Pressure (MB)	T, °C	Wind Knots
1000	+ 5	360° 13
850	+ 3	340° 23
700	- 3	340° 24
500	-20	340° 30
400	-33	340° 27
300	-50	340° 31
250	-55	340° 28
200	-47	330° 14
150	-48	310° 14
100	-47	270° 10
70	-48	320° 11
50	-48	40° 6
30	-44	100° 10

Significant Levels

1010	+ 5
990	+ 6
896	+ 1
891	+ 4
870	+ 4
806	+ 1
758	0
677	- 5
584	-14
524	-18
276	-55
255	-56
198	-48
40	-47
27	-43

Wind Data
Thousands

of Feet	Direction	Knots
1	350°	22
5	340°	24
10	340°	24
14	330°	26
20	350°	34
25	330°	29
30	340°	30
35	340°	24
40	330°	16
45	310°	14
50	290°	10
60	220°	12
70	60°	6
80	110°	9

1151 - FLIGHT DESCRIPTION

Flight 1151 for the University of Chicago was launched at 0704z on 15 June under the direction of G. Mancuso and T. Pappas. After 16.4 hours, the flight was successfully terminated by radio command from the Cessna 185. This flight was the third launched in three hours, following Flights 1150 and 1152. Layout, launch, and flight were all smooth with no major problems.

Principal investigators from the University of Chicago were Dr. Peter Meyer and Mr. J. L'Heureux. Their experiment was designed to study the flux and energy spectrum of primary cosmic ray electrons in the range of 10 Mev to 5 Bev. Plastic scintillation and Cerenkov counters were again used. Data was both automatically recorded and transmitted to the ground. In addition to the main package, a small, cosmic ray emulsion stack was flown mounted on the side of the gondola. Raven provided radio command with timer back-up to flip the emulsion stack 90 Deg after reaching float altitude. This was successfully accomplished at 1013Z by radio command.

As the time-altitude curves indicate, barocoder performance was improving. The instrumentation container water trap vent had been enlarged from 1/32 in to 3/16 in. Level float was indicated but basic, barocoder deficiencies still caused erroneous data. A photobarograph was also flown on this flight;



Parachute descending with University of Chicago sphere.

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1151 - Flight Description (cont.)

some defect, however, in the lens of the device caused unreadable film frames so no data was available.

Instrumentation consisted of Raven's basic command/ telemetry/ ballast equipment with the addition of sensors to monitor supply voltages and various temperatures inside the instrumentation container. Performance was degraded by a faulty RF feed-through connector which caused the telemetry signal to weaken at 1150Z, become lost, and then reappear at 1336Z. Performance was normal before and after this event. Radio command ballasting was used nine times with no malfunctions. Termination backup was again provided by a Brailsford motor.

Transmitter frequencies and command channels were as follows:

Transmitter Frequency:	253.1 MHz
Command Channels:	Cutdown 1
	Ballast 2
	Emulsion Flip 12
	Private Line 1

R-1866

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LAUNCH LOG, SKYHOOK FLIGHT 1151

University of Chicago (Meyer-L'Heureux) cylinder
Balloon: 6×10^6 cubic foot Stratofilm
all times in CDT 15 June 1966

This flight followed flights 1150 and 1152. The same launch truck was used for all three. It was necessary to return to the hanger for this gondola after the launch of flight 1152, at 0003.

0030 Winds indicated on launch site mast, 220° , 2 knots.
0105 Gondola and launch truck reached launch area.
0105 Winds 225° , 4 knots.
0115-0120 Balloon laid out along 290° line, in accordance with pibal.
0125 Winds 220° , 6 knots.
0130 DOT winds 240° , 7 mph.
0135 Inflation started, using two tubes, one helium trailer.
0151 Inflation completed, instrumentation still being attached.
0204 Launch, 60° cross-wind at surface, aligned as bubble rose; short truck run, and smooth launch.
0210 Winds, 240° , 6 knots. AURORA south.
0200 DOT weather: scattered clouds at 1800 feet. Temperature 41° , SLP 1012.3 Mb. Winds: WSW 10 mph.

Range Test Number: 81.6 SB165-A IL.
Tropopause at 1200E, 15 June: -60°C at 239 Mb (35,263 ft.).

R-1866

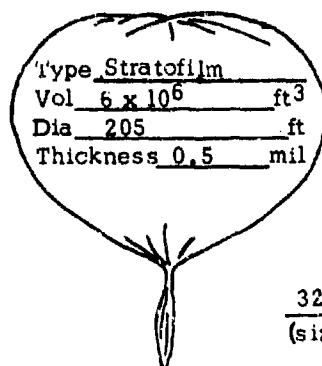
SKYHOOK BALLOON FLIGHT INFORMATION

NAVEXOS 3900/2 (Rev. 8-66)

RAVEN

Industries, Inc.

1. Company Raven Flight Number 1151-N Director Mancuso, Pappas
2. Scientist Meyer Group Univ. of Chicago Date/Time 6/15 / 0704 Z
3. Launch: Site Pt. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: Clear 41°F 15 MPH 1012.8 MB Cross Wind Angle None
(Sky-Temp-Wind-Pressure)
Trop(Coldest)Ht 42,200 ft Temp -59 °C Inflation Start 0635 Z
Hrs Sunshine on Bubble None Train Length(Layout) 380 ft.
5. Balloon Theoretical 2.94 Mbs 135,000 ft. How Determined?
Ceiling: Actual 2.94 Mbs 135,000 ft. Radar
6. Ascent: Surface to Trop. 839 fpm Trop. to Ceiling 714 fpm.
7. Flight Duration: Total 16 hrs 26 min. At Ceiling 13 hrs. 25 min.
8. Termination: Time 0030 Z Altitude 130,000 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 6/16/ 0108 Z Location 58° 23'N 110° 18' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
253.1 Altitude Telemetry 17.0 hrs.
149.4 Communication & Cmd 17.0 hrs.
12. Balloon: Code Number SF-250.2-050-NSC-02 (Serial Number 3)



WEIGHTS

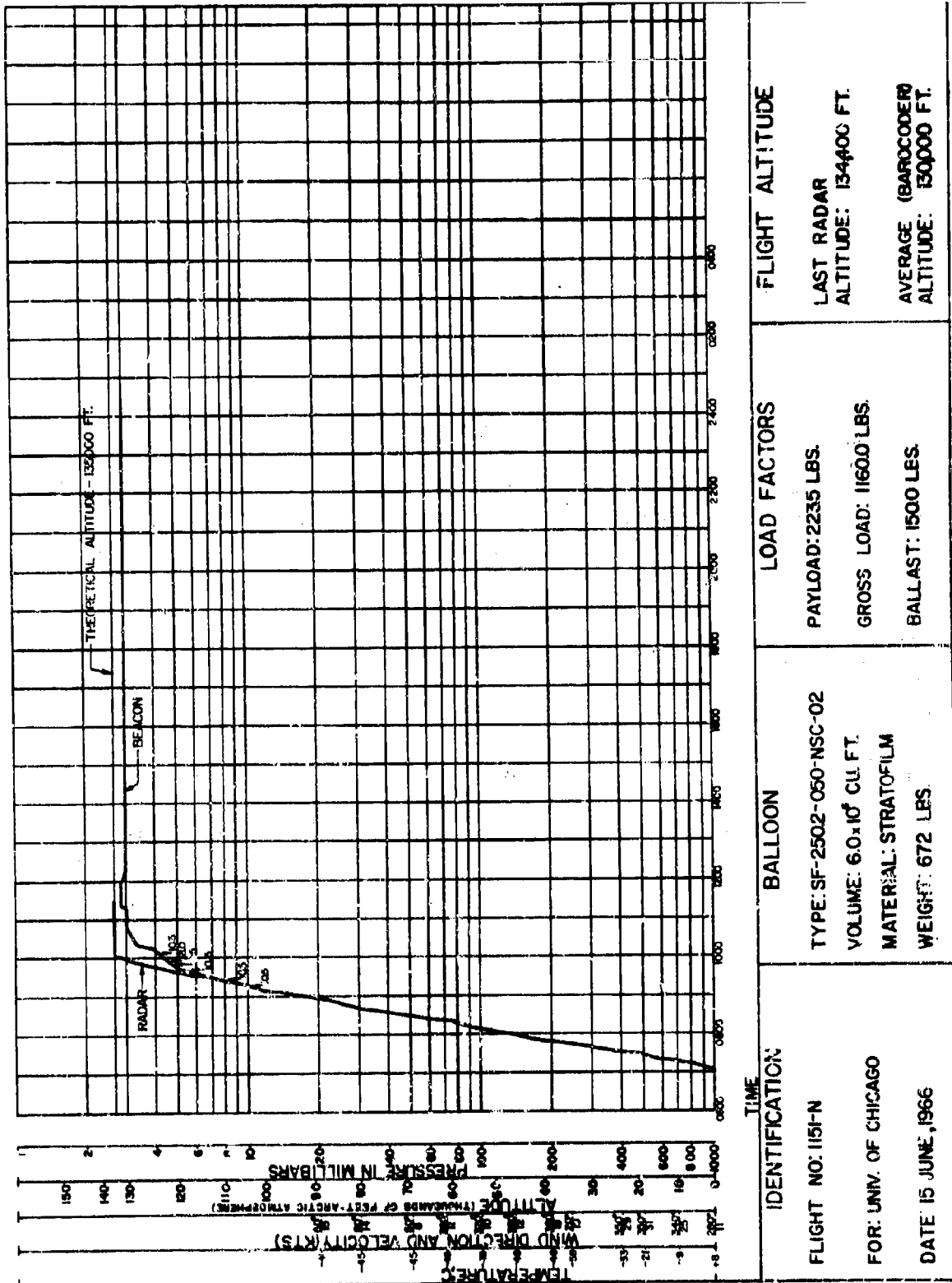
Balloon.....	672.0
Parachute.....	29.0
Instrumentation.....	50.0
Ballast.....	150.0
Scientific Package.....	223.5
Other Kansas Emulsions.....	9.0
Other Frame and photobarq....	26.5
Gross Weight.....	1160.0
Free Lift.....	116.0
Gross Inflation.....	1276.0
Helium used (cu. ft.).....	20416

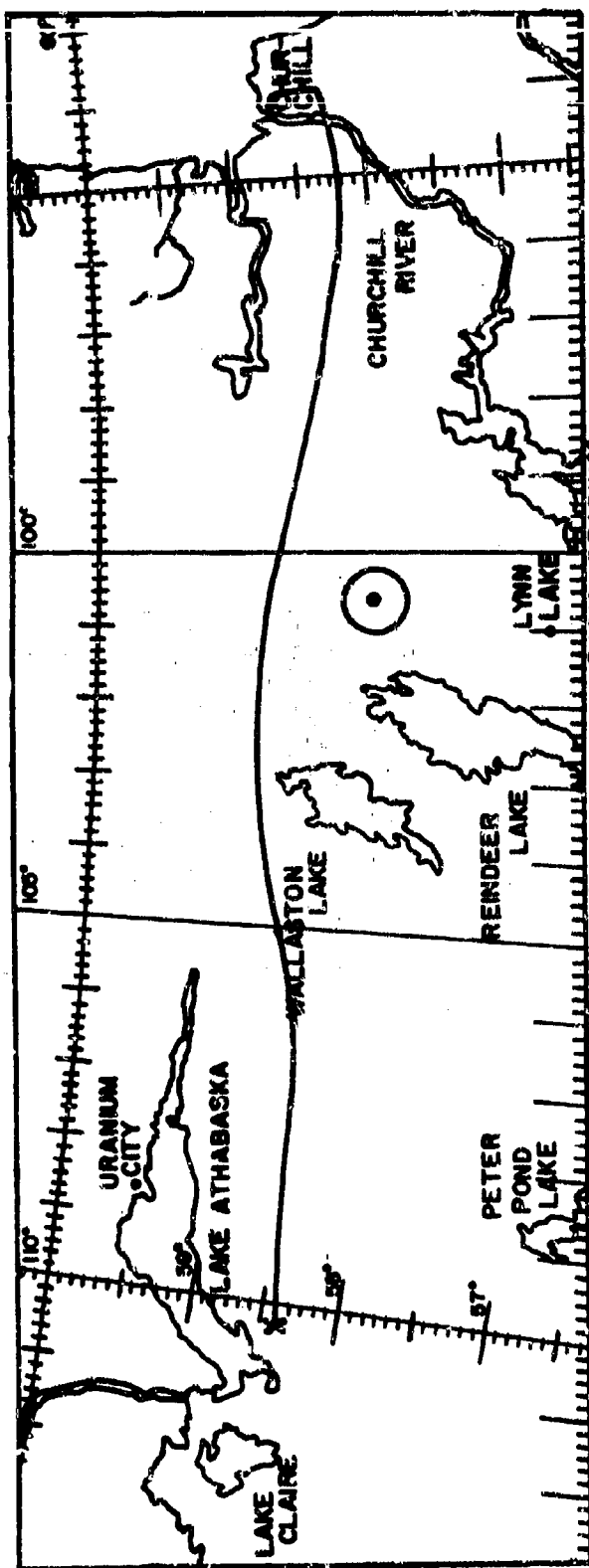
13. Flight Failures Bad lens prevented photobarograph readout
(Nature of flight failures - if any)
14. Comments Telemetry lost from 1150Z to 1336Z due to faulty RF connector
(Significant factors concerning the operation)

Copy to:
ONR/Fld Rep/Minn
ONR/Code 421

RAVEN

industries, inc.





POSITION FIXES		RADIO BEARINGS	
TIME(Z)	LATITUDE LONG.	TIME(Z)	LATITUDE LONGITUDE
0704.5	Fort Churchill	Launch	
0718	58°-39' 93°-58'	Radar	Lost signals from 1159Z to 1335Z, 1344Z 58°-04' 100°-39'
0740	58°-27' 93°-53'	Radar	
0800	58°-21' 93°-57'	Radar	
0840	58°-18' 93°-55'	Radar	
0910	58°-16' 94°-08'	Radar	
0940	58°-13' 94°-31'	Radar	
1000	58°-12' 94°-56'	Radar	
1030	58°-12' 95°-34'	Radar	
1109	58°-15' 96°-11'	Radar	
1209	58°-23' 97°-30'	Radar	
1425	58°-47' 100°-30'	C-47	(1) 2 Station Fix
1926	58°-29' 105°-03'	185	(2) 3 Station Fix
2248	58°-29' 108°-03'	185	
0108	58°-23' 110°-13'	Impact	

Flight 1151 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1151 launched on 15 June 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0700Z and 0030Z (termination), 48 pounds of ballast was automatically dropped at the rate of 2.8 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I
Ballast Data-Flight 1151

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
0921	10.5	139.5
0934	10.5	129.0
0944	10.5	118.5
0952	10.5	108.0
0957	21.0	87.0
1009	10.5	76.5

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

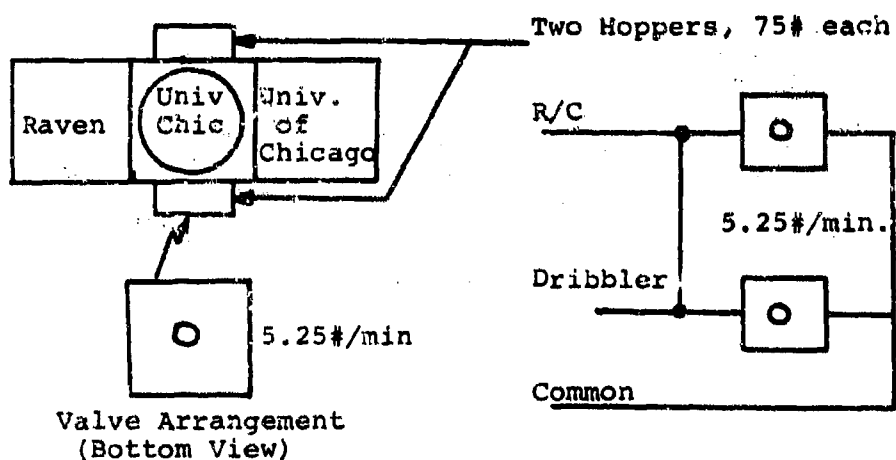


Figure 1

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1151-N

RAVEN
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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0704.5	-	Launch	0704.5	-	Launch
0710.7	838	5,100	0712	801	6,300
0721.8	573	15,000	0718	652	11,700
0732.7	377	25,100	0722	573	15,000
0738.0	298	30,400	0728	460	20,400
0743.3	234	35,700	0734	371	25,500
0750.4	190	40,200	0740	284	31,500
0757.5	151.5	45,100	0748	234	35,700
0804.9	117.8	50,600	0755	173	42,300
0810.6	96.4	55,000	0805	110	50,100
0818.3	74.4	60,500	0815	87.5	57,000
0823.9	60.5	65,100	0825	63	64,200
0831.8	47.6	70,300	0835	46.5	70,800
0839.3	36.6	76,000	0845	32.5	78,600
0845.5	29.4	80,800	0855	22.2	87,000
0852.0	23.5	85,700	0905	15.9	94,500
0857.4	19.4	90,000	0915	10.85	103,200
0905.2	15.0	95,800	0925	7.98	110,400
0910.0	12.3	100,400	0935	5.98	117,300
0925.7	7.76	111,000	0940	5.09	121,200
0934.5	6.3	116,000	0945	4.51	124,200
0943.7	5.35	120,000	0948	4.09	126,600
0959.0	4.9	122,100	0950	3.95	127,500
1010.5	4.53	124,100	1000	3.23	132,600
1013.1	4.28	125,500	1035	2.94	135,000
1023.5	3.89	127,900	1015	2.91	135,300
1050	3.57	130,000	1030	2.84	135,900
1100	3.57	130,000	1050	2.91	135,300
1200	3.57	130,000	1110	2.94	135,000
1300	3.57	130,000	1130	3.01	134,400
1330	3.57	130,000			
1400	3.57	130,000			
1423	3.28	122,200			
1517	3.57	130,000			
1600	3.57	130,000			
1700	3.57	130,000			
1800	3.57	130,000			
1900	3.57	130,000			
2000	3.57	130,000			
2200	3.57	130,000			
2300	3.57	130,000			
0000	3.57	130,000			
0030	3.57	130,000			

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Flight 1151
Upper Air Data for 1200Z, June

Standard Levels

Pressure (MB)	T, °C	Wind Knots
1000	+ 8	280° 11
850	+ 6	340° 20
700	- 9	340° 25
500	-21	350° 31
400	-33	350° 29
300	-58	360° 26
250	-58	20° 19
200	-48	360° 18
150	-48	350° 12
100	-48	320° 10
70	-48	350° 11
50	-45	50° 8
30	-45	80° 14
20	-41	60° 15

Significant Levels

1008	+ 7
987	+ 9
930	+ 7
914	+ 8
895	+ 7
887	+ 8
826	+ 5
780	+ 2
682	- 5
636	- 7
496	-21
359	-40
288	-52
239	-60
227	-53
209	-49
123	-50
40	-46
31	-47
27	-43
19	-41

Wind Data

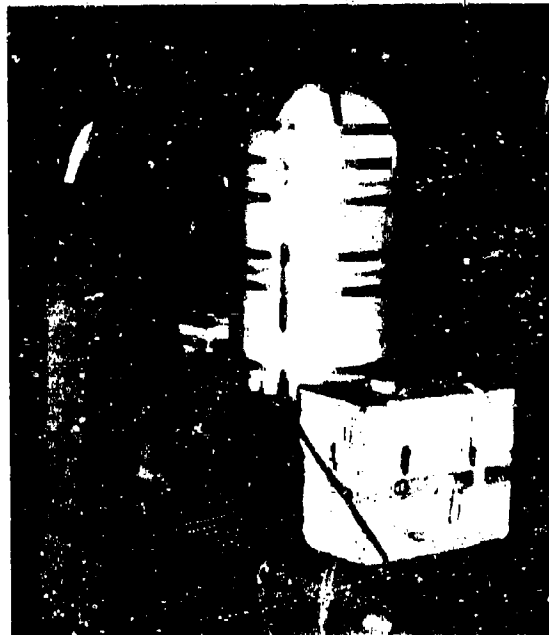
Thousands of Feet	Direction	Knots
2	280°	11
8	350°	12
10	340°	25
16	350°	27
20	360°	30
25	350°	28
30	360°	26
35	100°	20
40	350°	17
45	350°	11
50	320°	5
60	330°	11
70	60°	10
80	80°	14
89	60°	15

1152 - FLIGHT DESCRIPTION

Flight 1152 for California Institute of Technology was launched at 0504Z on 15 June 1966, the second of three flights in a three-hour period. The flight was terminated 17.4 hours later by radio command. Layout, launch, and flight of the balloon was accomplished with no problems. Cross-wind at the time of launch was 140 degrees with a velocity of approximately 2 knots. The use of the M-36 vehicle was again proven with this cross-wind. By backing up the truck, a smooth launch was performed.

Principal investigator for California Institute of Technology was Dr. R. Vogt. His gondola contained equipment necessary to measure the flux and energy spectrum of protons, electrons, alpha particles, and heavy nuclear particles up to and including oxygen, in the range of 1 Mev to 1 Bev per nucleon. Detection was accomplished with a dE/dx Cerenkov telescope and a dE/dx range telescope using solid state detectors. A magnetic tape recorder was carried on board. The equipment was a prototype for similar detectors to be carried on a OGO-F satellite.

Evidence of a small instrumentation vent hole is again shown in the time-altitude curve for this flight. Raven's photo-barograph didn't perform much better although it did indicate level flight. Dr. Vogt's sensor was satisfactory; oscillating right around the theoretical float altitude.



Hanger rigging of California Institute
of Technology gondola.

R-1866

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1152 - Flight Description (cont)

A special Hayden timer mounted on top of the parachute with batteries located at the base of the balloon provided backup termination although it wasn't used. Termination was performed by radio command at 2225Z.

A few hours after launch, the barocoder audio oscillator nearly became inoperative from 0725Z to 1000Z. The cause was found, in post-flight analysis, to be due to the low temperature encountered on this flight. Modifications were immediately made to the oscillator circuit to insure better low temperature operation.

Tracking was getting better and better although accuracy was still occasionally questionable. Three position fixes were taken with the remainder of tracking being performed by radar and aircraft. Uranium City acquired the beacon at 0935Z when the balloon was 104 miles out of Fort Churchill.

Radio command ballasting was satisfactory. Eleven commands were issued, and eleven commands were performed. Transmitter frequency and command channels used on this flight were as follows:

Transmitter Frequency:	225.1 MHz	
Command Channels:	Cutdown	9
	Ballast	10
	Private Line	2

R-1866

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LAUNCH LOG, SKYHOOK FLIGHT 1152

Cal. Tech. (Vogt)

Balloon : 10.6×10^6 cubic foot Stratofilm
all times in CDT 14-15 June 1966

2247 Gondola reached launch area, Flight 1150 nearly ready to go. (Both used same launch truck.)
2251 Flight 1150 off.
2257 Rigging commenced on launch truck.
2315 Balloon laid out along taxi-way, 360° , per pibal.
2330 Balloon attached to gondola.
2332 Winds on launch site mast, 225° ; cups turning slowly, pibal from 360° .
2336 Inflation began; two tubes, one trailer.
2355 Indicated winds 230° , 3 knots.
2356 Inflation completed.
0003 Launch. 140° cross-wind, 2 knots at surface. Upper winds light, 270° .
Truck backed up 130 feet, smooth launch.
0000 DOT weather: broken clouds at 1500 feet, temperature 42°F , SLP 1013.4 Mb.
Winds WSW 5.

AURORA noted 0100 to 0200, June 15

Range Test Number: 78.6 SB165-A 7L

Tropopause at 0000Z, 15 June: -55°C , at 276 Mb (32,144 ft.).

R-1866

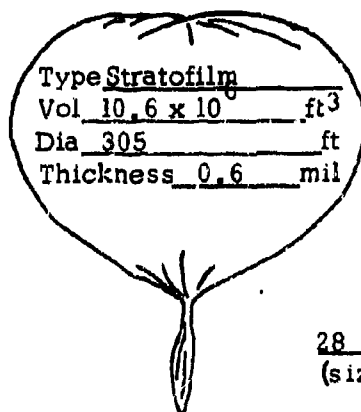
SKYHOOK BALLOON FLIGHT INFORMATION

NAVEXOS 3900/2 (Rev. 8-66)

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1. Company Raven Flight Number 1152-N Director Keuse, Pappas
2. Scientist Vogt Group Cal Tech Date/Time 6/15 / 0504 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 15 ϕ , 42 $^{\circ}$ F, 7 MPH 1013.4 MB Cross Wind Angle 140 $^{\circ}$
(Sky-Temp-Wind-Pressure)
Trop (Coldest) Ht. 42,200 ft Temp -59 $^{\circ}$ C Inflation Start 0436 Z
Hrs Sunshine on Bubble None Train Length (Layout) 480 ft.
5. Balloon Theoretical 1.97 Mbs 145,500 ft. How Determined?
Ceiling: Actual 1.80 Mbs 148,000 ft. Cal Tech-Photobarograph.
6. Ascent: Surface to Trop 778 fpm Trop. to Ceiling 450 fpm.
7. Flight Duration: Total 17 hrs 21 min. At Ceiling 13 hrs. 41 min.
8. Termination: Time 2225 Z Altitude 130,500 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 6/15/ 2305 Z Location 59 $^{\circ}$ 22' N 110 $^{\circ}$ 13' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
255.1 Altitude Telemetry 18.0 hrs.
149.4 Communications & Cmd. 18.0 hrs.
12. Balloon: Code Number SF-305.85-060-NSC-01 Serial Number 49



WEIGHTS

Balloon.....	1108.0
Parachute.....	29.0
Instrumentation.....	50.0
Ballast.....	150.0
Scientific Package.....	111.0
Other Photobarograph.....	8.0
Other Misc.....	21.0
Gross Weight.....	1477.0
Free Lift.....	148.0
Gross Inflation.....	1625.0
Helium used (cu. ft.).....	26,000

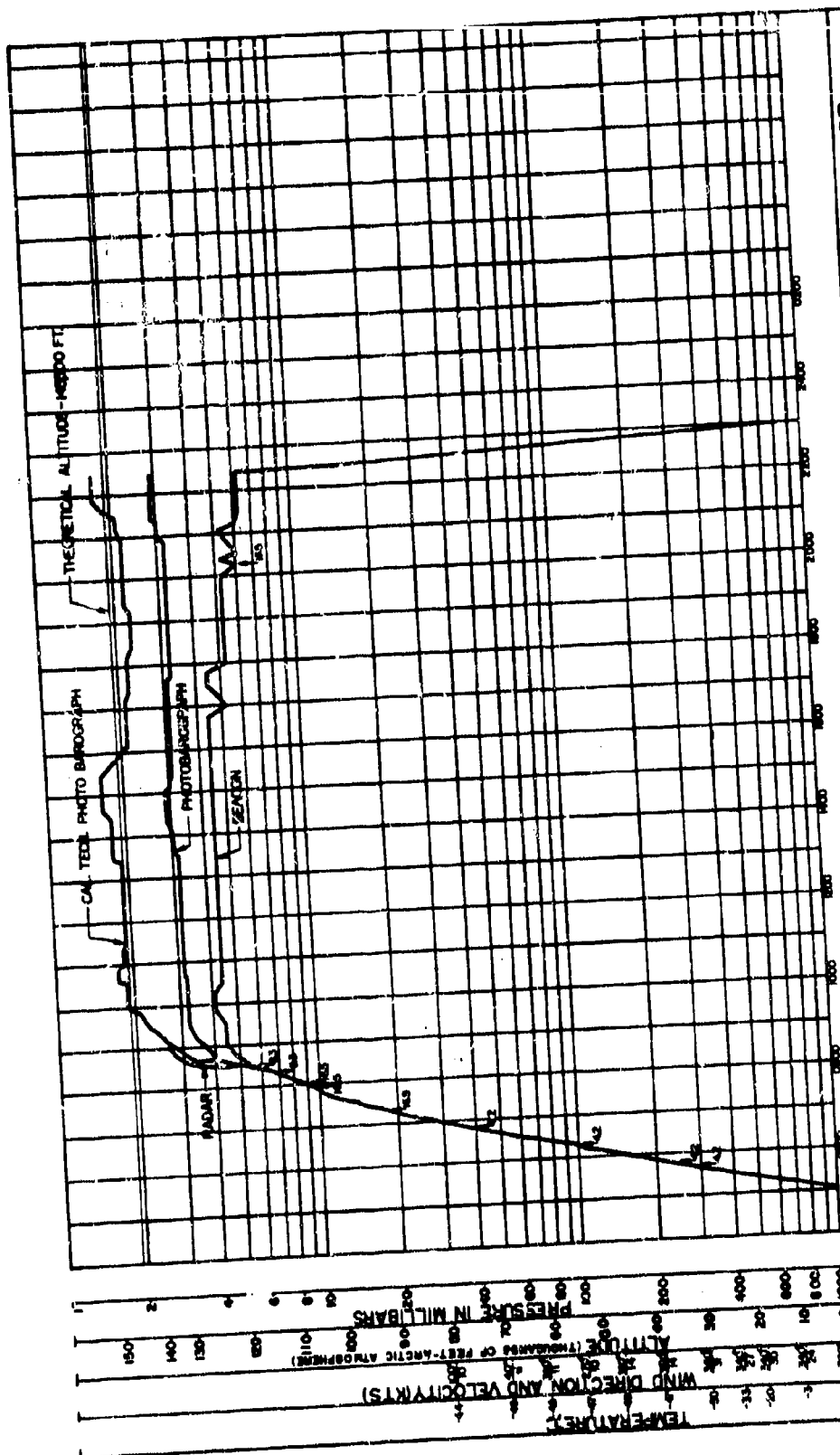
28 Ft. chute
(size)

13. Flight Failures None
(Nature of flight failures - if any)
14. Comments None
(Significant factors concerning the operation)

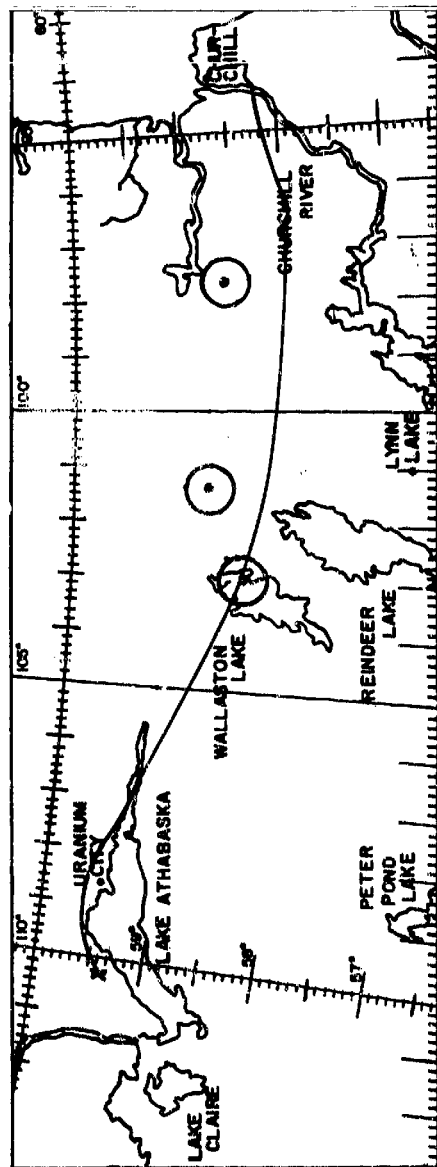
Copy to:
ONR/Fld Rep/Minn
ONR/Code 421

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IDENTIFICATION	BALLOON	LOAD FACTORS	FLIGHT ALTITUDE
TIME FLIGHT NO: 1152-N FOR: CAL. TECH. DATE: 15 JUNE, 1966	TYPE: SF-30586-060-NSC-01 VOLUME: 106x10⁶ CU. FT. MATERIAL: STRATOFILM WEIGHT: 1108.0 LBS.	PAYLOAD: 1110 LBS. GROSS LOAD: 1477.0 LBS. BALLAST: 1500 LBS.	LAST RADAR ALTITUDE: 14,000 FT. AVERAGE CAL TECH PHOTO ALTITUDE: BAROGRAPH 14,7000 FT



TIME(Z)	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0503.4	Fort Churchill	Launch	1215 ⁴	58°-34'	97°-40'
0520	58°-37', 93°-58'	Radar	1430 ¹	58°-43'	101°-24'
0600	58°-20', 93°-56'	Radar	1639 ⁴	58°-25'	102°-58'
0650	58°-16', 93°-52'	Radar			
0710	58°-16', 94°-09'	Radar			
0740	58°-12', 94°-15'	Radar			
0800	58°-12', 94°-30'	Radar			
0840	58°-10', 95°-04'	Radar			
0900	58°-04', 95°-28'	Radar			
0935	57°-57', 96°-19'	Radar			
1639	58°-25', 102°-58'	C-47	(1) 2 Station Fix		
1903	59°-15', 106°-24'	206	(2) 3 Station Fix		
2025	59°-33', 106°-00'	206			
2225.5	Termination				
2305	59°-22', 110°-13'	Impact			

Flight 1152 Ballasting Information

Table I below presents Radio Controlled Ballast data for Flight 1152 launched on 15 June 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0415Z and 2222.5Z (termination), 31 pounds of ballast was automatically dropped at the rate of 1.68 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I
Ballast Data-Flight 1152

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
0542	4.2	145.8
0547	4.2	141.6
0621	4.2	137.4
0652	4.2	133.2
0723	16.5	116.7
0759	16.5	100.2
0804	16.5	83.7
0821	8.3	75.4
0831	8.3	67.1
2018	16.5	50.6

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

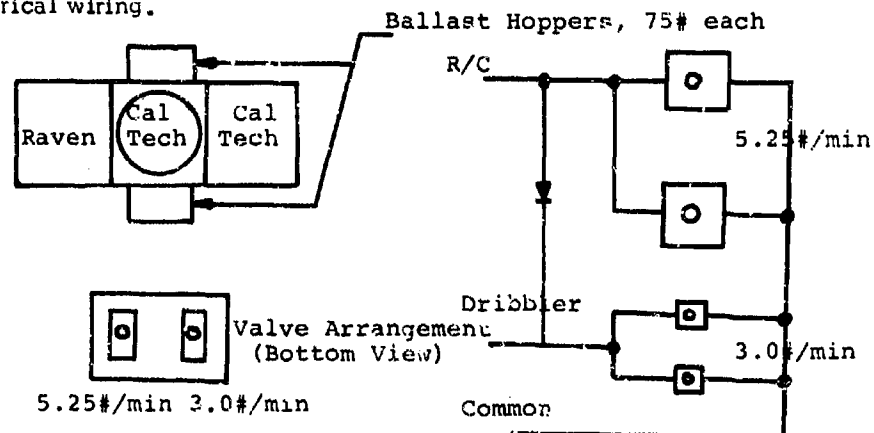


Figure 1

R-1866

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PHOTOBAROGRAPH DATA

Flight 1152-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0636	58.5	65,820	1006	3.3	132,069
0641	50.8	68,600	1011	3.3	132,069
0646	43.9	72,061	1016	3.3	132,069
0651	38.2	75,085	1018.5	3.2	132,856
0656	33.0	78,275	1023.5	3.3	132,069
0701	29.8	80,511	1026	3.3	132,069
0706	25.7	83,775	1031	3.3	132,069
0711	22.8	86,431	1038.5	3.3	132,069
0716	20.3	89,022	1041	3.2	132,856
0721	18.0	91,719	1048.5	3.2	132,856
0726	16.6	93,544	1058.5	3.2	132,856
0731	14.9	95,990	1101	3.15	133,260
0736	13.5	98,234	1103.5	3.2	132,856
0741	11.9	101,118	1108.5	3.2	132,856
0746	11.0	102,925	1116	3.2	132,856
0751	10.5	103,996	1121	3.2	132,856
0756	9.7	105,828	1128.5	3.2	132,856
0801	9.0	107,568	1131	3.2	132,856
0806	8.2	109,749	1133.5	3.3	132,069
0811	7.5	111,856	1138.5	3.2	132,856
0816	7.2	112,826	1243.5	3.2	132,856
0821	6.6	114,905	1248.5	3.2	132,856
0826	5.9	117,608	1253.5	3.2	132,856
0831	5.1	121,163	1303.5	3.2	132,856
0836	4.6	123,709	1308.5	3.2	132,856
0841	4.1	126,577	1313.5	3.2	132,856
0846	4.0	127,196	1316	3.2	132,856
0851	3.9	127,832	1321	3.2	132,856
0856	3.8	128,487	1323.5	3.15	133,260
0901	3.7	129,160	1331	3.15	133,260
0906	3.65	129,505	1333.5	3.1	133,671
0911	3.55	130,209	1336	3.1	133,671
0916	3.55	130,209	1338.5	3.0	134,515
0921	3.4	131,307	1353.5	3.0	134,515
0926	3.35	131,685	1356	3.1	133,671
0931	3.35	131,685	1403.5	3.1	133,671
0936	3.3	132,069	1406	3.0	134,515
0951	3.3	132,069	1423.5	3.0	134,515
0956	3.3	132,069	1426	2.9	135,390
1001	3.3	132,069	1441	2.9	135,390

R-1866
 Photobarograph Data
 Flight 1152-N
 Page 2

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1443.5	3.0	134,515	1743.5	3.2	132,856
1446	2.9	135,390	1753.5	3.2	132,856
1451	2.9	135,390	1816	3.2	132,856
1453.5	2.8	136,299	1838.5	3.2	132,856
1456	2.8	136,299	1841	3.15	133,260
1458.5	2.9	135,390	1848.5	3.15	133,260
1502.5	2.9	135,390	1851	3.2	132,856
1505	3.0	134,515	1916	3.2	132,856
1518.5	3.0	134,515	1918.5	3.15	133,260
1521	3.1	133,671	1943.5	3.15	133,260
1533.5	3.1	133,671	1946	3.1	133,671
1536	3.15	133,260	1948.5	3.1	133,671
1558.3	3.15	133,260	1951	3.15	133,260
1601	3.1	133,671	2013.5	3.15	133,260
1603.5	3.15	133,260	2016	3.1	133,671
1611	3.15	133,260	2021	3.0	134,515
1613.5	3.2	132,856	2023.5	3.1	133,671
1626	3.2	132,856	2036	3.1	133,671
1628.5	3.15	133,260	2038.5	3.15	133,260
1638.5	3.15	133,260	2049.5	3.15	133,260
1641	3.2	132,856	2051	3.1	133,670
1643.5	3.15	133,230	2058.5	3.0	134,515
1711	3.15	133,260	2123.5	3.0	134,515
1713.5	3.2	132,856	2126	2.9	135,390
1731	3.2	132,856	2141	2.9	135,390
1733.5	3.15	133,260	2143.5	2.85	135,840
1741	3.15	133,260	2156	2.85	135,840
			2203.5	2.85	135,840

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Cal. Tech. Pressure Data
Flight 1152-N

Time (Z)	Press. (MP)	Alt. (ft.)	Time (Z)	Press. (MP)	Alt. (ft.)
0630.8	65.8	62,930	0810.9	7.4	111,856
0633.3	62.2	62,930	0813.4	6.8	111,856
0635.8	57.7	62,930	0815.9	6.8	111,856
0638.3	54.0	62,930	0818.4	6.4	115,644
0640.8	50.0	62,930	0823.4	6.0	115,644
0643.3	46.7	62,930	0825.9	5.6	118,876
0645.8	43.6	62,930	0828.5	5.0	118,876
0648.3	40.8	62,930	0831.0	4.6	123,709
0650.8	38.2	62,930	0833.4	4.2	125,974
0653.3	35.4	62,930	0835.9	3.9	127,832
0655.8	33.6	62,930	0838.5	3.5	127,832
0658.3	31.6	62,930	0841	3.4	131,307
0700.8	29.8	62,930	0843.5	3.3	131,307
0703.3	27.5	62,930	0845.9	3.1	133,671
0705.8	26	62,930	0848.5	3.0	133,671
0708.3	24.5	62,930	0851.0	3.0	133,671
0710.8	23.0	62,930	0853.5	2.9	133,671
0713.3	21.5	87,739	0858.4	2.9	133,671
0715.8	20.4	88,912	0903.5	2.7	137,244
0718.3	19.4	90,038	0906.0	2.7	137,244
0720.8	18.2	91,471	0908.5	2.7	137,244
0723.3	17.4	92,483	0911.0	2.7	137,244
0725.8	16.2	92,483	0913.5	2.7	137,244
0728.3	15.4	95,241	0916.0	2.6	138,227
0730.8	15.0	95,241	0918.5	2.6	138,227
0733.3	14.0	95,241	0921.0	2.5	139,253
0735.8	13.3	98,574	0923.5	2.3	141,447
0738.3	12.5	98,574	0926.0	2.3	141,447
0740.9	11.8	101,311	0930.5	2.3	141,447
0743.4	11.5	101,311	0933.6	2.2	142,623
0745.9	10.9	103,135	0941.0	2.2	142,623
0748.4	10.9	103,135	0943.5	2.2	142,623
0750.9	10.3	103,135	0946.0	2.1	143,856
0753.4	10.1	104,893	0948.6	2.1	143,856
0755.9	9.5	104,893	0951.1	2.1	143,856
0758.4	9.0	104,893	0953.5	1.9	146,514
0800.9	8.9	107,829	0956.0	1.9	146,514
0803.4	8.2	107,829	0958.6	1.9	146,514
0805.9	7.9	107,829	1003.5	-	-
0808.4	7.5	111,856	1008.6	1.9	146,514

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Cal Tech Pressure Data
Flight 1152-N
Page 2

RAVEN[®]
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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1016.0	1.9	146,514	1313.7	1.9	146,514
1021.1	1.9	146,514	1316.3	1.9	146,514
1026.0	1.9	146,514	1321.3	1.9	146,514
1031.1	1.9	146,514	1328.8	1.8	147,955
1036.1	1.9	146,514	1333.8	1.8	147,955
1038.6	1.8	147,955	1341.3	1.8	147,955
1046.1	1.8	147,955	1356.3	1.8	147,955
1051.1	1.8	147,955	1426.3	1.8	147,955
1053.6	1.9	146,514	1441.4	1.7	149,480
1056.1	1.8	147,955	1456.3	1.7	149,480
1058.6	1.8	147,955	1511.4	1.7	149,480
1101.1	1.9	146,514	1526.4	1.8	147,955
1103.6	1.9	146,514	1541.4	1.9	146,514
1111.2	1.9	146,514	1556.4	1.9	146,514
1118.7	1.9	146,514	1611.5	2.1	143,856
1121.2	1.8	147,955	1626.4	2.1	143,856
1123.6	1.9	146,514	1641.5	2.1	143,856
1126.1	1.9	146,514	1711.5	2.1	143,856
1131.2	1.9	146,514	1726.5	2.2	142,623
1133.6	1.8	147,955	1756.5	2.2	142,623
1138.7	1.8	147,955	1810.5	2.2	142,623
1143.7	1.8	147,955	1826.5	2.3	141,447
1146.1	1.9	146,514	1841.6	2.1	143,856
1148.8	1.8	147,955	1856.6	2.3	141,447
1151.2	1.8	147,955	1926.6	2.2	142,623
1153.7	1.9	146,514	1941.7	2.1	143,856
1158.7	1.9	146,514	1956.7	2.2	142,623
1206.2	1.9	146,514	2011.7	2.2	142,623
1213.7	1.9	146,514	2026.7	2.1	143,856
1221.3	1.9	146,514	2041.7	2.2	142,623
1231.3	1.9	146,514	2055.7	2.2	142,623
1243.7	1.9	146,514	2111.7	2.1	143,856
1251.3	1.9	146,514	2141.7	1.9	146,514
1301.3	1.9	146,514	2156.7	1.8	147,955
1306.3	1.9	146,514	2211.7	1.8	147,955

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1152-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0509.2	834	5,200	0503.4	-	Launch
0515.5	696	10,000	0520	614	13,200
0528.0	468	20,000	0530	438	21,600
0545.5	233	35,800	0540	292	30,900
0554.8	189	40,300	0550	215.5	37,500
0601.3	154.5	44,700	0600	161	43,800
0609.4	121	50,000	0610	119	50,400
0619.8	91.5	56,100	0620	88	56,700
0626.7	74.6	60,500	0630	66.5	63,000
0634.9	61.4	64,800	0640	50.5	69,000
0649.2	39.6	74,300	0650	37.3	75,600
0710.1	22.4	86,800	0700	29.5	80,700
0725.1	17.55	92,300	0710	22.8	86,400
0731.5	15.42	95,200	0720	18.2	91,500
0747.8	11.8	101,300	0730	14.5	96,600
0814.7	7.84	110,800	0740	11.75	101,400
0832.2	7.18	116,500	0745	9.84	105,500
0839.8	5.55	119,100	0755	9.3	106,800
0844.0	5.2	120,700	0800	8.6	108,600
0905.0	4.91	122,100	0810	6.85	114,000
0930	4.91	122,100	0820	6.12	116,700
1015	4.58	123,800	0830	4.64	123,600
1030	4.91	122,100	0840	3.51	130,500
1036	4.58	123,800	0850	3.16	133,200
1051	4.91	122,100	0900	2.88	135,600
1130	4.91	122,100	0910	2.81	136,200
1230	4.91	122,100	0930	2.5	139,200
1330	4.91	122,100	0935	2.34	141,000
1430	4.91	122,100			
1600	4.91	122,100			
1700	5.55	119,100			
1730	4.91	122,100			
1800	5.55	119,100			
1900	5.55	119,100			
1930	5.55	119,100			
2024	5.55	119,100			
2105	5.55	119,100			
2115	6.0	117,200			
2200	6.18	115,500			
2225.5		Terminate			
2236	102.8	53,500			
2301	859	4,400			

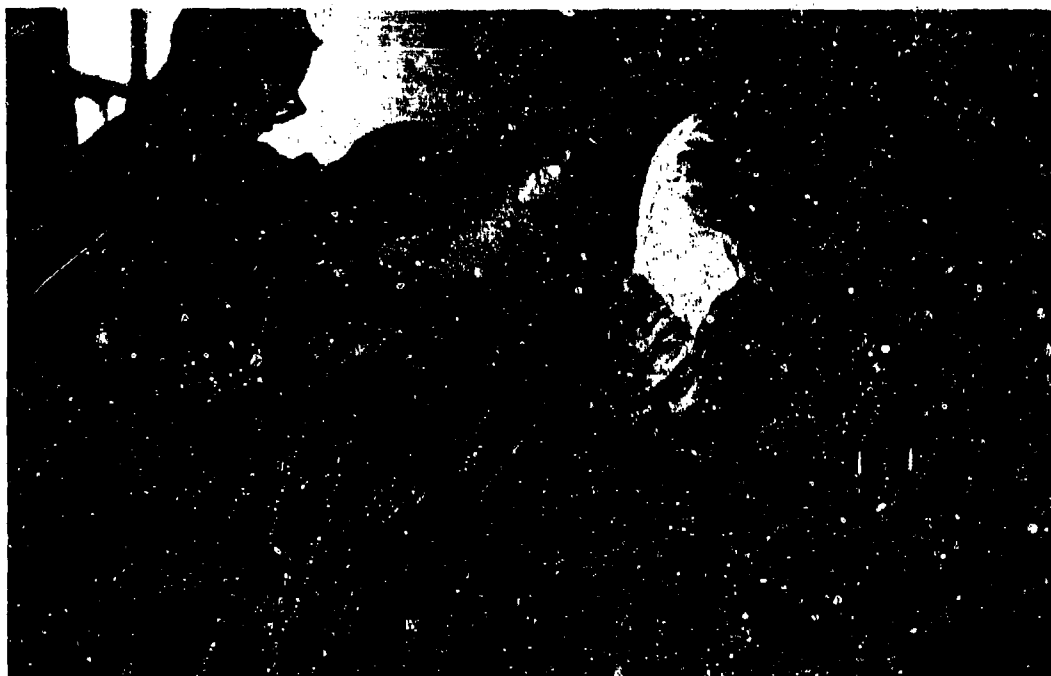
1153 - FLIGHT DESCRIPTION

Flight 1153 for the University of Chicago was launched at 0342Z on 20 June under the direction of R. Keuser and G. Mancuso. Twenty hours and forty-seven minutes later, the flight was terminated by radio command from the C-47 tracking aircraft. Although the launch was conducted in winds of from 12 to 16 knots, take-off was smooth and no equipment touched the ground.

This flight marked the third time that this gondola was used this season by the University of Chicago. The experiment, as before, was designed to study the flux and energy spectrum of primary cosmic ray electrons in the range of 10 Mev to 5 Bev. Principal investigators were Dr. Peter Meyer and Mr. J. L'Heureux.

Raven's standard command/telemetry instrumentation package was used with the addition of sensors to monitor internal temperatures and Silvercell[®] voltages. Temperature of the Chicago cylinder was also monitored and telemetered to the tracking stations. Termination backup was provided with a Brailsford top timer.

Increased use of tracking provided more complete position data as indicated on the Position Fix Map for this flight. In this case, as with most flights, interpolation of the



Preparing for flight of the Chicago sphere.

R-1866

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Industries, Inc.

1153 - Flight Description (cont)

primary balloon track must be performed between periods of radar and aircraft fixes. Although these tracks have been made as objective as possible, it is quite likely that the errors indicated between balloon track and radio position fixes are much smaller than shown. On later flights, this becomes increasingly apparent when aircraft fixes correspond with our tracking network coordinates.

Radio command ballast performed flawlessly; operating 13 times out of 13 attempts. Signal pickup by Lynn Lake was obtained at 0458Z when the balloon was ascending at 65,000 feet.

Transmitter frequency and command channels used were:

Transmitter Frequency:	251.5 MHz	
Command Channels:	Cutdown	1
	Ballast	2
	Private Line	1

K-1866

RAVEN[®]
industries, inc.

LAUNCH LOG, SKYHOOK FLIGHT 1153

University of Chicago (Meyer-L'Heureux) cylinder
Balloon: 6 x 10⁶ cubic foot Stratofilm
all times in CDT 19 June 1966

2100 Crew assembled in hanger, NOTAM activated for 2300 launch.
2110 Gondola loaded on launch truck.
2127 Gondola left hanger.
2135 Crew arrived at launch site.
2143 Laid out ground cloth with an 8 knot wind from 090°, per indicator on mast.
2152 Balloon layout started.
2218 Inflation started.
2225 Wind increased to 12 to 16 knots, from 120°.
2238 Inflation completed.
2242 Launch, in winds of 12 to 16 knots, from 120°; 30° off of layout.
Launch truck not running smoothly, engine wanted to quit. Balloon
got ahead of the truck and took gondola off fast, but smoothly. No antennas
or other equipment touched the ground.
2300 DOT weather: Winds ESE 10 mph. Pressure 1013.4 Mb. Scattered clouds at
10,000 feet, broken at 20,000 feet. Temperature, 45°F.

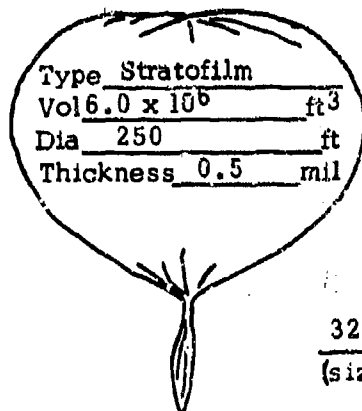
Range Test Number: 86.6 S8165-A 2L

Tropopause at 0000Z, 19 June: -61°C, at 272 Mb (32,462 ft.).

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

RAVEN
 industries, inc.

1. Company Raven Flight Number 1153-N Director Keuser, Mancuso
2. Scientist Meyer Group Univ of Chicago Date/Time 6/20 / 0342 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 100 Ø 200 40°F, 15 MPH 1013.4 MB Cross Wind Angle 30
 (Sky-Temp-Wind-Pressure)
 Trop(Coldest)Ht. 33,330 ft Temp -56 °C Inflation Start 0318 Z
 Hrs Sunshine on Bubble None Train Length(Layout) 380 ft.
5. Balloon Theoretical 2.94 Mbs 135,000 ft. How Determined?
 Ceiling: Actual 2.78 Mbs 136,500 ft. Radar 0843Z
6. Ascent: Surface to Trop. 968 fpm. Trop. to Ceiling 514 fpm.
7. Flight Duration: Total 20 hrs 47 min. At Ceiling 17 hrs. 09 min.
8. Termination: Time 0029.5Z Altitude 132,000 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 6/21 / 0107 Z Location 56° 52' N 111° 25' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd 22 hrs.
251.5 Altitude Telemetry 22 hrs.
7.465 & 4.015 Communicators 22 hrs.
12. Balloon: Code Number SF-250.2-050-NSC-02 Serial Number 4



32 Ft. chute
 (size)

WEIGHTS

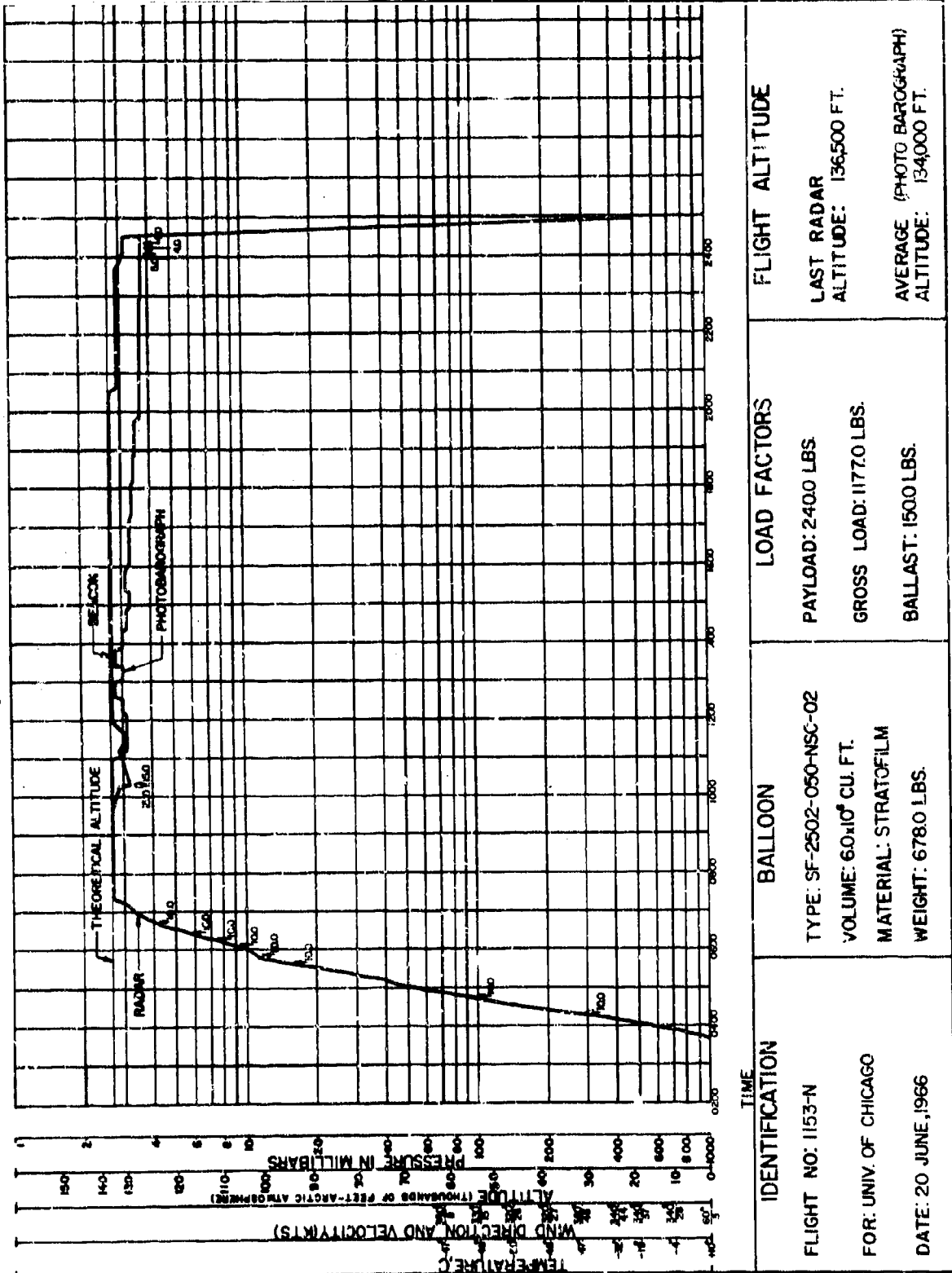
Balloon.....	678.0
Parachute.....	31.0
Instrumentation.....	50.0
Ballast.....	150.0
Scientific Package.....	240.0
Other. Photobarograph.....	8.0
Other. Misc.....	20.0
Gross Weight.....	1177.0
Free Lift.....	118.0
Gross Inflation.....	1295.0
Helium used (cu. ft.).....	20,720

13. Flight Failures None
 (Nature of flight failures - if any)
14. Comments None
 (Significant factors concerning the operation)

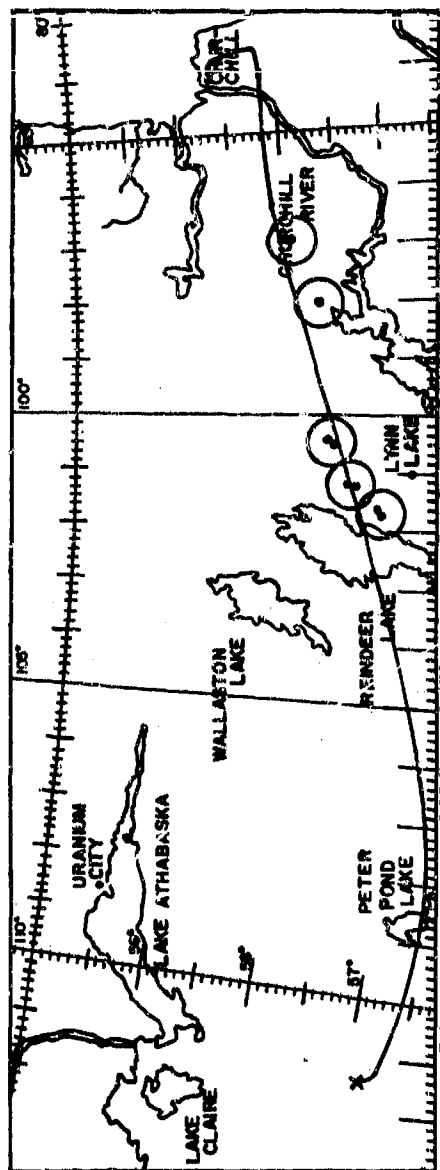
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TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0342.5	Fort Churchill		Launch	0939	57°-55'	96°-55'
0400	58°-38'	93°-55'	Radar	11042	57°-40'	98°-00'
0440	58°-13'	93°-38'	Radar	11501	57°-35'	100°-30'
0500	58°-11'	93°-37'	Radar	12232	57°-36'	106°-25'
0600	58°-10'	94°-05'	Radar	13001	57°-21'	101°-13'
0620	58°-09'	94°-21'	Radar	13202	57°-26'	101°-12'
0640	58°-08'	94°-41'	Radar	14421	57°-08'	101°-40'
0710	58°-07'	95°-12'	Radar	15251	57°-07'	101°-46'
0740	58°-08'	95°-37'	Radar	1549	56°-29'	103°-20'
0800	58°-08'	95°-41'	Radar			
0845	58°-03'	96°-20'	Radar			
1730	56°-35'	106°-55'	C-47			
0005	56°-44'	111°-17'	C-47			
0029.5	56°-44'	111°-35'	C-47			
0107	56°-52'	111°-29'	Impact			

 (1) 2 Station Fix
 (2) 3 Station Fix

Flight 1153 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1153 launched on 19 June 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0330Z and 0029.5Z (termination), 37 pounds of ballast was automatically dropped at the rate of 1.75 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I
Ballast Data-Flight 1153

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
0424	10.0	140.0
0452	10.0	130.0
0544	10.0	120.0
0557	10.0	110.0
0608	10.0	100.0
0622	10.0	90.0
0632	10.0	80.0
0649	10.0	70.0
1014	5.0	65.0
1016	5.0	60.0
0006(6/20)	5.0	55.0
0016	4.0	51.0
0025	4.0	47.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

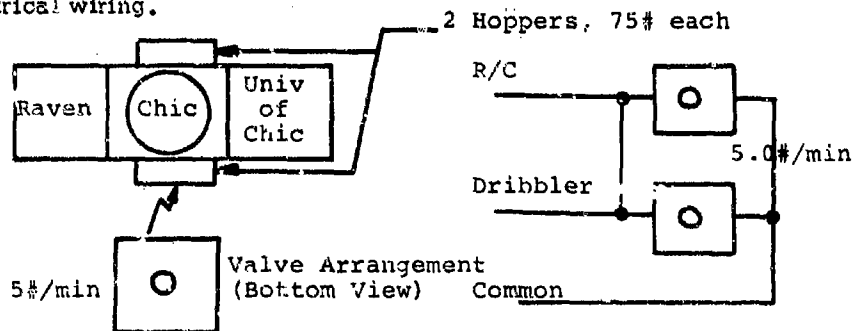


Figure 1

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PHOTOBAROGRAPH DATA
Flight 1153-N

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0501.5	52.3	68,500	0641.5	4.3	125,386
0504	47.8	70,211	0644	4.15	126,273
0506.5	44.8	71,620	0646.5	4.0	127,196
0509	40.7	73,707	0649	3.8	128,487
0511.5	37.3	75,604	0651.5	3.8	128,487
0514	34.5	77,304	0654	3.75	128,821
0516.5	32.0	78,949	0656.5	3.6	129,854
0519	29.2	80,958	0659	3.3	132,069
0521.5	26.7	82,931	0701.5	3.3	132,069
0524	24.9	84,475	0704	3.25	132,459
0526.5	23.2	86,044	0709	3.15	133,260
0529	21.5	87,739	0714	3.0	134,515
0531.5	20.0	89,355	0716.5	2.85	135,840
0534	18.6	90,982	0721.5	2.80	136,299
0536.5	17.4	92,483	0729	2.80	136,299
0539	16.3	93,956	0734	2.80	136,299
0541.5	15.4	95,241	0739	2.80	136,299
0544	14.7	96,296	0749	2.80	136,299
0546.5	13.5	98,234	0759	2.80	136,299
0549	12.7	99,628	0809	2.80	136,299
0551.5	12.0	100,926	0814	2.80	136,299
0554	11.1	102,716	0819	2.80	136,299
0556.5	10.6	103,778	0824	2.80	136,299
0559	10.2	104,665	0829	2.80	136,299
0601.5	9.4	106,556	0831.5	2.80	136,299
0604	8.8	108,093	0834	2.85	135,840
0606.5	8.5	108,905	0844	2.85	135,840
0609	8.1	110,038	0846.5	2.80	136,299
0611.5	7.6	111,542	0854	2.80	136,299
0614	7.4	112,175	0859	2.80	136,299
0616.5	6.75	114,366	0904	2.80	136,299
0619	6.6	114,905	0909	2.80	136,299
0621.5	6.4	115,644	0914	2.80	136,299
0624	5.75	118,233	0924	2.80	136,299
0626.5	5.65	118,650	0939	2.80	136,299
0627	5.5	119,315	0941.5	2.75	136,766
0631.5	5.2	120,687	0954	2.75	136,766
0634	4.9	122,147	1009	2.75	136,766
0636.5	4.7	123,177	1011.5	2.65	137,730
0639	4.65	133,441	1014	2.75	136,766

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 Photobarograph Data
 Flight 1153-N
 Page 2

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1016.5	2.80	136,299	1429	3.15	133,260
1024	2.80	136,299	1454	3.25	132,459
1029	2.80	136,299	1504	3.25	132,459
1031.5	2.83	136,022	1521.5	3.15	133,260
1036.5	2.85	135,840	1539	3.15	133,260
1039	2.85	135,840	1549	3.15	133,260
1041.5	3.0	134,515	1559	3.0	134,515
1046.5	3.0	134,515	1607	3.25	132,459
1049	2.85	135,840	1619	3.25	132,459
1101.5	2.85	135,840	1628	3.3	132,069
1104	3.0	134,515	1637	3.25	132,459
1109	3.0	134,515	1643	3.15	133,260
1111.5	3.15	133,260	1700	3.15	133,260
1116.5	3.15	133,260	1715	3.25	132,459
1119	3.0	134,515	1721	3.25	132,459
1121.5	3.15	133,260	1727	3.25	132,459
1126.5	3.15	133,260	1749.5	3.3	132,069
1129	3.25	132,459	1800	3.25	132,459
1139	3.15	133,260	1810.5	3.3	132,069
1159	3.15	133,260	1828	3.3	132,069
1211.5	3.0	134,515	1843	3.3	132,069
1226.5	3.0	134,515	1855	3.4	132,069
1229	3.15	132,260	1859	3.4	131,307
1234	3.0	134,515	1923	3.5	130,569
1239	2.85	135,840	1939	3.6	129,850
1244	2.83	136,022	1951	3.75	128,821
1251.5	2.85	135,840	2035	3.75	128,821
1304	3.0	134,515	2109.5	3.75	128,821
1319	3.0	134,515	2114.5	3.6	129,854
1329	2.85	135,840	2134.5	3.75	128,821
1339	2.85	135,840	2204.5	3.75	128,821
1354	2.85	134,515	2229.5	3.75	128,821
1409	3.0	134,515	2259.5	3.8	128,487
1426.5	3.15	133,260	2309	3.8	128,487
			2345	3.8	128,487
			0003	3.8	128,487
			0027	3.8	128,487

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PRESSURE AND ALTITUDE DATA
Flight 1153-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0342.5	-	Launch	0342.5	-	Launch
0355.1	659	11,400	0400	546	16,200
0409.1	387	24,500	0410	338	27,600
0415.1	291	31,000	0420	207	38,400
0419.3	235	35,600	0430	168	42,900
0425.9	187.5	40,500	0440	117	50,700
0438.1	118.5	50,500	0450	81.5	58,650
0444.5	94	55,500	0500	58.0	66,000
0451.7	72.8	61,100	0510	44.6	71,700
0503.1	48.2	70,000	0535	16.3	93,900
0521.1	27.85	82,000	0540	15.6	94,950
0534.8	18.4	91,200	0550	12.15	100,650
0550.0	12.5	100,000	0600	10.5	103,950
0605.6	8.05	110,200	0610	8.28	109,500
0625.5	5.24	120,500	0620	6.85	114,000
0657.5	3.37	131,500	0630	5.7	118,500
0717.5	3.06	134,000	0640	4.73	123,000
0900	2.73	137,000	0650	3.95	127,500
0945	3.06	134,000	0700	3.51	130,500
1011	3.37	131,500	0710	3.16	133,200
1015	3.69	129,200	0720	2.84	135,900
1110	3.37	131,500	0730	2.84	135,900
1130	3.69	129,200	0740	2.81	136,200
1145	3.37	131,500	0750	2.75	136,800
1200	3.06	134,000	0800	2.88	135,600
1215	3.06	134,000	0810	2.75	136,800
1245	3.06	134,000	0820	2.75	136,800
1330	3.06	134,000	0830	2.88	136,600
1430	3.06	134,000	0843	2.78	136,500
1600	3.06	134,000			
1700	3.06	134,000			
1800	3.06	134,000			
1900	3.06	134,000			
2000	3.06	134,000			
2041	3.37	131,500			
2230	3.37	131,500			
2345	3.37	131,500			
0004	3.69	129,200			
0029.5		Terminate			
0034.0	3.69	75,100			
0042.0	3.69	43,600			
0054	3.69	18,600			

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Flight 1153
Upper Air Data for 0000Z, 20 June

Standard Levels

Pressure (MB)	T, °C	Wind Knots
1000	+10	60° 3
850	0	340° 11
700	- 4	340° 28
500	-19	340° 37
400	-32	340° 44
300	-47	360° 48
250	-55	350° 57
200	-48	320° 27
150	-50	320° 26
100	-48	330° 15
70	-47	350° 8

Wind Data

Thousands
of Feet

Significant Levels

		Direction	Knots
1009	+10	40°	5
874	0	10°	6
820	- 1	340°	12
679	- 5	340°	28
530	-16	340°	37
347	-39	330°	44
259	-56	350°	42
219	-49	360°	48
147	-51	350°	52
116	-48	320°	29
108	-52	320°	26
103	-49	300°	11
65	-48	340°	9
		350°	7

R-1866

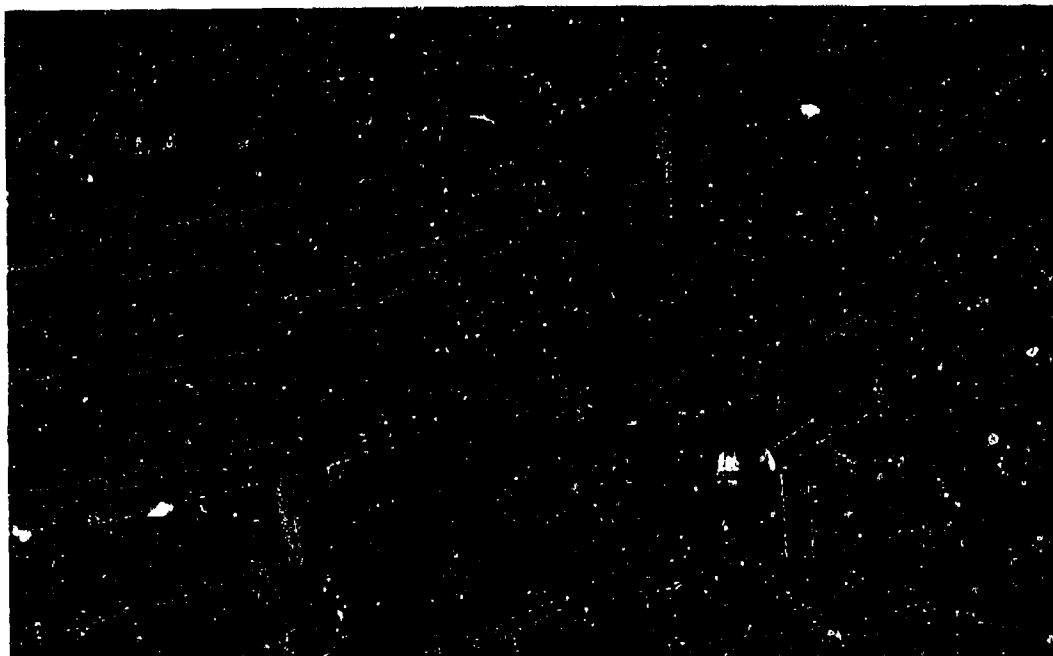
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1154 - FLIGHT DESCRIPTION

The last flight for the University of Chicago sphere was launched at 0547Z on 27 June 1966 under the direction of G. Mancuso and M. Fulkerson. The flight was completely satisfactory although launch caused some tense moments. An original 2-3 knot in-line wind changed to about 70 degrees at the moment of launch carrying the balloon rapidly away from the lay-out line. By increasing speed of the M-36 launch vehicle to approximately 20 to 25 mph, making a 90 degree turn, and going to the edge of the taxiway, damage to the gondola and instrumentation was prevented. One side of the crush pad did scrape the runway opposite to the command antenna when the load pendulumed. There was no sign of damage, however, and when the command channels were tried, performed satisfactorily. Termination was accomplished from the Cessna 206 aircraft after 16.4 hours of flight.

Scientific equipment remained the same as flown in Flights 1148 and 1150, being designed to measure the ratio of positrons to electrons in the primary cosmic radiation energy ranges of 100 Mev to 6 Bev. Principal investigators were Dr. Peter Meyer and Mr. J. Fanselow.

Raven's instrument package was standard and had the added capability of turning on the gondola power at altitude. As before, it was not used since power was turned on at launch.



Interior, DOT hanger, where rigging was done.

R-1866

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1154 - Flight Description (cont)

Radio command ballasting functioned well in 15 commands out of 15 attempts.

The barocoder was unsatisfactory and showed an apparent "leaker" throughout the flight. This was due to the small (1/16 in) vent hole in the instrumentation container water trap.

The first major use of radio positioning occurred during this flight (see Position Fix Map). Thirteen, two and three station cross-fixes were taken which followed the projected radar-aircraft track quite well. Improvement, at this stage, was still desirable...as shown in later flights.

Transmitter frequency and command channels used were:

Transmitter Frequency: 251.5 MHz

Command Channels:	Cutdown	7
	Ballast	8
	Turn On	9
	Private Line	1



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R-1866

LAUNCH LOG, SKYHOOK FLIGHT 1154

University of Chicago (Meyer-Fanselow) sphere

Balloon: 10.6×10^6 cubic foot Stratofilm

all times in CDT, 25-26 June 1966

2200 Winds at DOT NW 7 mph. NOTAM activated to fly at 0000. Crew called out.
2230 Crew in hanger.
2241 Gondola ready to tie to launch truck.
2245 Wind at DOT 280-300°, 5-8 mph.
2300 Advance crew left hanger for launch site.
2313 Launch truck with gondola left hanger.
2338 Launch truck reached launch site.
2335 Balloon layout begun, following pibal winds at 334°. (Balloon packed in box upside down.)
2342 Balloon layout complete.
2355 Wind indicated on mast in launch area 290°, 5 knots. Pibal showing 310°. Inflation started, using two tubes, one trailer.
0015 Winds 285°, 5 knots.
0030 Pibal showing 290°.
0040 Wind 285°, 3 knots on mast.
0040 Inflation completed. Crew included: Mancuso on spool, Pappas and Hanson on inflation tubes, Fulkerson on truck, Keuser on bubble and then general supervision, Oliver and Kerschmann on instruments, Minor at hanger on telemetry, Smith on timing and records. Rupp and Vandersnick in hanger working with Vogt for Flight 1155.
0047 Launch. The prelaunch pibal showed a wind about 40° cross the layout. At launch the balloon picked up speed very quickly, and moved steadily through a cross-angle, eventually getting to about 80° crosswind. The truck shifted gears twice, caught up with the balloon, made a 90° turn without difficulty, and launched at the edge of the taxi-way

At lift-off, the payload pendulumed, and the crush pad swept across the gravel at the edge of the taxi-way. It struck the side opposite the radio-command antenna. No signs of any damage. The radio-command was checked at once, and worked satisfactorily. The radar target was also retained with the package. This launch could not have been made without the use of the launch truck. With the speed of the truck in use, this probably was a limiting wind speed. Estimates of the speed of the truck at lift-off were 20-25 mph.

0110 Noctilucent clouds observed forming; these lasted for at least an hour, then were obscured by lower clouds.
0100 DOT weather readings: wind 290°, 8 mph; temperature 51°F; SLP 1001.5 Mb; Clouds; scattered, at 1500 feet, broken at 2500 feet,

Range Test Number: 95.6 SB165-A II.

Tropopause at 0000Z, 26 June: -48°C at 278 Mb (31,987 ft.).

R-1866

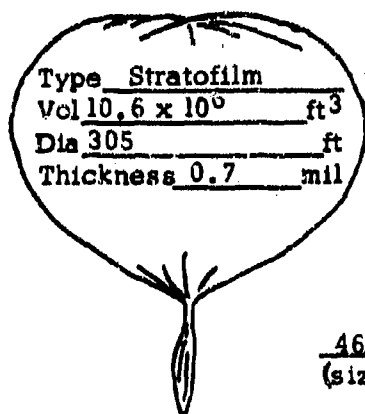
SKYHOOK BALLOON FLIGHT INFORMATION

NAVEXOS 3900/2 (Rev. 8-66)

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1. Company Raven Flight Number 1154-N Director Mancuso, Fulkerson
2. Scientist Mayer Group Univ of Chicago Date/Time 6/27 / 0547 Z
3. Launch: Site Ft. Church, Ill Technique/Launch Veh. M-36 Truck
4. Wx: 50 / 250 / 51°F 15 MPH 1001.5 MB Cross Wind Angle 70°
(Sky-Temp-Wind-Pressure)
Trop (Coldest) Ht. 31987 ft Temp -48 °C Inflation Start 0500 Z
Hrs Sunshine on Bubble None Train Length (Layout) 480 ft.
5. Balloon Theoretical 2.94 Mbs 135,000 ft. How Determined?
Ceiling: Actual 2.83 Mbs 135,000 ft. Photobarograph
6. Ascent: Surface to Trop. 780 fpm Trop. to Ceiling 546 fpm.
7. Flight Duration: Total 16 hrs 22 min. At Ceiling 12 hrs. 39 min.
8. Termination: Time 2209 Z Altitude 134,000 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 6/26 / 2246 Z Location 58° 34' N 109° 12' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd 17 hrs.
251.5 Altitude Telemetry 17 hrs.
2.465 & 4.015 Communication 17 hrs.
12. Balloon: Code Number SF-305.86-070-NSC-02 Serial Number 48



WEIGHTS

Balloon.....	1213.0
Parachute.....	48.0
Instrumentation.....	50.0
Ballast.....	200.0
Scientific Package.....	624.5
Other Photobarograph.....	9.5
Other Misc.....	28.0
Gross Weight.....	2173.0
Free Lift.....	217.0
Gross Inflation.....	2390.0
Helium used (cu. ft.).....	38,256

13. Flight Failures None
(Nature of flight failures - if any)
14. Comments Launch could not have been made due to crosswind without the M-36 vehicle
(Significant factors concerning the operation)

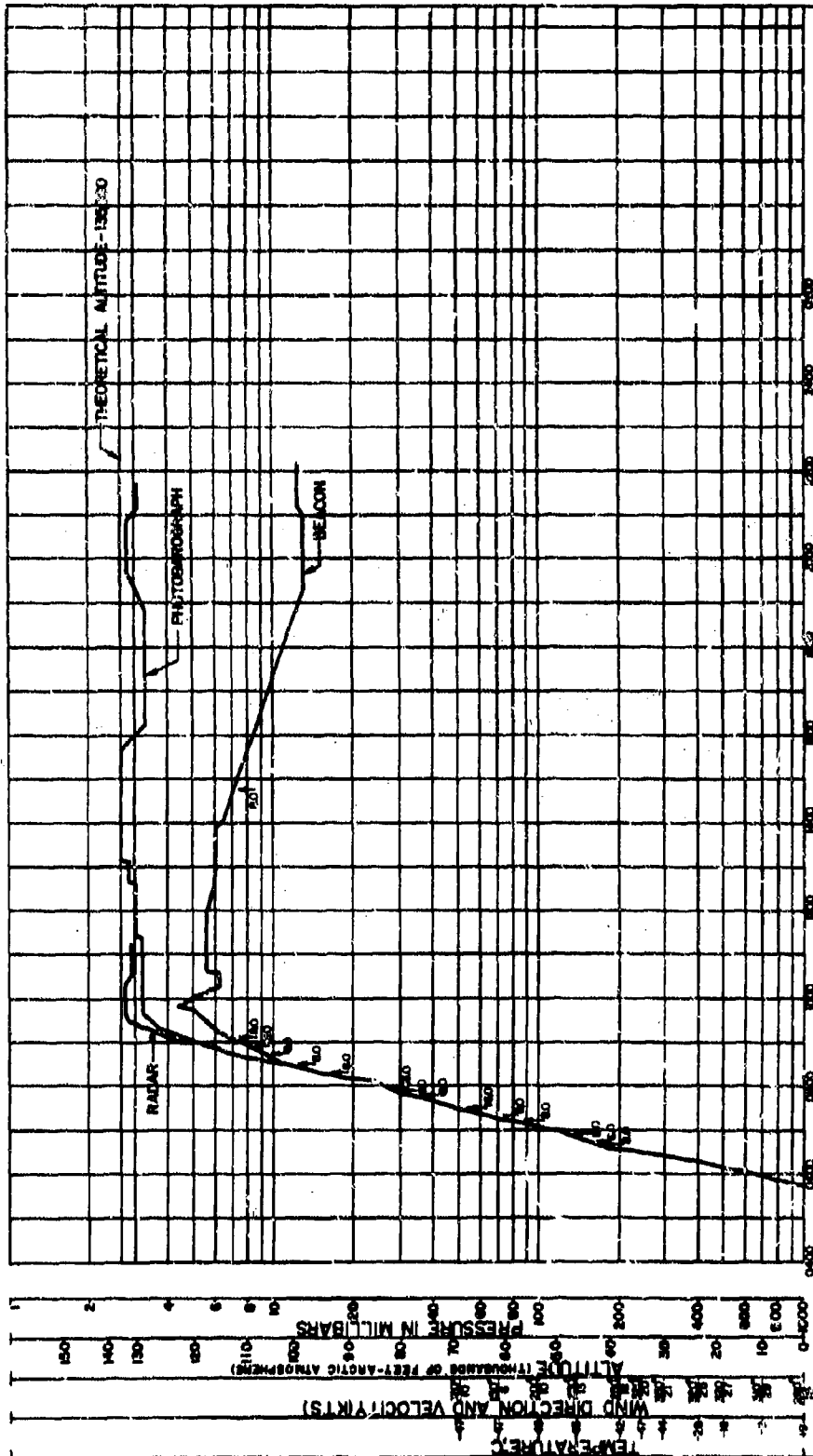
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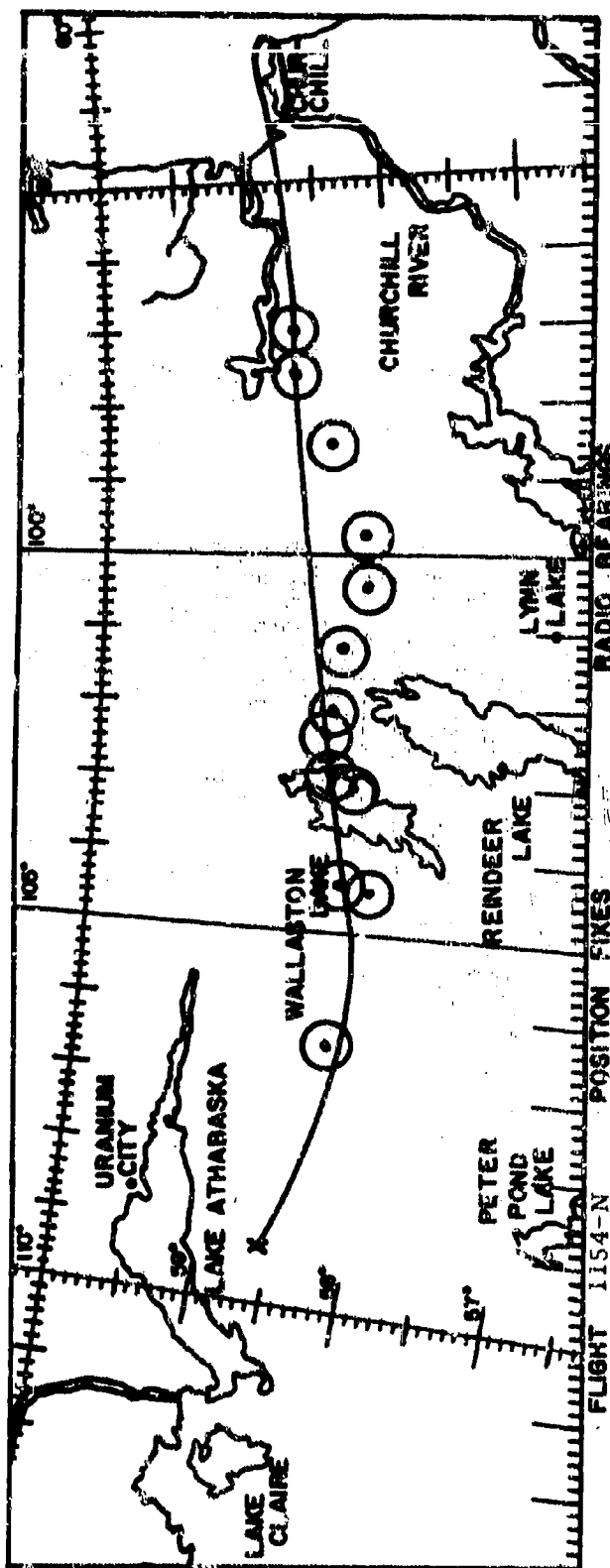
ONR/Code 421

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TIME		FLIGHT ALTITUDE	
IDENTIFICATION	FLIGHT NO: 1154-N FOR: UNIV. OF CHICAGO DATE: 27 JUNE, 1966	BALLOON	LOAD FACTORS
		TYPE: SF-30586-070-NSC-02 VOLUME: 106X10 CU. FT. MATERIAL: STRATOFILM WEIGHT: 12130 LBS.	PAYLOAD: 6245 LBS. GROSS LOAD: 21730 LBS. BALLAST: 2000 LBS.
		LAST RADAR ALTITUDE: 128000 FT. AVERAGE (PHOTOBAROGRAPH) ALTITUDE: 135000 FT.	



TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0546.8	Fort Churchill		Launch	1130 ¹	58°-40'	97°-00'
0600	58°-39'	93°-51'	Radar	1200 ¹	58°-37'	97°-36'
0640	58°-41'	93°-19'	Radar	1300 ¹	59°-23'	98°-31'
0700	59°-47'	93°-13'	Radar	1400 ¹	58°-18'	99°-44'
0800	58°-51'	93°-24'	Radar	1430 ¹	58°-18'	100°-26'
0840	58°-50'	93°-50'	Radar	1500 ¹	58°-19'	101°-16'
0920	58°-47'	94°-26'	Radar	1530 ¹	58°-22'	102°-06'
1000	58°-42'	95°-15'	Radar	1555 ¹	58°-23'	102°-25'
1040	58°-40'	96°-03'	Radar	1630 ¹	58°-22'	103°-07'
1120	58°-39'	96°-43'	Radar	1730 ¹	58°-16'	104°-47'
1555	58°-22'	102°-55'	C-47	1800 ¹	58°-25'	104°-31'
1740	58°-15'	104°-23'	C-47	1830 ¹	58°-04'	104°-28'
2205	58°-31'	109°-30'	C-47	2000 ²	58°-17'	106°-28'
2209	Termination					
2246	58°-34'	109°-12'	Impact			

 (1) 2 Station Fix
 (2) 3 Station Fix

Flight 1154 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1154 launched on 26 June 1966. Initial ballast on board at the time of launch was 200 pounds. Between 0530Z and 2209Z (termination), 46.2 pounds of ballast was automatically dropped at the rate of 2.8 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I
Ballast Data-Flight 1154

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
0640	8.0	192.0
0643	8.0	184.0
0656	8.0	176.0
0711	8.0	168.0
0718	8.0	160.0
0729	16.0	144.0
0745	8.0	136.0
0752	8.0	128.0
0758	16.0	112.0
0817	8.0	104.0
0827	8.0	96.0
0843	8.0	88.0
0856	8.0	80.0
0905	8.0	72.0
1446	8.0	64.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

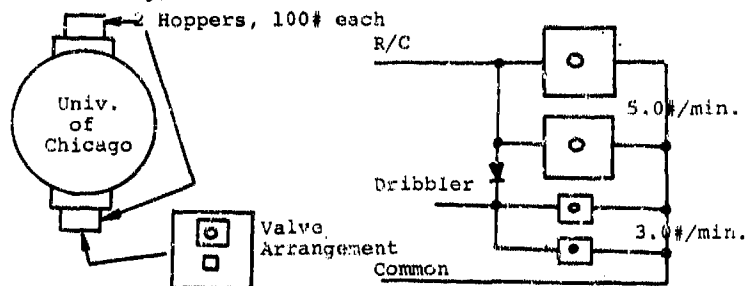


Figure 1

R-1866

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PHOTOBAROGRAPH DATA
Flight 1154-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0726	57.1	66,350	0906	4.55	123,980
0728.5	53.6	67,800	0908.5	4.55	123,980
0731	50.3	69,100	0911	4.2	125,974
0733.5	47.6	70,302	0913.5	4.2	125,974
0736	44.5	71,864	0916	4.05	126,884
0738.5	41.0	73,547	0918.5	3.85	128,157
0741	37.6	75,430	0921	3.75	128,821
0743.5	35.6	76,619	0923.5	3.75	128,821
0746	34.2	77,495	0928.5	3.55	130,209
0748.5	32.4	78,677	0931	3.5	130,569
0751	30.2	80,218	0933.5	3.3	132,069
0753.5	28.4	81,570	0938.5	3.25	132,459
0756	26.6	83,014	0946	3.25	132,459
0758.5	25.0	84,386	0953.5	3.15	133,260
0801	23.6	85,665	1001	3.15	133,260
0803.5	21.6	87,636	1006	3.15	133,260
0806	20.3	89,022	1011	3.15	133,260
0808.5	19.0	90,505	1018.5	3.2	132,856
0811	18.0	91,719	1026	3.25	132,459
0813.5	17.0	93,007	1033.5	3.25	132,459
0816	16.0	94,376	1036	3.3	132,069
0818.5	15.3	95,389	1043.5	3.28	132,224
0821	14.2	97,083	1048.5	3.25	132,459
0823.5	13.6	98,066	1053.5	3.15	133,260
0826	12.45	100,100	1058.5	3.1	133,671
0828.5	11.7	101,507	1106	3.1	133,671
0831	10.9	103,135	1116	3.1	133,671
0833.5	9.8	105,590	1123.5	3.1	133,671
0836	9.4	106,556	1126	3.05	134,089
0838.5	8.7	108,360	1136	3.05	134,089
0841	8.0	110,330	1138.5	3.0	134,515
0843.5	77.7	111,233	1143.5	3.05	134,089
0846	7.5	111,856	1151	3.05	134,089
0848.5	6.9	113,841	1156	3.05	134,089
0851	6.15	116,604	1206	3.05	134,089
0853.5	6.0	117,201	1216	3.05	134,089
0856	5.5	119,315	1223.5	3.05	134,089
0858.5	5.3	120,220	1226	3.1	133,671
0901	5.15	120,924	1236	3.1	133,671
0903.5	4.9	122,147	1238.5	3.05	134,089

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Photobarograph Data
Flight 1154-N
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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1241	2.95	134,948	1726	3.3	133,069
1246	2.9	135,390	1736	3.3	133,069
1248.5	2.9	135,390	1751	3.3	133,069
1253.5	2.95	135,390	1753.5	3.28	132,224
1256	2.9	135,390	1801	3.3	133,069
1301	2.85	135,390	1811	3.3	133,069
1306	2.8	136,299	1821	3.3	133,069
1316	2.8	136,299	1831	3.3	132,069
1326	2.8	136,299	1838.5	3.3	132,069
1336	2.8	136,299	1841	3.28	132,224
1346	2.8	136,299	1843.5	3.25	132,459
1401	2.8	136,299	1848.5	3.15	133,260
1411	2.8	136,299	1853.5	3.05	134,089
1426	2.8	136,299	1901	3.1	133,671
1441	2.8	136,299	1906	3.1	133,671
1451	2.8	136,299	1913.5	3.1	133,671
1501	2.8	136,299	1916	3.05	134,089
1516	2.8	136,299	1923.5	3.05	134,089
1526	2.8	136,299	1931	3.05	134,089
1541	2.8	136,299	1941	3.05	134,089
1548.5	2.9	135,390	1943.5	2.9	135,390
1556	3.05	134,089	1946	2.8	136,299
1601	3.1	133,671	1951	2.8	136,299
1611	3.15	133,260	1956	2.8	136,299
1613.5	3.25	132,459	2006	2.8	136,299
1616	3.3	133,069	2016	2.8	136,299
1626	3.3	133,069	2026	2.8	136,299
1636	3.3	133,069	2036	2.8	136,299
1646	3.3	133,069	2046	2.8	136,299
1648.5	3.4	131,307	2058.5	2.9	135,390
1653.5	3.3	133,069	2106	2.9	135,390
1701	3.35	131,685	2108.5	3.05	134,089
1703.5	3.4	131,307	2121	3.1	133,671
1708.5	3.35	131,685	2133.5	3.1	133,671
1713.5	3.3	133,069	2136	3.05	134,089
1721	3.3	133,069	2146	3.05	134,089

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PRESSURE AND ALTITUDE DATA
Flight 1154-N

Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (in. Hg)	Alt. (ft.)
0546.8	-	Launch	0546.8	-	Launch
0552.5	834	5,200	0600	622	12,900
0618.5	379	25,000	0610	495	18,600
0625.3	297	30,500	0620	357	26,400
0632.0	241	35,100	0630	258	33,600
0642.6	187.5	40,500	0640	201	39,000
0649.0	152.5	45,000	0650	146.1	45,900
0720.4	62.3	64,300	0700	112.5	51,600
0740.0	38.35	75,000	0710	83.0	58,200
0824.7	14.75	96,200	0720	63.5	64,200
0843.4	10.1	105,000	0730	49.2	69,600
0855.1	8.0	110,300	0740	36.8	75,900
0912.0	6.3	116,000	0800	22.3	86,900
0923.4	5.8	118,000	0810	17.9	91,800
0943.0	5.48	119,400	0820	13.6	98,100
0947.5	4.91	122,100	0830	9.92	105,300
1000	5.24	120,500	0840	7.49	111,900
1011	6.05	117,000	0850	5.9	117,600
1013.5	6.3	116,000	0900	4.9	122,150
1015.8	6.57	115,000	0910	4.1	126,600
1024.0	6.3	116,000	0920	3.63	129,600
1028.5	6.05	117,000	0930	3.31	132,000
1040.5	5.8	118,000	0940	3.12	133,500
1200	5.8	118,000	0950	3.16	133,200
1226	6.05	117,000	1000	3.19	132,900
1258	6.3	116,000	1010	3.19	132,900
1330	6.3	116,000	1020	3.23	132,600
1354	6.57	115,000	1030	3.43	131,100
1412	7.11	113,100	1040	3.47	130,300
1444	8.0	110,300	1050	3.51	130,500
1515	8.5	108,900	1100	3.63	130,000
1608	9.75	105,700	1120	3.72	129,000
1700	10.95	103,000			
1715	11.3	102,300			
1815	12.5	100,000			
1830	12.89	99,300			
1850	13.18	98,800			
2000	13.51	98,200			
2126	13.18	98,800			
2209		Terminate			
2217.5	64.2	63,900			
2230	372.5	25,400			

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Flight 1154
Upper Air Data for 1200Z, 26 June

Standard Levels

Pressure (MB)	T, °C	Wind Knots
1000	+ 9	280° 16
850	+ 2	310° 24
700	- 2	310° 29
500	-18	320° 27
400	-28	320° 25
300	-44	350° 21
250	-47	320° 20
200	-42	250° 18
150	-43	250° 13
100	-48	200° 10
70	-37	150° 6
50	-47	120° 10

Wind Data
Thousands

Significant Levels

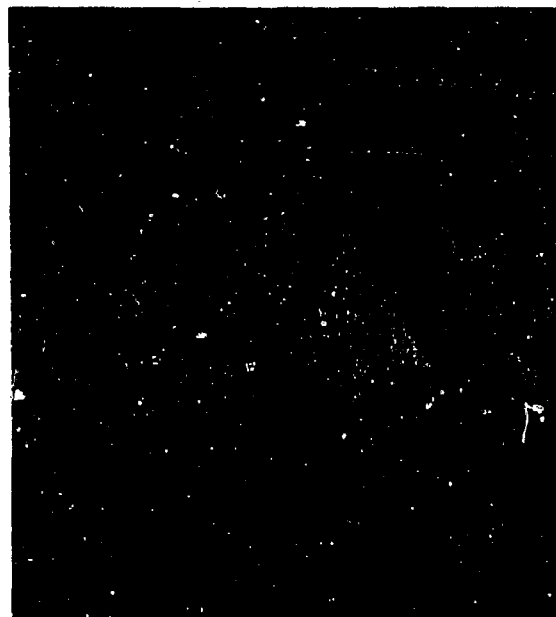
		of Feet	Direction	Knots
1002	+ 9	1	310°	20
961	+10	2	310°	22
824	0	5	300°	24
799	- 1	10	310°	28
761	0	16	320°	32
713	- 1	20	310°	25
666	- 5	25	330°	22
596	-12	30	350°	21
554	-13	35	320°	16
331	-40	40	250°	18
280	-48	45	250°	13
240	-48	50	250°	12
143	-44	60	220°	6
123	-49	70	130°	10
81	-50	77	090°	3
40	-47			
32	-46			

1155 - FLIGHT DESCRIPTION

Flight 1155 for the California Institute of Technology was launched on 27 June 1966 at 0323Z under the direction of R. Keuser and G. Mancuso. The flight was then terminated 15 hours later by radio command from Uranium City. No problems were encountered with the launching, flight, or recovery of this system.

The California Institute of Technology's gondola was designed to measure flux and energy spectrum of protons, electrons, alpha particles, and heavy nuclear particles up to and including oxygen in the range of 1 Mev to 1 Bev per nucleon. Data was automatically recorded on an on-board recorder. Principal investigator was Dr. R. Vogt.

The only difference in Raven's instrument package on this flight was the addition of a special Hayden timer placed on top of the parachute for termination backup. Instrumentation voltages and container temperatures were also telemetered to our ground stations. Raven's barocoder was still not functioning properly. Some changes had been made but not sufficient enough to allow complete venting of battery gasses. The time-altitude curves reflect this. Another problem occurred at 1555Z when the code drum on the barocoder stopped, preventing further altitude readout. Post flight inspection showed that the code drum was binding. Radio command ballasting worked satisfactorily 13 times out of 13 attempts.



Release of payload from M-36 truck,
radar antenna ready for launch.

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1155 - Flight Description (cont)

Tracking proficiency was still increasing as reflected by the Position Fix Map. Fort Churchill tracking station lost the beacon signal at 1633Z at 515 miles.

Transmitter frequency and command channels used were:

Transmitter Frequency:	253.1 MHz	
Command Channels:	Cutdown	1
	Ballast	2
	Private Line	1

R-1866

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LAUNCH LOG, SKYHOOK FLIGHT 1155

Cal. Tech. (Vogt)

Balloon: 10.6 x 10⁶ cubic foot Stratofilm
all times in CDT 26 June 1966

2000 Crew assembled at hanger, NOTAM activated for 2230 launch.
2000 Winds at DOT hanger NW 13.
2030 Winds at DOT hanger 280-300°, 10-14 mph.
2102-2120 Launch truck, with Vogt's package, moved from hanger to launch site.
2120 Wind indicated on mast in launch area 280-290°, 6 knots.
2130 Ground cloth laid out at 280°, per pibal.
2145 Wind 280°, 6 knots.
2130-2140 Balloon laid out.
2157 Inflation started, using two tubes, one trailer. Sun still up, shining on bubble.
2201 Bubble up.
2200 Winds 280°, 6 knots.
2218 Inflation completed.
2223 Launch; smooth, easy, no cross wind. Sun had just set.
2225 Radar acquired balloon.
2225 Winds on mast, 260°, 5 knots.
2200 DOT weather: Temperature 650°, winds WNW 13, sea-level pressure 1003.6 Mb.
Clouds; scattered at 8000, 11,000 and 25,000 feet.

Range Test Number: 96.6 SB165-A 2L.

Tropopause at 0000Z, 27 June: -53°C, at 259 Mb (53,523 ft.).

R-1866

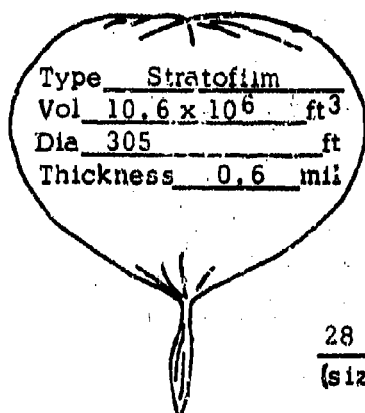
SKYHOOK BALLOON FLIGHT INFORMATION

NAVEXOS 3900/2 (Rev. 8-66)

RAVEN

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1. Company Raven Flight Number 1155-N Director Keuser, Mancuso
2. Scientist Veot Group Cal. Tech. Date/Time 6/27 / 0923 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 80 Ø 110 Ø 65°F 13 MPH 1003.6 MB Cross Wind Angle 10°
(Sky-Temp-Wind-Pressure)
Trop (Coldest) Ht. 33,523 ft Temp -53 °C Inflation Start 0257 Z
Hrs Sunshine on Bubble None Train Length (Layout) 460 ft.
5. Balloon Theoretical 2.01 Mbs 145,000 ft. How Determined?
Ceiling: Actual 2.02 Mbs 144,800 ft. Photobarograph
6. Ascent: Surface to Trop. 905 fpm Trop. to Ceiling 462 fpm.
7. Flight Duration: Total 14 hrs 57 min. At Ceiling 10 hrs. 10 min.
8. Termination: Time 1820 Z Altitude 142,000 ft. Cause Radio Command
9. Balloon Destruction-confirmed (Unknown (clouds)) (visual, unknown, etc)
10. Impact: Date/Time 6/27 / 1900 Z Location 58° 11' N 109° 48' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd. 15 hrs.
253.1 Altitude Telemetry 15 hrs.
4.015 & 7.465 Communication 15 hrs.
12. Balloon: Code Number SF-305.86-060-NSC-01 Serial Number 50



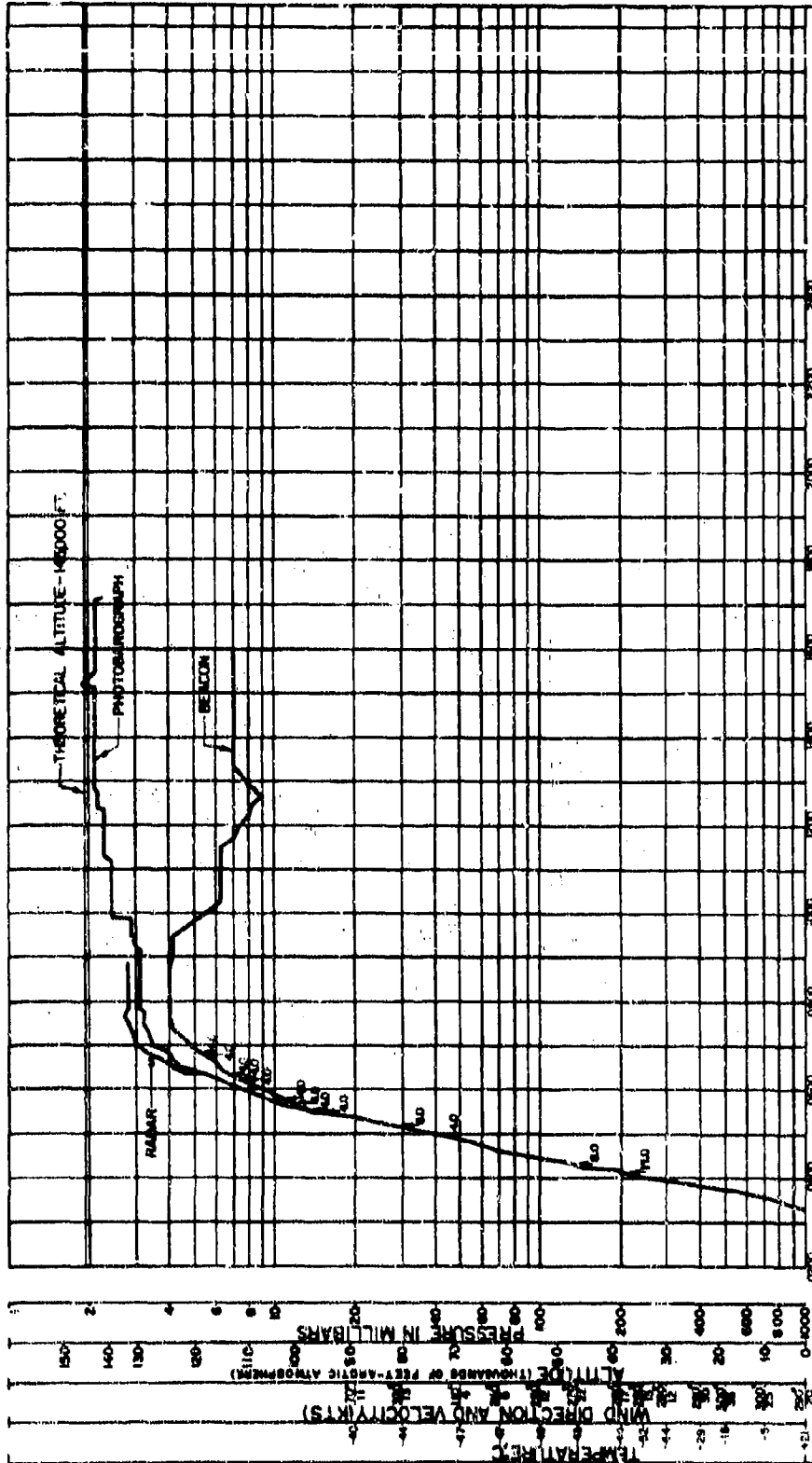
WEIGHTS

Balloon.....	1095.0
Parachute.....	29.0
Instrumentation.....	50.0
Ballast.....	150.0
Scientific Package.....	119.0
Other Photobarograph.....	8.0
Other Misc.....	18.0
Gross Weight.....	1469.0
Free Lift.....	146.0
Gross Inflation.....	1615.0
Helium used (cu. ft.).....	25,840

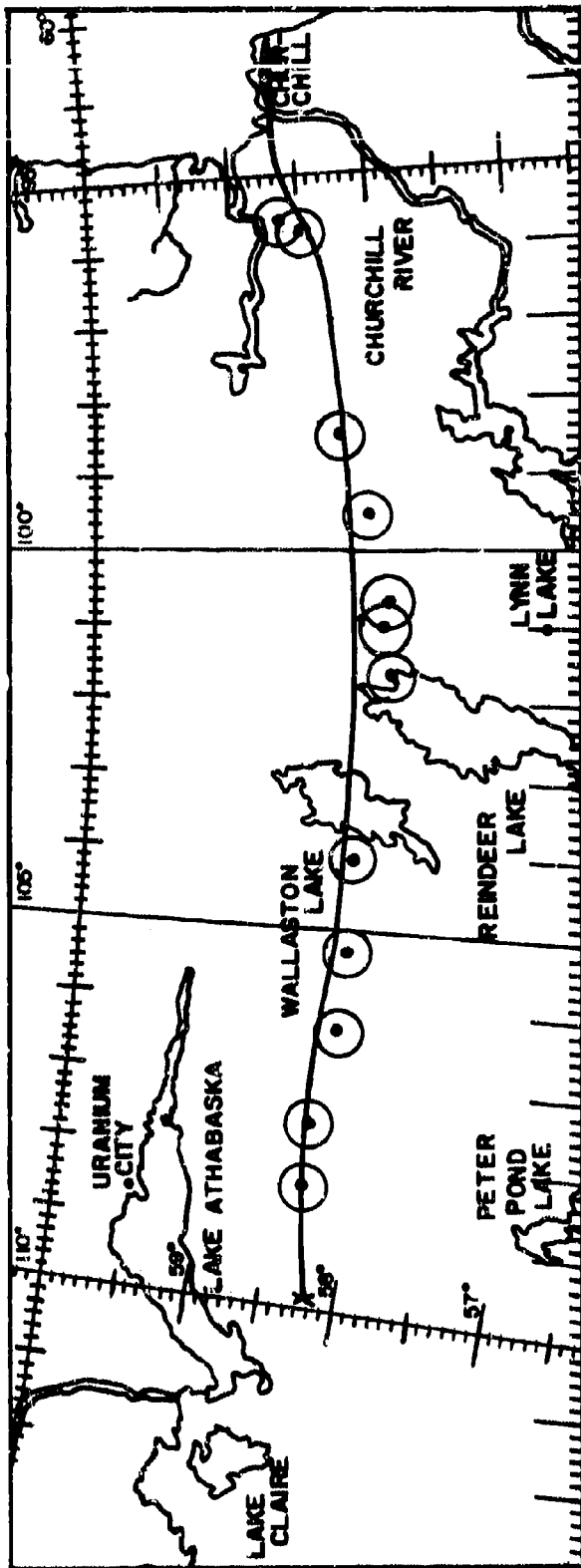
28 Ft. chute
(size)

13. Flight Failures Barocoder failed at 1555Z due to binding code drum.
(Nature of flight failures - if any)
14. Comments None
(Significant factors concerning the operation)

Copy to:
ONR/Fld Rep/Minn
ONR/Code 421



TIME	IDENTIFICATION	BALLOON	LOAD FACTORS	FLIGHT ALTITUDE
	FLIGHT NO: 1155-N FOR: CAL. TECH. DATE: 27 JUNE, 1966	TYPE: SF-305.86-060-NSC-01 VOLUME: 10.6 X 10 ³ CU. FT. MATERIAL: STRATOFILM WEIGHT: 10950 LBS.	PAYLOAD: 1190 LBS. GROSS LOAD: 14690 LBS. BALLAST: 1500 LBS.	LAST RADAR ALTITUDE: 132,000 FT. AVERAGE (PHOTOGRAPH) ALTITUDE: 143,000 FT.



POSITION FIXES		RADIO BEARINGS	
TIME(Z)	LATITUDE LONG.	TIME(Z)	LATITUDE LONGITUDE
0323.3	Fort Churchill	0700	58°-38' 95°-35'
0340	58°-41' 93°-44'	0800	58°-30' 95°-45'
0400	58°-38' 93°-32'	0950	58°-15' 98°-28'
0440	58°-39' 93°-18'	1040	58°-15' 98°-26'
0500	58°-39' 93°-22'	1100	59°-02' 99°-31'
0540	58°-39' 93°-49'	1120	57°-57' 100°-40'
0600	58°-39' 94°-03'	1130	57°-58' 101°-00'
0640	58°-39' 94°-39'	1215	57°-55' 101°-40'
0700	58°-37' 94°-51'	1345	58°-08' 104°-05'
0720	58°-31' 95°-16'	1500	58°-10' 105°-15'
0800	58°-23' 96°-02'	1530	58°-12' 106°-19'
0840	58°-10' 96°-57'	1600	58°-18' 107°-31'
1400	58°-14' 105°-10'	1630	58°-19' 108°-21'
1645	58°-18' 108°-20'		
1900	58°-11' 109°-48'		
Obtained by:		Station Fix	
Launch		2 Station Fix	
Radar		3 Station Fix	
Radar			
Radar			
Radar			
Radar			
Radar			
Radar			
Radar			
Radar			
C-47			
Cessna 206			
Impact			

Flight 1155 Ballasting Information

Table 1 below presents Radio Controlled ballast data for Flight 1155 launched on 27 June 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0200Z and 1820Z (termination), 58 pounds of ballast was automatically dropped at the rate of 3.6 pounds per hour. No problems were experienced with the ballast system during this flight.

Table 1
Ballast Data - Flight 1155

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
0408	16.0	134.0
0420	8.0	126.0
0500	4.0	122.0
0512	8.0	114.0
0532	4.0	110.0
0535	4.0	106.0
0544	4.0	102.0
0546	4.0	98.0
0614	8.0	90.0
0617	4.0	86.0
0618	4.0	82.0
0643	4.0	78.0
0649	4.0	74.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

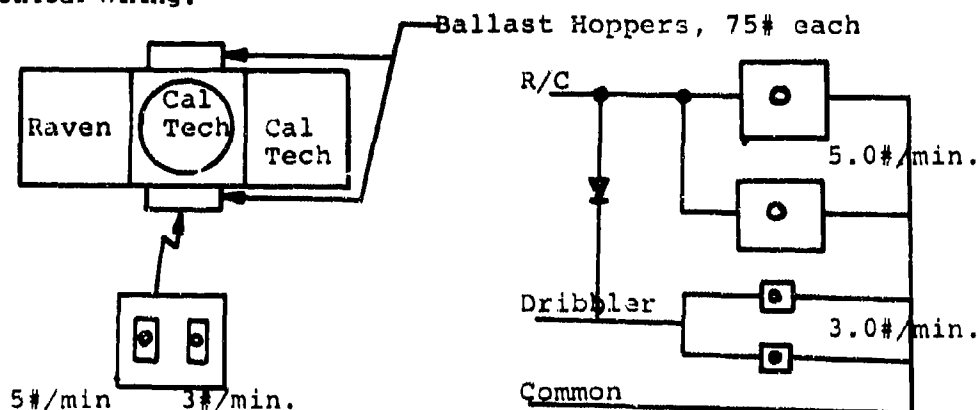


Figure 1

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PHOTOBAROGRAPH DATA
Flight 1155-N

RAVEN

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0449	57.8	66,100	0629	4.64	123,495
0451.5	52.6	68,200	0631.5	4.5	124,255
0454	48.1	70,075	0634	4.42	124,700
0456.5	43.6	72,210	0636.5	4.28	125,502
0459	40.3	73,921	0639	4.18	126,093
0501.5	37.4	75,546	0641.5	4.1	126,577
0504	34.5	77,304	0644	4.06	126,822
0506.5	31.5	79,294	0646.5	4.0	127,196
0509	29.0	81,109	0649	4.0	127,196
0511.5	26.5	83,097	0651.5	3.89	127,897
0514	24.1	85,199	0654	3.8	128,487
0516.5	22.0	87,227	0656.5	3.71	129,092
0519	20.4	88,912	0659	3.62	129,714
0521.5	18.8	90,742	0706.5	3.56	130,209
0524	17.5	92,353	0714	3.5	130,569
0529	15.0	95,838	0719	3.47	130,788
0531.5	14.3	96,923	0721.5	3.4	131,307
0534	13.4	98,403	0726.5	3.29	132,146
0536.5	12.4	100,175	0734	3.25	132,459
0539	11.5	101,903	0744	3.19	132,936
0541.5	10.8	103,347	0746.5	3.1	133,671
0544	10.0	105,123	0759	3.1	133,671
0546.5	9.65	105,947	0809	3.1	133,671
0549	9.2	107,056	0824	3.1	133,671
0551.5	8.95	107,698	0839	3.1	133,671
0554	8.38	109,230	0849	3.1	133,671
0556.5	8.11	109,990	0859	3.1	133,671
0559	7.62	111,475	0909	3.1	133,671
0601.5	7.06	113,375	0911.5	3.05	134,089
0604	6.82	114,100	0916.5	3.01	134,429
0606.5	6.5	115,271	0921.5	2.99	134,601
0609	6.3	116,023	0926.5	2.95	134,948
0611.5	6.2	116,409	0931.5	2.92	135,212
0614	5.79	118,085	0936.5	2.88	135,569
0616.5	5.6	118,876	0939	2.85	135,840
0619	5.4	119,763	0941.5	2.8	136,299
0621.5	5.18	120,730	0944	2.76	136,672
0624	5.0	121,650	0946.5	2.72	137,052
0626.5	4.85	122,400	0949	2.62	138,027

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Photobarograph Data
Flight 1155-N
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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0951.5	2.57	138,521	1509	2.15	143,232
0954	2.52	139,045	1519	2.15	143,232
1004	2.52	139,045	1521.5	2.11	143,730
1006.5	2.49	139,359	1526.5	2.11	143,730
1019	2.49	139,359	1529	2.08	144,109
1029	2.49	139,359	1536.5	2.08	144,109
1044	2.49	139,359	1546.5	2.08	144,109
1054	2.49	139,359	1549	2.02	144,886
1109	2.49	139,359	1551.5	2.02	144,886
1111.5	2.39	140,435	1559	2.02	144,886
1116.5	2.36	140,768	1601.5	2.08	144,109
1119	2.29	141,562	1606.5	2.02	144,886
1121.5	2.29	141,562	1609	1.98	145,418
1124	2.29	141,562	1616.5	1.98	145,418
1126.5	2.36	140,768	1619	2.08	144,109
1139	2.29	141,562	1624	2.11	143,730
1154	2.29	141,562	1626.5	2.11	143,730
1209	2.29	141,562	1629	2.15	143,232
1224	2.29	141,562	1644	2.15	143,232
1226.5	2.23	142,264	1646.5	2.20	142,383
1234	2.23	142,264	1649	2.23	142,264
1246.5	2.23	142,264	1659	2.23	142,264
1249	2.20	142,623	1704	2.23	142,264
1254	2.15	143,232	1706.5	2.29	141,562
1304	2.15	143,232	1719	2.29	141,562
1314	2.15	143,232	1734	2.29	141,562
1316.5	2.11	143,730	1741.5	2.29	141,562
1326.5	2.11	143,730	1749	2.29	141,562
1329	2.08	144,109	1756.5	2.29	141,562
1339	2.08	144,109	1804	2.29	141,562
1344	2.08	144,109	1806.5	2.29	141,562
1346.5	2.11	143,730	1811.5	2.23	142,264
1409	2.11	143,730	1814	2.23	142,264
1429	2.11	143,730	1819	2.15	143,232
1431.5	2.15	143,232	1821.5	18.2	91,471
1454	2.15	143,232	1824	41.9	73,075

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PRESSURE AND ALTITUDE DATA
Flight 1155-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0323.3	-	Launch	0323.3	-	Launch
0338.9	631	12,500	0330	774	7,200
0347.1	454	20,700	0340	559	15,600
0400.6	266	32,900	0350	390	24,300
0405.0	227	36,400	0400	260	33,450
0410.3	195	39,700	0410	193	39,900
0424.0	126	49,100	0420	140.2	46,800
0439.0	71.3	61,500	0430	94	55,500
0458.1	38.3	75,000	0440	64.8	63,600
0506.7	29.8	80,500	0450	45.2	71,400
0513.1	24.6	84,700	0500	31.1	79,600
0522.9	19.0	90,500	0510	22.5	86,700
0530.8	16.0	94,400	0520	16.8	93,300
0542.5	12.5	100,800	0530	12.9	99,300
0603.5	8.31	109,400	0540	9.8	105,600
0625.4	6.8	114,200	0550	7.87	110,700
0637.9	5.93	117,500	0600	6.6	114,900
0656.0	5.3	120,200	0610	6.05	117,000
0722.0	4.73	123,000	0620	5.04	121,500
0738.0	4.64	124,500	0630	4.56	123,900
0815	4.64	124,500	0640	4.14	126,300
0859	4.73	123,000	0650	3.86	128,100
0918	4.64	124,500	0700	3.51	130,500
0928	4.75	123,000	0730	3.23	132,600
0941	5.01	121,600	0740	3.16	133,200
0943	5.3	120,200	0750	3.27	132,300
0945	5.58	119,000	0800	3.31	132,000
1009	5.93	117,500	0810	3.31	132,000
1012	6.18	116,500	0820	3.31	132,000
1017	6.46	115,400	0830	3.31	132,000
1044	6.18	116,500	0840	3.31	132,000
1100	6.18	116,500	0850	3.31	132,000
1105	6.46	115,400			
1145	7.4	112,200			
1215	8.0	110,300			
1230	8.32	109,400			
1240	8.65	108,500			
1250	8.32	109,500			
1308	7.7	111,200			
1400	7.4	112,200			
1545	7.4	112,200			
1555	Barocoder stopped				

R-1866

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Flight 1155

Upper Air Data for 0000Z, 27 June (RAWIN)
and 1630Z, 27 June (ROCOB)Standard Levels (RAWIN)

Pressure (MB)	T, °C
1000	21
850	7
700	- 5
500	-18
400	-29
300	-44
250	-52
200	-44
150	-43
100	-48
70	-47
50	-47
30	-44
20	-40

Wind Kts.

290° 20
290° 22
300° 25
300° 36
290° 30
290° 12
280° 13
280° 17
270° 22
250° 12
250° 8
110° 4
300° 13
70° 11

Significant Levels (RAWIN)

Pressure (MB)	T, °C
717	- 5
662	- 5
586	-10
342	-37
322	-40
259	-53
240	-53
207	-45
153	-43
97	-49
40	-46
19	-41

ROCOB Data

Alt. KM	T, °C
24	-46
25	-45
26	-43
28	-40
30	-33
32	-30
34	-25
35	-23
36	-22
38	-16
40	- 8
42	- 3
44	- 2
45	+ 1
46	+ 4
48	+ 8
50	+ 7

Wind Kts.

90° 16
100° 20
90° 19
110° 19
90° 20
90° 24
100° 26
100° 25
100° 35
100° 39
100° 29
90° 30
90° 45
90° 51
90° 55
90° 61
110° 66

Wind Data (RAWIN)

Thousands of Feet	Direction	Knots
1	300°	22
5	290°	22
10	310°	27
16	290°	36
20	300°	37
25	300°	33
30	290°	13
35	280°	15
40	260°	16
45	270°	21
50	240°	8
60	230°	8
70	120°	4
80	320°	13
84	120°	6
90	70°	8

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1156 - FLIGHT DESCRIPTION

Flight 1156 for the University of Minnesota was launched at 2215Z on 27 June 1966 under the direction of M. Fulkerson and T. Pappas. Since the flight was of a simple "up and down" nature, the full compliment of Raven instrumentation was not flown. Launch and recovery were satisfactory.

Contents of the Minnesota gondola were used to make a vertical sounding of the dust concentration, dust size distribution, ozone concentration, and temperature. The dust counter itself was essentially a dark field microscope with a sensitive photomultiplier used as a detector. Air being sampled was directed in a well-defined stream through the focal point of the condenser lens where individual dust particles scatter light into the microscope and photomultiplier. If the particle size was large enough, the photomultiplier responded with an electrical pulse proportional to the particle size. The output of the sensor was then fed into a two-channel pulse height discriminator. Ozone detection was accomplished by a chemiluminescent detector. Principal investigators for this flight were Dr. Ney and Dr. Rosen.

Raven provided a Brailsford motor for backup cut-down in addition to a radio command primary system. The University of Minnesota provided their own low frequency beacon.



Churchill Research Range helicopter recovering payload from Flight 1156, in muskeg area near Fort Churchill.

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1156 - Flight Description (cont)

Termination was accomplished 3.8 hours after launch by radio command. No ballasting was used or carried during this flight.

R-1866

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LAUNCH LOG, SKYHOOK FLIGHT 1156

University of Minnesota (Rosen) Dust Analyzer
Balloon: 250,000 cubic foot Stratofilm, horse-tail duct
all times in CDT 27 June 1966

1500 Winds in DOT hanger East 8 mph.
1500 NOTAM activated for Flight at 1700.
1515 Advance party left hanger for launch site.
1530 Gondola loaded on truck (not launch truck).
1545 Gondola and launch truck left hanger for launch site.
1556 Gondola convoy arrived at launch site.
1600 Winds on mast in launch area indicated 090°, 4 knots.
1610 Balloon laid out for 060° winds, in line with pibals.
1645 Wind indicated at 360°, 3 knots; pibal showing 045°.
1655 Inflation started (1 tube, 1 trailer).
1708 Inflation completed.
1715 Launch. Balloon had been in full sun throughout inflation. Launch was slow and smooth. Truck held for balloon to come nearly overhead, moved 10 yards, sideways. Wind shear not significant.
1720 Wind readings on mast in launch area 360°, 2 knots.
1700 DOT weather; wind, ENE 5 mph, sea-level pressure 1003.7 Mb; Temperature 68°; Clouds scattered at 3000 feet.

Range Test Number: 97.5 SB165-A 3L.

Note, this balloon (#25) had two eye-bolt fittings, one on top and one on bottom. The inflation tube was small, poorly made, and had no crow's footing, or other reinforcement, and only a small tape seal into wall.

Tropopause at 0000Z, 28 June, -50°C at 282 Mb (31,675 ft.).

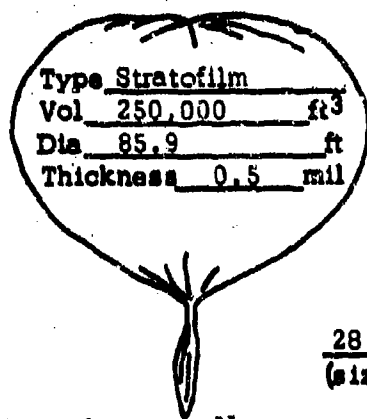
R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

RAVEN[®]

industries, inc.

1. Company Raven Flight Number 1156-N Director Fulkerson, Pappas
2. Scientist Ney-Rosen Group Univ. of Minn. Date/Time 6/27 / 2215 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 30 Ø 68°F 5 MPH 1003.7 MB Cross Wind Angle 60°
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 31,675 ft Temp -50 °C Inflation Start 2155 Z
 Hrs Sunshine on Bubble 0.3 Train Length (Layout) 160 ft.
5. Balloon Theoretical 9.47 Mbs 106,400 ft. How Determined?
 Ceiling: Actual 9.17 Mbs 107,100 ft. Radar-0000Z
6. Ascent: Surface to Trop. 1100 fpm Trop. to Ceiling 1220 fpm.
7. Flight Duration: Total 3 hrs 46 min. At Ceiling 1 hrs. 16 min.
8. Termination: Time 0101 Z Altitude 105000 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 6/28/ 0158 Z Location 58° 39' N 93° 45' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time

<u>149.4</u>	<u>Communication and Cmd.</u>	<u>3.5 hrs.</u>
<u>1710.8</u>	<u>Tracking</u>	<u>3.5 hrs.</u>
12. Balloon: Code Number SF-85,9-050-TT-02 Serial Number 25



28 Ft. chute
 (size)

WEIGHTS

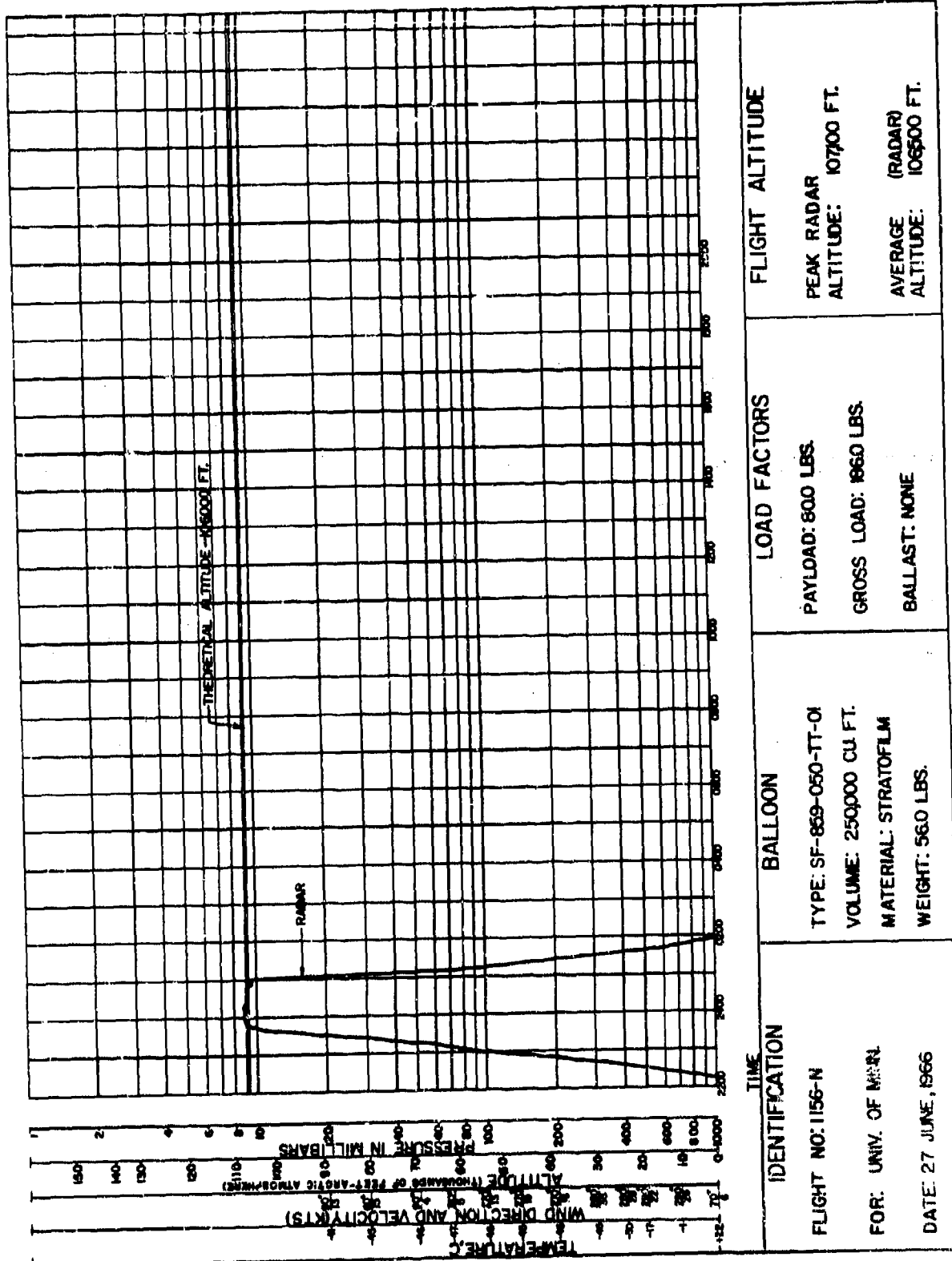
Balloon.....	56.0
Parachute.....	24.5
Instrumentation.....	13.5
Ballast.....	None
Scientific Package.....	80.0
Other. Minn. Transmitter.....	3.0
Other. Load Line and Ant.....	11.0
Gross Weight.....	186.0
Free Lift.....	42.7
Gross Inflation.....	228.7
Helium used (cu. ft.).....	3664

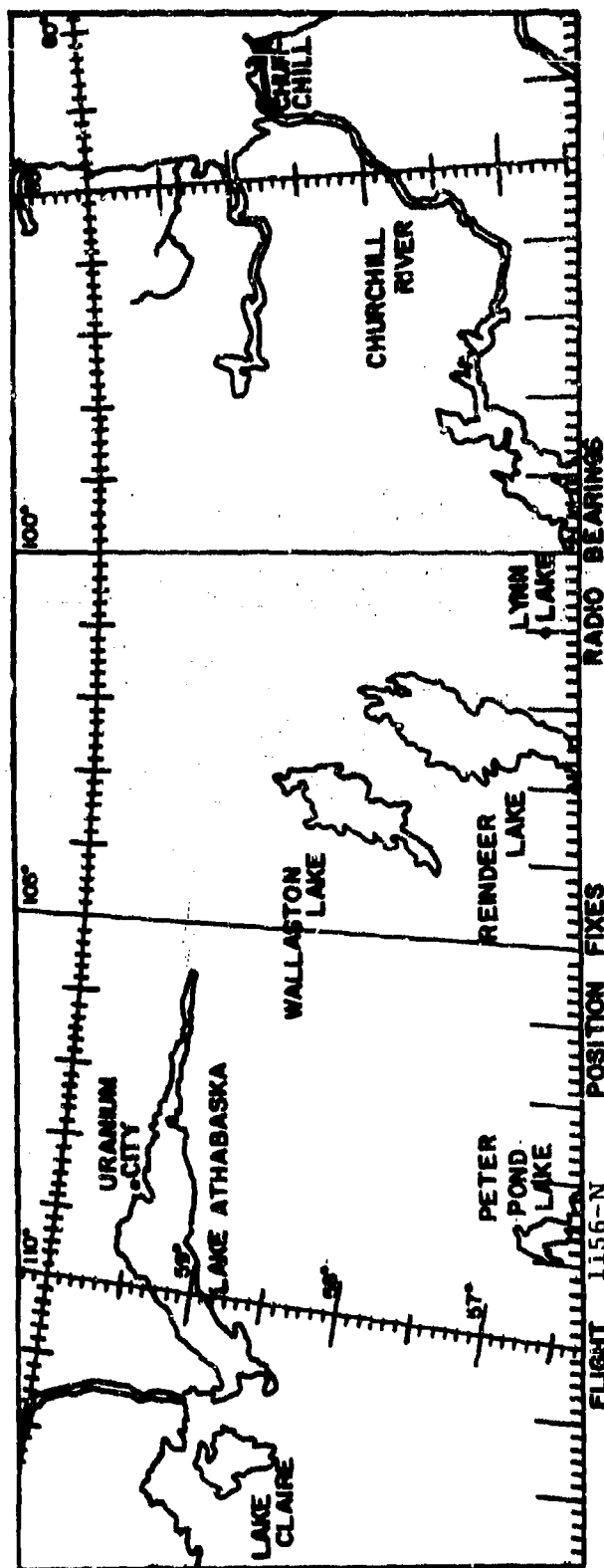
13. Flight Failures None
 (Nature of flight failures - if any)
14. Comments None
 (Significant factors concerning the operation)

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TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
2215	Fort Churchill		Launch			
2240	58°-41'	93°-44'	Radar			
2300	58°-40'	93°-26'	Radar			
2320	58°-40'	93°-20'	Radar			
2340	58°-40'	93°-31'	Radar			
0000	58°-40'	93°-41'	Radar			
0020	58°-40'	93°-51'	Radar			
0040	58°-40'	94°-00'	Radar			
0100	58°-41'	94°-09'	Termination			
0120	58°-40'	94°-07'	Radar			
0140	58°-39'	93°-49'	Radar			
0158	58°-38'	93°-42'	Impact			

Radio positioning not used for this flight

R-1866

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 PRESSURE AND ALTITUDE DATA
 Flight 1156-N

Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
Altitude Beacon not used on this flight.			2215	-	Launch
			2240	338	27,600
			2245	265	33,000
			2250	204	38,700
			2255	148.2	45,600
			2300	108.4	52,200
			2305	82.0	58,500
			2315	60.5	65,100
			2320	43.8	72,000
			2325	31.2	79,500
			2330	22.2	87,000
			2335	15.3	94,500
			2340	11.35	102,000
			2345	9.42	106,500
			2350	9.3	106,800
			2355	9.3	106,800
			0000	9.17	107,100
			0005	9.17	107,100
			0010	9.17	107,100
			0015	9.17	107,100
			0020	9.42	106,500
			0025	9.42	106,500
			0030	9.42	106,500
			0035	9.42	106,500
			0040	9.42	106,500
			0045	9.42	106,500
			0050	9.54	106,200
			0055	9.92	105,300
			0101 (term)	10.05	105,000
			0110	73.4	60,900
			0120	193	39,900
			0130	352	26,700
			0140	539	16,500
			0150	800	6,300
			0158	-	Landing

R-1866

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Flight 1156

Upper Air Data for 0000Z, 28 June (RAWIN)
and 1630Z, 27 June (ROCOB)Standard Levels (RAWIN)

Pressure (MB)	T, °C	Wind Kts.
1000	+22	70° 6
850	+11	270° 12
700	- 1	290° 26
500	-17	290° 22
400	-30	280° 28
300	-45	280° 35
250	-51	280° 36
200	-45	270° 16
150	-45	270° 19
100	-46	270° 13
70	-47	310° 5
30	-46	90° 4
30	-45	60° 15
20	-41	90° 13

Significant Levels (RAWIN)

Pressure (MB)	T, °C
777	+ 4
691	- 2
576	-10
318	-40
282	-50
235	-51
203	-46
88	-48
40	-45
29	-45
15	-38
10	-29

ROCOB Data

Alt. KM	T, °C	Wind Kts.
24	-46	90° 16
25	-45	100° 20
26	-43	90° 19
28	-40	110° 19
30	-33	90° 20
32	-30	90° 24
34	-25	100° 25
35	-23	100° 25
36	-22	100° 35
38	-16	100° 39
40	- 0	100° 29
42	- 3	90° 30
44	- 2	90° 45
45	+ 1	90° 51
46	+ 4	90° 55
48	+ 8	90° 61
50	+ 7	110° 66

Wind Data (RAWIN)

Thousands of Feet	Direction	Knots
1	100°	3
5	270°	13
10	290°	26
16	290°	30
20	280°	30
25	280°	29
30	280°	34
35	280°	31
40	270°	16
45	280°	18
50	230°	13
60	300°	6
70	80°	4
80	60°	16
90	90°	12
100	110°	22
105	110°	24

R-1866

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1157 - FLIGHT DESCRIPTION

Flight 1157 for the University of Minnesota was launched at 0859Z on 30 June 1966 under the direction of R. Keuser and T. Pappas. After an easy launch, trajectory problems began to appear which ended up with the loss of this payload in Hudson Bay.

The original flight plan and weather analysis called for a trajectory similar to that flown on Flight 1156. On that flight, the balloon moved east and then south and east...never over the bay. Flight 1157 started out in an easterly direction, turned north at the floating level, and then headed west. This meant that the flight had to be extended to permit it to cross over land north of Fort Churchill. Unfortunately, the Brailsford timer, added at Churchill, was improperly set (four hours instead of the selected five hours). Although the flight was terminated over land, easterly winds during parachute descent blew the chute and load out over Hudson Bay where it could not be recovered.

The relatively short duration flights were made at the request of the scientists since they desired data during descent and had to keep it within range of a GMD station.



DOT hanger, where space was provided
for scientific users, ONR, and Raven.

R-1866

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1157 - Flight Description (cont.)

Principal investigators for the University of Minnesota were Dr. Ney and Dr. Rosen. The experiment was identical to that flown on Flight 1156...vertical sounding of dust concentration, dust size distribution, ozone concentration, and temperature.

Raven Instrumentation was again very abbreviated...consisting of a basic radio command termination device. No altitude beacon or photobarograph was flown.

Cause of lost payload...human error in setting a rudimentary timer or in not insisting on a more accurate timer to begin with.

R-1866

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LAUNCH LOG, SKYHOOK FLIGHT 1157

University of Minnesota (Rosen) Dust Analyzer

Balloon: 250,000 cubic foot Stratofilm, horse-tail duct

Very short inflation tube. Not long enough to fill bubble; had to stand on ladder.
all time in CDT 30 June 1966

2000 June 29, Winds in DOT hanger 17 gusting to 25. Weather watch instituted.
0000 Winds SE 17
0100 Winds SSE 10
0200 Winds SSE 9, crew called out.
0240 Crew arrived in hanger, winds 180° 8 mph. NOTAM activated for launch
at 0430.
0315 Crew, with payload, reached launch area. Winds on mast in launch area
indicated 200° 2 knots. Pibal put up, showing 240°.
0325 Balloon laid out, per 240°.
0330 Inflation commenced, Air Radio requested to advance time of launching to 0400.
0350 Inflation completed.
0358 Launch. Light wind, truck moved forward, then to one side, no significant
cross wind. Easy launch.
0400 DOT weather: Wind SSW 7 mph; temperature 55°F; SLP 1001.9 Mb; scattered
clouds at 7000 feet. Patches of fog beginning to form in low spots.

Range Test Number: 103.6 SB165-A 3L.

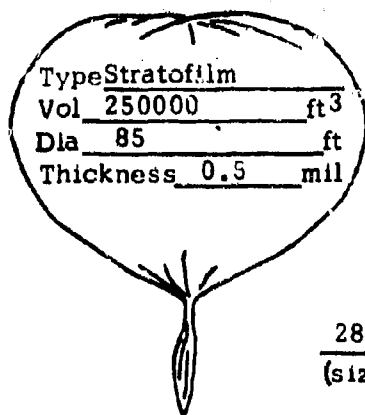
Tropopause at 1200Z, 30 June: -52°C at 236 Mb (35,337 ft.).

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

RAVEN[®]
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1. Company Raven Flight Number 1157-N Director Keuser, Pappas
2. Scientist Ney-Rosen Group Univ of Minnesota Date/Time 6/30 / 0859 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 70 @ 55°F 7 MPH 1001.9 MB Cross Wind Angle None
 (Sky-Temp-Wind-Pressure)
 Trop(Coldest)Ht. 37057 ft Temp -57 °C Inflation Start 0830 Z
 Hrs Sunshine on Bubble None Train Length(Layout) 160 ft.
5. Balloon Theoretical 9.42 Mbs 106500 ft. How Determined?
 Ceiling: Actual 8.95 Mbs 107700 ft. Radar-1105Z
6. Ascent: Surface to Trop. 1010 fpm Trop. to Ceiling 1095 fpm.
7. Flight Duration: Total 3 hrs 54 min. At Ceiling 2 hrs. 25 min.
8. Termination: Time 1255 Z Altitude 102000 ft. Cause Timer
9. Balloon Destruction-confirmed Unknown-Fog (visual, unknown, etc)
10. Impact: Date/Time 6/30/ 1342 Z Location 94° 12' W 59° 11' N
11. Frequency used:

(Kcs, Mcs)	Purpose	Total Time
<u>149.4 Mc</u>	<u>Command & Comm.</u>	<u>3 hrs.</u>
<u>1710 Kc</u>	<u>Tracking</u>	<u>3 hrs.</u>
<u>1680 Mc</u>	<u>GMD Data</u>	<u>3 hrs.</u>
12. Balloon: Code Number SF-85 9-050-TT-02 Serial Number 26



28 Ft. chute
 (size)

WEIGHTS

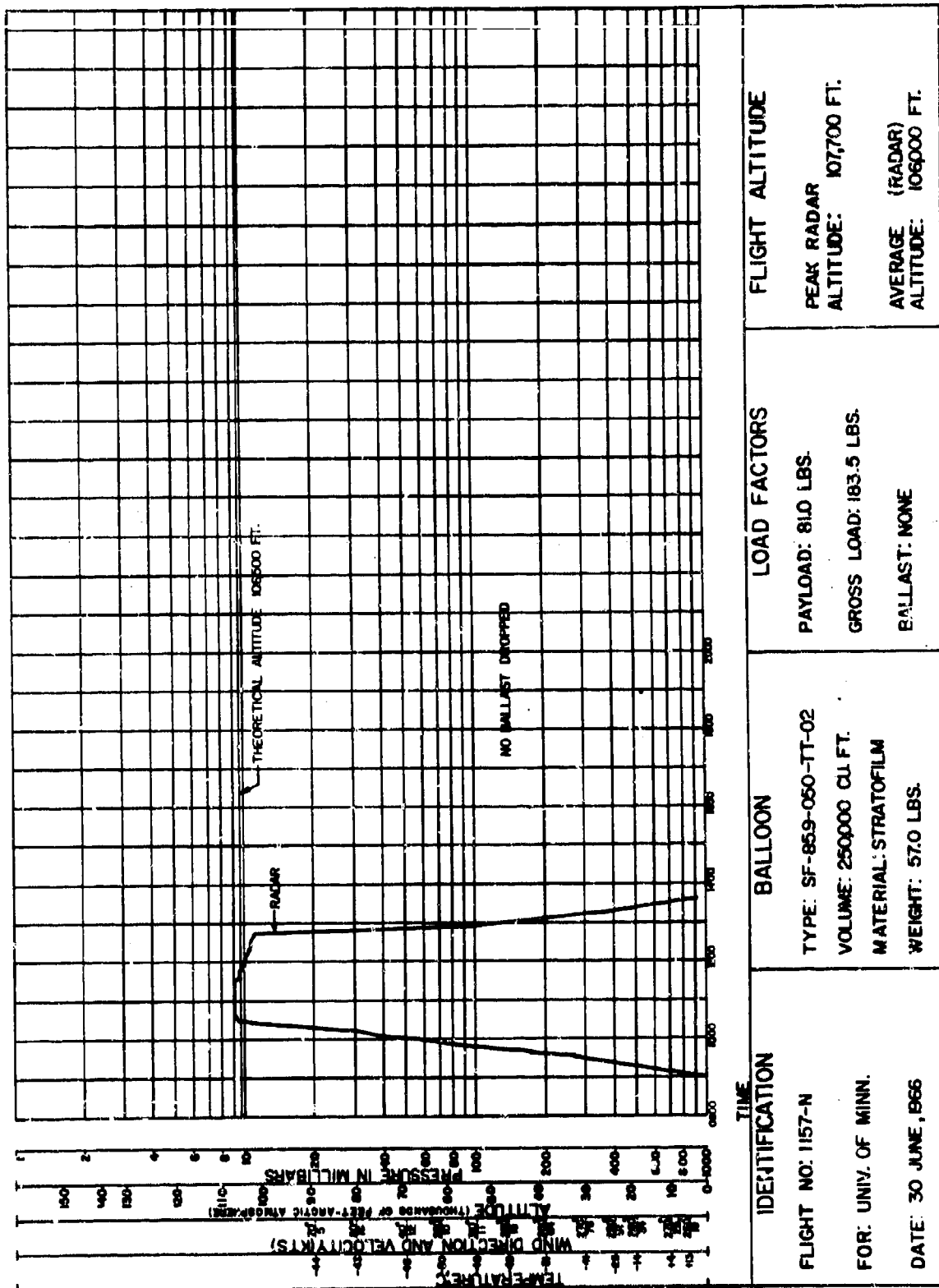
Balloon.....	<u>57.0</u>
Parachute.....	<u>22.5</u>
Instrumentation.....	<u>12.0</u>
Ballast.....	<u>None</u>
Scientific Package.....	<u>81.0</u>
Other. Minn Transmitter.....	<u>3.0</u>
Other.. Misc.....	<u>12.0</u>
Gross Weight.....	<u>183.5</u>
Free Lift.....	<u>36.7</u>
Gross Inflation.....	<u>220.2</u>
Helium used (cu. ft.).....	<u>3520</u>

13. Flight Failures Parachute Payload lost in Hudson Bay. Incorrect timer setting.
 (Nature of flight failures - if any)
14. Comments None
 (Significant factors concerning the operation)

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IDENTIFICATION

FLIGHT NO: 1157-N
FOR: UNIV. OF MINN.
DATE: 30 JUNE, 1966

BALLOON

TYPE: SF-859-050-TT-02
VOLUME: 250000 CU FT.
MATERIAL: STRATOFILM
WEIGHT: 570 LBS.

LOAD FACTORS

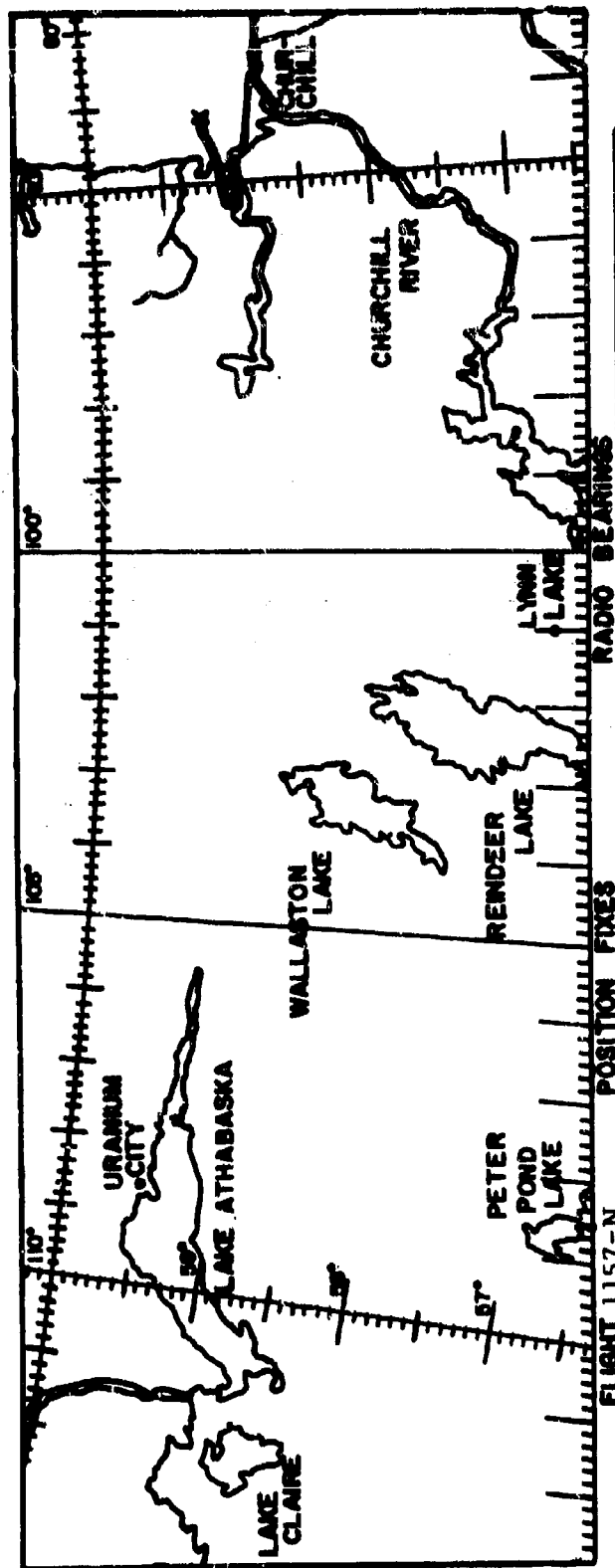
PAYLOAD: 810 LBS.
GROSS LOAD: 183.5 LBS.
BALLAST: NONE

FLIGHT ALTITUDE

PEAK RADAR
ALTITUDE: 107,700 FT.
AVERAGE (RADAR)
ALTITUDE: 106000 FT.

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TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0895	Fort Churchill		Launch			
0933	58°-48'	93°-25'	Radar			
0950	58°-49'	92°-56'	Radar			
1010	58°-47'	92°-59'	Radar			
1030	58°-47'	93°-10'	Radar			
1110	58°-49'	93°-51'	Radar			
1130	58°-52'	94°-05'	Radar			
1150	58°-54'	94°-24'	Radar			
1210	58°-58'	94°-39'	Radar			
1230	59°-00'	94°-59'	Radar			
1246	Termination					
1255	59°-00'	95°-18'	Radar			
1315	59°-07'	94°-40'	Radar			
1330	59°-12'	94°-20'	Radar			
1342	59°-11'	94°-12'	Impact			

Radio positioning not used for this flight

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1157-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
			0859	-	Launch
			0933	278	32,00
			0940	180	41,400
No Altitude Beacon or Photobarographs flown on this flight.			0950	100.9	54,000
			1000	56.4	66,600
			1005	41.1	73,500
			1010	29.8	80,500
			1015	21.65	87,600
			1020	15.9	94,500
			1025	11.6	101,700
			1030	9.42	106,500
			1035	9.3	106,800
			1040	9.18	107,100
			1045	9.18	107,100
			1050	9.18	107,100
			1055	9.06	107,400
			1100	9.06	107,400
			1105	8.95	107,700
			1110	8.95	107,700
			1115	8.95	107,700
			1120	8.95	107,700
			1125	9.06	107,400
			1130	9.3	106,800
			1135	9.66	105,900
			1140	9.8	105,600
			1145	10.1	105,000
			1150	10.19	104,700
			1155	10.45	104,100
			1210	10.87	103,200
			1220	11.15	102,600
			1230	11.45	102,000
			1246 (Term)	12.22	100,500
			1255	90.2	56,400
			1300	140.2	46,800
			1305	221.5	36,900
			1310	292	30,900
			1315	376	25,200
			1320	454	20,700
			1330	667	11,100
			1340	956	1,500
			1342	-	Landing

R-1866

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Flight 1157
Upper Air Data for 1200Z, 30 June

Standard Levels

Pressure (MB)	T, °C	Wind Kts.
850	+13	290° 19
700	+ 4	270° 25
500	-14	260° 34
400	-25	250° 51
300	-41	270° 76
250	-49	270° 120
200	-51	250° 64
150	-48	260° 19
100	-48	310° 11
70	-50	260° 10
50	-48	40° 12
30	-43	80° 16
20	-44	70° 5

Wind Data

Significant Levels

		Thousands of Feet	Direction	Knots
1000	+14	1	330°	19
975	+16	2	340°	19
880	+15	5	280°	19
766	+ 7	10	270°	25
754	+ 8	16	260°	29
460	-19	20	260°	41
236	-52	25	260°	52
168	-47	30	270°	69
74	-50	35	270°	122
40	-47	37	280°	69
31	-43	40	260°	64
19	-44	44	260°	60
14	-38	45	260°	33
		46	260°	19
		50	270°	46
		57	270°	26
		60	260°	8
		68	320°	3
		70	70°	17
		80	80°	15
		90	80°	7
		96	50°	17

1158 - FLIGHT DESCRIPTION

California Institute of Technology Flight 1158 was launched at 0751Z on 3 July 1966 under the direction of M. Fulkerson and T. Pappas. Ten hours and 25 minutes later, the flight was terminated from Uranium City by radio command.

California's equipment consisted of a dE/dx Cerenkov telescope and a dE/dx range telescope with solid state detectors to measure flux and energy spectrum of protons, electrons, alpha particles, and heavy nuclear particles up to and including oxygen in the range of 1 Mev to 1 Bev per nucleon. Data was recorded on board with a recorder. Dr. R. Vogt headed the project.

Raven Industries' standard instrumentation set was provided with a few modifications. The gondola was to be flown upside down and then flipped upright when on parachute descent. The flip was to be performed by radio command from the tracking aircraft or by pressure switch activated at 15,000 feet.

A pressure switch was added to the instrument package to provide a pulse to a latching relay on ascent. This armed the pressure switch circuit so that the flip squibs would fire on descent. In practice, the flip squibs were fired by radio command from the aircraft. Unfortunately, the radar target line became



Rigging in DOT hanger. California Institute of Technology upside down flight.

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1158 - Flight Description (cont.)

entangled in the rigging, preventing a complete flip. Impact was in Lake Archibald. The gondola and instrument container were not damaged but the photobarograph was ruined as was the Haydon top timer.

Tracking had considerably improved with practice and minor equipment changes...as indicated by the Position Fix Map. Lynn Lake first acquired the beacon signal while the balloon was ascending at 58,000 feet (0855Z). Churchill tracking then, lost the signal at 1745Z when the balloon was approximately 490 miles away.

In addition to the special "flip" circuit, telemetered instrumentation voltages and container temperatures were installed and used.

Radio command ballasting was used and confirmed seven times.

Transmitter frequency and command channels used were:

Transmitter Frequency:	253.1 MHz	
Command Channel	Cutdown	7
	Ballast	8
	Gondola Flip	9
	Private Line	1

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LAUNCH LOG, SKYHOOK FLIGHT 1158

Cal. Tech. (Vogt)

Balloon: 10.6 x 6¹⁰ cubic foot 0.6 mil Stratofilm
with cap. Upside-down gondola
all times in CDT 3 July 1966

0000 Winds at DOT hanger 340°, 7 mph. Crew called up. NOTAM activated
for launch at 0200.
0015 Crew in hanger; rigging on upside down gondola commenced.
0100 Winds 330-360°, 5-8 mph in DOT hanger.
0115 Gondola rigging completed, mounted on launch truck.
0130 Launch truck convoy left DOT hanger for launch site. Remainder of
crew went ahead to lay out pibal and balloon.
0213 Gondola and launch truck reached launch site. Balloon already laid
out in accord with pibal from 360°. Wind on mast in launch area: 360°,
5 knots. Wind reported at DOT hanger; North, 6 mph. Launch notice
advanced to 0300.
0222 Inflation commenced.
0225 Bubble up.
0243 Inflation completed.
0251 Launch. Truck moved only a few feet. Very easy launch. Winds indicated
360°, 2 knots.
0300 DOT weather: clear; wind North 6; SLP 1021.9 Mb; Temperature 46°F.

Range Test Number: 106.6 SB165-A 3L.

Tropopause at 1200Z -49°C, at 276 Mb (32,144 ft.).

R-1866

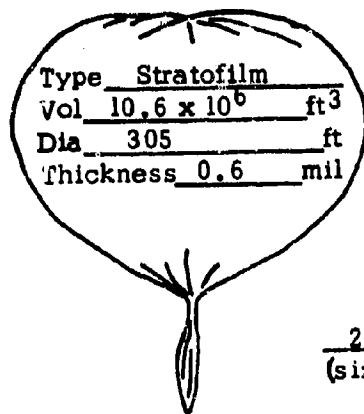
SKYHOOK BALLOON FLIGHT INFORMATION

NAVEXOS 3900/2 (Rev. 8-66)

RAVEN

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1. Company Raven Flight Number 1158-N Director Fulkerson, Pappas
2. Scientist Vogt Group Cal Tech Date/Time 7/3 /0751 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: Clear 46 °F 6 MPH 1021.9 MB Cross Wind Angle None
(Sky-Temp-Wind-Pressure)
- Trop (Coldest) Ht. 32144 ft Temp -49 °C Inflation Start 0522 Z
- Hrs Sunshine on Bubble None Train Length (Layout) 480 ft.
5. Balloon Theoretical 2.00 Mbs 145200 ft. How Determined?
Ceiling: Actual 2.11 Mbs 143300 ft. Photobarograph
6. Ascent: Surface to Trop. 1000 fpm Trop. to Ceiling 1130 fpm.
7. Flight Duration: Total 10 hrs 25 min. At Ceiling 7 hrs. 36 min.
8. Termination: Time 1816 Z Altitude 139250 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 7/3 / 1853 Z Location 59 ° 01 ' N 108 ° 31 ' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
- | | | |
|--------------------------|--------------------------------|----------------|
| <u>253.1</u> | <u>Altitude Telemetry</u> | <u>12 hrs.</u> |
| <u>149.4</u> | <u>Communication & Cmd</u> | <u>12 hrs.</u> |
| <u>7.456 & 4.015</u> | <u>Communication</u> | <u>12 hrs.</u> |
12. Balloon: Code Number SF-305.86-060-NSC-01 Serial Number 51



WEIGHTS

Balloon.....	1095.0
Parachute.....	30.0
Instrumentation.....	52.5
Ballast.....	150.0
Scientific Package.....	126.5
Other Photobarograph.....	9.0
Other Misc.....	17.0
Gross Weight.....	1480.0
Free Lift.....	148.0
Gross Inflation.....	1628.0
Helium used (cu. ft.).....	26,048

28 Ft. chute
(size)

13. Flight Failures Water Landing-Photobarograph ruined
(Nature of flight failures - if any)
14. Comments Radar target became entangled with gondola during descent. Prevented
(Significant factors concerning the operation)
complete flip of gondola.

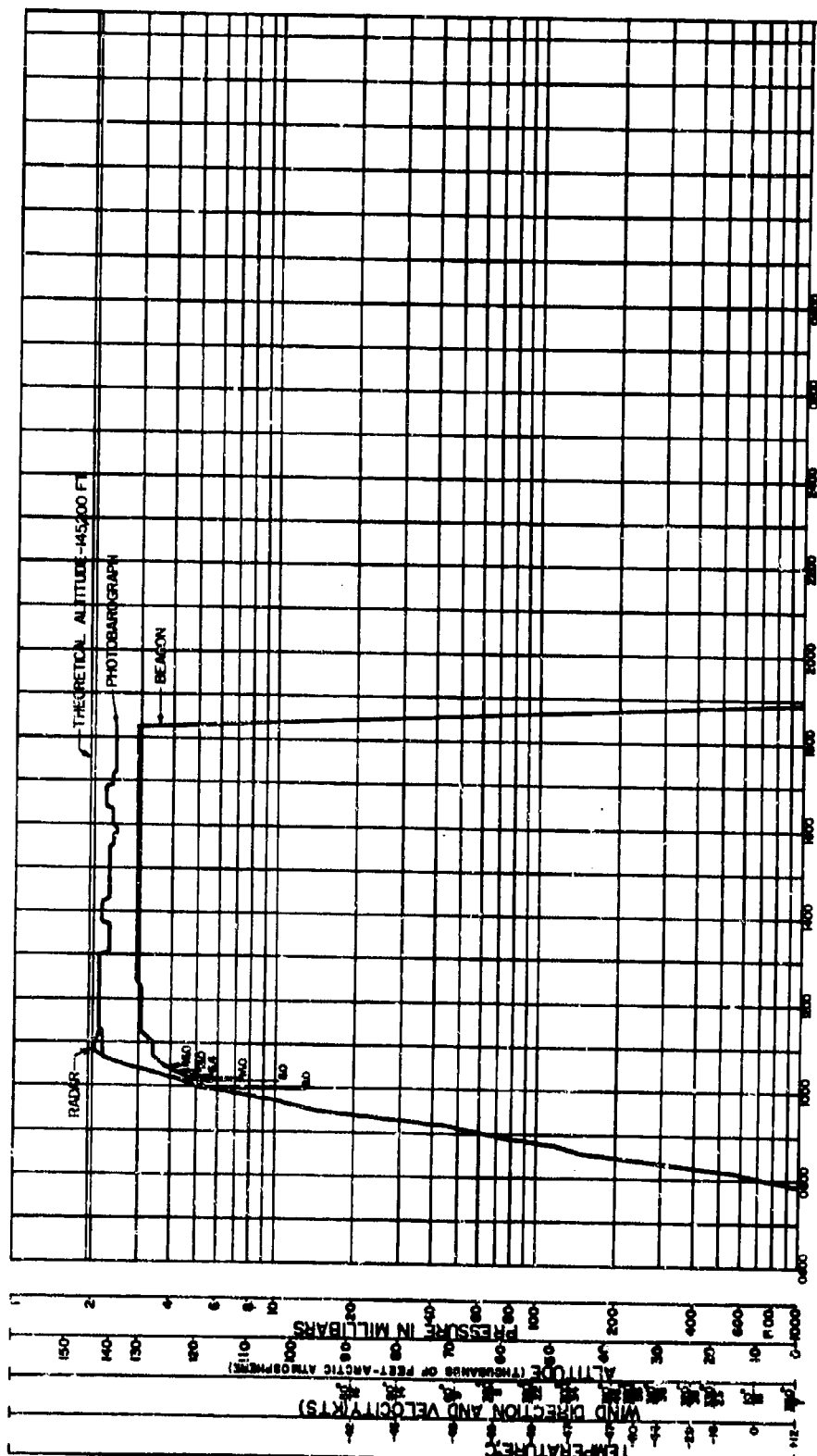
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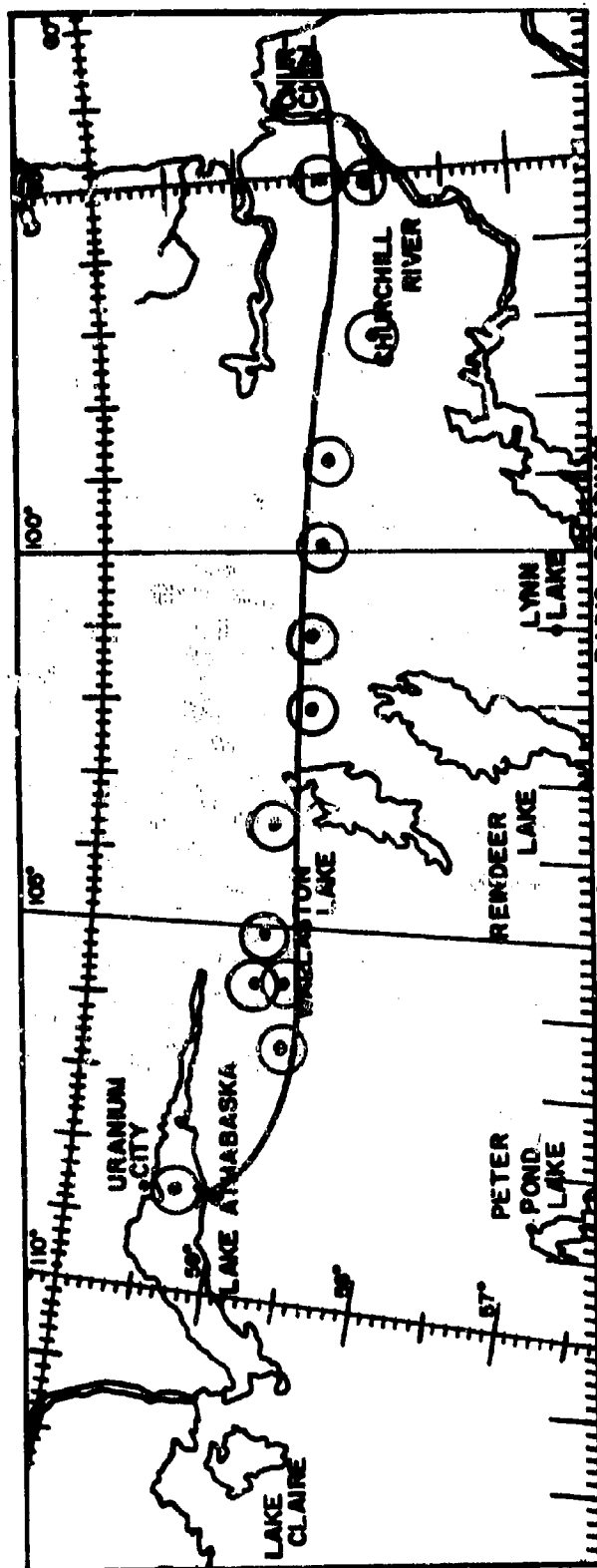
ONR/Code 421

RAVEN

Industries, Inc.



TIME		
IDENTIFICATION	BALLOON	FLIGHT ALTITUDE
FLIGHT NO: 1158-N	TYPE: SF-305.96-060-NSC-01	LAST RADAR ALTITUDE: 14600 FT.
FOR: CAL. TECH.	VOLUME: 106X10 ⁶ CU. FT.	AVERAGE (PHOTOBAROGRAPH) ALTITUDE: 141000 FT.
DATE: 3 JULY, 1966	MATERIAL: STRATOFILM	
	WEIGHT: 1095.0 LBS.	
	PAYLOAD: 126.5 LBS.	
	GROSS LOAD: 1480.0 LBS.	
	BALLAST: 1500 LBS.	



FLIGHT 1158-N		POSITION FIXES		RADIO BEARINGS	
TIME(Z)	LATITUDE LONG.	OBTAINED BY	TIME(Z)	LATITUDE LONGITUDE	
0751.5	Fort Churchill	Launch	10301	58°-03' 95°-09'	
0800	58°-41' 94°-02'	Radar	11001	58°-21' 95°-03'	
0830	58°-29' 93°-45'	Radar	11301	58°-02' 97°-10'	
0850	58°-25' 93°-26'	Radar	13001	58°-25' 98°-47'	
0930	58°-20' 93°-30'	Radar	13301	58°-28' 99°-57'	
0950	58°-18' 93°-46'	Radar	14001	58°-32' 101°-03'	
1010	58°-16' 94°-03'	Radar	14301	58°-31' 102°-06'	
1050	58°-15' 95°-02'	Radar	15302	58°-46' 103°-40'	
1110	58°-16' 95°-40'	Radar	16002	58°-48' 105°-07'	
1130	58°-18' 96°-18'	Radar	16302	58°-51' 105°-46'	
1150	58°-22' 96°-50'	Radar	17002	58°-40' 105°-44'	
1635	58°-33' 105°-33'	C-47	17301	58°-39' 106°-37'	
1733	58°-40' 107°-31'	Cessna 185	17501	59°-31' 108°-32'	
1816	Termination				
1853	59°-01' 108°-31'	Impact			

 (1) 2 Station Fix
 (2) 3 Station Fix

Flight 1158 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1158 launched on 3 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0729Z and 1816Z (termination), 35.5 pounds of ballast was automatically dropped at the rate of 3.3 pounds per hour. No problems were encountered with the ballasting system on this flight.

Table I
Ballast Data-Flight 1158

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
0959.5	8.0	142.0
1009.5	8.0	134.0
1014.0	16.0	118.0
1019.0	6.4	111.6
1023.5	16.0	95.6
1034.0	11.0	79.6

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

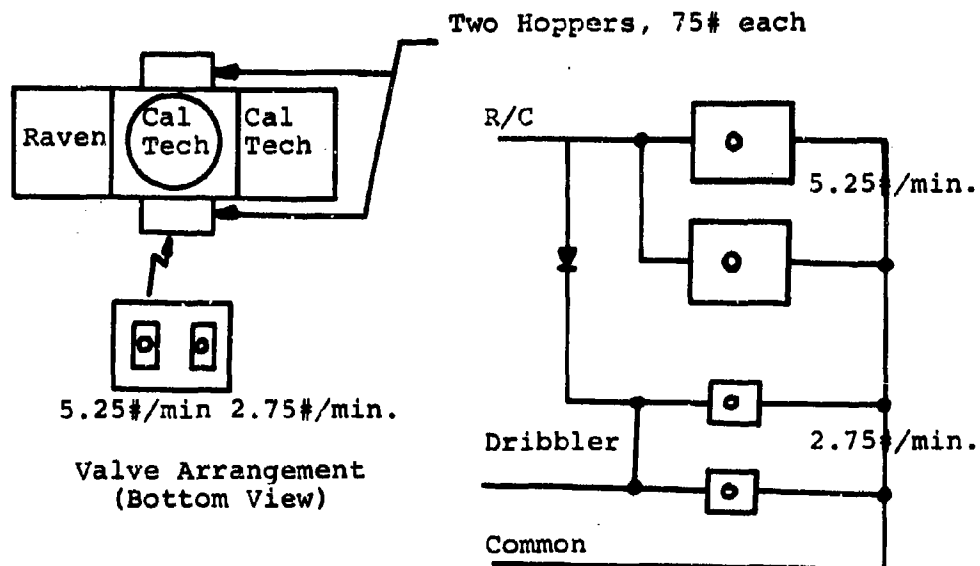


Figure 1

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PHOTOBAROGRAPH DATA
Flight 1158-N

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0904.5	58.0	65,007	1047	2.25	142,028
0907	49.1	69,627	1049.5	2.25	142,028
0909.5	44.3	71,864	1052	2.25	142,028
0912	39.4	74,413	1057	2.25	142,028
0914.5	35.4	76,742	1059.5	2.25	142,028
0917	31.6	79,224	1102	2.25	142,028
0919.5	26.5	83,097	1104.5	2.25	142,028
0922	22.6	86,627	1107	2.25	142,028
0924.5	20.4	88,912	1114.5	2.25	142,028
0927	18.3	91,348	1117	2.18	142,865
0929.5	16.4	93,818	1122	2.18	142,865
0932	15.0	95,838	1127	2.18	142,865
0934.5	13.6	98,066	1132	2.18	142,865
0937	11.0	101,118	1137	2.18	142,865
0939.5	10.8	103,347	1139.5	2.18	142,865
0942	9.9	105,355	1144.5	2.18	142,865
0944.5	9.0	107,568	1147	2.1	143,856
0947	8.2	109,749	1152	2.1	143,856
0949.5	7.55	111,699	1157	2.1	143,856
0952	6.9	113,841	1202	2.1	143,856
0954.5	6.2	116,409	1207	2.1	143,856
0957	5.75	118,233	1212	2.1	143,856
0959.5	5.15	120,924	1214.5	22.1	143,856
1002	4.8	122,656	1222	2.1	143,856
1004.5	4.5	124,255	1227	2.1	143,856
1007	4.25	125,678	1232	2.1	143,856
1009.5	4.15	126,273	1237	2.1	143,856
1012	3.9	127,832	1242	2.1	143,856
1014.5	3.65	129,505	1247	2.1	143,856
1017	3.4	131,307	1249.5	2.1	143,856
1019.5	3.4	131,307	1252	2.18	142,865
1022	3.17	133,098	1254.5	2.18	142,865
1024.5	2.9	135,390	1257	2.25	142,028
1027	2.9	135,390	1302	2.25	142,028
1029.5	2.75	136,766	1304.5	2.28	141,678
1032	2.55	138,735	1312	2.28	141,678
1034.5	2.5	139,253	1317	2.28	141,678
1039.5	2.25	142,028	1319.5	2.28	141,678
1042	2.25	142,028	1322	2.25	142,028
1044.5	2.25	142,028	1327	2.25	142,028

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Photobarograph Data
Flight 1158-N
Page 2

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1332	2.25	142,028	1557	2.5	139,253
1339.5	2.25	142,028	1559.5	2.4	140,325
1342	2.18	142,865	1602	2.4	140,325
1344.5	2.18	142,865	1607	2.4	140,325
1352	2.18	142,865	1609.5	2.32	141,219
1359.5	2.18	142,865	1614.5	2.32	141,219
1407	2.18	142,865	1617	2.4	140,325
1414.5	2.18	142,865	1624.5	2.4	140,325
1417	2.25	142,028	1627	2.28	141,678
1419.5	2.28	141,678	1634.5	2.28	141,678
1422	2.28	141,678	1642	2.28	141,678
1427	2.28	141,678	1644.5	2.28	141,678
1429.5	2.28	141,678	1652	2.28	141,678
1434.5	2.28	141,678	1654.5	2.32	141,219
1442	2.28	141,678	1657	2.4	140,325
1444.5	2.32	141,219	1659.5	2.4	140,325
1449.5	2.32	141,219	1702	2.4	140,325
1452	2.28	141,678	1709.5	2.4	140,325
1459.5	2.28	141,678	1712	2.5	139,253
1502	2.25	142,028	1714.5	2.5	139,253
1507	2.25	142,028	1717	2.5	139,253
1509.5	2.25	142,028	1722	2.5	139,253
1512	2.28	141,678	1724.5	2.4	140,325
1517	2.28	141,678	1727	2.4	140,325
1522	2.28	141,678	1729.5	2.5	139,253
1529.5	2.28	141,678	1732	2.5	139,253
1532	2.32	141,219	1737	2.5	139,253
1534.5	2.4	140,325	1742	2.5	139,253
1537	2.4	140,325	1747	2.5	139,253
1539.5	2.4	140,325	1752	2.5	139,253
1542	2.4	140,325	1757	2.5	139,253
1544.5	2.4	140,325	1802	2.5	139,253
1547	2.5	139,253	1807	2.5	139,253
1549.5	2.5	139,253	1812	2.5	139,253
1554	2.5	139,253	1814.5	2.5	139,253

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PRESSURE AND ALTITUDE DATA
Flight 1158-N

RAVEN

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0751.5	-	Launch	0751.5	-	Launch
0756.6	853	4,600	0800	731	8,700
0812.5	468	20,000	0811	477	19,500
0822.4	304	30,000	0820	312	29,400
0826.8	242	35,000	0830	208.5	38,100
0833.5	190	40,200	0840	145.8	45,900
0839.8	151	45,200	0850	99.5	54,300
0845.4	122	49,800	0900	65.7	63,300
0851.5	95	55,300	0910	42.8	76,600
0857.7	72.8	61,100	0920	28.0	81,900
0900.5	46.7	70,700	0930	18.2	91,500
0913.6	37.1	75,700	0940	11.9	101,100
0918.6	29.8	80,500	0950	8.08	110,100
0924.1	23.45	85,800	1000	5.63	118,800
0934.6	15.1	95,700	1010	4.25	125,700
0938.6	12.82	99,400	1020	3.31	132,000
0944.9	10.05	105,000	1030	2.78	136,500
0950.7	8.08	110,100	1040	2.18	142,800
0957.5	6.52	115,200	1050	2.14	143,400
1007.6	5.35	120,000	1100	2.14	143,400
1021.9	4.51	124,200	1110	2.21	142,500
1028.9	4.23	125,800	1120	2.29	141,600
1043.0	3.97	127,400	1130	2.37	140,700
1100	3.97	127,400	1140	2.39	140,400
1115	3.68	129,300	1150	2.29	141,600
1145	3.68	129,300			
1200	3.68	129,300			
1215	3.68	129,300			
1231.5	3.37	131,500			
1300	3.37	131,500			
1400	3.37	131,500			
1500	3.37	131,500			
1530	3.37	131,500			
1600	3.37	131,500			
1700	3.37	131,500			
1730	3.37	131,500			
1800	3.37	131,500			
1816		Terminate			
1818	8.45	109,000			
1822	52.9	68,000			
1848	723	9,000			

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R-1866

Flight 1158
Upper Air Data for 1200Z, 3 July

Standard Levels

Pressure (MB)	T, °C	Wind Kts.
1000	+12	350° 7
850	+ 5	10° 15
700	0	10° 15
500	-16	330° 23
400	-29	320° 38
300	-44	310° 38
250	-50	330° 56
200	-47	310° 46
150	-47	300° 34
100	-49	320° 22
70	-49	360° 9
50	-48	60° 9
30	-46	80° 14
20	-42	50° 16

Significant Levels

	T, °C
1019	+ 8
892	+ 5
866	+ 6
680	- 1
582	- 7
276	-49
237	-51
214	-48
46	-49
24	-46
14	-37

Wind Data

Thousands of Feet	Direction	Knots
1	360°	9
5	10°	15
10	10°	15
16	360°	18
20	330°	26
25	320°	37
30	310°	37
35	330°	58
40	310°	47
45	300°	36
50	300°	30
60	340°	13
70	90°	8
80	80°	15
90	60°	17
96	80°	16

1159 - FLIGHT DESCRIPTION

Flight 1159 for NASA-Goddard Space Flight Center was launched at 0521Z on 7 July 1966 under the direction of G. Mancuso and M. Fulkerson. Layout and launch went smoothly with essentially no cross-wind. After a 16.4 hour flight, termination was made with the main timer which operated four minutes late. Impact occurred in a lake and damaged the photobarograph.

Principal investigator for Flight 1159 was Dr. V. K. Balasubrahmanyam. The experiment was one of a continuing series of measurements designed to study the effect of solar activity of the number and energy distribution of galactic cosmic rays. The equipment contained a Cerenkov scintillation counter array which can give information of charge composition of rays from protons to oxygen and energy distribution from 200 Mev/nucleon to 1 Bev/nucleon.

Problems with radio command equipment occurred immediately after launch although all command channels functioned normally during pre-flight checkout. Post-flight analysis revealed that the center conductor of the command antenna was open at the BNC connector...preventing signals from entering the command receiver. As a result, no command ballast was dropped, however, the dribbler continued to function normally. Results of no ballast drops during ascent can be seen from the "rounded" entry into float.



Communications room in Uranium City hotel.

R-1866



1159 - Flight Description (cont.)

Barocoder deficiencies are reflected in the time-altitude curves.

Poor communications from 1100Z to 1800Z resulted in few position fixes since coordinates and times couldn't be referenced. The blackout condition existed at all three stations and is undoubtedly due to solar activity. In the next few years, this will increase in severity and duration. A recommendation is given in Section IV, Conclusions and Recommendations, on how Raven Industries proposes to circumvent this problem.

Transmitter frequency and Command channels used were:

Transmitter Frequency:	251.5 MHz	
Command Channels:	Cutdown	1
	Ballast	2
	Radar Target	
	Release	12
	Private Line	1

R-1866

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industries, inc.

LAUNCH LOG, SKYHOOK FLIGHT 1159

NASA-Goddard Space Flight Center (Balasubrahmanyam)
Balloon: 10.6×10^6 cubic foot Stratofilm
all times in CDT 6-7 July 1966

2100 Winds at DOT hanger dropped from 12-15 mph to 8 mph from 340° .
2120 Crew called out; NOTAM activated for a launch at midnight.
2145 Crew in hanger, truck sent to pick up NASA load at Tech. Support building.
2200 Wind at DOT hanger 340° , 7-8 mph.
2210 NASA gondola in hanger, being fitted into frame.
2245 Gondola and frame, ready to tie to launch truck.
2245 Winds $320-340^\circ$, 7-8 mph.
2302 Rigging completed. Crew departed for launch area, some in convoy with the payload and launch truck.
2330 Crew arrived at launch area. Winds indicated on mast there 330° , 4-5 knots.
2340 Balloon laid out, in accord with pibal, along a line of 340° . Launch notice changed to 0015.
2350 Inflation started, using two tubes, one trailer.
0012 Inflation completed.
0021 Launch. Very smooth and easy. The truck held for the bubble to rise over it, then moved a few feet at a 40° angle to the left. Layout was essentially in line with winds at launch.
0000 Weather at DOT: Temperature 47°F ; SLP 1006.9 Mb; Wind NNW 6 mph; Clouds; scattered at 2000 feet (over the bay), broken at 3500 feet.

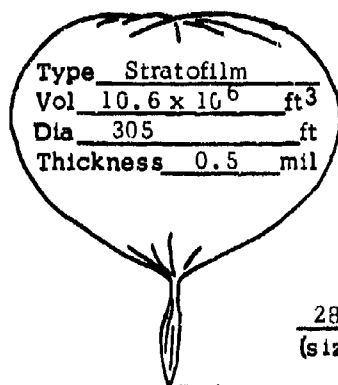
Range Test Number: 108.6 SB165-A 3L.
Tropopause at 0000Z, 7 July, 236 Mb (35,537 ft.).

R-1866

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 8-66)
RAVEN®

industries, inc.

1. Company Raven Flight Number 1159-N Director Mancuso, Fulkerson
2. Scientist Dr. V.K.B. Group Goddard SFC Date/Time 7/7 / 0521 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 20 Ø 35 Ø 47°F, 6 MPH 1006.9 MB Cross Wind Angle None
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 35,537 ft Temp -54 °C Inflation Start 0450 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 480 ft.
5. Balloon Theoretical 1.85 Mbs 147,200 ft. How Determined?
 Ceiling: Actual 2.00 Mbs 145,100 ft. Photobarograph
6. Ascent: Surface to Trop. 890 fpm Trop. to Ceiling 433 fpm.
7. Flight Duration: Total 12 hrs. 21 min. At Ceiling 11 hrs. 52 min.
8. Termination: Time 2102 Z Altitude 144,200 ft. Cause Timer
9. Balloon Destruction-confirmed Unknown - Clouds (visual, unknown, etc)
10. Impact: Date/Time 7/7 / 2218 Z Location 59° 07' N 112° 02' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd. 17 hrs.
251.4 Altitude Telemetry 17 hrs.
4.015 - 7.465 Communication 17 hrs.
12. Balloon: Code Number SF-305.86-050-NSC-04 Serial Number 32


28 Ft. chute
 (size)

WEIGHTS

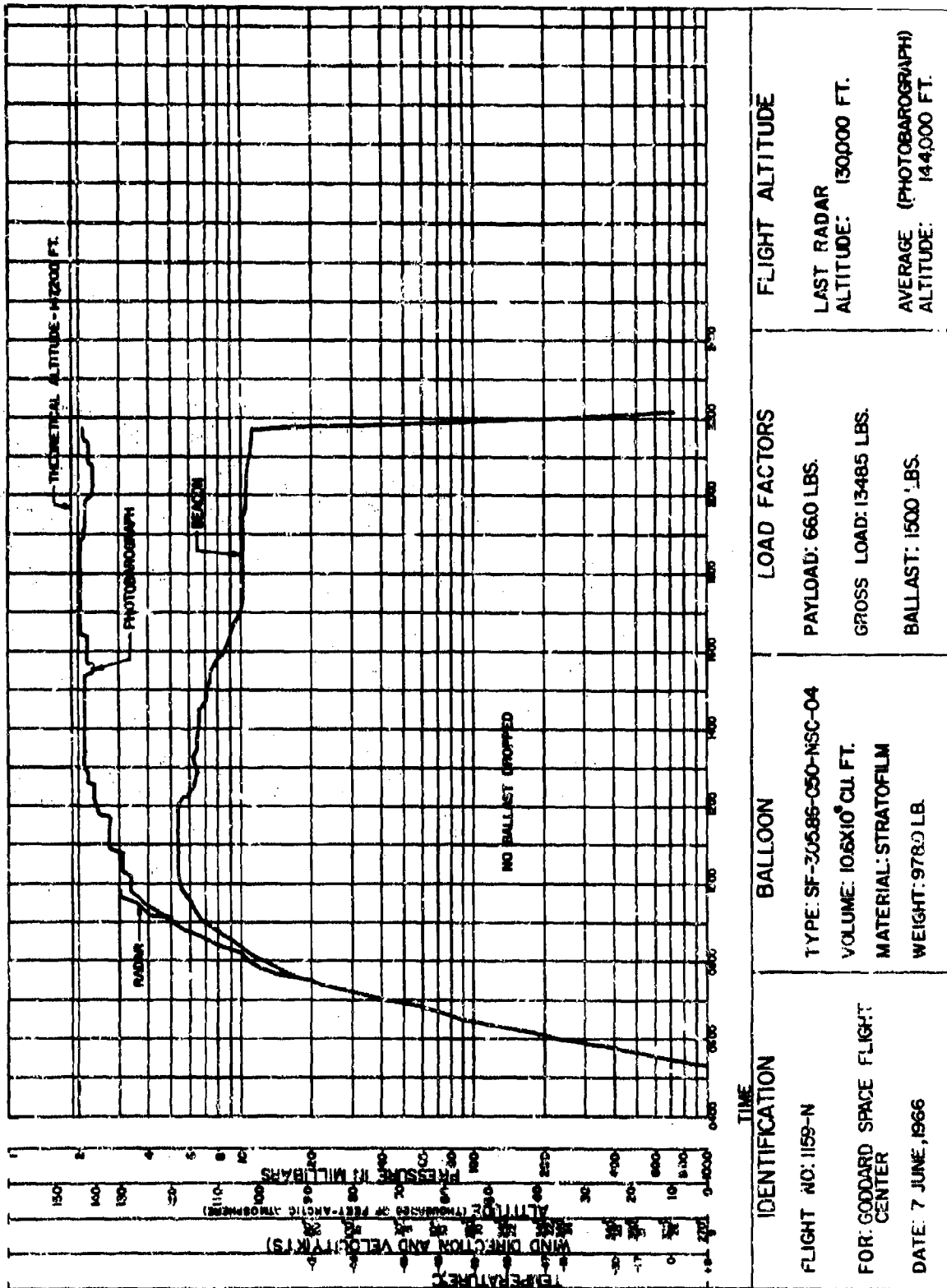
Balloon.....	978.0
Parachute.....	29.0
Instrumentation.....	51.0
Ballast.....	150.0
Scientific Package.....	66.0
Other..Photobarograph (2)....	27.5
Other.Misc.....	47.0
Gross Weight.....	1348.5
Free Lift.....	135.0
Gross Inflation.....	1483.5
Helium used (cu. ft.).....	23,744

13. Flight Failures Radio command antenna failure - no command ballast drops.
 (Nature of flight failures - if any)
14. Comments SSB communication blackout from 1100Z to 1800Z. Did not affect VHF.
 (Significant factors concerning the operation)

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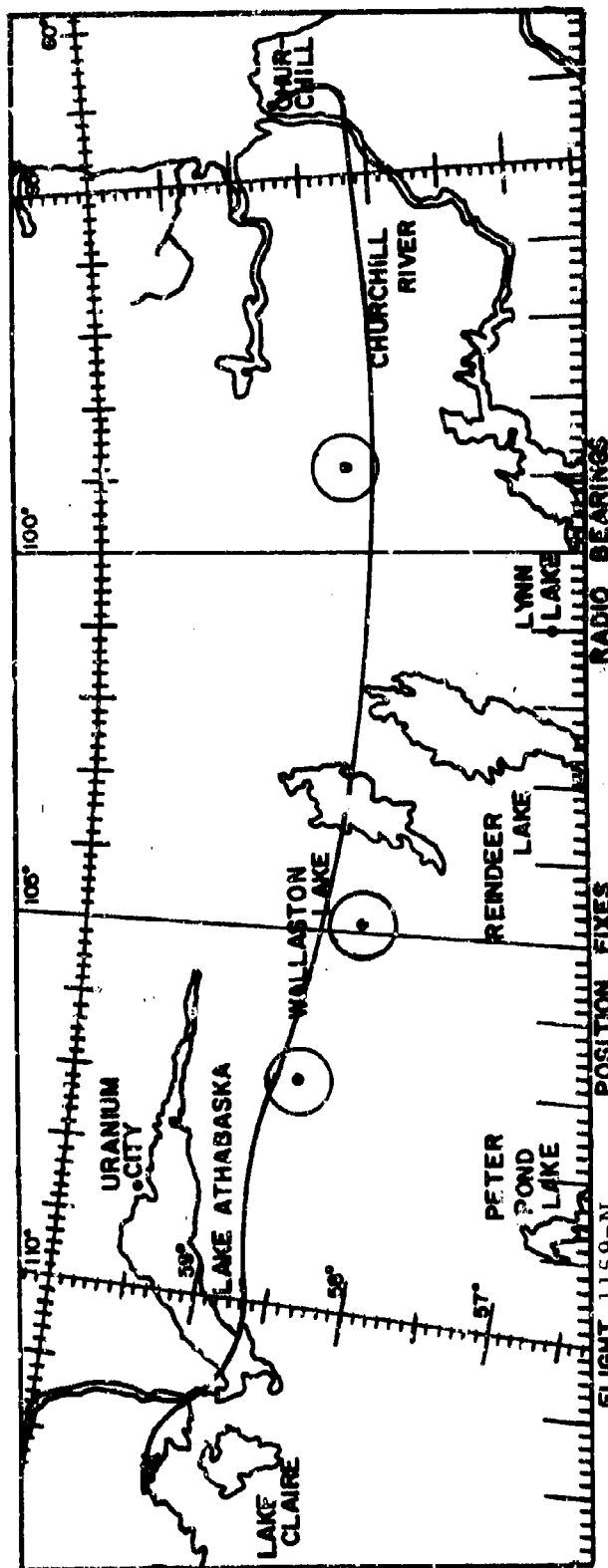
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industries, inc.



POSITION FIXES		RADIO BEARINGS	
TIME(Z)	LATITUDE LONG.	TIME(Z)	LATITUDE LONGITUDE
0521	Fort Churchill	12001	58°-15' 98°-52'
0550	58°-30' 93°-58'	16271	58°-07' 104°-55'
0610	58°-19' 93°-56'	17301	58°-28' 105°-35'
0630	58°-13' 93°-54'		
0710	58°-09' 94°-00'		
0750	58°-07' 94°-27'		
0830	58°-07' 94°-57'		
0910	58°-06' 95°-36'		
0950	58°-02' 96°-25'		
1715	58°-38' 107°-00'		
1940	58°-40' 109°-49'		
2058	58°-58' 111°-22'		
2120	59°-06' 111°-52'		
2144	59°-06' 112°-36'		
2218	59°-06' 112°-02'		
	Launch		
	Radar		
	Radar		
	Radar		
	Radar		
	Radar		
	Radar		
	Radar		
	Radar		
	C-47		
	C-47		
	C-47		
	C-47		
	Termination		
	Impact		

(1) 2 Station Fix

R-1266

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Flight 1159 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1159 launched on 7 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0448Z and 2218Z (termination), 84 pounds of ballast was automatically dropped at the rate of 4.8 pounds per hour.

Table I
Ballast Data-Flight 1159

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
	None-Radio Malfunction	

From the flight profile and lack of confirmation signals, it was evident early in the flight that no Radio Command ballast was being dropped. Several attempts to drop ballast were made during ascent. Post-flight analysis revealed an open in the Radio Command antenna which prevented voltage from being applied to the ballast valves as shown in the figure below. The ballast system and dribbler, however, functioned properly.

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

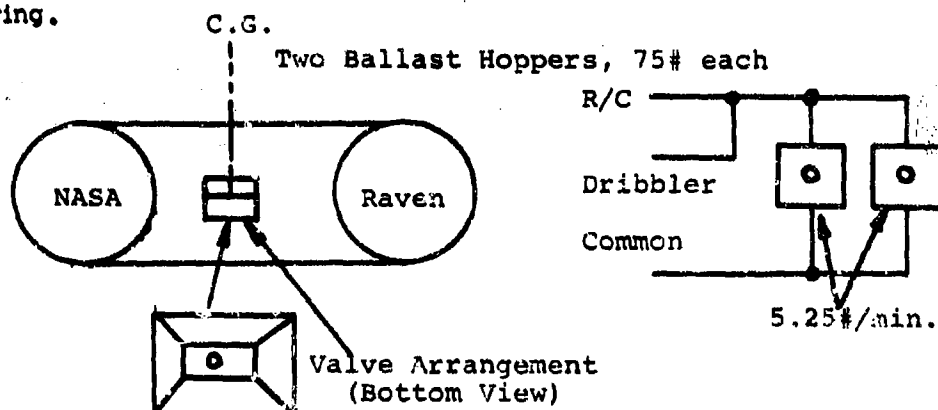


Figure 1

R-1866

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PHOTOBAROGRAPH DATA
Flight 1159-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0649	58.5	65,820	1011.5	3.3	132,069
0654	50.2	69,190	1016.5	3.2	132,856
0659	42.5	72,766	1021.5	3.05	134,089
0704	36.8	75,897	1026.5	3.05	134,089
0709	31.7	79,155	1036.5	3.05	134,089
0714	26.5	83,097	1041.5	3.05	134,089
0719	24.1	85,199	1046.5	3.05	134,089
0724	22.3	86,925	1049	2.95	134,948
0729	19.6	89,808	1054	2.85	135,840
0734	17.1	92,875	1059	2.85	135,840
0739	15.4	95,241	1104	2.85	135,840
0744	13.8	97,733	1106.5	2.85	135,840
0749	13.4	98,403	1114	2.85	135,840
0754	12.3	100,360	1121.5	2.85	135,840
0759	11.6	101,704	1131.5	2.85	135,840
0804	10.6	103,778	1134	2.78	136,485
0809	9.65	105,472	1141.5	2.78	136,485
0814	9.3	106,805	1144	2.74	136,861
0819	8.7	108,360	1146.5	2.71	137,147
0824	8.2	109,749	1149	2.55	138,735
0829	7.7	111,233	1154	2.46	139,677
0834	7.2	112,826	1156.5	2.55	138,735
0839	6.55	115,087	1201.5	2.55	138,735
0844	6.15	116,604	1209	2.55	138,735
0849	5.82	117,815	1211.5	2.46	139,677
0851	5.7	118,445	1214	2.46	139,677
0859	5.2	120,687	1219	2.46	139,677
0904	4.95	121,897	1229	2.46	139,677
0909	4.7	123,177	1234	2.46	139,677
0914	4.5	124,255	1236.5	2.35	140,880
0919	4.25	125,678	1244	2.35	140,880
0924	4.1	126,577	1251.5	2.35	140,880
0929	3.9	127,832	1254	2.29	141,562
0934	3.9	127,832	1259	2.25	142,028
0939	3.75	128,821	1306.5	2.25	142,028
0944	3.4	131,307	1314	2.25	142,028
0949	3.4	131,307	1316.5	2.2	142,623
0954	3.4	131,307	1319	2.25	142,028
0959	3.4	131,307	1321.5	2.25	142,028
1009	3.4	131,307	1326.5	2.29	141,562

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Photobarograph Data
Flight 1159-N
Page 2

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1331.5	2.29	141,562	1734	2.07	144,237
1336.5	2.29	141,562	1736.5	2.07	144,237
1339	2.25	142,028	1739	2.0	145,151
1344	2.25	142,028	1749	2.0	145,151
1346.5	2.2	142,623	1751.5	2.0	145,151
1351.5	2.2	142,623	1754	2.0	145,151
1359	2.2	142,623	1756.5	2.07	144,237
1409	2.2	142,623	1804	2.07	144,237
1416.5	2.2	142,623	1829	2.07	144,237
1419	2.13	143,480	1839	2.07	14,237
1429	2.13	143,480	1846.5	2.07	144,237
1436.5	2.13	143,480	1851.5	2.07	144,237
1439	2.2	142,623	1854	2.13	143,480
1444	2.2	142,623	1904	2.13	143,480
1446.5	2.25	142,028	1906.5	2.13	143,480
1459	2.25	142,028	1909	2.2	142,623
1504	2.25	142,028	1919	2.2	142,623
1506.5	2.29	141,562	1934	2.2	142,623
1511.5	2.35	140,880	1936.5	2.25	142,028
1519	2.35	140,880	1946.5	2.2911	141,562
1524	2.46	139,677	1951.5	2.35	140,880
1534	2.46	139,677	1959	2.35	140,880
1539	2.46	139,677	2001.5	2.46	139,677
1544	2.35	140,880	2019	2.46	139,677
1546.5	2.29	141,562	2024	2.46	139,677
1554	2.29	141,562	2029	2.46	139,677
1559	2.25	142,028	2034	2.46	139,677
1601.5	2.29	141,562	2039	2.46	139,677
1604	2.29	141,562	2049	2.46	139,677
1606.5	2.25	142,028	2051.5	2.35	140,880
1614	2.29	141,562	2056.5	2.35	140,880
1616.5	2.25	142,028	2101.5	2.35	140,880
1621.5	2.2	142,623	2104	2.29	141,562
1629	2.13	143,480	2109	2.29	141,562
1631.5	2.07	144,237	2111.5	2.25	142,028
1639	2.07	144,237	2121.5	2.2	142,623
1649	2.07	144,237	2129	2.07	144,237
1659	2.07	144,237	2134	2.07	144,237
1714	2.07	144,237	2139	2.07	144,237
1724	2.07	144,237	2141.5	2.07	144,237

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1159-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0521	-	Launch	0521	-	Launch
0533.5	674	10,800	0530	723	9,000
0544.3	468	20,000	0540	528	17,000
0556.7	291	31,000	0550	371	25,500
0601.3	241	35,100	0600	245	34,750
0609.2	190	40,200	0610	185.8	40,750
0616.7	152	45,000	0620	126.5	49,000
0624.9	120	50,200	0630	89	56,750
0633.0	92	56,000	0650	51.4	68,400
0649.2	58.3	65,900	0700	39.2	74,500
0723.8	24.1	85,200	0710	29.5	80,750
0748.9	15.5	95,100	0720	23.5	85,750
0903	7.11	113,100	0730	18.4	91,250
0933.0	6.03	117,100	0740	15.55	95,000
1015	5.69	118,500	0750	13.9	97,500
1045	5.69	118,500	0800	11.35	102,000
1054.5	6.03	117,100	0810	9.85	105,500
1117	5.69	118,500	0820	8.78	108,000
1145	5.69	118,500	0830	7.75	111,000
1217	6.03	117,100	0840	6.65	114,750
1229	6.4	115,600	0850	5.93	117,750
1254	2.74	114,400	0900	5.24	120,500
1313	6.4	115,600	0910	4.73	123,000
1328	6.74	114,400	0920	4.24	125,750
1409	7.11	113,100	0930	4.03	127,000
1444	7.43	112,100	0940	3.4	130,500
1516	7.76	111,000	0950	3.57	130,000
1547	8.1	110,000			
1556	8.45	109,000			
1616	8.75	108,200			
1639	9.1	107,300			
1645	9.4	106,500			
1654	9.75	105,700			
1721	10.45	104,100			
1815	10.45	104,100			
1900	10.45	104,100			
1949	11.45	102,000			
2030	11.45	102,600			
2124	11.8	101,300			
2141	12.5	100,000			
2144 (term)	12.5	100,000			
2147	17.7	92,000			
2154	88	57,000			
2214	723	9,000			

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R-1866

Flight 1159
Upper Air Data for 1200Z, 7 JulyStandard Levels

Pressure (MB)	T, °C	Wind Kts.
1000	+ 8	270° 9
850	+ 3	350° 5
700	0	350° 26
500	-17	350° 31
400	-30	340° 25
300	-45	340° 22
250	-51	340° 34
200	-47	340° 26
150	-48	340° 22
100	-48	350° 10
70	-46	10° 10
50	-45	80° 8
30	-45	100° 15
20	-41	80° 20

Significant Levels

Pressure (MB)	T, °C
1003	+ 8
982	+10
934	+ 9
847	+ 2
815	+ 3
752	+ 1
728	0
684	0
636	- 6
595	- 9
558	- 9
554	-11
497	-18
333	-40
249	-52
230	-53
194	-47
144	-49
40	-47
24	-45
16	-39

Wind Data

Thousands of Feet	Direction	Knots
1	310°	14
5	350°	14
10	350°	16
16	350°	33
20	340°	29
25	340°	24
30	340°	21
35	340°	35
40	340°	27
45	340°	22
50	340°	19
60	20°	9
70	60°	12
80	100°	15
90	90°	22
92	90°	26

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1160 - FLIGHT DESCRIPTION

Flight 1160 for California Institute of Technology was launched at 1202Z on 11 July 1966 under the direction of G. Mancuso and M. Fulkerson. The balloon was allowed to float to main timer cutdown at 0340Z (12 July) which occurred four minutes late. The launch, flight, and recovery were satisfactory with no problems throughout the flight.

Dr. R. Vogt's equipment on this flight was identical to that flown on Flights 1152, 1155, and 1158. Basic purpose was to measure flux and energy spectrum of heavy nuclear particles up to and including oxygen.

The instrumentation package consisted of the standard Raven equipment with the addition of voltage and temperature telemetry. Barocoder venting with 3/16 in. holes proved adequate although limitations of the device do not give accurate altitude/pressure information above 100,000 feet, or 12 millibars. Ballasting was performed eleven times with no failures.

A special Haydon top-timer was used on this flight, set one hour past termination time of the main, lower timer. Transmitter frequency and command channels used were:



Communications room in DOT hanger

R-1866

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1160 - Flight Description (cont.)

Transmitter Frequency:	251.1 MHz	
Command Channel:	Cutdown	1
	Ballast	2
	Radar Target	
	Release	12
	Private Line	2

R-1866

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LAUNCH LOG, SKYHOOK FLIGHT 1160

Cal. Tech. (Vogt)

Balloon: 10.6×10^6 cubic foot Stratofilm
all times in CDT 10-11 July 1966

2200 10 July, Winds in DOT hanger. 16 mph gusts to 22.
2300 Winds 13 mph.
0000 Winds 14-15.
0100 Winds 12 mph. Pibal shows light winds up to 20,000 feet.
0200 Winds 11 mph.
0300 Winds 11 mph. Detailed observation from 0115 show winds varying 10-13.
0340 Winds 9-11 mph.
0400 Winds 10 mph.
0430 Winds 8 mph.
0440 Crew called: NOTAM activated for 0700 launch. Dr. Vogt willing to accept flight duration consistent with 0700 launch.
0510 Crew at DOT hanger, putting payload on launch truck. Winds 6 mph.
0535 Advance crew left DOT hanger.
0555 Payload on launch truck left DOT hanger in convoy.
0635 Payload reached launch site. Balloon laid out at 0615, per pibal, at 080°.
0640 Winds on mast in launch area indicated at 3 knots, 060°.
0643 Inflation began.
0647 Bubble up.
0700 Inflation completed. Winds 5 knots, 060°. Sun shone on balloon throughout inflation.
0708 Launch. Truck moved straight ahead 150 feet. Smooth and easy launch.
0700 Weather at DOT: Winds 060°, 9 mph; SLP 1009.2 Mb; temperature 43°F. Clouds scattered at 8000 feet.

Range Test Number: 111.6 SB165-A 3L.

Tropopause at 1200Z, 11 July, -54°C at Mb (34,638 ft.).

R-1866

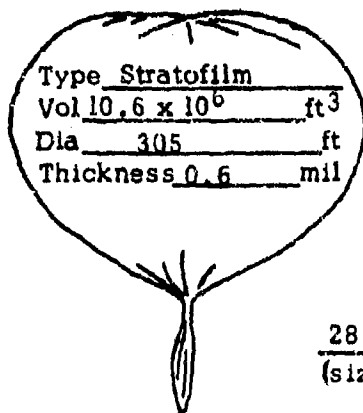
SKYHOOK BALLOON FLIGHT INFORMATION

NAVEXOS 3900/2 (Rev. 8-66)

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1. Company Raven Flight Number 1160-N Director Mancuso, Fulkerson
2. Scientist Vogt Group Cal Tech Date/Time 7/11 / 1202 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 80 @ 43°F ENE 9 MPH 1009.2 MB Cross Wind Angle 20°
(Sky-Temp-Wind-Pressure)
Trop(Coldest)Ht. 34638 ft Temp -54 °C Inflation Start 1143 Z
Hrs Sunshine on Bubble 0.4 Train Length(Layout) 480 ft.
5. Balloon Theoretical 2.01 Mbs 145000 ft. How Determined?
Ceiling: Actual 2.12 Mbs 144600 ft. Radar-1520 Z
6. Ascent: Surface to Trop. 908 fpm Trop. to Ceiling 745 fpm.
7. Flight Duration: Total 15 hrs 32 min. At Ceiling 12 hrs. 20 min.
8. Termination: Time 0340 Z Altitude 141000 ft. Cause Timer
9. Balloon Destruction-confirmed Unknown (visual, unknown, etc)
10. Impact: Date/Time 7/12/ 0420 Z Location 58° 49' N 109° 34' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd 16 hrs.
251.5 Altitude Telemetry 15 hrs.
7.465-4.015 Communication 16 hrs.
12. Balloon: Code Number SF-305.85-060-NSC-01 Serial Number 52



WEIGHTS

Balloon.....	1073.0
Parachute.....	30.0
Instrumentation.....	51.0
Ballast.....	150.0
Scientific Package.....	114.5
Other... Photobarograph.....	8.0
Other... Misc.....	17.5
Gross Weight.....	1444.0
Free Lift.....	145.0
Gross Inflation.....	1589.0
Helium used (cu. ft.).....	25440

28 Ft. chute
(size)

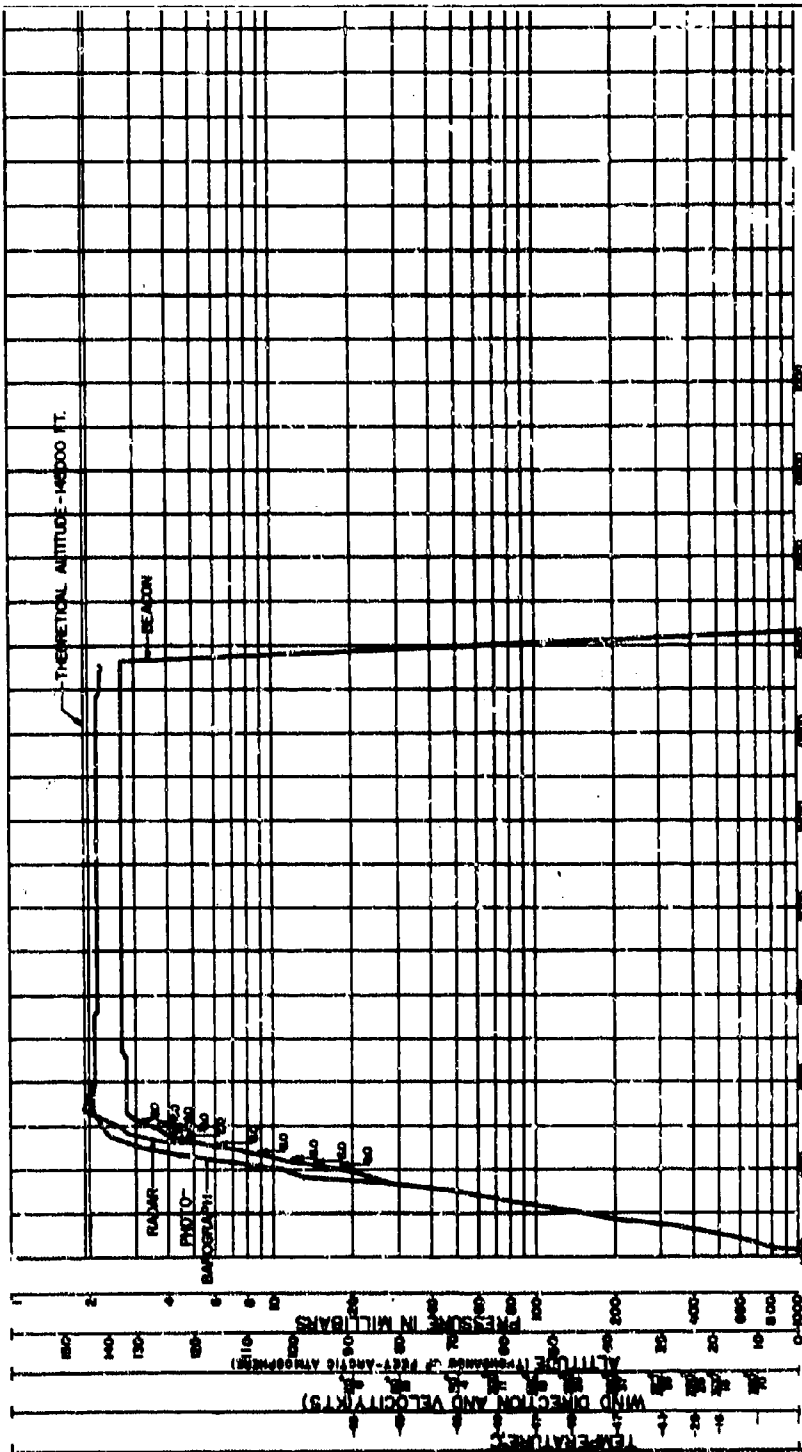
13. Flight Failures None
(Nature of flight failures - if any)
14. Comments Balloon allowed to float to MoIn Timer Cutdown
(Significant factors concerning the operation)

Copy to:

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ONR/Code 421

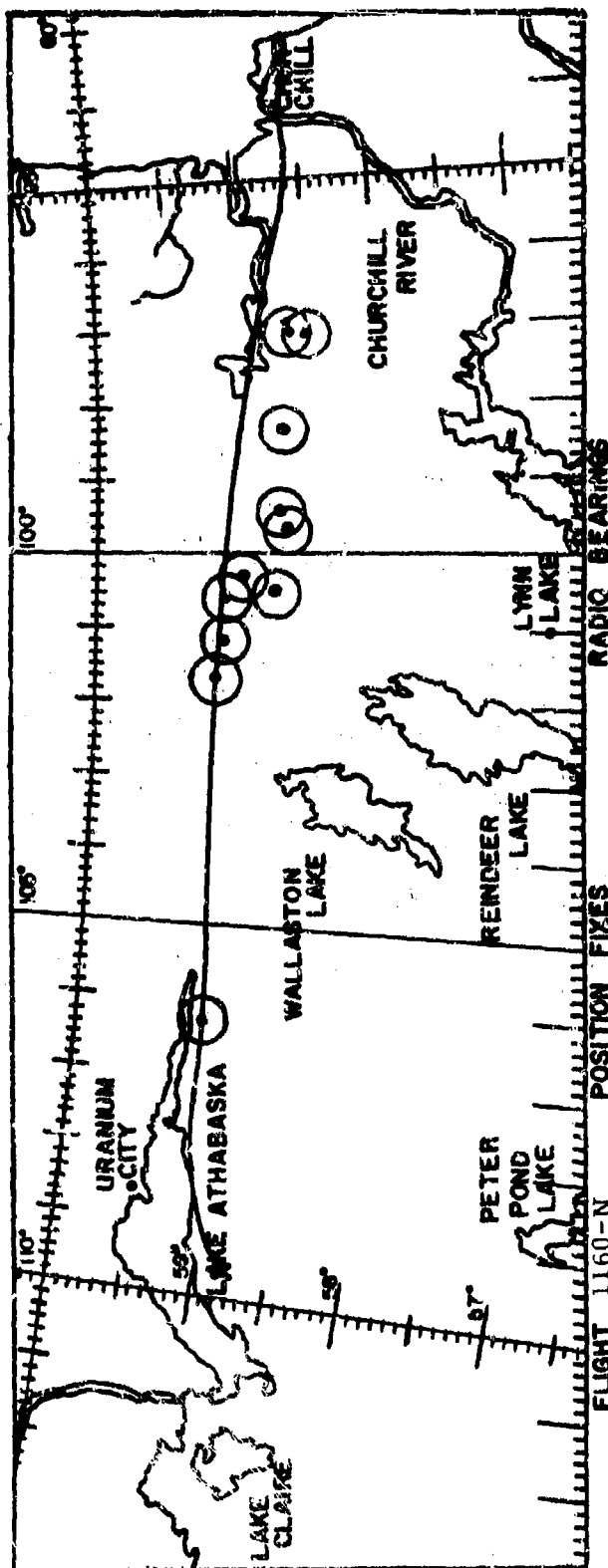
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TIME IDENTIFICATION	BALLOON	LOAD FACTORS	FLIGHT ALTITUDE
FLIGHT NO: 1160-N	TYPE: SF-305.86-060-NSC-01	PAYLOAD: 1143 LBS.	LAST RADAR ALTITUDE: 143400 FT.
FOR: CAL. TECH.	VOLUME: 10.6 X 10 ³ CU. FT. MATERIAL: STRATOFILM	GROSS LOAD: 14440 LBS.	AVERAGE (PHOTOBAROGRAPH) ALTITUDE: 143200 FT.
DATE: 11 JULY, 1966	WEIGHT: 10730 LBS.		

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TIME(Z) LATITUDE LONG. OBTAINED BY		TIME(Z) LATITUDE LONGITUDE	
FLIGHT 1160-N		RADIO BEARINGS	
1208	Fort Churchill	16201	58°-30' 97°-07'
1220	58°-43' 94°-00'	17001	58°-37' 97°-01'
1240	58°-41' 93°-48'	18001	58°-20' 98°-20'
1300	58°-37' 93°-26'	18302	58°-41' 99°-28'
1340	58°-34' 93°-11'	19002	58°-38' 99°-40'
1400	58°-33' 93°-18'	19301	58°-43' 100°-30'
1420	58°-33' 93°-30'	20002	59°-05' 100°-41'
1500	58°-36' 94°-11'	20302	59°-05' 101°-10'
1520	58°-34' 94°-41'	21002	59°-03' 101°-42'
1555	58°-38' 95°-25'	01301	58°-58' 100°-19'
1925	59°-07' 100°-35'	01551	59°-07' 106°-15'
2330	59°-10' 105°-03'		
0147	59°-10' 107°-12'		
0340	Termination		
0420	58°-49' 109°-34'		
		(1) 2 Station Fix	
		(2) 3 Station Fix	

Flight 1160 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1160 launched on 11 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 1200Z and 0340Z (termination), 42 pounds of ballast was automatically dropped at the rate of 2.8 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I
Ballast Data-Flight 1160

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
1405	8.0	142.0
1408	8.0	134.0
1411	8.0	126.0
1425	8.0	118.0
1434	8.0	110.0
1446	8.0	102.0
1453	8.0	94.0
1500	8.0	86.0
1503	8.0	78.0
1506	8.0	70.0
1510	8.0	62.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

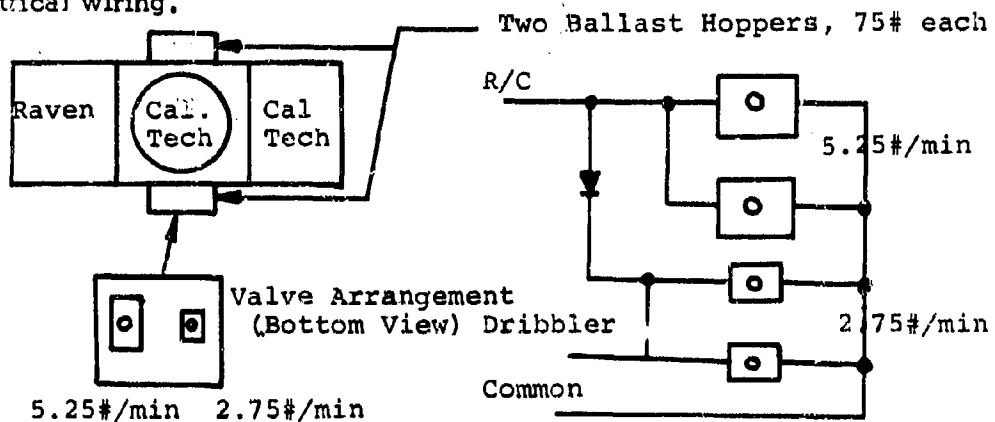


Figure 1

P-1866

RAVENPHOTOBAROGRAPH DATA
Flight 1160-N

industries, inc.

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1331.5	49.7	69,363	1645	2.15	143,232
1334	41.0	73,547	1650	2.15	143,232
1336.5	33.7	77,816	1655	2.15	143,232
1339	28.3	81,647	1700	2.1	143,856
1341.5	23.5	85,759	1705	2.1	143,856
1344	19.5	89,922	1710	2.1	143,856
1346.5	16.8	93,274	1715	2.15	143,232
1349	14.0	97,405	1720	2.15	143,232
1401.5	11.6	101,704	1725	2.15	143,232
1404	9.3	106,805	1730	2.15	143,232
1406.5	7.7	111,233	1735	2.15	143,232
1410	6.82	114,100	1740	2.15	143,232
1413.5	5.9	117,608	1745	2.15	143,232
1417.5	5.0	121,650	1750	2.15	143,232
1421.5	4.4	124,813	1755	2.15	143,232
1426	3.8	128,487	1800	2.15	143,232
1431	3.25	132,459	1805	2.15	143,232
1436	3.15	133,260	1810	2.15	143,232
1442	2.7	137,244	1815	2.15	143,232
1448	2.55	138,735	1820	2.15	143,232
1505	2.3	141,447	1825	2.15	143,232
1510	2.2	142,623	1830	2.15	143,232
1515	2.1	143,856	1835	2.15	143,232
1520	2.1	143,856	1840	2.15	143,232
1525	2.1	143,856	1845	2.15	143,232
1530	2.1	143,856	1850	2.15	143,232
1535	2.1	143,856	1855	2.15	143,232
1540	2.1	143,856	1900	2.15	143,232
1545	2.1	143,856	1905	2.15	143,232
1550	2.1	143,856	1910	2.15	143,232
1555	2.15	143,232	1915	2.15	143,232
1600	2.15	143,232	1920	2.15	143,232
1605	2.15	143,232	1925	2.15	143,232
1610	2.15	143,232	1930	2.15	143,232
1615	2.15	143,232	1935	2.15	143,232
1620	2.15	143,232	1940	2.2	142,623
1625	2.15	143,232	1945	2.2	142,623
1630	2.15	143,232	1950	2.2	142,623
1635	2.15	143,232	2000	2.2	142,623
1640	2.15	143,232	2010	2.2	142,623

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Photobarograph Data
Flight 1160-N
Page 2

RAVEN[®]
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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
2015	2.2	142,623	2315	2.2	142,623
2025	2.2	142,623	2325	2.2	142,623
2030	2.2	142,623	2330	2.2	142,623
2035	2.3	141,447	2345	2.2	142,623
2040	2.3	141,447	2355	2.2	142,623
2045	2.2	142,623	0000	2.2	142,623
2050	2.2	142,623	0005	2.2	142,623
2055	2.2	142,623	0010	2.2	142,623
2100	2.2	142,623	0015	2.2	142,623
2105	2.15	143,232	0020	2.2	142,623
2110	2.15	143,232	0025	2.2	142,623
2115	2.15	143,232	0030	2.2	142,623
2120	2.15	143,232	0035	2.2	142,623
2125	2.1	143,856	0040	2.2	142,623
2130	2.1	143,856	0045	2.2	142,623
2135	2.15	143,232	0100	2.2	142,623
2140	2.15	143,232	0115	2.2	142,623
2145	2.15	143,232	0130	2.2	142,623
2150	2.15	143,232	0145	2.2	142,623
2155	2.15	143,232	0200	2.2	142,623
2200	2.15	143,232	0215	2.2	142,623
2205	2.15	143,232	0225	2.2	142,623
2210	2.15	143,232	0230	2.2	142,623
2215	2.15	143,232	0235	2.2	142,623
2220	2.15	143,232	0240	2.2	142,623
2225	2.15	143,232	0245	2.2	142,623
2230	2.15	143,232	0250	2.2	142,623
2235	2.15	143,232	0255	2.3	141,447
2240	2.15	143,232	0300	2.3	141,447
2245	2.15	143,232	0305	2.3	141,447
2250	2.15	143,232	0310	2.3	141,447
2255	2.15	143,232	0315	2.3	141,447
2300	2.15	143,232	0320	2.3	141,447
2305	2.15	143,232	0327	2.3	141,447
2310	2.2	142,623	0336	2.3	141,447

R-1866

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PRESSURE AND ALTITUDE DATA
Flight 1160-N

Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1208	-	Launch	1208	0	Launch
1215	844	4,900	1215	915	2,700
1222.5	680	10,800	1220	683	10,500
1233.4	466	20,100	1225	572	15,000
1243.3	304	30,000	1230	487	19,000
1255.6	191	40,100	1235	396	24,000
1307.5	123.2	49,600	1240	347	27,000
1314.7	95.4	55,200	1245	258	33,600
1326.5	59.4	65,500	1250	221.5	36,900
1339.0	37.8	75,300	1255	190.2	40,200
1345.5	30.2	80,200	1300	171	43,500
1358.7	19.25	90,200	1310	112.5	51,600
1406.2	15.0	95,800	1320	78.6	59,400
1410.9	12.5	100,000	1330	54.9	67,200
1425.0	7.84	110,800	1340	37.8	75,300
1430.7	6.74	114,400	1350	25.8	83,700
1440.9	5.3	120,200	1400	18.4	91,200
1447	4.58	123,800	1410	12.4	100,200
1451.5	4.23	125,800	1420	8.5	108,900
1458.7	3.9	127,800	1430	6.28	116,100
1508.1	3.58	130,000	1440	4.51	124,200
1522.0	3.26	132,400	1450	3.31	132,000
1545	3.26	132,400	1500	2.71	137,100
1630	3.26	132,400	1510	2.34	141,000
1644	2.94	135,000	1520	2.04	144,600
1730	2.94	135,000	1545	2.14	143,400
1830	2.94	135,000	1555	2.21	142,500
1930	2.94	135,000			
2015	2.94	135,000			
2045	2.94	135,000			
2200	2.94	135,000			
2300	2.94	135,000			
0000	2.94	135,000			
0100	2.94	135,000			
0200	2.94	135,000			
0300	2.94	135,000			
0330	2.94	135,000			
0340 (term)	2.94	135,000			
0343	15.0	95,800			
0349	79.0	59,300			
0357	233	35,800			
0408	533	16,800			
0418	879	3,800			

R-1866

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Flight 1160
Upper Air Data for 1200Z, 11 July (RAWIN)
and 1630Z, 12 July (ROCOB)

Standard Levels (RAWIN)

Pressure (MB)	T, °C	Wind Kts.
1000	-	-
850	-	-
700	-	-
500	-16	320° 10
400	-28	300° 18
300	-44	290° 25
250	-53	290° 39
200	-47	290° 43
150	-45	280° 37
100	-47	290° 26
70	-46	290° 19
50	-45	300° 11
30	-43	20° 4
20	-43	80° 15
		110° 8

Significant Levels (RAWIN)

Pressure (MB)	T, °C
1006	+ 6
988	+ 5
964	+11
840	+ 9
720	0
669	- 2
659	- 3
599	- 9
562	-10
512	-15
246	-54
228	-50
184	-44
58	-49
47	-45
21	-44
10	-33

ROCOB Data

24km	-45	130° 12
25	-45	60° 10
26	-41	60° 19
28	-37	140° 19
30	-34	80° 14
32	-30	90° 21
34	-27	90° 20
35	-25	100° 25
36	-24	90° 24
38	-18	90° 27
40	-11	100° 34
42	- 4	90° 36
44	- 1	100° 45
45	+ 1	100° 51
46	+ 2	90° 56

Wind Data (RAWIN)

Thousands of Feet	Direction	Knots
1	200°	3
5	350°	2
10	320°	10
16	290°	19
20	300°	20
25	290°	27
30	290°	37
35	290°	44
40	290°	36
45	290°	26
50	290°	22
60	300°	14
70	20°	3
80	80°	16
88	180°	6
90	80°	9
100	60°	26
103	80°	28

R-1866

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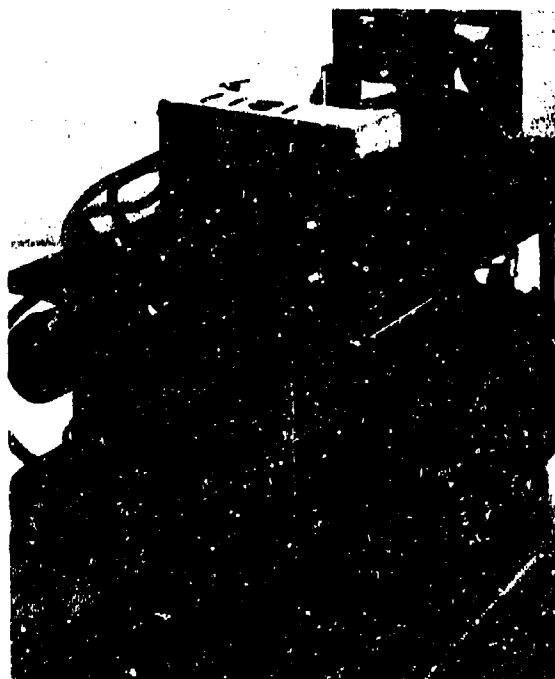
1161 - FLIGHT DESCRIPTION

Directed by M. Fulkerson and T. Pappas, Flight 1161 for NASA-Goddard Space Flight Center was launched at 0317Z on 13 July 1966. The launch was conducted with a 5 knot, 20 Deg crosswind causing some maneuvering of the M-36 truck. The flight was allowed to float to main timer termination but was interrupted by operation of the Brailsford top-timer occurring 2.4 hours early. The main timer had been set to activate at 0046 while the top-timer was set for 0138Z. It fired at 2315Z. Fortunately, the early termination occurred over a desirable recovery area. Desired flight time was reduced by approximately one-half hour. The failure was caused by a faulty governor on the timer motor. The remainder of the equipment functioned well.

Dr. V. K. Balasubrahmanyam's equipment for this flight was identical to that flown on Flight 1159...designed to measure the effect of solar activity on the number and energy distribution of galactic cosmic rays.

Ballasting was commanded 14 times and operated properly on each command.

Tracking was still in the process of "shaking out", but had improved over earlier flights.



Raven command and control instrument package.

R-1866

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1161 - Flight Description (cont.)

Transmitter frequency and command channels used were:

Transmitter frequency:	253.1 MHz	
Command Channels:	Cutdown	4
	Ballast	5
	Radar Target	
	Release	11
	Private Line	1

R-1866



LAUNCH LOG, SKYHOOK FLIGHT 1161

NASA-Goddard Space Flight Center (Balasubrahmanyam)
Balloon: 10.6×10^6 cubic foot Stratofilm
all times in CDT 12 July 1966

1800 Winds at DCT hanger 040°, 11 mph.
1900 Winds 060°, 9 mph.
2000 Winds 070°, 9 mph.
2015 NOTAM activated for flight at 2230, just at sunset, the earliest time desirable.
2035 Crew in hanger, per earlier call. DOT winds 070°, 9-11 mph.
2045 Scientists began to make final settings in gondola.
2057 Gondola ready to tie into launch truck.
2100 DOT winds 090°, 9 mph.
2107 Gondola ready, convoy left for launch area. Other crew men also departed hanger.
2125 Crew in launch area, ground cloth laid out with pibal at 090°.
2130 Wind on mast in launch area (SAC area) indicating 120°, 6 knots.
2132 Launch truck with payload arrived in launch area.
2145 Winds 120-130°, 5-6 knots.
2146 Inflation begun. Two tubes were used, bleeding out one trailer so tank-car can be emptied and returned.
2149 Bubble up.
2200 Winds 120°, 6 knots.
2212 Inflation completed. Sun on bubble throughout inflation.
2218 Smooth launch. Truck held still; bubble took a slight turn to the left while rising. Truck moved about 120 feet. Cross wind angle total effect: 20° from trucks initial point to final point. Winds indicated at 120°, 5 knots.
2200 Weather at DCT: Scattered clouds at 9000 feet; SLP 1018.7 Mb; Wind SE 10 mph; Temperature 48°F.

Range Test Number: 114.6 SB165-A 2L

Tropopause at 0000Z, July 13, -50°, at 286 Mb (31,366 ft.).

R-1866

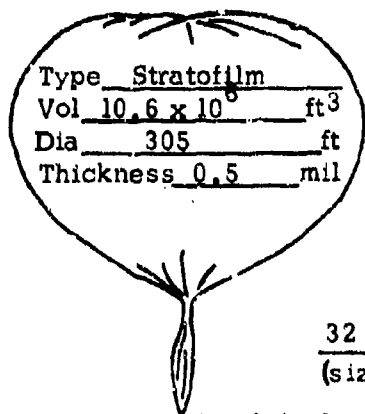
SKYHOOK BALLOON FLIGHT INFORMATION

NAVEXOS 3900/2 (Rev. 8-66)

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1. Company Raven Flight Number 1161-N Director Fulkerson, Pappas
2. Scientist Dr. V. K. B. Group Goddard SFC Date/Time 7/13 / 0317 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 90 °C, 48 °F, 10 MPH, 1018.7 MB Cross Wind Angle 20°
(Sky-Temp-Wind-Pressure)
Trop(Coldest)Ht. 31366 ft Temp -50 °C Inflation Start 0246 Z
Hrs Sunshine on Bubble None Train Length(Layout) 480 ft.
5. Balloon Theoretical 1.94 Mbs. 146000 ft. How Determined?
Ceiling: Actual 2.21 Mbs. 142500 ft. Photobarograph
6. Ascent: Surface to Trop. 836 fpm Trop. to Ceiling 468 fpm.
7. Flight Duration: Total 19 hrs 58 min. At Ceiling 15 hrs. 35 min.
8. Termination: Time 2315 Z Altitude 138000 ft. Cause Timer
9. Balloon Destruction-confirmed Unknown (visual, unknown, etc)
10. Impact: Date/Time 7/14 /0000 Z Location 57° 05' N 117° 19' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
253.1 Altitude Telemetry 20 hrs.
149.4 Communication & Cmd 20 hrs.
4.015-7.465 Communication 20 hrs.
12. Balloon: Code Number SF-305,86-050-NSC-04 Serial Number 33



Type Stratofilm
Vol 10.6 x 10³ ft³
Dia 305 ft
Thickness 0.5 mil

WEIGHTS

Balloon.....	<u>959.0</u>
Parachute.....	<u>30.0</u>
Instrumentation.....	<u>51.0</u>
Ballast.....	<u>150.0</u>
Scientific Package.....	<u>153.0</u>
Other... Photobarograph.....	<u>8.0</u>
Other... Misc.....	<u>58.0</u>
Gross Weight.....	<u>1409.0</u>
Free Lift.....	<u>140.0</u>
Gross Inflation.....	<u>1549.00</u>
Helium used (cu. ft.).....	<u>24800</u>

32 Ft. chute
(size)

13. Flight Failures Brailford Top-Timer cut down 2 hrs 35 min early.
(Nature of flight failures - if any)
14. Comments None
(Significant factors concerning the operation)

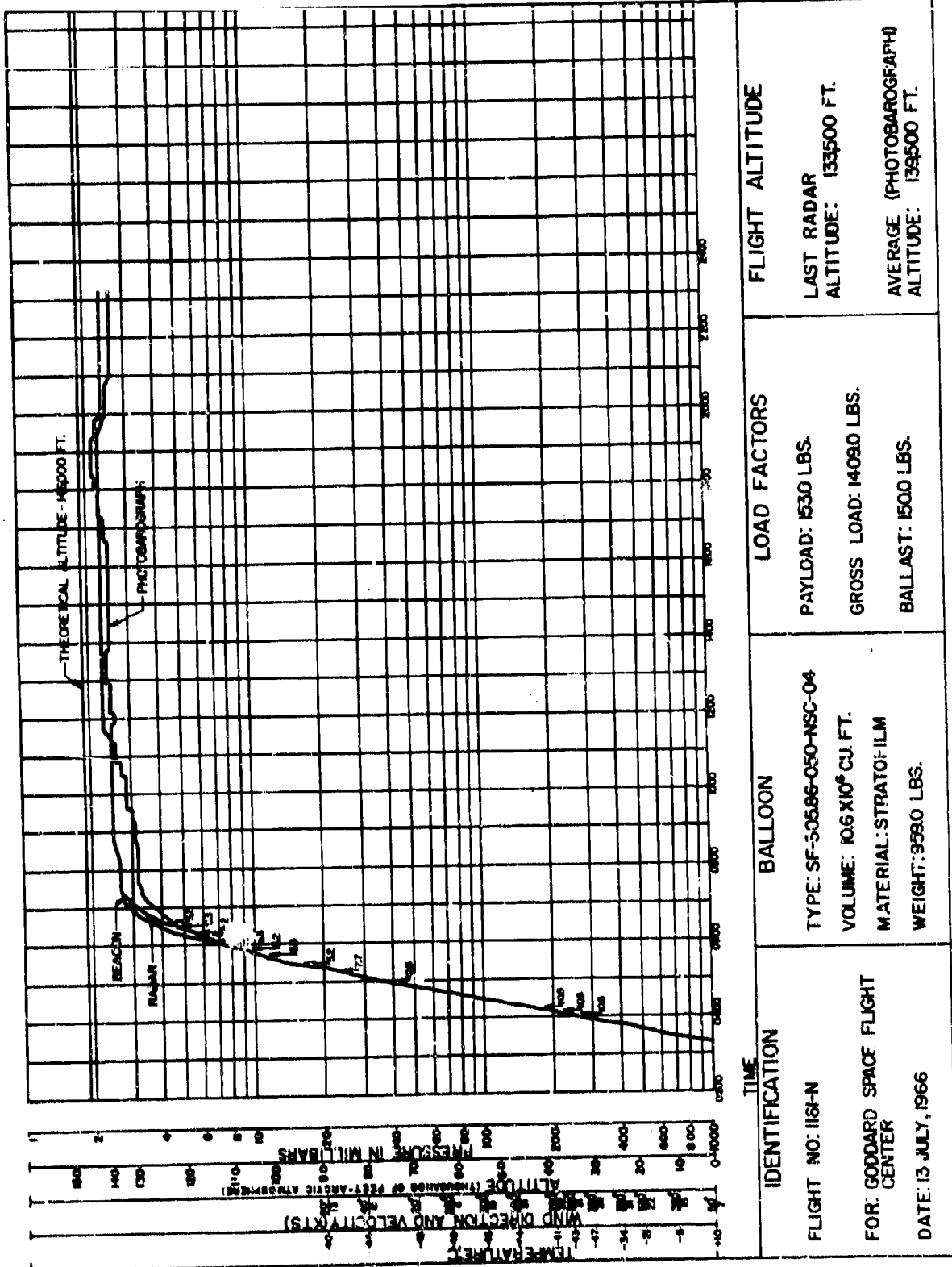
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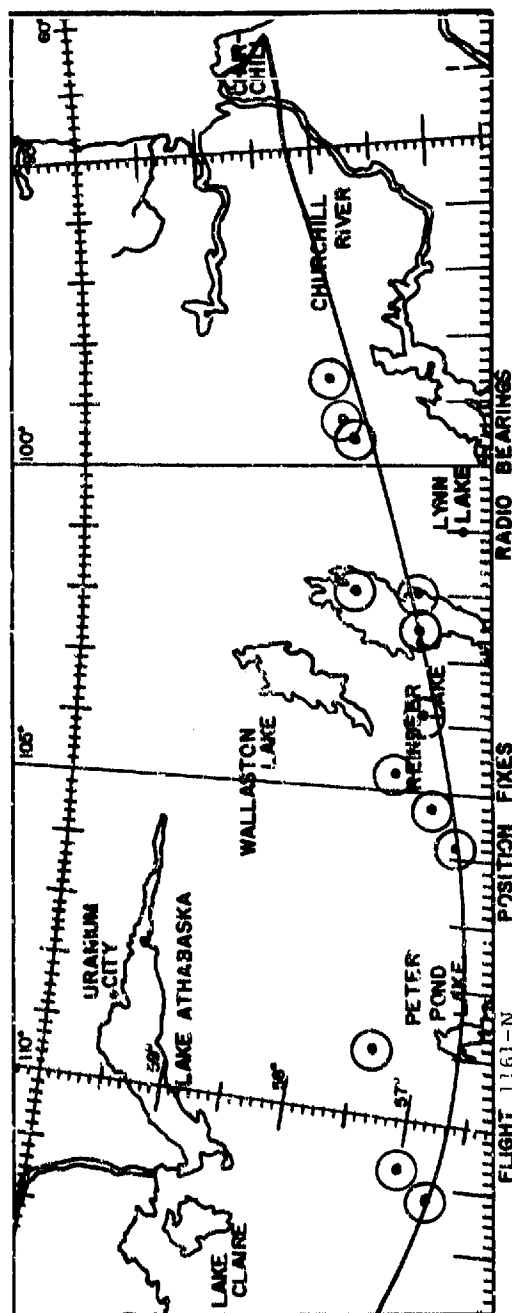
ONR/Code 421

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TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0317.5	Fort Churchill		Launch	10301	57°0-55'	98°-38'
0330	58°-42'	93°-57'	Radar	11001	57°-48'	99°-17'
0400	58°-30'	93°-41'	Radar	11301	57°-42'	99°-36'
0430	58°-23'	93°-26'	Radar	12101	57°-43'	101°-58'
0500	58°-19'	93°-20'	Radar	13001	57°-09'	101°-58'
0530	58°-17'	93°-34'	Radar	14062	57°-11'	102°-31'
0600	58°-16'	93°-53'	Radar	14301	57°-08'	103°-50'
0630	58°-14'	94°-20'	Radar	15002	57°-02'	105°-12'
0700	58°-13'	94°-45'	Radar	15302	57°-21'	104°-46'
0800	58°-01'	96°-06'	Radar	16001	56°-50'	105°-50'
1557	56°-41'	107°-28'	C-47	16251	56°-45'	108°-39'
1815	56°-45'	111°-11'	C-47	18001	57°-21'	108°-59'
2000	56°-57'	113°-05'	C-47	18301	57°-01'	110°-48'
2315	57°-08'	117°-28'	Termination	(1) 2 Station Fix		
0600	57°-05'	117°-19'	Impact	(2) 3 Station Fix		

Flight 1161 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1161 launched on 13 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0300 and 2030Z (termination), 49 pounds of ballast was automatically dropped at the rate of 2.8 pounds per hour. No problems were encountered with the ballasting system on this flight.

Table I
Ballast Data - Flight

Time	Amount Dropped by Radio Command	Amount Remaining (pounds)
0403	10.5	139.5
0408	10.5	129.0
0414	10.5	118.5
0459	10.5	108.0
0517	7.7	100.3
0430	5.2	95.1
0542	5.3	89.8
0553	5.2	84.6
0601	5.3	79.3
0607	5.2	74.1
0615	5.3	68.8
0620	5.2	63.6
0631	5.3	58.3
0638	5.2	53.1

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

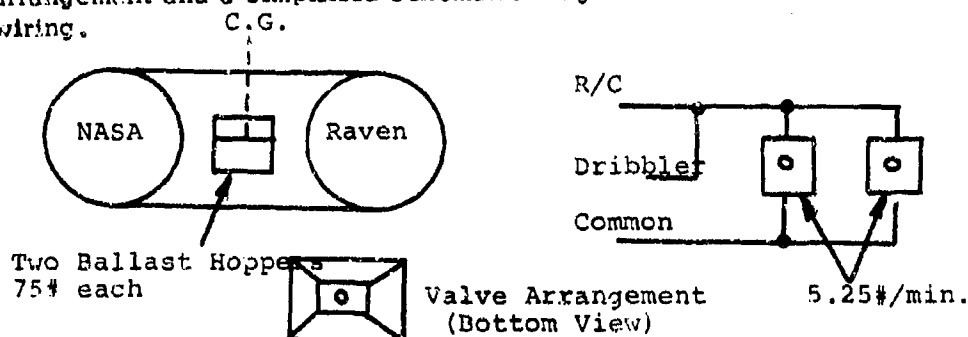


Figure 1

R-1866

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 PHOTOBAROGRAPH DATA
 Flight 1161-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0447	57.6	66,150	0902	3.1	133,671
0452	46.9	69,716	0912	3.1	133,671
0457	42.1	72,971	0917	3.0	134,515
0502	35.9	76,437	0927	3.0	134,515
0507	30.7	79,858	0934.5	3.0	134,515
0512	25.9	83,603	0937	2.95	134,948
0517	22.5	86,726	0947	2.95	134,948
0522	19.2	90,270	0957	2.95	134,948
0527	16.7	93,409	1007	2.95	134,948
0532	14.6	96,451	1009.5	2.9	135,390
0537	12.7	99,628	1022	2.9	135,390
0542	11.1	102,716	1027	2.9	135,390
0547	9.9	105,355	1029.5	2.82	136,114
0552	9.15	107,183	1042	2.82	136,114
0557	7.8	110,928	1047	2.82	136,114
0602	7.05	113,327	1049.5	2.77	136,578
0607	6.65	114,724	1059.5	2.74	136,861
0612	6.15	116,604	1107	2.74	136,861
0617	5.78	118,100	1109.5	2.7	137,244
0622	5.25	120,452	1119.5	2.7	137,244
0627	4.94	121,947	1122	2.65	137,730
0632	4.75	122,915	1137	2.65	137,730
0637	4.5	124,255	1139.5	2.6	138,227
0642	4.25	125,678	1149.5	2.6	138,227
0647	4.1	126,577	1152	2.65	137,730
0652	3.84	128,223	1154.5	2.7	137,244
0657	3.8	128,487	1209.5	2.65	137,730
0702	3.7	129,160	1222	2.65	137,730
0709.5	3.55	130,209	1229.5	2.65	137,730
0714.5	3.4	131,307	1232	2.65	137,730
0719.5	3.4	131,307	1234.5	2.6	138,227
0724.5	3.37	131,533	1247	2.6	138,227
0734.5	3.3	132,069	1254.5	2.6	138,227
0739.5	3.25	132,459	1257	2.52	139,045
0747	3.25	132,459	1304.5	2.41	140,216
0757	3.25	132,459	1309.5	2.41	140,216
0804.5	3.25	132,459	1312	2.52	139,045
0819.5	3.2	132,856	1322	2.52	139,045
0832	3.2	132,856	1337	2.52	139,045
0844.5	3.15	133,260	1347	2.52	139,045

R-1866
 Photobarograph Data
 Flight 1161-N
 Page 2

RAVEN[®]
 industries, inc.

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1349.5	2.6	138,227	1919.5	2.27	141,794
1402	2.6	138,227	1922	2.35	140,880
1409.5	2.6	138,227	1927	2.35	140,880
1412	2.65	137,730	1932	2.35	140,880
1422	2.65	137,730	1934.5	2.41	140,216
1432	2.65	137,730	1952	2.41	140,216
1434.5	2.6	138,227	1954.5	2.52	139,045
1512	2.6	138,227	2002	2.52	139,045
1527	2.6	138,227	2009.5	2.52	139,045
1537	2.6	138,227	2014.5	2.52	139,045
1539.5	2.65	137,730	2017	2.6	138,227
1552	2.65	137,730	2024.5	2.6	138,227
1602	2.65	137,730	2032	2.6	138,227
1614.5	2.65	137,730	2042	2.6	138,227
1617	2.7	137,244	2049.5	2.6	138,227
1619.5	2.65	137,730	2057	2.6	138,227
1627	2.65	137,730	2104.5	2.6	138,227
1629.5	2.6	138,227	2112	2.6	138,227
1639.5	2.6	138,227	2119.5	2.6	138,227
1642	2.52	139,045	2127	2.6	138,227
1652	2.52	139,045	2137	2.6	138,227
1702	2.52	139,045	2142	2.6	138,227
1712	2.52	139,045	2149.5	2.6	138,227
1714.5	2.41	140,216	2152	2.52	139,045
1722	2.41	140,216	2157	2.52	139,045
1732	2.41	140,216	2202	2.52	139,045
1742	2.41	140,216	2207	2.52	139,045
1759.5	2.41	140,216	2214.5	2.52	139,045
1802	2.35	140,880	2222	2.52	139,045
1807	2.35	140,880	2224.5	2.6	138,227
1809.5	2.27	141,794	2229.5	2.6	138,227
1814.5	2.27	141,794	2237	2.6	138,227
1822	2.21	142,503	2242	2.6	138,227
1824.5	2.21	142,503	2247	2.6	138,227
1827	2.21	142,503	2252	2.6	138,227
1837	2.21	142,503	2257	2.52	139,045
1847	2.21	142,503	2259.5	2.52	139,045
1857	2.21	142,503	2302	2.6	138,227
1859.5	2.27	141,794	2307	2.65	137,730
1912	2.27	141,794	2312	2.6	138,227

R-1860

PRESSURE AND ALTITUDE DATA
Flight 1161-N

RAVEN
Industries, Inc.

Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0319.3	-	Launch	0319.3	-	Launch
0324.5	822	5,500	0330	706	9,600
0337.4	561	15,500	0340	514	17,200
0344.0	456	20,600	0350	357	26,400
0355.0	299	30,400	0400	269	32,700
0403.7	238	35,300	0410	207	38,400
0418.7	152	45,000	0420	156.4	45,450
0426.2	119.4	50,300	0430	108	52,500
0439.8	74	60,700	0440	76.5	60,000
0446.0	60.2	65,200	0450	55.4	67,050
0502.0	37.5	75,500	0500	41.1	73,500
0509.7	29.8	80,500	0510	29.5	80,700
0516.6	24.0	85,300	0520	21.6	87,600
0533.6	14.92	95,900	0530	16.3	93,900
0504.4	12.4	100,200	0540	14.1	97,200
0547.3	10.05	105,000	0550	9.65	105,900
0606.5	6.37	115,700	0600	7.68	111,300
0615.6	5.41	119,200	0610	6.28	116,100
0622.8	4.87	122,300	0620	5.61	118,800
0634.0	4.33	125,200	0630	4.73	123,000
0646.0	3.83	128,300	0640	4.25	125,200
0700.0	3.56	130,100	0650	3.86	128,100
0710.0	3.3	132,000	0700	3.68	129,300
0735	3.08	133,800	0710	3.27	132,300
0827	2.81	136,200	0720	3.19	132,900
0850	2.57	138,500	0730	3.05	134,100
0930	2.57	138,500	0740	2.87	135,600
1015	2.57	138,500	0750	2.94	135,000
1030	2.81	135,200	0800	2.94	135,000
1038	2.57	138,500	0810	3.16	133,200
1130	2.57	138,500	0820	3.12	133,500
1145	2.34	141,000			
1245	2.34	141,000			
1400	2.34	141,000			
1500	2.34	141,000			
1600	2.34	141,000			
1700	2.34	141,000			
1800	2.34	141,000			
1900	2.34	141,000			
20000	2.57	138,500			
2100	2.81	136,200			
2200	2.81	136,200			
2315		Terminate			

R-1866

RAVEN

industries, inc.

Flight 1161
Upper Air Data for 0000Z, 13 July (RAWIN)
and for 1630Z, 13 July (ROCOB)

Standard Levels (RAWIN)

Pressure (MB)	T, °C	Wind Kts.
1000	+10	50° 7
850	+ 3	350° 4
700	- 5	350° 15
500	-21	330° 22
400	-34	330° 31
300	-47	320° 38
250	-43	300° 31
200	-41	290° 32
150	-44	290° 31
100	-46	300° 19
70	-48	280° 6
50	-45	20° 8
30	-44	40° 8
20	-40	90° 13

Significant Level (RAWIN)

Pressure (MB)	T, °C
1014	+ 9
996	+10
925	+ 7
890	+ 6
824	+ 2
738	- 1
475	-24
328	-44
286	-50
268	-45
221	-44
68	-44
15	-37
11	-31

ROCOB Data

25km	-42	90° 13
30	-35	80° 15
35	-24	90° 22
40	- 9	80° 37
45	+ 5	100° 40
50	+ 4	120° 44

Wind Data (RAWIN)

Thousands of Feet	Direction	Knots
1	70°	4
2	120°	2
5	350°	5
10	350°	14
16	340°	16
20	320°	25
25	330°	35
30	320°	38
35	300°	32
40	290°	34
45	300°	32
50	300°	32
60	290°	9
70	50°	7
80	40°	7
90	80°	13
100	70°	20
102	80°	23

1162 - FLIGHT DESCRIPTION

The University of Minnesota's gondola was launched at 0903Z on 13 July under the direction of G. Mancuso and M. Fulkerson. Lay-out, launch, and flight were all successful.

Dr. Webber's equipment carried on Flight 1162 was designed to measure the charge and energy spectrum of galactic cosmic rays above 50 Mev. Detectors consisted of a scintillator and a Cerenkov counter telescope. All data was telemetered to a ground station on 227 MHz. The flight was considered only a partial success since one of the three data channels was inoperative.

Tracking was satisfactory with the Churchill station losing signals when the balloon was over Uranium City (2141Z). Radio command termination was performed from the Cessna 206

Radio command ballasting operated satisfactorily seven times out of seven attempts.

Transmitter frequency and command channel utilization were:

Transmitter Frequency: 255.1 MHz

Command Channels:	Cutdown	1
	Ballast	8
	Radar Target	
	Release	9
	Private Line	1



University of Minnesota payload configuration.

R-1866



LAUNCH LOG, SKYHOOK FLIGHT 1162

University of Minnesota (Webber)
Balloon: 10.6 x 10⁶ cubic foot Stratofilm
all times in CDT 13 July 1966

0000 DOT hanger winds 150°, 10 mph.
0100 Winds 180°, 9 mph; aurora NW.
0130 Crew call, per schedule. NOTAM activated for launch at 0400. Crew to Tech Support building to pick up gondola.
0145 DOT winds 180°, 6-7 mph. Minnesota payload in hanger, commencing to tie onto launch truck.
0200 Winds 180°, 7 mph. Pibal (0000) 11806 22706 33305
0243 Advance crew left hanger for launch site. Gondola and launch truck held up 10 minutes for runway traffic clearance. Aurora NW. Ground fog in low spots on land.
0310 Launch truck arrived at launch site. Ground cloth already laid out.
0308 Balloon laid out, per pibal, from 190°.
0315 Wind on mast in SAC launch area indicated 195°, 4 knots. DOT wind report 210°, 8 mph.
0328 Inflation started, using one trailer and two tubes; bottles drained to facilitate filling from low pressure tank car, and sending tank car back.
0331 Bubble up. Wind on mast in SAC launch area 200°, 5 knots. DOT wind 210° 7 mph.
0357 Inflation completed. No sunshine on bubble. Sun down or behind low clouds.
0404 Launch. A cross-wind of about 30° was quite light. Truck moved to the right and stopped; good launch.
0405 Winds in SAC area 210° 6 knots.
0400 DOT weather: scattered clouds at 9000 feet; temperature 43°; SLP 1019.9; wind SSW 7.

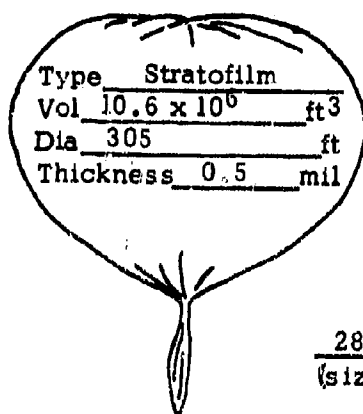
Range Test Number: 115.6 SB165-A 2L.

Tropopause: 1200Z, July 13, -53° at 275 Mb (32,223 ft.).

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

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 industries, inc.

1. Company Raven Flight Number 1162-N Director Mancuso, Fulkerson
2. Scientist Webber Group Univ. of Minnesota Date/Time 7/13 / 0903 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 90 ϕ , 43 $^{\circ}$ F, 10MPH, 1019.9 MB Cross Wind Angle 35 $^{\circ}$
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 32223 ft Temp -53 $^{\circ}$ C Inflation Start 0828 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 480 ft.
5. Balloon Theoretical 1.70 Mbs 149500 ft. How Determined?
 Ceiling: Actual 1.59 Mbs 151270 ft. Photobarograph
6. Ascent: Surface to Trop. 921 fpm Trop. to Ceiling 735 fpm.
7. Flight Duration: Total 12 hrs 44 min. At Ceiling 9 hrs. 37 min.
8. Termination: Time 2147 Z Altitude 151000 ft. Cause Radio Command
9. Balloon Destruction-confirmed Unknown (visual, unknown, etc)
10. Impact: Date/Time 7/13/2228 Z Location 59 $^{\circ}$ 52' N 109 $^{\circ}$ 00' W
11. Frequency used: (Kos, Mcs) Purpose Total Time
149.4 Communication & Cmd 13 hrs.
255.1 Altitude Telemetry 13 hrs.
4.015-7.465 Communication 13 hrs.
12. Balloon: Code Number SF-305,86-050-NSC-01 Serial Number 43

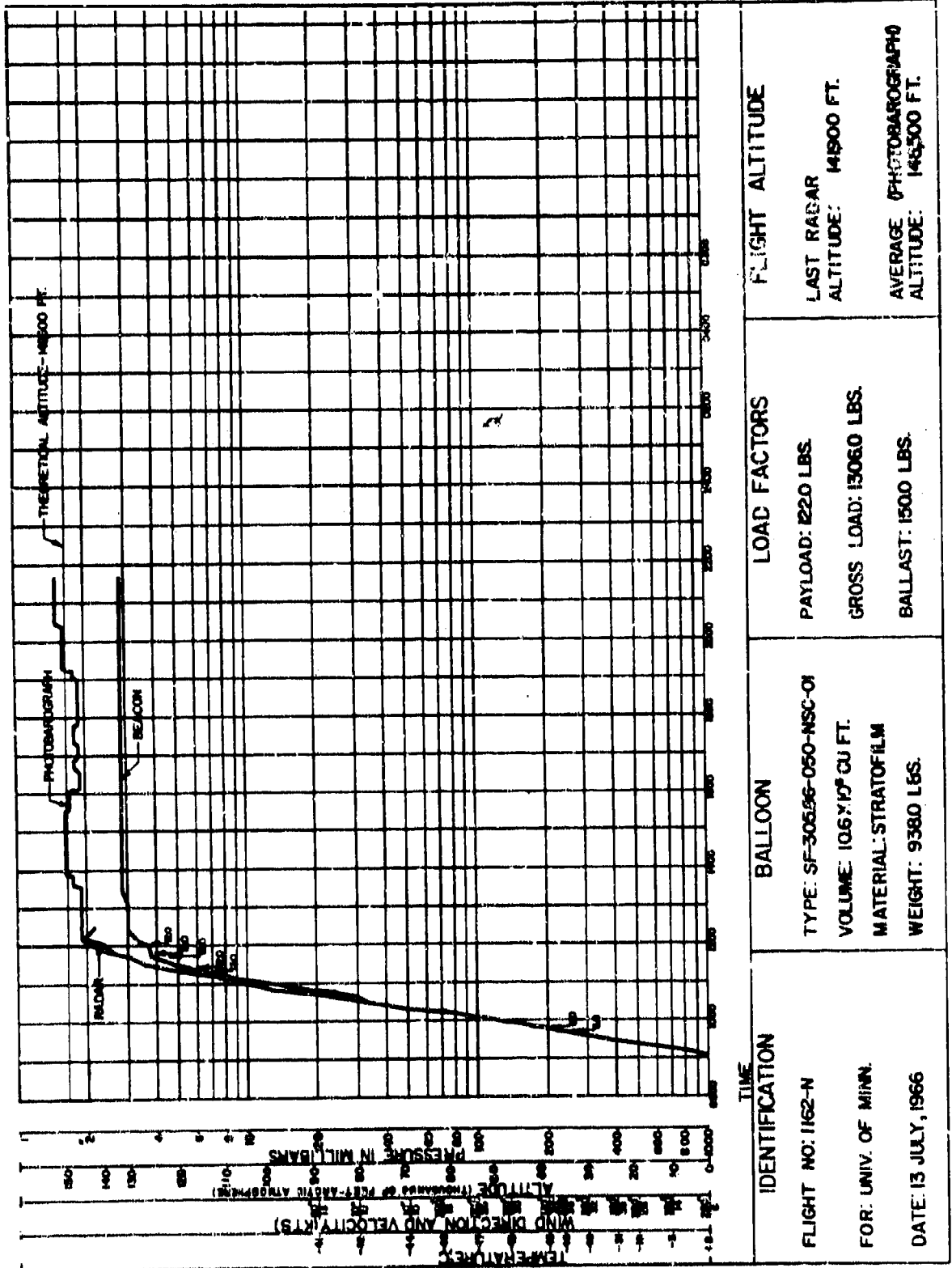


WEIGHTS

Balloon.....	<u>938.0</u>
Parachute.....	<u>27.0</u>
Instrumentation.....	<u>53.0</u>
Ballast.....	<u>152.0</u>
Scientific Package.....	<u>122.0</u>
Other.....	
Other.....	
Gross Weight.....	<u>1306.0</u>
Free Lift.....	<u>131.0</u>
Gross Inflation.....	<u>1437.0</u>
Helium used (cu. ft.).....	<u>22992</u>

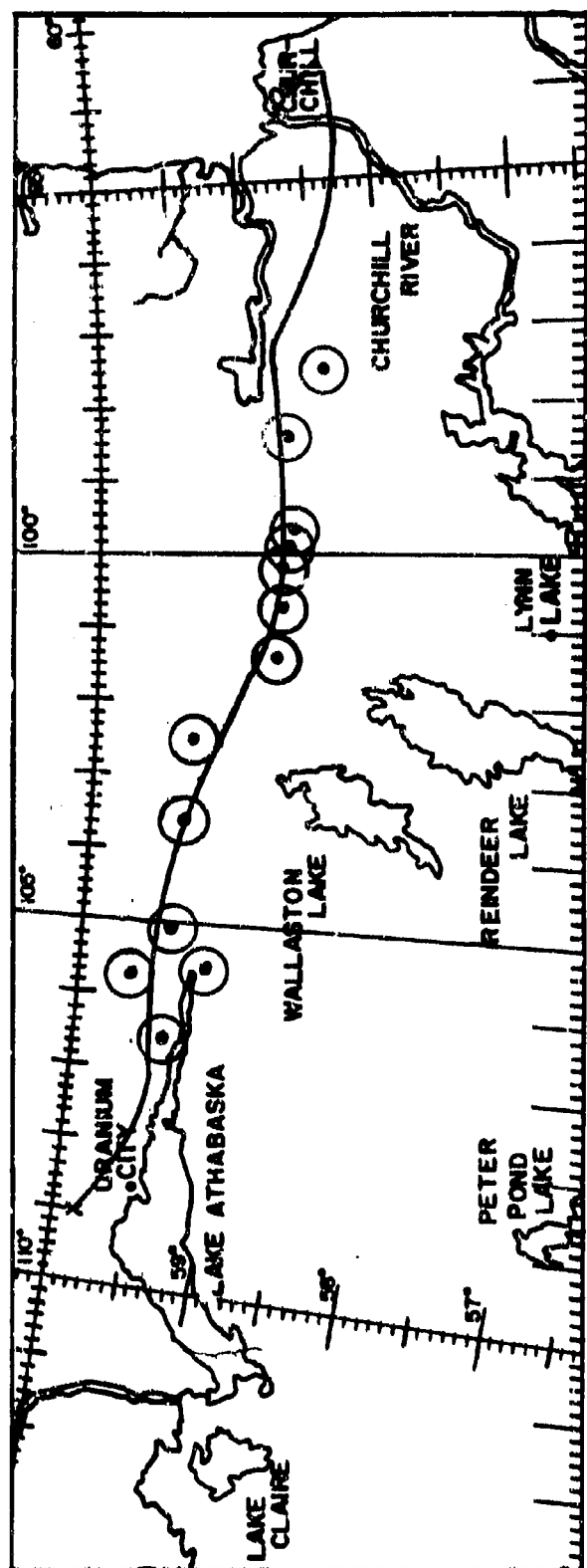
13. Flight Failures None (Nature of flight failures - if any)
14. Comments Terminated from aircraft. Defect in Uranium City Command Transmitter
 (Significant factors concerning the operation)

Copy to:
 ONR/Fld Rep/Minn
 ONR/Code 421



RAVEN

Industries, Inc.



POSITION FIXES			RADIO BEARINGS		
TIME(Z)	LATITUDE	LONG.	TIME(Z)	LATITUDE	LONGITUDE
0920	58°-41'	93°-56'	13002	58°-23'	97°-32'
0935	58°-32'	93°-55'	14001	58°-39'	98°-25'
0950	58°-27'	93°-47'	14301	58°-36'	99°-42'
1010	58°-22'	93°-34'	15001	58°-38'	99°-57'
1030	58°-18'	93°-33'	15301	58°-42'	100°-10'
1050	58°-18'	93°-39'	16002	58°-42'	100°-42'
1105	58°-17'	93°-50'	16252	58°-43'	101°-25'
1125	58°-16'	94°-07'	17301	59°-18'	102°-30'
1145	58°-15'	94°-34'	18002	59°-21'	103°-39'
1220	58°-14'	94°-24'	19001	59°-40'	105°-47'
1230	58°-19'	94°-41'	20002	59°-08'	105°-33'
1331	58°-45'	97°-12'	20302	59°-24'	106°-33'
2000	59°-29'	106°-52'	21001	59°-23'	106°-04'
2147	Terminate		(1) 2 Station Fix		
2228	59°-52'	109°-00'	(2) 3 Station Fix		
		Landing			

FLIGHT 1162. BALLASTING INFORMATION

Table I below presents Radio Controlled ballast data for Flight 1162 launched on 13 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0845Z and 2147 Z (termination), 57.2 pounds of ballast was automatically dropped at the rate of 4.4 pounds per hour. No problems were encountered with the ballasting system during this flight.

Table I

BALLAST DATA - FLIGHT 1162

Time (Z)	Amount Dropped by Radio Command	Amount Remaining (pounds)
0947	6.0	144.0
0950	6.0	138.0
1119	12.0	126.0
1126	12.0	114.0
1143	12.0	102.0
1148	12.0	90.0
1203	12.0	78.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

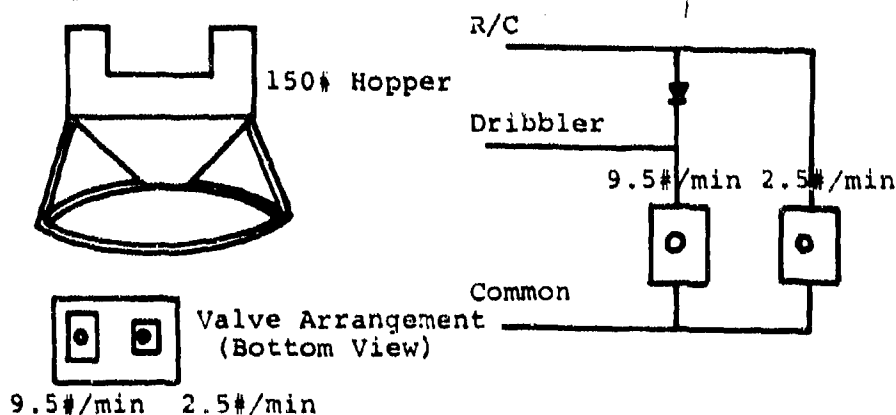


Figure 1

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PHOTOBAROGRAPH DATA

Flight 1162-N

Time (Z)	Press. (MB)	Alt. (ft)	Time (Z)	Press. (MB)	Alt. (ft.)
1014	60.0	65,300	1154	2.40	141,447
1016.5	54.0	67,500	1156.5	2.30	141,447
1019	48.5	69,800	1159	2.15	143,232
1021.5	44.5	71,766	1201.5	1.95	145,824
1024	40.0	74,084	1204	1.95	145,824
1026.5	35.9	76,437	1209	1.95	145,824
1029	32.5	78,609	1214	1.95	145,824
1031.5	29.5	80,733	1219	1.95	145,824
1034	27	82,684	1229	1.95	145,824
1036.5	24.5	84,834	1234	1.95	145,824
1039	21.9	87,328	1239	1.95	145,824
1041.5	19.9	89,467	1249	1.95	145,824
1044	17.8	91,971	1254	1.95	145,824
1046.5	15.9	94,518	1259	1.95	145,824
1049	14.5	96,607	1309	1.95	145,824
1051.5	13.0	99,095	1314	1.95	145,824
1054	12.0	100,926	1319	1.95	145,824
1056.5	11.0	102,925	1329	1.95	145,824
1059	10.0	105,123	1334	1.95	145,824
1101.5	9.2	107,056	1336.5	1.85	147,225
1104	8.42	109,083	1339	1.85	147,225
1106.5	7.65	111,387	1344	1.85	147,225
1109	7.60	111,542	1349	1.85	147,225
1111.5	6.41	115,644	1354	1.75	148,706
1114	5.90	117,608	1359	1.75	148,706
1116.5	5.40	119,763	1404	1.70	149,480
1119	5.00	121,650	1409	1.70	149,480
1121.5	4.65	123,441	1414	1.70	149,480
1124	4.30	125,384	1419	1.70	149,480
1126.5	4.05	126,884	1429	1.70	149,480
1129	3.75	128,821	1434	1.70	149,480
1131.5	3.65	129,505	1436.5	1.59	151,270
1134	3.41	131,232	1439	1.59	151,270
1136.5	3.25	132,459	1441.5	1.70	149,480
1139	3.10	133,671	1444	1.70	149,480
1141.5	2.85	135,840	1446	1.75	148,706
1144	2.85	135,840	1454	1.75	148,706
1146.5	2.65	137,730	1459	1.75	148,706
1149	2.60	138,227	1501.5	1.70	149,480
1151.5	2.40	140,325	1509	1.75	149,480

R-1866
 Photobarograph Data
 Flight 1162-N
 Page 2

RAVEN
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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1516.5	1.75	149,480	1846.5	1.95	145,824
1524	1.75	149,480	1854	1.95	145,824
1529	1.75	149,480	1859	1.95	145,824
1531.5	1.85	147,225	1901.5	1.85	147,225
1541.5	1.85	147,225	1904	1.85	147,225
1546.5	1.75	148,706	1906.5	1.75	148,706
1551.5	1.75	148,706	1909	1.70	149,480
1556.5	1.85	147,225	1911.5	1.75	148,706
1559	1.75	148,706	1914	1.70	149,480
1601.5	1.85	147,225	1916.5	1.75	148,706
1604	1.85	147,225	1924	1.75	148,706
1606.5	1.95	145,824	1926.5	1.70	149,480
1611.5	1.95	145,824	1939	1.70	149,480
1619	1.95	145,824	1941.5	1.70	149,480
1624	1.95	145,824	1944	1.59	151,270
1629	1.95	145,824	1946.5	1.59	151,270
1636.5	1.95	145,824	1949	1.70	149,480
1639	1.85	147,225	1954	1.70	149,480
1644	1.85	147,225	1959	1.70	149,480
1649	1.85	147,225	2004	1.70	149,480
1659	1.95	145,824	2009	1.70	149,480
1709	1.95	145,824	2011.5	1.70	149,480
1716.5	1.95	145,824	2019	1.70	149,480
1719	1.85	147,225	2026.5	1.70	149,480
1729	1.75	148,706	2029	1.59	151,270
1734	1.75	148,706	2034	1.59	151,270
1736.5	1.85	147,225	2039	1.59	151,270
1739	1.95	145,824	2044	1.59	151,270
1741.5	1.85	147,225	2049	1.59	151,270
1744	1.85	147,225	2059	1.59	151,270
1746.5	1.95	145,824	2104	1.59	151,270
1754	1.95	145,824	2109	1.59	151,270
1759	1.95	145,824	2116.5	1.59	151,270
1896.5	1.95	145,824	2119	1.59	151,270
1814	1.95	145,824	2126.5	1.59	151,270
1816.5	1.85	147,225	2124	1.59	151,270
1819	1.95	145,824	2126.5	1.55	151,952
1824	1.95	145,824	2134	1.55	151,952
1829	1.95	145,824	2136.5	1.55	151,952
1839	1.95	145,824	2141.5	1.55	151,952

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1162-N

RAVEN[®]

industries, inc.

Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0903.5	-	Launch	0903.5	-	Launch
0908.5	853.0	4,600	0915	675.0	10,800
0921.4	561.0	15,500	0920	559.0	15,600
0932.5	376.0	25,200	0930	395.0	24,000
0937.8	293.0	30,800	0935	325.0	28,500
0951.6	187.0	40,600	0945	216.0	37,500
1014.5	75.0	60,400	0950	196.0	39,600
1021.0	58.0	66,000	0955	161.0	43,800
1033.0	36.1	76,300	1010	90.5	56,400
1038.2	29.8	80,500	1020	60.5	65,100
1043.5	24.3	85,000	1030	40.0	74,100
1049.2	19.2	90,700	1040	26.0	82,500
1055.0	15.1	95,700	1050	17.8	91,800
1059.2	12.7	99,600	1100	12.4	100,200
1100.5	11.7	101,100	1115	8.4	109,200
1103.1	11.1	102,700	1120	6.15	116,700
1105.7	9.95	105,200	1125	5.3	120,300
1108.0	9.2	107,000	1130	4.51	124,200
1110.2	8.45	109,000	1135	3.90	127,800
1113.0	7.8	111,000	1140	3.51	130,500
1116.2	7.15	113,000	1145	3.16	133,200
1118.5	6.85	114,100	1150	2.84	135,900
1121.0	6.5	115,300	1200	2.43	140,100
1124.0	6.15	116,600	1210	2.06	144,300
1127.2	5.8	118,000	1220	2.02	144,900
1130.0	5.5	119,300	1230	2.26	141,900
1132.5	5.1	121,000			
1138.5	4.85	122,400			
1143.0	4.51	124,200			
1201.0	4.20	126,000			
1207.0	3.87	128,000			
1225.0	3.58	130,000			
1249.0	3.58	130,000			
1300.0	3.58	130,000			
1330.0	3.24	132,500			
1400	3.24	132,500			
1430	3.24	132,500			
1530	3.24	132,500			
1600	3.24	132,500			
1700	3.24	132,500			
1730	3.24	132,500			
1900	3.24	132,500			
2100	3.24	132,500			
2147		Terminate			

R-1866

RAVEN[®]

industries, inc.

Flight 1162
Upper Air Data for 1200Z, 13 July (RAWIN)
and 1630Z, 13 July (ROCOB)

Standard Levels (RAWIN)

Pressure (MB)	T, °C	Wind Kts.
1000	+ 8	260° 6
850	+ 4	340° 8
700	- 3	330° 14
500	-19	360° 26
400	-31	350° 35
300	-48	360° 32
250	-49	330° 33
200	-43	310° 34
150	-45	310° 30
100	-47	320° 20
70	-48	330° 18
50	-44	10° 10
30	-42	10° 10
20	-41	80° 13

Significant Levels (RAWIN)

Pressure (MB)	T, °C
1017	+ 6
984	+ 9
940	+ 9
859	+ 5
783	- 1
764	0
672	- 5
604	-12
567	-13
275	-53
203	-43
66	-48
48	-44
35	-46
16	-39

ROCOB Data

25km	-42	90° 13
30	-35	80° 15
35	-24	90° 22
40	- 9	80° 37
45	+ 5	100° 40
50	+ 4	120° 44

Wind Data (RAWIN)

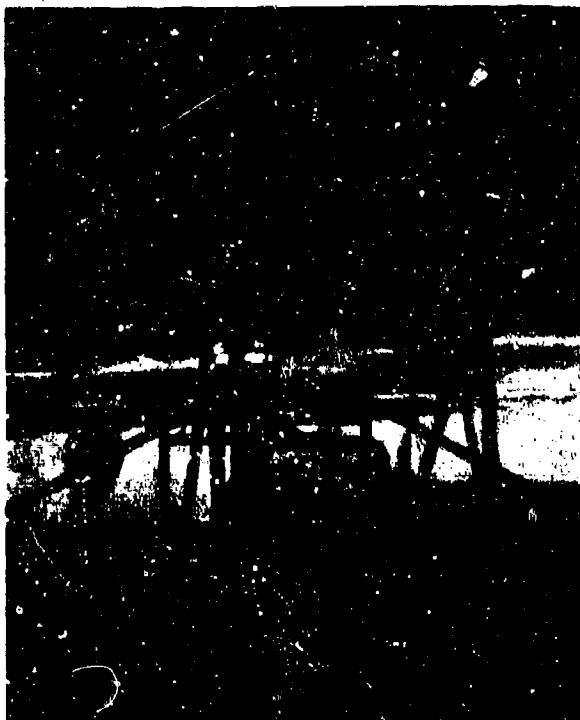
Thousands of Feet	Direction	Knots
1	280°	6
2	310°	6
5	340°	8
10	320°	13
16	350°	21
20	360°	26
25	360°	31
30	360°	32
35	320°	31
40	310°	32
45	310°	31
50	310°	23
60	330°	17
70	20°	11
80	110°	9
90	80°	12
94	60°	15

1163 - FLIGHT DESCRIPTION

Flight 1163 for the University of Rochester was launched at 0333 on 14 July 1966 under the direction of R. Keuser and G. Mancuso. The flight was terminated 18.8 hours later from Uranium City.

The scientific purpose of Rochester's equipment was to measure the flux and spectrum of charged particles with particular concern for the relative abundance of He^3 and He^4 . The total energy was detected by a large sodium iodide crystal while dE/dx was sensed with a thin scintillation counter. All information was to be recorded on board the gondola. In Dr. Deney's evaluation, the flight was not considered completely successful since launch problems caused inadequate ballast drops providing only a few hours at float altitude.

Special circuitry was used on this flight which required some modification of Raven's equipment in order to turn on the gondola power and telemeter its operation. The turn-on was accomplished by the use of a dual-coil latching relay in the Raven instrumentation package activated by radio command. A tone shift in the beacon was used to confirm this command function. Power was turned on at 100,500 feet (0606.5Z) during balloon ascent.



Preparing the Rochester gondola for flight.

1163 - Flight Description (cont.)

A 10.5 kHz VCO was used to telemeter pulse data from the Rochester Gondola. Pulse format was as follows: Rochester camera pulses scaled by eight to provide a 100 millisecond, 28 volt pulse to a relay in Raven's package. At float altitude, these occurred at a random rate of about 5 pulses per minute.

Rochester gondola performance was also monitored and telemetered. A gondola pressure loss would produce a 5-second on and a 5-second off pattern while camera-out-of-film would give a 10-second pulse.

Ground station equipment consisted of a 10.5 kHz discriminator feeding a strip chart recorder so that a permanent record of scaled camera pulses was available. Beacon frequency shift provided for aural pulse monitoring at down-range stations and in the aircraft.

Raven's entire instrument package was suspended below the University of Rochester gondola. Because of a wind shift prior to launch (90 Deg), the Raven container scraped on the gravel and broke a wire leading to the 10 pound/minute ballast valve. Since this was not discovered until after recovery, ground personnel thought they were dropping the correct amount of ballast when, in reality, only the 3 pound/minute valve was operating. Hence, the slow rate of rise as reflected on the time-altitude curve. The launch impact also broke the lower aluminum ring in the Raven gondola which was then observed to be hanging from the telemetry and receiver antennas. Telemetry, however, was satisfactory throughout the flight; being lost at 38,000 feet when on parachute descent. This loss of telemetry was probably caused by the aluminum ring damaging the transmitting antenna.

Tracking was excellent. The signal at Churchill was finally lost at 1815Z (500 miles). Transmitter frequency and command channels used were:

Transmitter Frequency:	251.5 MHz	
Command Channels:	Cutdown	7
	Ballast	8
	Gondola Turn-on	9
	Private Line	1

R-1866

RAVEN
industries, inc.

LAUNCH LOG, SKYHOOK FLIGHT 1163

University of Rochester (Deney)
Balloon: 10.6×10^6 cubic foot Stratofilm
all times in CDT 13 July 1966

2000 DOT hanger winds North 4. Crew called per schedule. NOTAM activated for 2230 launch.
2025 Payload rigging completed, ready to attach to launch truck.
2100 Winds 110° , 5-6 mph.
2108 Advance crew left hanger for launch site.
2120 Gondola rigging to launch truck completed. Convoy left for launch site.
2144 Gondola and launch truck reached launch site.
2145 Winds in launch site, on mast 120° , 1 knot. Balloon laid out per pibal from 180° .
2152 Inflation started. Helium truck bled out through two tubes.
2154 Bubble up.
2200 Winds at DOT ESE 5 mph. Winds at SAC launch area 120° , 1 knot.
2202 Pappas found and patched small finger tear 90 feet from 70 foot mark on bubble. Pibal straight over balloon.
2218 Inflation completed. Slight cross wind felt. Sunset. Sun had been behind distant cloud bank 2/3 of time bubble was up.
2223 Ready to launch; held for aircraft traffic.
2233 Launch. Surface (mast) winds 110° , 4 knots. Bubble moved off 90° from layout. Truck turned downwind and ran to edge of runway, off into gravel and bogged down. Payload released and Raven (lower) package hit the ground and dragged a few feet, then lifted off. Beacon and radio command instruments working.
2300 DOT weather: Temperature 55°F ; SLP 1020.7 Mb, Wind SE 9 mph; Scattered clouds at 8000 feet and at 25,000 feet.

Range Test Number: 117.6 SB165-A IL.

Tropopause at 0000Z 14 July: -53°C at 259 Mb (33,523 ft.).

R-1866

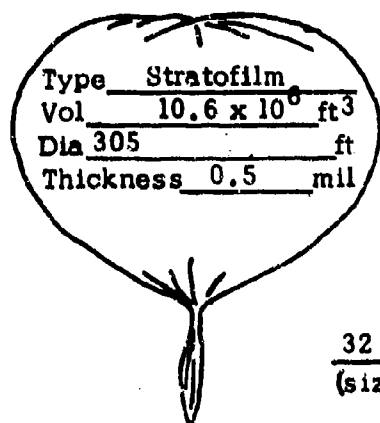
SKYHOOK BALLOON FLIGHT INFORMATION

NAVEXOS 3900/2 (Rev. 8-66)

RAVEN®

industries, inc.

1. Company Raven Flight Number 1163-N Director Keuser, Manouso
2. Scientist Denev Group Univ of Rochester Date/Time 7/14 / 0333 Z
3. Launch Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 80 Ø 250 Ø 55°F, 9 MPH Cross Wind Angle 90°
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 32523 ft Temp -53 °C Inflation Start 0252 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 480 ft.
5. Balloon Theoretical 2.09 Mbs 144000 ft. How Determined?
 Ceiling: Actual 2.50 Mbs 139200 ft. Photobarograph
6. Ascent: Surface to Trop. 915 fpm Trop. to Ceiling 214 fpm.
7. Flight Duration: Total 18 hrs 47 min. At Ceiling 10 hrs. 9 min.
8. Termination: Time 2200 Z Altitude 138000 ft. Cause Radio Command
9. Balloon Destruction-confirmed Unknown (visual, unknown, etc)
10. Impact: Date/Time 7/14/ 2250 Z Location 59° 16' N 113° 00' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd 19 hrs.
251.5 Altitude Telemetry 19 hrs.
4.015-7.465 Communication 19 hrs.
12. Balloon: Code Number SF-305.86-050-NSC-04 Serial Number 40



32 Ft. chute
(size)

WEIGHTS

Balloon.....	949.0
Parachute.....	30.0
Instrumentation.....	52.5
Ballast.....	150.0
Scientific Package.....	293.0
Other... Photobarograph.....	8.0
Other... Misc.....	15.0
Gross Weight.....	1497.5
Free Lift.....	150.0
Gross Inflation.....	1647.5
Helium used (cu. ft.).....	26352

13. Flight Failures Radio Command Ballast wire broke off in a rough launch.
 (Nature of flight failures - if any)
14. Comments Sudden crosswind caused some damage to Raven package. Ballast
 (Significant factors concerning the operation)
control was the only unit affected.

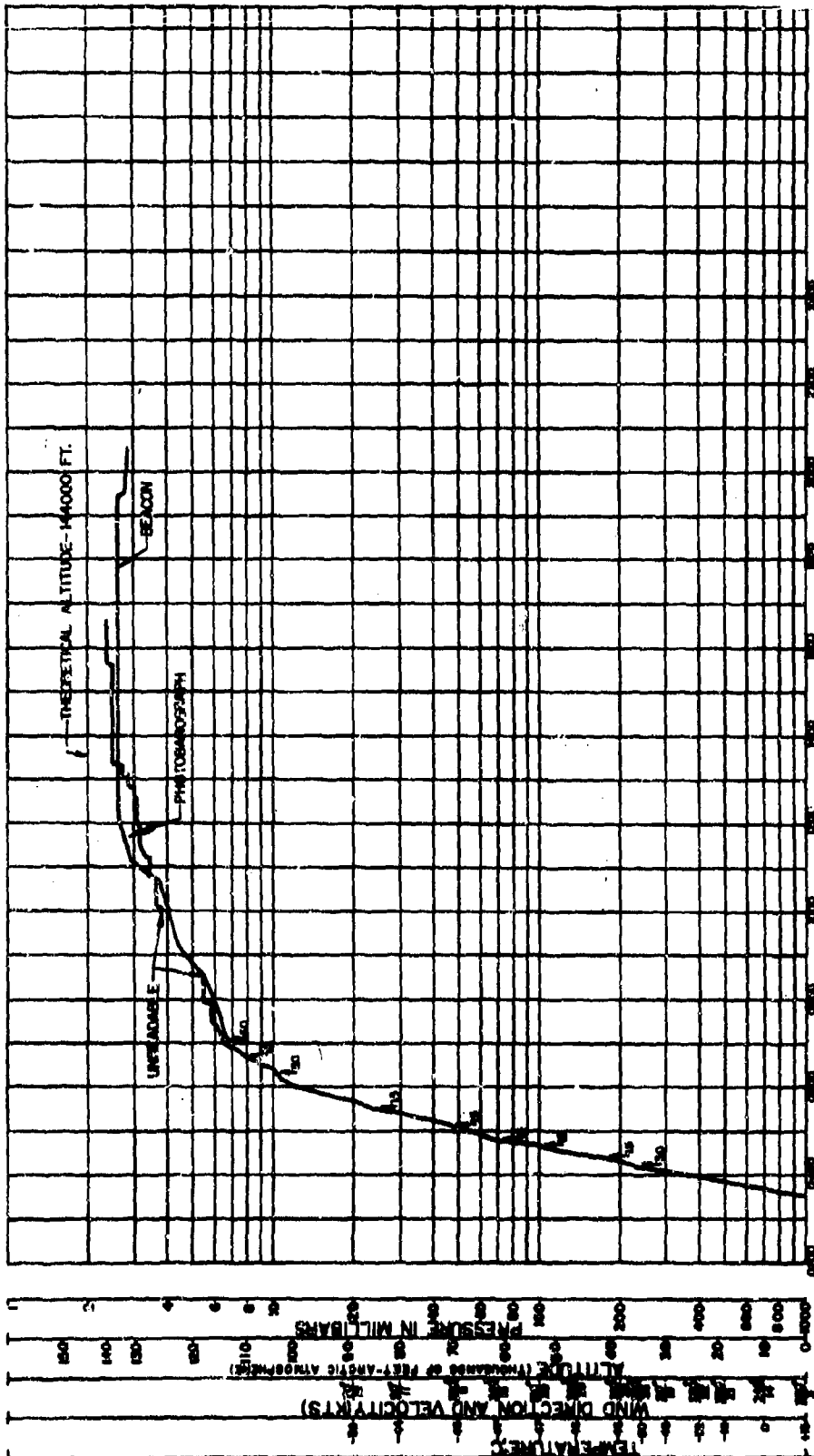
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ONR/Code 421

RAVEN

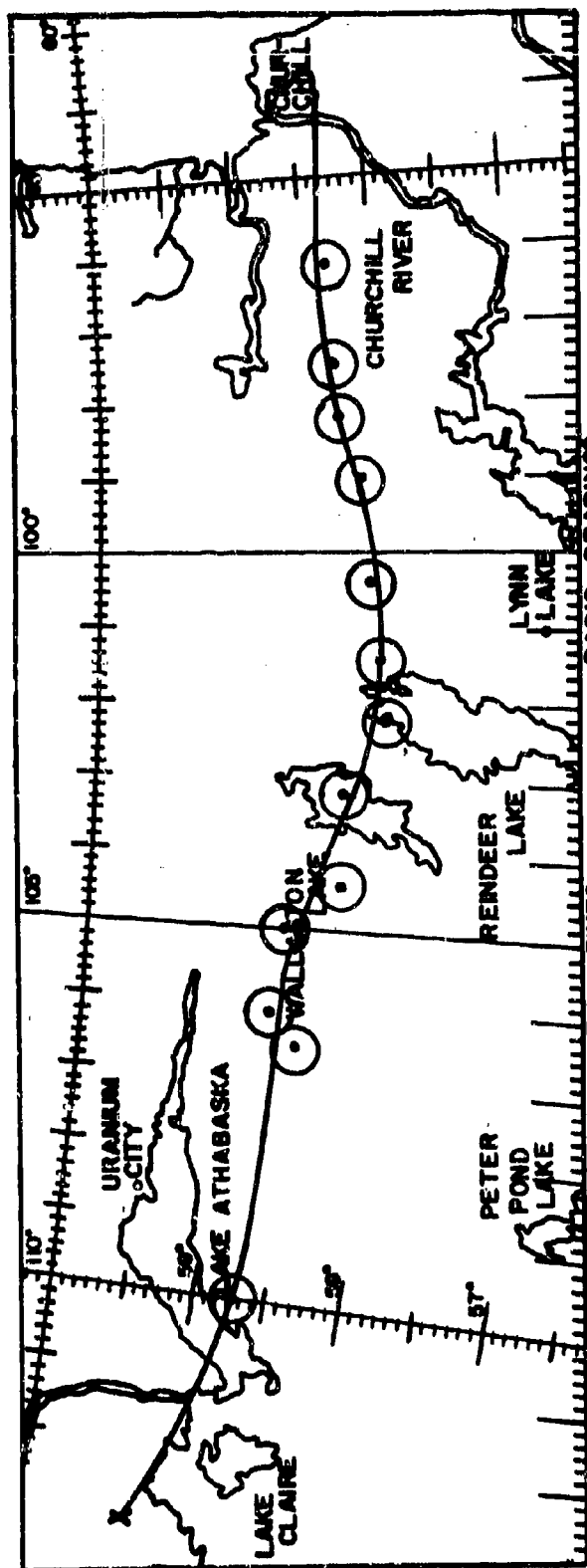
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TIME		IDENTIFICATION	
FLIGHT NO: 1163-N		FOR: UNIV. OF ROCHESTER	
DATE: 14 JULY, 1966			
BALLOON		LOAD FACTORS	
TYPE: SF-30586-050-HSC-04		PAYLOAD: 293.0 LBS.	
VOLUME: 106X10 ⁶ CU FT.		GROSS LOAD: 14975 LBS.	
MATERIAL: STRATOFILM		BALLAST: 1500 LBS.	
WEIGHT: 9490 LBS.		FLIGHT ALTITUDE	
		LAST RADAR ALTITUDE: 119,000 FT.	
		AVERAGE PHOTOBAROGRAPH ALTITUDE: 138,000 FT.	

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POSITION FIXES			RADIO BEARINGS		
TIME(Z)	LATITUDE	LONG.	TIME(Z)	LATITUDE	LONGITUDE
0350	58°-40'	93°-55'	0800 ¹	58°-18'	96°-11'
0400	58°-37'	93°-52'	1000 ¹	58°-16'	97°-30'
0410	58°-33'	93°-55'	1030 ¹	58°-15'	98°-10'
0425	58°-29'	93°-49'	1100 ¹	58°-07'	99°-00'
0440	58°-26'	93°-39'	1200 ²	58°-04'	100°-21'
0455	58°-23'	93°-37'	1300 ²	58°-00'	101°-24'
0525	58°-20'	93°-42'	1400 ²	57°-57'	102°-12'
0605	58°-19'	94°-01'	1500 ²	58°-15'	103°-11'
0645	58°-19'	94°-31'	1600 ²	58°-33'	104°-24'
0715	58°-18'	94°-55'	1630 ²	58°-36'	105°-00'
1753	58°-39'	107°-32'	1700 ¹	58°-42'	106°-06'
1900	58°-40'	108°-58'	1800 ¹	58°-30'	106°-36'
2210	59°-09'	112°-41'	2000 ¹	58°-41'	110°-02'
2220	Terminate		(1) 2 Station Fix		
2250	59°-16'	113°-00'	(2) 3 Station Fix		
					Impact

Flight 1163 Ballasting Information

Table I below presents Radio Controlled ballast data for flight 1163 launched on 14 July 1966. Initial ballast on board at the time of launch was 150 pounds. Automatic ballast drops should have been made at the rate of 4.7 pounds per hour, but post-flight analysis showed that they did not occur. Apparently, a cross-wind launching, which scrapped the raven Instrument Package across the gravel, broke a ballast valve wire when the protective aluminum ring was torn away. This wire, indicated in the simplified wiring diagram below as "point X" prevented operation of the 10 pound/minute valve. Thus, during flight, the Radio Command flow rate was reduced to 3 pounds per minute and the automatic drops did not occur.

Table I
Ballast Data-Flight 1163

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
0416	3.0	147.0
0426	1.5	145.5
0442	1.5	144.0
0452	1.5	142.5
0508	1.5	141.0
0533	1.5	139.5
0618	3.0	136.5
0644	1.5	135.0
0706	6.0	129.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

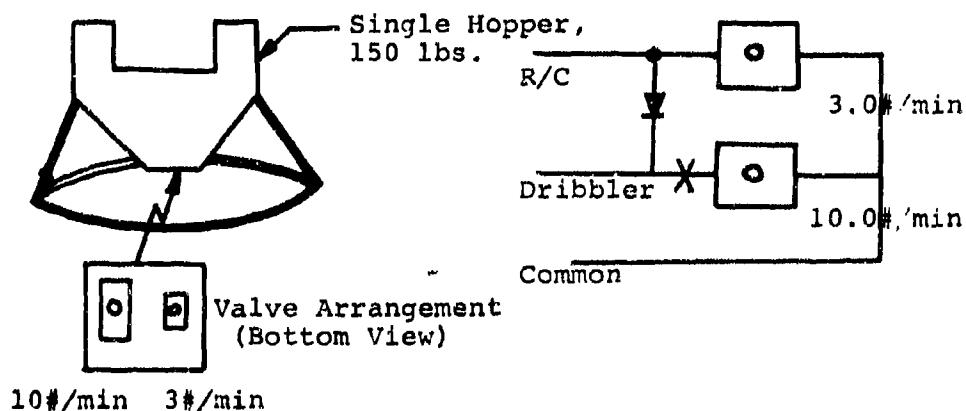


Figure 1

R-1866

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PHOTOBAROGRAPH DATA

Flight 1163-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0500.5	56.2	66,700	0640.5	8.0	110,330
0503	52.0	68,380	0643	7.7	111,233
0505.5	48.2	70,030	0645.5	7.6	111,542
0508	46.2	70,951	0648	7.3	112,498
0510.5	43.4	72,310	0650.5	7.3	112,498
0513	40.4	73,868	0653	7.0	113,497
0515.5	38.2	75,085	0655.5	7.0	113,497
0518	35.3	76,804	0658	6.7	114,544
0520.5	32.8	78,408	0700.5	6.7	114,544
0523	30.8	79,786	0703	6.6	114,905
0525.5	28.6	81,415	0705.5	6.6	114,905
0528	26.8	82,848	0708	6.6	114,905
0530.5	25.3	84,122	0710.5	6.3	116,023
0533	24.3	85,016	0713	6.3	116,023
0535.5	22.8	86,431	0715.5	6.2	116,409
0538	21.4	87,843	0718	6.15	116,604
0540.5	20.3	89,022	0720.5	6.1	116,802
0543	19.0	90,505	0723	6.05	117,001
0545.5	18.4	91,225	0725.5	6.0	117,201
0548	17.8	91,971	0728	6.0	117,201
0550.5	16.8	93,274	0730.5	5.9	117,608
0553	15.8	94,661	0733	5.9	117,608
0555.5	15.2	95,537	0738	5.9	117,608
0558	14.3	96,923	0740.5	5.9	117,608
0600.5	13.7	97,899	0743	5.9	117,608
0603	13.2	98,746	0745.5	5.9	117,608
0605.5	12.5	99,991	0748	5.8	118,023
0608	12.1	100,736	0750.5	5.8	118,023
0610.5	11.4	102,103	0753	5.8	118,023
0613	11.0	102,925	0755.5	5.8	118,023
0615.5	10.9	103,135	0758	5.7	118,445
0618	10.5	103,996	0800.5	5.7	118,445
0620.5	10.3	104,440	0803	5.6	118,876
0623	9.85	105,472	0805.5	5.6	118,876
0625.5	9.6	106,068	0808	5.6	118,876
0628	9.3	106,805	0810.5	5.5	119,315
0630.5	9.0	107,568	0813	5.5	119,315
0633	8.9	107,829	0815.5	5.5	119,315
0635.5	8.7	108,360	0818	5.5	119,315
0638	8.1	110,038	0820.5	5.5	119,315

R-1866
Photobarograph Data
Flight 1163-N
Page 2

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0823	5.5	119,315	1303	2.9	135,390
0825.5	5.5	119,315	1305.5	2.8	136,299
0828	5.5	119,315	1313	2.8	136,299
0833	5.5	119,315	1318	2.8	136,299
0835.5	Unreadable		1320.5	2.65	137,730
0955.5	3.85	128,157	1330.5	2.65	137,730
1000.5	3.85	128,157	1338	2.65	137,730
1003	3.85	128,157	1348	2.65	137,730
1005.5	3.85	128,157	1353	2.65	137,730
1008	3.75	128,821	1355.5	2.65	137,730
1013	3.75	128,821	1358	2.8	136,299
1018	3.75	128,821	1403	2.65	137,730
1020.5	3.7	129,160	1413	2.65	137,730
1028	3.7	129,160	1420.5	2.65	137,730
1040.5	3.7	129,160	1428	2.65	137,730
1043	3.55	130,209	1433	2.65	137,730
1048	3.55	130,209	1438	2.65	137,730
1053	3.55	130,209	1448	2.65	137,730
1058	3.55	130,209	1453	2.65	137,730
1103	3.55	130,209	1458	2.65	137,730
1105.5	3.5	130,569	1500.5	2.65	137,730
1113	3.5	130,569	1503	2.65	137,730
1115.5	3.35	131,685	1505.5	2.6	138,227
1120.5	3.35	131,685	1513	2.6	138,227
1125.5	3.35	131,685	1518	2.6	138,227
1128	3.2	132,856	1523	2.6	138,227
1135.5	3.2	132,856	1530.5	2.6	138,227
1138	3.2	132,856	1538	2.6	138,227
1148	3.2	132,856	1540.5	2.5	139,253
1155.5	3.2	132,856	1545.5	2.5	139,253
1158	3.1	133,671	1553	2.5	139,253
1208	3.1	133,671	1558	2.5	139,253
1218	3.1	133,671	1603	2.5	139,253
1223	3.1	133,671	1608	2.5	139,253
1228	3.1	133,671	1615.5	2.5	139,253
1235.5	3.1	133,671	1618	2.6	138,227
1238	3.0	134,515	1623	2.6	138,227
1245.5	3.0	134,515	1628	2.6	138,227
1248	2.9	135,390	1633	2.6	138,227
1253	2.9	135,390	1638	2.6	138,227

Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0333.3	-	Launch	0333.3	-	Launch
0338.4	837.0	5,100	0345	654.0	11,500
0342.3	737.0	8,500	0350	518.0	17,500
0350.9	550.0	16,000	0355	440.0	21,500
0354.5	485.0	19,100	0400	371.0	25,500
0359.0	412.0	23,000	0405	304.0	30,000
0406.7	301.0	30,200	0410	241.0	35,000
0411.5	240.0	35,200	0415	211.0	38,000
0417.4	204.0	38,700	0420	188.0	40,500
0427.3	159.0	44,100	0425	166.0	43,000
0428.4	153.0	44,900	0430	138.0	47,250
0433.1	131.0	48,300	0435	121.0	50,000
0435.8	120.0	50,200	0440	106.0	53,000
0443.7	95.0	55,300	0445	89.5	56,600
0453.2	71.5	61,400	0450	68.0	62,500
0458.5	60.5	65,000	0455	66.5	63,000
0504.1	52.0	68,400	0505	50.0	69,250
0517.6	35.8	76,500	0510	39.3	74,500
0521.0	32.7	78,500	0525	29.1	81,000
0528.3	26.6	83,000	0535	23.5	85,750
0536.0	22.2	87,000	0545	19.0	90,500
0544.2	18.6	91,000	0550	15.2	95,500
0551.0	16.1	94,200	0605	12.8	99,500
0558.0	14.1	97,200	0615	11.0	103,000
0607.4	11.9	101,100	0625	9.85	105,500
0619.8	10.5	104,000	0645	7.6	111,500
0623.5	10.0	105,100	0655	7.15	113,000
0630.7	9.2	107,100	0705	6.85	114,000
0642.9	8.1	110,000	0715	6.7	114,500
0710.6	7.05	113,300	0725	6.3	116,000
0741.5	6.5	115,200	0735	6.2	116,500
0828.9	5.75	118,200	0745	5.55	119,000
0908.2	4.97	121,800			
1039.0	4.16	126,200			
1107.2	3.36	131,600			
1211.5	2.83	136,000			
1500	2.83	136,000			
1600	2.83	136,000			
1820	2.83	136,000			
1925	2.83	136,000			
1932	3.12	133,500			
2030	3.36	131,600			
2220		Terminate			
2226	71.5	61,400			

Flight 1163
 Upper Air Data for 0000Z, 14 July (RAWIN)
 and 1630Z, 13 July (ROCOB)

Standard Levels (RAWIN)

Pressure (MB)	T, °C	Wind Kts.
1000	+15	350° 3
850	+ 4	310° 10
700	0	340° 14
500	-19	320° 21
400	-32	330° 22
300	-48	20° 19
250	-50	350° 26
200	-46	310° 29
150	-46	300° 26
100	-47	310° 20
70	-47	340° 13
50	-45	360° 6
30	-44	90° 11
20	-39	70° 18

Significant Levels (RAWIN)

Pressure (MB)	T, °C
1017	+16
914	+10
800	+ 5
786	+ 3
751	+ 2
703	0
531	-16
307	-48
259	-53
191	-46
120	-48
40	-47
11	-35

ROCOB Data

25km	-42	90° 13
30	-35	80° 15
35	-24	90° 22
40	- 9	80° 37
45	+ 5	100° 40
50	+ 4	120° 44

Wind Data (RAWIN)

Thousands of Feet	Direction	Knots
1	300°	3
2	290°	4
5	310°	10
10	340°	10
16	350°	18
20	320°	21
25	330°	21
30	10°	19
35	330°	26
40	310°	28
45	300°	26
50	310°	24
60	310°	12
70	20°	6
80	90°	11
90	70°	16

1164 - FLIGHT DESCRIPTION

Flight 1164 for California Institute of Technology was launched at 0313Z on 15 July 1966 under the direction of G. Mancuso and F. Vandersnick. Due to a command decoder failure in the Raven instrumentation package, the flight was terminated by main timer at 0039Z (16 July). A special Haydon back-up timer had also been used and set for one hour after the main timer. Total flight time was 21.4 hours making this flight the longest of the season (900 miles).

Dr. Vogt's gondola was the same as flown in Flights 1152, 1155, 1158, and 1160; measuring flux and energy spectrum of protons, electrons, alpha particles, and heavy nuclear particles up to and including oxygen in the range from 1 Mev to 1 Bev per nucleon.

Raven Industries standard compliment of instrumentation was carried. Late in the flight, radio command failed to operate on any channel. Upon return of the package, the 22 volt, K15, battery for the command decoder was found to be dead. Disassembly of the battery showed one open cell; the other 14 cells were found to be in good working order. This confirmed that the battery alone was responsible for the command failure. At 1600Z the command system was working normally when



Technical Support Building; with several
work areas for scientific users.

1164 - Flight Description (cont)

the radar target was released from Uranium City. The failure appeared at 2130Z when radio command termination was attempted. It did not affect the ballasting system, because the radio command circuit was functioning during ascent.

Tracking was satisfactory. Transmitter frequency and command channels used were:

Transmitter Frequency:	253.1 MHz	
Command Channels:	Cutdown	1
	Ballast	2
	Radar Target	
	Release	12
	Private Line	1

LAUNCH LOG, SKYHOOK FLIGHT 1164

Cal. Tech. (Vogt)

Balloon: 10.6 x 10⁶ cubic foot Stratofilm
all times in CDT 14 July 1966

1945 DOT hanger winds 7 mph, from 150°.
2000 Full crew in hanger, per schedule. DOT winds SE, 7 mph. NOTAM activated for flight at 2230.
2015 Gondola ready to rig on launch truck.
2030 Winds 180°, 9-11 mph.
2045 Advance crew left hanger for launch site.
2100 DOT winds 180°, 9 mph.
2102 Convoy left hanger, with gondola on launch truck.
2125 Balloon laid out, per pibal, from 180°.
2130 Payload convoy arrived at launch site.
2135 Wind on mast in launch area reading 180°, 6 knots. DOT winds 180°, 10 mph.
2147 Inflation started.
2150 Bubble up. Sunshine on bubble until launch.
2200 Winds in launch area 180° 9 knots. DOT winds S 13 mph.
2207 Inflation completed.
2208 Dynamometer reading 880. This corresponds to desired lift.
2213 Launch. Truck moved straight ahead, easy launch. Wind estimate, 0 knots, at top of balloon train.
2200 DOT weather: Winds south 13 mph; SLP 1018.3; Temperature 64°F; Scattered clouds at 10,000 and 25,000 feet.

Range Test Number: 118.6 SB 165-A IL.

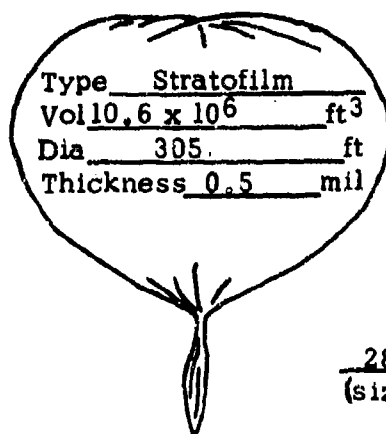
Tropopause at 0000Z 15 July; -58°C at 219 Mb (37,156 ft.).

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

RAVEN
 industries, inc.

1. Company Raven Flight Number 1164-N Director Mancuso, Vandersnick
2. Scientist Vogt Group Cal. Tech Date/Time 7/15 / 0313 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh M-36 Truck
4. Wx: 100 @ 250 @ 64°F, 13 MPH 1018.3 MB Cross Wind Angle None
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 37156 ft Temp -58 °C Inflation Start 0247 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 480 ft.
5. Balloon Theoretical 1.86 Mbs 147200 ft. How Determined?
 Ceiling: Actual 1.86 Mbs 147225 ft. Photobarograph
6. Ascent: Surface to Trop. 1100 fpm Trop. to Ceiling 714 fpm.
7. Flight Duration: Total 21 hrs 26 min. At Ceiling 18 hrs. 09 min.
8. Termination: Time 0039 Z Altitude 141400 ft. Cause Timer
9. Balloon Destruction-confirmed Unknown (visual, unknown, etc)
10. Impact: Date/Time 7/16 / 0123 Z Location 59° 18' N 119° 10' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time

<u>149.4</u>	<u>Communication & Cmd</u>	<u>22 hrs.</u>
<u>253.1</u>	<u>Altitude Telemetry</u>	<u>22 hrs.</u>
<u>4.015-7.465</u>	<u>Communication</u>	<u>22 hrs.</u>
12. Balloon: Code Number SF-305.86-050-NSC-04 Serial Number 35



WEIGHTS

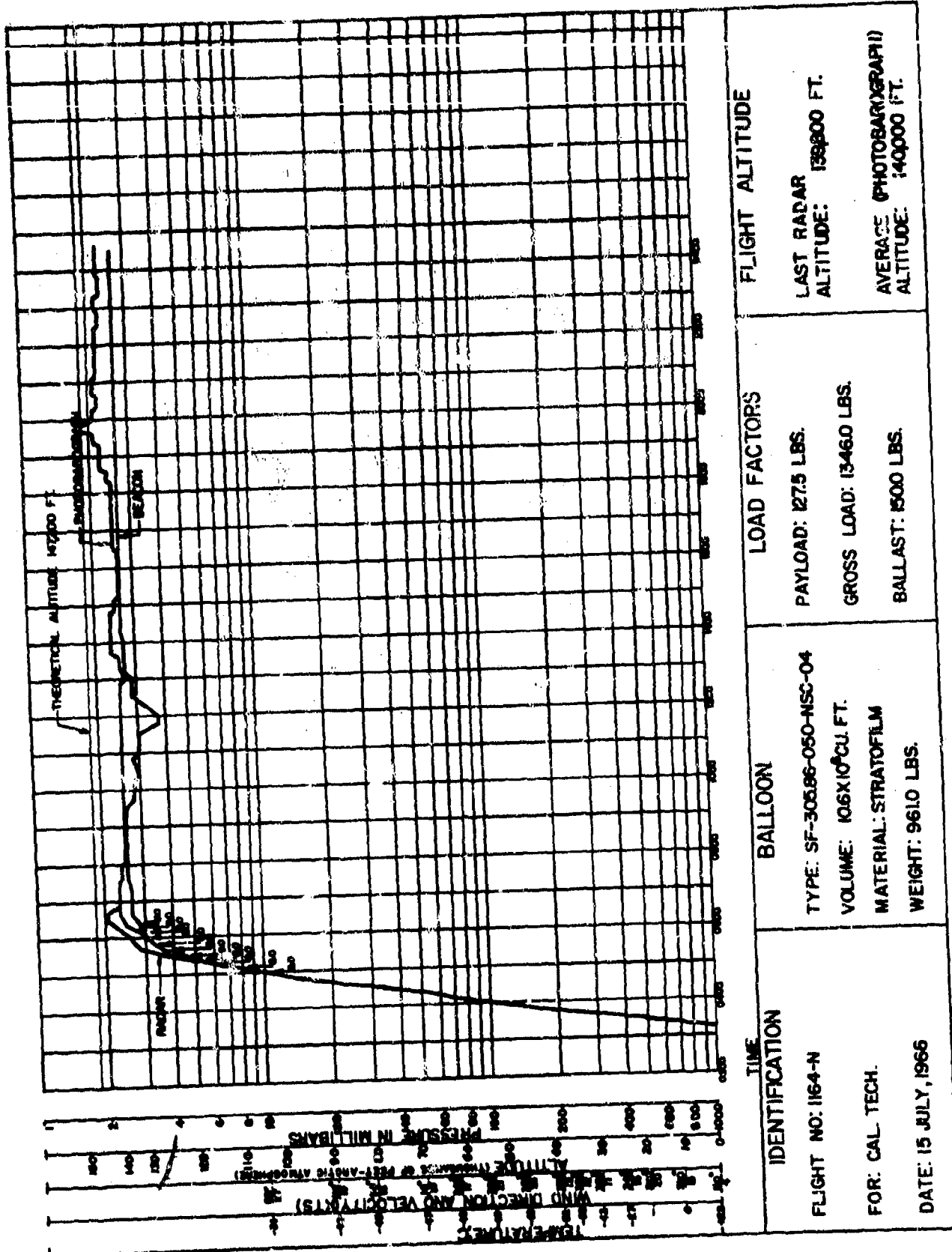
Balloon.....	<u>961.0</u>
Parachute.....	<u>30.0</u>
Instrumentation.....	<u>52.0</u>
Ballast.....	<u>150.0</u>
Scientific Package.....	<u>127.5</u>
Other. Photobarograph.....	<u>8.0</u>
Other. Misc.....	<u>17.5</u>
Gross Weight.....	<u>1346.0</u>
Free Lift.....	<u>135.0</u>
Gross Inflation.....	<u>1481.0</u>
Helium used (cu. ft.).....	<u>23696</u>

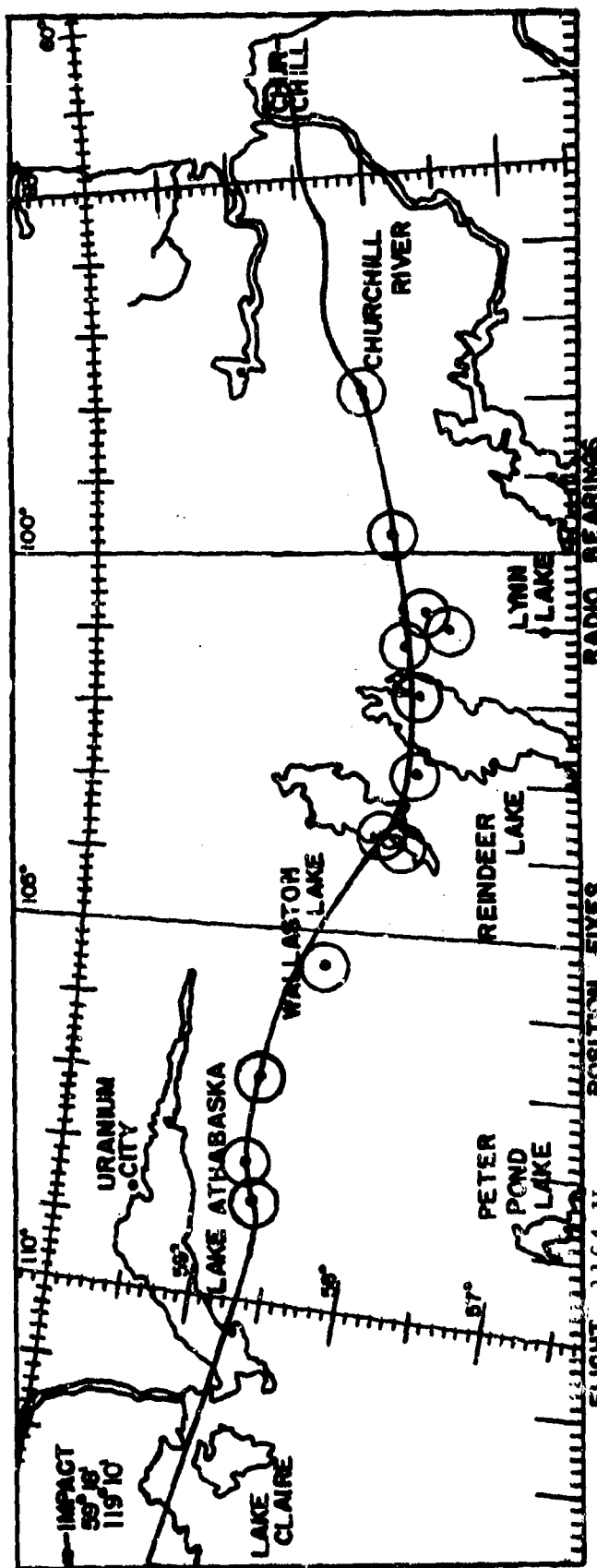
13. Flight Failures Defective K15 battery for Command Decoder prevented Radio
 (Nature of flight failures - if any) command cut down.
14. Comments Main Timer terminated flight. All instruments worked normally with the
 (Significant factors concerning the operation)
exception of the K15 battery.

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industries, inc.





RADIO BEARINGS

FLIGHT 1164-N POSITION FIXES

TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0313.5	Fort Churchill		Launch	0800 ¹	58°-05'	97°-50'
0330	58°-40'	93°-55'	Radar	0900 ¹	57°-53'	99°-44'
0400	58°-34'	93°-47'	Radar	1000 ¹	57°-37'	100°-47'
0440	58°-28'	93°-54'	Radar	1030 ¹	57°-30'	101°-00'
0500	58°-28'	94°-08'	Radar	1100 ²	57°-40'	101°-15'
0520	58°-27'	94°-26'	Radar	1200 ²	57°-41'	101°-55'
0540	58°-26'	94°-46'	Radar	1230 ¹	57°-43'	102°-53'
0600	58°-23'	95°-08'	Radar	1300 ¹	57°-57'	103°-42'
0620	58°-16'	95°-38'	Radar	1330 ¹	57°-50'	103°-50'
0640	58°-17'	96°-04'	Radar	1400 ²	58°-18'	105°-24'
0710	58°-21'	96°-53'	Radar	1430 ²	58°-41'	107°-00'
1326	58°-28'	105°-20'	C-47	1500 ²	58°-44'	108°-08'
2130	59°-28'	115°-46'	C-47	1600 ¹	58°-39'	108°-38'
0039	59°-18'	119°-06'	Termination			
0120	59°-18'	119°-10'	Impact			

 (1) 2 Station Fix
 (2) 3 Station Fix

Flight 1164 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1164 launched on 15 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0300Z and 0039Z (Termination), 60 pounds of ballast was automatically dropped at the rate of 2.8 pounds per hour. No problems were encountered with the ballasting system during this flight.

Table I
Ballast Data-Flight 1164

Time	Amount Dropped By Radio Command	Amount Remaining (pounds)
0500	8.0	142.0
0509	8.0	134.0
0518	8.0	126.0
1526	8.0	118.0
1532	8.0	110.0
1539	8.0	102.0
1550	8.0	94.0
0600	8.0	86.0
0609	8.0	78.0
0619	6.0	70.0
0625	8.0	62.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

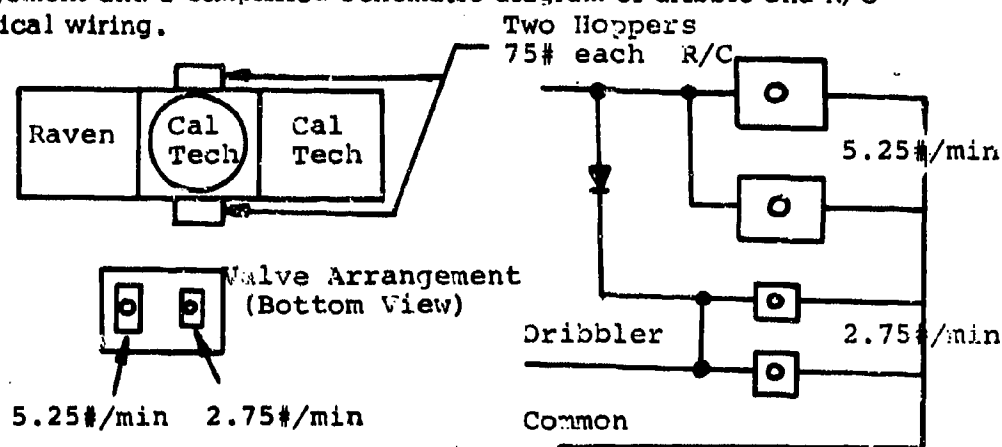


Figure 1

R-1866

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PHOTOBAROGRAPH DATA

Flight 1164-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0418	55.2	66,880	0738	2.5	139,253
0423	42.0	73,075	0743	2.5	139,253
0428	34.6	77,241	0748	2.5	139,253
0433	26.5	83,097	0753	2.5	139,253
0438	21.5	87,739	0758	2.5	139,253
0443	18.1	91,595	0803	2.59	138,328
0448	15.0	95,838	0808	2.59	138,328
0453	12.3	100,360	0813	2.67	137,534
0458	10.1	104,893	0818	2.67	137,534
0503	9.5	106,311	0823	2.67	137,534
0508	7.2	112,826	0828	2.67	137,534
0513	6.45	115,457	0833	2.67	137,534
0518	5.5	119,315	0838	2.67	137,534
0523	5.1	121,163	0843	2.67	137,534
0528	4.6	123,709	0848	2.59	138,328
0533	4.15	126,273	0853	2.59	138,328
0538	3.75	128,821	0858	2.59	138,328
0543	3.4	131,307	0913	2.59	138,328
0548	3.32	131,914	0918	2.59	138,328
0553	3.18	133,017	0923	2.67	137,534
0558	3.1	133,671	0928	2.67	137,534
0603	3.02	134,343	0933	2.67	137,534
0608	2.92	135,212	0943	2.67	137,534
0613	2.92	135,212	0953	2.67	137,534
0618	2.73	136,956	0958	2.67	137,534
0623	2.67	137,534	1003	2.73	136,956
0628	2.59	138,328	1008	2.73	136,956
0633	2.5	139,253	1013	2.73	136,956
0638	2.38	140,546	1018	2.73	136,956
0643	2.38	140,546	1023	2.73	136,956
0648	2.38	140,546	1028	2.67	137,534
0653	2.38	140,546	1033	2.67	137,534
0658	2.38	140,546	1053	2.67	137,534
0703	2.38	140,546	1058	2.67	137,534
0708	2.38	140,546	1103	2.67	137,534
0713	2.3	141,447	1108	2.73	136,956
0718	2.38	140,546	1113	2.73	136,956
0723	2.38	140,546	1118	2.67	137,534
0728	2.38	140,546	1123	2.67	137,534
0733	2.38	140,546	1128	2.73	136,956

R-1866
 Photobarograph Data
 Flight 1164-N
 Page 2

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1133	2.73	136,956	1558	2.67	137,534
1138	2.67	137,534	1608	2.67	137,534
1143	2.67	137,534	1628	2.67	137,534
1153	2.67	137,534	1633	2.59	138,328
1158	2.67	137,534	1648	2.59	138,328
1203	2.59	138,328	1708	2.59	138,328
1208	2.59	138,328	1713	2.5	139,253
1213	2.59	138,328	1723	2.5	139,253
1218	2.59	138,328	1728	2.59	138,328
1223	2.59	138,328	1743	2.59	138,328
1228	2.67	137,534	1758	2.5	139,253
1232	2.67	137,534	1813	2.5	139,253
1238	2.67	137,534	1818	2.38	140,546
1248	2.67	137,534	1833	2.38	140,546
1253	2.67	137,534	1838	2.3	141,447
1258	2.73	136,956	1853	2.3	141,447
1303	2.73	136,956	1903	2.3	141,447
1313	2.73	136,956	1908	2.25	142,028
1318	2.67	137,534	1923	2.12	143,604
1328	2.67	137,534	1928	2.12	143,604
1338	2.67	137,534	1933	2.0	145,151
1343	2.59	138,328	1938	1.85	147,225
1348	2.5	139,253	1948	1.85	147,225
1353	2.5	139,253	1953	2.0	145,151
1358	2.38	140,546	1958	2.12	143,028
1403	2.3	141,447	2018	2.25	142,028
1408	2.3	141,447	2043	2.12	143,028
1413	2.3	141,447	2118	2.25	142,028
1418	2.25	142,028	2133	2.25	142,028
1423	2.3	141,447	2153	2.25	142,028
1428	2.38	140,546	2218	2.25	142,028
1438	2.38	140,546	2233	2.3	141,447
1448	2.5	139,253	2258	2.25	142,028
1453	2.5	139,253	2313	2.3	141,447
1458	2.5	139,253	2323	2.38	140,546
1503	2.59	138,328	2338	2.38	140,546
1508	2.59	138,328	2353	2.3	141,447
1513	2.67	137,534	0008	2.3	141,447
1528	2.67	137,534	0023	2.3	141,447
1548	2.67	137,534	0038	2.3	141,447

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PRESSURE AND ALTITUDE DATA
Flight 1164-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0313.5	-	Launch	0313.5	-	Launch
0318.7	831	5,300	0330	477	19,500
0327.6	572	15,000	0335	376	25,200
0332.5	468	20,000	0340	296	30,600
0342.2	297	30,500	0345	221.5	36,900
0345.7	240	35,200	0350	175	42,000
0350.4	188.5	40,400	0355	140.2	46,800
0355.7	147.2	45,700	0400	112.5	51,600
0400.1	119.2	50,300	0405	90.3	56,400
0409.2	77.5	59,700	0410	71.4	61,500
0415.0	60.7	65,000	0415	56.5	66,600
0425.0	38.0	75,200	0420	45.9	71,100
0431.0	29.7	80,600	0425	36.8	75,900
0441.7	19.2	90,300	0430	29.5	80,700
0447.5	15.1	95,700	0435	23.8	85,500
0457.9	10.2	104,700	0440	19.2	90,300
0504.6	8.1	110,000	0445	15.5	95,100
0513.4	6.52	115,200	0450	12.7	99,600
0524.4	5.18	120,800	0455	10.6	103,800
0533.0	4.55	124,000	0500	8.95	107,700
0551.5	3.87	128,000	0505	7.4	112,200
0605.0	3.58	130,000	0510	6.53	115,200
0620.0	3.31	132,000	0515	5.76	118,200
0639.0	2.94	135,000	0520	5.23	120,600
0730	2.67	137,500	0525	4.62	123,600
0930	2.94	135,000	0530	4.24	125,700
0945	3.31	132,000	0540	3.35	131,700
1022	3.58	130,000	0550	3.01	134,400
1050	3.31	132,000	0600	2.74	136,800
1100	3.58	130,000	0610	2.5	139,200
1140	3.87	128,000	0620	2.29	141,600
1150	4.18	126,100	0630	2.14	143,400
1235	3.31	132,000	0640	2.21	142,500
1314	2.94	135,000	0650	2.37	140,700
1420	2.67	137,500	0700	-	-
1600	2.94	135,000	0710	2.45	139,800
1616	2.67	137,500			
1800	2.67	137,500			
1900	2.67	137,500			
2000	2.67	137,500			
2100	2.67	137,500			
2200	2.67	137,500			
2300	2.67	137,500			
0039		Terminate			

R-1866

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Flight 1164
 Upper Air Data for 0000Z, 15 July (RAWIN)
 and 1630Z, 15 July (ROCOB)

Standard Levels (RAWIN)

Pressure (MB)	T, °C	Wind Kts.
1000	+22	110° 4
850	+10	320° 19
700	0	320° 15
500	-	320° 20
400	-27	340° 15
300	-42	350° 11
250	-52	360° 12
200	-52	350° 13
150	-49	330° 25
100	-49	320° 21
70	-49	340° 17
50	-47	10° 10
30	-43	90° 16
20	-40	110° 13
10	-34	60° 27

ROCOB Data

25km	-41	80° 17
27	-39	100° 42
30	-38	90° 29
35	-24	100° 28
40	-11	90° 39
42	- 1	90° 44
45	+ 5	90° 52

Significant Levels (RAWIN)

Pressure (MB)	T, °C
1016	+23
818	+ 7
773	+ 5
678	0
321	-33
219	-58
190	-51
40	-47
23	-40
16	-41
9	-33

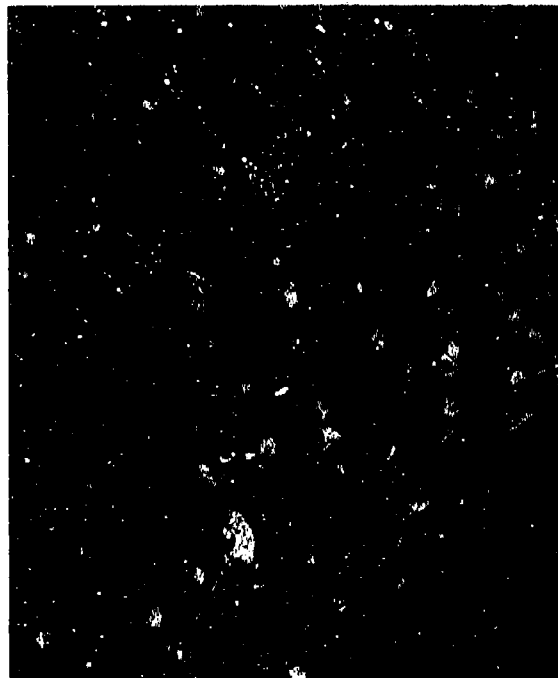
Wind Data (RAWIN)

Thousands of Feet	Direction	Knots
1	150°	3
2	260°	5
5	320°	19
10	320°	15
16	320°	21
20	320°	19
25	340°	16
30	340°	11
35	360°	12
40	330°	14
45	330°	26
50	320°	18
60	330°	12
70	360°	10
80	90°	17
90	110°	12
100	70°	15
107	70°	30

1165 - FLIGHT DESCRIPTION

The last flight for NASA-Goddard Space Flight Center, number 1165, was launched at 0755Z on 16 July 1966. It was to be the first of three launches within five hours. The launch was under the direction of G. Mancuso and F. Vandersnick. Since the C-47 tracking aircraft was not yet back from Uranium City, the decision was taken and concurred with by Mr. H. Demboski of ONR to launch anyway. Confidence in our tracking network was improving!

After a 21 hour flight, the C-47 aircraft initiated termination. Although all systems could be considered to have been working properly, a minor problem occurred with the ballasting. Fortunately, Raven's method of radio confirmation of every command enabled the ground crew to rectify the situation (see Ballasting Information). Upon return of the flight container, a check indicated a faulty resonant reed relay in the command decoder for the ballast system. A photobarograph was also flown on this flight, but its motor didn't start and no data was available. Goddard Space Flight Center's scientific equipment was similar to that flown in Flights 1159 and 1161, designed to study the effect of solar activity on the number and energy distribution of galactic cosmic rays. Principal investigator was Dr. V. K. Balasubrahmanyam.



NASA-Goddard equipment on launch truck.

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1165 - Flight Description (cont)

No problems were encountered with tracking or recovery operations. Fort Churchill lost telemetry signals at 2000Z when the balloon was 510 miles out and Lynn Lake lost its signal at 0145Z (480 miles away). Transmitter frequency and command channels used were:

Transmitter Frequency:	253.1 MHz	
Command Channels:	Cutdown	1
	Ballast	2
	Radar Target	
	Release	12
	Private Line	1

R-1866

RAVEN

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LAUNCH LOG, SKYHOOK FLIGHT 1165

NASA-Goddard Space Flight Center (Balasubrahmanyam)

Balloon: 10.6×10^6 cubic foot Stratofilm

all times in CDT 15-16 July 1966

2000 Crew in hanger, rigging gondola. DOT winds SE, 14 mph.
2100 Rigging completed; winds SE 11. Crew on standby.
2200 Winds SE 11.
2230 Winds 150° , 10-13. Crew left. Weather watch set up.
0000 Winds 170° , 9 mph.
0015 Winds 10-12 mph, 170° .
0030 Winds 180° , 8-9 mph. Winds at 100 ft. 230° , 13 knots.
0100 Winds 180° , 9 mph.
0115 Winds 180° , 8 mph; crew called.
0130 Crew in hanger
0140 Gondola left hanger, on launch truck. Winds at 180° 8 mph.
0205 Gondola arrived on launch truck in launch site. Winds on mast there 160° , 6 kt.
0210 Balloon laid out with pibal at 180° .
0228 Wind in launch area 170° , 7 knots; wind at DOT hanger 170° , 8-9 mph.
0232 Inflation started, two tubes out of one trailer.
0234 Bubble up.
0250 - Inflation completed.
0255 Launch. Straight ahead, smooth and easy. Wind 170° , 8 knots per mast aerovane.
0300 DOT weather: Temperature 59°F ; SLP 1005.1 Mb; Winds S 10 mph; clouds; scattered at 9000 feet, broken at 25,000 feet.

Range Test Number: 119.6 SB165-A 2L.

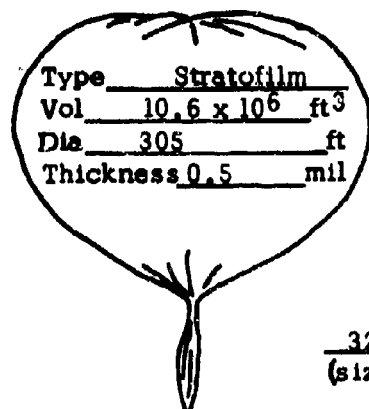
Tropopause at 1200Z 16 July: -59°C at 233 Mb (35,814 ft.).

R-1866
SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

RAVEN[®]
 industries, inc.

1. Company Raven Flight Number 1165-N Director Mancuso, Vandersnick
2. Scientist Balashubrah ^{manyam} Group Goddard SFC Date/Time 7/16 / 0755 Z
3. Launch: Site F2, Churchill Technique/Launch Veh. M-35 Truck
4. Wx: 90 @ 250 @ , 59°F, 10 MPH, 1005.1 MB Cross Wind Angle 10°
 (Sky-Temp-Wind-Pressure)
 Trop(Coldest)Ht. 35814 ft Temp -59 °C Inflation Start 0732 Z
 Hrs Sunshine on Bubble None Train Length(Layout) 480 ft.
5. Balloon Theoretical 1.98 Mbs 145,500 ft. How Determined?
 Ceiling: Actual 2.13 Mbs 143,400 ft. Rader - 1130Z
6. Ascent: Surface to Trop. 915 fpm Trop. to Ceiling 604 fpm.
7. Flight Duration: Total 21 hrs 03 min. At Ceiling 17 hrs. 29 min.
8. Termination: Time 0459 Z Altitude Unknown ft Cause Radio Command
9. Balloon Destruction-confirmed Unknown (visual, unknown, etc)
10. Impact: Date/Time 7/17 / 0541 Z Location 59° 59' N 113° 48' W
11. Frequency used:

(Kcs, Mcs)	Purpose	Total Time
<u>149.4</u>	<u>Communication & Cmd.</u>	<u>22 hrs.</u>
<u>253.1</u>	<u>Altitude Telemetry</u>	<u>22 hrs.</u>
<u>4.015-7.465</u>	<u>Communication</u>	<u>22 hrs.</u>
12. Balloon: Code Number SF-305.86-050-NSC-04 Serial Number 34



WEIGHTS

Balloon.....	977.0
Parachute.....	29.0
Instrumentation.....	52.0
Ballast.....	150.0
Scientific Package.....	149.0
Other Photobarograph.....	8.0
Other Misc.....	59.0
Gross Weight.....	1424.0
Free Lift.....	143
Gross Inflation.....	1567.0
Helium used (cu. ft.).....	25072

32 Ft. chute
 (size)

13. Flight Failures Intermittent resonant reed relay in ballast command circuit
 (Nature of flight failures - if any)
14. Comments None
 (Significant factors concerning the operation)

Copy to:
 ONR/Fld Rep/Minn
 ONR/Code 421

RAVEN

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TIME

IDENTIFICATION

FLIGHT NO: 1165-N

FOR: GODDARD SPACE FLIGHT
CENTER

DATE: 16 JULY, 1966

BALLOON

TYPE: SF-305.86-050-NSC-04

VOLUME: 10.6X10³ CU. FT.

MATERIAL: STRATOFILM

WEIGHT: 977.0 LBS.

LOAD FACTORS

PAYLOAD: 148.0 LBS.

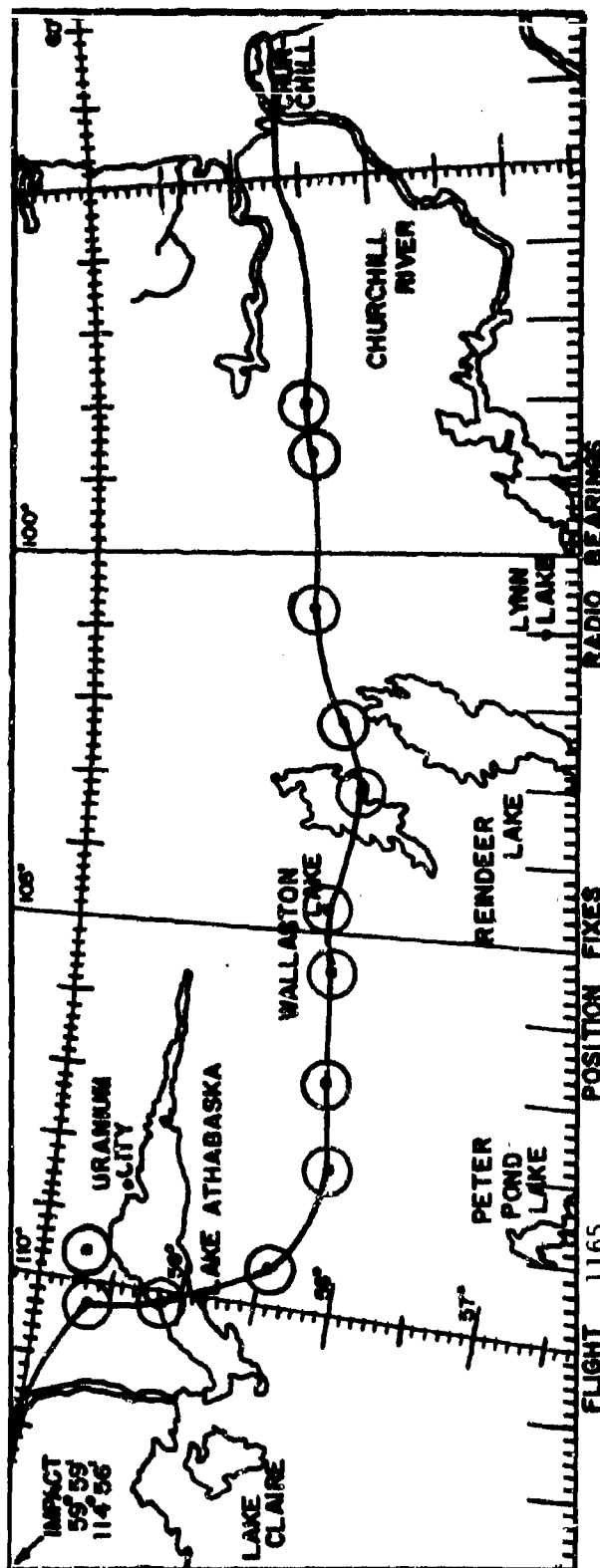
GROSS LOAD: 1424.0 LBS.

BALLAST: 1500 LBS.

FLIGHT ALTITUDE

LAST RADAR
ALTITUDE: 140000 FT.

AVERAGE (BEACON)
ALTITUDE: 135000 FT.



TIME(Z) LATITUDE LONG.		OBTAINED BY		TIME(Z) LATITUDE LONGITUDE	
0825	58°-46'	93°-49'	Radar	14001	58°-30' 98°-00'
0840	58°-47'	93°-31'	Radar	14452	58°-26' 98°-38'
0855	58°-45'	93°-18'	Radar	15452	58°-26' 100°-42'
0910	58°-42'	93°-15'	Radar	16152	58°-13' 102°-12'
0920	58°-40'	93°-13'	Radar	16451	58°-06' 103°-09'
1000	58°-39'	93°-35'	Radar	18152	58°-17' 104°-41'
1020	58°-37'	93°-51'	Radar	18452	58°-15' 105°-30'
1100	58°-38'	94°-46'	Radar	19152	58°-12' 106°-58'
1150	58°-29'	95°-49'	Radar	19452	58°-07' 108°-04'
0020	60°-05'	111°-58'	C-47	20451	58°-26' 109°-30'
0210	60°-17'	111°-58'	C-47	21451	59°-07' 110°-09'
0335	60°-10'	113°-40'	C-47	23451	59°-37' 110°-13'
0415	60°-08'	114°-18'	C-47	21001	59°-42' 109°-35'
0459	Terminate			(1) 2 Station Fix	
0541	59°-59' 114°-56'	Impact		(2) 3 Station Fix	

Flight 1165 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1165 launched on 16 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0745Z and 0459Z, 17 July (termination), 56 pounds of ballast was dropped automatically at the rate of 2.65 pounds per hour.

A minor problem developed early during the balloon's ascent when the protective time delay, built into the Radio Command decoder, usually around two seconds in the ballast channel, lengthened to as much as 60 seconds. Correction was made in flight by increasing the Radio Command "time on" signal as necessary to overcome the additional delay. Confirmation of successful ballast drops were made from the time-altitude curves. Post-flight analysis revealed an intermittent resonant reed relay in the Radio Command ballast channel. The remainder of the ballast system functioned normally.

Table I
Ballast Data-Flight 1165

Time	Amount Dropped By Radio Command	Amount Remaining (Pounds)
0910	5	145.0
0915	5	140.0
0924	5	135.0
0939	5	130.0
1003	5	125.0
1017	5	120.0
1025	5	115.0
1038	5	110.0
1045	11	99.0
1052	11	88.0
1100	11	77.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

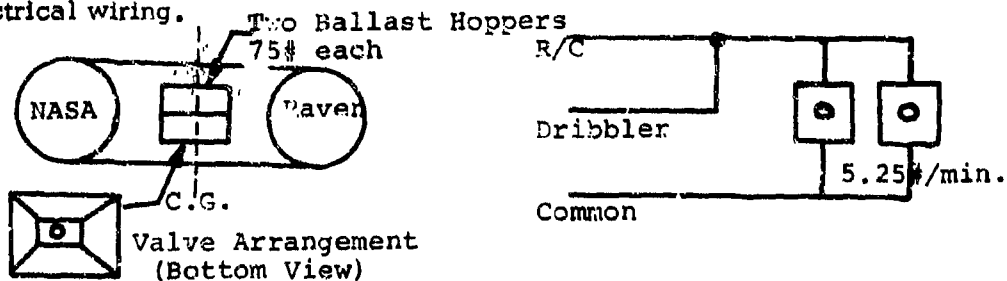


Figure 1

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1165-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB.)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0755.5	-	Launch	0805	735.0	8,750
0802.1	825.0	5,500	0810	601.0	13,750
0805.9	751.0	8,000	0815	497.0	18,500
0813.0	563.0	15,400	0820	400.0	23,750
0816.6	497.0	18,500	0825	322.0	28,700
0824.6	360.0	26,200	0830	277.0	32,050
0834.4	236.0	35,500	0835	211.0	38,000
0840.5	183.0	41,000	0840	183.0	41,000
0850.7	132.0	48,100	0845	160.0	44,000
0857.3	104.0	53,300	0850	133.0	48,000
0908.7	71.5	61,500	0855	114.0	51,300
0920.5	47.0	70,600	0900	96.5	54,900
0927.5	36.5	76,100	0905	82.0	58,500
0932.5	30.5	80,000	0910	70.5	61,800
0950.8	15.2	95,500	0915	59.0	65,550
0956.4	12.5	100,000	0920	49.1	69,600
0959.5	11.1	102,800	0925	41.1	73,500
1002.8	10.1	105,000	0930	33.9	77,700
1006.4	8.7	108,400	0935	25.6	83,850
1010.0	7.6	111,600	0940	22.8	86,400
1012.5	6.9	113,800	0945	18.7	90,900
1016.0	6.25	116,200	0950	15.1	95,700
1019.4	5.95	117,500	0955	12.9	99,300
1026	5.0	121,600	1000	10.6	103,800
1032.8	4.46	124,800	1005	8.85	108,000
1157.0	3.58	130,000	1010	7.3	112,500
1229.5	3.0	134,500	1015	6.3	116,100
1400	2.7	137,200	1020	5.55	119,100
1600	2.7	137,200	1030	4.51	124,200
1700	2.7	137,200	1040	3.72	129,000
1730	3.0	134,500	1050	3.16	133,200
1800	3.0	134,500	1100	2.72	137,100
1900	3.0	134,500	1110	2.42	140,100
2000	3.0	134,500	1120	2.21	142,500
2100	3.0	134,500	1130	2.14	143,400
2300	3.0	134,500	1140	2.16	143,100
0000	3.0	134,500	1150	2.33	141,000
0100	3.0	134,500			
0130	3.310	132,000			
0200	3.310	132,000			
0430	3.310	132,000			
0459		Terminate			
0500.5	6.90	113,800			
0514.0	178.0	41,600			

R-1866

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Flights 1165, 1166, 1167
Upper Air Data for 1200Z, 16 July

Standard Levels

Pressure (MB)	T, °C	Wind Kts.
1000	+ 9	310° 10
850	+ 5	310° 18
700	- 4	310° 28
500	-21	320° 33
400	-34	330° 47
300	-50	340° 49
250	-56	330° 41
200	-51	330° 31
150	-49	320° 23
100	-49	330° 10
70	-48	360° 11
50	-47	90° 12
30	-45	70° 13
20	-41	90° 17

Significant Levels

1008	+ 7
976	+14
941	+12
772	0
742	- 1
556	-16
502	-21
444	-28
362	-40
290	-52
233	-59
193	-50
40	-47
9	-33

Wind Data
Thousands
of Feet

Direction	Knots
180°	5
170°	6
170°	8
180°	4
300°	4
320°	18
280°	19
260°	25
250°	37
290°	20
280°	28
310°	23
250°	12
70°	1
100°	8
70°	18
80°	15
70°	23

1166 - FLIGHT DESCRIPTION

Flight 1166 signified the second of three launches within a five hour period. Three gondolas for NASA-Langley and New York University were launched at 1020Z on 16 July. The first package weighing 172 pounds, was hung from the launch truck; the second was on a cart while the third was hand-held by R. Keuser. The launch was made in a light cross wind of about 30 Deg with no apparent problems. The last, small, load lightly hit the gravel as the balloon moved away but caused no damage. The operation was under the direction of G. Mancuso and M. Fulkerson.

Apparatus for this, and other flights were under the direction of Dr. Foelsche for NASA and Dr. Mendel for New York University. Three different experiments were carried, described as follows:

1. Phoswich-type scintillator to measure flux and spectrum of fast neutrons in the range from one to ten Mev. Data was passed through a seven channel analyzer and then recorded on a tape recorder and photograph.
2. Tissue-equivalent ion chamber with its own on-board recorder.



NASA-Langley, NYU flight train. One package on M-36 launch truck, a second on a wheeled cart, and a third hand-held.

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1166 - Flight Description (cont.)

3. Emulsions to detect heavy primaries and seed corn, to be planted for possible detection of radiation induced mutations.

All three packages were to be flown at various altitudes to provide an altitude profile and especially to collect data at altitudes of importance to super-sonic transport aircraft.

All instrumentation performed well. In addition to the regular functions, Raven used sensors to measure and telemeter temperature and voltages within their container.

Tracking and position fixing was satisfactory for the majority of the flight. Towards the end, however, when "straight-on" fixes were made between Uranium City and Lynn Lake, positioning became somewhat less accurate. Fort Churchill tracked the balloon to a distance of 490 miles (0208Z).

Transmitter frequency and command channels were:

Transmitter Frequency:	251.5 MHz	
Command Channels:	Cutdown	7
	Ballast	8
	Target Release	9
	Private Line	2

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LAUNCH LOG, SKYHOOK FLIGHT 1166

NASA-Langley, NYU (Foelsche-Mendel)
Balloon: 2.94 x 10⁶ cubic foot Stratofilm
all times in CDT 16 July 1966

This package consisted of three parts. The heavy one was hung from the launch truck. The second was on a cart, as for an anchor line launch, but without any anchor below the launch truck. R. Keuser carried the third, a package of emulsions and seeds.

Following flight 1165, the launch truck was returned to the DOT hanger to hang and rig the NASA-Langley, NYU load.

0310 Truck arrived in hanger. Rigging commenced.
0325 Winds on mast in launch area 170°, 6 knots.
0415 Advance crew arrived in launch area.
0430 Balloon laid out at 140°, following shifting lower pibal. This angle gave more maneuverability than a layout of 170°, used for flight 1165.
Winds in launch area 180°, 4 knots. Winds at DOT hanger, 6-7 mph, 180°.
0447 Gondola reached launch area.
0450 Inflation commenced, using a single filling tube (only one provided).
0515 Inflation finished. Sun on bubble 50% of time.
0520 Launch. A cross wind of about 30° was light. The main load was launched successfully, as was the second load on the launch cart. The third hit the ground, but not with much force, as train swept off over edge of the runway.
0500 DOT weather: Clouds; scattered at 10,000 and 14,000, broken at 25,000 feet. Temperature 59°; SLP 1004.0; Winds S 9mph.

Range Test Number: 121.6 SB165-A IL.

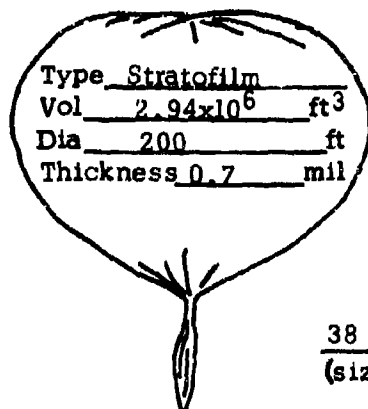
Tropopause at 1200Z, 16 July: -59°C at 233 Mb (35,814 ft.).

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

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1. Company Raven Flight Number 1166-N Director Mancuso, Fulkerson
2. Scientist Foelsche Group NASA Langley NYU Date/Time 7/16 / 1020 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 10 Ø - 140 Ø 250 Ø, 59°F, 9 MPH, 1004.0 MB Cross Wind Angle 30°
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 35814 ft Temp -59 °C Inflation Start 0950 Z
 Hrs Sunshine on Bubble 0.5 Train Length (Layout) 325 ft.
5. Balloon Theoretical 4.75 Mbs 122,900 ft. How Determined?
 Ceiling: Actual 4.36 Mbs 125,000 ft. Photobarograph
6. Ascent: Surface to Trop. 892 fpm Trop. to Ceiling 768 fpm.
7. Flight Duration: Total 17 hrs 58 min. At Ceiling 14 hrs. 22 min.
8. Termination: Time 0335 Z Altitude 125,000 ft. Cause Radio Command
9. Balloon Destruction-confirmed Unknown (visual, unknown, etc)
10. Impact: Date/Time 7/17 / 0418 Z Location 58° 41.5' N 109° 08.5' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time

<u>149.4</u>	<u>Communication & Cmd</u>	<u>18 hrs.</u>
<u>251.5</u>	<u>Altitude Telemetry</u>	<u>18 hrs.</u>
<u>4.015-7.465</u>	<u>Communication</u>	<u>18 hrs.</u>
12. Balloon: Code Number SF-199.78-070-NS-04 Serial Number 254



38 Ft. chute
 (size)

WEIGHTS

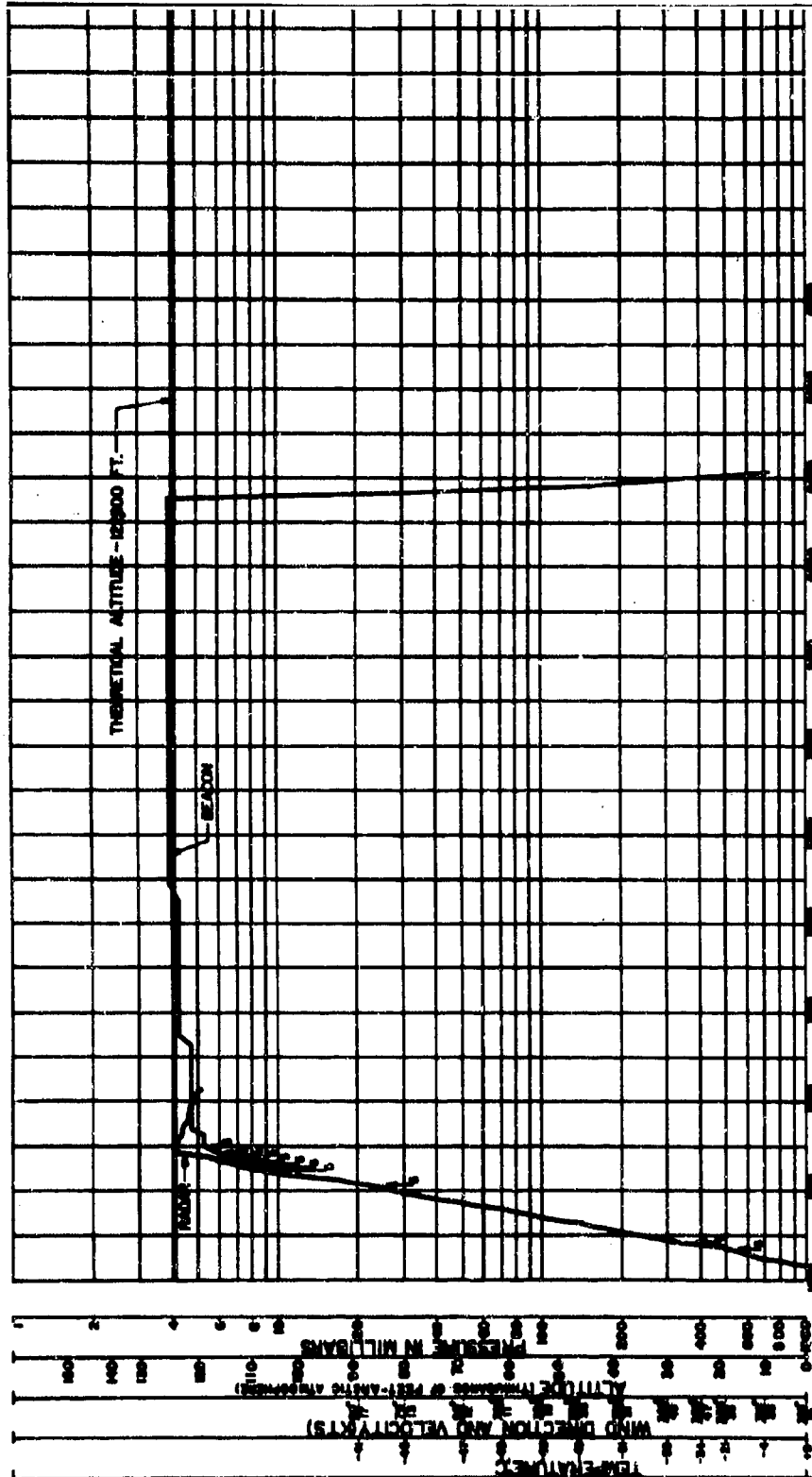
Balloon.....	470.0
Parachute.....	36.0
Instrumentation.....	51.0
Ballast.....	150.0
Scientific Package.....	79.0
Other..NYU.....	172.5
Other.....	48.5
Gross Weight.....	1007.6
Free Lift.....	110.0
Gross Inflation.....	1117.0
Helium used (cu. ft.).....	17872

13. Flight Failures None
 (Nature of flight failures - if any)
14. Comments None
 (Significant factors concerning the operation)

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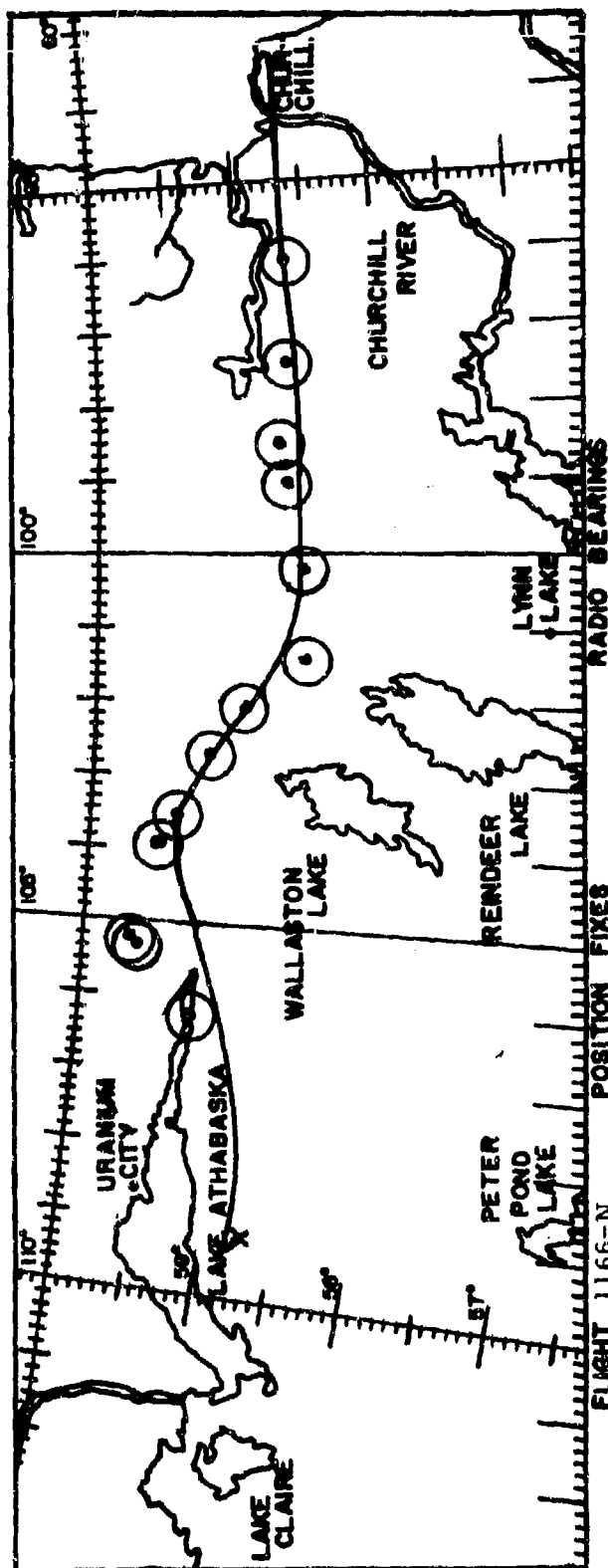
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IDENTIFICATION	BALLOON	LOAD FACTORS	FLIGHT ALTITUDE
TIME FLIGHT NO: 1166-N FOR: NASA LANGLEY-NYU. DATE: 16 JULY, 1966	TYPE: SF-19978-070-NS-04 VOLUME: 294X10 ⁶ CU. FT. MATERIAL: STRATOFILM WEIGHT: 4700 LBS.	PAYLOAD: 2315 LBS. GROSS LOAD: 10070 LBS. BALLAST: 1500 LBS.	LAST RADAR ALTITUDE: 119700 FT. AVERAGE ALTITUDE: (BEACON) 124000 FT.

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POSITION FIXES		RADIO BEARINGS	
TIME(Z)	LATITUDE LONG.	TIME(Z)	LATITUDE LONGITUDE
1020	Fort Churchill	1430 ¹	58°-38' 96°-05'
1033	58°-45' 94°-00'	1530 ¹	58°-39' 97°-29'
1053	58°-44' 93°-53'	1630 ²	58°-42' 98°-30'
1133	58°-41' 93°-23'	1700 ²	58°-38' 99°-04'
1203	58°-38' 93°-29'	1800 ²	58°-32' 100°-12'
1223	58°-37' 93°-41'	1900 ²	58°-31' 101°-23'
1303	58°-38' 94°-25'	2000 ²	58°-57' 102°-03'
1323	58°-36' 94°-52'	2030 ²	59°-12' 102°-43'
1343	58°-36' 95°-15'	2100 ²	59°-25' 103°-35'
1413	58°-38' 95°-45'	2200 ²	59°-32' 103°-58'
2337	59°-18' 105°-14'	2230 ²	59°-42' 105°-11'
0142	59°-57' 107°-03'	2300 ²	59°-37' 105°-18'
0330	58°-47' 109°-20'	0100 ²	59°-15' 106°-10'
0335	Termination		
0418	58°-41.5' 109°-08.5' Impact		

(1) 2 Station Fix

(2) 3 Station Fix

FLIGHT 1166. BALLASTING INFORMATION

Table I below presents Radio Controlled ballast data for Flight 1166 launched on 16 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 1000Z and 0335Z (termination), 82 pounds of ballast was automatically dropped at the rate of 4.8 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I

BALLAST DATA - FLIGHT 1166

Time (Z)	Amount Dropped by Radio Command	Amount Remaining (pounds)
1037	5	145.0
1050	5	140.0
1207	5	135.0
1230	5	130.0
1235	5	125.0
1240	5	120.0
1242	5	115.0
1247	5	110.0
1249	5	105.0
1251	5	100.0
1259	5	95.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

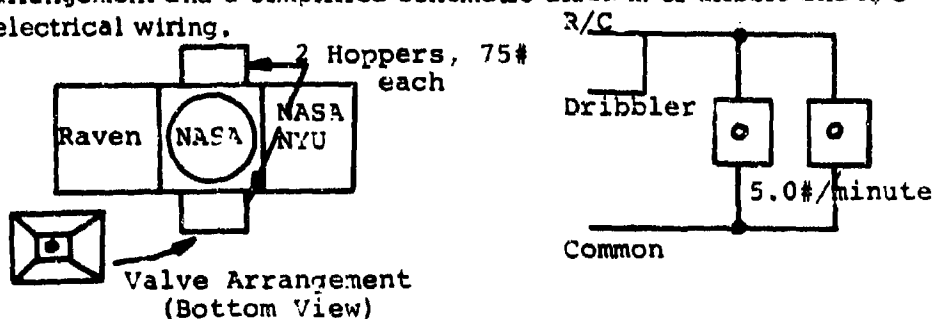


Figure 1

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1166-N

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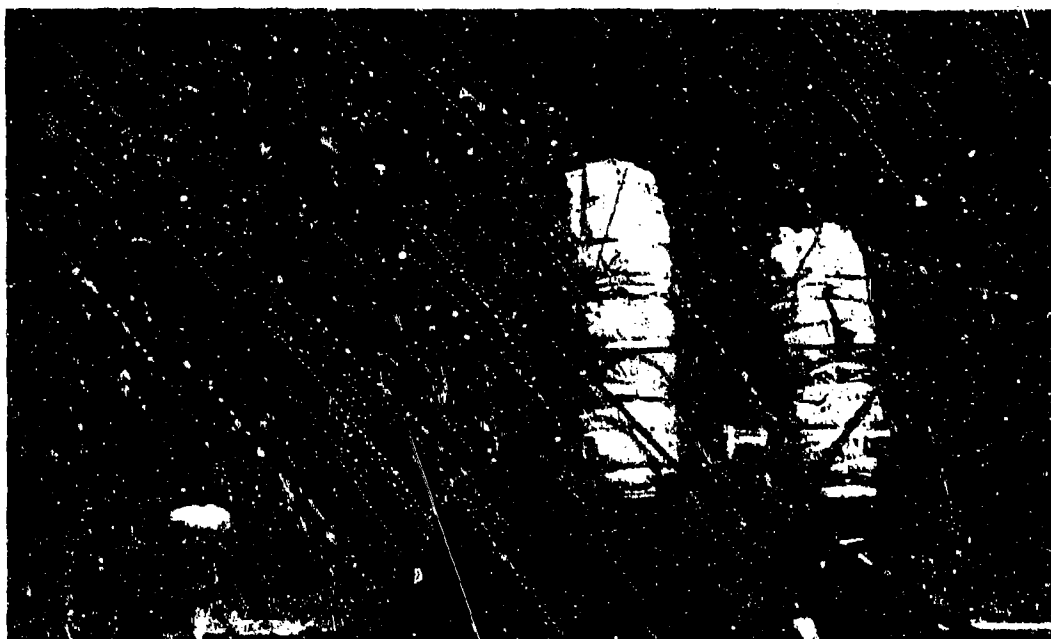
Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MR)	Alt. (ft.)
1020.5	-	Launch	1020.5	-	Launch
1034.2	701	9,800	1033	667	11,100
1048.8	430	22,000	1043	477	19,500
1057.0	300	30,300	1053	317	29,100
1102.5	232	35,900	1103	202.5	38,850
1106.9	187	40,600	1113	152.2	45,000
1114.8	143	46,400	1123	108	52,500
1123.0	106.5	52,800	1133	76.5	60,000
1131.9	73.0	61,000	1143	53.4	67,800
1145.0	49.4	69,500	1153	36.3	76,200
1151.0	39.6	74,300	1203	24.72	84,600
1157	31.2	79,500	1213	16.31	93,900
1210.7	18.25	91,400	1223	11.0	102,900
1221	12.08	100,800	1233	7.67	111,300
1227.1	9.61	106,000	1243	5.74	118,300
1235.2	8.11	110,000	1253	4.62	123,600
1240.2	7.15	113,000	1303	4.73	123,000
1247.0	6.18	116,500	1313	4.91	122,100
1249.5	5.81	118,000	1323	4.85	122,400
1251.5	5.5	119,300	1333	5.03	121,500
1300	5.5	119,300	1343	5.06	121,200
1324	5.14	121,000	1353	5.03	121,500
1400	5.14	121,000	1403	5.32	120,100
1500	5.14	121,000	1413	5.41	119,700
1530	4.83	122,500			
1600	4.83	122,500			
1630	4.83	122,500			
1730	4.83	122,500			
1800	4.83	122,500			
1855	4.36	125,000			
1930	4.36	125,000			
2000	4.36	125,000			
2100	4.36	125,000			
2200	4.36	125,000			
2300	4.36	125,000			
0000	4.36	125,000			
0100	4.36	125,000			
0200	4.36	125,000			
0300	4.36	125,000			
0335		Terminate			
0338.5	21.4	87,800			
0343.0	71.0	61,600			
0349.5	161	43,800			

1167 - FLIGHT DESCRIPTION

Flight 1167 for the University of Minnesota was launched at 1237Z on 16 July; the third flight that morning. Launch was under the direction of G. Mancuso and F. Vandersnick. Weather conditions were excellent and no problems were experienced with any phase of the launch or climb to altitude.

The scientific apparatus carried on this flight was a prototype of equipment being designed for use on a Pioneer satellite. The charge and energy spectrum of galactic cosmic rays was detected by several solid-state detectors coupled with a Cerenkov telescope. All information was telemetered to the ground via their own FM-FM system.

Raven flew its standard radio command-telemetry system with a Brailsford back-up timer on top of the parachute. Cut-down occurred 3.3 hours prior to the planned, main timer cut-down. A governor run-away of the timer had caused premature termination. Confirmation of toptimer squibs firing first was validated when the parachute was returned with all squibs attached. Squibs connected to the top timer were fired and their holes were clean, indicating tension on the nylon line at the time of firing. The squibs connected to the main timer had obviously fired after impact in the water because loose, unsevered nylon strands were protruding from either side of both squibs. Impact was in a lake and recovery was made the



Mounting crushpads on the University
of Minnesota gondola.

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1167 - Flight Description (cont)

day after impact when the package was found submerged in water. Only a small amount of water was in the Raven Instrumentation container but the photobarograph was ruined.

Tracking was excellent, providing recovery pilots with a predicted impact. When Lynn Lake lost the signal at 22,000 feet (on parachute descent), the radio horizon was computed at that altitude (185 miles) and, when coupled with the azimuth, gave predicted coordinates of impact. Estimated impact was: 59° 23'N; 104° 52'W while the actual impact was: 59° 26'N; 103° 56'W (30 mile error). Because of the premature cutdown and the fact that the C-47 was tracking Flight 1165, the Cessna 185 tracking Flight 1166, and the Cessna 206 heading towards the premature cut-down of Flight 1167, these coordinates were instrumental in locating the gondola.

Transmitter frequency and command channels used were:

Transmitter Frequency:	225.1 MHz	
Command Channel:	Cutdown	4
	Ballast	5
	Radar Target	
	Release	11
	Private Line	1

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LAUNCH LOG, SKYHOOK FLIGHT 1167

University of Minnesota (Webber)
Balloon: 4 x 10⁶ cubic foot Stratofilm
all times in CDT 16 July 1966

This flight followed flight 1166. The launch truck was used for both flights.

0540 Launch truck returned to hanger, rigging of payload commenced.
0608 University of Minnesota gondola on truck; commencing RII package rigging.
0630 Winds at DOT hanger: 240°, 7-8 mph.
0628 Completion of gondola rigging.
0631 Gondola on launch truck left for launch area in convoy across runway. Other crew members also departed DOT hanger for launch area.
0705 Gondola and launch truck reached launch area. Winds on mast there indicated 200°, 2 knots. Balloon laid out, with pibal, at 240°.
0717 Inflation started, using two inflation tubes.
0720 Bubble up.
0725 Winds 190°, 2 knots.
0731 Inflation complete. Bubble in sunshine throughout inflation.
0737 Launch. Calm; cups not turning. Truck did not move; balloon slowly came directly overhead. Completely smooth launch.
0800 DOT weather: Clouds; broken at 9000 and 25,000 feet. SLP 1003.2 Mb; Winds 270°, 4 mph; Temperature 65°F.

Range Test Number: 122.6 SB165-A IL

Tropopause at 1200Z, 16 July: -59°C at 233 Mb (35, 814 ft.).

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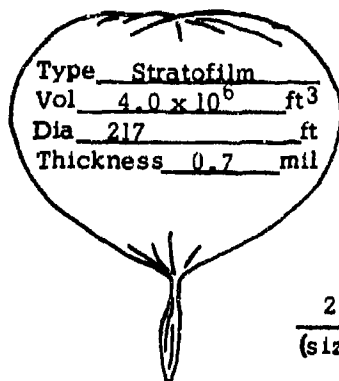
SKYHOOK BALLOON FLIGHT INFORMATION

NAVEXOS 3900/2 (Rev. 8-66)

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1. Company Raven Flight Number 1167-N Director Mancuso, Vandersnick
2. Scientist Webber Group Univ of Minnesota Date/Time 7/16 / 1237 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 900 Ø 250 Ø 65°F, 4 MPH, 1003.2 MB Cross Wind Angle None
(Sky-Temp-Wind-Pressure)
Trop (Coldest) Ht. 35814 ft Temp -59 °C Inflation Start 1217 Z
Hrs Sunshine on Bubble 0.5 Train Length (Layout) 340 ft.
5. Balloon Theoretical 3.06 Mbs 134,000 ft. How Determined?
Ceiling: Actual 3.15 Mbs 133,200 ft. Radar-1540Z
6. Ascent: Surface to Trop. 1045 fpm Trop. to Ceiling 739 fpm.
7. Flight Duration: Total 11 hrs 19 min. At Ceiling 9 hrs. 5 min.
8. Termination: Time 2356 Z Altitude 126,400 ft. Cause Timer
9. Balloon Destruction-confirmed Continued Float (visual, unknown, etc)
10. Impact: Date/Time 7/17/ 0025 Z Location 59° 26' N 103° 56' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd 12 hrs.
255.1 Altitude Telemetry 12 hrs.
4,015-7.465 Communication 12 hrs.
12. Balloon: Code Number SF-217.5-070-NS-03 Serial Number 8



WEIGHTS

Balloon.....	577.0
Parachute.....	22.0
Instrumentation.....	53.0
Ballast.....	150.0
Scientific Package.....	105.0
Other.. Photobarograph.....	8.0
Other.. Misc.....	14.0
Gross Weight.....	929.0
Free Lift.....	93.0
Gross Inflation.....	1022.0
Helium used (cu. ft.).....	16352

28 Ft. chute
(size)

13. Flight Failures Top Timer cutdown 3 hours 27 min. early
(Nature of flight failures - if any)
14. Comments Impact in lake ruined photobarograph data
(Significant factors concerning the operation)

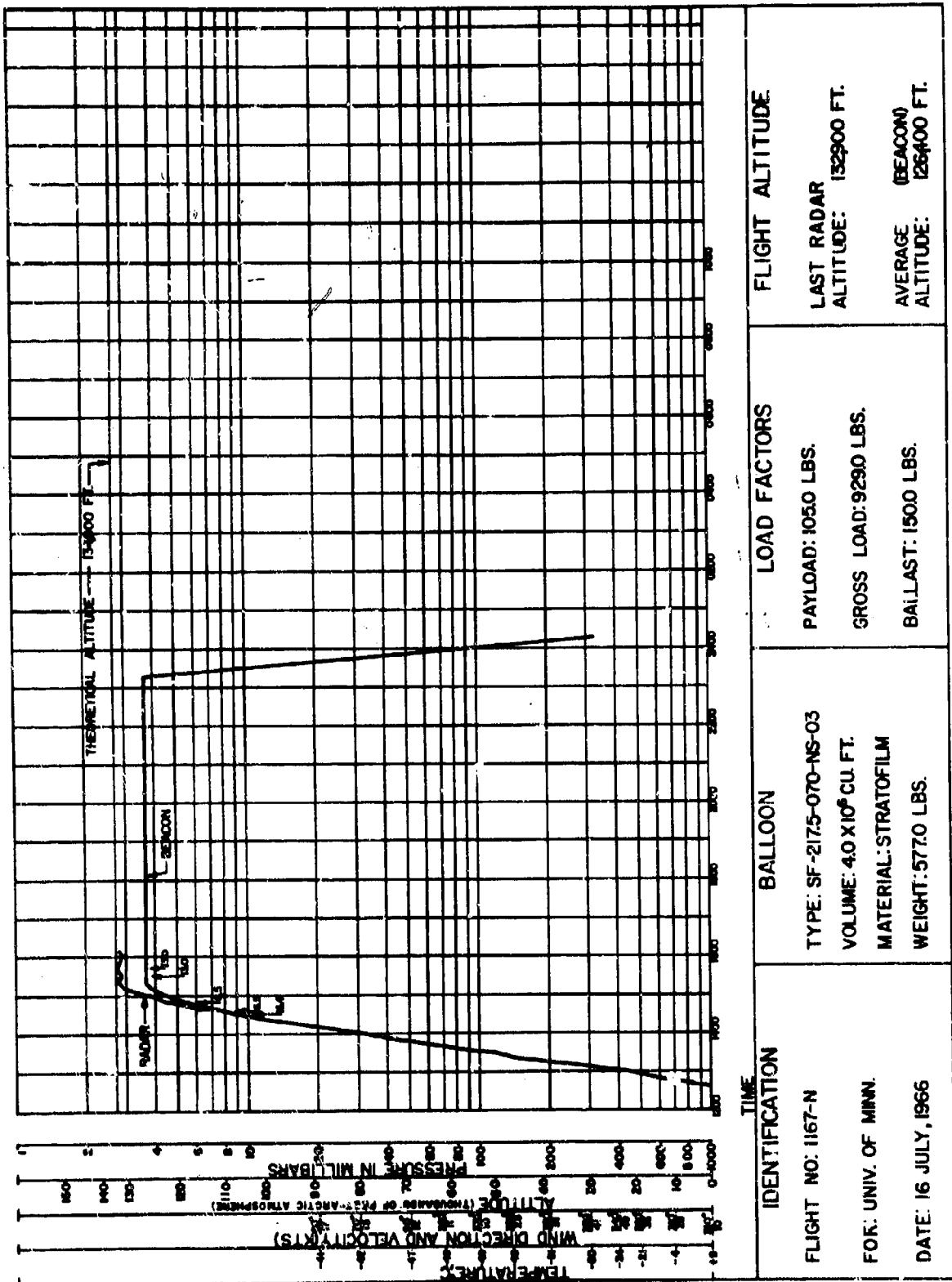
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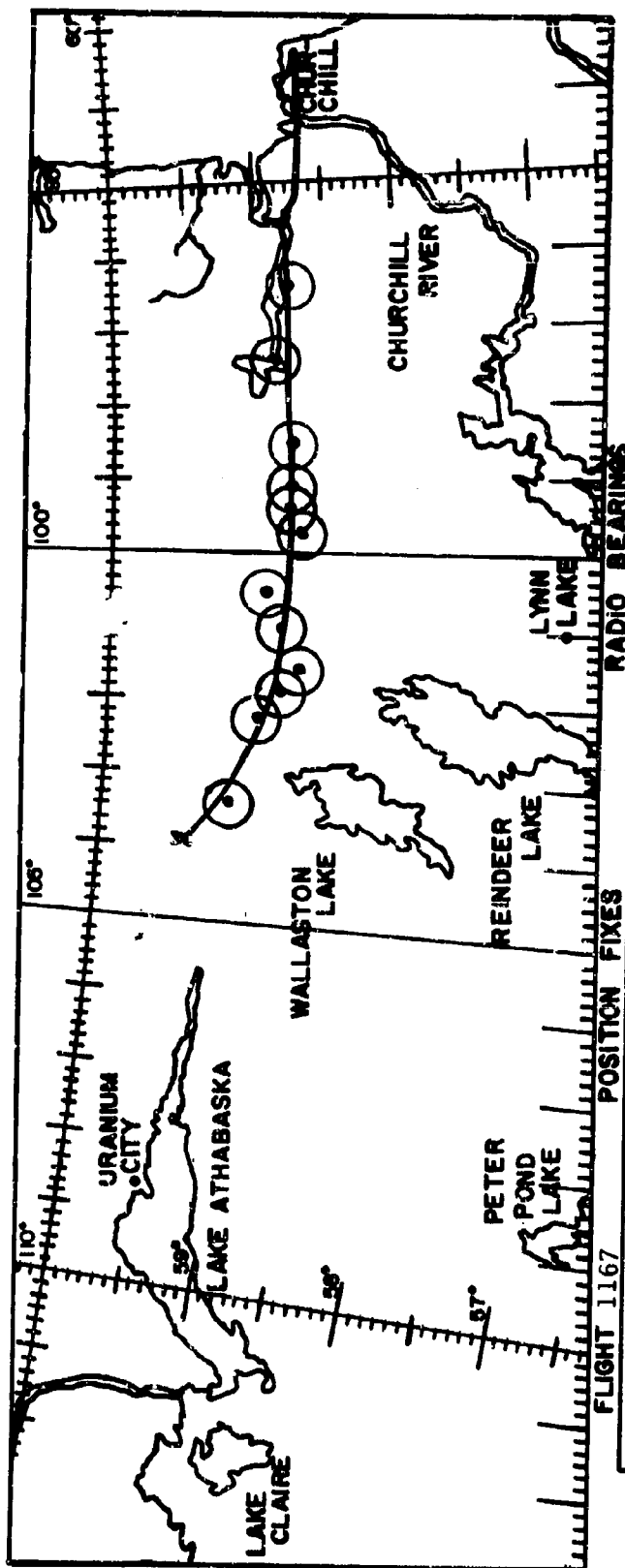
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TIME (Z)	LATITUDE	LONG.	OBTAINED BY	TIME (Z)	LATITUDE	LONGITUDE
1245	58°-44'	93°-58'	Radar	16301	58°-45'	96°-27'
1306	58°-42'	93°-58'	Radar	17001	58°-50'	97°-25'
1320	58°-43'	93°-41'	Radar	17301	58°-42'	98°-30'
1335	58°-38'	93°-21'	Radar	19002	58°-43'	99°-08'
1345	58°-39'	93°-30'	Radar	19302	58°-37'	99°-43'
1405	58°-37'	93°-36'	Radar	20002	58°-44'	99°-25'
1415	58°-36'	93°-40'	Radar	20302	58°-55'	100°-31'
1430	58°-36'	93°-51'	Radar	21002	58°-47'	101°-00'
1500	58°-38'	94°-21'	Radar	21302	58°-40'	101°-34'
1540	58°-40'	95°-10'	Radar	22002	58°-47'	101°-53'
1610	58°-44'	95°-22'	Radar	22302	58°-57'	102°-12'
2356	Terminate			23002	59°-07'	103°-24'
1930	59°-26'	103°-56'	Impact	(1) 2 Station Fix		
				(2) 3 Station Fix		

FLIGHT 1167. BALLASTING INFORMATION

Table I below presents Radio Controlled Ballast data for Flight 1167 launched on 16 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 1140Z and 2356Z (termination), 65 pounds of ballast was automatically dropped at the rate of 5.4 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I

BALLAST DATA - FLIGHT 1167

Time (Z)	Amount Dropped by Radio Command	Amount Remaining (pounds)
To		
1430	16.4 (drib)	133.6
1437	6.5	127.1
1450	6.5	120.6
1533	13.0	107.6
1542	13.0	94.6

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

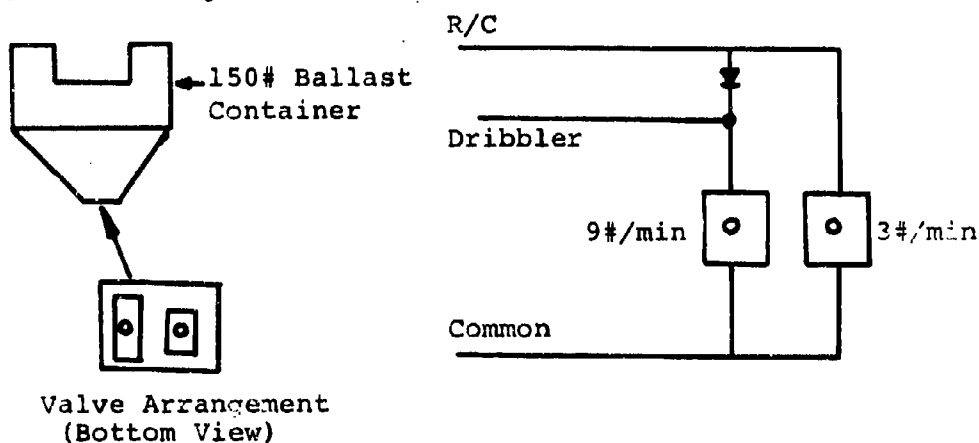


Figure 1

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PRESSURE AND ALTITUDE DATA
Flight 1167-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1237.1	-	Launch	1240	915	2,700
1242.0	844	4,900	1245	774	7,200
1252.5	566	15,300	1250	600	13,800
1258.5	449	21,000	1255	495	18,600
1311.9	242	35,000	1300	406	23,400
1316.8	191	40,100	1306	313	29,400
1323.1	149	45,500	1310	248	34,500
1334.5	95	55,300	1315	190	40,200
1340.8	73.5	60,800	1320	162	43,650
1351.0	47.2	70,500	1325	136	47,550
1401.0	30.5	80,000	1330	112	51,700
1412.0	19.3	90,200	1335	90.5	56,400
1423.0	12.0	100,900	1340	74.5	60,600
1428.0	10.1	105,000	1345	60.5	65,100
1433.1	8.8	108,100	1350	49.4	69,900
1438.1	7.6	111,500	1355	38.7	74,800
1439.2	7.35	112,400	1400	30.8	79,800
1440.7	77.05	113,400	1405	24.9	84,500
1442.1	6.75	114,400	1410	20	89,400
1444.2	6.4	115,700	1415	16.3	94,000
1446.5	6.1	116,900	1420	13.2	98,700
1450.3	5.8	118,000	1430	9.05	107,400
1452.5	5.55	119,200	1440	6.45	115,500
1454.8	5.25	120,400	1450	4.97	121,800
1501.6	4.97	121,800	1500	4.1	126,600
1504.4	4.68	123,300	1510	3.47	130,800
1509.7	4.38	124,900	1520	3.23	132,600
1518.5	4.13	126,400	1530	3.35	131,700
1530	4.13	126,400	1540	3.16	133,200
1545	4.13	126,400	1550	3.23	132,600
1615	4.13	126,400	1600	3.27	132,300
1630	4.13	126,400	1610	3.19	132,900
1653	4.38	124,900			
1700	4.13	126,400			
1730	4.13	126,400			
1800	4.13	126,400			
1900	4.13	126,400			
2100	4.13	126,400			
2200	4.13	126,400			
2315	4.13	126,400			
2356		Terminate			
0001.0	37.5	75,500			
0004.5	84	58,000			
0016	328	28,300			

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1168 - FLIGHT DESCRIPTION

Flight 1168 was the last of six flights for California Institute of Technology. It was launched at 0515Z on 26 July under the direction of G. Mancuso and M. Fulkerson. Weather conditions and the launch itself were satisfactory. No problems were experienced.

The California Institute of Technology's gondola was to be carried in an inverted position again; to be flipped while descending on parachute either by radio command or pressure switch. The equipment was designed to measure flux and energy spectrum of protons, alpha particles, electrons and heavy nuclear particles in the range from 1 Mev to 1 Bev.

Instrumentation was modified to provide a pressure switch and relay to flip the gondola...as in Flight 1158. The only problem with Raven instruments occurred when the photobarograph lights stopped flashing every 2.5 minutes during float. Usable pictures were obtained prior to the failure.

Tracking was satisfactory. Uranium City acquired the beacon signal at 0930Z and lost it at 2039Z when the balloon was at 5200 feet on a chute and 75 miles distant. Fort Churchill lost the signal at 1855Z at a distance of approximately 515 miles. The California gondola was "flipped" by radio command



Float plane base at Uranium City.

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1168 - Flight Description (cont)

from Uranium City and visually confirmed by the C-47 tracking aircraft who was in radio contact with Uranium City. After the gondola flip, the Raven Industries instrumentation box was riding in an inverted position but continued to operate normally and experienced no impact damage.

The ballast system worked satisfactorily twelve times out of twelve attempts. One other special device was the addition of a Haydon back-up timer for termination.

Transmitter frequency and command channels used were:

Transmitter Frequency: 253.1 MHz

Command Channel:	Cutdown	7
	Ballast	8
	Gondola Flip	9
	Private Line	1

R-1866

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LAUNCH LOG, SKYHOOK FLIGHT 1168

Cal. Tech. (Vogt)

Balloon: 10.6 x 10⁶ cubic foot Stratofilm

all times in CDT 25-26 July 1966

2000 Wind at DOT hanger calm.
2100 Wind calm, cups not turning. NOTAM activated for launching at 2330.
Crew assembling in hanger.
2135 Payload brought to launch truck for attachment.
2200 Wind calm.
2210 Wind 180°, 1 mph. Launch truck carrying payload left DOT hanger.
2317 Launch truck with gondola arrived in launch area. Advance crew already there.
2318 Wind on mast in launch area 200°, 4 knots.
2220 Balloon laid out per pibal, from 244°. No sun; ground fog in patches.
2346 Inflation started.
2349 Bubble up.
0000 Inflation completed. Aurora seen to northeast, later spread over zenith.
0015 Launch. Very smooth, truck moved a few feet, no cross wind.
0016 Wind indicated in launch area (on mast) 240°, 5 knots. Noctilucent clouds W.
0000 DOT weather: Wind WSW 8; Temperature 56° F; SLP 1019.8; scattered clouds at 7000 feet.

Range Test Number: 126.6 SB165-A 6L.

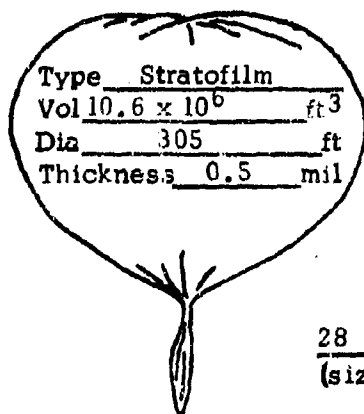
Tropopause at 0000Z 26 July: -54°C at 237 Mb (35,445 ft.)

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

RAVEN
 industries, inc.

1. Company Raven Flight Number 1168-N Director Mancuso, Fulkerson
2. Scientist Vogt Group Cai Tech Date/Time 7/26 / 0515 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 70 M, 56°F, 8 MPH, 1019.8 MB Cross Wind Angle None
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 35445 ft Temp -54 °C Inflation Start 0446 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 480 ft.
5. Balloon Theoretical 1.78 Mbs, 148,300 ft. How Determined?
 Ceiling: Actual 2.20 Mbs, 142,600 ft. Photobarograph
6. Ascent: Surface to Trop. 908 fpm Trop. to Ceiling 523 fpm.
7. Flight Duration: Total 15 hrs 28 min. At Ceiling 11 hrs. 10 min.
8. Termination: Time 2005 Z Altitude 132,500 ft. Cause
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 7/27/ 2043 Z Location 59° 49' N 110° 31' W
11. Frequency used:

(Kcs, Mcs)	Purpose	Total Time
<u>149.4</u>	<u>Communication & Cmd</u>	<u>16 hrs.</u>
<u>253.1</u>	<u>Altitude Telemetry</u>	<u>16 hrs.</u>
<u>4,015-7,465</u>	<u>Communication</u>	<u>16 hrs.</u>
12. Balloon: Code Number SF-305.86-050-NSC-04 Serial Number 36

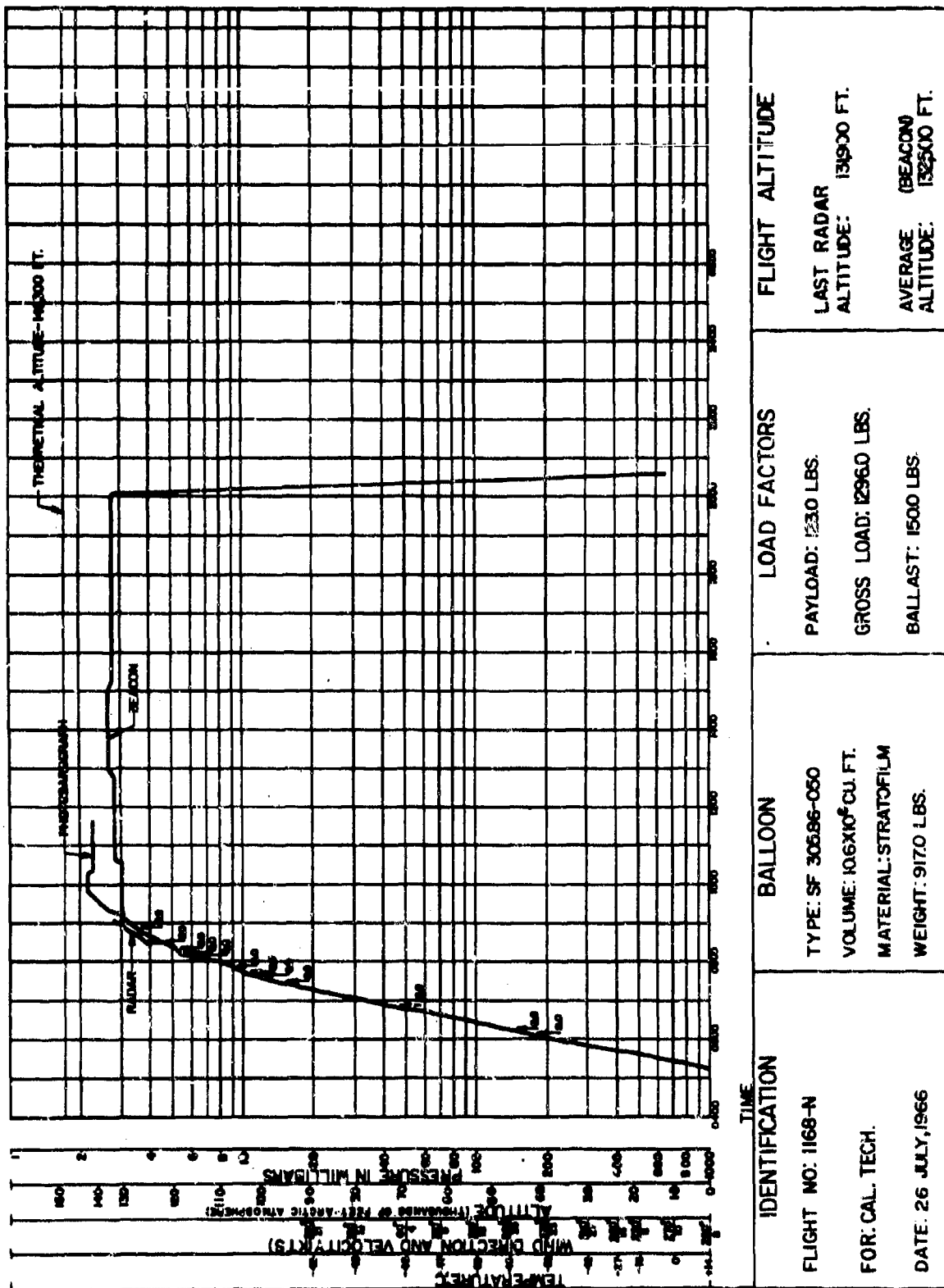


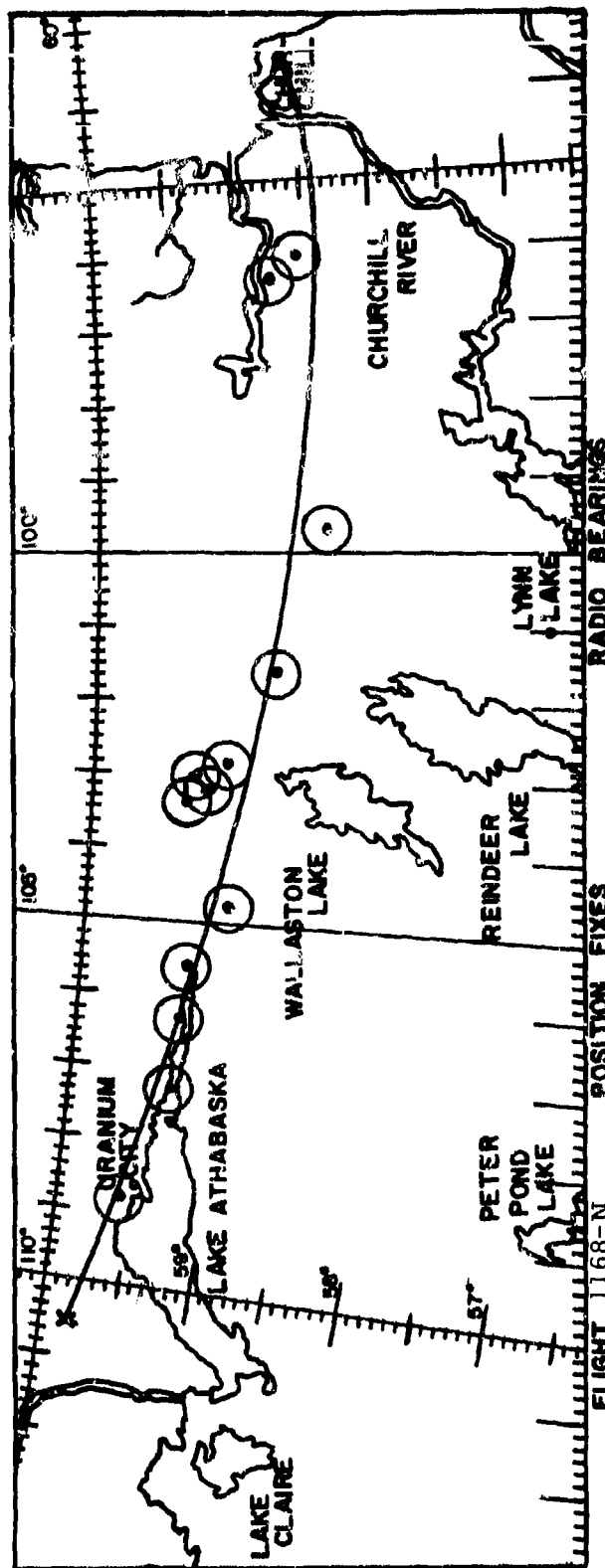
WEIGHTS

Balloon.....	917.0
Parachute.....	29
Instrumentation.....	52.0
Ballast.....	150.0
Scientific Package.....	123.0
Other Photobarograph.....	8.0
Other Misc.....	17.0
Gross Weight.....	1296.0
Free Lift.....	130.0
Gross Inflation.....	1426.0
Helium used (cu. ft.).....	22815

13. Flight Failures Photobarograph stopped at 1141Z. Cause undetermined
 (Nature of flight failures - if any)
14. Comments None
 (Significant factors concerning the operation)

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TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0515	Fort Churchill		Launch	1100	58°-32'	96°-02'
0530	58°-42'	93°-55'	Radar	1130	58°-44'	96°-21'
0600	58°-39'	93°-47'	Radar	1200	58°-22'	99°-41'
0630	58°-35'	93°-28'	Radar	1300	58°-44'	101°-39'
0700	58°-33'	93°-28'	Radar	1400	59°-03'	102°-50'
0730	58°-31'	93°-42'	Radar	1430	59°-16'	103°-01'
0800	58°-29'	94°-04'	Radar	1500	59°-13'	103°-16'
0830	58°-26'	94°-35'	Radar	1600	59°-21'	103°-22'
0905	58°-24'	95°-12'	Radar	1630	59°-02'	104°-49'
1850	59°-33'	108°-38'	Visual (U. City)	1730	59°-17'	105°-33'
2005	Termination			1800	59°-18'	106°-17'
2043	59°-49'	110°-31'	Impact	1830	59°-19'	107°-14'
				1930	59°-34'	108°-45'

 (1) 2 Station Fix
 (2) 3 Station Fix

FLIGHT 1168. BALLASTING INFORMATION

Table I below presents Radio Controlled ballast data for Flight 1168 launched on 26 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0500Z and 2005Z (termination), 24 pounds of ballast was automatically dropped at the rate of 1.6 pounds per hour. No problems were encountered with the ballasting system during this flight.

Table I

BALLAST DATA - FLIGHT 1168

Time (Z)	Amount Dropped By Radio Command	Amount Remaining (pounds)
0608	8.0	142.0
0615	8.0	134.0
0652	8.0	126.0
0730	8.0	118.0
0741	8.0	110.0
0746	8.0	102.0
0751	8.0	94.0
0812	8.0	86.0
0816	8.0	78.0
0822	8.0	62.0
0834	8.0	54.0
0854	8.0	46.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

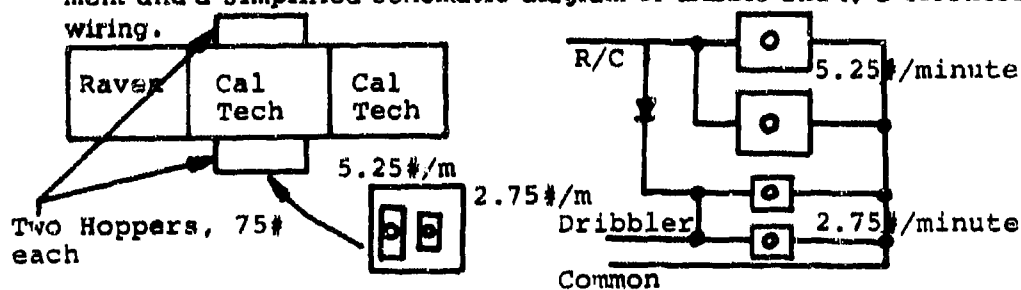


Figure 1

R-1866

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PHOTOBAROGRAPH DATA

Flight 1168-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0641.5	-	-	0821.5	5.08	121,240
0644	57.7	66,100	0824	4.8	112,656
0646.5	52.6	68,150	0826.5	4.67	123,335
0649	48.4	69,940	0829	4.67	123,335
0651.5	44.5	71,766	0831.5	4.42	124,700
0654	41.1	73,494	0834	4.28	125,502
0656.5	37.9	75,257	0836.5	4.23	125,796
0659	34.8	77,115	0839	3.93	127,640
0701.5	31.8	79,086	0841.5	3.93	127,640
0704	29.3	80,883	0844	3.76	128,754
0706.5	26.6	83,014	0846.5	3.76	128,754
0709	24.5	884,834	0849	3.71	129,092
0711.5	23.0	86,237	0851.5	3.5	130,569
0714	21.3	87,948	0854	3.5	130,569
0716.5	19.6	89,808	0856.5	3.3	132,069
0719	18.3	91,348	0859	3.26	132,380
0721.5	17.2	92,743	0901.5	3.26	132,380
0724	16.4	93,818	0904	3.19	132,936
0726.5	15.1	95,687	0906.5	3.08	133,837
0729	14.3	96,923	0909	3.0	134,515
0731.5	13.1	98,920	0911.5	3.0	134,515
0734	11.9	101,118	0914	2.85	135,840
0736.5	11.2	102,510	0916.5	2.85	135,840
0739	10.7	103,561	0919	2.75	136,766
0741.5	10.3	104,440	0921.5	2.7	137,244
0744	9.7	105,828	0924	2.7	137,244
0746.5	9.35	105,828	0926.5	2.63	137,928
0749	9.1	107,311	0929	2.55	138,735
0751.5	8.55	108,768	0931.5	2.48	139,464
0754	7.95	110,478	0934	2.48	139,464
0756.5	7.45	112,015	0936.5	2.34	140,992
0759	7.05	113,327	0939	2.34	140,992
0801.5	6.55	115,087	0941.5	2.27	141,794
0804	6.1	116,802	0944	2.27	141,794
0806.5	5.8	118,023	0946.5	2.2	142,623
0809	5.7	118,445	0949	2.2	142,623
0811.5	5.7	118,445	0951.5	2.2	142,623
0814	5.32	120,140	0954	2.2	142,623
0816.5	5.25	120,452	0956.5	2.2	142,623
0819	5.19	120,710	0959	2.2	142,623

R-1866
 Photobarograph Data
 Flight 1168-N
 Page 2

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1001.5	2.2	142,623	1054	2.27	141,794
1004	2.2	142,623	1056.5	2.27	141,794
1006.5	2.2	142,623	1059	2.27	141,794
1009	2.2	142,623	1101.5	2.27	141,794
1011.5	2.27	141,794	1104	2.27	141,794
1014	2.2	142,623	1106.5	2.27	141,794
1016.5	2.2	142,623	1109	2.27	141,794
1019	2.2	142,623	1111.5	2.27	141,794
1021.5	2.27	141,794	1114	2.2	142,623
1024	2.27	141,794	1116.5	2.27	141,794
1026.5	2.27	141,794	1119	2.27	141,794
1029	2.27	141,794	1121.5	2.27	141,794
1031.5	2.27	141,794	1124	2.27	141,794
1034	2.27	141,794	1126.5	2.27	141,794
1036.5	2.27	141,794	1129	2.27	141,794
1039	2.27	141,794	1131.5	2.27	141,794
1041.5	2.27	141,794	1134	2.27	141,794
1044	2.2	142,623	1136.5	2.27	141,794
1046.5	2 2.2	142,623	1139	2.27	141,794
1049	2.2	142,623	1141.5	2.34	140,992
1051.5	2.27	141,794			

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1168-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0515.0	-	Launch	0515.0	-	Launch
0521.1	834	5,200	0530	636	12,300
0533.9	572	15,000	0540	460	20,400
0547.8	368	25,700	0550	321	28,800
0552.8	303	30,100	0600	212.5	37,800
0558.2	241	35,100	0610	159	44,100
0605.3	189.2	40,300	0620	122	49,800
0620.4	121	50,000	0630	86.5	57,300
0626.9	96.3	55,000	0640	61.4	64,800
0634.6	74.4	60,600	0650	44.6	71,700
0642.5	59.1	65,600	0700	32.5	78,600
0649.6	46.7	70,700	0710	22.8	86,400
0703.0	30.4	80,100	0720	17.2	92,700
0709.9	24.0	85,300	0730	13.4	98,400
0718.3	18.65	90,900	0740	10.45	104,100
0726.1	15.5	95,100	0750	8.71	108,300
0733.8	12.32	100,300	0800	6.52	115,200
0744.5	10.0	105,100	0810	5.55	119,100
0804.3	7.65	114,700	0820	5.15	120,900
0819.4	5.95	117,400	0830	4.35	125,100
0829.6	5.3	120,200	0840	3.95	127,500
0835.9	4.93	122,000	0850	3.68	129,300
0844.5	4.56	123,900	0900	3.44	131,000
0854.8	4.19	126,000	0905	3.32	131,900
0903.1	3.87	128,000			
0920.7	3.58	130,000			
0930	3.58	130,000			
1030	3.58	130,000			
1038	3.24	132,500			
1100	3.24	132,500			
1200	3.24	132,500			
1245	3.24	132,500			
1300	3.0	134,500			
1400	3.0	134,500			
1500	3.0	134,500			
1512	3.24	132,500			
1600	3.24	132,500			
1700	3.24	132,500			
1800	3.24	132,500			
1900	3.24	132,500			
2005	3.24	132,500			
2005	5.57	119,000			
2009.1	24.1	85,200			
2035.0	659	11,400			

R-1866

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Flights 1168 and 1171
Upper Air Data for 1200 Z, 26 July

Standard Levels

Pressure (MB)	T, °C	Wind Kts.
1000	+14	290° 8
850	+ 4	310° 9
700	0	270° 17
500	-16	230° 8
400	-27	260° 13
300	-42	290° 27
250	-53	290° 31
200	-52	270° 23
150	-48	260° 23
100	-50	310° 18
70	-47	310° 9
50	-46	80° 4
30	-45	100° 15
20	-42	260° 21

Significant Levels

1016	+10
997	+10
807	+ 1
785	+ 2
761	+ 2
745	+ 1
587	-10
550	-12
380	-28
221	-58
212	-59
207	-52
195	-53
183	-48
104	-51
40	-46
36	-48
18	-41

Wind Data

Thousands of feet	Direction	Knots
1	320°	8
5	310°	9
10	270°	16
16	260°	5
20	210°	9
25	280°	19
30	300°	25
35	290°	32
40	270°	22
45	260°	22
50	290°	25
60	290°	12
70	80°	3
80	90°	15
90	60°	23

1169 - FLIGHT DESCRIPTION

The second in the series of NASA-Langley and New York University flights was launched at 0331Z on 24 July under the direction of G. Mancuso and M. Fulkerson. Flight time for this system was 21 hours being terminated by the Lynn Lake tracking station. Layout, launch, and flight were satisfactory.

Dr. Foelsche and Dr. Mendel flew the same three gondolas as flown in Flight 1166. Flight altitude was to be 70,000 feet. In order to get the float altitude desired, a section of the balloon duct was cut which, in effect, produces a smaller volume and a slack balloon.

Temperature and voltages inside the Raven instrumentation container was telemetered to the ground stations. Since the low float altitude presented a much colder temperature environment than normal, higher altitudes, the black, heat dissipator port under the Raven telemetry transmitter was covered with one inch of styrofoam. Temperature did get somewhat colder than normally experienced but had no effect on instrumentation performance.

Tracking was satisfactory although the Lynn Lake-Churchill antenna angles for position fixing led to higher errors than encountered with "deflection" fixes. Among regular radio-command functions carried on this flight, a ballast trapdoor



Final checkout of NASA-Langley and NYU gondola. Position of the command receiver antenna is being adjusted.

R-1866

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1169 - Flight Description (cont)

was provided for extra dead weight to be released after termination to obtain a slower parachute descent. Regular command ballast performed four times out of four attempts.

Transmitter frequency and command channels used were:

Transmitter Frequency: 251.5 MHz

Command Channels:	Cutdown	1
	Ballast	2
	Ballast Trapdoor	11
	Private Line	2

R-1866

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LAUNCH LOG, SKYHOOK FLIGHT 1169

NASA-Langley, NYU (Foelsche-Mendell)
Balloon: 0.325×10^6 cubic foot Stratofilm
all times in CDT 23 July 1966

1900 Winds at DOT hanger NE 4 mph.
1930-2000 Crew assembled in hanger for 2000 crew call.
2000 NOTAM activated for 2200 launch. DOT winds NE 5. Payload rigging on launch truck commenced. Main payload suspended from M36 truck, with two smaller payloads below - the second on a wheeled launch cart, the third hand-held.
2100 Advance party left DOT hanger for launch area. DOT winds 330-350°, 3 mph.
2125 Launch truck and payload ready to leave for launch site. Held up for air traffic.
2133 Launch truck left for launch area.
2140 Balloon laid out per pibal with wind from 315°.
2152 Payload and launch truck arrived in launch area.
2155 Aerovane on mast in launch area showing 1 knot, 325°: cups turning.
2200 Inflation started. Duct cut for float at 70,000 ft. No sun on bubble.
2203 Bubble up.
2229 Inflation completed, using one filling tube. Pressure drained to facilitate draining tubes in tank car.
2231 Launch. Slow, straight ahead. All packages lifted off very smoothly,
2200 DOT weather: SLP 1010.3 Mb; Winds NNW 3; Temperature 57°F; Clouds, scattered at 4500 ft., broken at 9000 ft.

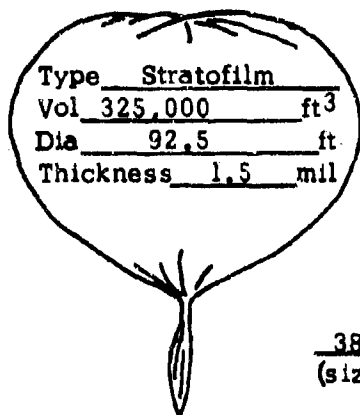
Range Test Number: 127.6 SB165-A 4L
Tropopause at 0000Z, 24 July: -47°C at 274 Mb (32,303 ft.).

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 6-66)

RAVEN[®]
 industries, inc.

1. Company Raven Flight Number 1169-N Director Mancuso, Fulkerson
2. Scientist Foelsche Group NASA Langley- ^{NYU} Date/Time 7/24 / 0331 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 45 Ø 90 Ø, 57°F, 3 MPH, 1010.3 MB Cross Wind Angle None
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 32,303 ft Temp -47 °C Inflation Start 0300 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 175 ft.
5. Balloon Theoretical 44.0 Mbs 72,000 ft. How Determined?
 Ceiling: Actual 40.1 Mbs 74,000 ft. Barocoder
6. Ascent: Surface to Trop. 843 fpm Trop. to Ceiling 647 fpm.
7. Flight Duration: Total 20 hrs 58 min. At Ceiling 19 hrs. 27 min.
8. Termination: Time 0030 Z Altitude 74,800 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 7/25/0110 Z Location 58° 10' N 99° 23' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time

<u>251.5</u>	<u>Altitude Telemetry</u>	<u>21 hrs.</u>
<u>149.4</u>	<u>Communication and Cmd</u>	<u>21 hrs.</u>
<u>7.465 & 4.015</u>	<u>Communications</u>	<u>21 hrs.</u>
12. Balloon: Code Number SF-92.5-150-NS-02 Serial Number 169



38 Ft. chute
 (size)

WEIGHTS

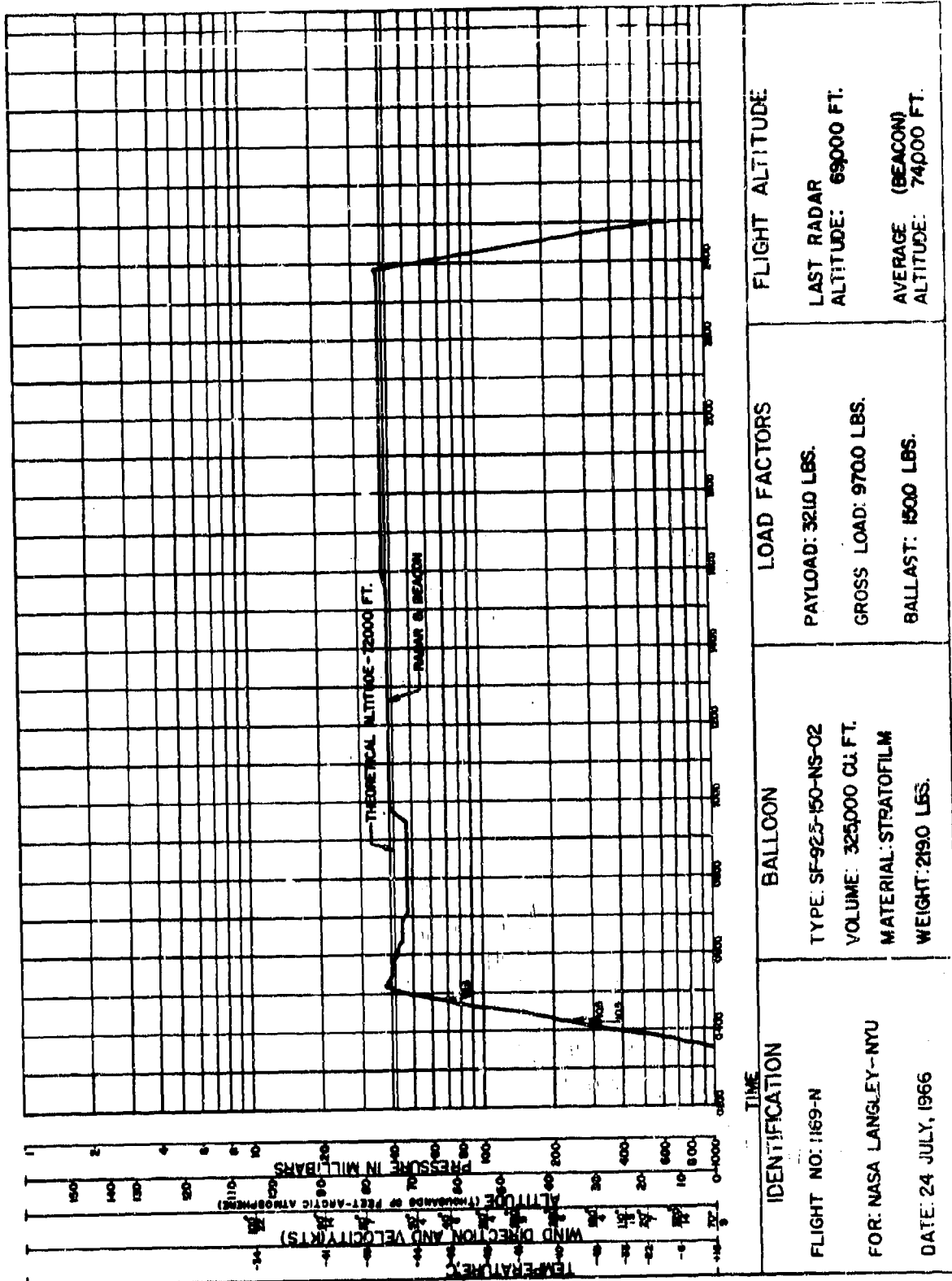
Balloon.....	<u>219.0</u>
Parachute.....	<u>30.0</u>
Instrumentation.....	<u>50.0</u>
Ballast.....	<u>150.0</u>
Scientific Package.....	<u>81.0</u>
Other... NYU.....	<u>240.0</u>
Other... Dead weight.....	<u>200.0</u>
Gross Weight.....	<u>970.0</u>
Free Lift.....	<u>97.0</u>
Gross Inflation.....	<u>1067.0</u>
Helium used (cu. ft.).....	<u>17,072</u>

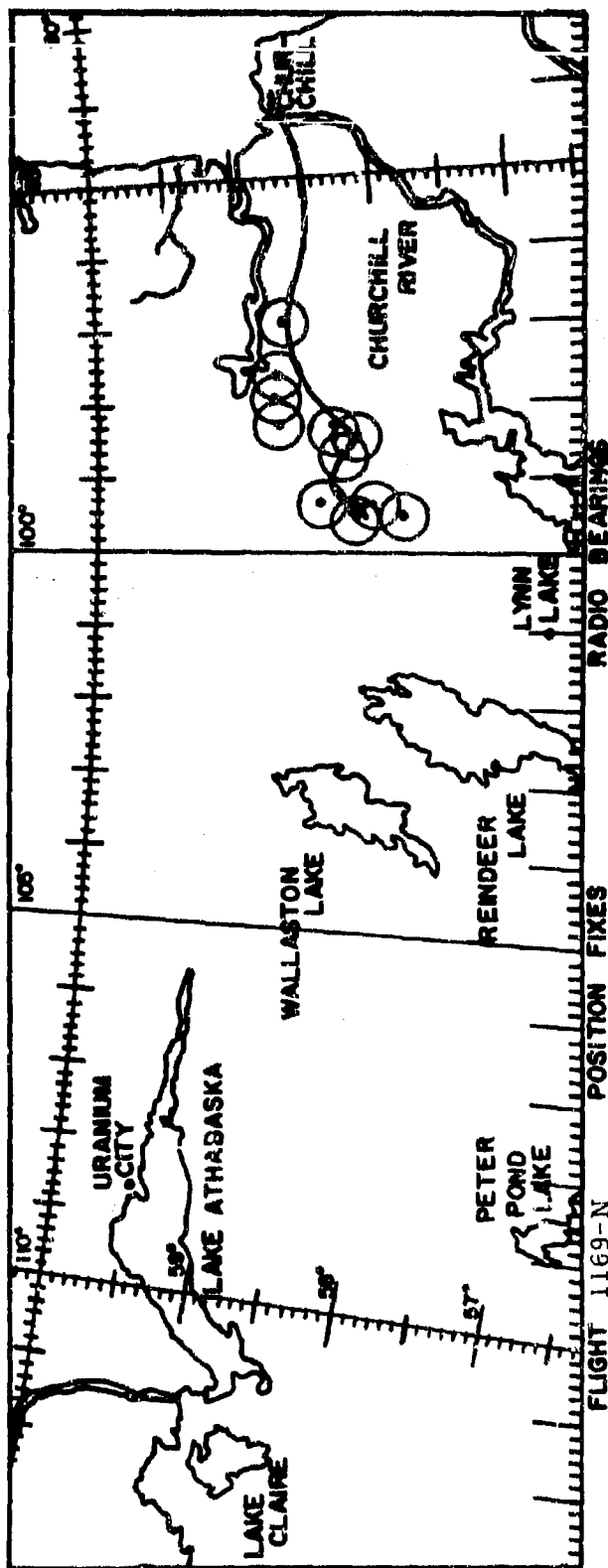
13. Flight Failures None
 (Nature of flight failures - if any)
14. Comments Duct was shortened 35 feet prior to launch
 (Significant factors concerning the operation)

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 ONR/Code 421

RAVEN

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TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0331.4	Fort Churchill		Launch	14001	58°-38'	96°-57'
0345	58°-40'	93°-57'	Radar	15301	58°-42'	97°-39'
0400	58°-39'	93°-59'	Radar	16001	58°-43'	97°-58'
0430	58°-37'	94°-02'	Radar	16301	58°-41'	98°-17'
0500	58°-34'	94°-02'	Radar	17001	58°-41'	98°-17'
0635	58°-36'	94°-04'	Radar	18001	58°-17'	98°-18'
0705	58°-36'	94°-11'	Radar	19001	58°-08'	98°-28'
0805	58°-33'	94°-25'	Radar	19301	58°-13'	98°-42'
0905	58°-30'	94°-44'	Radar	20001	57°-49'	99°-31'
0935	58°-29'	94°-48'	Radar	20301	58°-02'	99°-22'
1249	58°-35'	96°-25'	C-47	22001	58°-19'	98°-29'
2030	58°-15'	98°-15'	Cessna 206	22301	58°-04'	99°-23'
2330	58°-20'	99°-05'	Cessna 206	23001	58°-25'	99°-20'
0029.5	Termination					
0110	58°-09'	99°-23'	Impact			

 (1) 2 Station Fix
 (2) 3 Station Fix

FLIGHT 1169 BALLASTING INFORMATION

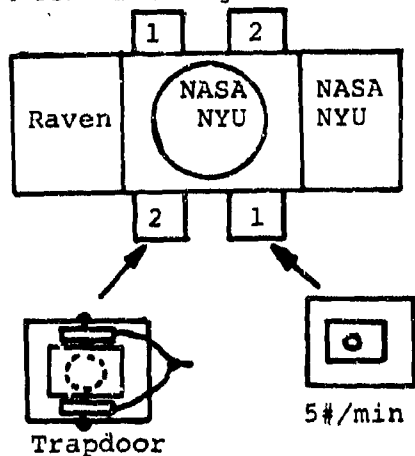
Table I below presents Radio Controlled ballast data for Flight 1169 launched on 24 July 1966. Initial ballast on board at launch was 150 pounds controlled by magnetic valves. In addition, 200 pounds of ballast was flown as dead weight controlled by a separate Radio Command channel and squib-activated trapdoors in the bottom of the hoppers. The specific purpose of the dead weight was to reduce float altitude to the desired level, but it could have been used for altitude correction if the need arose. It was, in fact, released 0.3 minutes after termination in order to provide a slower parachute descent and subsequent, softer impact. Between 030Z and 0030Z on 25 July (termination), 105 pounds of ballast was automatically dropped at the rate of 4.9 pounds per hour. No problems were encountered with the ballast system on this flight.

Table I

BALLAST DATA - FLIGHT 1169

Time (Z)	Amount Dropped By Radio Command	Amount Remaining (pounds)
0411.5	10.5	139.5
0417.0	10.5	129.0
0454.0	10.5	118.5

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.



- (1) 75# Hopper-magnetically controlled
- (2) 100# Hopper-Squib activated trapdoor.

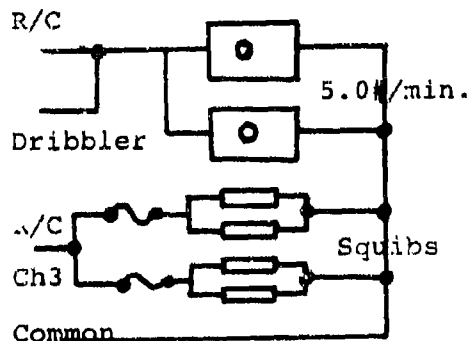


Figure 1

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1169-N

RAVEN[®]
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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0331.4	-	Launch	0331.4	-	Launch
0356.0	451	20,900	0345	-	11,700
0406.0	304	30,000	0400	-	24,000
0421.1	201	39,000	0415	-	35,400
0434.3	116.5	50,800	0430	-	46,650
0446.4	75.0	60,400	0445	-	59,100
0500.1	48.2	70,000	0500	49.2	69,600
0511.0	40.3	73,900	0515	49.2	74,100
0524.6	42.8	72,600	0535	43.4	72,300
0540.0	43.4	72,300	0545	43.7	72,150
0553.8	44.4	71,800	0555	44.0	72,000
0615.2	45.7	71,200	0605	44.6	71,700
0656.3	47.4	70,400	0615	45.3	71,400
0715.4	48.7	69,800	0625	45.9	71,100
0744	49.2	69,600	0635	47.1	70,500
0843	48.7	69,800	0645	47.1	70,500
0854	48.2	70,000	0655	47.1	70,500
0915	47.8	70,200	0705	47.8	70,200
0933	45.3	71,400	0715	48.5	69,900
0947	42.0	73,000	0725	48.8	69,750
1015	42.0	73,000	0735	49.8	69,300
1055	42.4	72,800	0745	50.5	69,000
1127	42.4	72,800	0755	50.5	69,000
1216	42.0	73,000	0805	50.5	69,000
1305	41.3	73,400	0815	51.2	68,700
1350	41.1	73,500	0825	47.8	70,200
1528	40.3	73,900	0835	52.0	68,400
1546	39.8	74,200	0845	51.2	68,700
1620	39.8	74,200	0855	49.6	69,450
1702	39.8	74,200	0905	49.8	69,300
1733	40.3	73,900	0915	50.5	69,000
1753	39.2	74,500	0925	49.8	69,300
1855	38.7	74,800	0935	50.5	69,000
1915	38.2	75,100			
1940	38.7	74,800			
2045	38.7	74,800			
2115	38.7	74,800			
2205	38.2	75,100			
2232	38.7	74,800			
2300	38.7	74,800			
2350	38.2	75,100			
0029.5	38.2	75,100			
0046.9	343	27,300			
0101	723	9,000			

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Flight 1169
Upper Air Data for 0000Z 24 July

Standard Levels

Pressure (MB)	T, °C	Wind Kts.
1000	+15	70° 9
850	+ 4	360° 12
700	- 6	320° 14
500	-22	20° 7
400	-33	110° 15
300	-45	180° 4
250	-44	240° 9
200	-40	280° 6
150	-41	290° 9
100	-45	310° 4
70	-45	40° 6
50	-44	90° 4
30	-43	50° 7
20	-41	90° 14
10	-34	100° 22

Wind Data
Thousands

Significant Levels

		of Feet	Direction	Knots
1006	+16	1	40°	6
900	+ 7	2	10°	6
758	- 3	5	360°	13
719	- 6	10	320°	14
701	- 6	16	320°	6
637	- 9	20	70°	9
506	-21	25	90°	10
436	-29	30	310°	5
303	-45	35	260°	6
274	-47	40	290°	5
238	-42	45	280°	9
160	-41	50	300°	8
105	-46	60	310°	8
40	-45	70	110°	4
25	-44	80	50°	10
		90	80°	15
		100	70°	22
		105	100°	22

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1170 - FLIGHT DESCRIPTION

Flight 1170 was the second in a series of five flights for NASA-Langley and New York University. Launched at 1159Z on 31 July, the flight was terminated after 5.1 hours because of an unfavorable float altitude. Lay-out and launch of the system was under the direction of M. Fulkerson and F. Vandersnick.

Dr. Foelsche and Dr. Mendel were principal investigators for this flight...carrying essentially the same equipment as in Flights 1166 and 1169. Float altitude was to be 70,000 feet.

Standard Raven Industries instrumentation was used with the addition of the radio-command trapdoor as in Flight 1169 and an additional command channel. The third command channel was set up on the same channel as cut-down but with a one second time delay (cut-down was 4-seconds). A 16mm gun camera set to run at 32 frames per second was mounted on the upper gondola looking down at the two lower packages. A latching relay in the third command channel was then used so that upon receipt of a one second tone the relay would activate, the trapdoor ballast squibs would fire, and the camera would start. Termination occurred after three more seconds of channel activation. The camera was used to investigate motion of the two smaller payloads. On a previous flight, trouble was experienced and a small payload lost.



Launch of balloon at Fort Churchill.

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1170 - Flight Description (cont)

Since radar was available throughout the flight, no radio tracking was used. Transmitter frequency and command channels were:

Transmitter Frequency: 251.5 MHz

Command Channels:	Cutdown	1
	Ballast	2
	Trapdoor ballast,	
	Camera Start	1
	Private Line	2

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LAUNCH LOG, SKYHOOK FLIGHT 1170

NASA-Langley, NYU (Foelsche-Mendell)
Balloon: 325,000 cubic foot Stratofilm
all times in CDT 31 July 1966

0300 Wind at DOT hanger, 9 mph, (from 7-11,) 280°-330°.
0400 Wind WNW 8 mph.
0405 Wind 290°, 10 mph.
0415 Winds were 8-9 mph. R. Freeman approved delayed launch, estimated at 0700.
0428 Crew called out.
0445 NOTAM activated for launch at 0700. Radar crew called out.
0453 Crew in hanger.
0500 DOT winds NW 9 mph.
0518 Gondola ready to rig on launch truck.
0520 Advance crew left DOT hanger for launch site.
0545 Launch truck convoy, with gondola, left for launch site. DOT wind 300°, 8-9 mph.
0605 Convoy arrived at launch site. Balloon already laid out from 334°, per pibal. Wind on mast in launch site 300°, 6-7 knots. Ground fog in patches.
0623 Inflation started, using one filling tube. Pressure to be drained to aid in transfer of low-pressure gas from tank car. Balloon inflation tube diffuser (in balloon) had too few holes, resulting in slow filling.
0625 Bubble up. The sun shone on balloon throughout the inflation.
0655 Inflation ended. Mast wind 300°, 4 knots.
0659 Launch. Smooth, straight ahead, wind steady, cart and hand held packages off easily.
0700 DOT weather: Temperature 51°F, SLP 1013.9 Mb; Wind WNW 9; scattered clouds at 1500, 2000, and 8000 feet.

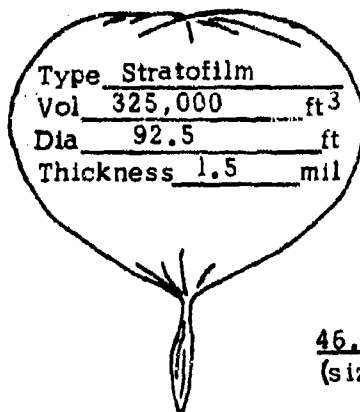
Range Test Number: 127.6 SB165-A 9L

Tropopause at 1200Z, 31 July: -56°C at 250 Mb (34,289 ft.).

R-1866
SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 8-66)

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1. Company Raven Flight Number 1170-N Director Fulkerson, Vandersnick
2. Scientist Foelsche Group NASA Langley-NYU Date/Time 7/31 / 1159 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 15 Ø 20 Ø 80 Ø, 51°F, 9 MPH, 1013.9 MB Cross Wind Angle None
(Sky-Temp-Wind-Pressure)
Trop (Coldest) Ht. 34,289 ft Temp -56 °C Inflation Start 1123 Z
Hrs Sunshine on Bubble 0.6 Train Length (Layout) 175 ft.
5. Balloon Theoretical 50.5 Mbs 69,000 ft. How Determined?
Ceiling: Actual 50.5 Mbs 69,000 ft. Barocoder
6. Ascent: Surface to Trop. 741 fpm Trop. to Ceiling 670 fpm.
7. Flight Duration: Total 5 hrs 04 min. At Ceiling 3 hrs. 26 min.
8. Termination: Time 1704 Z Altitude 71,500 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 7/31/1741 Z Location 58° 34' N 93° 21' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
451.5 Altitude Telemetry 6 hrs.
149.4 Communications & Comd 6 hrs.
7.456-4.015 Communications 6 hrs.
12. Balloon: Code Number SP-92.5-150-NS-02 Serial Number 168



WEIGHTS

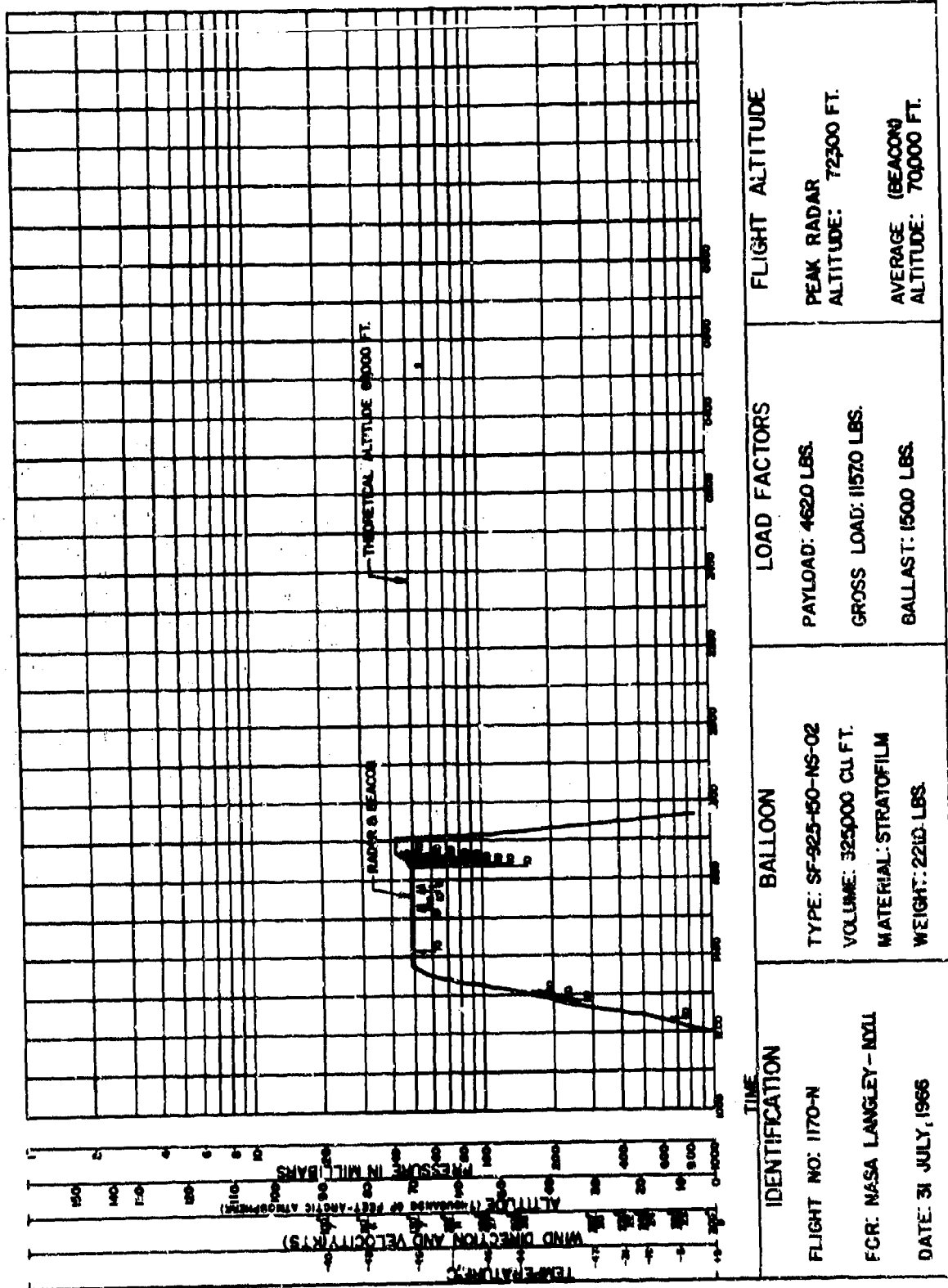
Balloon.....	221.0
Parachute.....	42.0
Instrumentation.....	52.0
Ballast.....	150.0
Scientific Package.....	289.0
Other, NYU.....	173.0
Other, Framed dead weight...	230.0
Gross Weight.....	1157.0
Free Lift.....	123.0
Gross Inflation.....	1280.0
Helium used (cu. ft.).....	20464

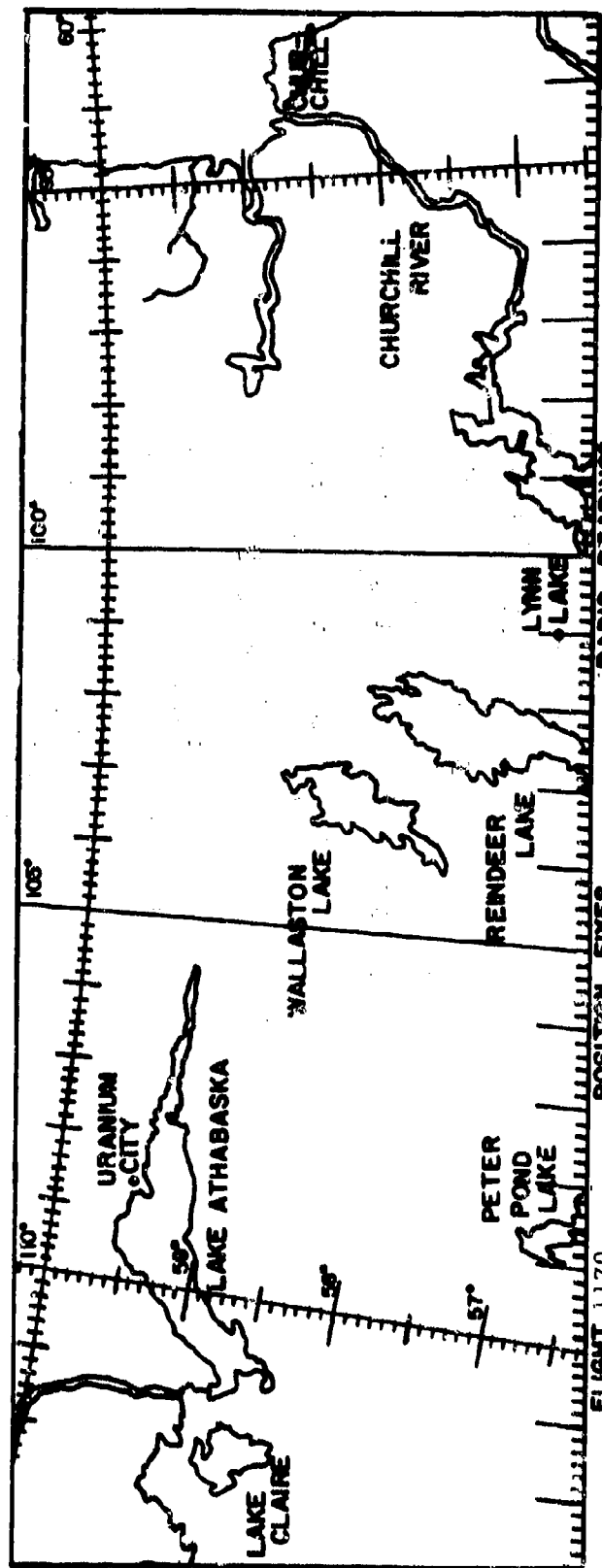
13. Flight Failures None
(Nature of flight failures - if any)
14. Comments Terminated early because of unfavorable float trajectory
(Significant factors concerning the operation)

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POSITION FIXES			RADIO BEARINGS	
TIME (Z)	LATITUDE	LONG.	TIME (Z)	LATITUDE LONGITUDE
1230	58°-32'	93°-58'	Radio positioning not used for this flight	
1300	58°-26'	93°-45'		
1315	58°-26'	93°-27'		
1330	58°-23'	93°-26'		
1345	58°-24'	93°-08'		
1400	58°-25'	93°-20'		
1435	58°-25'	93°-24'		
1530	58°-26'	93°-29'		
1600	58°-29'	93°-31'		
1700	58°-37'	93°-30'		
1704	Terminate			
1741	58°-34'	93°-21'		
C-47				

FLIGHT 1170 BALLASTING INFORMATION

Table I below presents Radio Controlled ballast data for Flight 1170 launched on 31 July 1968. Initial ballast on board at launch was 150 pounds. Between 1100Z and 1704Z (termination), 28 pounds of ballast was automatically dropped at the rate of 4.65 pounds per hour. An additional 185 pounds of ballast was flown as dead weight in order for the balloon to achieve the designated float altitude. This weight was releasable at termination if a slower parachute descent was desired. No problems were encountered with the ballast system during this flight.

Table I

BALLAST DATA - FLIGHT 1170

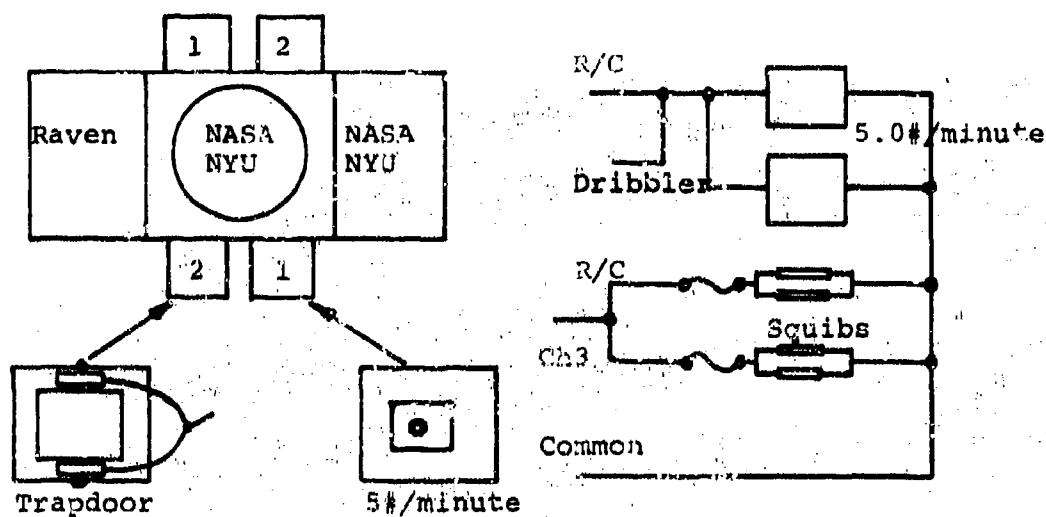
Time (Z)	Amount Dropped By Radio Command	Amount Remaining (pounds)
1222	5	145.0
1250	10	135.0
1256	5	130.0
1304	5	125.0
1407	5	120.0
1514	5	115.0
1521.5	5	110.0
1545	5	105.0
1550	5	100.0
1627	10	90.0
1629	10	80.0
1631	10	70.0
1633	10	60.0
1635	10	50.0
1637	10	40.0
1639*	10	30.0
1641	10	20.0
1643	10	10.0

*At this time, there should have been no ballast remaining due to the automatic dribbling. Two additional Radio Control releases were made, however, to insure all ballast was expended.

Flight 1170 Ballasting Information continued

All ballast drops from 1627Z on were made in an attempt to change trajectory of the balloon to a more favorable direction by going to a higher altitude.

Figure 1 below presents a simplified schematic diagram of the ballast system.



- (1) 75# Hopper magnetically controlled
- (2) 92.5# Hopper (Squib activated trapdoor)

Figure 1.

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PRESSURE AND ALTITUDE DATA
Flight 1170-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1200.6	-	Launch	1200.6	-	Launch
1207.1	822.0	5,600	1215	683.0	10,500
1222.6	566.0	15,300	1220	559.0	15,600
1230.3	456.0	20,600	1225	533.0	16,300
1242.4	288.0	31,200	1230	460.0	20,400
1245.5	251.0	34,200	1235	386.0	24,600
1250.3	229.0	36,200	1240	321.0	28,800
1256.1	202.0	38,900	1255	210.0	38,100
1304.3	159.0	44,100	1300	185.0	40,800
1308.7	136.0	47,500	1305	159.0	44,100
1321.4	86.0	57,400	1310	133.0	48,000
1324.6	77.0	59,800	1315	111.0	51,900
1327.4	69.0	62,200	1320	94.0	55,500
1333.7	58.0	66,100	1325	78.5	59,400
1338.0	48.9	69,700	1330	66.5	63,000
1343.0	48.9	69,700	1335	56.5	66,600
1344.8	49.6	67,400	1340	50.5	69,000
1345.7	50.0	69,200	1345	51.0	69,700
1350.5	50.5	69,000	1350	51.0	68,700
1404.0	50.5	69,000	1355	52.0	68,400
1406.1	51.0	68,800	1400	52.0	68,400
1408.3	50.5	69,000	1410	52.0	68,400
1415.0	51.0	68,800	1420	51.0	68,700
1419.0	50.5	69,000	1435	51.0	68,700
1423.0	51.0	68,800	1440	51.0	68,700
1430.0	51.0	68,800	1450	52.0	68,400
1445.0	51.0	68,800	1500	52.0	68,400
1500.0	51.0	68,800	1520	50.5	69,000
1516.5	50.5	69,000	1540	50.5	69,000
1522.0	50.0	69,200	1550	49.2	69,600
1530.0	50.0	69,200	1600	49.8	69,300
1548.0	49.6	69,400	1610	49.2	69,600
1600.0	50.0	69,200	1630	48.3	70,000
1615.0	50.0	69,200	1640	45.9	71,700
1629.5	48.9	69,700	1650	43.4	72,300
1632.0	47.6	70,300	1700	44.0	72,000
1633.0	47.3	70,500	1704	-	72,000
1636.0	46.3	70,900	1710	121.0	50,100
1638.5	45.5	71,300	1720	325.0	28,500
1641.0	44.6	71,700			
1645.0	45.0	71,500			
1704	-	71,500			
1709.5	114.0	51,300			
1738.5	915.0	2,700			

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Flight 1170
Upper Air Data for 1200 Z 31 July

Standard Levels

Pressure (MB)	T, °C	Wind	Knots
1000	+ 9	300°	9
850	+ 2	20°	17
700	- 5	360°	23
500	-18	240°	24
400	-31	230°	22
300	-47	310°	20
250	-55	290°	24
150	-44	280°	25
100	-46	250°	27
70	---	210°	11
50	-46	130°	7
30	-43	90°	6
20	-40	100°	7

Significant Levels

1010	+ 7
947	+10
797	- 1
693	- 6
657	- 5
588	-10
523	-16
278	-52
250	-56
227	-48
172	-45
86	-46
54	-47
40	-45
14	-38
11	-33

Wind Data

Thousands of feet	Direction	Knots
1	350°	1
2	10°	13
5	20°	17
10	360°	23
16	340°	26
20	340°	27
25	320°	23
30	210°	21
35	290°	28
36	290°	23
45	280°	25
50	290°	25
60	310°	15
70	130°	7
80	90°	6
90	110°	8
100	130°	11
102	110°	9

1171 - FLIGHT DESCRIPTION

Flight 1171 for Dr. Earl of the University of Maryland was launched at 0941Z on 26 July; the third for that day following 1168 and 1172. Launch was under the direction of G. Mancuso and T. Pappas. Weather conditions were satisfactory and the launch went smoothly.

Equipment carried by the system for this flight included a Geiger tube hodoscope to measure flux and direction of cosmic ray electrons, protons, and alpha particles. All data was to be telemetered to a GMD ground station.

Instrumentation was the standard command-telemetry package. Problems were experienced as the flight progressed...due to defective and weak batteries. Radio command operated properly during the initial part of the flight. Ballast was commanded ten times and functioned ten times, the last being at 1228Z. At 2047Z, a radio command check was made with no response in the ballast channel. A post-flight inspection revealed that the 22 volt, K15, decoder battery had opened. The failure was identical to that of Flight 1164. As a result, all remaining batteries of this type were discarded in favor of type "U15".



Attaching GMD transmitter to gondola prior to flight.

1171 - Flight Description (cont)

At about 0200Z, telemetry output slowly dropped in intensity and finally quit completely two hours prior to scheduled cut-down. Radio command cut-down was not attempted and the balloon floated until main timer termination (4 minutes early). After inspection of the package, it was determined that the failure was caused by a weak silvercell pack. This pack (No. 3) had been flown only twice before but had apparently been subjected to a damaging discharge on Flight 1161. After this flight, four cells had failed and were replaced. Following Flight 1171, the pack was removed from further service.

Many two and three station fixes were taken during the flight and are depicted on the Position Fix Map. Tracking apparently was quite good. Lynn Lake acquired the beacon at 1050Z (48,000 feet). Transmitter frequency and command channel utilization were:

Transmitter frequency:	251.5 MHz	
Command Channel:	Cutdown	1
	Ballast	2
	Private Line	1

University of Maryland telemetered on 1680 MHz using the GMD-1 system.

LAUNCH LOG, SKYHOOK FLIGHT 1171

University of Maryland (Earl)
Balloon: One million cubic foot Stratofilm
all times in CDT 26 July 1966

0030 Maryland crew setting up receiving equipment in van in launch area and checking out GMD. Tom Rygg on site in Lynn Lake set to take data.
0040 Winds at DOT hanger 270°, 11 mph.
0100 Winds at DOT hanger 270°, 10 mph.
0130 Winds 300°, 7 mph.
0200 Maryland gondola arrived in hanger, on schedule, for rigging. NOTAM activated for launch at 0400. Winds 270°, 6 mph.
0246 Gondola ready to put on launch truck. Winds 280°, 9 mph.
0328 Convoy with launch truck carrying gondola left DOT hanger for launch area.
0358 Convoy reached launch site. Advance crew already had balloon laid out, per pibal from 270°.
0400 Wind on mast in launch area indicating 270°, 5 knots. DOT winds 290°, 8-13 mph.
0411 Inflation started with one filling tube. Pressure to be bled out, to facilitate use of low pressure tubes in tank car.
0412 Hole observed near crown of balloon. Many patches observed. The hole resulted from tape sticking through to the other side. It was patched.
0418 Bubble up. Two men watched for holes.
0437 Inflation completed. No sunshine on balloon.
0441 Launch completed smoothly. No significant cross-wind. Truck moved ahead slowly for about 100 feet. Winds in launch area indicated 260°, 4 knots.
0500 DOT weather: Scattered clouds at 4000 and 9000 feet; SLP 1019.3; Temperature 56°F; Wind WNW 8 mph.

Range Test Number: 134.6 SB165-A IL

Tropopause at 1200Z, 26 July: -58°C, 221 Mb (36,954 ft.).

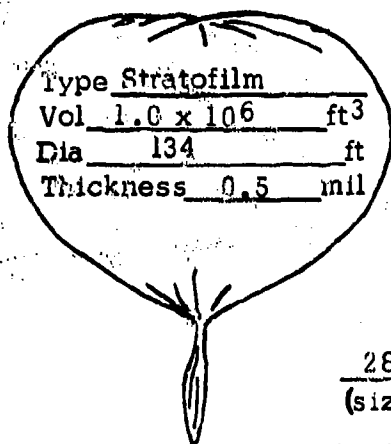
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SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 8-66)

1. Company Raven Flight Number ii7i-N Director Mancuso, Pappas
2. Scientist Earl Group Univ of Maryland Date/Time 7/26 / 0941 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 40 Ø 90 Ø, 56°F, 8 MPH, 1019.3 MB Cross Wind Angle None
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 36,959 ft Temp -58 °C Inflation Start 0911 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 230 ft.
5. Balloon Theoretical 6.05 Mbs 117,000 ft. How Determined?
 Ceiling: Actual 5.76 Mbs 118,200 ft. Radar - 1230Z
6. Ascent: Surface to Trop. 694 fpm Trop. to Ceiling 700 fpm.
7. Flight Duration: Total 17 hrs 53 min. At Ceiling 15 hrs. 9 min.
8. Termination: Time 0334 Z Altitude Unknown ft. Cause Timer
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 7/27 / 0412 Z Location 59° 24' N 106° 08' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time

<u>149.4</u>	<u>Communication & Cmd</u>	<u>18 hrs.</u>
<u>251.5</u>	<u>Altitude Telemetry</u>	<u>18 hrs.</u>
<u>4,015-7,465</u>	<u>Communication</u>	<u>18 hrs.</u>
12. Balloon: Code Number SF-134,6-050-NS-01 Serial Number 18

**WEIGHTS**

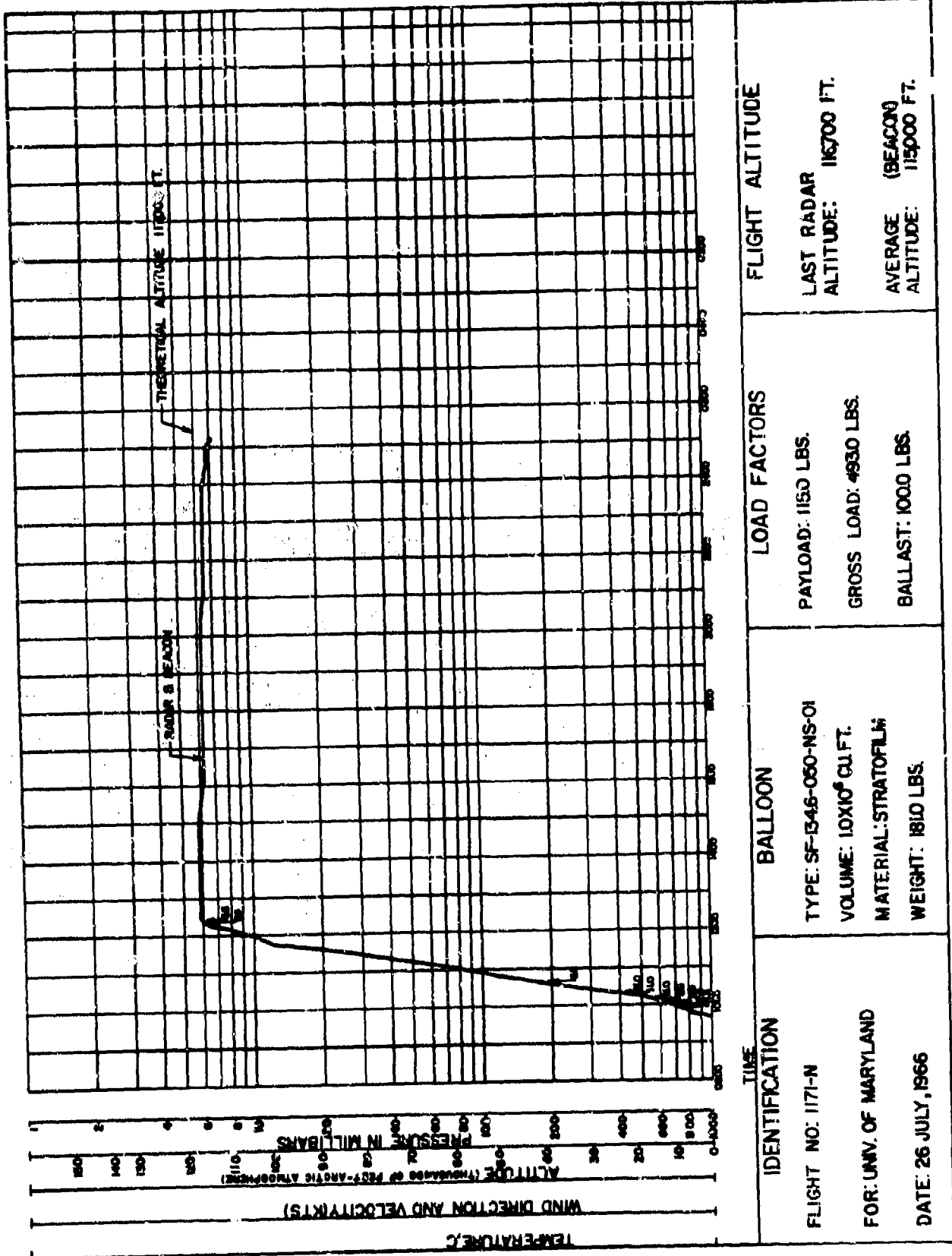
Balloon.....	<u>181.0</u>
Parachute.....	<u>20.0</u>
Instrumentation.....	<u>52.0</u>
Ballast.....	<u>100.0</u>
Scientific Package.....	<u>115.0</u>
Other. Crush Pad.....	<u>5.0</u>
Other. Flight Frame.....	<u>20.0</u>
Gross Weight.....	<u>493.0</u>
Free Lift.....	<u>54.0</u>
Gross Inflation.....	<u>547.0</u>
Helium used (cu. ft.).....	<u>8752</u>

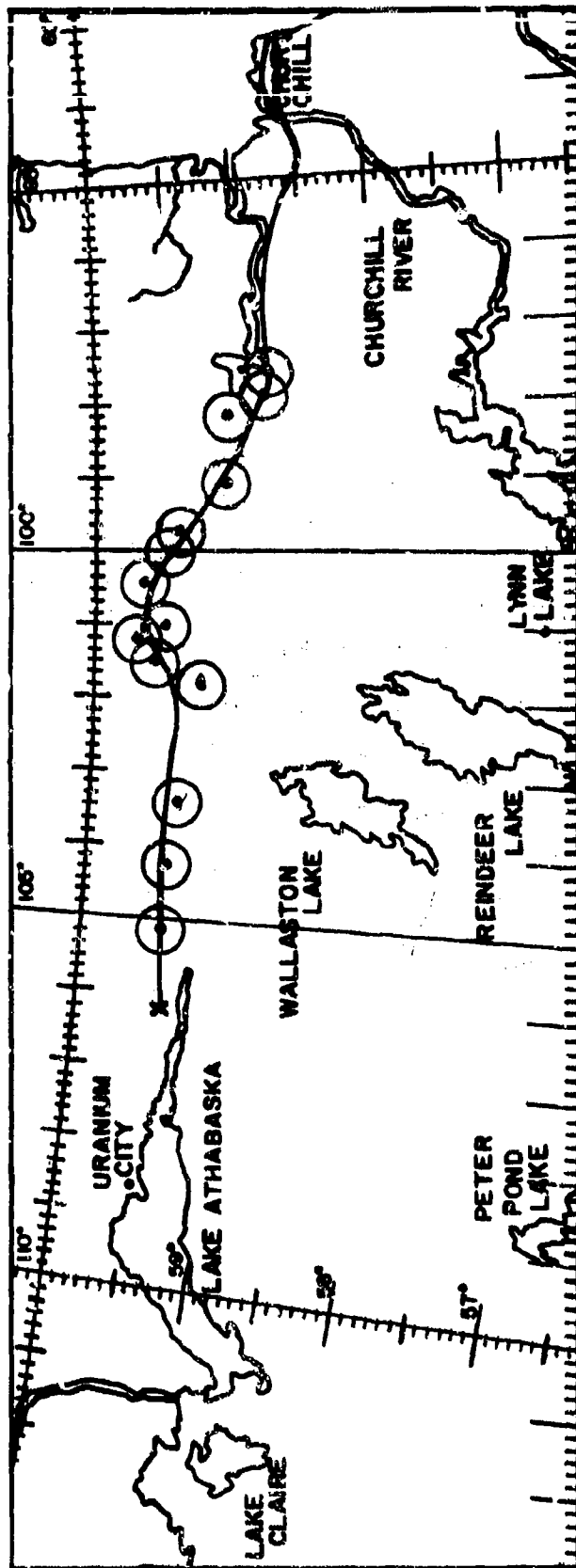
13. Flight Failures Decoder battery (K15) failure at 2000Z. Ballast Control
 (Nature of flight failures - if any)
14. Comments Telemetry transmitter stopped at 0200Z due to weak silver cell pack.
 (Significant factors concerning the operation)

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POSITION FIXES		RADIO BEARINGS	
TIME(Z)	LATITUDE LONG.	TIME(Z)	LATITUDE LONGITUDE
1000	58°-40' 93°-54'	15301	58°-45' 97°-36'
1020	58°-41' 93°-47'	16301	58°-48' 97°-53'
1100	58°-37' 93°-17'	17301	59°-02' 98°-10'
1115	58°-25' 93°-15'	18001	59°-04' 99°-03'
1135	58°-35' 93°-20'	19001	59°-24' 99°-44'
1150	58°-33' 93°-29'	19301	59°-23' 100°-00'
1215	58°-33' 93°-50'	20001	59°-37' 100°-25'
1230	58°-32' 94°-05'	21002	59°-29' 101°-01'
1300	58°-29' 94°-37'	21301	59°-41' 101°-12'
1320	58°-30' 95°	22002	59°-31' 101°-32'
1550	58°-45' 97°-25'	00302	59°-23' 103°-24'
1708	58°-58' 98°-42'	01302	59°-26' 104°-13'
0104	59°-29' 104°-14'	01581	59°-27' 105°-07'
0334	Terminate	(1) 2 Station Fix	
0412	59°-24' 106°-08'	(2) 3 Station Fix	
	Impact		

FLIGHT 1171 BALLASTING INFORMATION

Table 1 below presents Radio Controlled ballast data for Flight 1171 launched on 26 July 1966. Initial ballast on board at the time of launch was 100 pounds. Between 0930Z and 0150Z (battery failure), 24 pounds of ballast was automatically dropped at the rate of 1.5 pounds per hour. The battery failure occurred after all but a small amount of ballast had been expended.

Table 1
BALLAST DATA - FLIGHT 1171

Time (Z)	Amount Dropped By Radio Command	Amount Remaining (pounds)
0957.0	5.5	94.5
1000.5	5.5	89.0
1005.0	5.5	83.5
1008.5	5.5	78.0
1011.5	11.0	67.0
1018.0	11.0	56.0
1022.5	11.0	45.0
1041.5	5.5	39.5
1225.0	5.5	34.0
1228.0	5.5	28.5

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

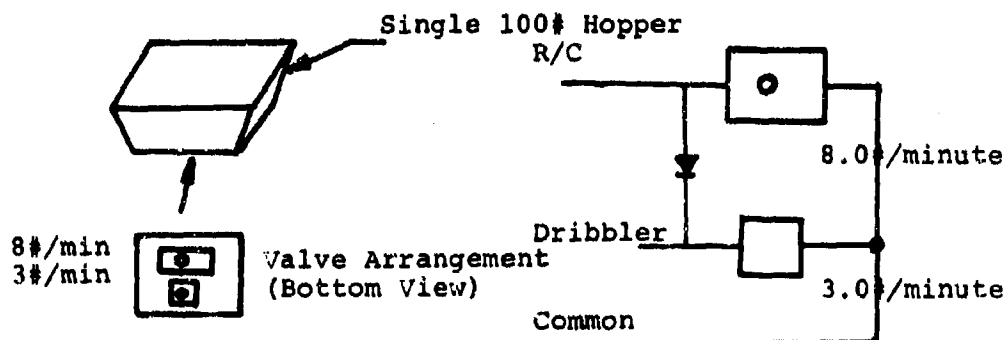


Figure 1

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1171-N

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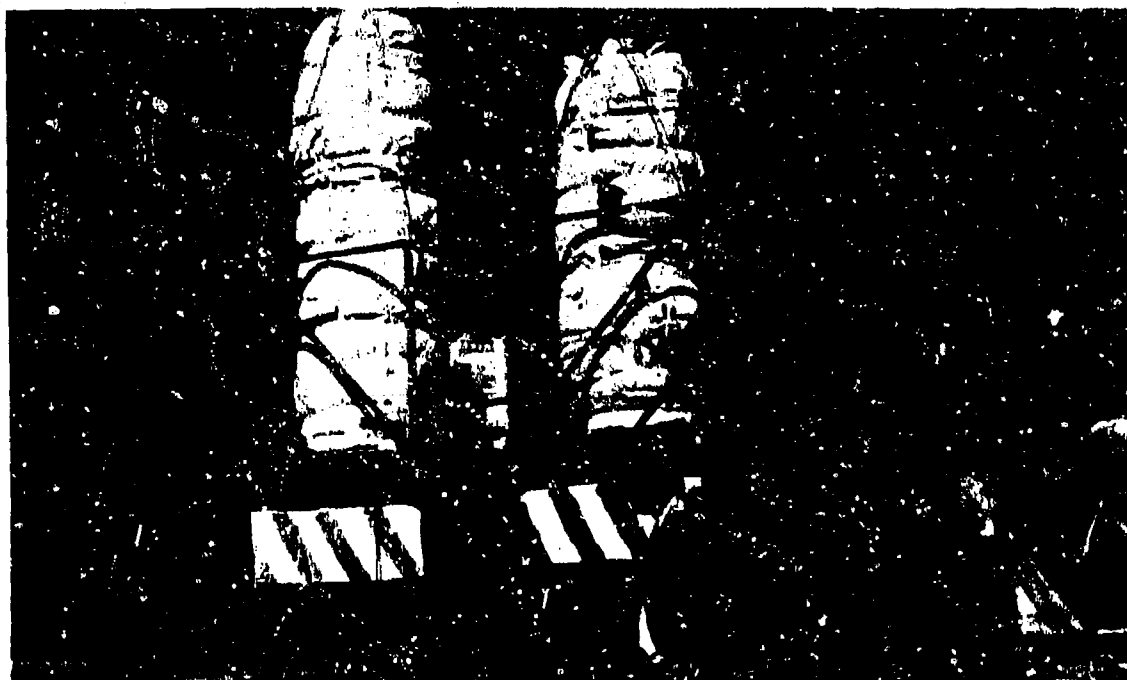
Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0941.0	-	Launch	0941.0	-	Launch
0948.4	841.0	5,000	0950	810.0	6,000
1000.7	693.0	10,100	0955	731.0	8,700
1015.8	468.00	20,000	1000	683.0	10,500
1023.2	368.0	25,700	1005	600.0	13,800
1028.5	297.0	30,500	1010	533.0	16,800
1030.2	275.0	32,200	1015	466.0	20,100
1033.0	242.0	35,000	1020	396.0	24,000
1036.5	211.0	38,000	1025	325.0	28,500
1040.8	184.0	40,900	1030	269.0	32,700
1051.3	127.0	49,000	1035	215.0	37,500
1055.7	106.0	53,000	1040	182.0	41,100
1104.1	76.5	60,000	1045	157.0	44,400
1122.5	39.2	74,500	1050	132.9	48,100
1133.5	25.3	84,100	1055	108.0	52,500
1137.7	21.2	88,000	1100	90.0	56,400
1145.0	16.1	94,200	1105	75.5	60,300
1155.1	11.8	101,400	1110	62.0	64,500
1158.9	10.5	104,200	1115	52.0	68,400
1205.5	8.45	109,100	1120	42.8	72,600
1208.8	7.85	110,800	1125	35.3	76,800
1215.5	6.85	117,000	1130	29.5	80,700
1218.2	6.55	115,100	1135	23.7	85,500
1220.3	6.25	116,300	1140	19.9	89,400
1230.0	5.95	117,500	1145	16.5	93,600
1245.0	5.95	117,500	1150	13.9	97,500
1300.0	5.95	117,500	1155	11.8	101,400
1400	5.95	117,500	1200	10.1	105,000
1500	5.95	117,500	1205	8.6	108,600
1600	6.25	116,300	1210	7.55	111,600
1630	6.55	115,100	1215	7.65	114,300
1650	6.55	115,100	1220	6.55	115,100
1700	6.55	115,100	1225	6.05	117,000
1930	6.55	115,100	1230	5.75	118,200
2000	6.55	115,100	1240	6.0	117,300
2030	6.55	115,100	1250	6.05	117,000
2103	6.85	114,000	1300	6.20	116,400
2200	6.85	114,000	1310	6.10	116,700
2300	6.85	114,000	1320	6.20	116,400
0000	6.85	114,000	1330	6.10	116,700
0035	7.15	112,900			
0100	7.15	112,900			
0115	7.50	111,800			
0150		Osc. malfunctioned			

1172 - FLIGHT DESCRIPTION

Flight 1172 for Dr. Webber of the University of Minnesota was launched at 1646Z on 25 July 1966 under the direction of G. Mancuso and M. Fulkerson. The midday launch was smooth and uneventful although a 10 mph wind was blowing. This was the first of three flights in succession, followed by 1168 and 1171.

Four balloons were ready to fly, but only three frequencies available due to a previous cancellation of 254.1 MHz by ONR. The newly assigned frequency of 254.4 MHz required modification of beacon transmitters and new crystals for aircraft tracking receivers...ordered, but not received. Dr. Webber agreed to a daytime launch and float through sunset with the ensuing loss of altitude, and then to recover in daylight. Accordingly, three other flights were scheduled ahead of him on the night of 24-25 July. Weather held up these flights, so Dr. Webber actually flew first.

Equipment carried in the gondola consisted of a double set of scientific devices. The scintillator and Cerenkov counter telescope carried on Flight 1162 was reflown with success. The second unit was comprised of a lead-glass Cerenkov telescope coupled with a scintillator to detect electron showers. All data was telemetered by the University's 234 MHz FM-FM radio link. No recorders were carried.



University of Minnesota payload configuration
being inspected by Dr. Webber.

1172 - Flight Description (cont)

Standard Raven instrumentation was flown with the addition of a Brailsford back-up termination timer on top of the parachute. At 0805Z, the barocoder oscillator stopped and then at 1111Z (cut-down), the transmitter carrier faded away. After examining the package upon its return to Churchill, it was determined that the Silvercell[®] power supply was near exhaustion. At cut-down, squibs drained the remaining supply causing failure of the transmitter carrier. The barocoder oscillator stopped earlier due to the low voltages and colder temperature of night. Sunset occurred on the balloon at 0445Z, 6.5 hours prior to cut-down.

Radio command ballasting worked satisfactorily...14 times out of 14 attempts. Tracking was also satisfactory although the Lynn Lake-Churchill angle gave larger errors at the beginning of the flight. Radio command termination came from Uranium City at 1111Z after 18.4 hours of flight time.

Transmitter frequency and command channels used were:

Transmitter Frequency:	255.1 MHz	
Command Channel:	Cutdown	4
	Ballast	5
	Private Line	1

R-1866

RAVEN[®]
industries, inc.

LAUNCH LOG, SKYHOOK FLIGHT 1172

University of Minnesota (Webber)
Balloon: 10.6 x 10⁶ cubic foot Stratofilm
all times in CDT 25 July 1966

0900 Winds at DOT hanger NNW 8 mph.
0930 Crew call. Since they were already in hanger, derigging the launch truck (carrying a package of Cal. Tech.'s) started at once. NOTAM activated for launch at 1130.
1000 Winds at DOT hanger NNW 5.
1030 Advance crew left DOT hanger for launch site.
1040 DOT winds 300°, 7 mph.
1052 Payload rigged on launch truck. Launch truck left hanger for launch area.
1110 Balloon laid out per pibal at 300°.
1115 Launch truck arrived with payload (two Minnesota gondolas in tandem). Winds in launch area 330°, 5 knots indicated. Actually felt like 8-10.
1122 Start of inflation. Sunshine on bubble 25% of the time.
1124 Bubble up.
1143 Inflation completed. Bubble length 67 feet. Dynamometer reading very high showing 1100, instead of calibrated 750. This indicates false lift in a wind estimated at 10 mph. Other recent dynamometer readings (in light winds) have been correct per calibration.
1146 Launch. Straight ahead, not very fast, smooth. Mast anemometer 6 knots, 330°. DOT weather: Temperature 54°F; SLP 1020.8 Mb; Wind NW 4; scattered clouds at 3000 feet, broken at 6000 and 8000 feet.

Range Test Number: 130.6 SB165-A IL.

Tropopause at 1200Z; 25 July: -50°C at 243 Mb (34,904 ft.).

R-1866

SKYHOOK BALLOON FLIGHT INFORMATION

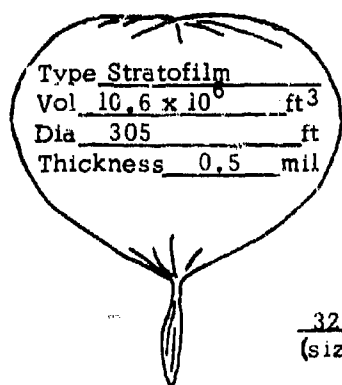
NAVEXOS 3900/2 (Rev. 8-66)

RAVEN

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1. Company Raven Flight Number 1172-N Director Mancuso, Fulkerson
2. Scientist Webber Group Univ of Minnesota Date/Time 7/25 / 1646 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 30 Ø 60 Ø 80 Ø, 54°F, 4 MPH, 1020.8 MB Cross Wind Angle None
(Sky-Temp-Wind-Pressure)
Trop (Coldest) Ht. 34904 ft Temp -50 °C Inflation Start 1622 Z
Hrs Sunshine on Bubble 0.25 Train Length (Layout) 480 ft.
5. Balloon Theoretical 2.27 Mbs. 141,800 ft. How Determined?
Ceiling: Actual 2.00 Mbs. 145,150 ft. Photobarograph
6. Ascent: Surface to Trop. 950 fpm Trop. to Ceiling 754 fpm.
7. Flight Duration: Total 18 hrs 25 min. At Ceiling 15 hrs. 42 min.
8. Termination: Time 1111 Z Altitude Unknown ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 7/26/ 1140 Z Location 59° 07' N 111° 53' W
11. Frequency used:

(Kcs, Mcs)	Purpose	Total Time
<u>149.4</u>	<u>Communication & Cmd</u>	<u>19 hrs.</u>
<u>255.1</u>	<u>Altitude Telemetry</u>	<u>19 hrs.</u>
<u>4.015-7.465</u>	<u>Communication</u>	<u>19 hrs.</u>
12. Balloon: Code Number SF-305.86-050-NSC-01 Serial Number 44



WEIGHTS

Balloon.....	<u>944.0</u>
Parachute.....	<u>29.0</u>
Instrumentation.....	<u>51.0</u>
Ballast.....	<u>150.0</u>
Scientific Package #1.....	<u>126.0</u>
Other #2.....	<u>150.0</u>
Other Misc.....	<u>142.0</u>
Gross Weight.....	<u>1592.0</u>
Free Lift.....	<u>160.0</u>
Gross Inflation.....	<u>1752.0</u>
Helium used (cu. ft.).....	<u>28160</u>

13. Flight Failures Transmitter carrier quit at termination-low silver cell pack.
(Nature of flight failures - if any)
14. Comments None
(Significant factors concerning the operation)

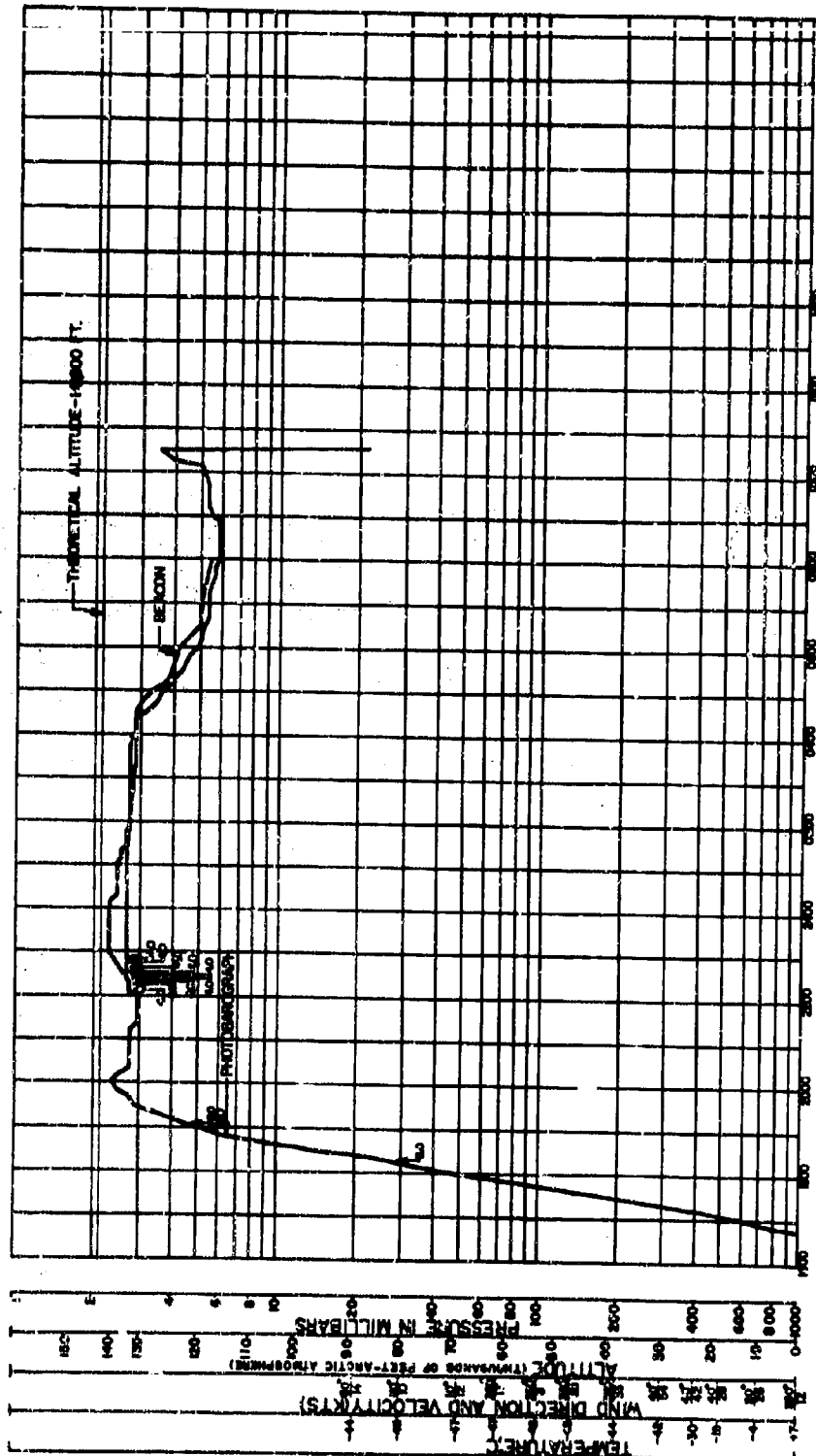
Copy to:

ONR/Fld Rep/Minn

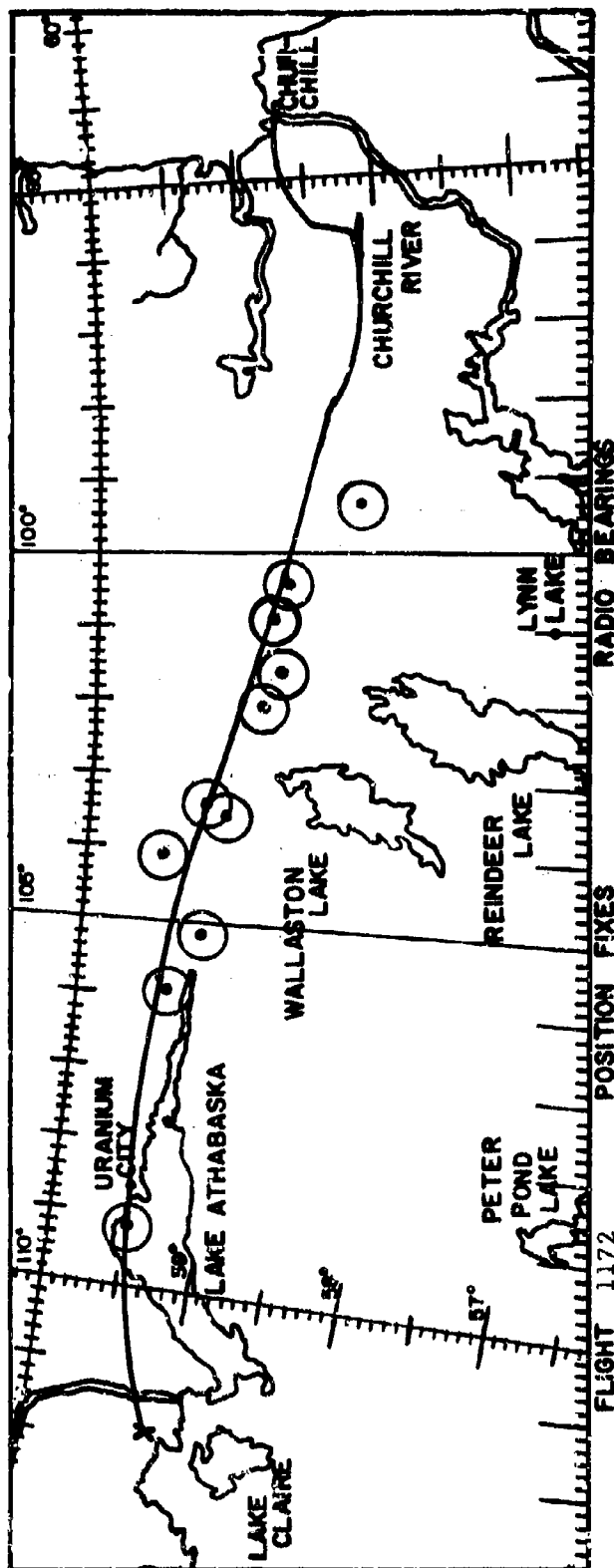
ONR/Code 421

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TIME	IDENTIFICATION	BALLOON	LOAD FACTORS	FLIGHT ALTITUDE
	FLIGHT NO: 1172-N FOR: UNIV. OF MINN. DATE: 25 JULY, 1966	TYPE: SF-30586-050-NSC-01 VOLUME: 106X10 ³ CU. FT. MATERIAL: STRATOFILM WEIGHT: 944.0 LBS.	PAYLOAD: 276.0 LBS. GROSS LOAD: 1592.0 LBS. BALLAST: 150.0 LBS.	PEAK RADAR ALTITUDE: 14550 FT. AVERAGE (PHOTOBAROGRAPH) ALTITUDE: 133,000 FT.



POSITION FIXES		RADIO BEARINGS	
TIME(Z)	LATITUDE LONG.	TIME(Z)	LATITUDE LONGITUDE
2000	58°-28' 95°-36'	00002	58°-08' 99°-20'
2015	58°-10' 95°-46'	00502	58°-45' 100°-52'
2030	58°-07' 96°-05'	01301	58°-41' 101°-38'
2045	58°-06' 95°-30'	0200	58°-50' 102°-05'
2110	58°-08' 97°-08'	0300	59°-12' 103°-25'
2155	58°-19' 97°-59'	0330	59°-03' 103°-34'
2215	58°-24' 98°-13'	0400	59°-30' 104°-04'
2240	58°-24' 98°-31'	0430	59°-02' 104°-18'
0023	58°-38' 100°-25'	0500	59°-12' 105°-08'
1111	Terminate	0530	59°-25' 105°-57'
1140	59°-07' 111°-53'	0900	59°-28' 109°-10'
		(1)	2 Station Fix
		(2)	3 Station Fix

FLIGHT 1172. BALLASTING INFORMATION

Table I below presents Radio Controlled ballast data for Flight 1172 launched on 25 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 1640Z and 0800Z (battery voltage), 43 pounds of ballast was automatically dropped at the rate of 2.8 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I

BALLAST DATA - FLIGHT 1172

Time (Z)	Amount Dropped by Radio Command	Amount Remaining (pounds)
1816	8.0	142.0
1859	8.0	134.0
1904	8.0	126.0
2207	4.0	122.0
2215	4.0	118.0
2220	4.0	114.0
2225	4.0	110.0
2230	4.0	106.0
2235	4.0	102.0
2240	4.0	98.0
2245	4.0	94.0
2250	4.0	90.0

A large amount of ballast was left for possible use at sunset.

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

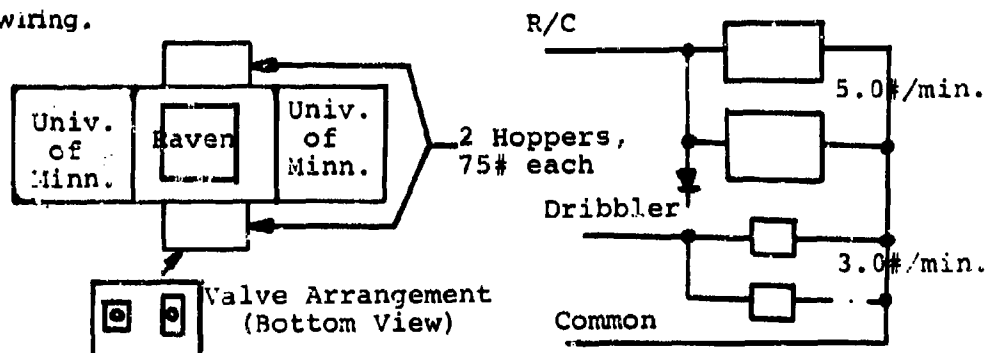


Figure 1

R-1866

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PHOTOBAROGRAPH DATA
Flight 1172-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1755	61.0	64,900	2130	2.92	135,200
1800	49.0	69,600	2135	33.02	137,200
1805	38.4	74,400	2140	3.02	137,200
1810	32.0	78,949	2145	2.92	135,200
1815	25.7	83,700	2150	2.92	135,200
1820	22.0	87,200	2155	2.92	135,200
1825	16.8	93,200	2200	2.92	135,200
1830	13.9	97,500	2205	2.83	136,000
1835	11.2	102,500	2210	2.83	136,000
1840	8.8	108,000	2215	2.83	136,000
1845	7.4	112,100	2220	2.83	136,000
1850	6.35	115,800	2225	2.75	136,700
1855	5.19	120,687	2230	2.75	136,700
1900	4.7	123,100	2235	2.65	137,700
1905	4.52	124,100	2240	2.65	137,700
1910	4.1	126,500	2245	2.55	138,700
1915	3.7	129,100	2250	2.45	143,800
1920	3.45	130,900	2255	2.45	143,800
1925	3.3	132,000	2300	2.38	145,151
1930	2.92	135,200	2310	2.45	143,856
1935	2.83	136,000	2315	2.38	145,151
1940	2.83	136,000	2320	2.38	145,151
1945	2.75	136,700	2330	2.38	145,151
1950	2.65	137,700	2340	2.38	145,151
1955	2.55	138,700	2350	2.38	145,151
2000	2.55	138,700	2400	2.38	145,151
2005	2.55	138,700	2410	2.38	145,151
2010	2.65	137,700	2415	2.45	143,856
2015	2.75	136,700	2420	2.45	143,856
2020	2.83	136,000	2425	2.55	138,700
2025	2.83	136,000	2435	2.55	138,700
2030	2.83	136,000	2440	2.55	138,700
2035	2.83	136,000	2455	2.55	138,700
2040	2.83	136,000	0105	2.55	138,700
2050	2.83	136,000	0110	2.65	137,700
2100	2.83	136,000	0120	2.65	137,700
2110	2.83	136,000	0125	2.75	136,700
2115	2.92	135,200	0135	2.75	136,700
2120	2.92	135,200	0145	2.75	136,700
2125	3.02	137,200	0150	2.83	136,000

R-1866
 Photobarograph Data
 Flight 1172-N
 Page 2

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0205	2.83	136,000	0630	5.19	120,600
0210	2.83	136,000	0635	4.28	120,200
0215	2.85	136,000	0640	4.28	120,200
0220	2.85	136,000	0645	5.42	119,300
0230	2.85	136,000	0650	5.42	119,300
0235	2.85	136,000	0700	5.42	119,300
0245	2.85	136,000	0715	5.42	119,300
0250	2.85	136,000	0720	5.6	118,800
0255	2.83	139,200	0725	5.61	118,700
0310	2.83	139,200	0730	5.7	118,400
0320	2.83	139,200	0735	5.8	118,000
0330	2.83	139,200	0750	5.8	118,000
0340	2.83	139,200	0755	5.9	117,600
0355	2.83	139,200	0805	5.9	117,600
0400	2.92	138,200	0815	5.9	117,600
0420	2.92	138,200	0825	5.9	117,600
0425	3.02	137,200	0830	5.9	117,600
0430	3.1	136,300	0835	5.9	117,600
0435	3.2	135,300	0840	5.8	118,000
0440	3.3	134,400	0845	5.7	118,400
0445	3.45	132,800	0850	5.9	117,600
0450	3.6	131,300	0855	5.9	117,600
0455	3.7	130,500	0900	5.7	118,400
0500	3.78	129,800	0905	5.61	118,700
0505	4.00	127,800	0910	5.51	119,200
0510	4.00	127,800	0915	5.43	119,600
0515	4.1	127,100	0920	5.43	119,600
0520	4.1	127,100	0925	5.43	119,600
0525	4.1	127,100	0930	5.35	119,900
0530	4.28	125,900	0935	5.25	120,400
0535	4.52	124,200	0940	5.43	119,300
0540	4.52	124,200	0945	5.25	120,200
0545	4.63	123,700	0950	5.00	121,600
0550	4.63	123,700	0955	-	-
0555	4.72	122,600	1005	-	-
0600	4.9	122,100	1010	-	-
0605	5.0	121,600	1015	4.09	127,100
0610	5.0	121,600	1020	4.09	127,100
0615	5.0	121,600	1025	3.92	128,400
0620	5.09	121,100	1030	3.8	129,800
0625	5.19	120,600			

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1172-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
1646.5	-	Launch	No radar available		
1652.5	789.0	6,700			
1700.1	607.0	13,500			
1711.3	408.0	23,300			
1736.4	138.0	47,200			
1743.2	107.0	52,800			
1748.3	85.5	57,500			
1800.4	50.5	69,000			
1808.0	37.4	75,500			
1820.5	23.1	86,100			
1830.5	15.5	95,000			
1838.0	10.3	104,500			
1839.8	9.60	106,000			
1841.0	8.90	107,800			
1842.9	8.30	109,500			
1846.0	7.65	111,400			
1847.2	7.30	112,400			
1850.2	6.70	114,500			
1855.5	5.40	119,700			
1906.5	4.46	124,500			
1918.0	3.87	128,000			
1929.0	3.26	132,400			
2045	3.26	132,400			
2145	3.31	130,200			
2213	3.25	132,400			
2246	2.94	135,000			
0030	2.94	135,000			
0155	2.94	135,000			
0215	2.94	135,000			
0315	3.25	132,400			
0400	3.25	132,400			
0430	3.25	132,400			
0445	3.31	130,200			
0501.5	3.87	128,000			
0513	4.11	126,500			
0538	4.46	124,500			
0555	4.83	122,500			
0600	4.83	122,500			
0630	5.40	119,700			
0700	5.40	119,700			
0710	5.75	118,200			
0730	5.75	118,200			
0800	5.75	118,200			
0805	Lost Signal				

R-1866

Flight 1172
Upper Air Data for 1200 Z 25 July

Standard Levels

Pressure (MB)	T, °C	Wind	Knots
1000	+ 7	350°	12
850	+ 1	20°	15
700	- 4	20°	26
500	-19	40°	28
400	-30	40°	42
300	-42	40°	54
250	-49	30°	40
200	-44	360°	33
150	-45	330°	30
100	-46	290°	8
70	-47	360°	17
50	-47	10°	12
30	-43	110°	10
20	-44	60°	14

Significant Levels

1015	+ 8
904	+ 5
782	- 3
766	- 1
720	- 3
678	- 4
625	- 9
525	-17
378	-32
265	-49
243	-50
203	-44
128	-48
40	-47
13	-38
11	-41

Wind Data

Thousands of
Feet

Direction	Knots
360°	14
10°	16
20°	15
20°	26
30°	33
40°	32
40°	48
40°	52
20°	49
360°	35
330°	32
330°	16
350°	19
20°	12
110°	10
60°	14
50°	26
40°	31

R-1866

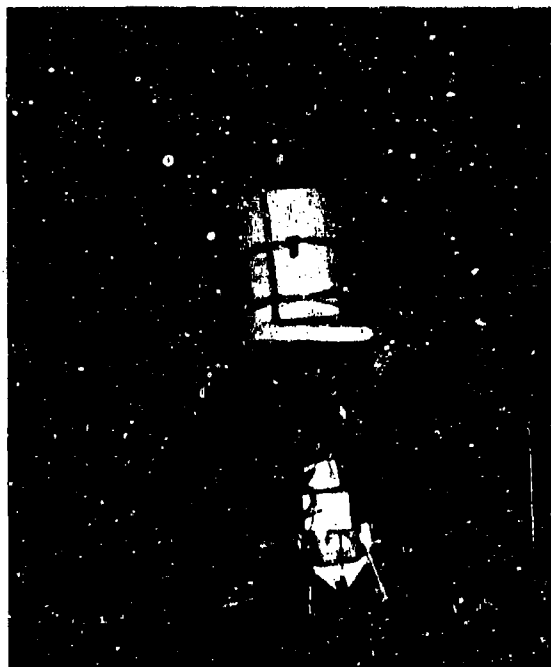
RAVEN
industries, inc.

1173 - FLIGHT DESCRIPTION

Flight 1173, the first of two flights on this evening, was launched at 0246Z on 30 July for the University of Rochester. Directing the launch were G. Mancuso and M. Fulkerson. No significant cross wind was present and a smooth launch ensued.

Principal investigators for this flight were Dr. Kaplon and Dr. Deney whose experiment was designed to measure flux and spectrum of charged particles, with particular concern for the relative abundance of He^3 and He^4 . Total energy was detected by a large sodium iodide crystal while dE/dx was sensed by a thin scintillation counter.

Instrumentation was identical to the last flight of Rochester's gondola. Raven supplied a command channel and circuitry to turn on the gondola power at 0534Z when the balloon had ascended to 115,000 feet. In addition, a subcarrier was used to telemeter Rochester pulse signals. A loose code drum on the barocoder gave false indication of floating over theoretical ceiling. Tracking and commanding functioned well. No problems were encountered. Churchill lost the beacon at 1942Z when the balloon was approximately 500 miles distant. Uranium City lost the signal at 2228Z when the descending parachute load reached 7000 feet at a distance of 125 miles.



University of Rochester gondola prior to transportation to the launch site.

R-1866

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1173 - Flight Description (cont)

Termination was performed by radio command from the tracking Cessna 206 aircraft at 2201Z after a 19.3 hour flight.

Transmitter frequency and command channels used were:

Transmitter Frequency: 255.1 MHz

Command Channel:	Cutdown	7
	Ballast	8
	Gondola Power	
	Town On	9
	Private Line	1

R-1866

RAVEN[®]
industries, inc.

LAUNCH LOG, SKYHOOK FLIGHT 1173

University of Rochester (Deney)
Balloon: 10.6×10^6 cubic foot Stratofilm
all times in CDT 29 July 1966

1900 Wind at DOT hanger ENE 7 mph. Crew assembled. NOTAM activated for 2200 launch.
1955 Start of rigging gondola on launch truck.
2000 DOT wind 090°, 8 mph.
2030 Wind 100°, 8-10 mph. Advance crew left hanger for launch site.
2039 Rigging completed. Wind 90-100°, 10 mph.
2047 Convoy left DOT hanger for launch site; launch truck carrying payload. DOT winds: 110°, 9 mph.
2115 Convoy arrived at launch site. Balloon already laid out per pibal, from 115°, wind on mast in launch area indicating 110°, 4 knots.
2124 Start of inflation, using two tubes. No sunshine on bubble during inflation.
2127 Bubble up.
2140 Winds on mast 110° 4-5 knots. DOT winds 110°, 9 mph. Inflation completed.
2146 Launch. Smooth and easy. Truck had to move ahead, and slightly to the right. No significant cross wind.
2200 DOT weather: Scattered clouds at 9000 and 12,000 feet, broken at 22,000; SLP 1010.5 Mb; Temperature 52° F; winds 120°, 10 mph.

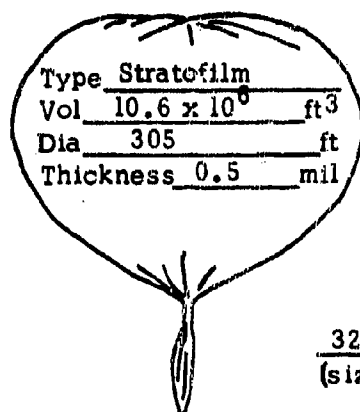
Range Test Number 136.6 SB165-A IL.

Tropopause at 0000Z 30 July: -56°C at 239 Mb (35,263 ft.).

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

RAVEN[®]
 industries, inc.

1. Company Raven Flight Number 1173-N Director Mancuso, Fulkerson
2. Scientist Deney Group Univ of Rochester Date/Time 7/30 / 0246 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 90 ø 120 ø 220 ø, 52°F, 10 MPH, 1010.5 MB Cross Wind Angle None
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 35263 ft Temp -56 °C Inflation Start 0224 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 480 ft.
5. Balloon Theoretical 2.09 Mbs 144,000 ft. How Determined?
 Ceiling: Actual 2.17 Mbs 143,000 ft. Barocoder
6. Ascent: Surface to Trop. 739 fpm Trop. to Ceiling 420 fpm.
7. Flight Duration: Total 19 hrs 15 min. At Ceiling 15 hrs 13 min.
8. Termination: Time 2201 Z Altitude 143,000 ft. Cause Radio Command
9. Balloon Destruction-confirmed Unknown (visual, unknown, etc)
10. Impact: Date/Time 7/30/2232 Z Location 58° 07' N 111° 02' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd 20 hrs.
255.1 Altitude Telemetry 20 hrs.
4.015-7.456 Communication 20 hrs.
12. Balloon: Code Number SF-305.86-050-NSC-04 Serial Number 39



WEIGHTS

Balloon.....	<u>945.0</u>
Parachute.....	<u>25.0</u>
Instrumentation.....	<u>52.0</u>
Ballast.....	<u>150.0</u>
Scientific Package.....	<u>295.0</u>
Other.. Photobarograph.....	<u>8.0</u>
Other.. Ballast Container.....	<u>13.0</u>
Gross Weight.....	<u>1488.0</u>
Free Lift.....	<u>149.0</u>
Gross Inflation.....	<u>1637.0</u>
Helium used (cu. ft.).....	<u>26192</u>

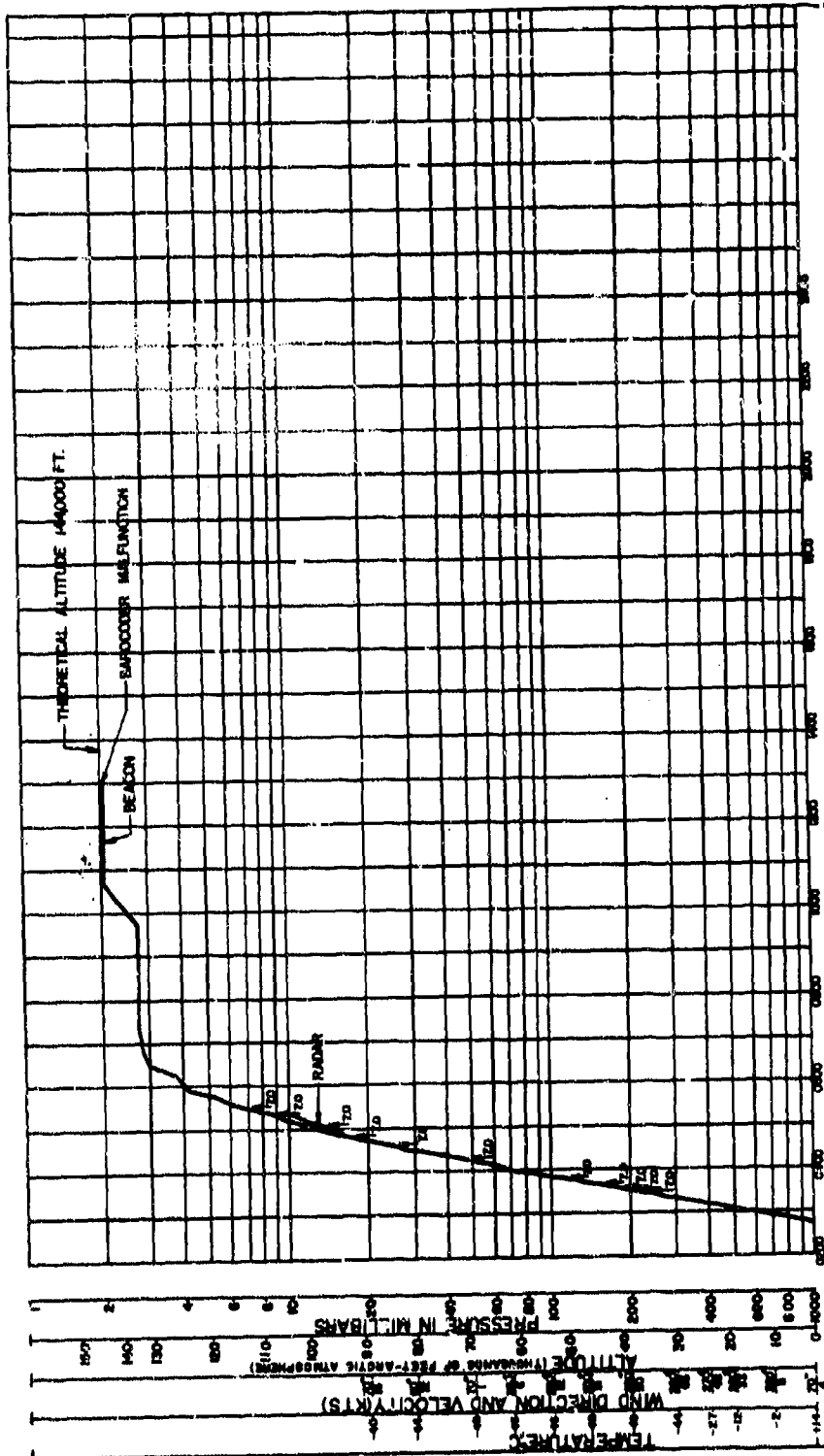
32 Ft. chute
 (size)

13. Flight Failures Loose code drum on barocoder occurred at 1250Z
 (Nature of flight failures - if any)
14. Comments None
 (Significant factors concerning the operation)

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RAVEN

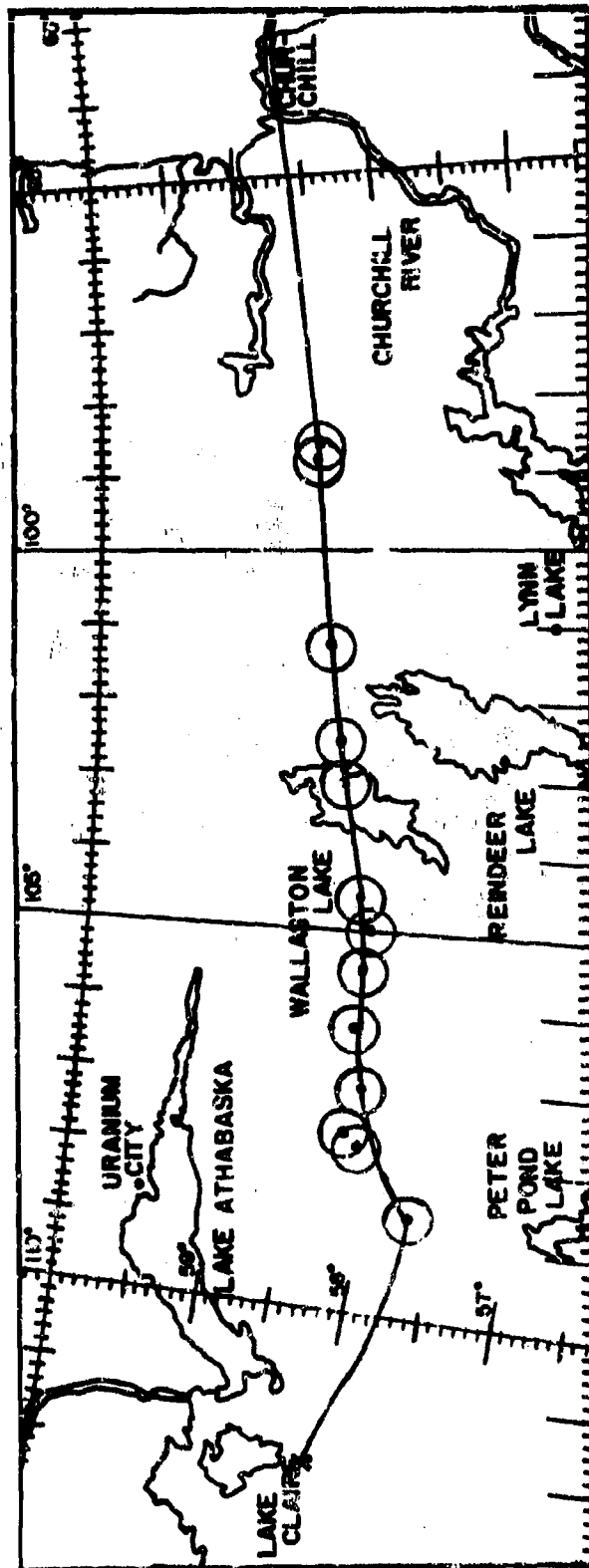
114400000, 114400000



IDENTIFICATION		BALLOON		LOAD FACTORS		FLIGHT ALTITUDE	
FLIGHT NO: 1173-N		TYPE: SF-305.86-050-NSC-04		PAYLOAD: 2950 LBS.		PEAK RADAR ALTITUDE: 105000 FT.	
FOR UNIV. OF ROCHESTER		VOLUME: 10.6X10 ³ CU. FT.		GROSS LOAD: 1488.0 LBS.		AVERAGE NOT AVAILABLE ALTITUDE:	
DATE: 30 JULY, 1966		MATERIAL: STRATOFILM		BALLAST: 1500 LBS.			
		WEIGHT: 9450 LBS.					

R-1666

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POSITION FIXES		RADIO BEARINGS	
TIME(Z)	LATITUDE LONG.	TIME(Z)	LATITUDE LONGITUDE
0315	58°-41' 93°-44'	1045	58°-30' 98°-35'
0330	58°-41' 93°-22'	1200	58°-31' 98°-45'
0350	58°-38' 93°-01'	1330 ¹	58°-23' 101°-15'
0420	58°-37' 92°-56'	1430 ²	58°-18' 102°-31'
0425	58°-37' 92°-58'	1500 ²	58°-17' 103°-05'
0440	58°-37' 93°-03'	1600 ²	58°-09' 104°-35'
0500	58°-36' 93°-12'	1630 ¹	58°-05' 104°-58'
0520	58°-38' 93°-25'	1700 ²	58°-06' 105°-30'
1950	57°-39' 108°-40'	1800 ²	58°-08' 106°-14'
2133	57°-54' 110°-50'	1830 ²	58°-04' 107°-02'
2201	Terminate	1900 ²	58°-10' 107°-40'
2232	58°-07' 111°-02'	1930 ²	58°-03' 107°-50'
		(1) 2 Station Fix	
		(2) 3 Station Fix	

FLIGHT 1173. BALLASTING INFORMATION

Table I below presents Radio Controlled ballast data for Flight 1173 launched on 30 July 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0240Z and 2201Z (termination), 73 pounds of ballast was automatically dropped at the rate of 4.2 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I

BALLAST DATA - FLIGHT 1173

Time (Z)	Amount Dropped by Radio Command	Amount Remaining (pounds)
0332	7.0	143.0
0335	7.0	136.0
0337	7.0	129.0
0341	7.0	122.0
0349	7.0	115.0
0413	7.0	108.0
0438	7.0	101.0
0452	7.0	94.0
0506	7.0	87.0
0524	7.0	80.0
0535	7.0	73.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

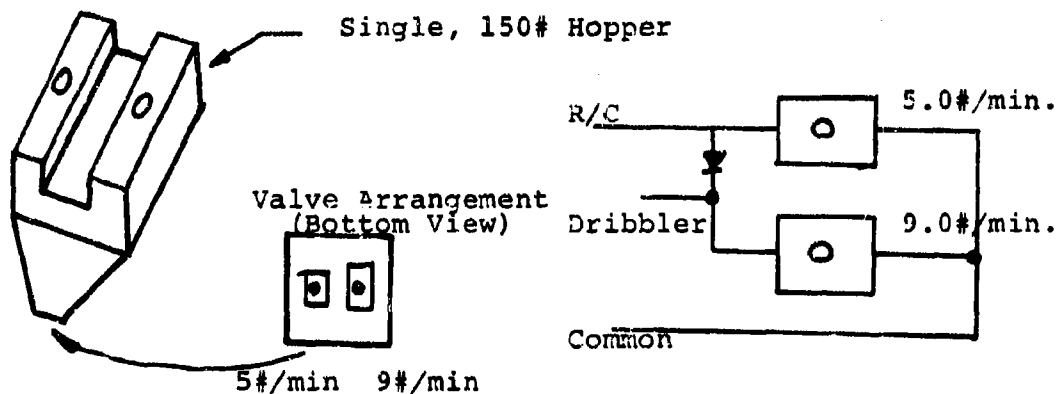


Figure 1

R-1866

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 PHOTOBAROGRAPH DATA
 Flight 1173-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0401.5	72.0	61.3	1509	12.4	100.1
0404	67.0	62.8	1511.5	11.8	101.3
0406.5	61.5	63.7	1514	11.0	102.9
0409	57.4	66.2	1516.5	10.6	103.7
0411.5	52.0	68.3	1519	9.82	105.5
0414	47.9	70.1	1521.5	9.57	106.1
0416.5	44.0	72.0	1524	9.15	107.1
0419	41.2	73.4	1526.5	8.72	108.2
0421.5	38.2	75.0	1529	8.39	109.2
0424	35.2	76.8	1531.5	8.40	109.1
0426.5	32.7	78.4	1534	7.78	111.1
0429	31.7	79.1	1536.5	7.42	112.0
0431.5	29.8	80.5	1539	7.16	112.9
0434	28.2	81.7	1541.5	7.00	113.4
0436.5	27.4	82.3	1544	6.90	113.8
0439	26.0	83.5	1546.5	6.55	115.0
0441.5	24.5	84.8	1549	6.55	115.0
0444	23.0	86.2	1551.5	6.29	116.1
0446.5	21.0	88.2	1554	5.94	117.5
0449	19.3	90.1	1556.5	5.94	117.5
0451.5	18.0	91.7	1559	5.94	117.5
0454	17.0	93.0	1601.5	5.75	118.2
0456.5	16.0	94.3	1604	5.59	118.9
0459	15.0	95.8	1606.5	5.59	118.9
1501.5	14.0	97.4	1609	5.59	118.9
1504	13.3	99.0	1611.5	5.59	118.9
1506.5	13.0	99.0			

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1173-N

RAVEN[®]
industries, inc.

Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0246	-	Launch	0255	722.0	9,000
0251.0	825.0	5,500	0300	605.0	13,500
0253.3	755.0	7,800	0305	501.0	18,300
0300.5	595.0	14,000	0310	416.0	22,800
0308.2	464.0	20,200	0315	343.0	27,300
0311.6	409.0	23,200	0320	284.0	31,500
0319.2	300.0	30,300	0325	234.0	35,700
0321.6	272.0	32,400	0330	198.0	39,300
0325.4	231.0	36,000	0335	180.0	41,400
0338.3	159.0	44,100	0340	157.0	44,400
0341.2	144.0	46,200	0345	131.0	48,300
0346.6	119.0	50,300	0350	112.0	51,600
0349.7	108.0	52,400	0355	98.0	54,600
0356.3	86.0	57,400	0400	86.50	57,300
0400.2	75.5	60,300	0405	64.5	62,700
0405.4	64.5	63,700	0410	58.0	66,000
0408.6	58.0	66,000	0415	50.5	69,000
0411.7	53.0	68,000	0420	42.2	72,900
0416.9	44.0	72,000	0422	38.8	74,700
0419.6	40.1	74,000	0424	37.30	75,600
0422.3	36.7	75,900	0426	35.3	76,800
0428.9	30.3	80,100	0428	33.4	78,000
0433.7	26.7	82,900	0430	32.0	78,900
0439.3	23.5	85,700	0440	25.4	84,000
0442.3	21.5	87,700	0450	19.4	90,000
0446.7	18.4	91,200	0500	15.5	95,000
0453.5	16.3	94,000	0510	12.2	100,500
0500.5	13.5	98,300	0520	10.0	105,000
0507.1	11.7	101,600			
0511.2	10.6	103,800			
0516.7	9.3	106,800			
0520.3	8.65	108,500			
0524.6	8.05	110,300			
0529.7	7.10	113,200			
0534.4	6.5	115,200			
0543.6	5.6	118,900			
0556.6	4.73	123,000			
0612.2	4.16	126,200			
0629.8	3.56	130,000			
0648.4	3.3	132,000			
0719.1	3.03	134,200			
0905	3.03	134,200			
1043	2.16	143,000			
1200	2.16	143,000			

R-1866

Flight 1173
Upper Air Data for 0000Z 30 July

Standard Levels

Pressure (MB)	T, °C	Wind	Knots
1000	+14	70°	4
850	+ 2	340°	13
700	- 2	320°	8
500	-12	280°	33
400	-27	270°	48
300	-44	280°	65
250	-53	280°	65
200	-49	280°	50
150	-48	290°	31
100	-46	290°	12
70	-46	350°	6
50	-45	70°	1
30	-44	80°	12
20	-40	70°	16

Significant Levels

		Wind Data Thousands of feet	Direction	Knots
1008	+15			
815	0	1	50°	6
752	0	5	340°	13
620	- 8	10	320°	18
584	- 9	16	280°	32
527	-13	20	270°	30
325	-40	25	270°	48
237	-56	30	270°	63
209	-57	35	280°	61
204	-50	40	280°	44
40	-45	45	290°	31
25	-44	50	290°	22
13	-32	60	330°	7
		70	70°	1
		80	90°	12
		90	80°	17
		100	120°	21

1174 - FLIGHT DESCRIPTION

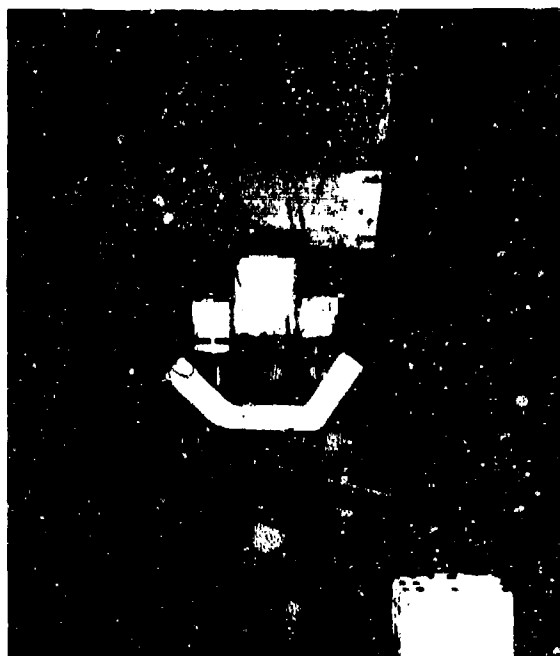
Flight 1174 was launched for the University of Maryland on 0916Z on 30 July 1966; the second of two flights that evening. The operation was directed by F. Vandersnick and M. Fulkerson in a 20 Deg cross wind at launch.

Dr. Earl's equipment consisted of a Geiger tube hodoscope to measure flux and directionability of cosmic ray electrons, protons, and alpha particles. All data was telemetered to a GMD-1 on 1690 MHz. A "hitch-hike" package was also flown underneath the main gondola by Dr. Kim from the University of Calgary, Canada.

The standard instrument package was flown and operated normally. No problems were encountered although the flight may not be considered a total success since it is believed that the scientific gondola malfunctioned to some degree.

Ballasting performed as designed as well as tracking. No photobarograph was flown because of the relatively low float altitude of this balloon. Termination was accomplished by radio command at 2330Z from the Cessna 206 after a 14.3 hour flight.

Transmitter frequency and command channels used were:



University of Maryland payload on launch truck with University of Saskatchewan oriented emulsion stack on wheeled cart in foreground.

R-1866

RAVEN[®]

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1174 - Flight Description (cont)

Transmitter Frequency: 253.1 MHz

Command Channel:	Cutdown	2
	Ballast	11
	Private Line	2

R-1866

RAVEN[®]
industries, inc.

LAUNCH LOG, SKYHOOK FLIGHT 1174

University of Maryland (Earl)
Balloon: One million cubic foot Stratofilm
all times in CDT 30 July 1966

0000 Winds at DOT hanger 180°, 10 mph.
0100 Winds 180°, 8 mph.
0130 Winds 170°, 8 mph. Crew called.
0200 Maryland load arrived in hanger. Winds 190-200°, 8-9 mph.
0215 Raven crew in hanger.
0230 NOTAM activated for launch at 0415. Winds 190° 9 mph.
0250 Gondola ready to hang from launch truck.
0300 DOT winds 190° 9-10 mph. Advance party left hanger for launch site.
0307 Launch vehicle with gondola left hanger.
0331 Launch vehicle with gondola arrived at launch site. Wind on mast in launch area indicated 180°, 6 knots.
0335 Balloon laid out, per pibal, from 200°.
0352 Equipment checked out, inflation commenced. One tube used; bottles drained. No sun on bubble during inflation. Patches observed in crown of balloon.
0355 Bubble up. Wind on mast in launch area 170°, 2 knots.
0416 Launch. Smooth and easy. A short truck run with the main load; T. Pappas hand launched Dr. Kim's hitch-hike. Cross wind of 20° at bubble height. Wind on mast in launch area indicating 170°, 3 knots.
0400 DOT weather: SLP 1009.3; Broken clouds at 6000 feet; Wind south 7 mph; Temperature 48°F.

Range Test Number: 135.6 SB165-A 2L

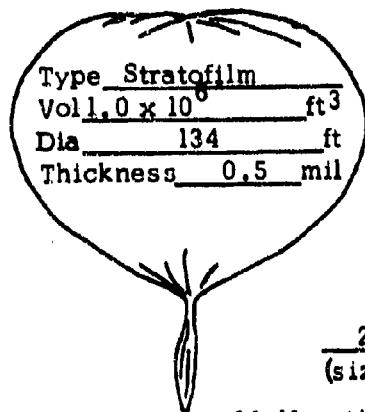
Tropopause at 1200Z, 30 July: -54°C at 231 Mb (36,001 ft.).

R-1866
SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 8-66)

RAVEN[®]
industries, inc.

1. Company Raven Flight Number 1174-N Director Vandersnick, Fulkerson
2. Scientist Earl Group Univ of Maryland Date/Time 7/30 / 0916 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 60 @ 48°F, 7 MPH 1009.3 MB Cross Wind Angle 20°
(Sky-Temp-Wind-Pressure)
Trop(Coldest)Ht. 36001 ft Temp -56 °C Inflation Start 0852 Z
Hrs Sunshine on Bubble None Train Length(Layout) 230 ft.
5. Balloon Theoretical 6.31 Mbs 116,000 ft. How Determined?
Ceiling: Actual 6.25 Mbs 116,200 ft. Radar-1200Z
6. Ascent: Surface to Trop. 828 fpm Trop. to Ceiling 646 fpm.
7. Flight Duration: Total 14 hrs 15 min. At Ceiling 11 hrs. 31 min.
8. Termination: Time 2331 Z Altitude 115,200 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 8/1 / 0008 Z Location 59° 33' N 100° 47' W
11. Frequency used:

(Kcs, Mcs)	Purpose	Total Time
<u>149.4</u>	<u>Communication & Cmd</u>	<u>15 hrs.</u>
<u>253.1</u>	<u>Altitude Telemetry</u>	<u>15 hrs.</u>
<u>4.015-7.456</u>	<u>Communication</u>	<u>15 hrs.</u>
12. Balloon: Code Number SF-134.6-050-NS-01 Serial Number 19



WEIGHTS

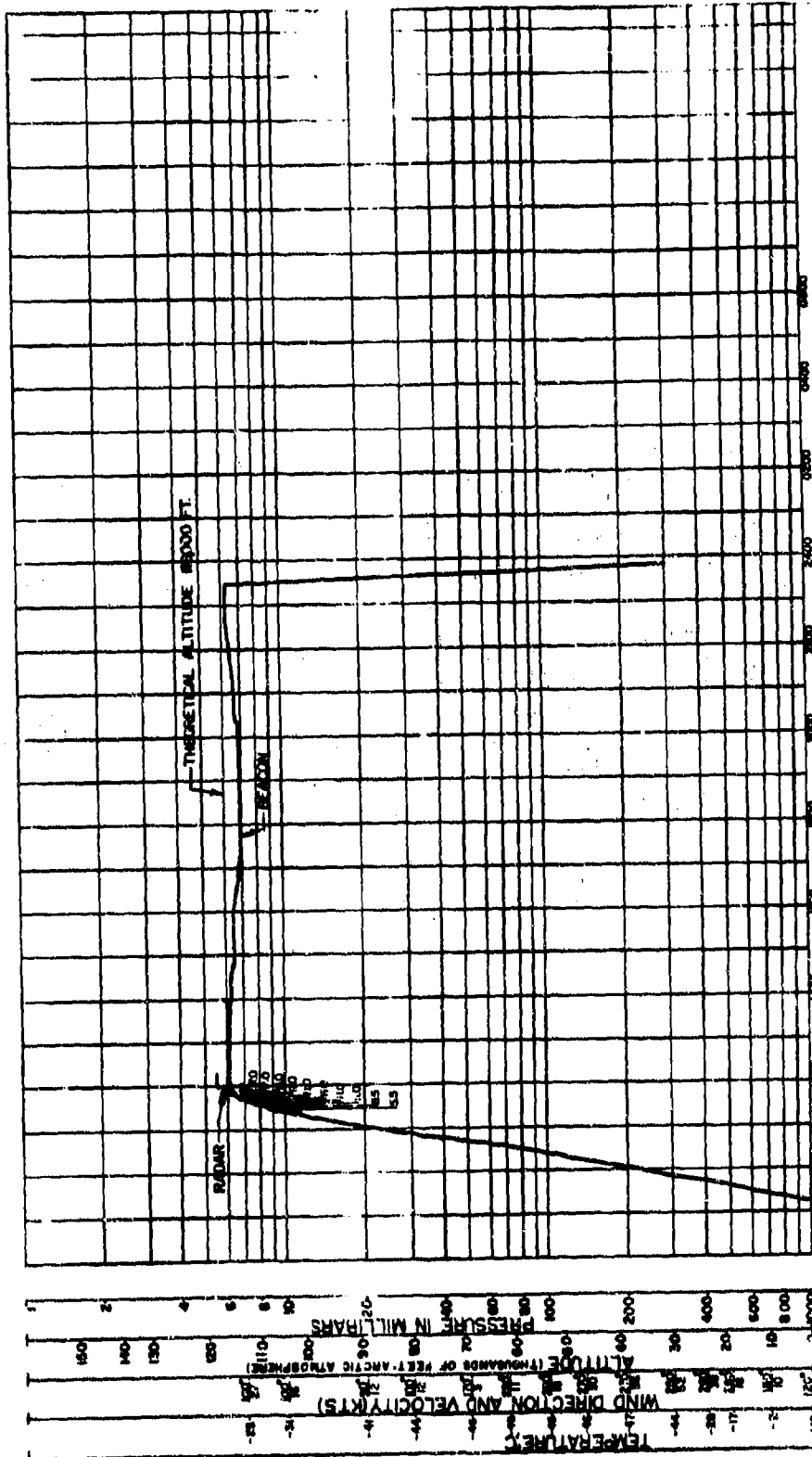
Balloon.....	<u>173.0</u>
Parachute.....	<u>19.0</u>
Instrumentation.....	<u>51.0</u>
Ballast.....	<u>100.0</u>
Scientific Package.....	<u>136.0</u>
Other..Calgary Emulsions....	<u>20.0</u>
Other..Misc.....	<u>23.0</u>
Gross Weight.....	<u>522.0</u>
Free Lift.....	<u>68.0</u>
Gross Inflation.....	<u>590.0</u>
Helium used (cu. ft.).....	<u>8408</u>

13. Flight Failures Malfunction in Univ of Maryland equipment
(Nature of flight failures - if any)
14. Comments None
(Significant factors concerning the operation)

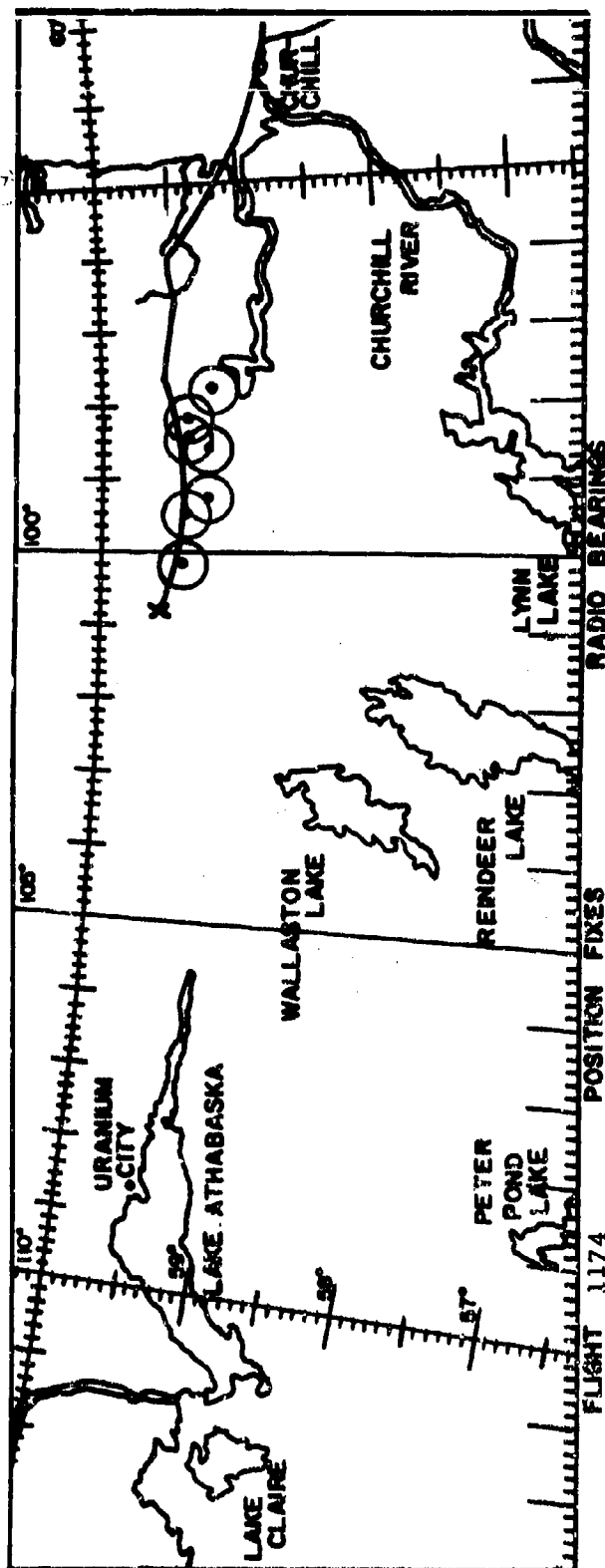
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RAVEN

Industries, Inc.



TIME		LOAD FACTORS		FLIGHT ALTITUDE	
IDENTIFICATION	BALLOON	PAYLOAD: 1560 LBS.		LAST RADAR ALTITUDE: 117900 FT.	
		GROSS LOAD: 5220 LBS.		AVERAGE (BEACON) ALTITUDE: 113500 FT.	
		BALLAST: 1000 LBS.			
		TYPE: SF-1346-050-NS-01			
		VOLUME: 10X10 ⁶ CU. FT.			
		MATERIAL: STRATOFILM			
		WEIGHT: 1730 LBS.			
FOR: UNIV. OF MARYLAND					
DATE: 30 JULY, 1966					



TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0951	58°-46'	93°-46'	GMD	1930 ²	59°-12'	98°-33'
1052	58°-46'	93°-40'	GMD	2000 ¹	59°-21'	98°-26'
1100	58°-43'	93°-05'	Radar	2030 ²	59°-21'	98°-12'
1130	58°-45'	93°-19'	Radar	2100 ²	59°-14'	99°-15'
1145	58°-46'	93°-30'	Radar	2130 ¹	59°-22'	99°-30'
1215	58°-49'	93°-45'	GMD	2200 ¹	59°-24'	99°-59'
1315	58°-56'	94°-24'	GMD	2230 ²	59°-24'	100°-08'
1415	59°-12'	95°-10'	GMD	2300 ¹	58°-12'	100°-37'
1527	59°-28'	95°-52'	C-47	2327 ¹	59°-41'	103°-35'
1622	59°-29'	96°-30'	C-47	(1) 2 Station Fix		
1715	59°-32'	97°-43'	GMD	(2) 3 Station Fix		
2333	Termination					
0008	59°-33'	100°-47'	Impact			

FLIGHT 1174. BALLASTING INFORMATION

Table I below presents Radio Controlled ballast data for Flight 1174 launched on 30 July 1966. Initial ballast on board at launch was 100 pounds. Due to a personnel error, the initial ballast was listed as 150 pounds for the telemetry operators and before the error could be corrected, all ballast was dropped by Radio Command while going to float altitude. No ballast remained for the automatic drops. Fortunately, the one million cubic foot balloon and small load prevented serious flight degradation. No other problems were experienced with the ballast system for this flight.

Table I

Time (Z)	Amount Dropped by Radio Command	Amount Remaining	
		Assumed	Actual
1131	5.5	144.5	94.5
1135	5.5	139.0	89.0
1138	11.0	128.0	78.0
1141	11.0	117.0	67.0
1144	11.0	106.0	56.0
1147	11.0	95.0	45.0
1150	11.0	84.0	34.0
1153	11.0	73.0	23.0
1156	11.0	62.0	12.0
1200	11.0	50.0	1.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

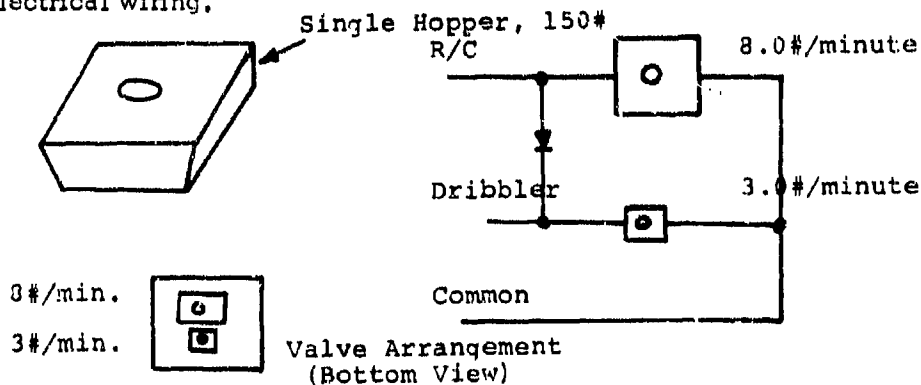


Figure 1

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1174-N

RAVEN[®]
industries, inc.

Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0916.5	-	Launch	1055	33.4	78,000
0930.0	675.0	10,800	1100	25.8	83,700
0942.8	449.0	21,000	1105	21.1	88,200
0947.2	386.0	24,600	1110	17.20	92,700
0953.9	293.0	30,800	1115	13.80	97,800
0959.0	242.0	35,000	1120	11.60	101,700
1003.4	204.0	38,700	1125	9.80	105,600
1011.6	161.0	43,900	1130	8.40	109,200
1019.9	110.0	50,200	1135	7.20	112,800
1027.1	93.0	55,700	1140	6.75	114,300
1039.4	58.5	65,800	1145	6.50	115,200
1043.2	51.0	68,900			
1045.1	46.1	71,000			
1047.4	42.0	73,000			
1049.5	38.3	75,000			
1053.1	33.3	78,100			
1057.9	27.0	82,700			
1106.5	19.3	90,100			
1110.5	16.3	94,000			
1118.4	12.0	100,900			
1124.5	9.95	105,200			
1130.2	8.60	108,700			
1135.4	7.50	111,900			
1145.5	7.00	113,500			
1152.7	6.50	115,200			
1200	6.25	116,200			
1230	6.25	116,200			
1330	6.25	116,200			
1400	6.50	115,200			
1430	6.50	115,200			
1450	6.75	114,300			
1500	6.75	114,300			
1646	7.00	113,500			
1700	7.00	113,500			
1713	7.20	112,800			
1800	7.20	112,800			
1940	7.20	112,800			
2020.0	7.20	112,800			
2125.0	7.00	113,500			
2246	6.50	115,200			
2330.8	6.50	115,200			
2331.8	8.85	108,000			
2339.0	9.30	55,800			
2349.1	304.0	30,000			

R-1866

Flight 1174
Upper Air Data for 1200Z, 30 July

Standard Levels

Pressure (MB)	T, °C	Wind	Knots
1000	+10	120°	4
850	+ 4	90°	21
700	- 2	180°	10
500	-17	260°	18
400	-28	260°	38
300	-44	250°	52
250	-51	260°	71
200	-47	270°	36
150	-46	270°	30
100	-45	290°	18
70	-45	290°	11
50	-46	170°	3
30	-44	100°	12
20	-41	90°	12
10	-31	100°	16
7	-28	100°	27

Significant Levels

1005	+ 9
985	+11
862	+ 3
842	+ 4
774	+ 1
742	0
642	- 6
569	-10
331	-40
231	-54
196	-46
40	-45
16	-39
12	-33
5	-25

Wind Data

Thousands

of feet	Direction	Knots
1	110°	13
5	90°	21
10	180°	11
16	270°	12
20	260°	21
25	270°	44
30	260°	52
35	260°	71
40	270°	32
45	270°	31
50	260°	25
60	270°	9
70	110°	5
80	100°	13
90	90°	12
100	110°	15
110	90°	21
120	100°	23
121	90°	22

R-1866

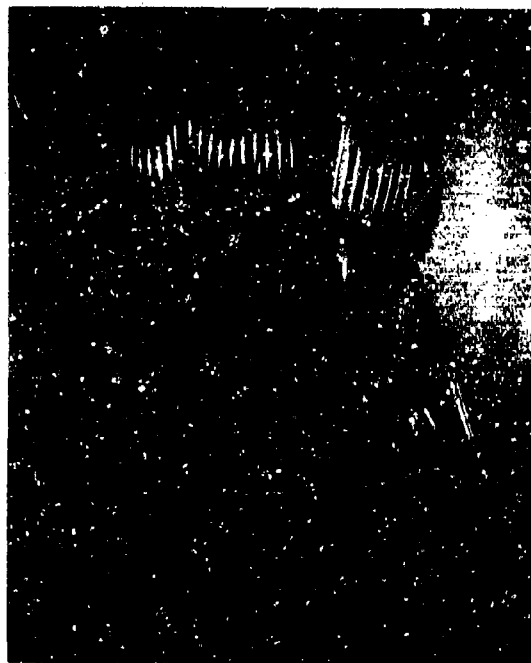
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1175 - FLIGHT DESCRIPTION

Flight 1175 for NASA-Langley and New York University was launched at 0316Z on 2 August under the direction of F. Vandersnick and M. Fulkerson. No significant cross wind was present and the launch proceeded smoothly. Radio cut-down was performed from Uranium City at 2240Z after 19.4 hours of flight time.

Scientific equipment of Dr. Foelsche and Dr. Mendel was similar to that carried on their previous flights with the primary purpose of investigating data at altitudes of importance to supersonic aircraft (70,000 feet and above).

This flight was unique in that it marked the first time that a "transponder" system was used to simultaneously talk to all ground stations using the balloon receiver and transmitter. This eliminates dependence on ground communications equipment and its inherent atmospheric problems while a balloon is in the air. A full explanation is given in Section V, Conclusions and Recommendations. Retransmission worked well to all three ground stations and, at 1550Z, a 0.75 watt Handie-Talkie was used at Fort Churchill to retransmit successfully to Uranium City and Lynn Lake! At 1630Z, the C-47 transmitted a position fix via balloon transponder when it was out of normal radio range from any station.



Inflation of a ten million cubic foot balloon.

R-1866



1175 - Flight Description (cont)

Radar tracking was not available due to a national holiday so a radiosonde transmitter was provided with battery pack to track with the GMD-1.

Radio command ballasting functioned 13 times out of 13 attempts.

Transmitter frequency and command channel utilization were:

Transmitter Frequency: 251.5 MHz

Command Channels:	Cutdown	1
	Ballast	2
	Camera	2
	(1 second delay)	
	Private Line	1 (command)
		2 (retransmit)

R-1866

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LAUNCH LOG, SKYHOOK FLIGHT 1175

NASA-Langley, NYU (Foelsche-Mendel)
Balloon: 10.6×10^6 cubic foot Stratofilm
all times in CDT 1 August 1966

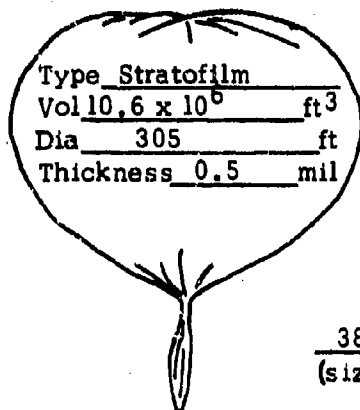
1900 Wind at DOT hanger 1 mph from N.
1930 Crew in hanger. NOTAM activated for 2200 launch.
2000 DOT wind West 1 mph.
2030 Gondola ready to hang from launch truck. Wind 300° , 4 mph.
2048 Rigging complete. Advance party left for launch area.
2108 Launch truck with payload ready to depart for launch area. Held up for aircraft traffic.
2110 Ground cloth laid out with prevailing wind and pibal in launch area, from 334° .
2125 Convoy, having held at approach to main runway, cleared to proceed.
2135 Balloon laid out.
2138 Launch truck with gondola arrived at launch area.
2145 Wind on mast anemometer reading 270° , 1 knot. Cups turning.
2150 Start of inflation. Sun below clouds in west; no sunshine on bubble.
2152 Bubble up.
2208 Inflation completed.
2216 Launch. Very light wind. Smooth launch, including second package on dolly and third package carried by G. Mancuso. No significant cross-wind.
2200 DOT weather: W 2 mph; SLP 1015.9 Mb; Temperature 58°F ; Scattered clouds at 8000 and 20,000 feet.

Range Test Number: 137.6 SB165-A IL,
Tropopause at 0000Z, 2 August: -52°C at 273 Mb (32,382 ft.).

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

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1. Company Raven Flight Number 1175-N Director Vandersnick, Fulkerson
2. Scientist Foelsche Group NASA Langley - NYU Date/Time 8/2 / 0316 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 80 Ø 200 Ø, 58°F, 2 MPH, 1015.8 MB Cross Wind Angle None
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 32382 ft Temp -52 °C Inflation Start 0250 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 480 ft.
5. Balloon Theoretical 2.17 Mbs 143,000 ft. How Determined?
 Ceiling: Actual 2.57 Mbs 137,500 ft. Barocoder
6. Ascent: Surface to Trop. 916 fpm Trop. to Ceiling 392 fpm.
7. Flight Duration: Total 19 hrs 24 min. At Ceiling 14 hrs. 33 min.
8. Termination: Time 2240 Z Altitude 137,500 ft. Cause Radio Command
9. Balloon Destruction-confirmed Unknown (visual, unknown, etc)
10. Impact: Date/Time 8/2 / 2321 Z Location 58° 03' N 110° 51' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd 20 hrs.
251.5 Altitude Telemetry 20 hrs.
4.015-7.456 Communication 20 hrs.
12. Balloon: Code Number SF-305, 86-050-NSC-04 Serial Number 38



WEIGHTS

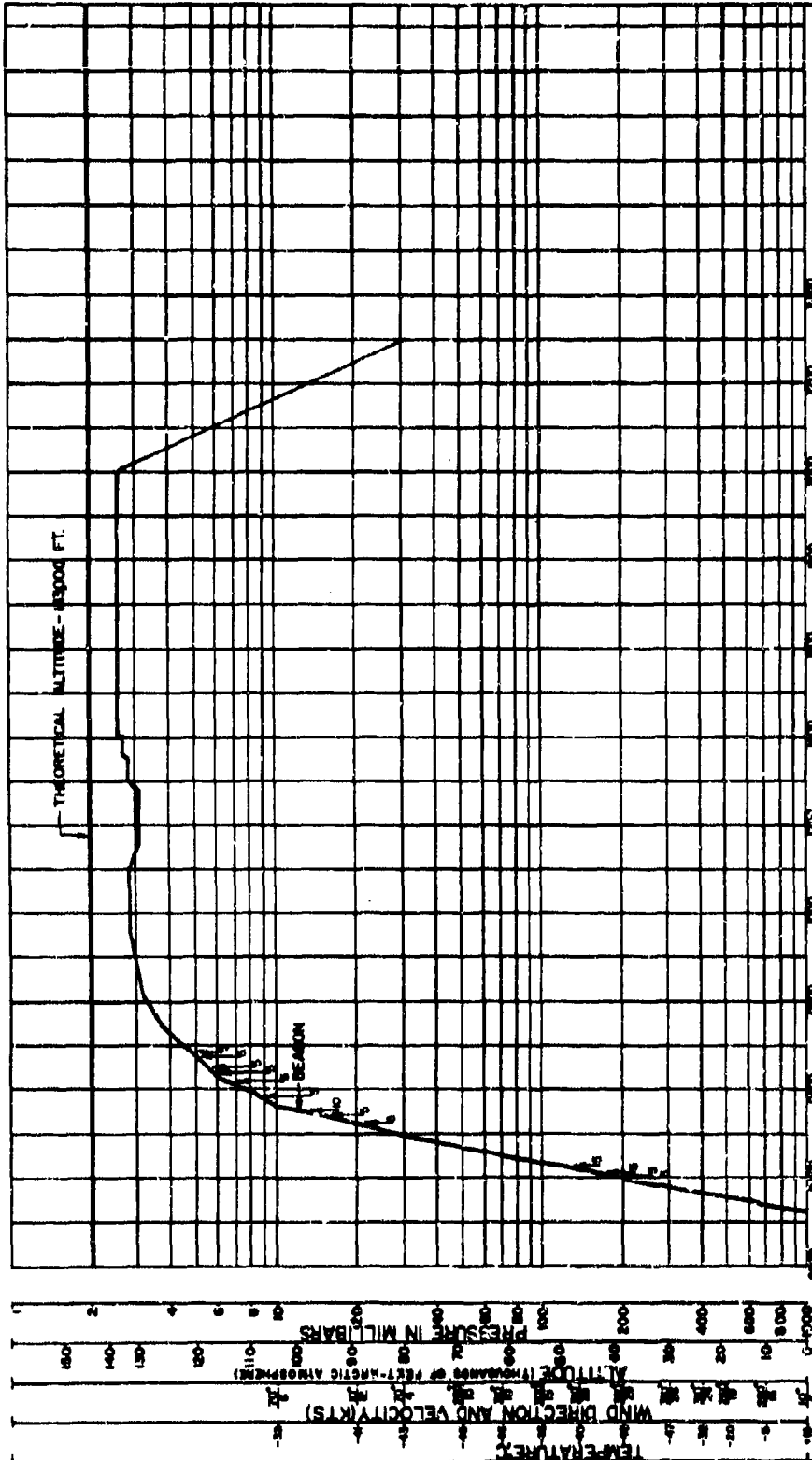
Balloon.....	950.0
Parachute.....	32.0
Instrumentation.....	52.0
Ballast.....	150.0
Scientific Package.....	94.5
Other..NYU.....	161.0
Other..Misc.....	98.0
Gross Weight.....	1537.5
Free Lift.....	153.5
Gross Inflation.....	1691.0
Helium used (cu. ft.).....	27056

13. Flight Failures None
 (Nature of flight failures - if any)
14. Comments None
 (Significant factors concerning the operation)

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TIME

IDENTIFICATION

FLIGHT NO: 1175-N

FOR: NASA LANGLEY-NJL

DATE: 2 AUG, 1966

BALLOON

TYPE: SF-305.86-050-NSC-04

VOLUME: 10.6×10^6 CU. FT.

MATERIAL: STRATOFILM

WEIGHT: 950.0 LBS.

LOAD FACTORS

PAYLOAD: 255.5 LBS.

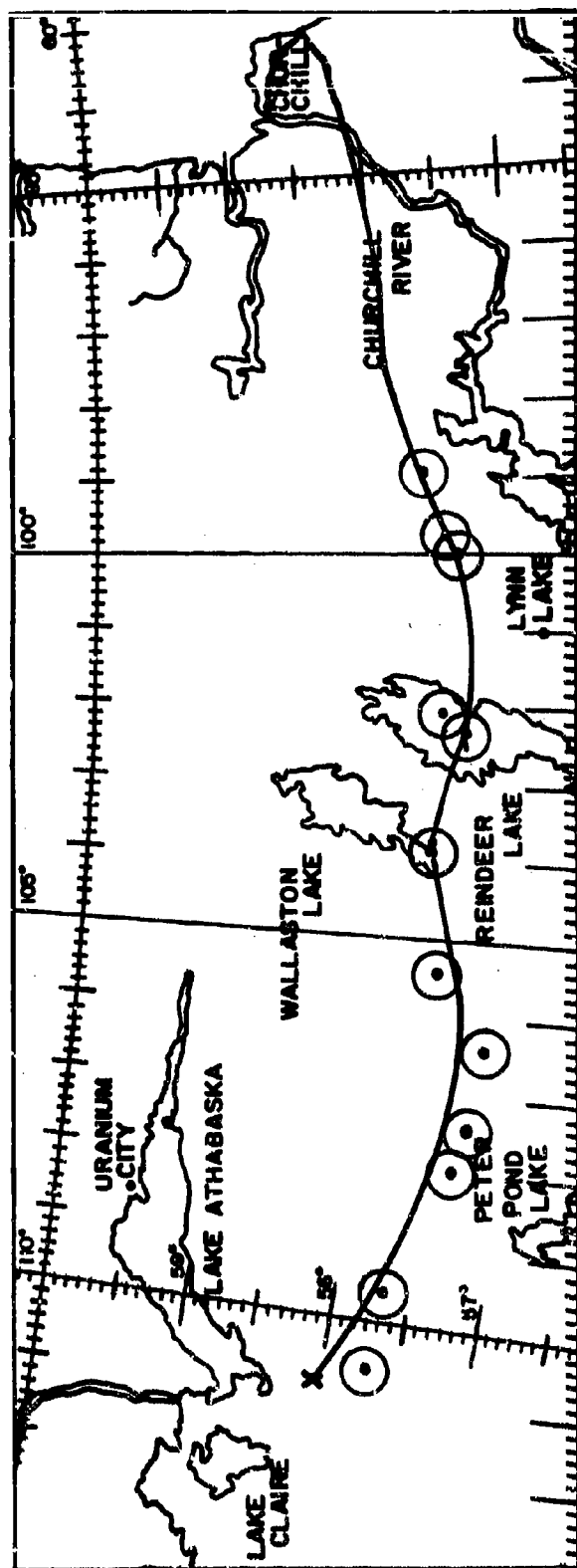
GROSS LOAD: 1537.5 LBS.

BALLAST: 1500 LBS.

FLIGHT ALTITUDE

PEAK BEACON
ALTITUDE: 137500 FT.

AVERAGE (BEACON)
ALTITUDE: 136000 FT.



TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0410	58°-32'	93°-30'	GMD	10002	58°-36'	94°-52'
0440	58°-21'	93°-11'	GMD	11002	57°-40'	98°-57'
0530	58°-15'	93°-14'	GMD	11302	57°-26'	99°-45'
0600	58°-12'	93°-32'	GMD	12002	57°-23'	100°-00'
0702	58°-08'	94°-01'	GMD	13001	57°-31'	102°-02'
0852	57°-54'	96°-30'	GMD	14002	57°-22'	102°-19'
0952	57°-54'	97°-35'	GMD	15001	57°-31'	103°-52'
1630	57°-23'	105°-25'	C-47	16002	57°-29'	105°-21'
2240	Termination			17001	57°-10'	106°-21'
2321	58°-03'	110°-51'	Impact	18302	57°-15'	107°-25'
				19002	57°-19'	108°-00'
				21001	57°-40'	109°-34'
				21301	57°-42'	110°-38'

 (1) 2 Station Fix
 (2) 3 Station Fix

FLIGHT 1175 BALLASTING INFORMATION

Table I below presents Radio Controlled ballast data for Flight 1175 launched on 2 August 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0315Z and 2000Z (termination), 80 pounds of ballast was automatically dropped at the rate of 4.7 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I

BALLAST DATA - FLIGHT 1175

Time (Z)	Amount Dropped By Radio Command	Amount Remaining (pounds)
0359	5	145.0
0401	5	140.0
0406	5	135.0
0414	5	130.0
0513	5	125.0
0527	5	120.0
0533	10	110.0
0549	5	105.0
0610	5	100.0
0624	5	95.0
0630	5	90.0
0642	5	85.0
0652	5	80.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C wiring.

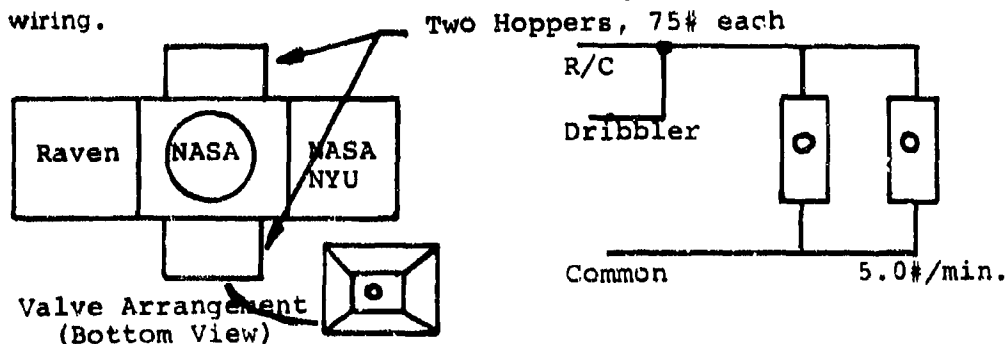


Figure 1

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1175-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0316	-	Launch	No radar available		
0321.6	828.0	5,400			
03303.3	619.0	13,000			
0335.0	526.0	17,100			
0340.0	425.0	22,300			
0348.2	312.0	29,400			
0355.3	231.0	36,000			
0402.0	192.0	40,000			
0409.7	151.0	45,200			
0416.2	120.0	50,200			
0424.1	90.5	56,400			
0445.0	46.7	70,700			
0458.8	30.2	80,200			
0512.0	20.1	88,100			
0524.9	15.8	94,700			
0535.5	12.0	100,900			
0556.2	8.35	109,300			
0615	6.35	115,900			
0726	3.99	127,200			
0807	3.65	129,500			
0940	3.30	132,000			
1030	3.30	132,000			
1100	3.30	132,000			
1140	3.65	129,500			
1200	3.65	129,500			
1247.3	3.65	129,500			
1300	3.30	132,000			
1333	3.30	132,000			
1340	3.00	134,500			
1400	3.00	134,500			
1404	2.67	137,500			
1430	2.67	137,500			
1530	2.67	137,500			
1600	2.67	137,500			
1630	2.67	137,500			
1700	2.67	137,500			
1800	2.67	137,500			
1900	2.67	137,500			
2000	2.67	137,500			
2240	2.67	137,500			
2243.7	20.5	88,800			
2258.9	31.9	79,000			



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Flight 1175
Upper Air Data for 0000g, 2 August

Standard Levels

Pressure (MB)	T, °C	Wind	Knots
1000	+15	10°	5
850	+ 6	330°	15
700	- 5	290°	16
500	-20	280°	19
400	-32	310°	24
300	-47	310°	26
250	-50	310°	37
200	-45	320°	29
150	-45	310°	25
100	-46	300°	13
70	-46	310°	10
50	-45	220°	10
30	-43	70°	4
20	-41	10°	12
10	-32	70°	6

Wind Data

Significant Levels

		Thousands of Feet	Direction	Knots
1012	+16	1	350°	7
887	+ 8	2	350°	11
670	- 4	5	330°	15
573	-19	10	290°	16
273	-52	16	290°	22
214	-46	20	280°	19
44	-47	25	310°	23
25	-45	30	310°	35
7	-29	35	310°	40
		40	310°	29
		45	310°	26
		50	300°	21
		60	280°	16
		70	130°	10
		80	60°	4
		90	20°	11
		100	100°	12
		110	80°	18
		112	90°	7

R-1866

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1176 - FLIGHT DESCRIPTION

Flight 1176, the first of two flights that evening, was launched for the University of Rochester at 0348Z on 7 August 1966. Operations were directed by G. Mancuso and M. Fulkerson. The launch was straight ahead with no cross wind.

Principal investigators for this flight were Dr. Kaplon and Dr. Deney. Scientific equipment was the same as that flown on previous flights by Rochester. Raven Industries again supplied a 10.5 kHz VCO for telemetering Rochester's pulse data. Power turn-on was accomplished by the University of Rochester pressure switch at 107,000 feet (0614Z).

All instrumentation worked well. Voice re-transmission was again used as on Flight 1175. All in all, over 140 separate transmissions were made through the system with all stations reporting excellent reception.

Tracking and ballasting performed satisfactorily. The beacon signal was picked up by Lynn Lake at 0500Z (53,500 feet) and at 1300Z for Uranium City. Signals were lost at Fort Churchill at cutdown...500 miles distant and at Uranium City when the payload was at 1000 feet and 40 miles away. Termination was commanded from Uranium City at 2238Z after an 18.9 hour flight.



DOT Hanger with C-47 tracking
aircraft in the background.

R-1866

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1176 - Flight Description (cont)

Transmitter frequency and command channels used were:

Transmitter Frequency: 255.1 MHz

Command Channels:	Cutdown	7
	Ballast	8
	Gondola Turn On	9
	Private Line	1 (command)
		2 (re-transmit)

R-1866



LAUNCH LOG, SKYHOOK FLIGHT 1176

University of Rochester (Deney)
Balloon: 10.6×10^6 cubic foot Stratofilm
all times in CDT 6 August 1966

1900 Wind at DOT hanger NE, 10 mph. Crew beginning to assemble.
2000 Wind NE 6, full crew in hanger. NOTAM activated for 2230 launch.
2140 Gondola mounted on launch truck. Advance crew left hanger for launch site.
2155 Wind NE 4, launch truck with payload left for launch area.
2215 Launch truck reached launch site. Layout commenced, per pibal.
2225 Inflation tube found stuck with Type 480 tape to adjacent gore. The hole was patched.
2230 Inflation started. No sunshine on bubble.
2245 Inflation complete.
2248 Launch. Smooth and easy, straight ahead.
2300 DOT weather: Wind N 4 mph; SLP 1024.4 Mb; Temperature 53°F , Scattered clouds.

Range Test Number: 138.6 SB165-A IL

Tropopause data at 0000Z, 7 August: -53°C at 274 Mb (32,303 ft.).

R-1866

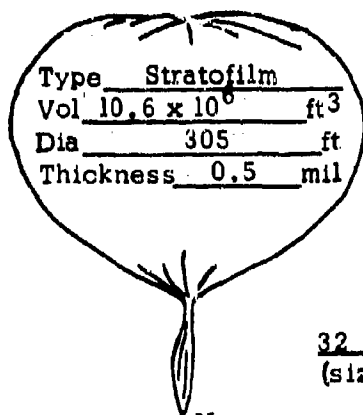
SKYHOOK BALLOON FLIGHT INFORMATION

NAVEXOS 3900/2 (Rev. 9-66)

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1. Company Raven Flight Number 1176-N Director Mancuso, Fulkerson
2. Scientist Deney Group Univ of Rochester Date/Time 8/7 / 0348 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: Clear, 52°F, 3 MPH, 1020.2 MB Cross Wind Angle None
(Sky-Temp-Wind-Pressure)
- Trop(Coldest)Ht. 34289 ft Temp -55 °C Inflation Start 0330 Z
- Hrs Sunshine on Bubble None Train Length(Layout) 480 ft.
5. Balloon Theoretical 2.13 Mbs 143,500 ft. How Determined?
Ceiling: Actual 2.30 Mbs 141,400 ft. 130,000 Photobarograph
6. Ascent: Surface to Trop. 905 fpm Trop. to Ceiling 514 fpm.
7. Flight Duration: Total 18 hrs 50 min. At Ceiling 15 hrs. 0 min.
8. Termination: Time 2238 Z Altitude 135,000ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 8/7 / 2311 Z Location 59° 13' N 107° 50' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd 19 hrs.
255.1 Altitude Telemetry 19 hrs.
4.015-7.456 Communication 19 hrs.
12. Balloon: Code Number SF-305.86-050-NSC-04 Serial Number 37



32 Ft. chute
(size)

WEIGHTS

Balloon.....	941.0
Parachute.....	25.0
Instrumentation.....	51.0
Ballast.....	150.0
Scientific Package.....	300.0
Other Photobarograph (2).....	16.0
Other Misc.....	12.0
Gross Weight.....	1495.0
Free Lift.....	150.0
Gross Inflation.....	1645.0
Helium used (cu. ft.).....	26280

13. Flight Failures None

(Nature of flight failures - if any)

14. Comments None

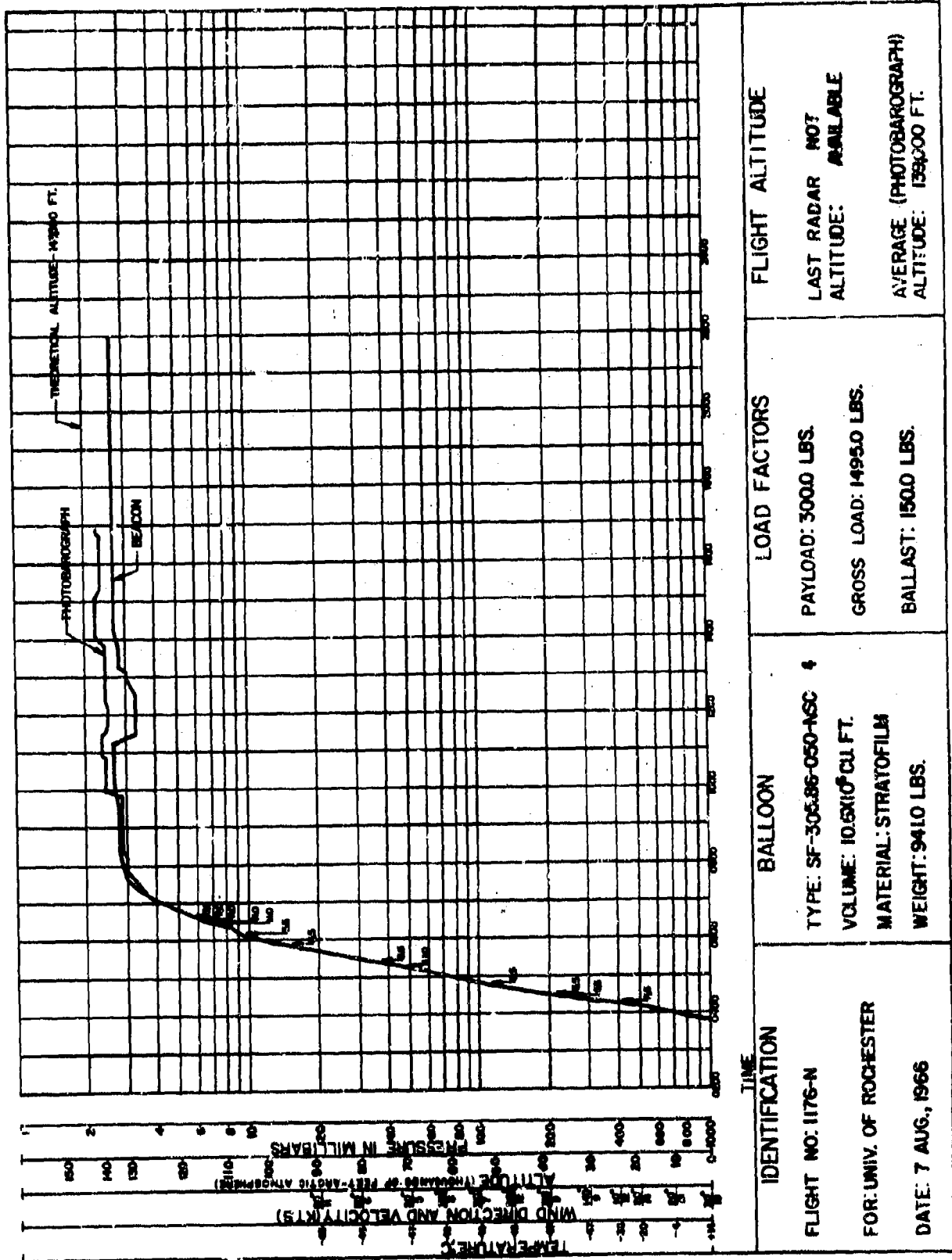
(Significant factors concerning the operation)

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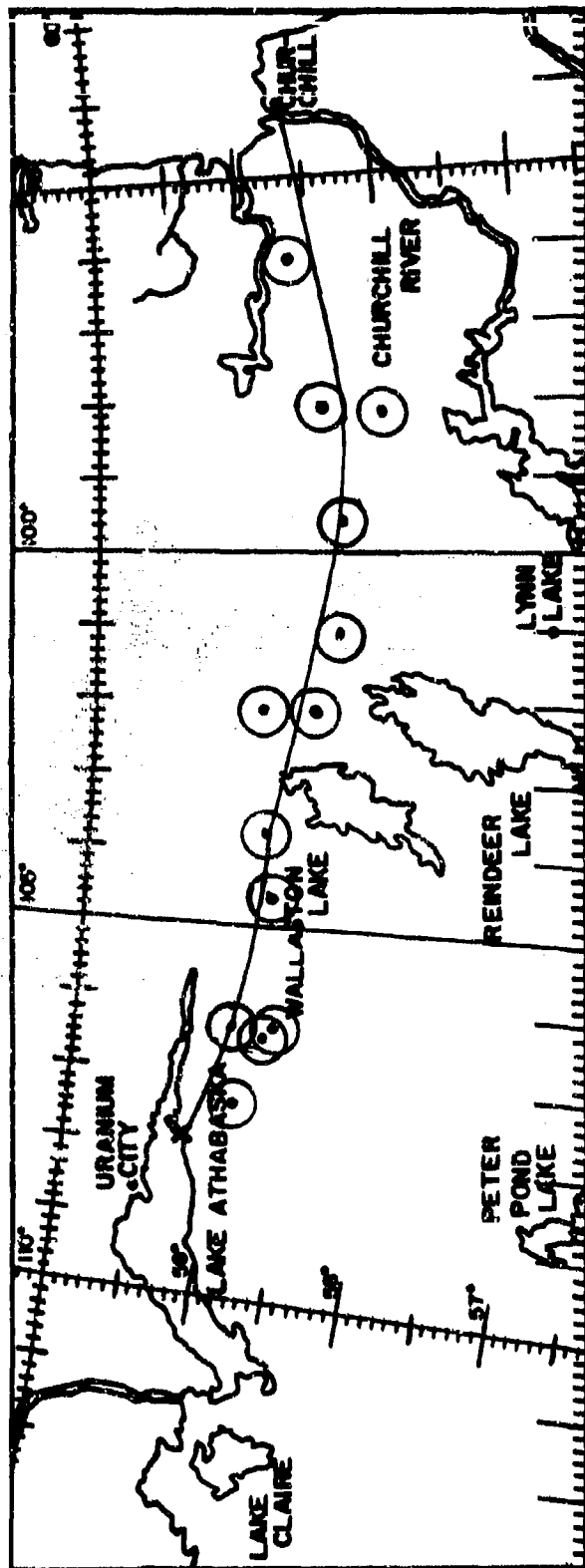
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POSITION FIXES		RADIO BEARINGS	
TIME(Z)	LATITUDE LONG.	TIME(Z)	LATITUDE LONGITUDE
1715	No Radar Available	1015	57°-59' 98°-08'
1909	58°-45' 104°-50'	1045 1	58°-36' 96°-08'
2200	58°-56' 106°-06'	1145 1	58°-25' 98°-03'
2237	59°-12' 107°-47'	1245 1	58°-16' 99°-36'
2311	Termination	1345 1	58°-19' 101°-05'
	59°-12' 107°-50'	1445 2	58°-50' 102°-06'
		1515 2	58°-28' 102°-09'
		1615 2	58°-47' 103°-44'
		1645 2	58°-43' 104°-40'
		1845 2	58°-39' 106°-18'
		1945 2	58°-57' 106°-18'
		2115 2	58°-42' 106°-27'
		2145 2	58°-54' 107°-21'
		(1) 2 Station Fix	
		(2) 3 Station Fix	

Flight 1176 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1176 launched on 7 August 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0340Z and 2238.5Z (termination), 26.6 pounds of ballast was automatically dropped at the rate of 1.4 pounds per hour. No problems were encountered with the ballast system during this flight.

Table I
Ballast Data-Flight 1176

Time	Amount Dropped by Radio Command	Amount Remaining (pounds)
0413	5.5	144.5
0429	5.5	139.0
0434	5.5	133.5
0450	5.5	128.0
0518	11.0	117.0
0527	5.5	111.5
0554	5.5	106.0
0608	5.5	100.5
0629	11.0	89.5
0632	11.0	78.5
0634	11.0	67.5
0636	11.0	56.5
0638	5.5	51.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

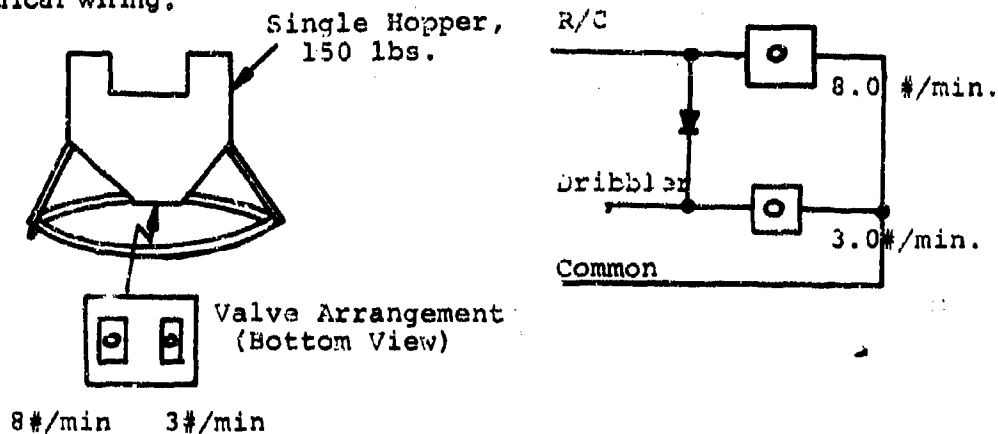


Figure 1

PHOTOBAROGRAPH DATA
 Flight 1176-N

Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0508	65.4	63.4	0648	4.82	122.5
0510.5	58.5	65.8	0650.5	4.75	122.9
0513	54.2	67.4	0653	4.65	123.4
0515.5	50.0	69.2	0655.5	4.42	124.5
0518	46.7	70.7	0658	4.35	125.0
0520.5	42.9	72.5	0700.5	4.18	126.0
0523	39.0	74.6	0703	4.15	126.2
0525.5	35.8	76.4	0705.5	4.1	126.5
0528	32.9	78.3	0708	4.1	126.5
0530.5	30.0	80.3	0710.5	4.0	127.1
0533	27.5	82.2	0713	3.9	127.8
0535.5	25.0	84.3	0715.5	3.82	128.3
0538	23.5	85.7	0718	3.75	128.8
0540.5	22.0	87.2	0720.5	3.65	129.5
0543	20.2	89.1	0723	3.57	130.0
0545.5	19.0	90.5	0725.5	3.57	130.0
0548	18.5	91.1	0728	3.48	130.7
0550.5	16.5	93.6	0730.5	3.42	131.1
0553	15.5	95.0	0733	3.3	132.0
0555.5	14.2	97.0	0735.5	3.3	132.0
0558	13.5	98.2	0738	3.2	132.8
0600.5	13.0	99.0	0740.5	3.2	132.8
0603	12.0	100.9	0743	3.1	133.6
0605.5	11.1	102.7	0745.5	3.1	133.6
0608	10.5	103.9	0748	3.0	134.5
0610.5	10.0	105.1	0750.5	3.0	134.5
0612	9.45	106.4	0753	3.0	134.5
0615.5	8.6	108.6	0755.5	3.0	134.5
0618	8.4	109.1	0803	3.0	134.5
0620.5	7.9	110.6	0808	3.0	134.5
0623	7.5	111.8	0810.5	3.0	134.5
0625.5	7.4	112.1	0813	2.9	135.3
0628	7.0	113.4	0815.5	3.0	134.5
0630.5	6.8	114.1	0818	2.9	135.3
0633	6.3	115.9	0823	2.9	135.3
0635.5	5.75	118.2	0825.5	3.0	134.5
0638	5.5	119.3	0828	2.9	135.3
0640.5	5.25	120.4	0835.5	2.9	135.3
0643	5.08	121.5	0838	3.0	134.5
0645.5	5.0	121.6	0848	3.0	134.5

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Photobarograph Data
Flight 1176-N
Page 2

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Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0855.5	3.0	134.5	1235.5	2.57	138.5
0858	2.9	135.3	1243	2.57	138.5
0900.5	3.0	134.5	1245.5	2.62	138.0
0903	2.9	135.3	1248	2.62	138.0
0905.5	2.9	135.3	1300.5	2.57	138.5
0910.5	3.0	134.5	1310.5	2.52	139.0
0913	2.9	135.3	1318	2.52	139.0
0915.5	3.0	134.5	1323	2.52	139.0
0933	3.0	134.5	1330.5	2.5	139.2
0943	3.0	134.5	1345.5	2.43	139.9
0945.5	2.9	135.3	1353	2.34	140.9
0955.5	2.95	134.9	1400.5	2.34	140.9
0958	2.73	136.9	1420.5	2.34	140.9
1000.5	2.62	138.0	1425.5	2.30	141.4
1003	2.62	138.0	1433	2.30	141.4
1005.5	2.52	139.0	1443	2.30	141.4
1008	2.62	138.0	1450.5	2.30	141.4
1013	2.52	139.0	1455.5	2.34	140.9
1020.5	2.52	139.0	1505.5	2.30	141.4
1028	2.62	138.0	1510.5	2.34	140.9
1040.5	2.62	138.0	1515.5	2.43	139.9
1050.5	2.58	138.4	1520.5	2.34	140.9
1055.5	2.52	139.0	1525.5	2.34	140.9
1108	2.62	138.0	1530.5	2.34	140.9
1110.5	2.52	139.0	1533	2.34	140.9
1118	2.52	139.0	1535.5	2.34	140.9
1125.5	2.52	139.0	1538	2.30	141.4
1128	2.52	139.0	1540.5	2.34	140.9
1130.5	2.62	138.0	1543	2.34	140.9
1135.5	2.69	137.3	1545.5	2.40	140.3
1145.5	2.69	137.3	1553	2.43	139.9
1150.5	2.72	137.0	1600.5	2.43	139.9
1200.5	2.72	137.0	1605.5	2.43	139.9
1205.5	2.72	137.0	1613	2.40	140.3
1208	2.69	137.3	1618	2.34	140.9
1215.5	2.69	137.3	1623	2.34	140.9
1218	2.62	138.0	1630.5	2.40	140.3
1223	2.69	137.3	1638	2.43	139.9
1228	2.69	137.3	1643	2.40	140.3
1230.5	2.62	138.0	1648	2.34	140.9

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1176-N

RAVEN
industries, inc.

Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0349.9	-	Launch	No radar available.		
0355.8	807.0	6,100			
0401.0	680.0	10,600			
0413.0	379.0	20,500			
0417.7	377.0	25,100			
0422.3	304.0	30,000			
0427.3	241.0	35,100			
0435.0	191.0	40,100			
0422.2	150.0	45,300			
0449.4	119.0	50,300			
0500.2	80.0	59,000			
0514.5	50.5	69,100			
0523.6	38.3	75,000			
0530.7	30.4	80,100			
0544.5	19.3	90,100			
0557.4	13.7	98,000			
0608.8	10.1	104,800			
0618.0	8.55	108,700			
0626.0	7.70	111,200			
0643.0	5.75	118,300			
0653.0	5.15	121,000			
0658.5	4.87	122,300			
0705.7	4.53	124,100			
0713.5	4.25	125,700			
0722	3.90	127,800			
0738	3.58	130,000			
0825	3.31	132,000			
0900	3.31	132,000			
0930	3.31	132,000			
1015	2.97	134,800			
1115	2.97	134,800			
1130	3.90	127,800			
1200	3.90	127,800			
1230	3.90	127,800			
1300	3.58	130,000			
1306	3.58	130,000			
1315	3.31	132,000			
1345	3.31	132,000			
1420	2.97	134,800			
1600	2.97	134,800			
1800	2.97	134,800			
2000	2.97	134,800			
2200	2.97	134,800			
2238.5		Terminate			

R-1866

RAVEN
industries, inc.

Flight 1176
Upper Air Data for 0000Z, 7 August

Standard Levels

Pressure (MB)	T, °C	Wind	Knots
1000	+14	30°	10
850	+ 5	40°	10
700	- 4	20°	18
500	-20	20°	14
400	-33	10°	12
300	-47	140°	9
250	-52	90°	6
200	-47	310°	9
150	-46	300°	12
100	-48	300°	7
70	-48	330°	8
50	-47	20°	5
30	-46	20°	6
20	-43	80°	11

Significant Levels

1022	+14
989	+14
790	+ 5
680	- 5
573	-12
264	-53
185	-46
96	-49
40	-47
13	-39
10	-34

Wind Data
Thousands
of feet

Direction	Knots
40°	10
40°	11
40°	10
20°	18
20°	13
10°	14
20°	10
140°	8
60°	6
310°	3
300°	11
320°	9
40°	7
20°	6
	calm
80°	5
100°	19

1177 - FLIGHT DESCRIPTION

The second flight during the morning of 7 August was launched at 0801Z for the Jet Propulsion Laboratory under the direction of G. Mancuso and M. Fulkerson. Dr. W. S. McDonald was principal investigator. As in the first launch, this was also smooth and easy. No cross wind was present to hamper operations. Termination came at 2313Z after a flight of 15.2 hours.

Dr. McDonald's experiment was for the purpose of determining the energy and angular distribution of energetic protons at high altitudes...including both primary protons emitted at the latitude of Fort Churchill and albedo protons resulting from the entry of more energetic cosmic rays. The instrument was a double element planar spark chamber triggered by the pulses recorded in plastic scintillator sheets mounted adjacent to the spark gaps. Spark-gap elements consisted of crossed grids or wires, each wire passing through a magnetic core which permitted an electrical readout of the spark location. Pulse height and spark location information was then recorded on an onboard tape recorder.

Raven provided its instrumentation package with the addition of circuitry to turn on the JPL tape recorder after reaching float altitude. A relay was mounted external to the JPL



Primary Launch Area, Fort Churchill



1177 - Flight Description (cont)

package to provide isolation between units. Radio command or a timer pulse five hours after launch would activate this relay which, in turn, latched a relay in the JPL gondola. An indication of this command was received as a momentary tone shift of the barocoder oscillator.

JPL turn on was accomplished by radio command at 1200Z as directed by Dr. McDonald.

Tracking information, usually relayed over the SSB communications network, was instead relayed via balloon retransmission on Flight 1176, launched four hours earlier. All communication between the C-47, Cessna 206, and Uranium City regarding both flights were monitored at Churchill.

The balloon was allowed to float to main timer termination which occurred 3.5 minutes early. Tracking and ballasting performed satisfactorily. Signals were lost at Churchill at 2322Z (54,000 feet - 330 miles); Lynn Lake at 2331Z (28,800 feet - 240 miles); Uranium City at 2334Z (21,600 feet - 210 miles).

Transmitter frequency and command channels used were:

Transmitter Frequency:	251.5 MHz	
Command Channels:	Cutdown	4
	Ballast	5
	Gondola Turn on	11
	Private Line	1 (command)
		2 (retransmit)

B-1866

RAVEN

industries, inc.

LAUNCH LOG, SKYHOOK FLIGHT 1177

Jet Propulsion Lab -- Cal. Tech. (McDonald)

Balloon: 5.25×10^6 cubic foot Stratofilm

all times in CDT 7 August 1966

0045 NOTAM activated for 0300 launch, following flight 1176. Crew in hanger.
0100 DOT wind 270° , 5 mph.
0115 JPL gondola checked out, ready to rig on launch truck.
0215 Launch truck and gondola arrived in launch area, balloon laid out, per
pibal, from 270° .
0230 Start of inflation. No sunshine on balloon.
0255 Inflation complete.
0301 Launch. Straight ahead, smooth and easy.
0300 DOT weather: Winds W 8 mph; SLP 1023.3 Mb; Scattered clouds, Temperature
 51°F .

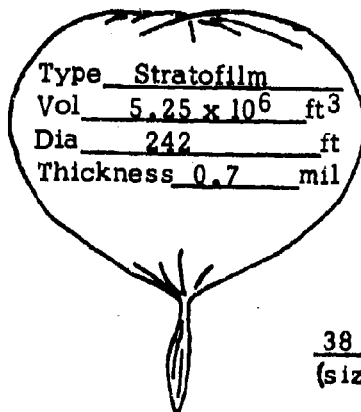
Range Test Number: 141.6 SB165-A 3L

Tropopause at 1200Z, 7 August: -57°C at 249 Mb (34,376 ft.).

R-1866
SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 8-66)

RAVEN
industries, inc.

1. Company Raven Flight Number 1177-N Director Manuelso, Fulkerson
2. Scientist McDonald Group JPL Date/Time 8/7 / 0801 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 53°F, 10 MPH 1020.4 MB Cross Wind Angle None
(Sky-Temp-Wind-Pressure)
Trop(Coldest)Ht. 34376 ft Temp -57 °C Inflation Start 0730 Z
Hrs Sunshine on Bubble None Train Length(Layout) 400 ft.
5. Balloon Theoretical 3.28 Mbs. 132,200 ft. How Determined?
Ceiling: Actual 3.31 Mbs. 132,000 ft. Theodolite-1315Z
6. Ascent: Surface to Trop. 843 fpm Trop. to Ceiling 427 fpm.
7. Flight Duration: Total 15 hrs 12 min. At Ceiling 11 hrs. 58 min.
8. Termination: Time 2313 Z Altitude 125,000 ft. Cause Timer
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 8/7 / 2349 Z Location 59° 49' N 103° 32' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd 16 hrs.
251.5 Altitude Telemetry 18 hrs.
4.015-7.456 Communication 16 hrs.
12. Balloon: Code Number SF-242.17-070-NS-03 Serial Number 27



WEIGHTS

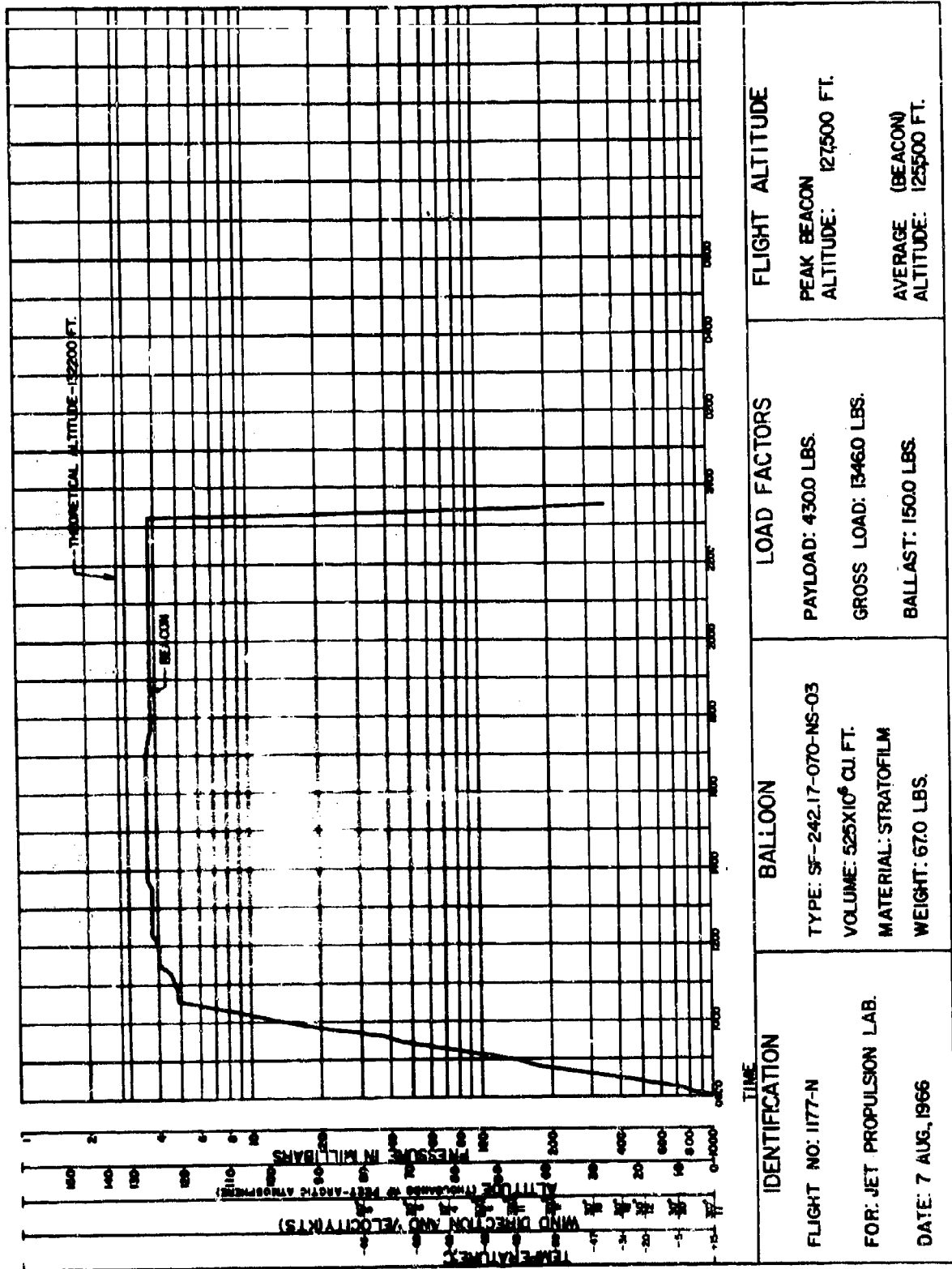
Balloon.....	671.0
Parachute.....	31.0
Instrumentation.....	52.0
Ballast.....	150.0
Scientific Package.....	430.0
Other.... B-Test Container ..	12.0
Other.....	
Gross Weight.....	1346.0
Free Lift.....	162.0
Gross Inflation.....	1508.0
Helium used (cu. ft.).....	24128

13. Flight Failures None
(Nature of flight failures - if any)
14. Comments None
(Significant factors concerning the operation)

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ONR/Code 421

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industries, inc.



IDENTIFICATION

FLIGHT NO: 1177-N

FOR: JET PROPULSION LAB.

DATE: 7 AUG, 1966

BALLOON

TYPE: SF-242.17-070-NS-03

VOLUME: 525X10⁶ CU. FT.

MATERIAL: STRATOFILM

WEIGHT: 670 LBS.

LOAD FACTORS

PAYLOAD: 4300 LBS.

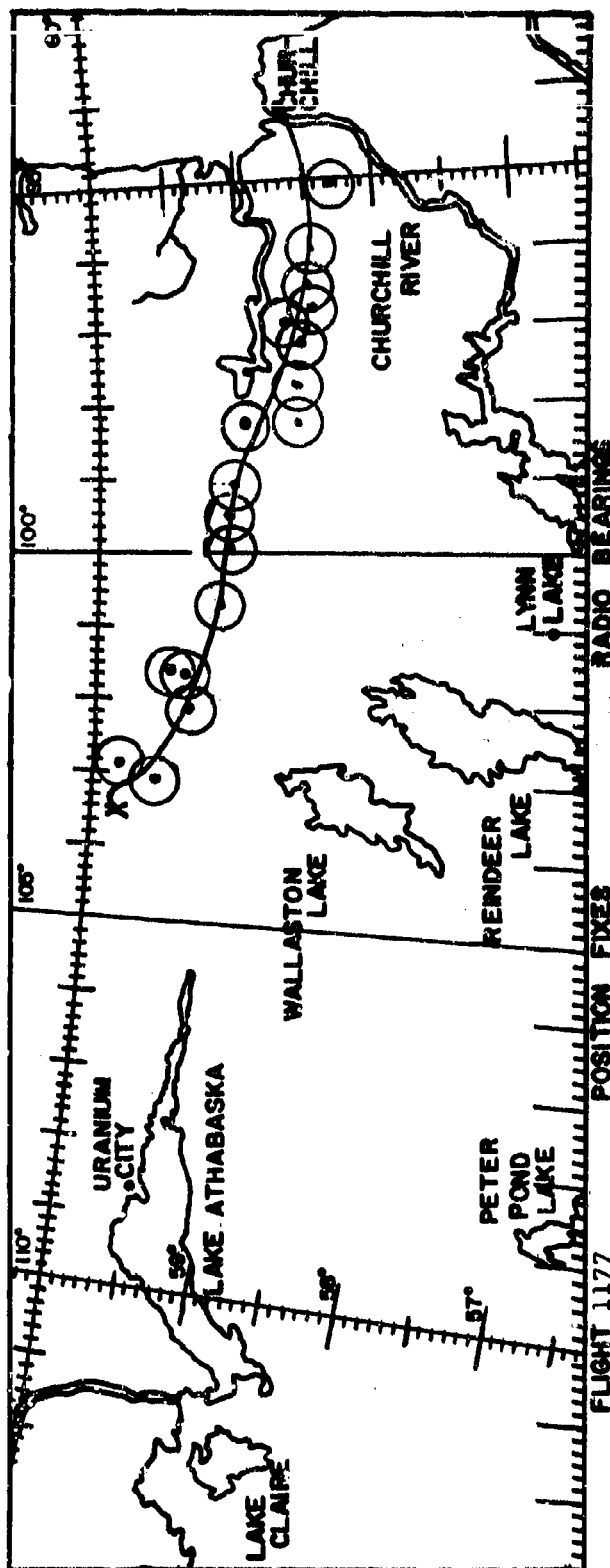
GROSS LOAD: 13460 LBS.

BALLAST: 1500 LBS.

FLIGHT ALTITUDE

PEAK BEACON ALTITUDE: 127500 FT.

AVERAGE (BEACON) ALTITUDE: 125500 FT.



TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
1145	58°-26'	95°-58'	Theodolite	10301	58°-18'	95°-03'
1215	58°-30'	96°-30'	Theodolite	12001	58°-27'	96°-43'
1250	58°-32'	97°-12'	Theodolite	13001	58°-36'	96°-54'
1315	58°-35'	97°-43'	Theodolite	14002	58°-49'	97°-00'
1345	58°-36'	98°-14'	Theodolite	14302	58°-56'	98°-13'
1530	59°-07'	99°-04'	C-47	16002	59°-04'	99°-30'
1800	59°-10'	100°-40'	C-47	17002	59°-04'	99°-58'
2252	59°-51'	103°-20'	Cessna 206	18002	59°-08'	100°-40'
2313.5	Termination			19002	59°-22'	101°-40'
2349	59°-49'	103°-32'	Impact	20002	59°-29'	101°-38'
				21002	59°-20'	102°-08'
				22002	59°-48'	102°-52'
				22301	59°-32'	103°-04'

(1) 2 Station Fix
 (2) 3 Station Fix

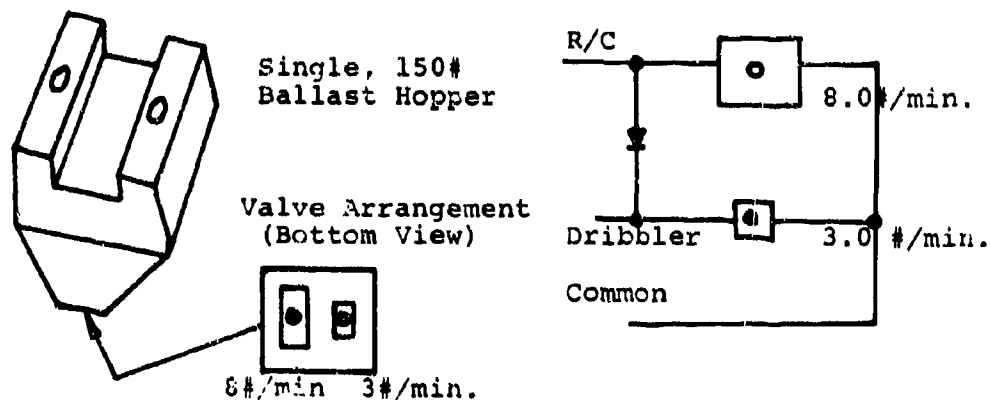
FLIGHT 1177 BALLASTING INFORMATION

Table I below presents Radio Controlled ballast data for Flight 1177 launched on 7 August 1966. Initial ballast on board at the time of launch was 150 pounds. Between 0800Z and 2313Z (termination), 21.4 pounds of ballast was automatically dropped at the rate of 1.4 pounds per hour. No problems were encountered with the ballasting system during this flight.

Table I
BALLAST DATA - FLIGHT 1177

Time (Z)	Amount Dropped By Radio Command	Amount Remaining (pounds)
0821	5.5	144.5
0824	5.5	139.0
0826	11.0	128.0
0846	11.0	117.0
0848	11.0	106.0
0853	11.0	95.0
0858	11.0	84.0
0902	11.0	73.0
1019	11.0	62.0
1023	11.0	51.0
1026	11.0	40.0
1039	11.0	29.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.


Figure 1

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1177-N

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industries, inc.

Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0801	-	Launch	No Radar Available.		
0807.5	841.0	5,000			
0821.6	556.0	15,700			
0827.5	454.0	20,700			
0834.5	340.0	27,500			
0842.5	241.0	35,000			
0852.0	185.0	40,800			
0900.5	140.0	46,900			
0905.4	115.0	51,100			
0911.6	90.5	56,300			
0915.8	76.5	60,000			
0922.0	59.5	65,500			
0928.3	47.6	70,300			
0938.0	34.6	77,200			
0944.2	27.3	82,400			
0946.8	24.6	84,700			
0952.3	20.2	89,100			
0953.9	19.0	90,500			
0956.8	17.1	92,900			
0957.7	16.4	93,800			
1000.6	14.9	96,000			
1003.7	13.3	98,600			
1017.7	8.15	109,900			
1023.0	6.85	114,000			
1026.8	6.20	116,300			
1032.2	5.25	120,500			
1048.0	5.25	120,500			
1115.0	4.60	122,300			
1130	4.58	123,800			
1200	4.58	123,800			
1214.3	4.28	125,500			
1230.0	4.28	125,500			
1300.0	4.28	125,500			
1330.0	4.28	125,500			
1345.0	3.95	127,500			
1600.0	3.95	127,500			
1700.0	3.95	127,500			
1742.0	4.28	125,500			
2100.0	4.28	125,500			
2200.0	4.28	125,500			
2300.0	4.28	125,500			
2313.0		Terminate			
2315.0	20.30	89,000			
2331.0	340.0	27,500			

R-1866

Flight 1177
Upper Air Data for 1200 Z, 7 August

<u>Standard Levels</u>			
Pressure (MB)	T, °C	Wind	Knots
1000	+15	310°	11
850	+ 6	30°	17
700	- 5	30°	20
500	-20	30°	12
400	-31	30°	18
300	-47	30°	18
250	-56	30°	14
200	-50	350°	9
150	-48	330°	11
100	-48	320°	8
70	-48	10°	4
50	-48	30°	6
30	-46	60°	5

<u>Significant Levels</u>		<u>Wind Data</u>	
		Thousands of feet	Knots
1020	+ 9	2	340° 9
1003	+16	5	30° 17
976	+14	10	30° 19
692	- 4	16	30° 16
674	- 9	20	30° 11
614	- 9	25	30° 15
560	-14	30	30° 20
513	-18	35	30° 13
344	-40	40	340° 10
249	-57	45	330° 11
232	-57	50	310° 8
209	-50	60	310° 5
126	-47	70	50° 6
40	-48	80	60° 5
24	-44	84	60° 7

R-1866

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1178 - FLIGHT DESCRIPTION

Flight 1178 for the University of Maryland was launched at 0928Z on 6 August and was the second of two flights launched that evening (1179 went first). Launch was under the direction of G. Mancuso and M. Fulkerson.

Principal investigator for this flight was Dr. Earl whose equipment was similar to that flown on earlier flights such as 1174. All data was telemetered to a GMD ground station operating at 1680 MHz.

Standard Raven Industries instrumentation was used and functioned normally. No malfunctions with it or the ballasting system were noted. Tracking was satisfactory.

Transmitter frequency and command channels used were:

Transmitter Frequency:	255.1 MHz	
Command Channel:	Cutdown	7
	Ballast	8
	Private Line	1



University of Maryland payload before launch.

R-1866

RAVEN
industries, inc.

LAUNCH LOG, SKYHOOK FLIGHT 1178

University of Maryland (Earl)
Balloon: 5.25×10^6 cubic foot Stratofilm
all times in CDT 6 August 1966

0100 DOT winds WSW 11 mph. NOTAM activated for 0400 launch. Crew in hanger.
0110 Maryland package brought to hanger for rigging on launch truck.
0120 DOT winds 260° 12-13 mph, rigging commenced.
0200 DOT winds 270° 11-14 mph.
0235 Advance crew left for launch site.
0300 Launch truck with payload enroute to launch site. DOT winds WNW, 8 mph.
0335 Balloon laid out, per pibal, from 270° . (Wind holding steady.)
0350 Inflation started. No sun on bubble.
DOT winds reported 8-10 mph.
0423 Inflation ended.
0428 Launch. Straight ahead, no difficulty.
0500 DOT weather: Temperature 50°F ; Winds, W 8 mph; SLP 1024.3 Mb; Scattered clouds.

Range Test Number: 140.6 SB165-A 2L

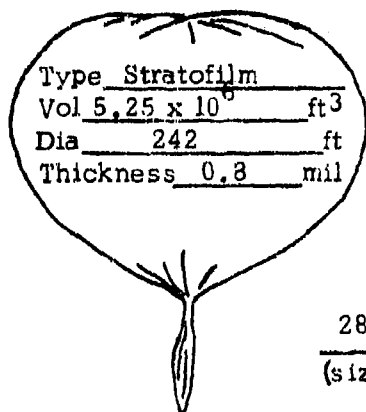
Tropopause at 12000 ft., 6 August: -54°C at 254 Mb (33,945 ft.).

R-1866
 SKYHOOK BALLOON FLIGHT INFORMATION
 NAVEXOS 3900/2 (Rev. 8-66)

RAVEN
 industries, inc.

1. Company Raven Flight Number 117C-N Director Mancuso, Fulkerson
2. Scientist Earl Group Univ of Maryland Date/Time 8/6 / 0928 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 53°F, 14 MPH, 1020.4 MB Cross Wind Angle None
 (Sky-Temp-Wind-Pressure)
 Trop (Coldest) Ht. 33945 ft Temp -54 °C Inflation Start 0850 Z
 Hrs Sunshine on Bubble None Train Length (Layout) 400 ft.
5. Balloon Theoretical 2.94 Mbs 135,000 ft. How Determined?
 Ceiling: Actual 3.49 Mbs 130,600 ft. Barocoder
6. Ascent: Surface to Trop. 855 fpm Trop. to Ceiling 806 fpm.
7. Flight Duration: Total 15 hrs 47 min. At Ceiling 13 hrs. 12 min.
8. Termination: Time 0115 Z Altitude 130,600 ft. Cause Radio Command
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 8/7 / 0152 Z Location 59° 44' N 106° 14' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time

149.4	Communication & Cmd	16 hrs.
255.1	Altitude Telemetry	16 hrs.
4.015-7.456	Communication	16 hrs.
12. Balloon: Code Number SF-242, 17-080-NS-01 Serial Number 29



WEIGHTS

Balloon.....	760.0
Parachute.....	21.0
Instrumentation.....	52.0
Ballast.....	155.0
Scientific Package.....	113.0
Other. Flight Frame.....	21.5
Other....Crush Pad.....	8.5
Gross Weight.....	1131.0
Free Lift.....	113.0
Gross Inflation.....	1244.0
Helium used (cu. ft.).....	19904

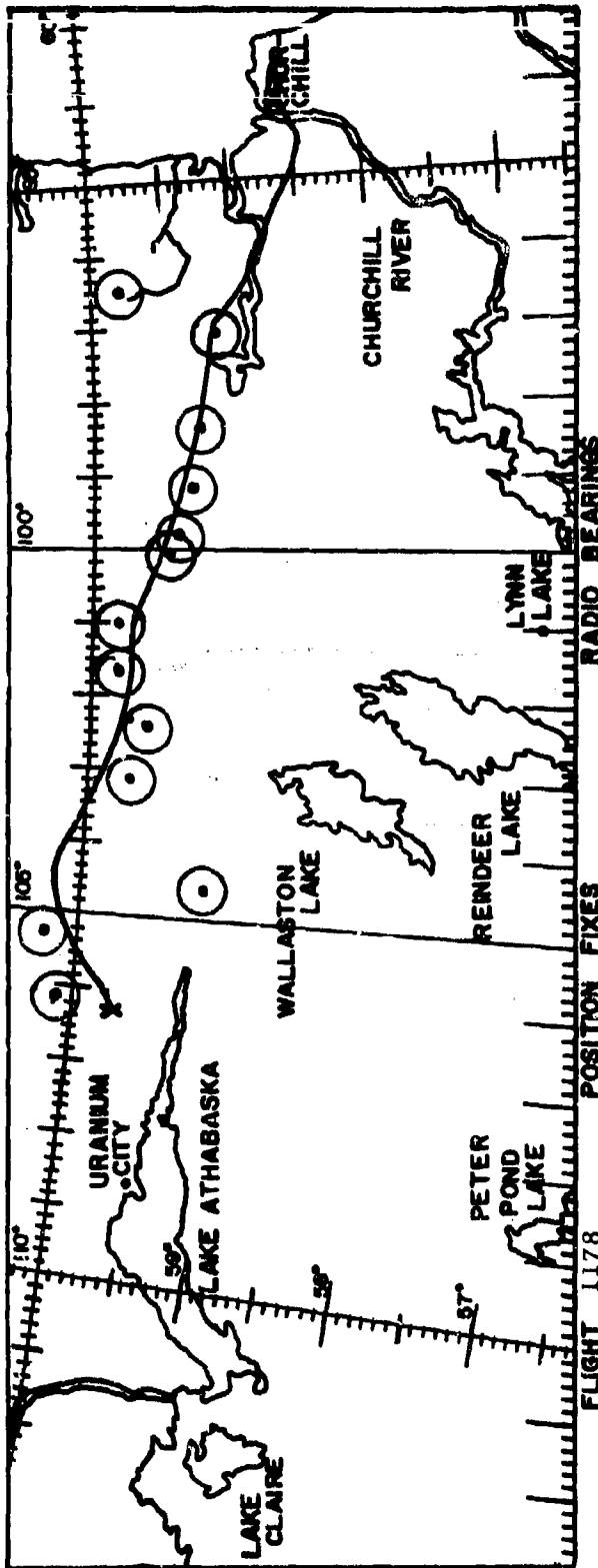
13. Flight Failures None
 (Nature of flight failures - if any)
14. Comments None
 (Significant factors concerning the operation)

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IDENTIFICATION	BALLOON	LOAD FACTORS	FLIGHT ALTITUDE
FLIGHT NO: 1178-N	TYPE: SF-242.17-080-NS-01	PAYLOAD: 1130 LBS.	PEAK BEACON ALTITUDE: 130600 FT.
FOR: UNIV. OF MARYLAND	VOLUME: 525X10 ⁵ CU. FT.	GROSS LOAD: 11310 LBS.	
DATE: 6 AUGUST, 1966	MATERIAL: STRATOFILM	BALLAST: 1550 LBS.	AVERAGE (BEACON) ALTITUDE: 128600 FT.
	WEIGHT: 760.0 LBS.		



TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
1050	58°-33'	93°-39'	GMD	13301	59°-50'	96°-31'
1133	58°-35'	93°-56'	GMD	14301	59°-06'	97°-02'
1207	58°-27'	94°-30'	GMD	16002	59°-15'	98°-20'
1245	58°-36'	95°-12'	GMD	17002	59°-18'	99°-10'
1320	58°-45'	95°-59'	GMD	18002	59°-23'	99°-49'
1455	59°-09'	96°-54'	GMD	18302	59°-26'	100°-02'
1615	59°-44'	101°-27'	GMD	19201	59°-50'	101°-00'
2223	60°-12'	104°-20'	Cessna 206	20302	59°-48'	101°-40'
0058	59°-50'	105°-58'	Cessna 206	21002	59°-36'	102°-25'
0115	Termination			21302	59°-42'	103°-08'
0152	59°-44'	106°-14'	Impact	23002	59°-07'	104°-38'
				00002	60°-16'	105°-16'
				00301	60°-07'	106°-06'

(1) 2 Station Fix
 (2) 3 Station Fix

Flight 1178 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1178 launched on 6 August 1966. Initial ballast on board at the time of launch was 155 pounds. Between 0900Z and 0115Z (termination), 25.5 pounds of ballast was automatically dropped at the rate of 1.5 pounds per hour. No problems were encountered with the ballasting system during this flight.

Table I
Ballast Data - Flight 1178

Time	Amount Dropped by Radio Command	Amount Remaining (pounds)
1012	5.5	149.5
1014	5.5	144.0
1017	5.5	138.5
1022	5.5	133.0
1146	5.5	127.5
1147	5.5	122.0
1150	5.5	116.5
1151	5.5	111.0
1154	5.5	105.5
1155	5.5	100.0
1159	11.0	89.0
1207	5.5	83.5
1208	5.5	78.0
1212	5.5	72.5
1213	5.5	67.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

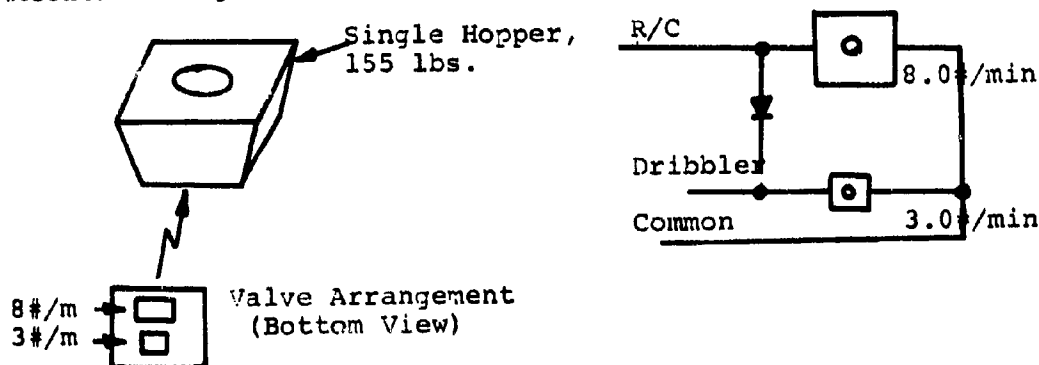


Figure 1

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1178-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0928.5	-	Launch	No Radar Available.		
0935.6	825.0	5,500			
0948.1	563.0	15,400			
0954.5	454.0	20,700			
0959.8	377.0	25,100			
1005.1	300.0	30,300			
1011.0	238.0	35,400			
1019.1	185.0	40,800			
1023.5	159.0	44,100			
1039.9	82.5	58,400			
1050.1	53.0	68,000			
1101.5	32.2	78,800			
1108.4	23.8	85,500			
1114.0	19.0	90,500			
1115.2	18.3	91,400			
1116.2	17.5	92,300			
1117.3	16.7	93,400			
1119.7	15.2	95,600			
1120.9	14.4	96,800			
1122.1	13.6	98,100			
1123.8	12.8	99,400			
1126.8	11.7	101,600			
1128.3	10.9	103,100			
1130.3	10.1	104,800			
1132.6	9.40	106,600			
1134.8	8.60	108,600			
1141.6	7.15	113,000			
1144.4	6.35	115,800			
1147.0	5.95	117,500			
1149.7	5.60	118,800			
1152.6	5.25	120,400			
1156.4	4.89	122,200			
1159.1	4.51	124,200			
1203	4.11	126,500			
1330	3.78	128,600			
1421	3.49	130,600			
1900	3.49	130,600			
1905	3.78	128,600			
2230	3.78	128,600			
2245	3.49	130,600			
0000	3.49	130,600			
0100	3.49	130,600			
0115.0		Terminate			
0116.5	5.60	118,800			

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Flight 1178
Upper Air Data for 1200Z, 6 August

Standard Levels

Pressure (MB)	T, °C	Wind	Knots
1000	+13	300°	14
850	+ 5	20°	15
700	- 3	20°	17
500	-21	350°	15
400	-32	20°	12
300	-47	280°	5
250	-53	290°	7
200	-46	310°	12
150	-45	320°	16
100	-48	310°	10
70	-48	340°	9
50	-48	40°	5
30	-45	50°	8
20	-42	90°	15
10	-37	90°	15

Significant Levels

		Thousands of Feet	Direction	Knots
1021	+ 9	1	310°	15
1008	+13	2	350°	13
938	+12	5	20°	15
873	+ 6	10	20°	18
769	0	16	360°	13
758	0	20	360°	16
751	0	25	10°	8
590	-11	30	290°	6
502	-21	35	310°	7
254	-54	40	300°	14
218	-47	45	320°	16
181	-45	50	310°	11
47	-49	60	330°	9
18	-42	70	50°	5
8	-35	80	60°	8
		90	90°	15
		100	90°	13
		106	90°	16

1179 - FLIGHT DESCRIPTION

The last flight of the season was launched for NASA-Langley and New York University at 0404Z on 6 August under the direction of G. Mancuso and F. Vandersnick. The technique used for their earlier flights was repeated; main gondola on the launch truck, second package on a cart, and the third hand-held. Lay-out and launch were performed without difficulty. Termination occurred at 2325Z after 19.4 hours by main timer activation (2.5 minutes early).

Dr. Foelsche's and Dr. Mendel's equipment consisted of three units designed to collect data at various altitudes to provide an altitude profile in a region of importance to supersonic transport aircraft.

Radio command ballast was successful five times out of five attempts. All command ballast was dropped after termination in order to allow a slower parachute descent.

Standard instruments were provided in addition to a radiosonde and dry battery pack for use in tracking with the GMD-1 ground station. The capability was present to drop the entire radiosonde transmitter in the event that the frequency of this unit drifted over to the frequency being used by the University of Maryland's telemetry (Flight 1178).



Raven helicopter bringing payload to rendezvous
with float planes in wilderness area.

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1179 - Flight Description (cont)

Transmitter frequency and command channels used were:

Transmitter Frequency:	253.1 MHz	
Command Channels:	Cutdown	1
	Ballast	2
	Radiosonde Drop	10
	Private Line	2

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LAUNCH LOG, SKYHOOK FLIGHT 1179

NASA-Langley, NYU (Foelsche-Mendel)
Balloon: 325,000 cubic foot Stratofilm
all times in CDT 5 August 1966

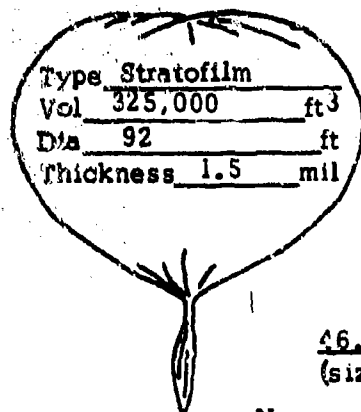
2030 Crew call, NOTAM activated for 2230.
2045 Crew in hanger, ready to put payload on launch truck.
2100 DOT winds ENE 3 mph.
2125 Payload ready for weighing and rigging.
2145 Advance crew left hanger for load site.
2200 Rigging complete, launch truck with gondola ready to move to launch site.
2220 Launch truck and gondola arrived at launch site, after hold for incoming aircraft. Balloon already laid out, per pibal. Winds on anemometer mast indicating 140°, 4 mph.
2225 Inflation started. No sunshine on bubble.
2255 Inflation finished.
2304 Launch. Virtually no wind Easy launch. Truck held for balloon to rise. Second and third packages launched (from dolly and hand-held) all without difficulty.
2300 DOT weather: Winds SSW, 1 mph; Temperature 52°F; SLP 1024.2 Mb. Clear skies.

Range Test Number: 139.6 SB165-A 2L.
Tropopause at 0000Z, 6 August: -55°C at 250 Mb (34,289 ft.).

R-1866
SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 8-66)

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1. Company Raven Flight Number 1179-N Director Mancuso, Vandersnick
2. Scientist Foelsche Group NASA Langley-NIU Date/Time 8/6 / 0404 Z
3. Launch: Site Ft. Churchill Technique/Launch Veh. M-36 Truck
4. Wx: 51°F, 5 MPH, 1019.0 MB Cross Wind Angle None
(Sky-Temp-Wind-Pressure)
Trop (Coldest) Ht. 34289 ft Temp -55°C Inflation Start 0325 Z
Hrs Sunshine on Bubble None Train Length (Layout) 175 ft.
5. Balloon Theoretical 38.3 Mbs 75,000 ft. How Determined?
Ceiling: Actual 35.6 Mbs 76,600 ft. Radar-1830Z
6. Ascent: Surface to Trop. 1110 fpm Trop. to Ceiling 1085 fpm.
7. Flight Duration: Total 19 hrs 21 min. At Ceiling 15 hrs 13 min.
8. Termination: Time 2325 Z Altitude 77,000 ft. Cause Timer
9. Balloon Destruction-confirmed Visual (visual, unknown, etc)
10. Impact: Date/Time 8/7 / 0009 Z Location 57° 35' N 97° 27' W
11. Frequency used: (Kcs, Mcs) Purpose Total Time
149.4 Communication & Cmd 20 hrs.
253.1 Altitude Telemetry 20 hrs.
4.015-7.456 Communication 20 hrs.
12. Balloon: Code Number SF-92.5-150-NS-02 Serial Number 170



WEIGHTS

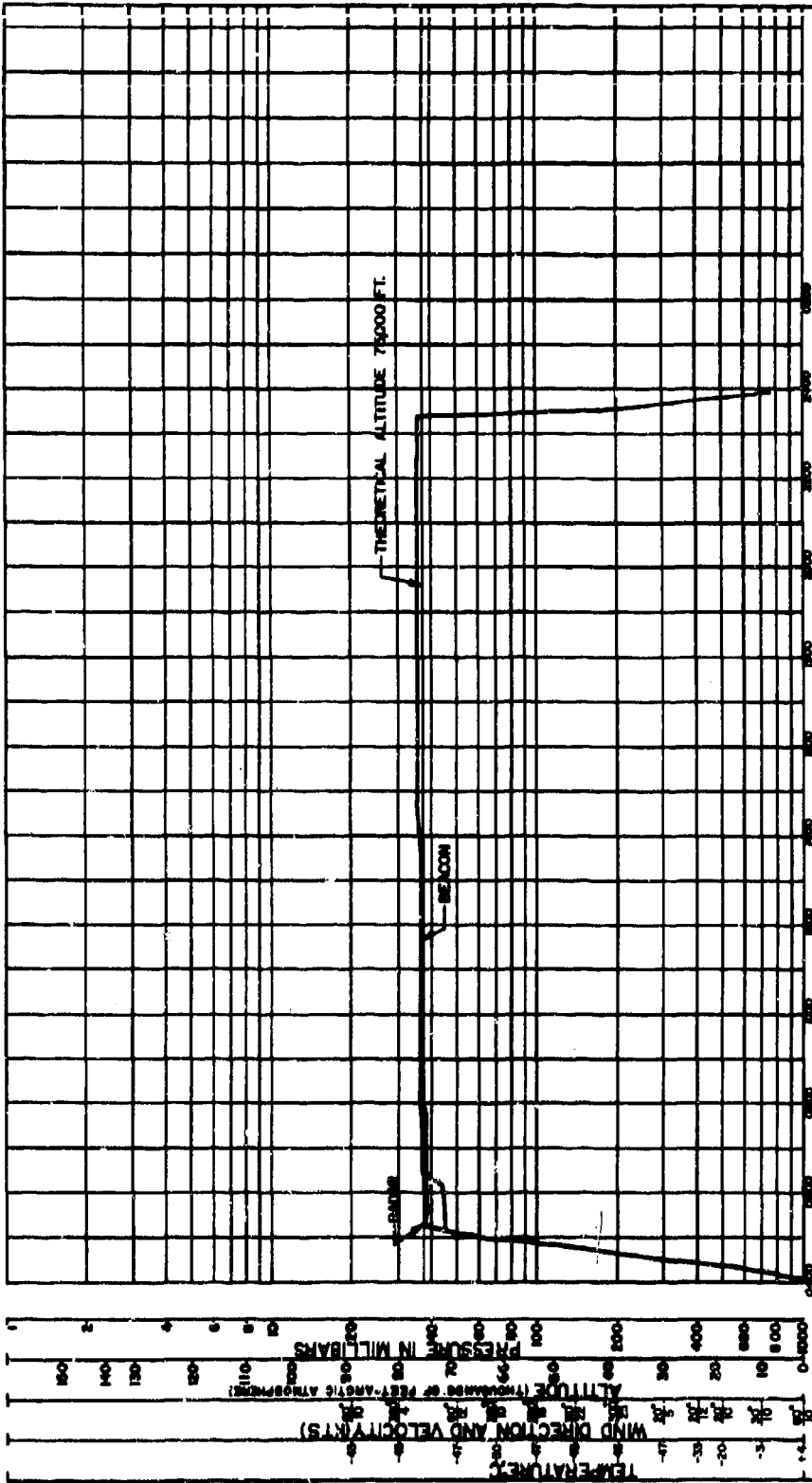
Balloon.....	<u>224.0</u>
Parachute.....	<u>38.0</u>
Instrumentation.....	<u>52.0</u>
Ballast.....	<u>300.0</u>
Scientific Package.....	<u>168.0</u>
Other... Misc.....	<u>80.0</u>
Other... Crush Pad-Dead Wt..	<u>178.5</u>
Gross Weight.....	<u>1040.5</u>
Free Lift.....	<u>187.5</u>
Gross Inflation.....	<u>1228.0</u>
Helium used (cu. ft.).....	<u>19632</u>

13. Flight Failures None
(Nature of flight failures - if any)
14. Comments None
(Significant factors concerning the operation)

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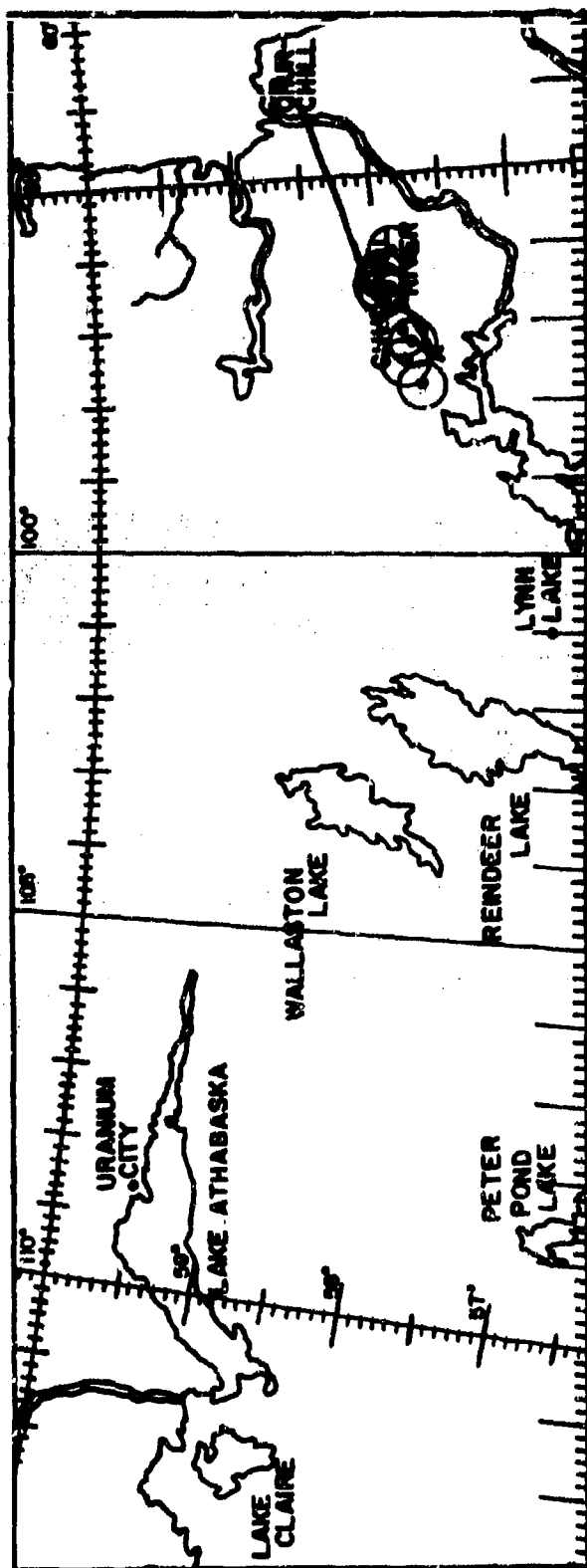


IDENTIFICATION	BALLOON	LOAD FACTORS	FLIGHT ALTITUDE
FLIGHT NO: 1179-N FOR: NASA LANGLEY-NYU DATE: 6 AUGUST, 1966	TYPE: SF-925-150-NS-02 VOLUME: 325000 CU.FT. MATERIAL: STRATOFILM WEIGHT: 2240 LBS.	PAYLOAD: 1680 LBS. GROSS LOAD: 10405 LBS. BALLAST: 3000 LBS.	LAST RADAR ALTITUDE: 76300 FT. AVERAGE (BEACON) ALTITUDE: 76000 FT.

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TIME(Z)	LATITUDE	LONG.	OBTAINED BY	TIME(Z)	LATITUDE	LONGITUDE
0445	58°-39'	93°-49'	GMD	1330	57°-59'	96°-20'
0515	58°-34'	93°-50'	Radar	1400	57°-57'	96°-09'
0540	58°-32'	93°-52'	Radar	1430	57°-55'	96°-21'
0610	58°-31'	93°-55'	Radar	1500	57°-44'	97°-13'
0640	58°-28'	93°-57'	Radar	1600	57°-55'	96°-31'
0700	58°-26'	94°-00'	Radar	1630	57°-57'	96°-45'
0800	58°-24'	94°-02'	GMD	1700	57°-48'	97°-27'
1000	56°-22'	94°-33'	GMD	1730	57°-54'	95°-55'
1400	57°-56'	96°-49'	GMD	1800	57°-40'	97°-48'
1700	57°-54'	96°-29'	GMD	2000	57°-48'	97°-27'
1945	57°-55'	96°-41'	Cessna 185	2030	57°-57'	96°-40'
2140	57°-43'	96°-53'	Cessna 185	2100	57°-56'	96°-34'
2325	Termination			2130	57°-49'	97°-05'
0009	57°-35'	97°-27'	Impact			

(1) 2 Station Fix
(2) 3 Station Fix

Flight 1179 Ballasting Information

Table I below presents Radio Controlled ballast data for Flight 1179 launched on 6 August 1966. Initial ballast on board at the time of launch was 300 pounds. Between 0340Z and 2325Z (termination), 92 pounds of ballast was automatically dropped at the rate of pounds per hours. No Radio Command ballast drops were needed during ascent or float. Table I ballasting occurred after termination to reduce the parachute descent rate. The dribbling left 208 pounds for these commands. No problems were encountered with the ballast system during this flight.

Table I
Ballast Data-Flight 1179

Time	Amount Dropped by Radio Command	Amount Remaining (pounds)
2329.5	52	156.0
2332	52	104.0
2336	26	78.0
2338	26	52.0
2341	26	26.0

Figure 1 shows the ballast hopper placement along with the valve arrangement and a simplified schematic diagram of dribble and R/C electrical wiring.

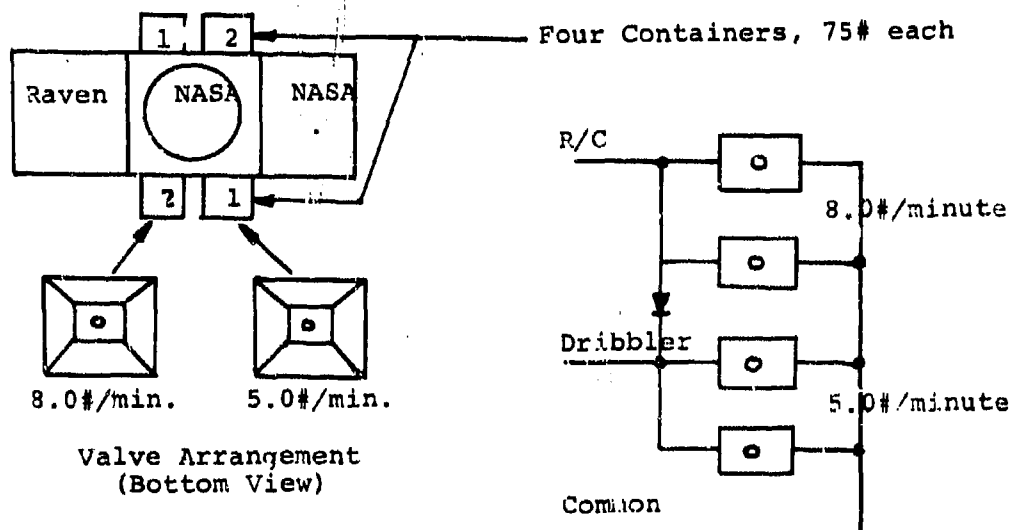


Figure 1

R-1866

PRESSURE AND ALTITUDE DATA
Flight 1179-N

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Raven Altitude Beacon			Churchill Radar		
Time (Z)	Press. (MB)	Alt. (ft.)	Time (Z)	Press. (MB)	Alt. (ft.)
0404	-	Launch	0515	41.1	73,500
0410.1	807.0	6,100	0520	40.5	73,800
0414.5	667.0	11,100	0525	39.9	74,100
0419.3	545.0	16,200	0530	39.9	74,100
0431.4	303.0	30,100	0540	40.5	73,800
0435.5	242.0	35,000	0550	39.9	74,100
0440.8	190.0	40,200	0600	39.9	74,100
0445.6	151.0	45,200	0610	39.7	74,250
0449.5	131.0	48,300	0620	39.5	74,400
0451.0	114.0	51,300	0630	39.5	74,400
0453.4	100.0	54,100	0640	39.7	74,250
0456.3	86.5	57,300	0650	39.5	74,400
0500.2	70.0	62,000	0700	39.5	74,400
0501.5	64.0	63,800			
0504.6	53.0	68,000			
0507.3	47.6	70,300			
0608.2	45.6	71,200			
0609.0	44.0	72,000			
0609.9	42.1	73,000			
0610.9	40.1	74,000			
0627.8	39	74,600			
0612	38.7	74,800			
0803	38.3	75,000			
0850	38.3	75,000			
0945	38.3	75,000			
1200	37.4	75,500			
1229	37.1	75,700			
1330	37.1	75,700			
1444	36.8	75,900			
1530	36.4	76,100			
1555	36.4	76,100			
1630	36.1	76,300			
1800	36.1	76,300			
1830	35.6	76,600			
1900	36.1	76,300			
2000	36.1	76,300			
2010	35.6	76,600			
2100	35.6	76,600			
2220	35.3	76,800			
2230	35.3	76,800			
2307	35.0	77,000			
2325.5		Terminate			
2334.5	181.0	41,300			
2355.5	751.0	8,000			

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Flight 1179
Upper Air Data for 0000 Z, 6 August

Standard Levels

Pressure (MB)	T, °C	Wind	Knots
1000	+14	60°	10
850	+ 5	20°	3
700	- 3	30°	10
500	-20	20°	10
400	-33	20°	12
300	-47	20°	5
250	-54	360°	10
200	-46	300°	25
150	-45	310°	22
100	-47	290°	15
70	-50	350°	10
50	-47	60°	12
30	-45	360°	4
20	-43	80°	10

Significant Levels

1020	+15
969	+13
912	+ 9
798	+ 1
719	- 2
600	-10
562	-14
499	-21
272	-53
227	-48
180	-45
69	-50
40	-45
27	-46
12	-35

Wind Data

Thousands of feet	Direction	Knots
1	70°	9
2	70°	6
5	20°	3
10	30°	10
16	20°	10
20	20°	12
25	70°	11
30	30°	6
35	340°	12
40	300°	26
45	310°	22
50	310°	13
60	340°	11
70	80°	10
80	360°	4
90	80°	10

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D		
(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)		
1. ORIGINATING ACTIVITY (Corporate author): Raven Industries, Inc. P.O. Box 1007 Sioux Falls, South Dakota 57101		2a. REPORT SECURITY CLASSIFICATION None
		2b. GROUP ----
3. REPORT TITLE FINAL REPORT - SKYHOOK CHURCHILL 1966		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Report - 1966		
5. AUTHOR(S) (Last name, first name, initial) White, Paul S.		
6. REPORT DATE 1 November 1966	7a. TOTAL NO. OF PAGES 380	7b. NO. OF REFS None
8a. CONTRACT OR GRANT NO. Nonr 3390 (14)	9a. ORIGINATOR'S REPORT NUMBER(S) R-1866	
8. PROJECT NO. d	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) -----	
10. AVAILABILITY/LIMITATION/NOTICES Qualified requesters may obtain copies of this report from DDC.		
11. SUPPLEMENTARY NOTES ----	12. SPONSORING MILITARY ACTIVITY Office of Naval Research Physics Branch (Code 421) Washington, D. C.	
13. ABSTRACT Contract Nonr 3390(14) was awarded to Raven Industries, Inc. on 13 April 1966 and specified furnishing facilities and personnel necessary to conduct thirty (30) high altitude balloon flights, involving not more than thirty-eight (38) launchings, from Fort Churchill, Manitoba, Canada. Amendment Number 1 increased these numbers to thirty-five (35) flights involving not more than forty-three (43) launchings. This report describes individual flights, equipment used, altitude and trajectory data, and an analysis, where applicable, of all program functions. Conclusions and recommendations for future programs are included.		

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
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Churchill 1966						
Balloons						
Stratospheric flight						
Stratofilm						
M-36 Launch Truck						
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- A2**

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XIII. University of Calgary

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Appendix B

1. Sunrise-Sunset-Fort Churchill
(Tables 1, 2, and 3)
2. Surface Wind Condition for June, July and August
3. Tropopause Data
4. Height of Wind Reversals
5. Analysis of Winds at 70,000 Feet

Altitude	June 8		June 12		June 19, 22, 26	
	Sunset	Sunrise	Sunset	Sunrise	Sunset	Sunrise
00	2123	0309	2126	0305	2131	0305
25	2153	0239	2157	0235	2203	0229
30	2157	0235	2203	0229	2206	0226
40	2206	0226	11	21	15	177
50	2213	0218	19	13	24	08
60	2220	0213	2226	0206	2233	0159
70	2227	0205	33	0200	42	50
80	34	0158	40	52	51	41
90	2242	0150	2247	0145	2259	0133
100	48	0144	53	39	07	26
110	2253	0139	59	33	12	20
120	59	32	2304	0128	2316	0116
130	2306	0126	10	22	24	08
140	14	0117	15	17	32	0050
150	2324	0108	2320	0112	40	52

Sunrise - Sunset, Fort Churchill

Table 1

Altitude	July 3		July 10		July 17		July 24		July 31	
	Sunrise	Sunset	Sunrise	Sunset	Sunrise	Sunset	Sunrise	Sunset	Sunrise	Sunset
00	2126	0312	2121	0321	2110	0333	2057	0346	2042	0401
25	2156	0236	2148	0244	2133	0259	2120	0312	2103	0329
30	2200	32	52	40	37	55	23	09	06	26
40	08	24	2200	32	43	49	29	03	12	20
50	2216	0216	06	26	49	43	35	0257	18	14
60	24	08	12	20	55	37	41	51	23	09
70	30	0201	18	14	2201	31	47	45	27	65
80	37	54	24	08	07	25	51	41	31	61
90	44	47	30	0202	13	19	55	37	35	57
100	2250	41	2236	0156	2217	0115	2159	33	39	53
110	57	35	42	50	21	11	03	29	43	49
120	03	29	48	44	25	07	07	25	47	45
130	09	23	54	38	29	03	09	23	50	42
140	15	17	2259	33	33	0159	11	21	52	40
150	2321	0111	2303	0129	37	0055	2213	0219	54	38

Sunrise-Sunset, Fort Churchill, Canada

Table 2

Altitude	August 7		August 14		August 21		August 28	
	Sunrise	Sunset	Sunrise	Sunset	Sunrise	Sunset	Sunrise	Sunset
00	2025	0417	2007	0433	1949	0448	1929	0504
25	2044	0348	2028	0404	2009	0423	1948	0444
30	47	45	31	01	12	20	50	42
40	53	39	35	57	16	16	54	38
50	59	33	39	53	20	12	1958	34
60	03	29	43	49	24	08	02	30
70	07	25	47	45	28	04	06	25
80	11	21	51	41	32	400	10	22
90	15	17	55	37	36	56	12	20
100	19	13	59	33	38	0354	14	18
110	22	10	02	30	41	51	16	16
120	24	08	04	28	43	49	18	14
130	26	06	06	26	45	47	20	12
140	28	04	08	24	47	45	22	10
150	30	02	10	22	49	43	24	08

Sunrise - Sunset, Fort Churchill, Canada

Table 3

Surface Wind Conditions Reported by DOT, Fort Churchill, for June, 1966

(Observations made every two hours: 360 reports)

Number of observations with winds of:

0-3	mph	10
4-7		55
8-10		83
11-15		99
16-19		38
20-24		38
25 or more		<u>37</u>
TOTAL		360

Winds were 10 mph or less 41.1% of the time.

Number of days winds were 10 mph or less:

Never	4
On one or more readings, but not on two consecutive readings	2
On two consecutive readings (4 hours)	6
On three consecutive readings (6 hours)	4
On four or five consecutive readings	10
On six to eight consecutive readings	1
On nine to twelve consecutive readings	<u>3*</u>
TOTAL	30

*On the 7th, not yet set up

On the 17th, no scientific packages ready, still in the field from Flights 1150-2.

On the 19th, one flight made; no other packages ready to fly

On twelve days when winds were less than 10 mph, they increased by 6 or more mph to at least 11 mph on the report two hours later. On four of those days the change was from 10 or less to 15 or more.

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Surface Wind Conditions Reported by DOT, Fort Churchill, for July 1966

(Observations made every 2 hours: 372 reports)

Number of observations with winds of:

0-3	mph	26
4-7		59
8-10		79
11-15		121
16-19		30
20-24		33
25 or more		<u>24</u>
TOTAL		372

Winds were 10 mph or less 44.3% of the time.

Number of days winds were 10 mph or less:

Never	3
On one or more readings, but not on two consecutive readings	2
On two consecutive readings (4 hours)	4
On three consecutive readings	3
On four or five consecutive readings	8
On six to eight consecutive readings	5
On nine to twelve consecutive readings	<u>6*</u>
	31

*On the third, one flight was ready to go, one made.

On the 13th, two were ready, two flown.

On the 16th, three ready, three flown.

On the 25-26th, four were ready; three flown, one cancelled.

On the 31st, one ready, one flown.

Ten flown out of a possible 18.

On seven days when the winds were less than 10 mph, they increased by 6 or more mph to at least 11 mph on the report two hours later. On 6 of those days, the change was from 10 or less to 15 or more.

Surface Wind Conditions Reported by DOT, Fort Churchill, for August 1966

(Observations made every 2 hours: 180 observations from 1-15 August)

Number of observations with winds of:

0-3	mph	9
4-7		23
8-10		36
11-15		57
16-19		26
20-24		10
25 or more		19
TOTAL		180

Winds were 10 mph or less 37.7% of the time.

Number of days winds were 10 mph or less:

Never	2
On one or more readings, but not on two consecutive readings	2
On two consecutive readings (4 hours)	2
On three consecutive readings (6 hours)	1
On four or five consecutive readings	4
On six to eight consecutive readings	2
On nine to twelve consecutive readings	2*
TOTAL	15

*On the first, one flight made; no other packages ready to fly.

On the 7th, one flight made; no other packages ready to fly.

On 4 days when the winds were less than 10 mph, they increased by 6 or more mph to at least 11 mph on the report two hours later. On one of these days the change was from 10 or less to 15 or more.

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Tropopause Data
Fort Churchill, Manitoba

<u>Date</u>	<u>Time</u>	<u>June</u>	<u>July</u>	<u>August</u>
1	0000		250 Mb -49°C	253 Mb -54°C
1	1200		265 Mb -50°C	254 Mb -53°C
2	0000		285 Mb -48°C	273 Mb -52°C
2	1200		301 Mb -45°C	239 Mb -54°C
3	0000		305 Mb -45°C	262 Mb -54°C
3	1200		276 Mb -49°C	281 Mb -51°C
4	0000		215 Mb -59°C	280 Mb -51°C
4	1200		199 Mb -57°C	287 Mb -50°C
5	0000		215 Mb -55°C	288 Mb -50°C
5	1200		226 Mb -54°C	280 Mb -52°C
6	0000		231 Mb -54°C	250 Mb -55°C
6	1200		246 Mb -50°C	254 Mb -54°C
7	0000		236 Mb -54°C	274 Mb -53°C
7	1200		299 Mb -52°C	249 Mb -57°C
8	0000	227 Mb -62°C	240 Mb -54°C	212 Mb -59°C
8	1200	228 Mb -62°C	237 Mb -54°C	205 Mb -61°C
9	0000	225 Mb -62°C	252 Mb -51°C	208 Mb -62°C
9	1200	247 Mb -57°C	248 Mb -53°C	204 Mb -62°C
10	0000	274 Mb -57°C	251 Mb -52°C	211 Mb -60°C
10	1200	257 Mb -52°C	246 Mb -52°C	-- --
11	0000	236 Mb -53°C	250 Mb -50°C	203 Mb -61°C
11	1200	224 Mb -60°C	246 Mb -54°C	208 Mb -60°C
12	0000	220 Mb -61°C	-- --	208 Mb -58°C
12	1200	244 Mb -54°C	264 Mb -51°C	206 Mb -57°C
13	0000	228 Mb -56°C	286 Mb -50°C	278 Mb -52°C
13	1200	252 Mb -56°C	275 Mb -53°C	245 Mb -56°C
14	0000	260 Mb -56°C	259 Mb -53°C	262 Mb -51°C
14	1200	250 Mb -56°C	235 Mb -57°C	260 Mb -51°C
15	0000	276 Mb -55°C	219 Mb -58°C	257 Mb -54°C
15	1200	239 Mb -60°C	223 Mb -55°C	
16	0000	233 Mb -59°C	218 Mb -57°C	
16	1200	233 Mb -59°C	233 Mb -59°C	
17	0000	235 Mb -59°C	237 Mb -53°C	
17	1200	276 Mb -54°C	226 Mb -52°C	
18	0000	267 Mb -56°C	242 Mb -52°C	
18	1200	240 Mb -58°C	250 Mb -52°C	
19	0000	272 Mb -61°C	238 Mb -56°C	
19	1200	272 Mb -50°C	206 Mb -61°C	
20	0000	259 Mb -56°C	210 Mb -59°C	
20	1200	-- --	207 Mb -59°C	

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<u>Date</u>	<u>Time, Z</u>	<u>June</u>	<u>July</u>	<u>August</u>
21	0000	225 Mb -59°C	187 Mb -62°C	
21	1200	219 Mb -61°C	196 Mb -61°C	
22	0000	-- --	202 Mb -52°C	
22	1200	242 Mb -61°C	242 Mb -52°C	
23	0000	180 Mb -61°C	318 Mb -45°C	
23	1200	170 Mb -61°C	236 Mb -46°C	
24	0000	176 Mb -62°C	274 Mb -47°C	
24	1200	218 Mb -47°C	298 Mb -48°C	
25	0000	287 Mb -47°C	339 Mb -46°C	
25	1200	259 Mb -49°C	243 Mb -50°C	
26	0000	278 Mb -48°C	237 Mb -54°C	
26	1200	280 Mb -48°C	221 Mb -58°C	
27	0000	259 Mb -55°C	226 Mb -58°C	
27	1200	244 Mb -52°C	239 Mb -54°C	
28	0000	282 Mb -50°C	240 Mb -54°C	
28	1200	240 Mb -55°C	240 Mb -57°C	
29	0000	263 Mb -53°C	233 Mb -57°C	
29	1200	198 Mb -55°C	217 Mb -57°C	
30	0000	270 Mb -57°C	239 Mb -56°C	
30	1200	236 Mb -52°C	231 Mb -54°C	
31	0000		258 Mb -52°C	
31	1200		250 Mb -56°C	

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Height of Wind Reversals Over Fort Churchill
(Thousands of feet)

	<u>June</u>	<u>July</u>	<u>August</u>
1	0000g	between 60 and 70	between 60 and 70
1	1200	between 63 and 65	near 70
2	0000	near 70	between 60 and 70
2	1200	between 67 and 70	between 60 and 70
3	0000	between 60 and 70	between 70 and 80
3	1200	between 60 and 70	between 60 and 70
4	0000	between 62 and 65	between 60 and 70
4	1200	between 62 and 70	between 60 and 70
5	0000	between 60 and 70	between 65 and 70
5	1200	between 50 and 60	between 60 and 70
6	0000	between 60 and 70	between 60 and 70
6	1200	between 60 and 70	between 60 and 70
7	0000	between 60 and 70	between 60 and 70
7	1200	near 60	between 60 and 70
8	0000	between 60 and 70	none below 90
8	1200	between 45 and 50	between 70 and 80
9	0000	between 60 and 70	between 70 and 80
9	1200	between 60 and 70	between 53 and 60
10	0000	between 60 and 70	between 70 and 80
10	1200	between 60 and 70	missing
11	0000	between 70 and 80	above 62
11	1200	between 60 and 70	between 60 and 70
12	0000	between 64 and 67	no Westerlies aloft
12	1200	between 60 and 70	no Westerlies aloft
13	0000	between 60 and 70	no Westerlies aloft
13	1200	near 70	between 60 and 70
14	0000	near 70	between 60 and 70
14	1200	between 70 and 80	between 60 and 70
15	0000	between 60 and 70	none below 94
15	1200	between 60 and 70	
16	0000	between 60 and 70	
16	1200	between 62 and 65	
17	0000	near 69	
17	1200	between 62 and 69	
18	0000	between 60 and 62	
18	1200	between 60 and 70	
19	0000	near 70	
19	1200	between 30 and 60	

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June

20	0000	none below 62
20	1200	between 60 and 70
21	0000	between 62 and 69
21	1200	between 62 and 69
22	0000	missing
22	1200	between 60 and 70
23	0000	between 62 and 69
23	1200	between 62 and 69
24	0000	missing
24	1200	missing
25	0000	between 62 and 69
25	1200	between 60 and 66
26	0000	between 62 and 69
26	1200	between 60 and 62
27	0000	between 60 and 70
27	1200	near 69
28	0000	between 60 and 70
28	1200	between 60 and 70
29	0000	between 60 and 70
29	1200	between 60 and 70
30	0000	between 70 and 80
31	0000	between 60 and 70
31	1200	between 60 and 70

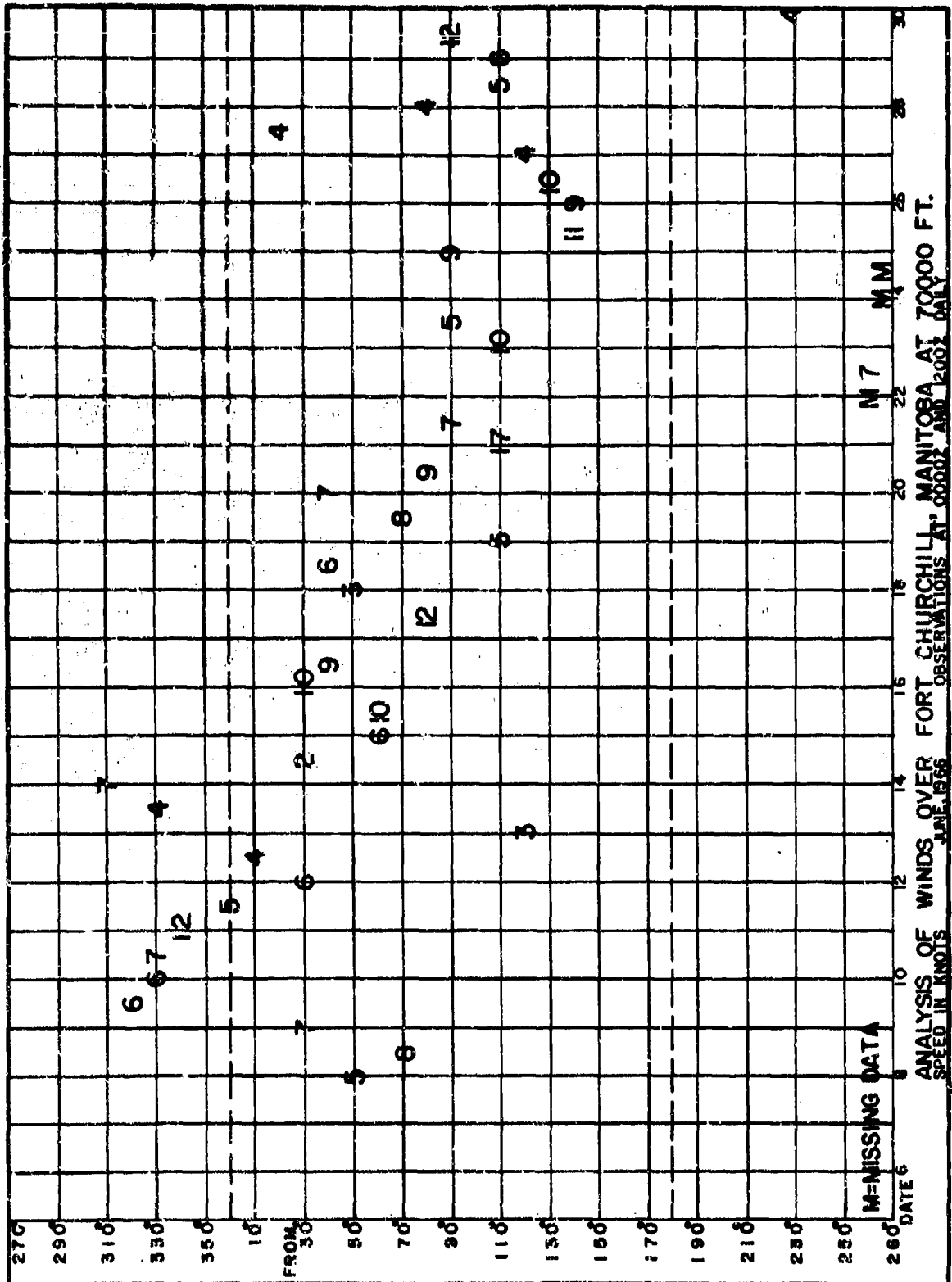
July

between 60 and 70
near 60
between 60 and 70
near 60
between 70 and 80
between 53 and 60
between 50 and 53
between 53 and 60
between 60 and 70
between 60 and 70
between 60 and 70
between 60 and 70
near 70
near 70
between 60 and 70
between 60 and 70
between 60 and 70
between 60 and 70
between 60 and 70
between 60 and 66
between 60 and 70
between 60 and 70

August

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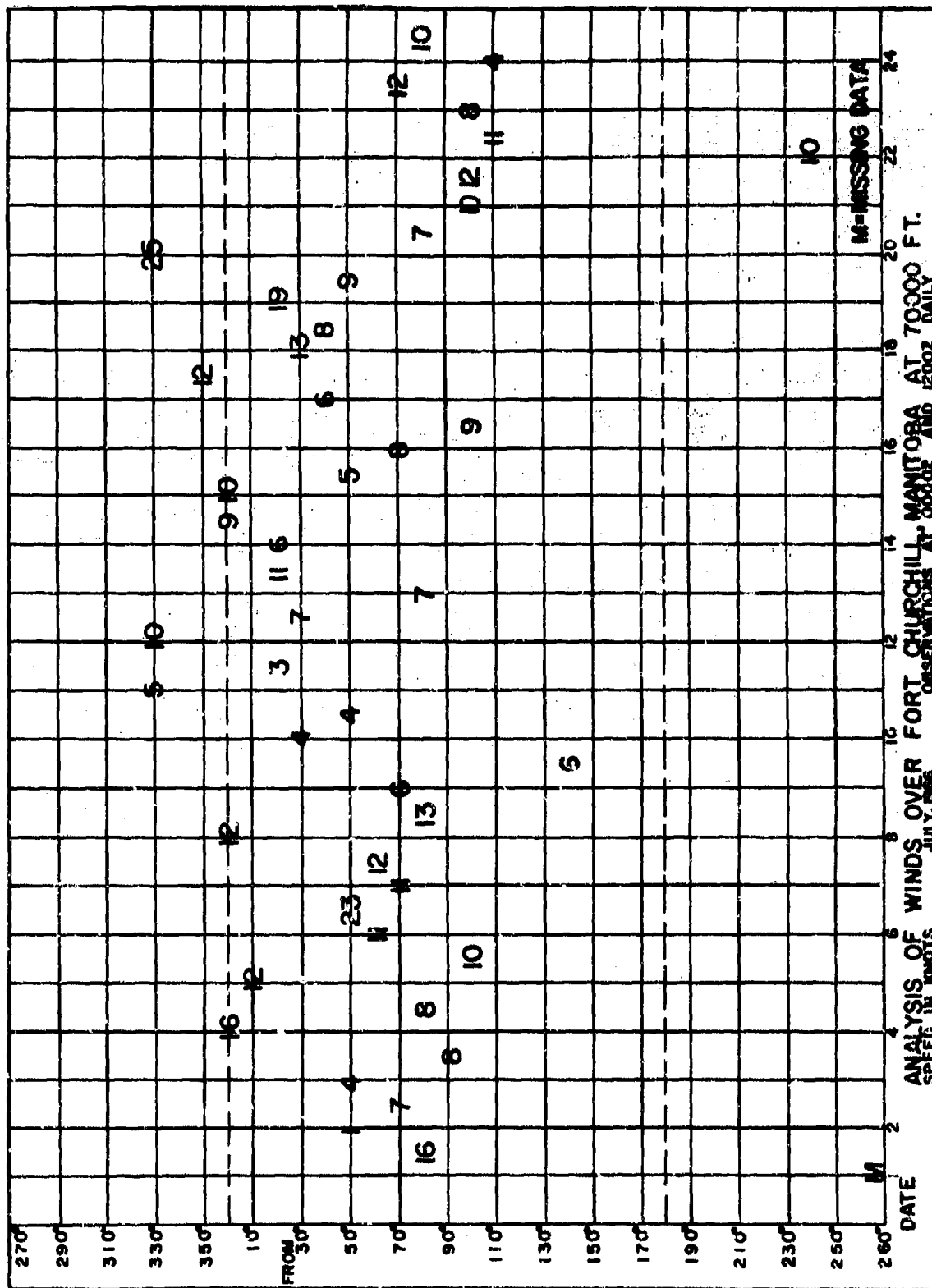
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