AD-A037 419 RAVEN INDUSTRIES INC SIOUX FALLS S DAK FLIGHT OPERA--ETC F/G 1/2
SKYHOOK 1976.(U)
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RAVEN

industries, inc.

SKYHOOK 1976

Contract N00014-76-C-0731
for
Office of Naval Research
Arlington, Virginia 22217

OFFICE OF
ONR
NAVAL RESEARCH

P.O. Box 1007, Sioux Falls, S.D. 57101

R-1276007

ELECTRONICS SYSTEMS DIVISION RAVEN industries, inc.

Interim Report

SKYHOOK 1976

Performed Under
Contract N00014-76-C-0731
Requisition No. NR211-205a/7-30-76
(465)

For

Department of the Navy
Office of Naval Research
Arlington, Virginia 22217

Report No. R-1276007

1 January 1977

Prepared By: Flight Operations Department
Electronic Systems Division

Raven Industries, Inc.
P.O. Box 1007
Sioux Falls, South Dakota 57101

405 675

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ABSTRACT

The 1976 Office of Naval Research Skyhook balloon program was awarded to Raven Industries, Inc. of Sioux Falls. The program included operations from two separate locations and initially included ten flights for eight different scientific groups.

For the most part flights were scheduled for the period of transition when upper winds became light and variable. Most flight durations were forty hours with some as high as sixty and eighty hours.

Raven Industries, under contract agreement, provided the following services:

1. Launch, electronic technicians and pilot for launching, tracking and recovering.

2. Flight hardware and rigging and services as required by each scientific group.

3. Aircraft tracking and logistics support, Cessna 206 and Douglas C-47.

4. Program Documentation.

I. INTRODUCTION

The 1976 program began in April with scientific groups arriving at both launch sites: the University of California Berkley group and University of Minnesota team at Watertown, South Dakota while the Washington University team was at Sioux Falls.

A second group from the University of California at Berkley cancelled plans for a balloon flight during the spring from Watertown due to technical difficulties with the experiment.

California Institute of Technology scientists likewise cancelled plans for a flight from Sioux Falls due to technical problems with their experiment.

Because of a lack of sufficient operational equipment, it was not feasible to operate both sites simultaneously. Due to the pecularity of the flight experiments, priority was given the Watertown site with its two flights during early turnaround.

II. PROGRAM DESCRIPTION

Facilities at the Watertown airport were adequate for two groups. One group was housed in an old gymnasium converted to a shop area and the University of Minnesota team was set up in the new fire hall.

The Watertown airport has adequate area for launching and the off-runway areas are particularly smooth. Air traffic at Watertown is minimal. Airport managements' cooperation in providing space and services was excellent.

Raven located its tracking station on the west end of the airport. Two antennas were available: one mounted on a 25 foot tower and the second on top of the telemetry trailer. A third antenna was available and used with the mobile telemetry station.

The telemetry station at Sioux Falls is located four miles east of the airport on a hill which gives a clear view of the airport. The elevation is 1525 feet M.S.L. which is the highest point in the area giving maximum range in all directions. During the fall flights this site was equipped with electrical power to accommodate the NASA mobile tracking station.

Throughout interface and checkout with the scientific experiment, it is often necessary to use the mobile station in close proximity to the gondola. Prelaunch checkout is performed with the command station east of the airport.

Scientific telemetry and computer equipment is normally located at the launch site for calibration and checkout and is then relocated to the command tracking station prior to launch.

The mobile station is usually located downrange before the balloon is launched and repositioned as required. While being fully independent with its own power plant, the mobile unit is usually located at an airport to facilitate communications with ATC and the tracking aircraft.

III. TRACKING AND DATA SYSTEM

The TRAC package designed by Raven Industries has evolved from many years of experience by the Raven Flight Operations group. This precision unit has a great capacity for flexibility as evidenced by the many experiment requirements over the years.

The command receiver portion of the TRAC instrument is an NBFM receiver. The function of this receiver is command reception, ranging, and transponding, i.e. voice communication between ground stations, vehicles, etc. by using the balloon to effectively multiply communication range.

The TRAC package is wired to accept two Raven command decoders. These decoders utilize resonant reed relays to interpret commands. Two decoder cards utilizing six resonant reeds each are installed. These decoders may both contain relay driver circuitry and relays for a twelve command system. If desired, one card containing the relay driver and relay circuitry may be removed and a decoder card containing photo-diode coupling installed. A separate card containing a BCD, CMOS logic circuit can also be installed. This permits six channels of 15 VDC, MOS compatible output command data.

All command channel outputs key a 2.5 KHz oscillator which is retransmitted to the ground station as command verification. A programmable matrix board interfaces the command decoder outputs with various flight functions such as ballasting, flight termination, and experiment commands.

A timer mounted on the decoder matrix board can be set to give from five to 45 seconds output when activated by the ballast command channel. A separate output provides command verification during the ballast period.

The commutator assembly consists of a master board with voltage regulators and the necessary clocking circuitry. The master board also contains two 7-segment data channels. Bandedge calibration voltages are also generated on the master card. In addition, one or two additional commutator cards may be installed. These cards are slaved to the master board clock and calibration functions. This provides a capability for 48 data channels with calibration data applied. In addition, four channels are available without band-edge calibration.

Altitude is continuously transmitted during a flight on a subcarrier. Altitude data is derived from a pair of pressure transducers covering a range of 1000 - 10 mb. and 10 to 0.1 mb. with a pressure operated crossover switch.

Up to sixteen channels may be multiplexed into the transmitted carrier in the standard IRIG FM-FM format. Two of the sixteen are normally used for internal housekeeping and altitude data leaving fourteen available for auxillary use. Four of the sixteen channels are continuous and may be used for either analog or digital data.

Down-link transmission of transponded voice communications, ranging, command verification, and subcarrier modulated data are handled by an L-Band (1525-1535 MHz) two watt transmitter.

Power for the TRAC package is supplied by a battery pack consisting of sixteen Yardney LR-40 Silver Cells. These provide a nominal 40 ampere hour capacity for a nominal 30 hour flight. If a longer flight is required, additional power can be supplied by external battery packs.

The TRAC package is designed to operate over a wide range of environmental conditions. The rugged construction and water tight seals allow the package to withstand high "G" forces and water emersion with a minimum of damage. The proper use of insulation, white paint, heat reflectors and conduction of internally generated heat are utilized for thermal stabilization.

Table 1

SKYHOOK ADMINISTRATION AND
OPERATIONAL ORGANIZATION

United States Navy
Office of Naval Research
Atmospheric Sciences, Code 465
Arlington, Virginia 22217

Physical Scientist: W.F. Martin
Project Officer: Cmdr. Wm. Smith

United States Navy
Office of Naval Research
Field Office
Minneapolis, Minnesota 55111

Representative: W.F. Cross
Representative: M.O. Evanick

Sounding Rocket Project Branch
Building E 108
Wallops Flight Center
Wallops Island, Virginia 23337

NASA Representative: James Gray
NASA Field Representative: B. Ballance

Raven Industries, Inc.
P.O. Box 1007
Sioux Falls, South Dakota 57101

Flight Crew: T. Pappas
M. Fulkerson
D. Reid
D. Rassmussen
E. Erpelding
C. Eisenhauer
G. Lindner
G. House
M. Forester

Table 2

SKYHOOK PROGRAM
SCIENTIFIC PERSONNEL

UNIVERSITY OF CALIFORNIA - BERKLEY

Dr. Charles Orth
Dr. Andrew Buffington
Harold Dougherty
John Gibson
Douglas Heine
John Yamada

UNIVERSITY OF MINNESOTA

Dr. Jake Waddington
Charles Gilman
Dr. Robert Scarlet
Gail Lanzatella
Vigean Nair
Tom Demaree

WASHINGTON UNIVERSITY, ST. LOUIS, MISSOURI

Patrick Love
Jack Tueler
John Epstein

MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALABAMA

Dr. T. Parnell
Dr. J. Gregory, University of Alabama
James Derickson
B. Austin
William Selig
W. Parker
W. Hammond

UNIVERSITY OF WYOMING

John Drummond
Norm Kjome

UNIVERSITY OF CALIFORNIA - BERKLEY

Dr. Brian G. Cartwright
Mr. Jan de Vries, Project Engineer
Steve Ahlen
Greg Tarle

C.E.N. SACLAY, FRANCE

Dr. L. Koch Miramond
Nicolas Petrou
Yvon Rio
Philippe Goret
Rene' Juan
Pierre Mostreau
Jean-Claude Christy

UNIVERSITY OF NEW HAMPSHIRE

Dr. J. Leniak
James Kish
Robin Wiley
John Barbary

Table 3

AIRCRAFT USAGE REPORT

C-47: N4682T

Maintenance	7:25	
Flight TRNG	11:15	
Flight Checkout	4:20	
Logistics	12:10	
Tracking	11:50	Flight 1392
	9:45	Flight 1393
	15:55	Flight 1394
	10:40	Flight 1395
Total...	83:20	

Cessna 206: N2212

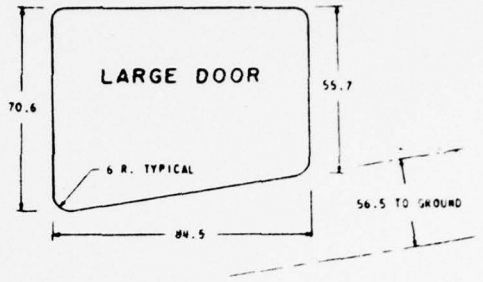
Logistics	38:6	
Tracking	20:5	Flight 1385
	3:3	Flight 1386
	4:5	Flight 1387
	8:7	Flight 1389
	4:4	Flight 1390
	3:0	Flight 1391
	4:9	Flight 1396
	5:8	Flight 1397
Total...	93.7	

For use as Chart E
in AN 01-1B-40

Table 4
T.O. No. 01-40NC-5A

MAXIMUM SIZE PACKAGE TABLE

LENGTH, INCHES	WIDTH, INCHES													
	4	8	12	16	20	24	28	32	36	40	44	48	52	56
69	69	69	69	69	69	69	69	69	69	69	69	69	69	68
73	73	73	73	73	73	73	73	73	73	73	73	73	73	60
77	77	77	77	77	77	77	77	77	77	77	76	76	76	60
81	81	81	81	81	80	80	80	80	80	80	72	72	72	60
85	85	84	84	80	76	76	72	72	72	72	68	64	64	60
89	84	84	80	80	76	72	72	68	68	64	64	64	60	56
93	84	84	80	80	76	72	68	68	64	64	64	64	60	56
97	84	84	80	76	72	72	68	64	64	64	64	60	60	56
101	84	80	76	76	72	68	64	64	64	64	64	60	60	
105	80	80	76	76	72	68	64	64	64	64	60	60	60	
109	80	80	76	72	68	68	64	60	60	56	56	56	56	
113	[illegible]													
117	76	76	76	72	68	64	60	60	60	56	56	56	52	
121	76	76	72	68	64	60	60	60	56	56	56	52		
125	76	76	72	68	64	60	60	56	56	56	56	52		
129	76	76	72	68	64	60	60	56	56	56	56	52		
133	72	72	68	68	64	60	60	56	56	56	52	48		
137	72	72	68	64	64	60	60	56	56	56	52			
141	72	72	68	64	64	60	60	56	56	56	52			
145	72	72	68	64	64	60	60	56	56	52	52			
149	72	72	68	64	64	60	60	56	56	52	48			
153	72	72	68	64	64	60	60	56	56	52	48			
157	72	72	68	64	60	60	56	56	52	52	48*			
161	72	72	68	64	60	60	56	56	52	48	44*			
165	72	68	68	64	60	60	56	56	52	48				
169	72	68	68	64	60	60	56	56	52	48*				
173	72	68	68	64	60	60	56	56	52	44*				
177	72	68	68	64	60	60	56	56	52	40*				
181	72	68	64	64	60	60	56	52	48					
185	72	68	64	64	60	60	56	52	48					
189	72	68	64	64	60	60	56	52	48					
193	68	68	64	64	60	60	56	52	44					
197	68	68	64	64	60	60	56	52	44					
201	68	68	64	64	60	60	56	48	36					
205	68	68	64	64	60	60	56	48						
209	68	68	64	64	60	60	56	48						
213	68	68	64	64	60	60	56	48						
217	68	68	64	60	60	56	56	48						
221	68	68	64	60	60	56	52	44						
225	68	68	64	60	60	56	52	44						
229	68	68	64	60	60	56	52	44						
233	68	68	64	60	60	56	52	40						
237	68	64	64	60	60	56	52	36						
241	68	64	64	60	60	56	48	36						
245	68	64	64	60	60	56	48	32						
249	68	64	64	60	60	56	48	32						
253	68	64	64	60	60	56	48							
257	68	64	64	60	56	52	44							
261	68	64	64	60	56	52	44							
265	68	64	64	60	56	52	44							
269	68	64	64	60	56	52	40							
273	64	64	64	60	56	52	40							
277	68	64	64	60	56	52	36							
281	64	64	64	60	52	52	36							
285	64	64	64	60	52	52	36							
289	64	64	64	60	52	48	36							
293	64	64	64	60	52	48	32							
297	64	64	64	60	52	48								
301	64	64	64	60	52	48								
305	64	64	60	60	52	44								
309	64	64	60	60	52	44								
313	64	64	60	60	52	40								
317	64	64	60	60	52	40								
321	64	64	60	60	52	40								
325	64	64	60	60	52	40								
329		64	60	60	52	36								
333		64	60	60	52	36								
337		64	60	60	52	36								
341		64	60	60	52	36								
345		64	60	60	52	36								
349		64	60	60	52	36								
353		64	60	60	52	36								
357		64	60	60	52	36								
361		64	60	60	52	36								
365		64	60	60	52	36								



USE THE PACKAGE TABLE AS FOLLOWS

1. IN THE "LENGTH" COLUMN, FIND THE LONGEST DIMENSION OF THE PACKAGE. (IF THE EXACT DIMENSION IS NOT SHOWN, USE THE NEXT LARGER DIMENSION)
2. IN THE "WIDTH" COLUMN, FIND THE SHORTEST DIMENSION OF THE PACKAGE. (IF THE EXACT DIMENSION IS NOT SHOWN, USE THE NEXT LARGER DIMENSION)
3. AT THE INTERSECTION OF THE "LENGTH" AND "WIDTH" DIMENSIONS IN THE BODY OF THE TABLE, WILL BE FOUND THE MAXIMUM HEIGHT THE PACKAGE MAY HAVE. IF THE HEIGHT OF THE PACKAGE IS THE SAME OR LESS THAN THIS DIMENSION, THE PACKAGE CAN BE LOADED IN THE AIRPLANE.
4. EXAMPLE: PACKAGE IS 168 X 35 X 51
   LENGTH (LONGEST DIM.)
   WIDTH (SHORTEST DIM.)
   HEIGHT (CHECK TABLE)

FROM THE TABLE IT IS FOUND THAT THE PACKAGE CAN BE LOADED.

LENGTH, INCHES	WIDTH, INCHES				
	32	36	40	44	48
161					
165					
169		52			
173					
177					
181					

*NOTE: HEIGHT DIMENSIONS IN TABLE MARKED THUS (*) INDICATE PACKAGE CAN BE LOADED BUT SEAT BEAM MUST BE REMOVED BETWEEN STA. 372.5 AND 450.5 R H SIDE.

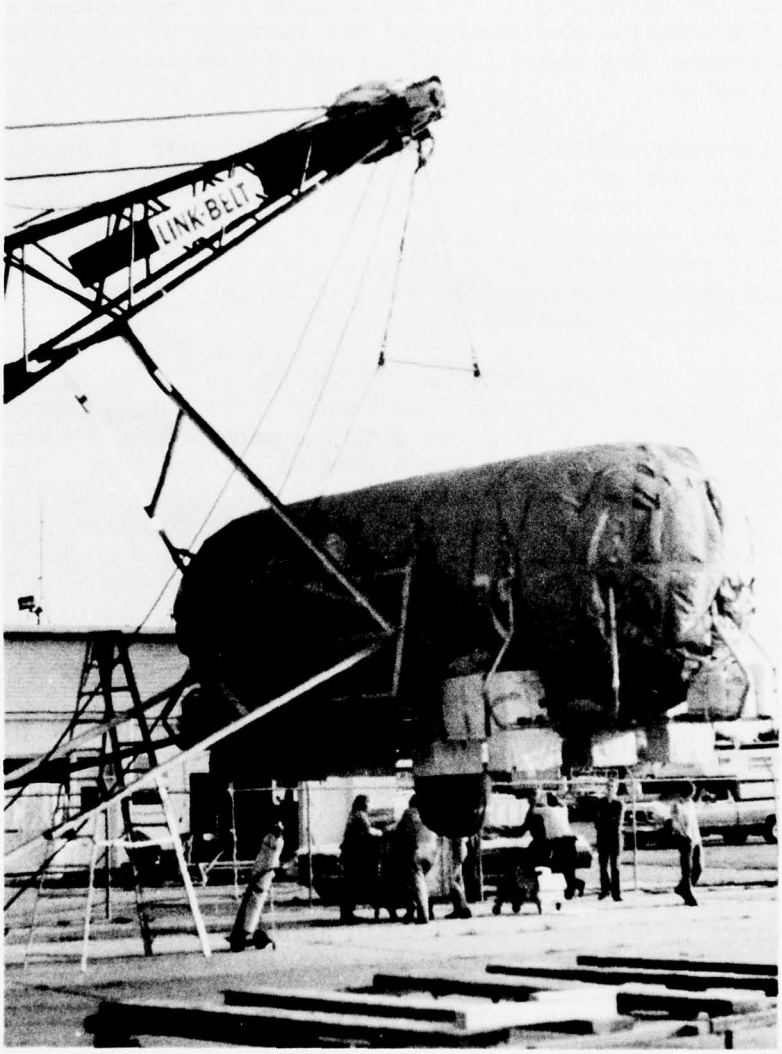
			ALTITUDE							
			DURATION		THEORETICAL - ①		MEASURED TRANSDUCER			
DATE	FLT NUMBER	SCIENTIST & GROUP	TOTAL	CEILING	WITH BALLAST	WITHOUT BALLAST	MAX	MIN	TERM	WT LBS
17 May 76	1384	U of C, Berkley - Alvarez								288
		Orth & Buffington								
7 May 76	1385	U of Minnesota - J. Waddington	62:37	58:18	2.61	1.82	2.7	3.75	2.4	193
25 May 76	1386	Washington U - M. Israel	36:06	31:30	4.44	4.04	3.5	5.5	22.0	500
29 May 76	1387	M.S.F.C. - T. Parnell	7·45	4:14	4.86	4.53	4	4.5	4.5	174
31 May 76	1388	M.S.F.C. - T. Parnell								173
27 June 76	1389	U of Wyo. - Hoffman, Rosen	7:10	0:7	1.67	1.20	2.02	NA	4.0	139
14 Sept 76	1393	U of Calif, Berkley - Cart-wright	27:37	24:16	3.88	2.80	2.5	4.0	2.5	254
23 Sept 76	1392	C.E.N., Saclay - L. Koch	38:22	33:24	6.07	5.0	5.0	8.0	7.8	224
24 Sept 76	1394	U of N.H. - Webber	35·38	27:20	3.18	3.0	2.7	5.0	3.5	160
29 Sept 76	1395A	MSFC - T. Parnell								188
29 Sept 76	1395B	MSFC - T. Parnell								159
30 Sept 76	1395C	MSFC - T. Parnell	21:03	16:27	4.66	4.0	4.4	6.05	6.0	187

TABLE 5

	BALLOON						HELIUM				LOAD & SUSP									
		MATERIAL THICKNESS									EQUIPMENT				BALLAST			PARAC		
RM	WT LBS	SHELL	CAP	VOL	R/S	S.N.	CUBIC FEET	FREE LIFT	%	GROSS LIFT	GROSS LOAD	SUSP LOAD	EXP WT	RAVEN WT	TOTAL LBS	TOTAL EXP	%	MFG	SIZE	
	2884	0.8	0.9/0.9	20.8	Yes	26	137,000	1100	14	9037	7927	5099	4252	847	200		2.5	SECURETY	120'	
.4	1939	0.5	0.5/0.6	25.84	Yes	2	68,084	552	14	4494	1939	2003	1025	978	550	510	16.2	PIONEER	84'	
.0	5003	0.8	3 ea 0.9	39.6	Yes	1	196,314	1388	12	12958	11570	6567	4320	2247	1500	1500	14.9	SECURETY	120'	
.5	1740	0.6	2 ea 0.6	15.6	Yes	19	80,719	654	14	5328	4674	2934	1720	1214	700	700	17.6	IRVING	100'	
	1732	0.6	2 ea 0.6	15.6	Yes	20	80,598	653	14	5320	4667	2935	1720	1215	700		17.6	IRVING	100'	
.0	1397	0.6	2 - 0.5	15.5	Yes	106	31,800	225	13.2	2097	1872	475	111	364	175	175	10.3	PIONEER	38'	
.5	2545	0.6	0.9-0.8	25.98	Yes	2	109,337	886	14	7217	6331	3786	2260	1526	950	950	17.6	IRVING	100'	
.8	2243	0.7	2 -0.9	15.39	Yes	8	107,459	871	14	7093	6222	3979	2320	1659	1030	1030	19.8	IRVING	100'	
.5	1607	0.5	2 -0.6	21.1	Yes	18	65,478	531	14	4322	3791	2184	1075	1009	700	700	22.6	NORTHRUP	84'	
	1888	0.6	2 -0.6	20.0	Yes	101	79,416	562	12	5242	4680	2792	1728	1064	600		14.	IRVING	100'	
	1598	0.5	2 -0.6	20.1	Yes	19	70,629	572	14	4662	4090	1728	1728	764	300		7.0	IRVING	100'	
.0	1872	0.7	2 -0.6	15.0	Yes	12	75,371	611	14	4975	4364	2492	1728	764	300	300	6.8	IRVING	100'	

	LOAD & SUSPENSION															
	EQUIPMENT				BALLAST			PARACHUTE					DESCENT			
SS FT	GROSS LOAD	SUSP LOAD	EXP WT	RAVEN WT	TOTAL LBS	TOTAL EXP	%	MFG	SIZE	TYPE	WT	SER. NO.	ALT	WT	TIME	RATE
7	7927	5099	4252	847	200		2.5	SECURETY	120'	FC	309	3				
4	1939	2003	1025	978	550	510	16.2	PIONEER	84'	RS	140	6-A	134	1453	45	16.4
8	11570	6567	4320	2247	1500	1500	14.9	SECURETY	120'	FC	307	4	88	5027	35	22.9
8	4674	2934	1720	1214	700	700	17.6	IRVING	100'	FC	215		121	2234	46	19.0
0	4667	2935	1720	1215	700		17.6	IRVING	100'	FC	210					
7	1872	475	111	364	175	175	10.3	PIONEER	38'	FC	50	184	124	300	73	17.0
7	6331	3786	2260	1526	950	950	17.6	IRVING	100'	FC	219		136	2836	43	20
3	6222	3979	2320	1659	1030	1030	19.8	IRVING	100'	FC	218		108	2949	42	20.5
2	3791	2184	1075	1009	700	700	22.6	NORTHRUP	84'	RS	134	6	126	1484	45	16.5
2	4680	2792	1728	1064	600		14.	IRVING	100'	FC	218					
2	4090	1728	1728	764	300		7.0	IRVING	100'	FC	218					
5	4364	2492	1728	764	300	300	6.8	IRVING	100'	FC	218		114	2192	50	17.5

IV. FLIGHT DESCRIPTIONS



FLIGHT 1386, 25 MAY 1976
WASHINGTON UNIVERSITY, ST. LOUIS, MISSOURI

FLIGHT 1384 - FLIGHT DESCRIPTION

UNIVERSITY OF CALIFORNIA - BERKLEY
Drs. L.W. Alverez, C.C. Orth, A. Buffington

The object of the University of California, Berkley experiment was to measure the relative abundancies of the isotopes of beryllium in the primary cosmic rays above 1.4 GV/c using a super-conducting magnetic spectrometer.

Flight requirements called for a launch at sunset with an ascent of 800 to 1000 feet per minute to theoretical float altitude and after fourteen to fifteen hours start a descent to a lower level where parachute descent could be initiated. Recovery of the large experiment was to be carried out under the supervision of a University of California, Berkley technician who would be at the landing site, arriving by plane or ground vehicle.

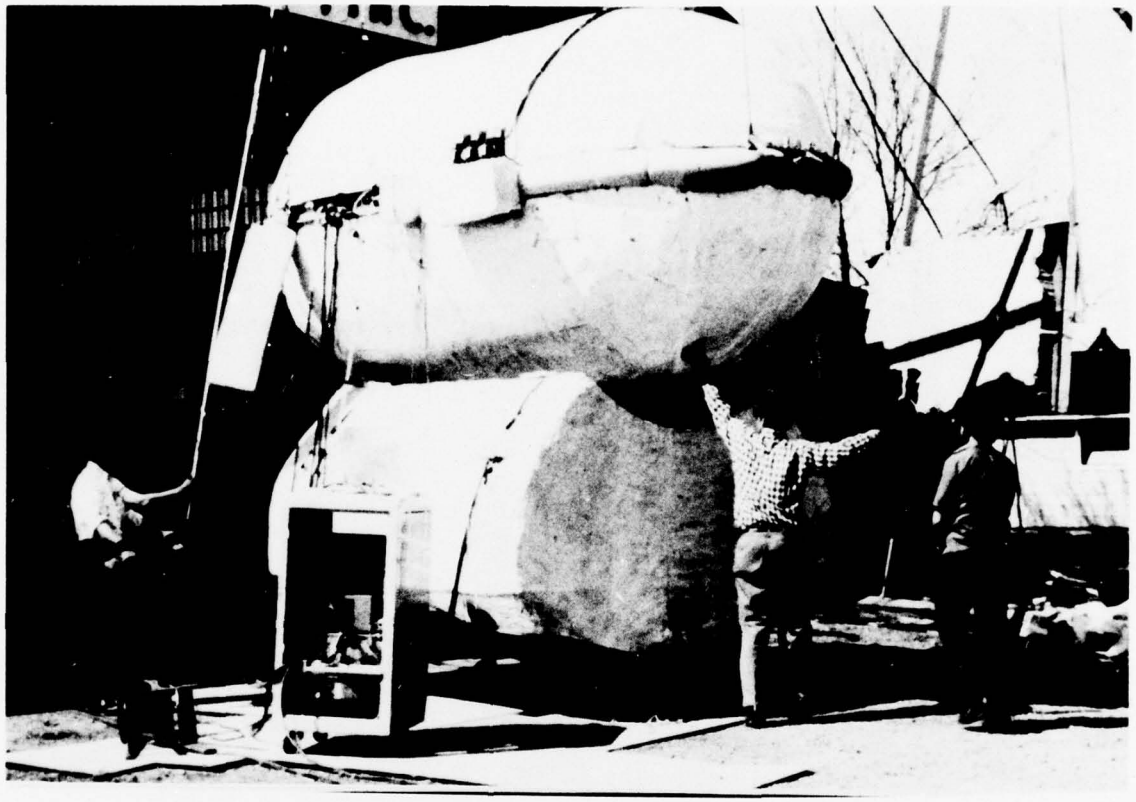
PARACHUTE SYSTEM - The parachute was one of two built for Raven by the Security Parachute Company of San Leandro, California. Specifically, it was 120 feet in diameter with 750 pounds dacron suspension lines and risers with a 36 inch steel ring in the top vent. The 120 lines terminated into twelve risers and four "D" rings. The top ring and twelve 3/16 inch cables terminated into single point for connecting to the termination link which was, in turn, coupled to a 270N Miller swivel.

A transponder was mounted in the top of the suspension cable assembly just below the parachute.

The backup termination receiver was mounted in the top of the parachute and wired to the double squib cannon - the other squib being wired into the TRAC pack Terminate Line 2.

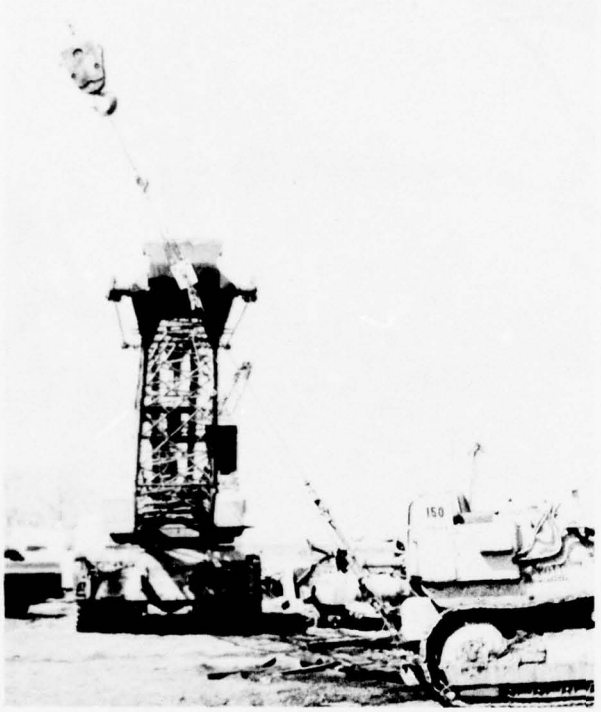
The instrument pack on top of the balloon contained two separate and independently powered command receivers and a digital timer. The timer was a backup in case of failure of the two receivers. The timer was wired to one valve which would allow a slow descent to 70,000 feet where termination would be executed by a pressure switch.

Watertown, South Dakota was selected as the launch site. This location would provide a trajectory above the desired geomagnetic cut off and allow for recovery in a reasonably accessible area free of lakes.



The building available at Watertown airport was not an ideal laboratory setup for an experiment of this size and weight. However, with perseverance, the use of a large wheeled cart and a hydraulic crane, the scientist and technicians were able to assemble and roll it out for weighing and rigging.

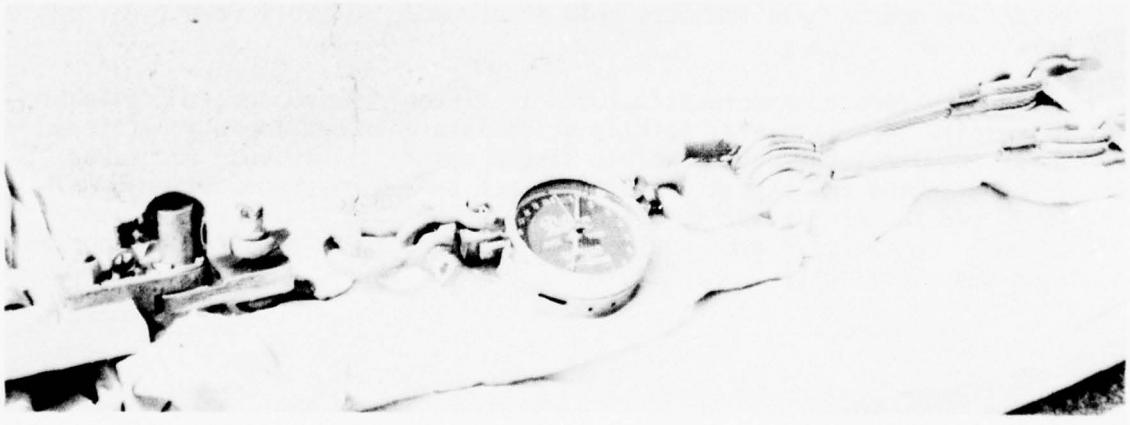
Having experienced numerous failures in eleven previous balloon flights, University of California, Berkley scientists have developed an attitude which requires that each possible single point failure must be backed up by a second and separate system. Each system or component must be subjected to tests prior to flight and the details and results be documented. Check lists are required for each and every phase of the operation and electronics.



Several changes in the crane pin fitting were required to facilitate the length of the Univeristy of California, Berkley gondola and the new pin plate.

The modified pin fitting was subjected to a pull test of 10,000 pounds in three directions to ascertain the integrity of the pin relative to the boom.

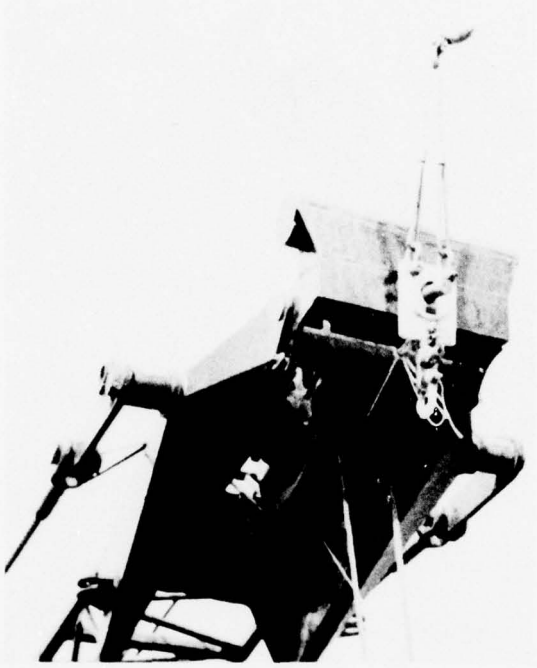
Flight train components were also tested, the parachute tested to 10,000 pounds and the equipment below the chute tested to 20,000 pounds. Although not used on the University of California, Berkley system, a parachute release and 1/2 inch cable ladder were simultaneously tested to 20,000 pounds.



The gondola weight of 3900 pounds made it necessary to use a crane for launch. This crane was the usual crane used by Raven for launching mid-range payloads - 3000 to 4500 pounds.

In addition to the tests of the crane fitting, University of California, Berkley scientists requested several other items for the crane to insure successful launch. These were a contrivance which served as a back board to stabilize the gondola during launch and a television camera mounted at the crane pin fitting to be monitored during launch to confirm that the balloon was actually lifting the gondola before release from the crane.

The first request was met quite simply by adapting the existing back board from the larger crane to mate with the small crane and the University of California, Berkley gondola.



The later requirement was somewhat more difficult to meet. The television camera idea was finally abandoned in preferance to a mechanical system.

The crane pin assembly was attached to the crane head in such a manner that the force of the balloon, if sufficient to lift the gondola, would pivot the assembly upward around its support pins. The amount of this motion was about 1/2 inch, limited by two 3/4 inch steel turn buckles anchored to the crane boom. The motion was coupled to a Dillion spring which in turn actuated two micro-switches which energized a series of lights.

The system was simple but difficult and time consuming to calibrate to three separate levels. The system was safe and could be locked out if not required.

INSTRUMENTATION - Originally University of California, Berkley requested two complete TRAC instruments for redundancy. However, a compromise was reached and a separate command receiver for termination was supplied along with two separate and individually powered receivers for valve operation.

No interface between the Raven TRAC package and the University of California, Berkley experiment was required. The TRAC pack was mounted above the experiment on the spreader bar, out of the magnetic field. Two hundred pounds of ballast was contained in a canvas hopper hung below the experiment on the end away from the magnet.

After 25 days in the field the experiment was ready for flight. On May 6th a launch was cancelled due to high surface winds. A second attempt was cancelled due to malfunction of the redundant terminate receiver in the top of the parachute. The receiver batteries were dead. The flight could have been flown without the receiver but University of California, Berkley scientists preferred not to fly without it.

On 17 May the launch was scheduled and all went well up to launch. As the balloon was released from the launch spool, the flight train dropped to the ground. The receiver in the parachute fired the terminate squib and allowed the balloon to ascend without the experiment.

The shock during launch was sufficient to cause the receiver to fire. In subsequent tests it was determined that laying the receiver over on its side was sufficient shock to cause it to fire.

A second receiver on top of the balloon for valve operation worked well, and was also working after the balloon landed. Details of the failure are documented in Raven Report 021-0101-007.

No further attempts to launch the experiment were made due to the schedule and lack of a suitable balloon.

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1384 Director Fulkerson

2. Scientist Orth Group U.C.B. Date/Time 5-18-76 /02:05 Z

3. Launch: Site Watertown, SD Technique/Launch Veh. Dynamic/Crane

4. Balloon Performance: Theoretical Ceiling 5.73 mb, 35.98 km
   Actual Ceiling -- mb, -- km

5. Ascent Rate: Surface to Ceiling, Average -- mps

6. Flight Duration: Total -- hr -- min At ceiling -- hr -- min

7. Termination: Date/Time 5-18-76 / 02:06 Z. Method Abort

8. Balloon Destruction: Confirmed, visually, etc. Visual

9. Landing: Date/Time -- / -- Z. Location --

10. NOTAM Close out: Date/Time 5-18-76 / 02:10 Z. Activity ATY

11. Frequencies Used:

(MHz)	Emission	Purpose	Power	Time
1529.5	1000F9	Telemetry	2W	4
149.4	30F9	Communications & Command	80W	4
7.465	3A3J	Communications	100W	4

12. Balloon Specs: SF375.08-080-NSC-09 Serial No. 26

    Material SF Vol. 20.8 MCF Gauge 0.8 mil. 2 ea. 0.9 caps

Balloon	2884
Parachute (Dia 36.6 m)	309
Raven Instrumentation	75
Ballast & Bag	207
Scientific Package & Crush Pads	4111
Spreader Bar & Pin Fitting	141
Cable Ladder & Transponder	133
Top Payload & Timers	67
Gross Weight	7927
Free Lift	1110
Gross Inflation	9037

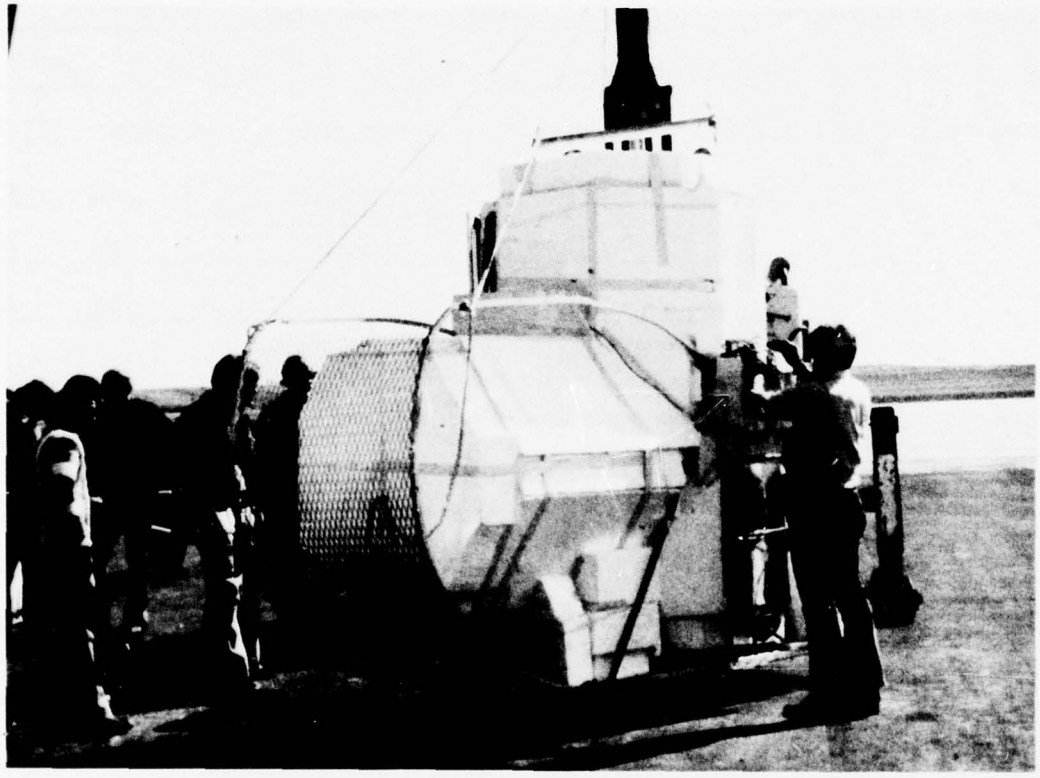
13. Comments Termination receiver at top of parachute caused the load line squib to fire when the balloon was released. Scientific payload was not released from the crane.

FLIGHT 1385 - FLIGHT DESCRIPTION

UNIVERSITY OF MINNESOTA
Professor C.J. Waddington

Originally scheduled for launch in the fall series of 1975 with an experiment designed to study highly charged cosmic ray nuclei utilizing a double Cerenkov - double Scintillator array with a fast timing capacity.

The balloon flight was rescheduled for the spring of 1976 with a new experiment built into the old gondola shell.



The experiment designated "CRISIS" (Cosmic Ray Instrument For Isotope Separation) was a cosmic ray heavy isotope detector using a combination of scintillators, Cerenkov and nuclear emulsion detectors.

Flight requirements were eight hours duration with a launch from the area of Sioux Falls or Watertown, South Dakota.

ELECTRONICS REQUIRED - A standard Raven TRAC instrument package incorporating twelve tone commands was used. The scientific P.C.M. data was transmitted via a separate transmitter with a backup channel on an IRIG "E" VCO in the TRAC package. Five tone commands were supplied to the scientific group and were used to set up a series of commands within the experiment.

The increased weight of the experiment plus the added weight of the additional batteries for the 80 hour flight duration minimized the amount of ballast that could be carried.

The balloon provided was a 0.5 mil 25.84 million cubic foot, with two caps of 0.5 mil and 0.6 mil, designed for a maximum suspended load of 2,000 pounds. The gross system weight of approximately 4,000 pounds made the system compatible for a truck launch.

The launch was scheduled for 3 May but was cancelled due to Raven electronics problem. A second attempt was cancelled due to wind conditions.

The experiment was finally sent aloft on 7 May. Winds aloft were of sufficient velocity to reduce the flight duration to approximately 60 hours. After a duration of 58 hours at ceiling the flight was terminated by command from the Cessna 206 tracking aircraft over the Idaho Washington border. The gondola landed 45 minutes later at 117° 27' longitude, 46° 44' latitude.

Post flight examination of the gondola indicated a leak in the pressure shell had caused the shell to implode slightly. Further examination showed that after approximately twelve hours of flight the spark chamber failed causing partial data loss.

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1385 Director Fulkerson

2. Scientist Waddington Group U of Minn. Date/Time 5-7-76 /12:08Z

3. Launch: Site Watertown, SD Technique/Launch Veh. Dynamic - M-36

4. Balloon Performance: Theoretical Ceiling 2.61 mb, 41.92 km
   Actual Ceiling 2.66 mb, 41.77 km

5. Ascent Rate: Surface to Ceiling, Average 3.22 mps

6. Flight Duration: Total 62 hr 37 min At ceiling 58 hr 18 min

7. Termination: Date/Time 5-10-76 / 02:00 Z. Method Command 206

8. Balloon Destruction: Confirmed, visually, etc. Visual

9. Landing: Date/Time 5-10-76 / 02:45 Z. Location 117°27'-46°44'

10. NOTAM Close out: Date/Time 5-10-76 / 02:45 Z. Activity Salt Lake Center

11. Frequencies Used:

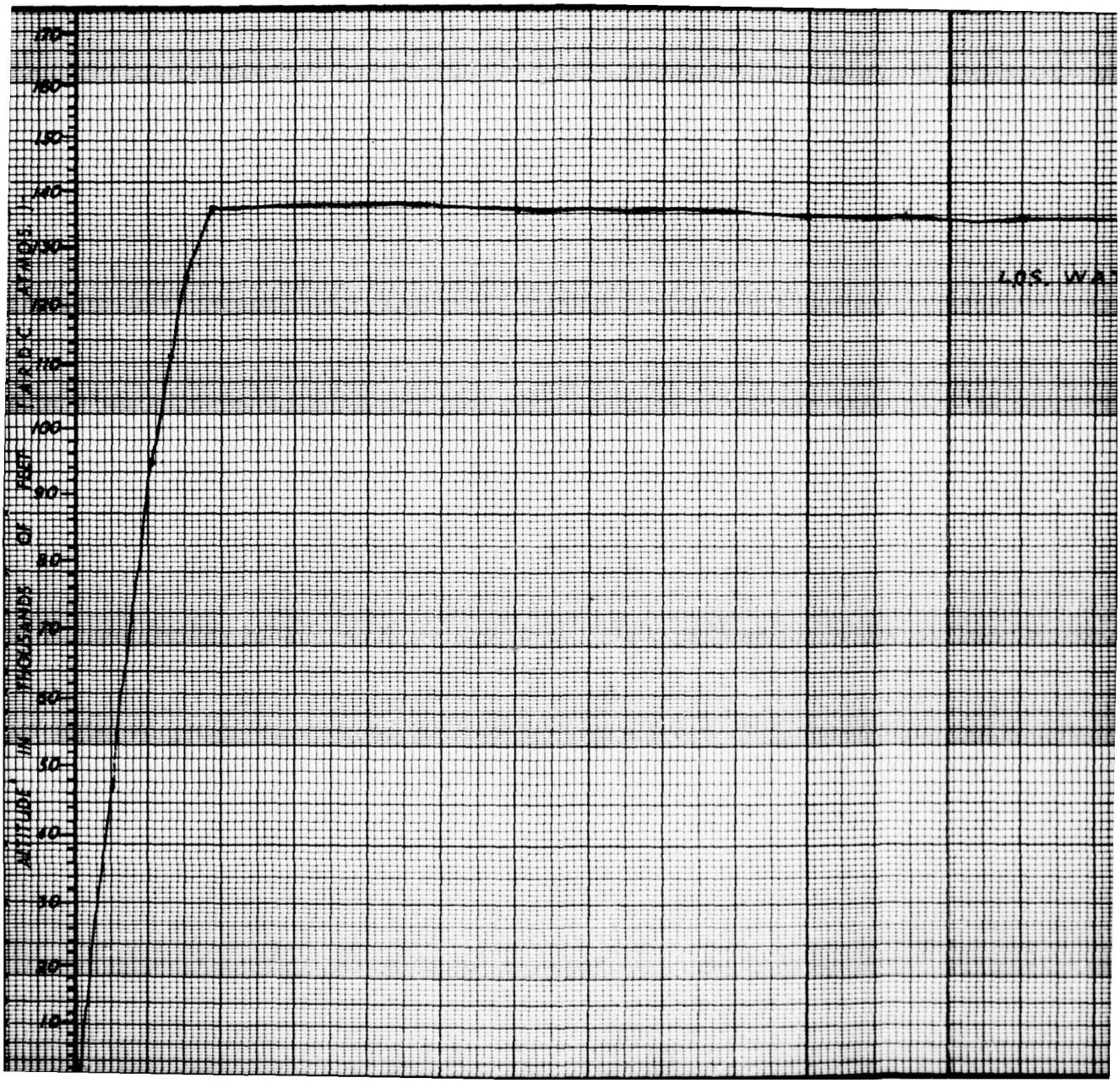
(MHz)	Emission	Purpose	Power	Time
1533.5	1000F9	Telemetry	2W	65
1529.5	1000F9	Telemetry	2W	65
149.4	30F9	Communications And Command	80W	65
7.465	3A3J	Communications	100W	65

12. Balloon Specs: SF415.57-050-NSC-01 Serial No. 2

Material SF Vol. 25.84 MCF Gauge 0.5 mil. 2 ea. 0.5 0.6 caps

Load Line	Balloon	1939
Pin Fitting &	Parachute (Dia 25.6 m)	140
	Raven Instrumentation	72
	Ballast	550
	Scientific Package	1025
	Crush Pad & Timers	38
	Strobe Light & Transponder	37
Extra Batteries	& Destruct Valve Timer	141
	Gross Weight	3942
	Free Lift...14%	552
	Gross Inflation	4494

13. Comments


170
160
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FEET
ABOVE MEAN SEA LEVEL
THOUSANDS OF
WITHDRAWAL IN

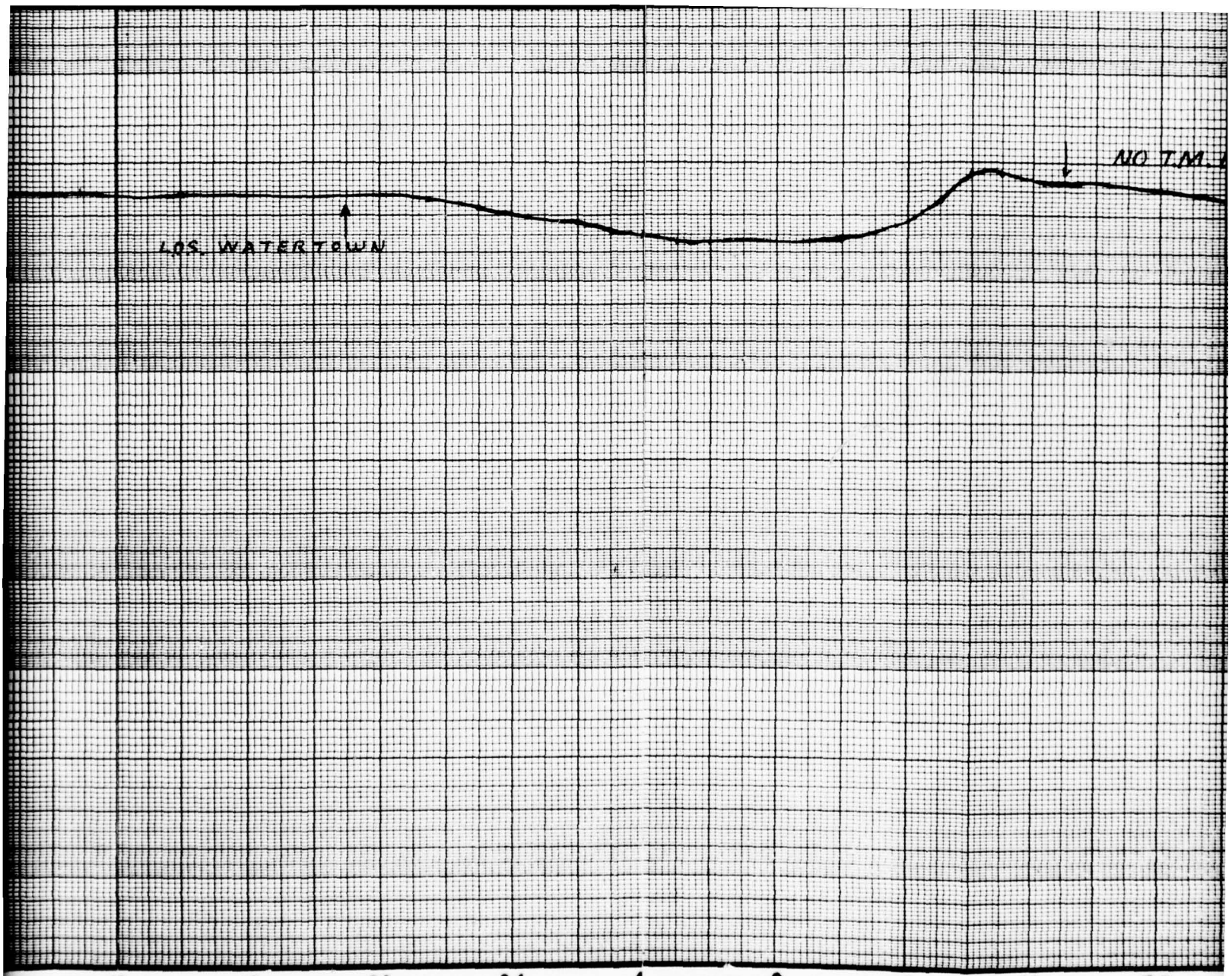
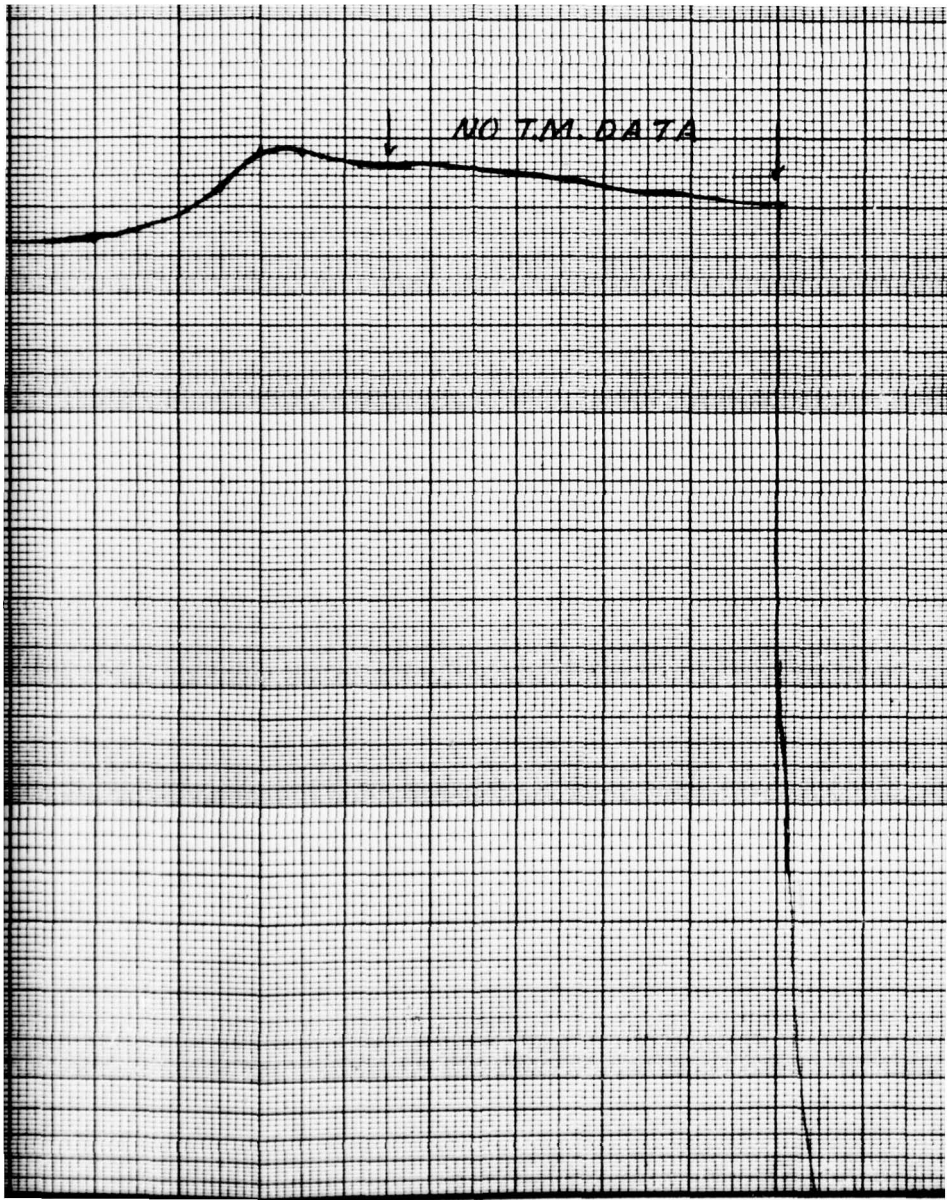
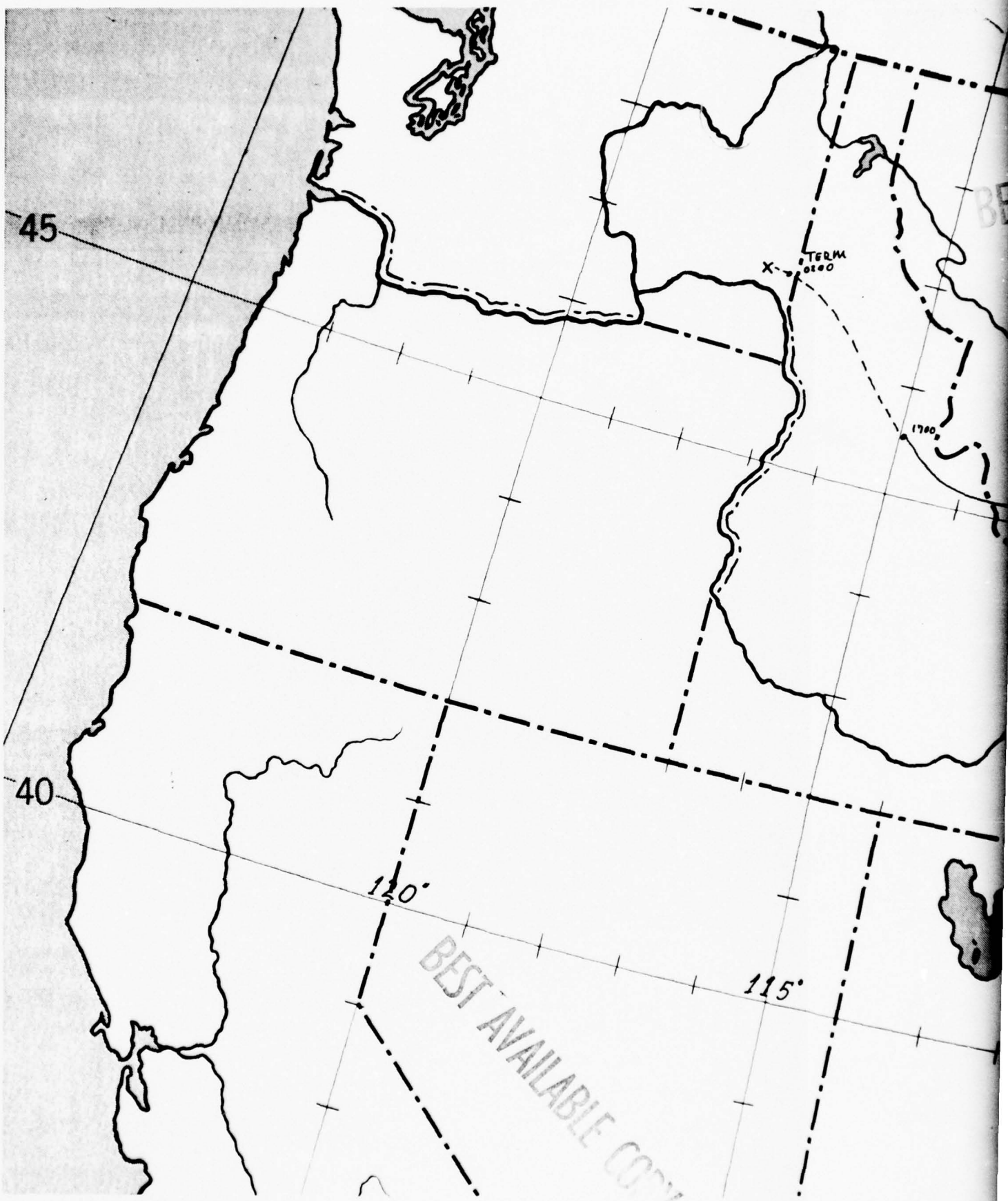
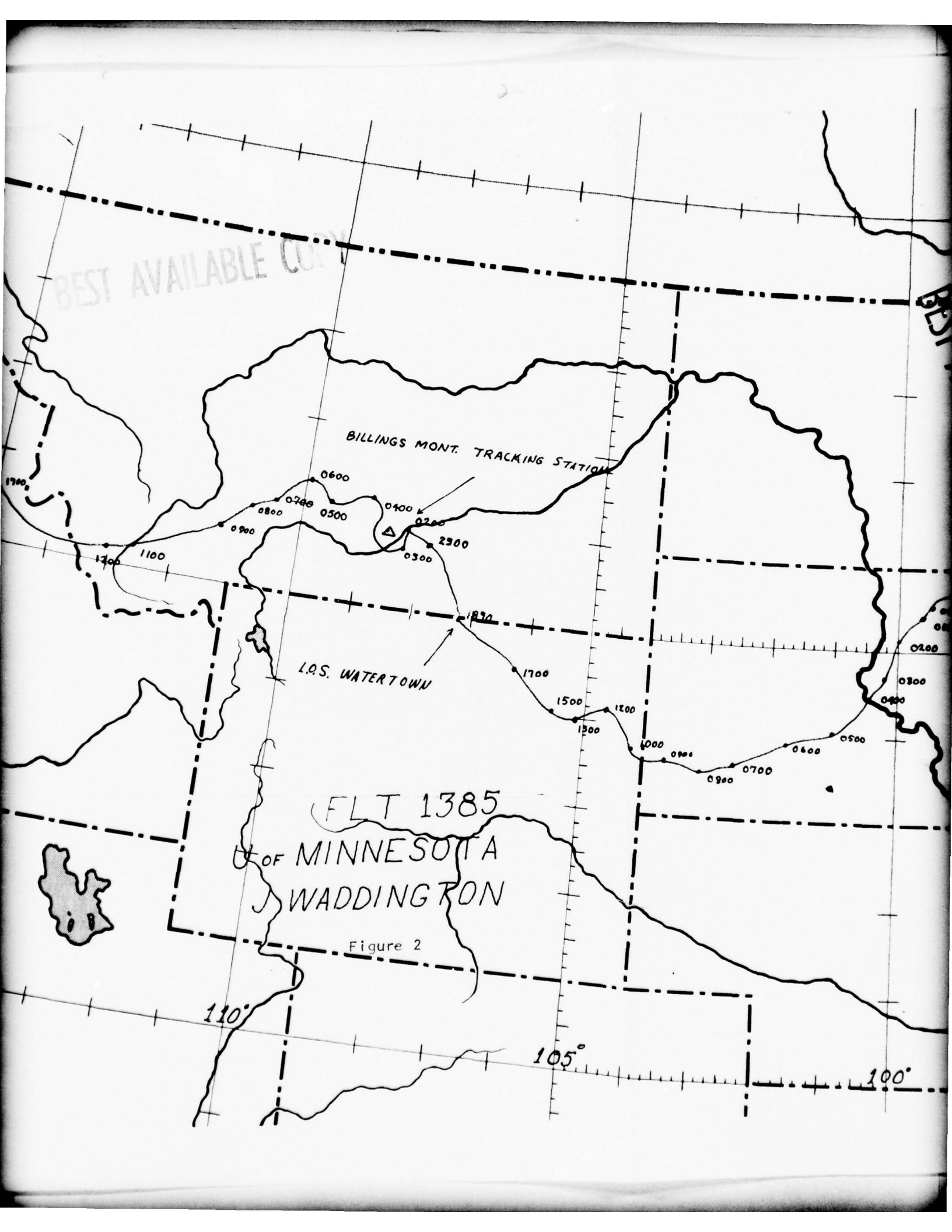


FIGURE 1


NO T.M. DATA


45
40
110°
115°
TERM
0200
1700
X
BEST AVAILABLE COPY

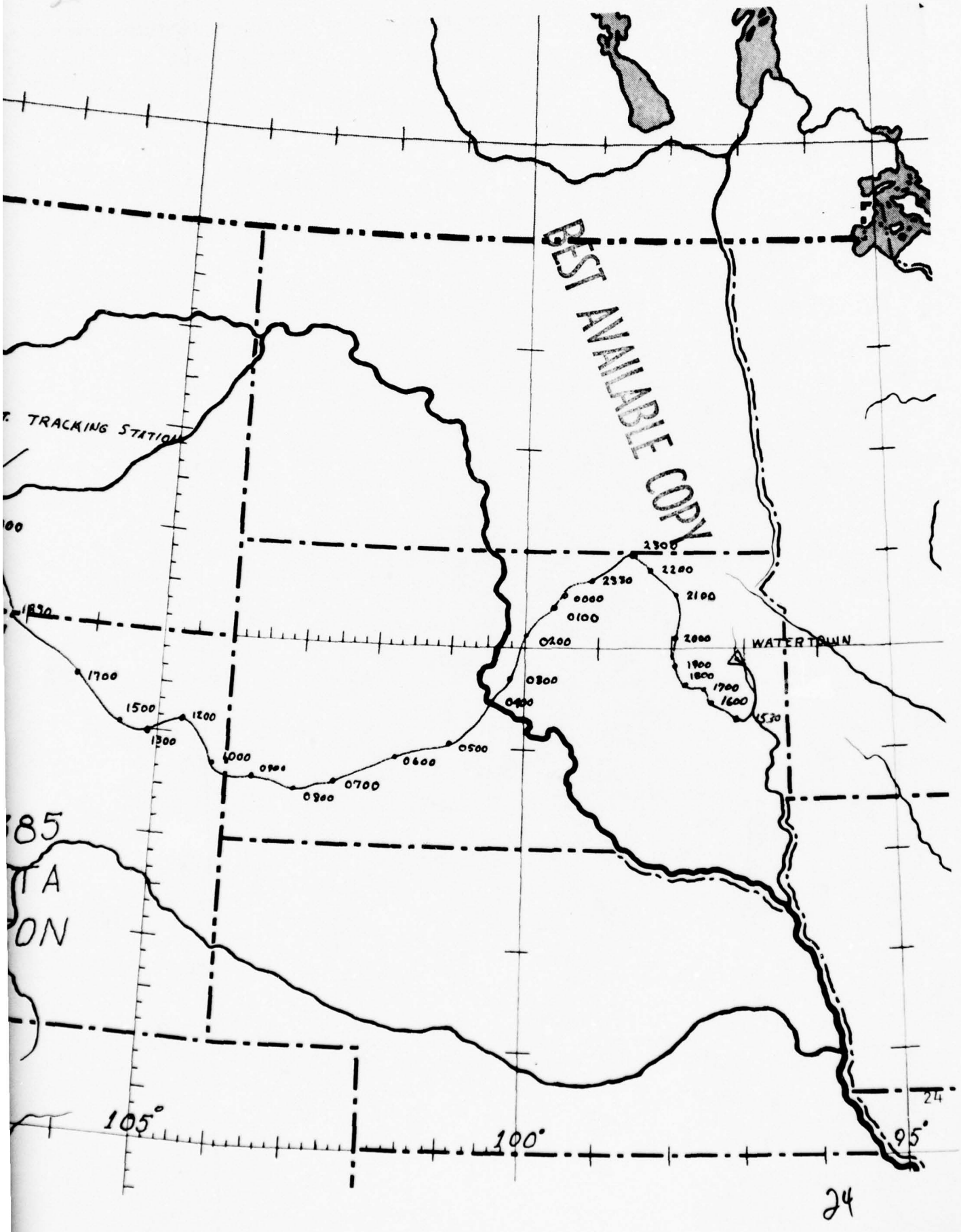


FLT 1385

OF MINNESOTA

WADDINGTON

Figure 2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TRACKING STATION
WATERTOWN
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2200
2100
2000
1900
1800
1700
1600
1530
0000
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0200
0300
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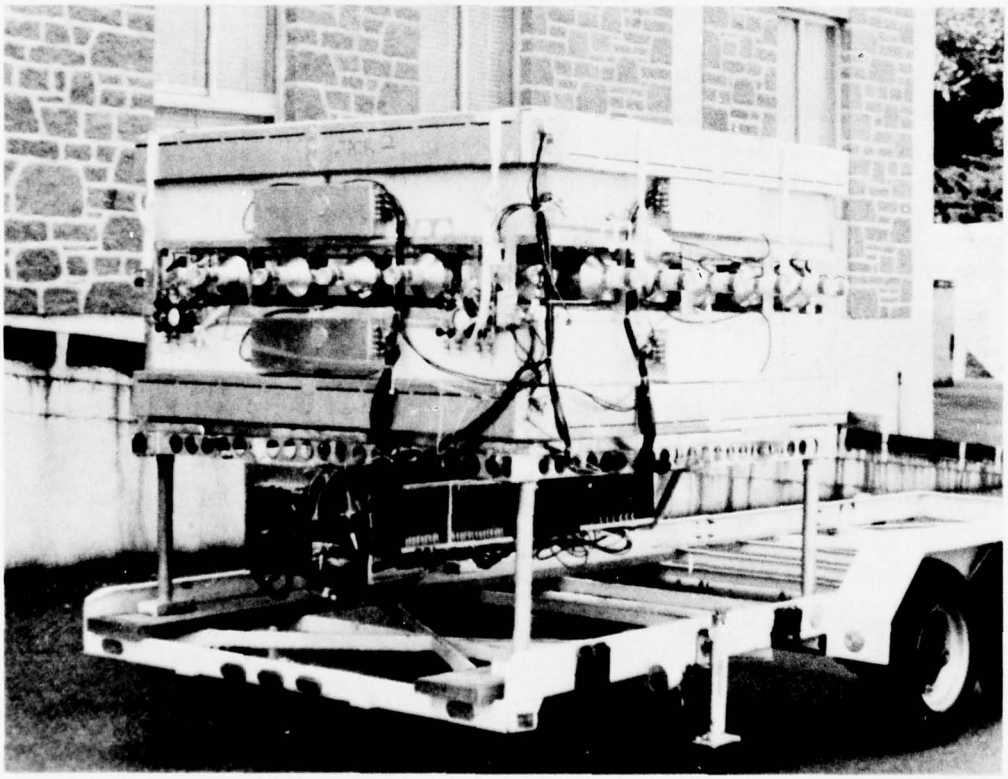
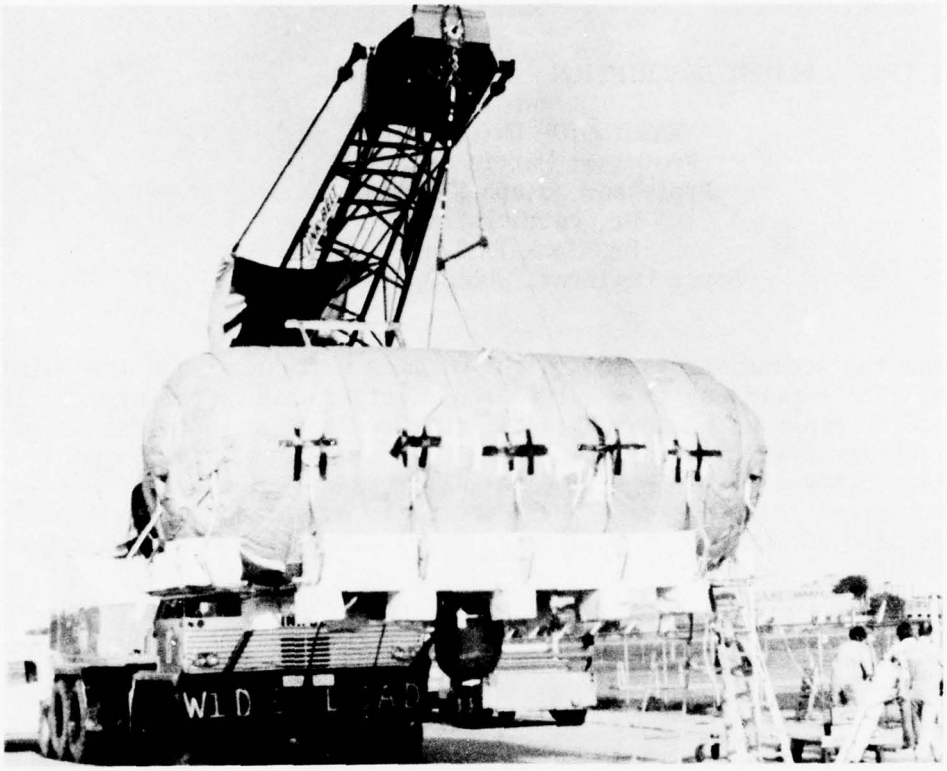
0500
0600
0700
0800
0900
1000
1200
1300
1500
1700
105°
100°
95°
24

FLIGHT 1386 - FLIGHT DESCRIPTION

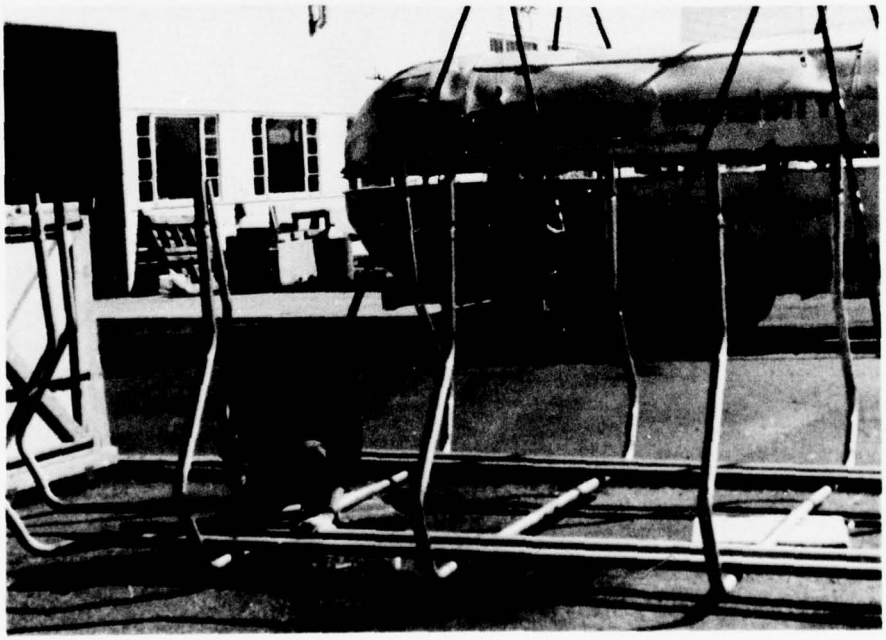
WASHINGTON UNIVERSITY
Professor Martin Israel
Professor Joseph Klarmann
Dr. Patrick Love
Dr. Jack Tueller
Space Engineer, John Epstein

This was the second successful flight of this experiment and its third launch. The experiment is a large area electronic detector principally designed to measure the abundance of individual elements of the ultra heavy (charge greater than zinc: Z = 30) cosmic rays. The large geometry factor of $6.6m^2$ - steradians is necessary to gather a reasonable number of these nuclei. The detector is organized in two dependent modules of $3.3m^2$ with a capability of one additional module for future experiments.



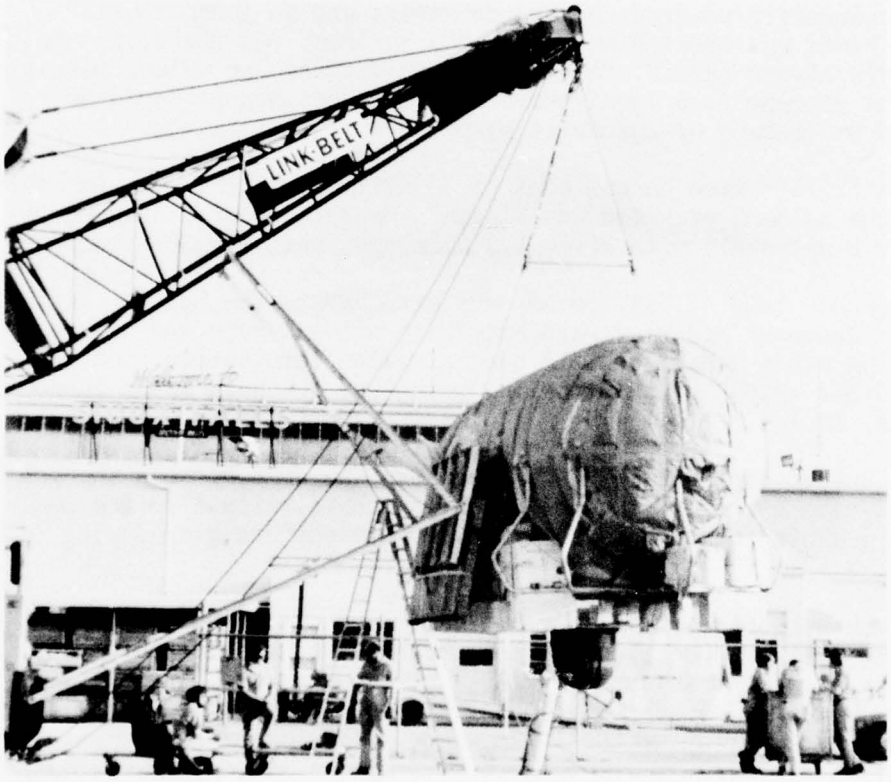


The gondola is 7-1/2 inches in diameter and 22 feet long. The support structure of aluminum tubing provides a platform for external power supplies, balloon instrumentation, and supplemental landing shock absorbers. The structure is designed to absorb landing forces and has proven very effective on all three landings.



Ballast was contained in a centrally located canvas hopper under the experiment. The hopper contained 1500 pounds of #110 steel shot expended through two electromagnetic valves at a rate of 21 pounds per minute. The hopper was also equipped with an emergency drop system with a flow rate of 1000 pounds per minute.

Two electric valves were installed for descending the system to an altitude for safe deployment of the parachute after a forty hour flight.



The launch vehicle selected for launching the Washington experiment was the HC-218 crane which is Raven's launcher for heavy gondolas. The crane configuration, included tag axle, 10,000 pound forward ballast, rear outrigger and 21,000 pound counter balance placed the vehicle weight at 130,000 pounds. Back board placement was adjusted to produce a six inch off center of gondola suspension.

A standard Raven TRAC pac with one auxillary battery pack was provided. Five command channels were used for the experiment.

Experiment house keeping data was returned on FM/FM data channels and displayed on chart recorders. Scientific data was recorded on two, on-board tape recorders.

Control instrumentation provided two commands for termination, two for ballast drops, an emergency ballast drop and parachute release device arming.

Two independently powered command receivers and an independently powered timer was mounted on top of the balloon. In the event the command receivers failed, the timer would actuate one valve, resulting in a slow descent to a level where parachute deployment could be executed by command or automatic by preset pressure switch.

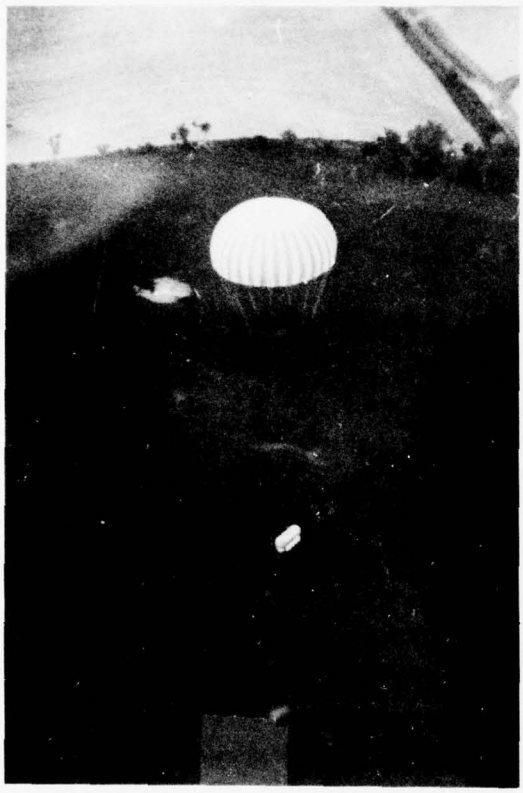
Previous flights were on balloons of 33 million cubic feet. For this flight the balloon provided was Winzen's Serial Number 1-39.6 mcf with a 0.8 mil shell with three 0.9 mil caps, weighing 5003 pounds.

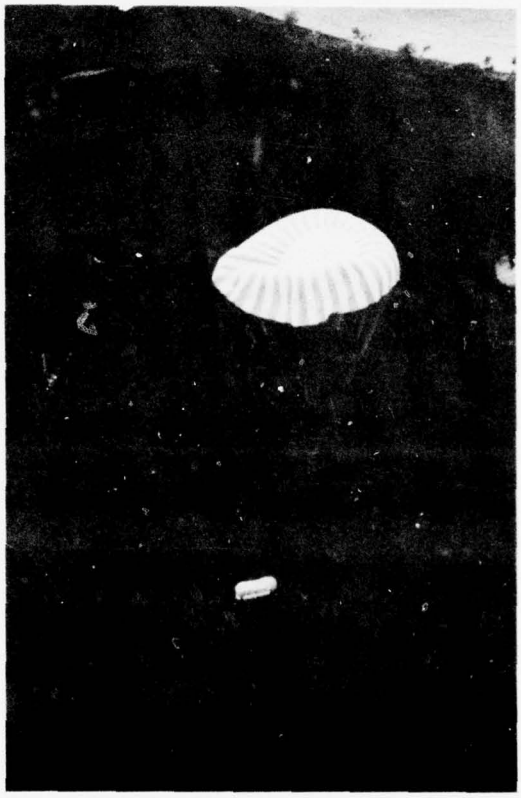
The suspended load of 6567 pounds was attached to the balloon via a 120 foot diameter Security parachute with nylon canopy and dacron suspension lines and risers. A special nylon termination link was designed for 40,000 pounds tensile, using the standard Raven cannons with dual squibs.

A cable suspension of 2-1/2", 80 feet long was used between the gondola and parachute. A standard Raven parachute release device was used to release the gondola on impact to prevent dragging during landing.

Launch was scheduled for 24 May but cancelled due to unfavorable surface winds and direction. The launch was rescheduled for the following night and released in a slight cross wind. Somewhat less than perfect, the launch was nonetheless smooth while requiring considerable manuevering of the large crane.

The balloon ascended normally through the tropopause and up to its' theoretical ceiling of 4.4 millibars. Both scientific and balloon instruments performed flawlessly throughout the float duration of 31.5 hours. The flight was shortened due to a weather system in the area.





Descent was initiated with termination being executed at 85,000 feet. The gondola landed some 85 miles from the launch site, was recovered and returned to the lab the same night.

The gondola "suffered" its usual outward damage but the contents were in excellent condition and still operating. Damage to the shell was limited to small cracks at sharp bends in the wrinkled shell.

This concluded the 1976 program for Washington University. The crew and equipment returned to St. Louis after six weeks in the field.

NOTE: All photos for this flight were taken by Mr. John Epstein.

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1386 Director Fulkerson

2. Scientist Israel Group Wash. U Date/Time 5-25-76 /11:29Z

3. Launch: Site Sioux Falls,SD Technique/Launch Veh. Dynamic/Crane

4. Balloon Performance: Theoretical Ceiling 4.44 mb, 37.86 km
Actual Ceiling 4.04 mb, 38.56 km

5. Ascent Rate: Surface to Ceiling, Average 2.67 mps

6. Flight Duration: Total 36 hr 06 min At ceiling 31 hr 30 min

7. Termination: Date/Time 5-26-76/ 23:00Z. Method R/C - 206

8. Balloon Destruction: Confirmed, visually, etc. Visual

9. Landing: Date/Time 5-26-76 / 23:35 Z. Location 95°38' - 42°20'

10. NOTAM Close out: Date/Time 5-26-76 / 23:30 Z. Activity Minneapolis Center

11. Frequencies Used:

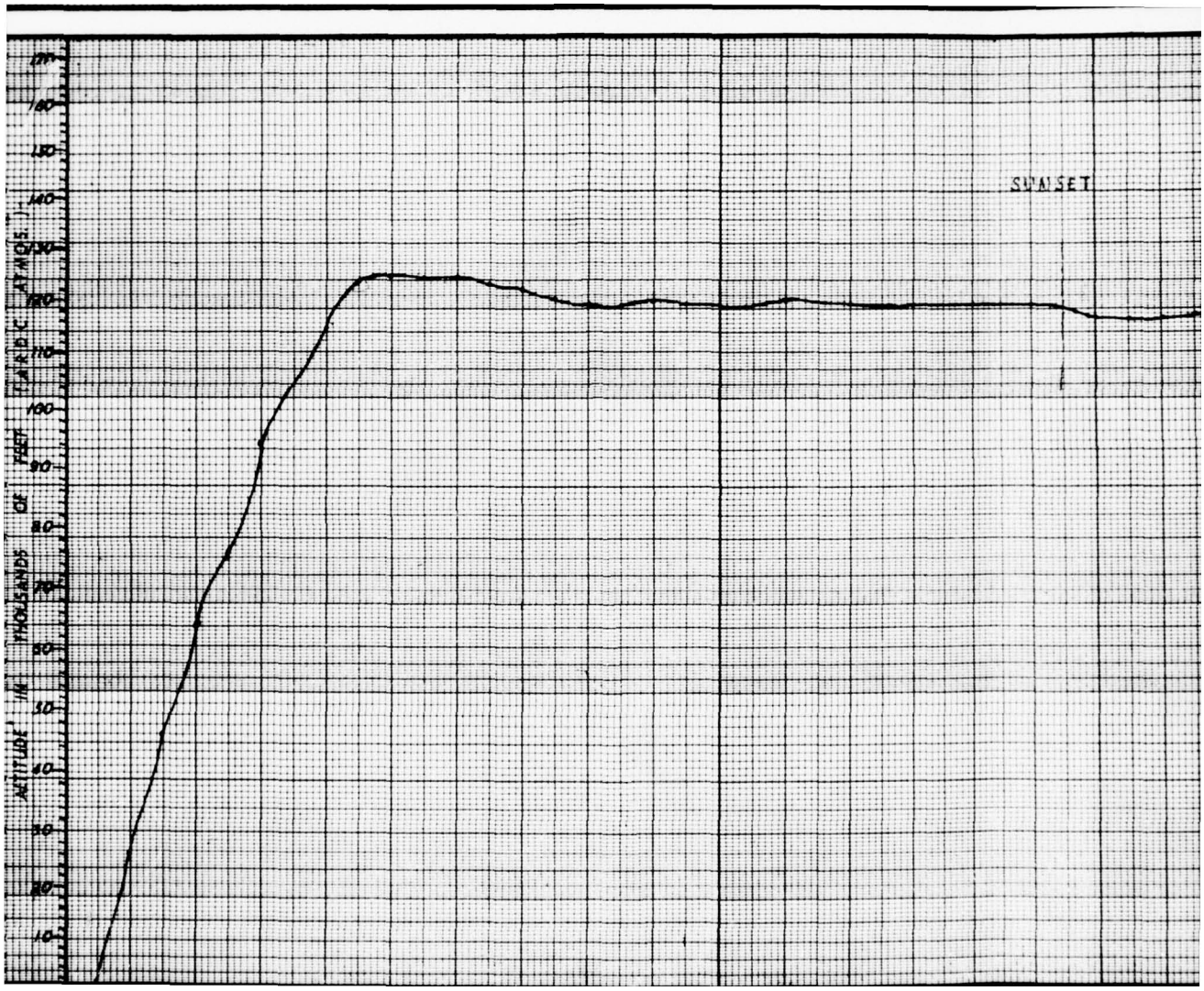
(MHz)	Emission	Purpose	Power	Time
1533.5	1000F9	Telemetry	2W	40
149.4	30F9	Communications and Command	80W	40
7.465	3A3J	Communications	100W	40

12. Balloon Specs: SF464.82-080-NSC-01 Serial No. 1

Material SF Vol. 39.6 MCF Gauge 0.8 mil. 3 ea. 0.9 cans

Balloon	5003
& Parachute (Dia 36.6 m)	307
Raven Instrumentation	78
Ballast & Bag	1555
Scientific Package	4300
Cable Ladder, Pin Fitting & Transponder	156
Timers, External Batteries & Strobelight	51
Crush Pad, Top Payload & Photo. Baro. W.U	120
Gross Weight	11570
Free Lift...12%	1388
Gross Inflation	12958

13. Comments


SUNSET
ALTITUDE IN THOUSANDS OF FEET
BASIC ATMOS.
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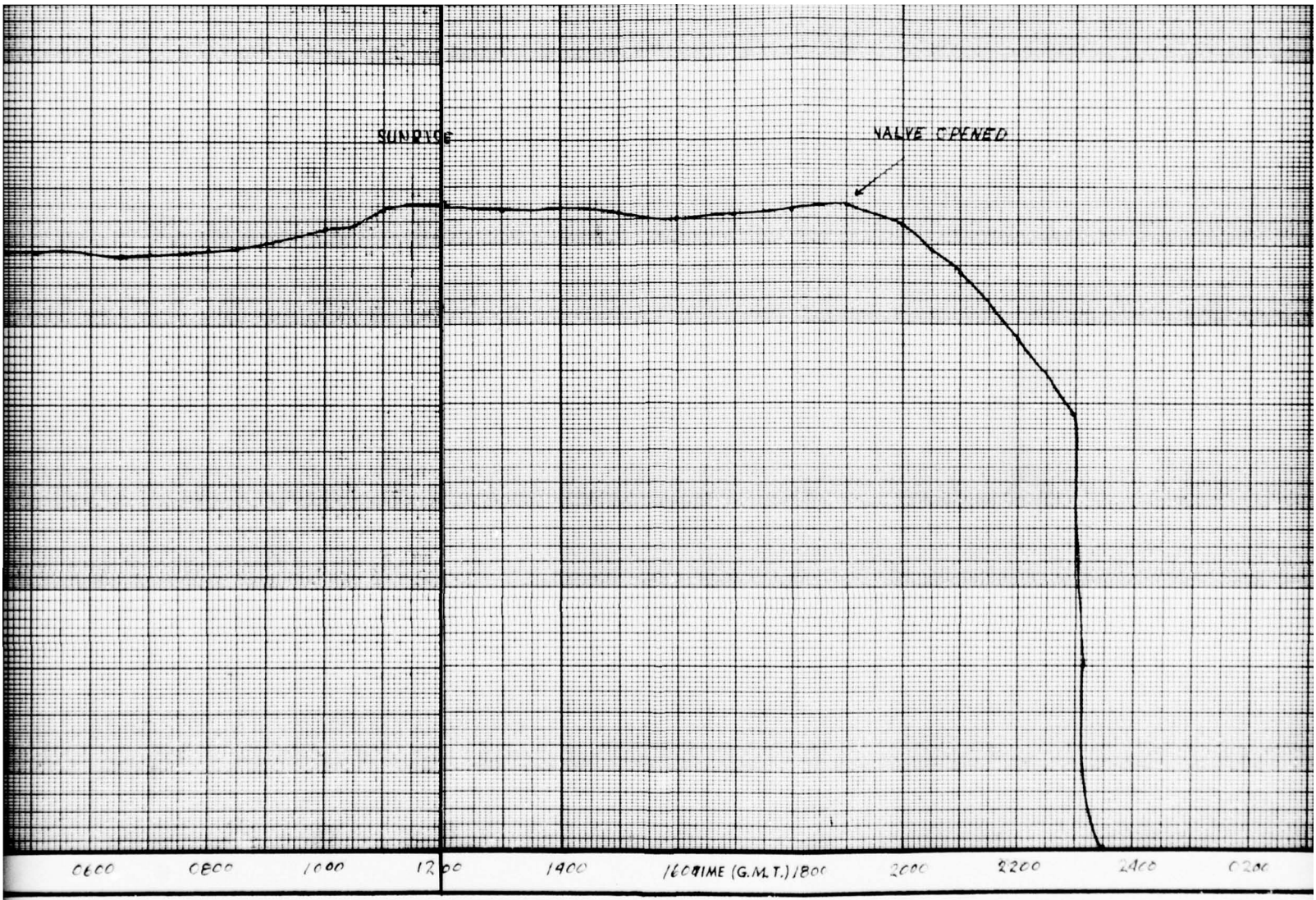
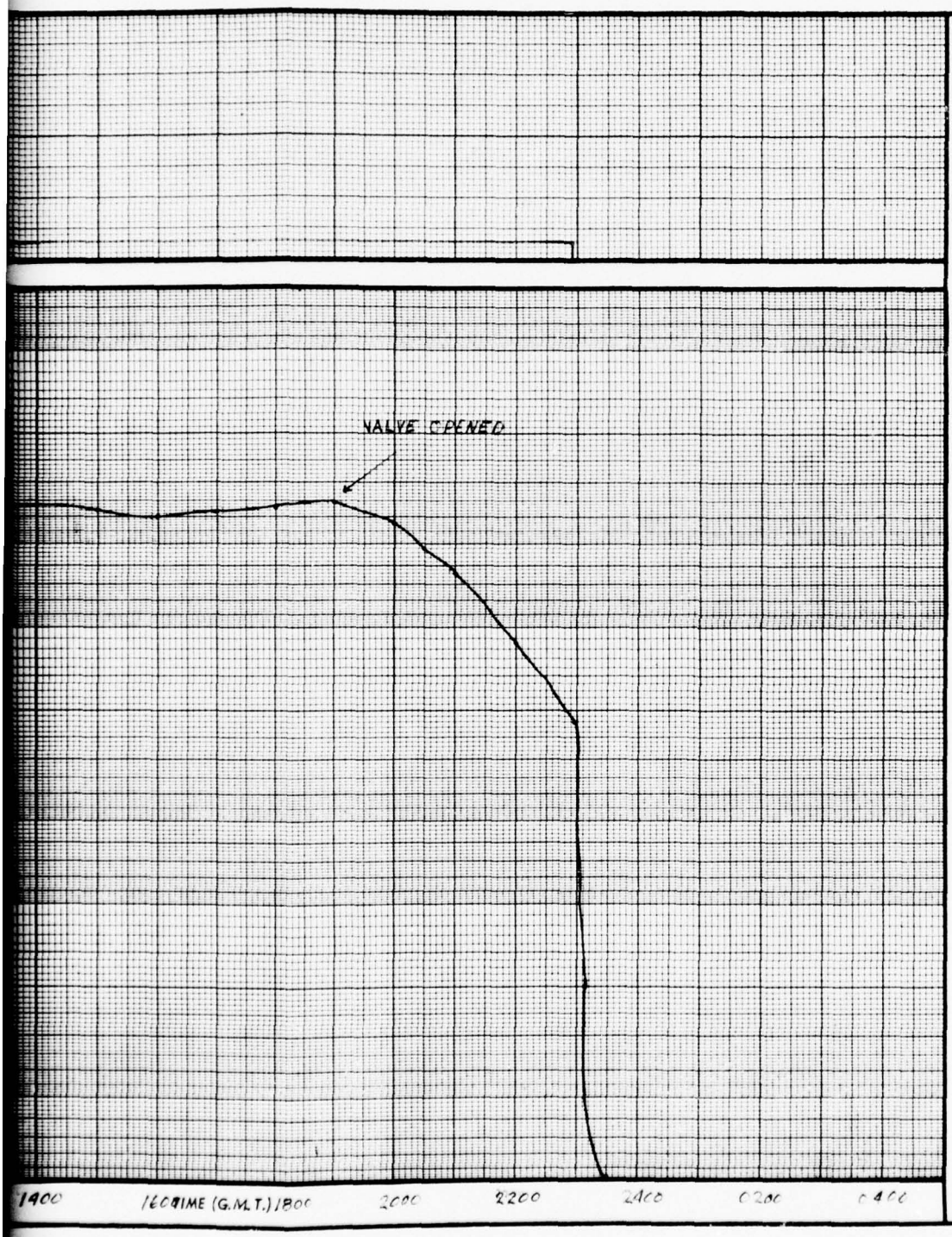

SUNRISE
VALVE OPENED
0600
0800
1000
1200
1400
1600
TIME (G.M.T.)
1800
2000
2200
2400
0200

Figure 3



FLIGHT NO. 1386

DATE: 25 MAY 76

FOR: WASHINGTON U
ISRAEL
KLARMANN
LOVE
TUELER

BALLOON

TYPE: NSC

VOL: 39.6

MATL: STRATOFILM

WT: 5003

LOAD FACTORS

PAYLOAD: 6567

GROSS LD: 11570

FREE LIFT: 1388

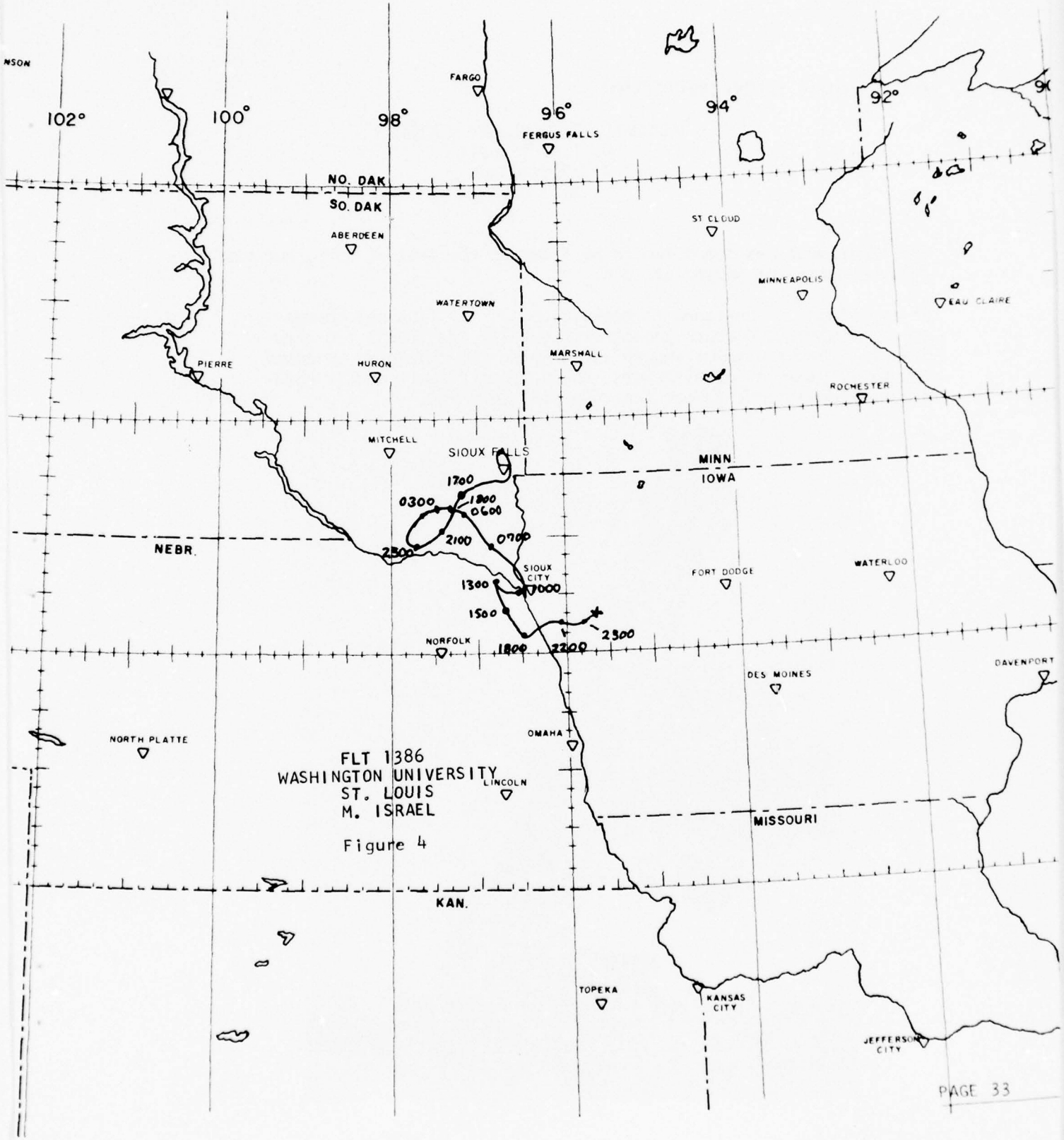
BALLAST: 1500

RAVEN industries, inc.

DR.

CHK.

APPR.



FLT 1386
WASHINGTON UNIVERSITY
ST. LOUIS
M. ISRAEL

Figure 4

FLIGHT 1387 - FLIGHT DESCRIPTION

MARSHALL SPACE FLIGHT CENTER
Dr. T.A. Parnell
Jim Derrickson
Pete Eby

The experiment was scheduled to be flown in the fall of 1975, but was delayed until the spring of 1976.

An experiment is designed to measure cosmic ray flux and charge spectrum above a certain geomagnetic cut-off and from Z = 6 thru Z = 28. The experiment incorporated pulse ion chambers, Cerenkov counters, plastic scintillators, and a proportional counter hodoscope. Geometrical factor was 1400 cm^2/steradian.

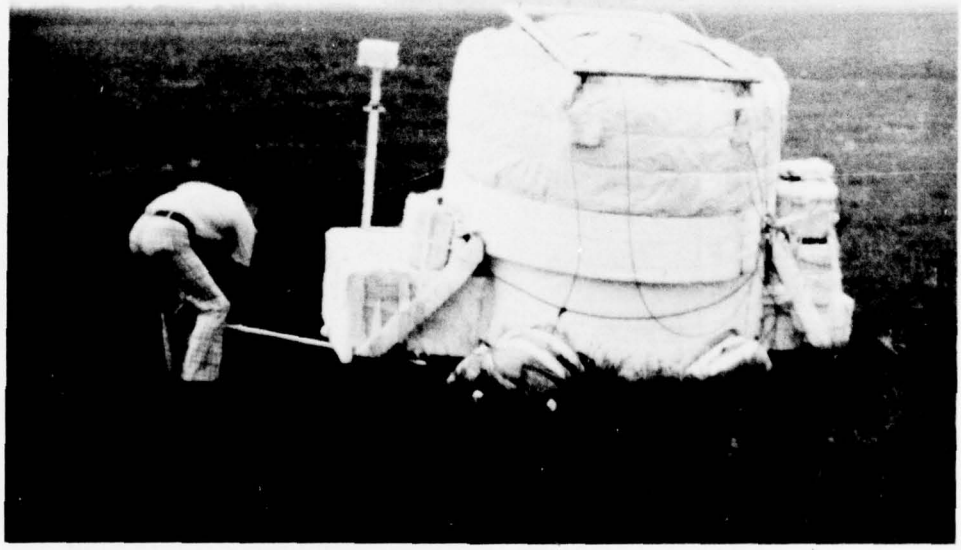
All data was transmitted via "L" band data link and recorded on tape in the scientific van. Normally a dual transmitter was used with a switching arrangement in case of failure of one transmitter. On this flight, however, a single transmitter was provided by Raven.

Launch requirements called for a launch which would enhance total duration with a minimum of ballast. A float level of 3.3 mbs for 40 hours was desired. Two Winzen 15.6 mcf balloons were provided.

Electronic interface required a binary TRAC pac with 30 commands available, of which 23 were for scientific use and seven for balloon functions.

After numerous cancellations due to surface conditions, the flight was finally launched on 29 May. As the balloon reached ceiling the data transmitter became intermittant. Some data was acquired but the signal strength was so low that the data was worthless.

After floating four hours the flight was terminated, recovered and returned back to the lab and refurbished for flight the following day.



SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1387 Director Fulkerson

2. Scientist Parnell Group M.S.F.C. Date/Time 5-29-76 /12:59Z

3. Launch: Site Sioux Falls,SD Technique/Launch Veh. Dynamic/Crane

4. Balloon Performance: Theoretical Ceiling 4.86 mb, 37.2 km
   Actual Ceiling 4.53 mb, 37.65 km

5. Ascent Rate: Surface to Ceiling, Average 3.7 mps

6. Flight Duration: Total 7 hr 50 min At ceiling 4 hr 14 min

7. Termination: Date/Time 5-29-76 / 20:03 Z. Method R/C - 206

8. Balloon Destruction: Confirmed, visually, etc.

9. Landing: Date/Time 5-29-76/ 20:49 Z. Location 98°42' - 43°32'

10. NOTAM Close out: Date/Time 5-29-76 / 20:50 Z. Activity Minneapolis Center

11. Frequencies Used:

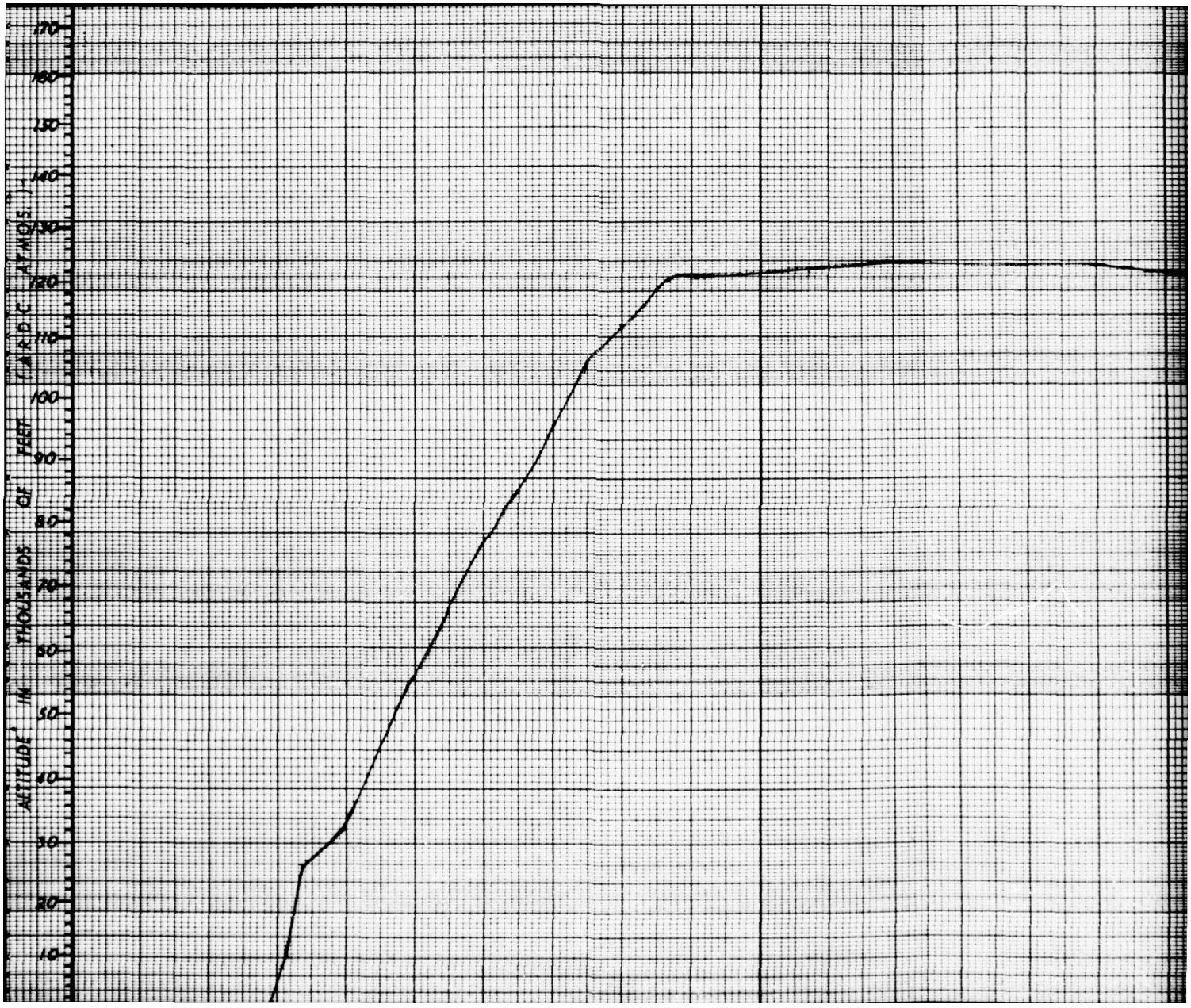
(MHz)	Emission	Purpose	Power	Time
1525.5	1000F9	Telemetry	2W	10
149.4	30F9	Communications And Command	80W	10
7.465	3A3J	Communications	100W	10

12. Balloon Specs: SF346.89-060-NSCH-04 Serial No. 19

Material SF Vol. 15.6 MCF Gauge 0.6 mil. 2 ea. 0.6 caps

	Balloon	1740
Load Line &	Parachute (Dia 30.5 m)	215
	Raven Instrumentation	78
	Ballast..&.Bag	720
	Scientific Package	1720
Cable	Ladder, Timers & Strobe	68
External	Batteries & Transponder	95
	Pin Fitting & Crush Pad	38
	Gross Weight	4674
	Free Lift.....14%.....	654
	Gross Inflation	5328

13. Comments Data transmitter failure - Flight had to be terminated.


ALTITUDE IN THOUSANDS OF FEET
170
160
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100
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80
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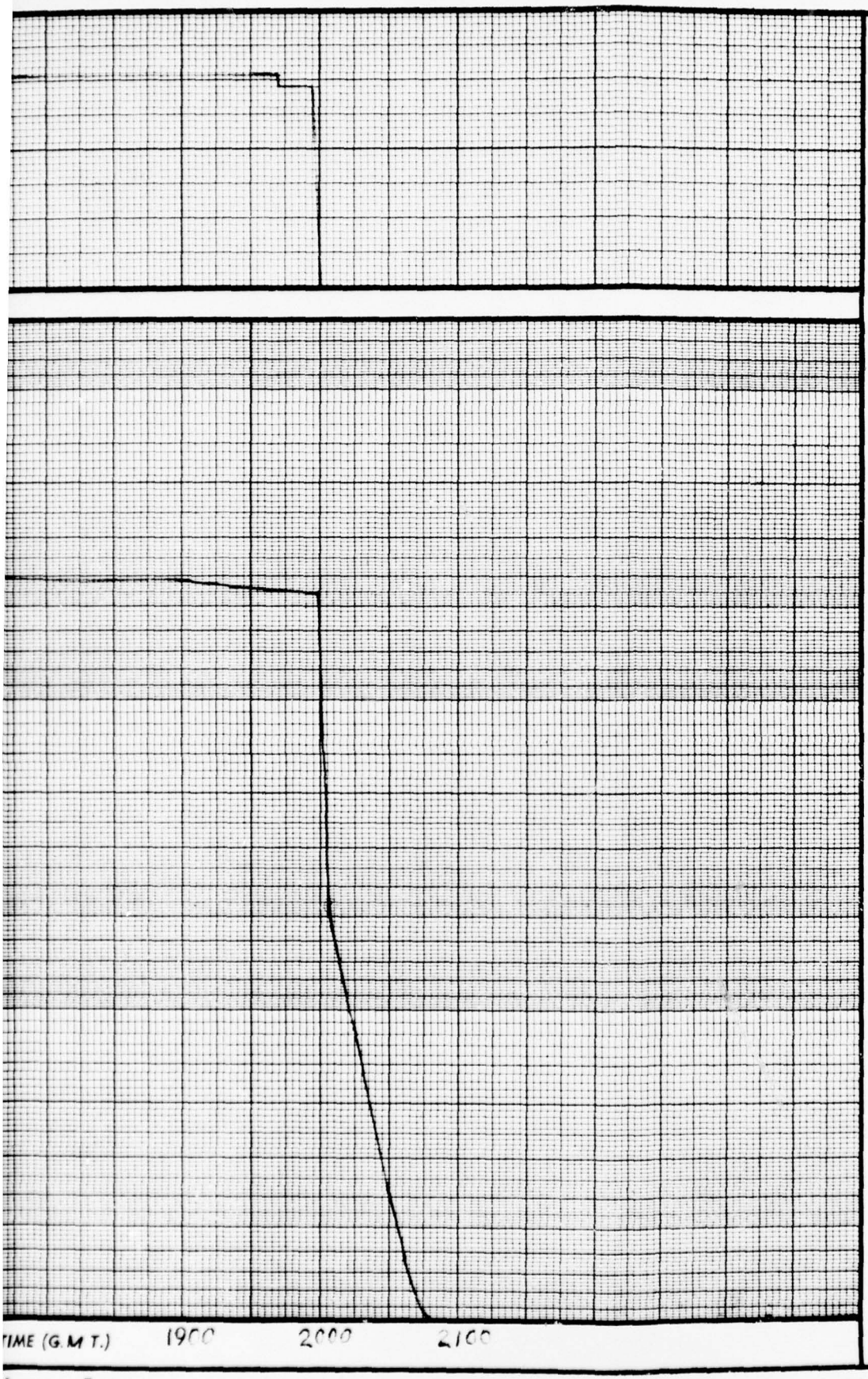
60
50
40
30
20
10



FLIGHT NO. 1387

DATE: 29 MAY 76

FOR: MARSHALL SPACE FLIGHT CENTER
DR. T. PARNELL

BALLOON

TYPE: NSCH
VOL: 15.6 10^6
MATL: STRATOFILM
WT: 1740

LOAD FACTORS

PAYLOAD: 2934
GROSS LD: 4674
FREE LIFT: 654
BALLAST: 700

RAVEN industries, inc.

DR.
CHK.
APPR.

igure 5

FLIGHT 1388 - FLIGHT DESCRIPTION

MARSHALL SPACE FLIGHT CENTER
Dr. T.A. Parnell
Jim Derrickson
Pete Eby

The experiment was checked out and found to be in excellent shape. Batteries were recharged and launch was scheduled for the evening of 31 May.

During inflation winds increased from five to twelve miles per hour. The inflation was completed with some difficulty.

During the launch the flight train became slack as the balloon moved toward the launch crane. The suspension cable between the gondola and parachute fell over the side of the crane and was hung up on a two inch pin on the crane rigging. Unable to safely remove the cable from the pin, the flight was aborted.

The cause of the abort was due to a combination of reasons. First, high wind during launch, cable deployment, and inadequate cover over the crane structure.

Plans for a third flight were cancelled due to funds and the time required to obtain another balloon.

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1388 Director Fulkerson

2. Scientist Parnell Group M.S.F.C. Date/Time 6-1-76 /02:26 Z

3. Launch: Site Sioux Falls,SD Technique/Launch Veh. Dynamic/Crane

4. Balloon Performance: Theoretical Ceiling 4.86 mb, 37.2 km
   Actual Ceiling -- mb, -- km

5. Ascent Rate: Surface to Ceiling, Average -- mps

6. Flight Duration: Total -- hr -- min At ceiling -- hr -- min

7. Termination: Date/Time 6-1-76 /05:28 Z. Method R/C-Flight Line

8. Balloon Destruction: Confirmed, visually, etc. Visual

9. Landing: Date/Time -- / -- Z. Location Foss Field-Abort

10. NOTAM Close out: Date/Time 6-1-76 / 05:30 Z. Activity Sioux Falls Tower

11. Frequencies Used:

(MHz)	Emission	Purpose	Power	Time
1525.5	1000F9	Telemetry	2W	2
149.4	30F9	Communications And Command	80W	2
7.465	3A3J	Communications	100W	2

12. Balloon Specs: SF346.89-060-NSCH-04 Serial No. 20

Material SF Vol. 15.6 MCF Gauge 0.6 mil. 2 ea. 0.6 caps

Balloon	1732
Parachute (Dia 30.5 m)	210
Raven Instrumentation	
Ballast & Bag	720
Scientific Package	1850*
External Batteries	75
Cable Ladder	60
Crush Pad	20
Gross Weight	4667
Free Lift 14%	653
Gross Inflation	5320

*Includes: Strobe, Timers, Transponder, Raven Inst., Antennas

13. Comments Strong surface wind at release. The cable ladder caught on the back of the crane causing the flight to be aborted.

FLIGHT 1389 - FLIGHT DESCRIPTION

UNIVERSITY OF WYOMING
Drs. J.M. Rosen & D.J. Hoffman
Mr. John Drummond

NITRIC OXIDE EXPERIMENT - Nitric oxide is an important constituent concerning the chemistry of the ozone layer in the stratosphere. The importance of the ozone and its function of shielding the earth from damaging ultraviolet light has been well documented in popular literature. Ozone is produced continuously by sunlight and is destroyed by chemical reaction. Current chemical models show that naturally occuring nitric oxide is responsible for catalytic destructions of 70% of the total. For this reason, accurate measurement of NO is very important. Relatively few NO soundings have been made to date. The highest in-situ measurements have been made to 34 km. The University of Wyoming experiment measures NO to approximately 46 km.

Wyoming's NO detector is of the chemiluminescent type using ozone and nitril oxide as reactants. Photons are produced by the reaction $NO + O_3 + NO_2 + O_2$ + Light, and are detected by a cooled photomultiplyer tube. The sample gas is admitted through a four inch glass inlet tube and is heated to 30°C. The gas in then mixed with ozone in front of the photomultiplyer tube in a gold lined glass reaction chamber. The gas in then pumped by a positive displacement lobe blower at three liters/sec and is exhausted through a ten foot tube away from the sample tube. Provisions are made for on-board calibrations and zeroing of the nitric oxide signal. The data is recorded on a four-channel tape cassette recorder, and by a ten channel FM telemetry link at 1680 MHz.

The experiment was compact, weighing just over 100 pounds including the let-down reel.

Flight requirements were launch after sunrise so that equilibrium in stratospheric NO distribution is reached. Once float altitude was reached, valve down to approximately 60,000 feet and terminate, descent and impact to be non-destructive.

The balloon provided for this flight was a Raven 15.5 mcf of 0.6 mil shell and two 0.5V caps, weighing 1,400 pounds.

Instrumentation included the standard TRAC pack, a command receiver mounted on the experiment with an E-Cell timer and command receiver on top of the balloon with a squib operated valve.

The purpose of the command receiver mounted on the experiment was for turning the experiment on and off to conserve battery power during the long slow descent. At launch the experiment was close coupled to the TRAC pack and ballast. During ascent a pressure switch in the experiment starts the let down reel at 3,000 feet. Deployment of the 300 foot line requires several minutes.

A hitchhike was flown for the ONR which was a command receiver with ranging capability. The receiver is the size of a shoe box and weighs about six pounds. Powered with a rechargeable dry battery, the unit is designed as an expendable instrument for flights where recovery is not necessary or required.

The launch was delayed several days and finally launch on 27 June.

The balloon reached its theoretical ceiling of 1.75 mbs and took up a westerly trajectory at a speed of 70 miles per hour.

The University of Wyoming experiment performed well up to 1500Z when data indicated the small lobe pump was malfunctioning due to over heating. The experiment was commanded off to allow the pump to cool. After twenty minutes it was turned on again but appeared to have seized. At various intervals the experiment was turned on with no results.

The experiment was shut off for good at 1644Z. Termination of the flight, however, was delayed until the balloon had moved down range a sufficient distance to check out the ranging system of the hitchhike command receiver and also to check out the balloons descent after the E-Cell timer opened the helium valve.

All balloon control instrumentation performed well throughout the flight except for a few moments when the balloon was directly overhead.

The balloon was terminated by command from the Cessna 206 tracking aircraft. During descent the scientific experiment became separated from the flight train and free fell but was recovered. Apparently the exhaust hose had swung down during initial descent and struck the parachute release (impact) switch on the gondola which in turn severed the support line to the experiment.

The Wyoming experiment was demolished, however, the onboard tape recorder was reasonably intact so the scientific data was recovered.

The TRAC package and receiver landed gently, disconnected from the parachute and rolled down into a gully. No damage was sustained.

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1389 Director Fulkerson

2. Scientist Hoffman-Rosen Group U of Wyoming Date/Time 6-27-76 / 11:10Z

3. Launch: Site Sioux Falls,SD Technique/Launch Veh. Dynamic M-36

4. Balloon Performance: Theoretical Ceiling 1.67 mb, 45.4 km
   Actual Ceiling 2.02 mb, 43.9 km

5. Ascent Rate: Surface to Ceiling, Average 2.9 mps

6. Flight Duration: Total 7 hr 10 min At ceiling 0 hr 7 min

7. Termination: Date/Time 6-27-76/17:07 Z. Method R/C - 206

8. Balloon Destruction: Confirmed, visually, etc. Visual

9. Landing: Date/Time 6-27-76 / 18:20 Z. Location 100°32'-43°59' Wyo.
   99°47'-43°59' Raven

10. NOTAM Close out: Date/Time 6-27-76 / 18:15 Z. Activity Minneapolis Center

11. Frequencies Used:

(MHz)	Emission	Purpose	Power	Time
1529.5	1000F9	Telemetry	2W	10
149.4	30F9	Communications & Command	80W	10
7.465	3A3J	Communications	100W	10

12. Balloon Specs: N405-15/25T-438.9 Serial No. 106

Material Poly Vol. 15.5 MCF Gauge 0.6 mil. 2 ea. 0.5 cans

Balloon	1397
Parachute (Dia 38' m)	50
Raven Instrumentation	78
Ballast	175
Scientific Package	111
Timers	17
Frame & Crush Pad	18
Receivers, 3 each	26
Gross Weight	1872
Free Lift	225
Gross Inflation	2097

13. Comments Scientific experiment free fell at termination due to a malfunction of the impact switch on the scientific experiment.
Hitchhike Williamson Receiver, Serial No. 2

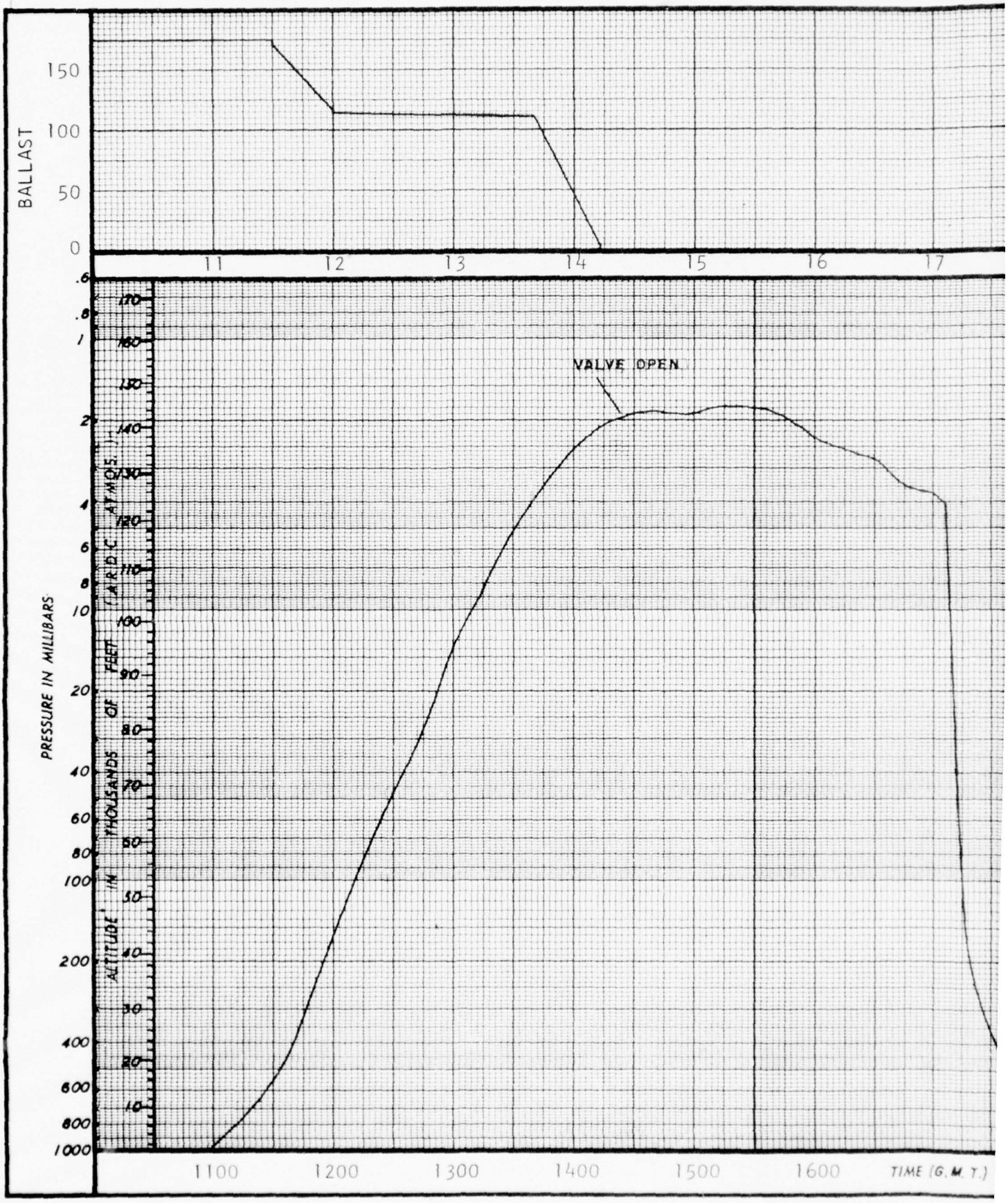
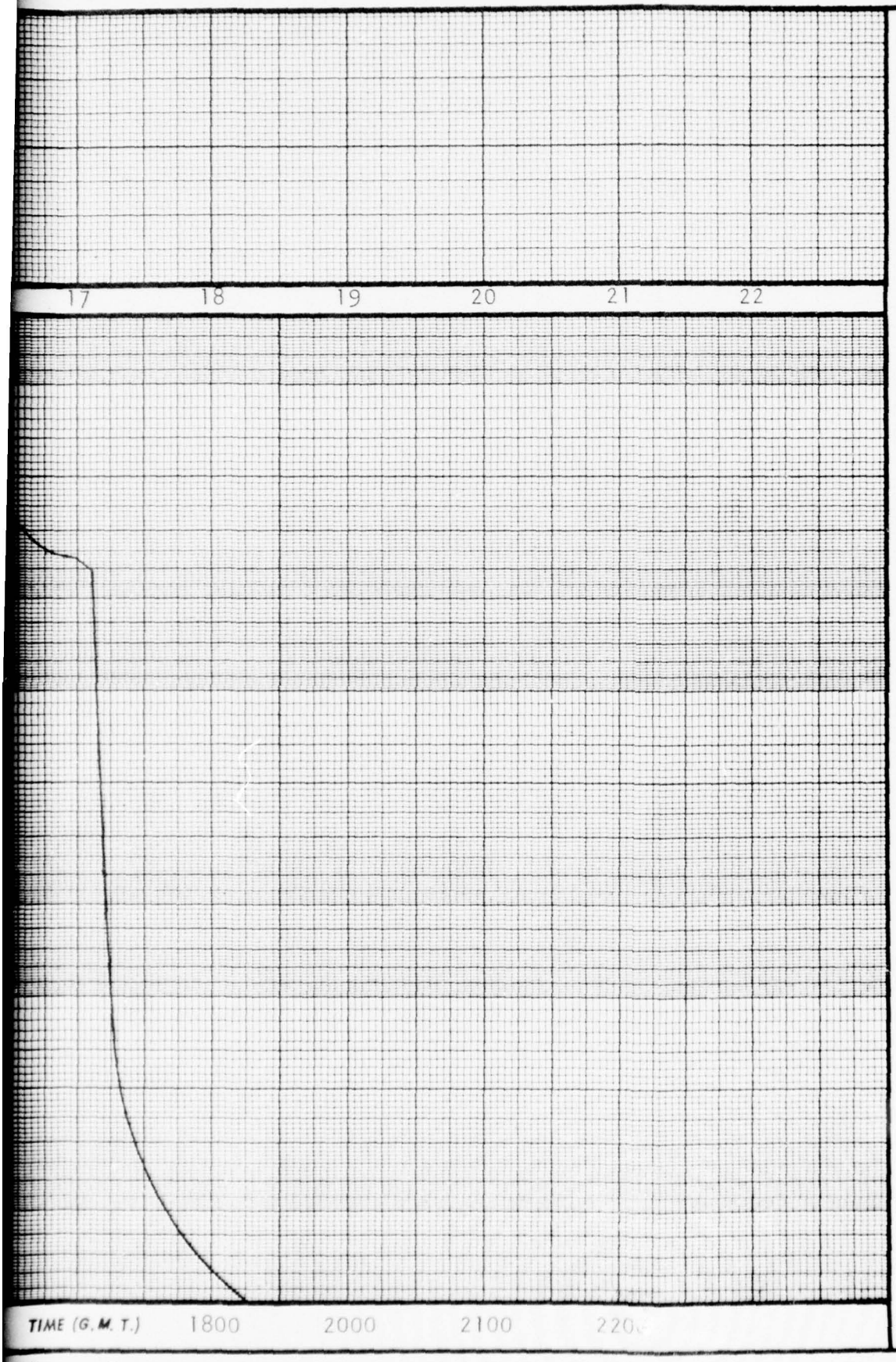

BALLAST
150
100
50
0
11
12
13
14
15
16
17
VALVE OPEN.
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (A.R.D.C. ATMOS.)
.6
.8
1
2
4
6
8
10
20
40
60
80
100
200
400
600
800
1000
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
1100
1200
1300
1400
1500
1600
TIME (G.M.T.)

Figure 7



FLIGHT NO. 1389

DATE: 27 JUNE 1976

FOR: U. of WYOMING
DR. HOFFMAN
DR. ROSEN
MR. DRUMMOND

BALLOON

TYPE: NSC

VOL: 15.5×10^6

MATL: X124

WT: 1397 (LBS.)

LOAD FACTORS (LBS.)

PAYLOAD:	475
GROSS LD:	1872
FREE LIFT:	225
BALLAST:	175

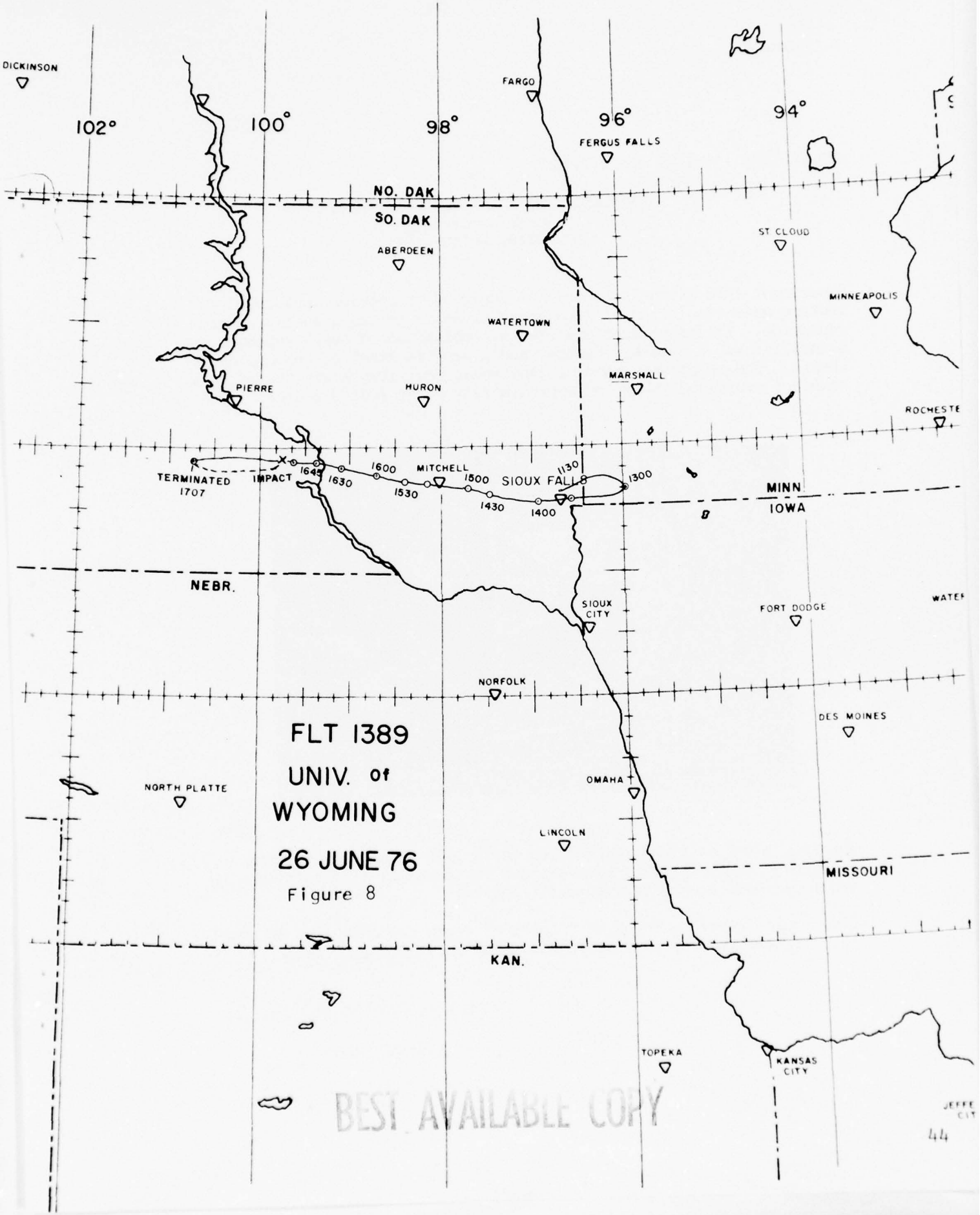
RAVEN industries, inc.

DR.

CHK.

APPR.

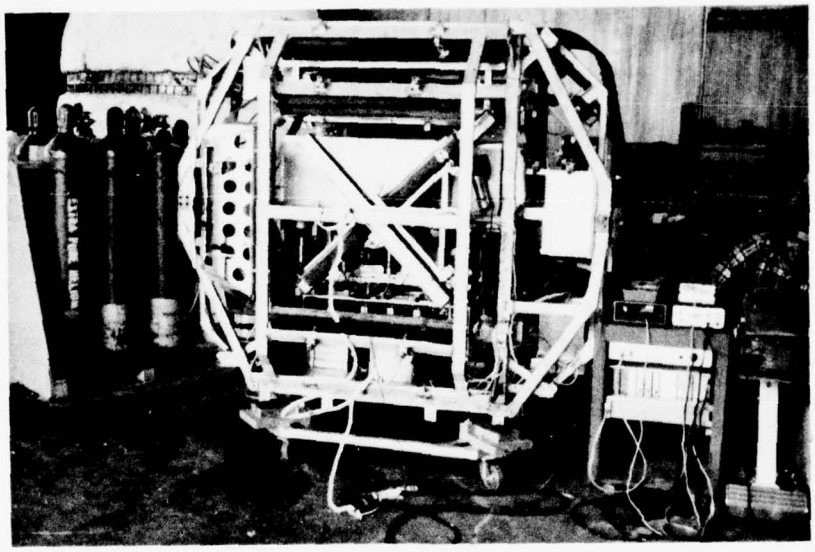
Figure 7



FLIGHT 1393 - FLIGHT DESCRIPTION

UNIVERSITY OF CALIFORNIA - BERKLEY
P. Buford Price
Dr. Brian Cartwright

Experiment IRIS (Iron Isotopes) was designed to provide individual isotope mass resolution of iron group elements in the galactic cosmic radiation. The experiment utilized a combination of spark chambers, scintillators, a Cerenkov counter and a passive stack of Lexan plastic sheets. The relatively compact electronic contrivance was housed in a somewhat oversized sphere of approximately eight foot diameter.

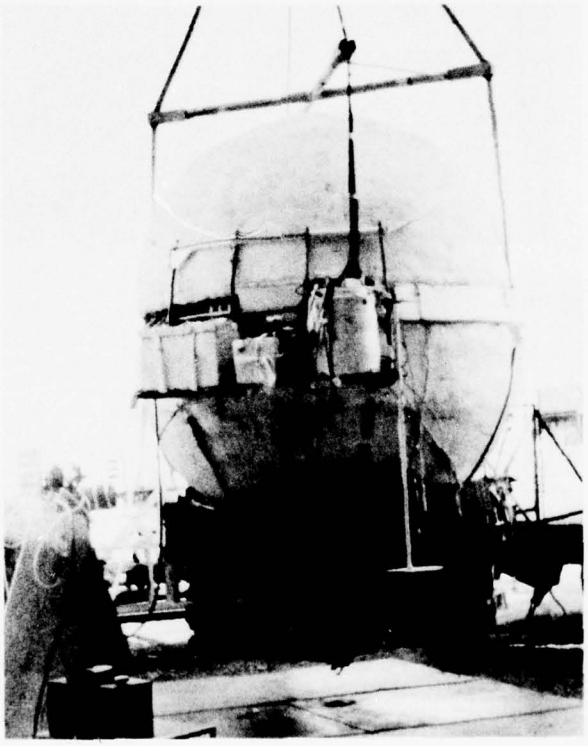


The launch was originally scheduled for a 1976 spring launch from Watertown, South Dakota. However, due to technical difficulties with the experiment it was delayed until the fall.

Electronic interface required a total of seven commands plus an auxillary transmitter for a separate data link for scientific data.

Due to the "shape of things", i.e. the spherical gondola, with all the control instrumentation and batteries around the equator, it was evident that landing would have to be straight down or considerable damage would occur to both experiment and peripheral appendages. Dragging after landing was an absolute No-No. University of California, Berkley scientists insisted the Raven parachute release device be installed between the suspension harness and bottom of the 100 foot parachute; to be available if surface wind conditions warranted.

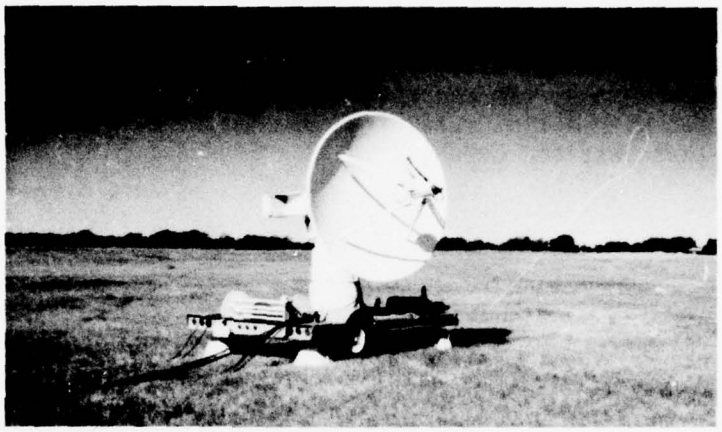
Nine hundred and fifty pounds of ballast was suspended below the sphere in a single canvas hopper, which incorporated dual ballast valves with a flow rate of 15 pounds per minute and an emergency ballast jettison capability.



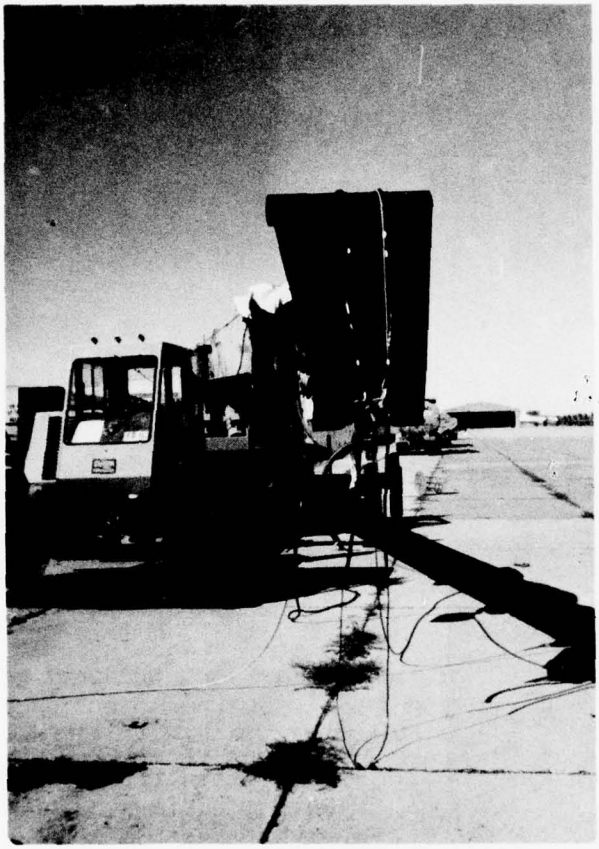
Raven control equipment and batteries were positioned on shelves attached at the equator of the sphere and held together with a multitude of cables and nylon.

A crush pad, formed to fit the lower portion of the sphere provided an open cylinder section in the center to accomodate the ballast. The impact cushion was, by necessity, a field preparation. The simple design required only several hours for engineering, design and fabrication. Days later, after the bonding adhesive cured, the cushion immerged as a structural integrity, such as only found in the pyramids of Egypt.

A special team of telemetry personnel from Wallops Island, Virginia manned a second tracking and telemetry station located at the Watertown airport.



Scientific data was acquired via the NASA antenna, recorded on tape, and also fed into the University of California, Berkley computer located in the Raven trailer. For comparison and general evaluation, ranging through the NASA system was performed. Due to the sensitivity of the NASA antenna, a slight difference was noted between the ranging data of the Raven equipment. Once the signal was approximately sixty miles away both systems agreed.



A 25.98 mcf Winzen balloon was provided for the flight, which would provide a theoretical pressure level of 3.2 mbs with the suspended load of 3786 pounds.

Since the gross system weight of 6331 pounds exceeded the safe launch capability of the launch truck, it was necessary to use the smallest and most portable crane we could find, a 25 ton Clark hydraulic.

Daily forecasts and weather briefings conducted by the ONR meterologist and Tech Representative indicated a launch should be scheduled for the 12th to 14th of September. Upper winds data indicated the flight duration would be considerably shorter than the 60 hours requested.

After a 24-hour standby the balloon was launched just after noon on the 14th of September. The launch required no manuevering of the crane; however, the crane crew backed down two feet and drove ahead two feet - presumably a union requirement.

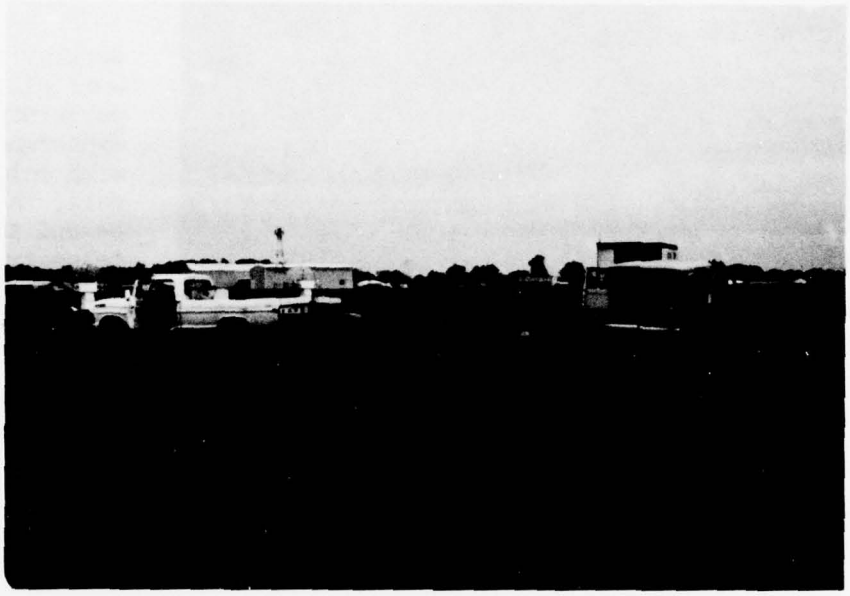
With 14% free lift the noon ascent was brisk at the lower level, tapering off to about 500 fpm going into ceiling. Two and one half hours after launch the experiment was at float level of 2.8 mbs.

An easterly track was taken up in the early ascent, turning to the northeast and then slightly east southeast over Minneapolis. East of Minneapolis, the balloon slowed down and formed a loop with a northeasterly heading into northern Wisconsin.

University of California, Berkley scientific telemetry equipment was placed inside the Raven telemetry van for convenience and communication with the Raven electronics personnel.

Berkley scientists were elated with the performance of their experiment. However, with only 25 hours of data, the balloon was beyond scientific telemetry range. Balloon control was turned over to the Raven mobile tracking station south of Wausau, Wisconsin which coordinated the termination with the C-47 and Minneapolis center.

The tracking crew managed to descend the balloon towards a dense wood in northern Wisconsin. Fortunately the impact was near a farm and an old logging road which considerably simplified recovery.



Instead of the usual low-boy trailer with tractor used for recovery, Raven employed the Ford pickup with a 23 foot tandem axle trailer which handled the 3400 pounds of gondola and support cradle efficiently and at a considerable savings in time and money. The experiment was returned to Watertown on 18 September.

Close examination of the experiment disclosed little or no damage. The impact had been as planned with the crush pad absorbing the full shock. Parachute disconnect, while not required, did function properly. One instrument shelf was bent and the parachute was damaged beyond repair.

The experiment will be redesigned for different studies and will be ready for flight again in 1978.

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1393 Director Fulkerson

2. Scientist Cartwright Group Berkley Date/Time 9-14-76 /17:58 Z

3. Launch: Site Watertown, SD Technique/Launch Veh. Dynamic - Crane

4. Balloon Performance: Theoretical Ceiling 3.88 mb, 38.9 km
Actual Ceiling 3.37 mb, 39.9 km

5. Ascent Rate: Surface to Ceiling, Average 4.26 mps

6. Flight Duration: Total 27 hr 37 min At ceiling 24 hr 16 min

7. Termination: Date/Time 9-15-76 / 20:52 Z. Method R/C C-47

8. Balloon Destruction: Confirmed, visually, etc. Visual

9. Landing: Date/Time 9-15-76 / 21:35 Z. Location 89°46' - 45°14'

10. NOTAM Close out: Date/Time 9-15-76 / 21:30 Z. Activity MPS-Center

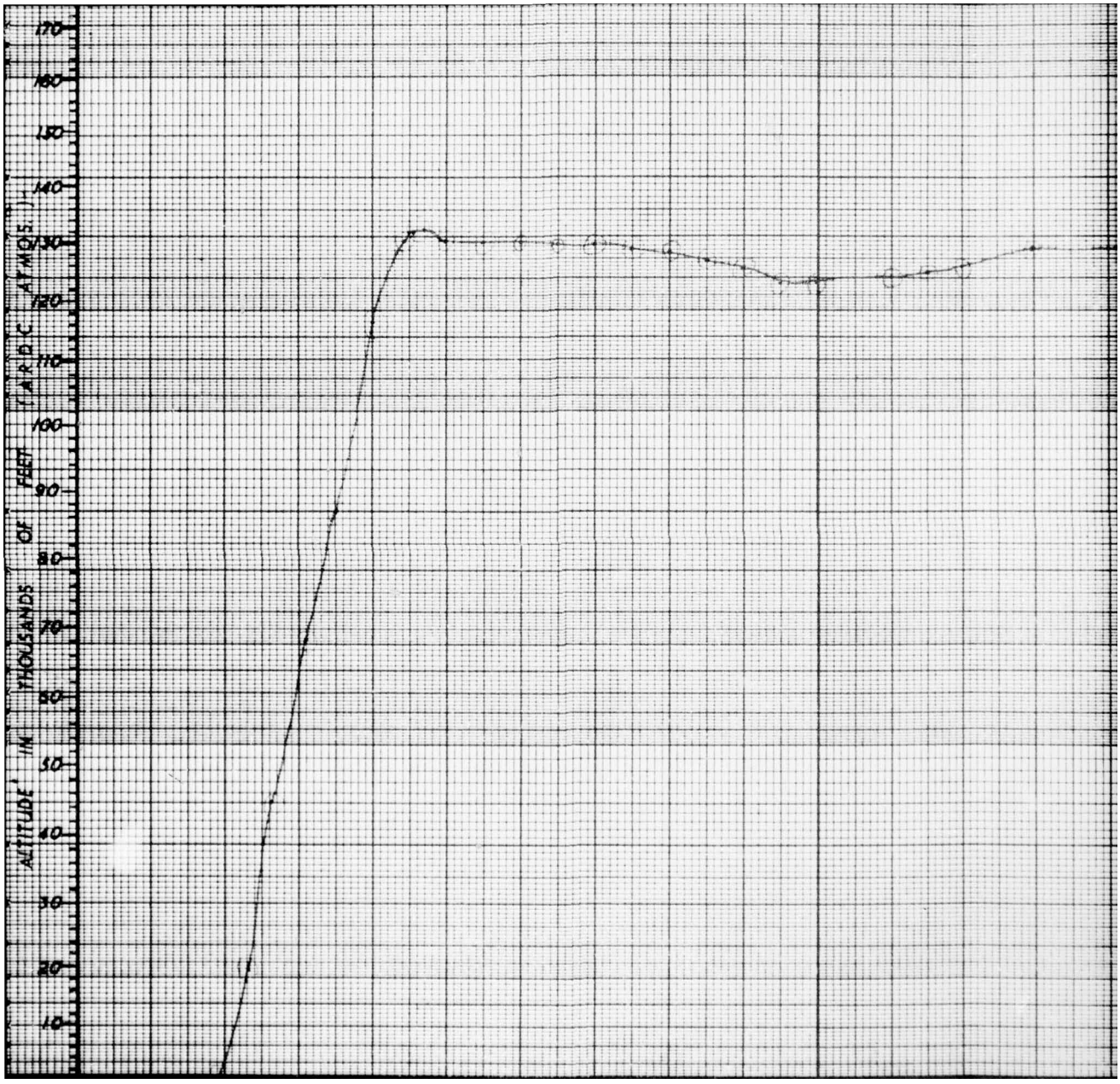
11. Frequencies Used:

(MHz)	Emission	Purpose	Power	Time
1527.5	1000F9	Cartwright	2-W	28.0
1531.5	1000F9	Telemetry	2-W	28.0
149.4	30F9	Command & Comm.	80-W	28.0
7.465	3A3J	Communications	100-W	28.0

12. Balloon Specs: SF406.27-060-NSC-01 Serial No. 2
Material SF Vol. 25.98 MCF Gauge 0.6 mil. 2 ea. 0.9 / 0.8 caps

Balloon	2545
Parachute (Dia 30.5 m)	219
Raven Instrumentation	78
Ballast 950. + Bag 15	965
Scientific Package	2185
Extra Batteries, Timer & Strobe	83
Cable Ladder & Pin Fitting	81
Xmitter, Batteries & Crush Pad	175
Gross Weight	6331
Free Lift 14%	886
Gross Inflation	7217

13. Comments


ALTITUDE IN THOUSANDS OF FEET (A.R.D.C. ATMOS.)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10

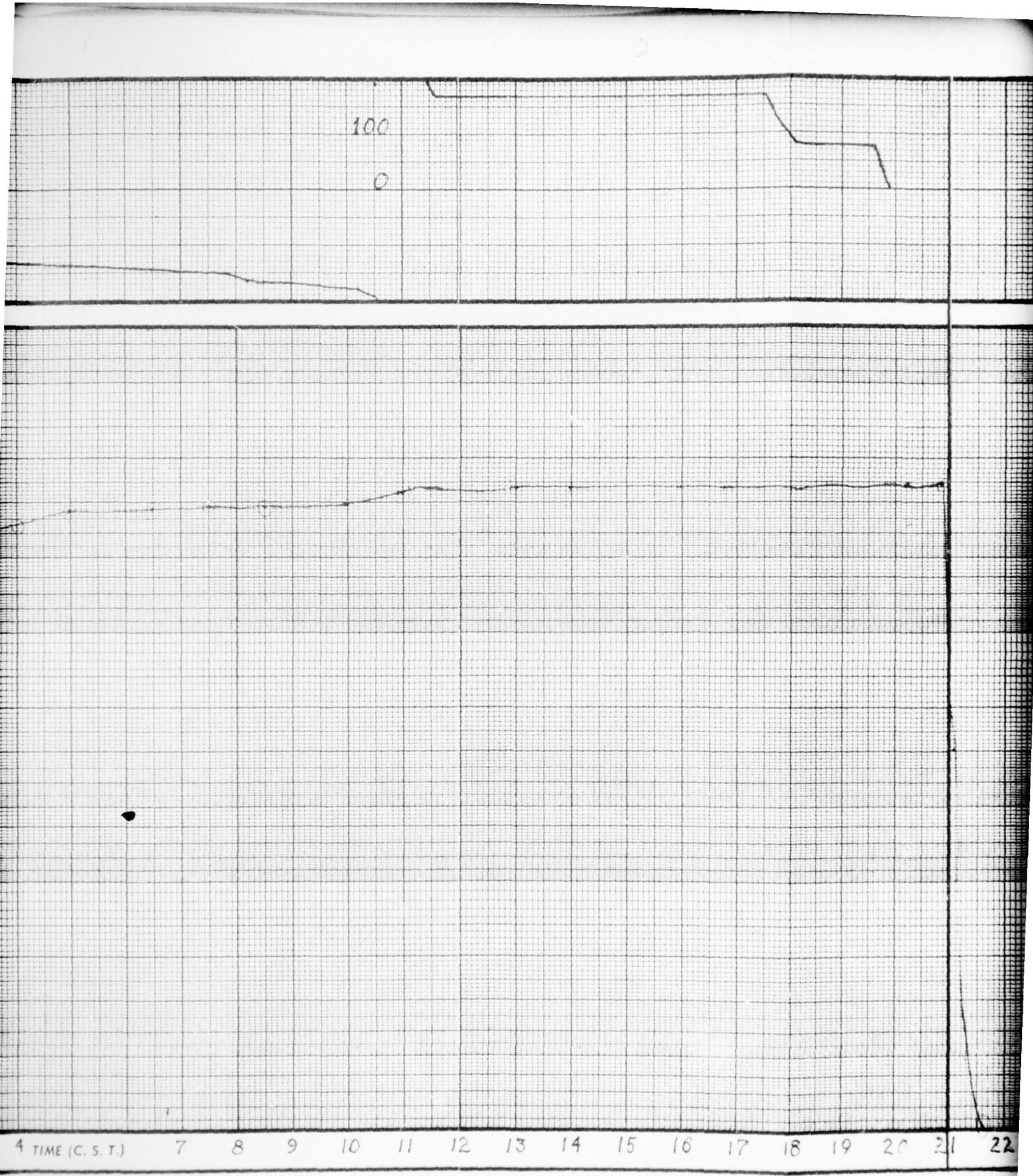
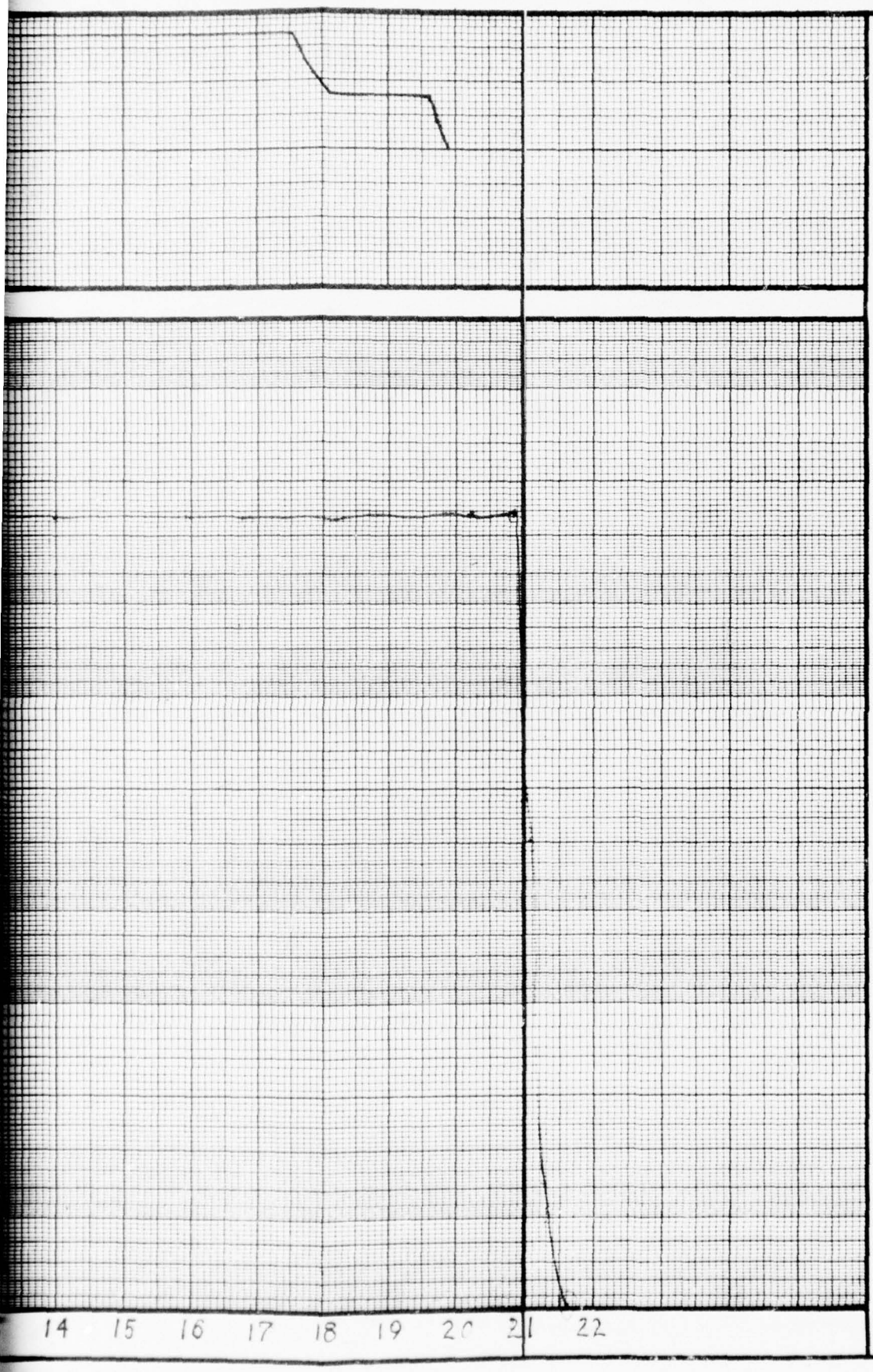


FIGURE 9



FLIGHT NO. 1393

DATE: 14 SEPT '76

FOR: U OF C BERKLEY CARTWRIGHT

BALLOON

TYPE: NSC

VOL: 25.98

MATL: 0.6 /0.9/0.8

WT: 2545

LOAD FACTORS

PAYLOAD: 3786

GROSS LD: 6331

FREE LIFT: 886

BALLAST: 950

RAVEN industries, inc.

DR.

CHK.

APPR.

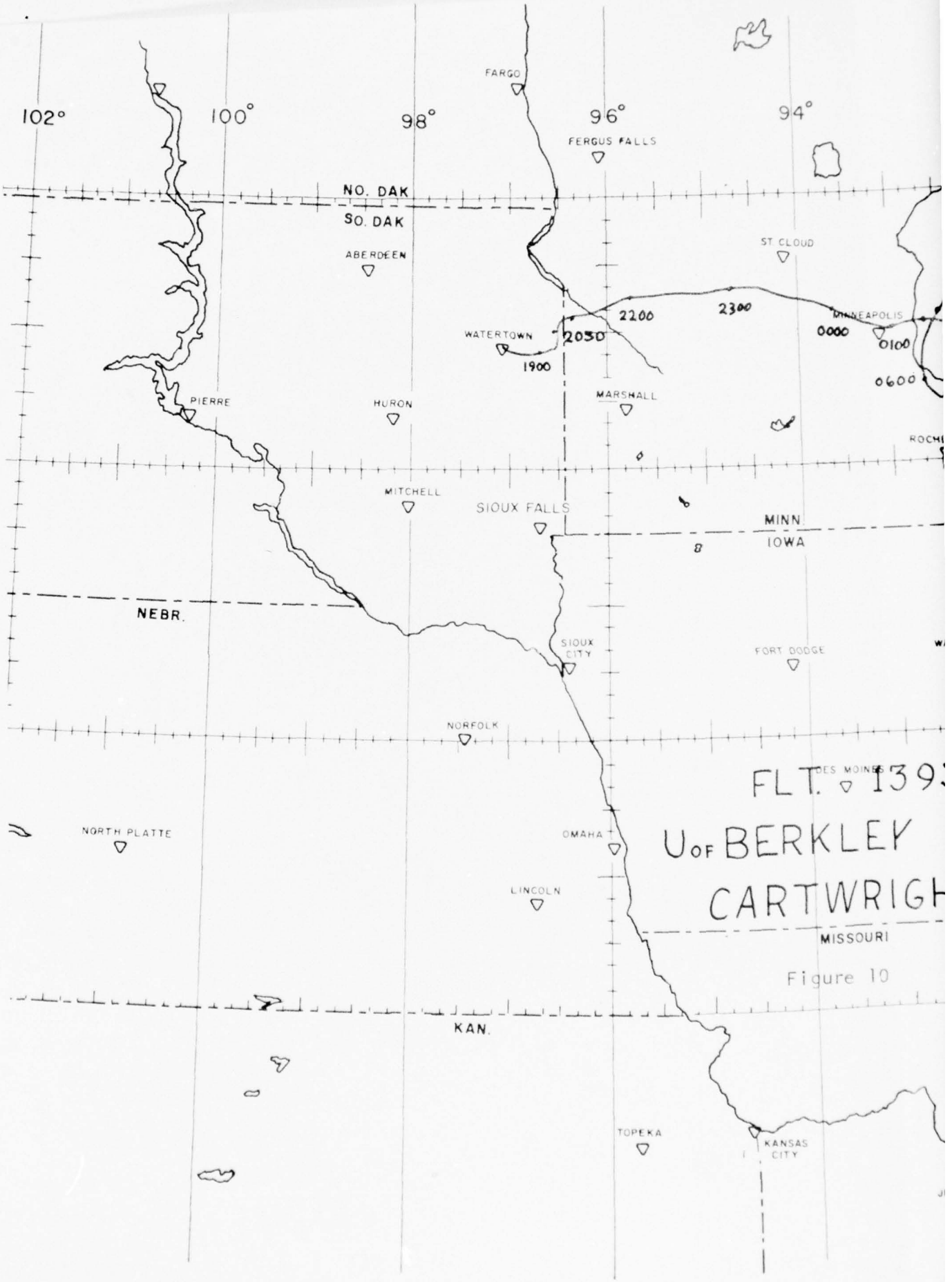
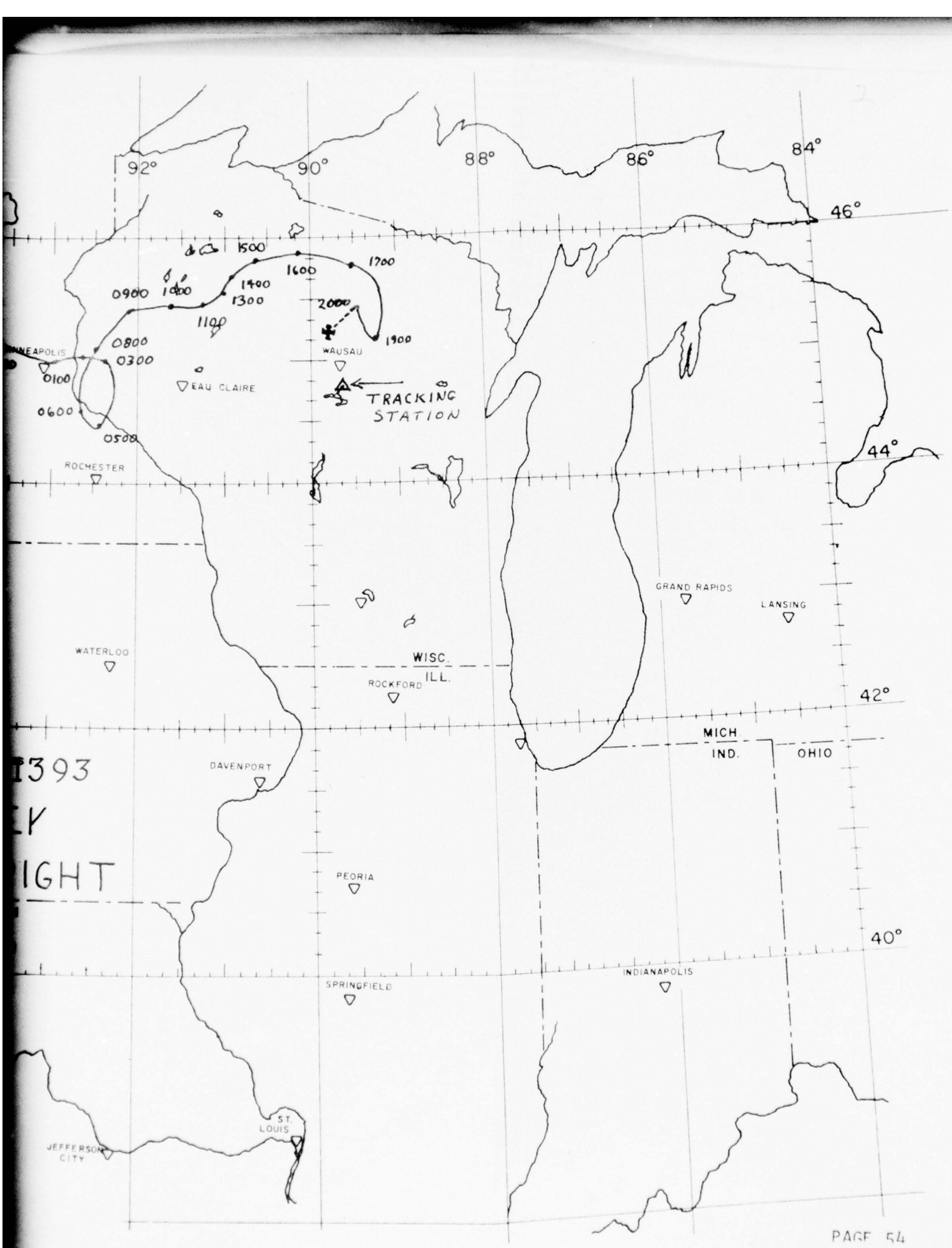

102°
100°
98°
96°
94°
FARGO
FERGUS FALLS
NO. DAK
SO. DAK
ABERDEEN
ST CLOUD
2200
2300
WATERTOWN
2030
1900
0000
0100
0600
PIERRE
HURON
MARSHALL
MITCHELL
SIOUX FALLS
MINN.
IOWA
NEBR.
SIOUX CITY
FORT DODGE
NORFOLK
DES MOINES
NORTH PLATTE
OMAHA
LINCOLN
MISSOURI
KAN.
TOPEKA
KANSAS CITY
FLT. 139
U OF BERKLEY
CARTWRIGH

Figure 10


92°
90°
88°
86°
84°
46°
44°
42°
40°
1500
1600
1700
1400
1300
0900
1000
2000
1100
1900
0800
0300
0100
0600
0500
MINNEAPOLIS
WAUSAU
EAU CLAIRE
TRACKING STATION
ROCHESTER
GRAND RAPIDS
LANSING
WATERLOO
WISC.
ILL.
ROCKFORD
MICH
IND.
OHIO
DAVENPORT
PEORIA
SPRINGFIELD
INDIANAPOLIS
ST. LOUIS
JEFFERSON CITY

PAGE 54

FLIGHT 1392 - FLIGHT DESCRIPTION

C.E.N. SACLAY
Dr. L. Koch Miramond

GOALS OF THE EXPERIMENT

The Saclay-Copenhagen "S1" experiment has two main purposes:

1. To test hardware to be used in the Franco-Danish experiment to be launched aboard the NASA satellite "HEAO-C" in 1979.

2. To obtain scientific data on the isotopic composition of galactic cosmic rays.

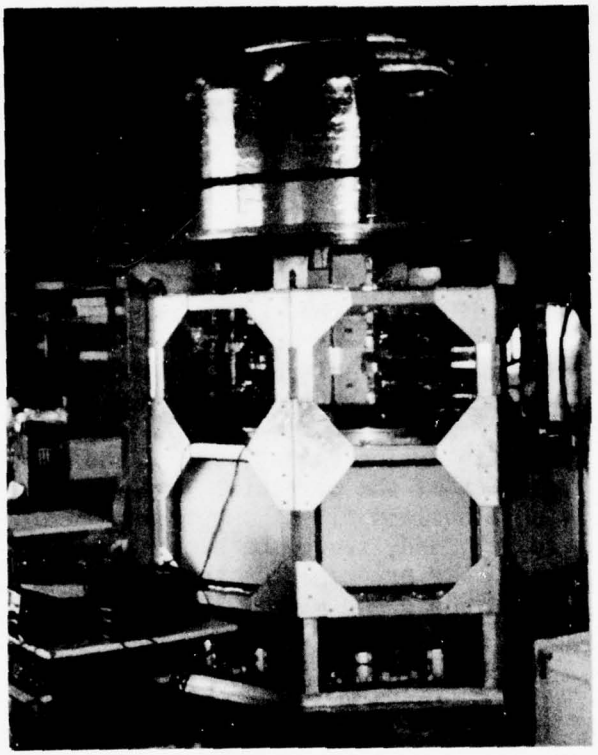
The chemical composition of cosmic rays is relatively well known now up to energies of approximately 20 GeV per nucleon. To choose between different models of source and propagation of cosmic rays, some data on the isotopic composition would be needed. This is the goal of the HEAO-C experiment which is based on the geomagnetic method: the fact that the satellite crosses a large range of geomagnetic latitudes is used as a means to analyze the isotopic composition, when combined with an instrument able to measure accurately the charge and the velocity of the particle. Since latitude does not vary appreciably on a balloon flight supplementary information on the particle has to be added, i.e., the slowing down of the particle in an absorber. The principle of the balloon experiment is thus based on the Cerenkov-Cerenkov slowing down method. (see J.P. Meyer 1975)

PRINCIPLE OF THE INSTRUMENT

A combination of three Cerenkov counters, two scientillation counters and a lead absorber, one inch thick, makes it possible to measure the charge of the particle at the entry, its' velocity before entering the absorber, and its' velocity after.

The types of the radiators used in the Cerenkov counters and the thickness of the lead absorber were optimized in order to analyze the isotopic composition of nuclei of charges between 12 and 30 (i.e., between Mg and Ni) for energies of the order of 750 MeV per nucleon.

In order to get good statistics in the number of events registered, detectors of large diameter were used: the Cerenkov and scintillation counters are 60 cm. in diameter. This detector size will be also used aboard HEAO-C2. These detectors are of the light diffusion box model, each one viewed by twelve, five inch photomultiplier tubes. To correct for variation of response with the impact point of the particle on the counter it is necessary to register the trajectory of the particle.



The sensors used for that are three double drift chambers. In each double chamber the x-y coordinates are measured. The mapping of each counter will be made in flight by using the relatively highly abundant nuclei of C and O. This calibration method will be used also on the HEAO experiment.

DESCRIPTION OF THE INSTRUMENT

The telescope assembly is shown in Figure 17.

DC1, DC2, DC3 are the double drift chambers. C1 to C5 are the counters composed respectively of:

C1 = F2 glass (Cerenkov-Scintillation light emission)

C2 = FC 75 Liquid (Cerenkov of 1.28 refractive index)

C3 & C5 = Scintillators

C4 = SP5 glass (Cerenkov of 1.72 refractive in dep)

The lead absorber is one inch thick.

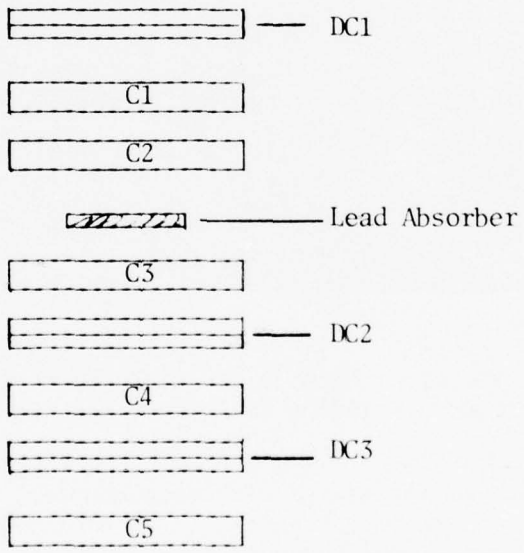
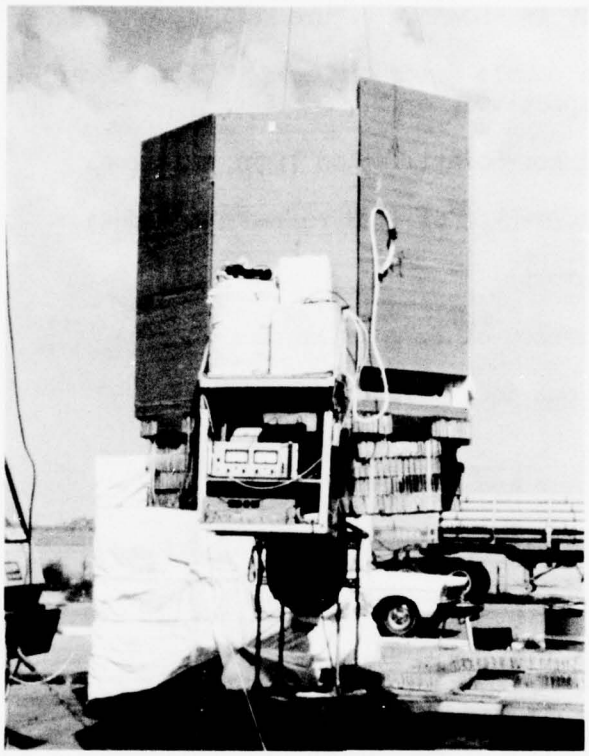


FIGURE 17

The telescope is triggered by particles simultaneously seen by detectors C1 and C3. The electronic threshold is such that only particles of $Z \geq 6$ will be analyzed.

A permanent flow of gas (A-methane) into the drift chambers was controlled during flight by an internal pressure gauge and a mass-constant flow-valve.



The weight of the experiment in its airtight container is approximately 2,100 pounds including batteries, gas tanks, and thermal shielding.

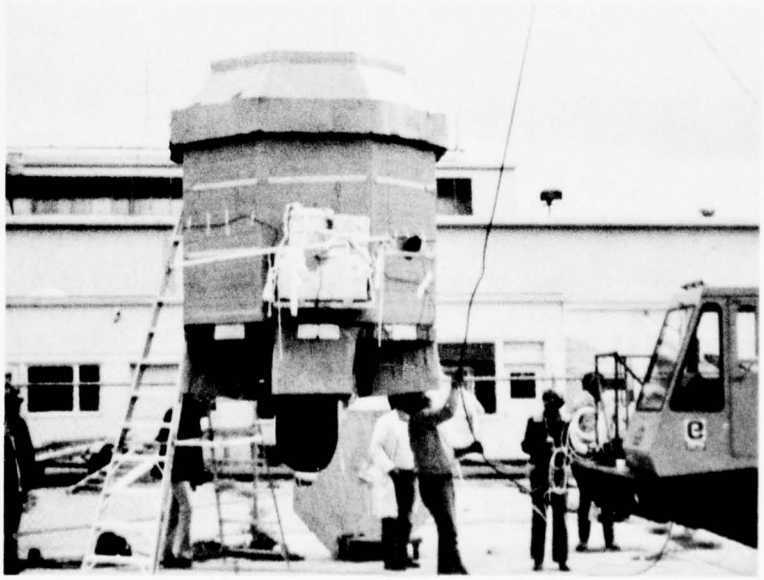
An analog chain is associated with each counter. Each chain is composed of a square root transfer curve amplifier in order to compress the high signal range (0 to 10^5) and an analog to digital converter (10 bits).

A drift time analyzer is associated with each drift chamber. The time mark of particle crossing is delivered by a "Start" circuit from the dynode nine signals of Cerenkov 1 photomultiplier tube.

For this flight a binary formatted command package was used providing 23 commands to the scientific experiment.

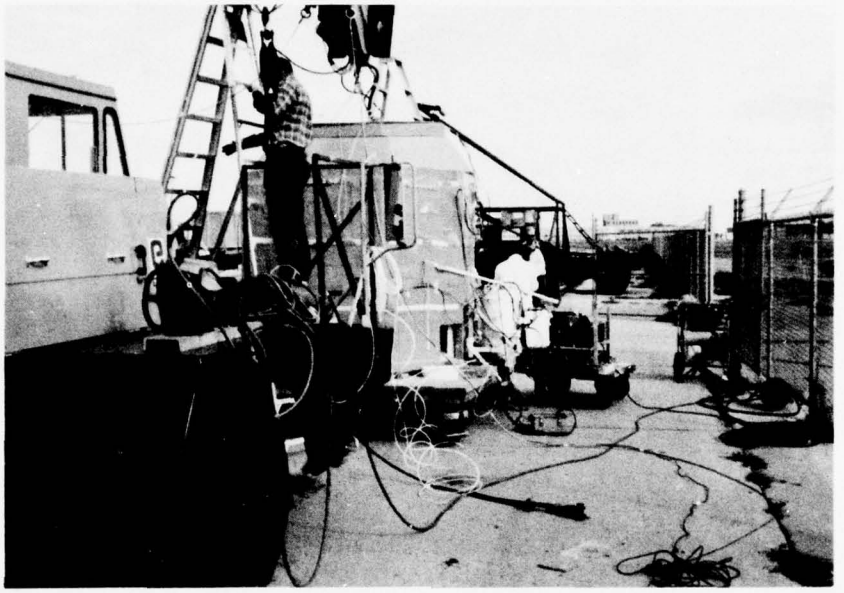
Scientists from France arrived in Sioux Falls in late August with tentative plans for an early September flight.

Lab space was provided in the Raven flight operations center located at the Sioux Falls airport. A special enclosure was erected of plastic and equipped with air conditioning and dehumidifier, enabled Saclay scientists to operate a computer for preflight calibration and checkout.



Prior to launch the computer was loaded into an air conditioned van and positioned four miles east of the airport at the telemetry size.

An additional on-board "L" band transmitter provided scientific data transmission to the main tracking station. The data, in PCM format, was fed into the computer for real time data reduction of selected channels. Data was also recorded on magnetic tape for future use.

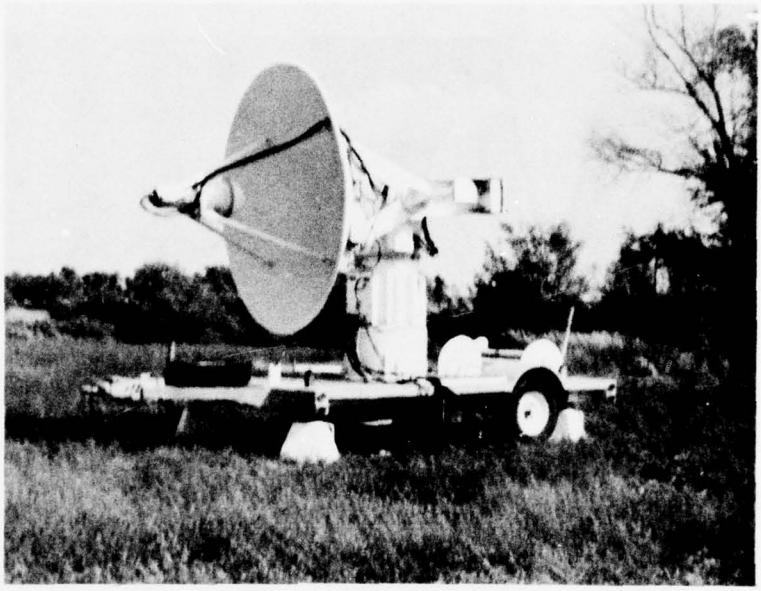


The experiment was ready for flight on 18 September. But, surface conditions were not acceptable until the 23 of September.

The principal investigator desired a flight duration of 80 hours - an unrealistic requirement, which created additional problems of supplying battery power for the control and data transmission system. Additional ballast was not practical due to the design of the support hardware. A maximum duration of 66 hours was finally agreed on.

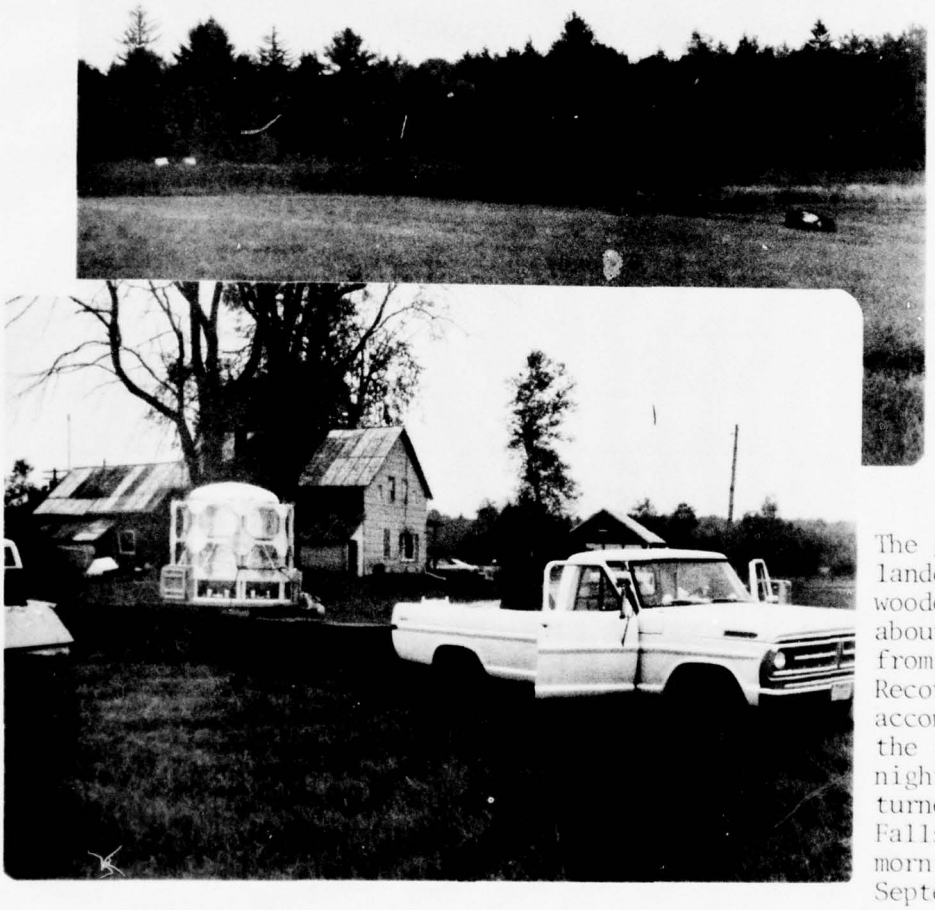
A smooth launch was performed in a cross wind of approximately six knots. A normal ascent followed with the balloon reaching its ceiling of 5.5 mbs four hours after launch. The experiment performed flawlessly in all modes and all 23 commands functioned properly. After floating 11-1/2 hours the balloon had drifted out of range of the Sioux Falls station.

The NASA tracking antenna worked very well but lost the signal a short time before the Raven antenna. This was primarily due to being mounted low to the ground.



The mobile tracking station located at Elkhart, Indiana acquired the data signals two hours prior to loss of signal at Sioux Falls. The mobile station recorded the data on magnetic tape on recorders provided by NASA.

The Elkhart tracking station tracked the balloon until 0710Z, 24 September at which time the balloon was at 7.8 mbs over the west end of Lake Ontario. In an effort to prevent an impact in water, the balloon was allowed to fly until 1400Z at which time it was back over land north of Utica, New York at the edge of the Adirondack mountains.



The gondola landed in a wooded area about 200 yards from a road. Recovery was accomplished the following night and returned to Sioux Falls on the morning of 29 September.

All equipment was in excellent condition except for the parachute which was ruined being removed from the trees.

The balloon was at ceiling for 33 hours with a total of 26 hours of data being obtained.

The experiment was packaged and returned to France via Air France.

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1392 Director Fulkerson

2. Scientist Koch Group Saclay Date/Time 9-24-76 /00:24 Z

3. Launch: Site Sioux Falls, SD Technique/Launch Veh. Dynamic - Crane

4. Balloon Performance: Theoretical Ceiling 6.07 mb, 35.5 km
Actual Ceiling 5.49 mb, 36.3 km

5. Ascent Rate: Surface to Ceiling, Average 2.36 mps

6. Flight Duration: Total 38 hr 22 min At ceiling 33 hr 24 min

7. Termination: Date/Time 9-25-76 / 14:04 Z. Method R/C - C-47

8. Balloon Destruction: Confirmed, visually, etc. Visual

9. Landing: Date/Time 9-25-76 / 14:46 Z. Location 75°16' - 43°36'

10. NOTAM Close out: Date/Time 9-25-76 / 15:30 Z. Activity Cleveland Center

11. Frequencies Used:

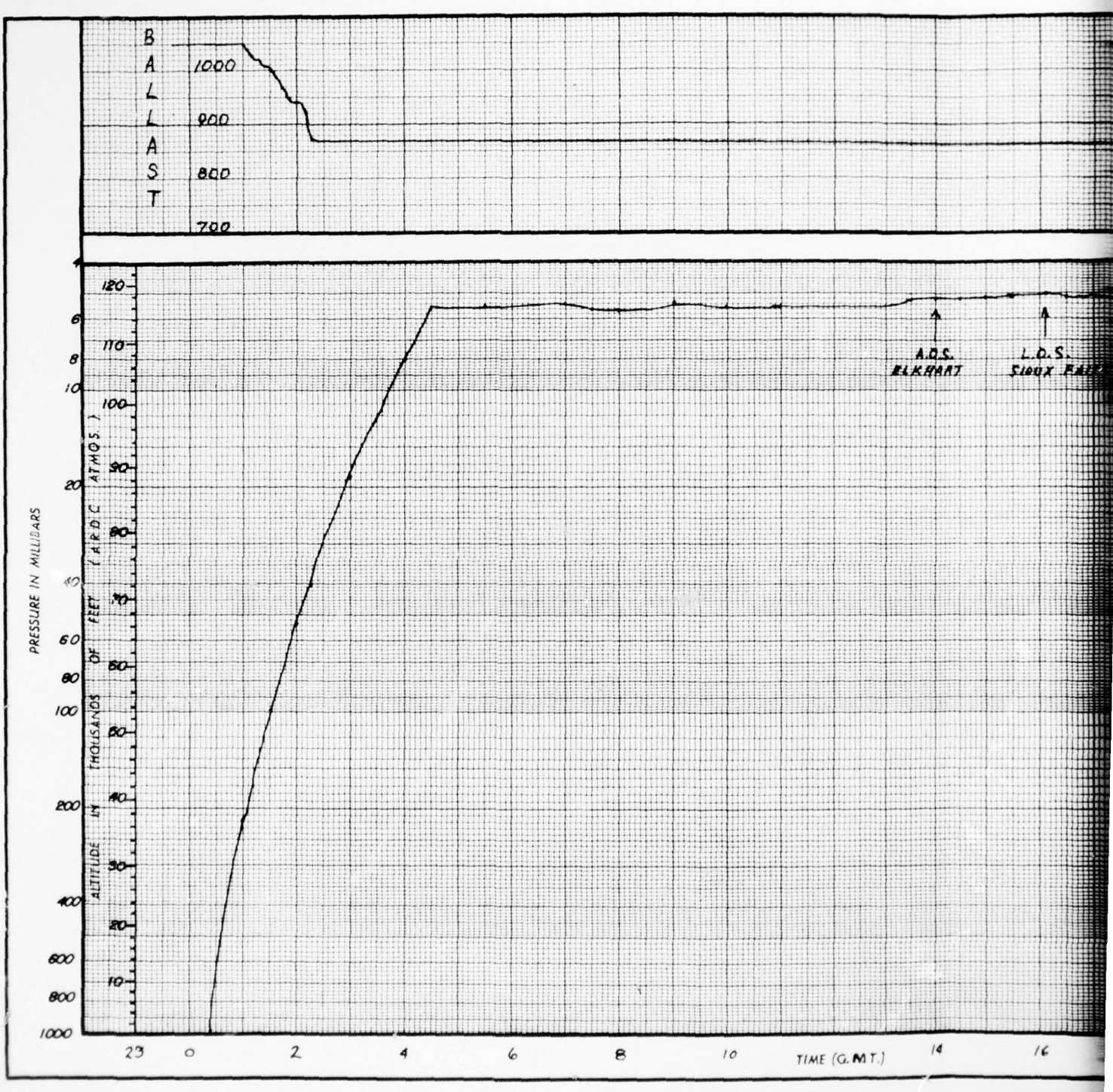
(MHz)	Emission	Purpose	Power	Time
1529.5	1000F9	Saclay	2-W	40
1533.5	1000F9	Telemetry	2-W	40
149.4	30F9	Command & Comm.	80-W	40
7.465	3A3J	Communications	100-W	40

12. Balloon Specs: SF341.38-070-NSCH-01 Serial No. 8

Material SF Vol. 15.39 MCF Gauge 0.7 mil. 2 ea. 0.9 caps

Balloon & load line	2243
Parachute (Dia 30.5 m)	218
Raven Instrumentation	76
Ballast & Bag	1058
Scientific Package	2320
Transponder, Data Xmitter, And Batteries	111
Crush Pad, Strobe Light & Cable Ladder & Pin Fitting	119
Timers & External Batteries	77
Gross Weight	6222
Free Lift 14%	871
Gross Inflation	7093

13. Comments


BALLAST
1000
900
800
700
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (A.R.D.C. ATMOS.)
A.O.S. ELKHART
L.O.S. SIOUX FALLS
TIME (G.M.T.)
23
0
2
4
6
8
10
14
16

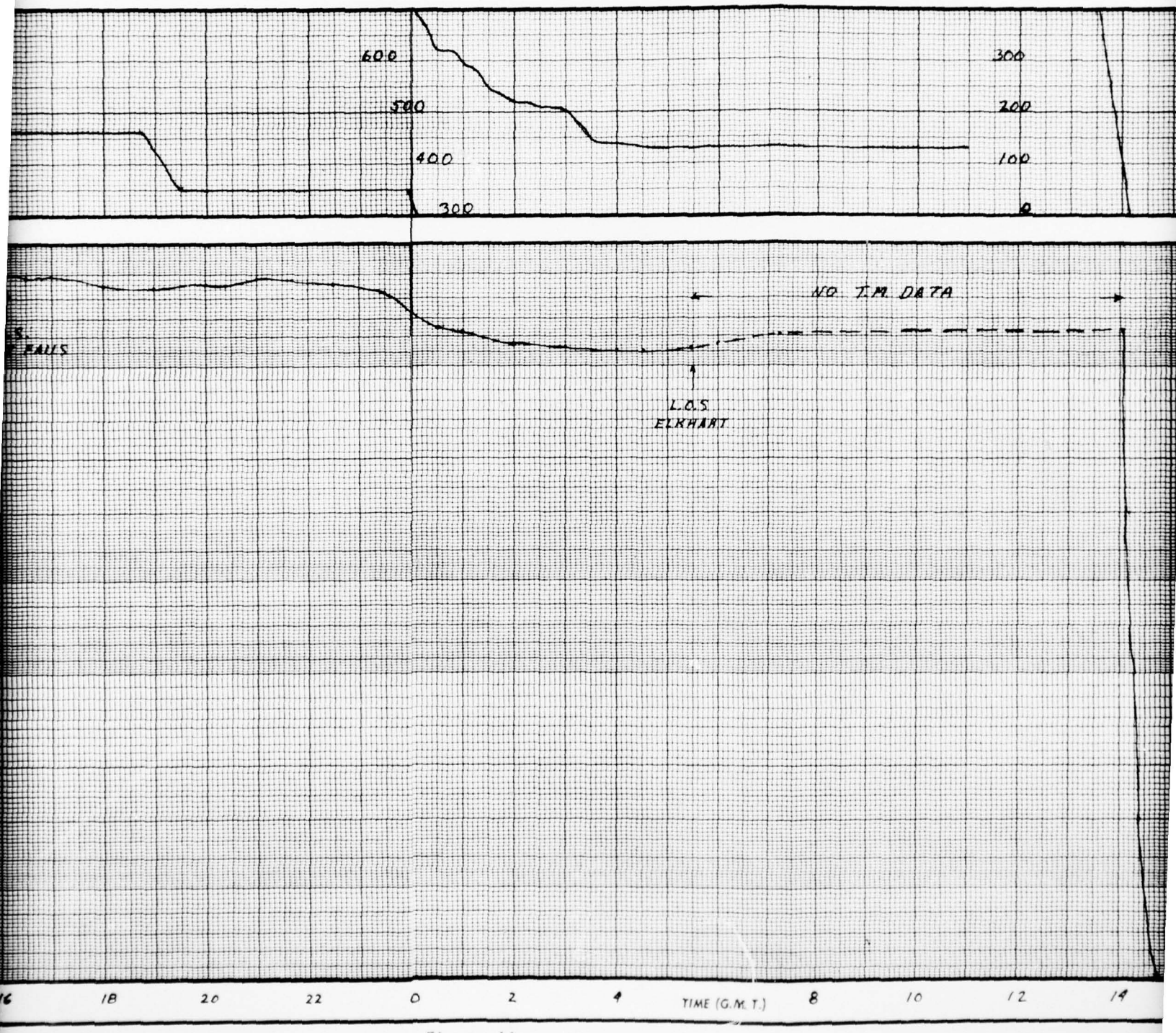
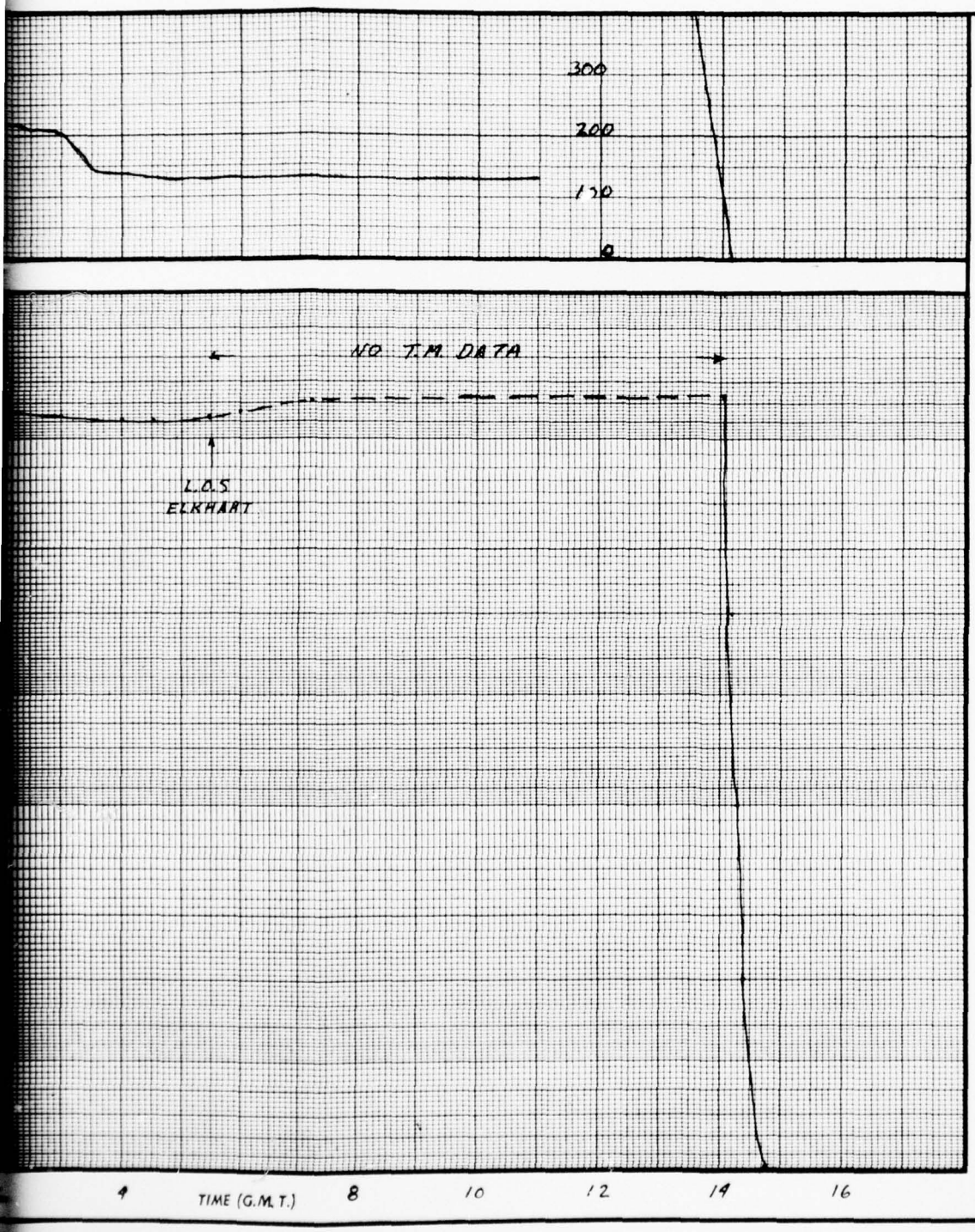

600
500
400
300
300
200
100
0
NO T.M. DATA
L.O.S
ELKHART
TIME (G.M.T.)
16
18
20
22
0
2
4
8
10
12
14

Figure 11



FLIGHT NO. 1392

DATE: 23 SEPT 76

FOR: KOCH
SACLAY

BALLOON

TYPE: NSC

VOL: 15.4

MATL: 0.5-0.6/0.6

WT: 2243

LOAD FACTORS

PAYLOAD: 3979

GROSS LD: 6222

FREE LIFT: 871

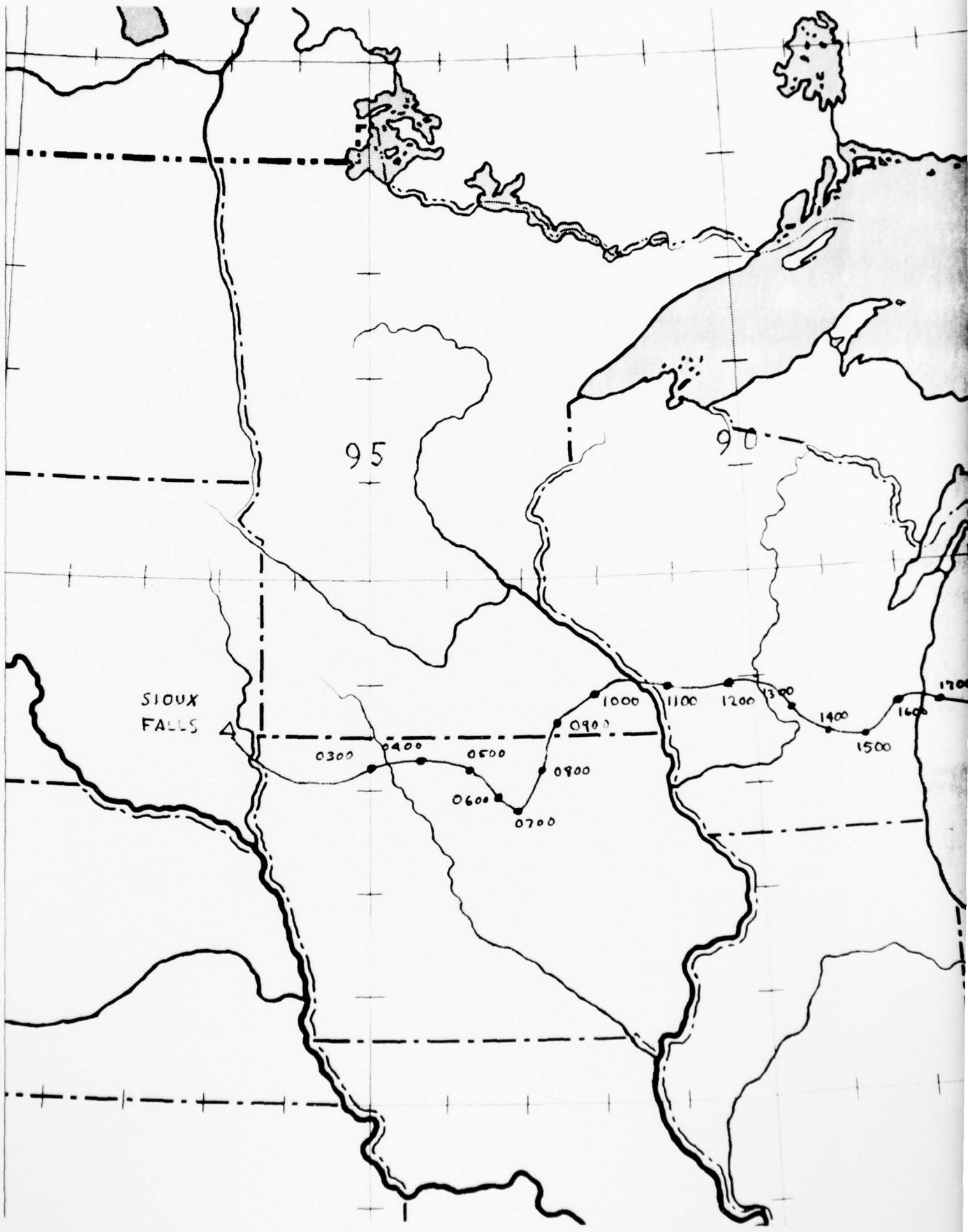
BALLAST: 1050

RAVEN
industries, inc.

DR.

CHK.

APPR.


95
90
SIOUX
FALLS
0300
0400
0500
0600
0700
0800
0900
1000
1100
1200
1400
1500
1600

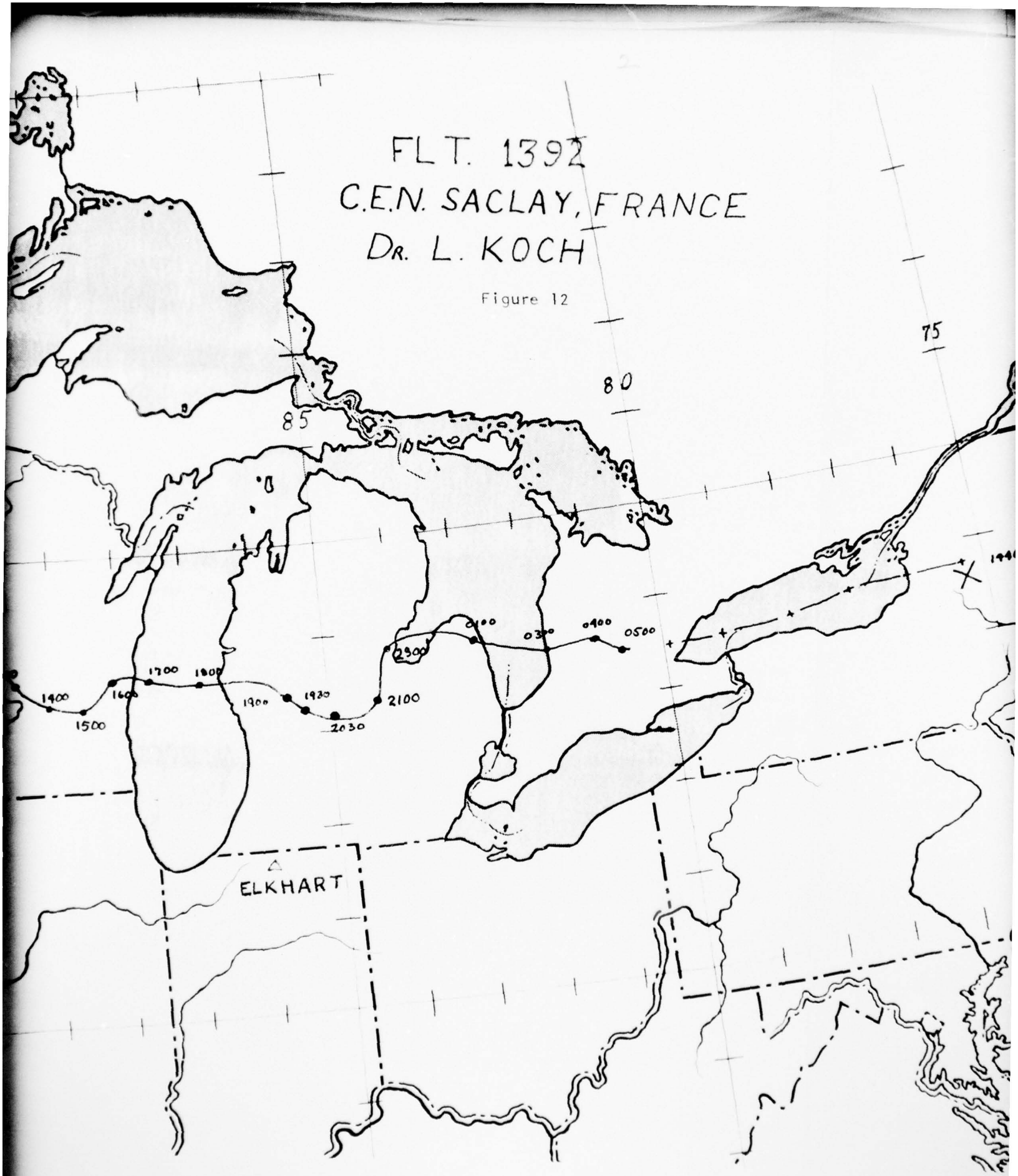
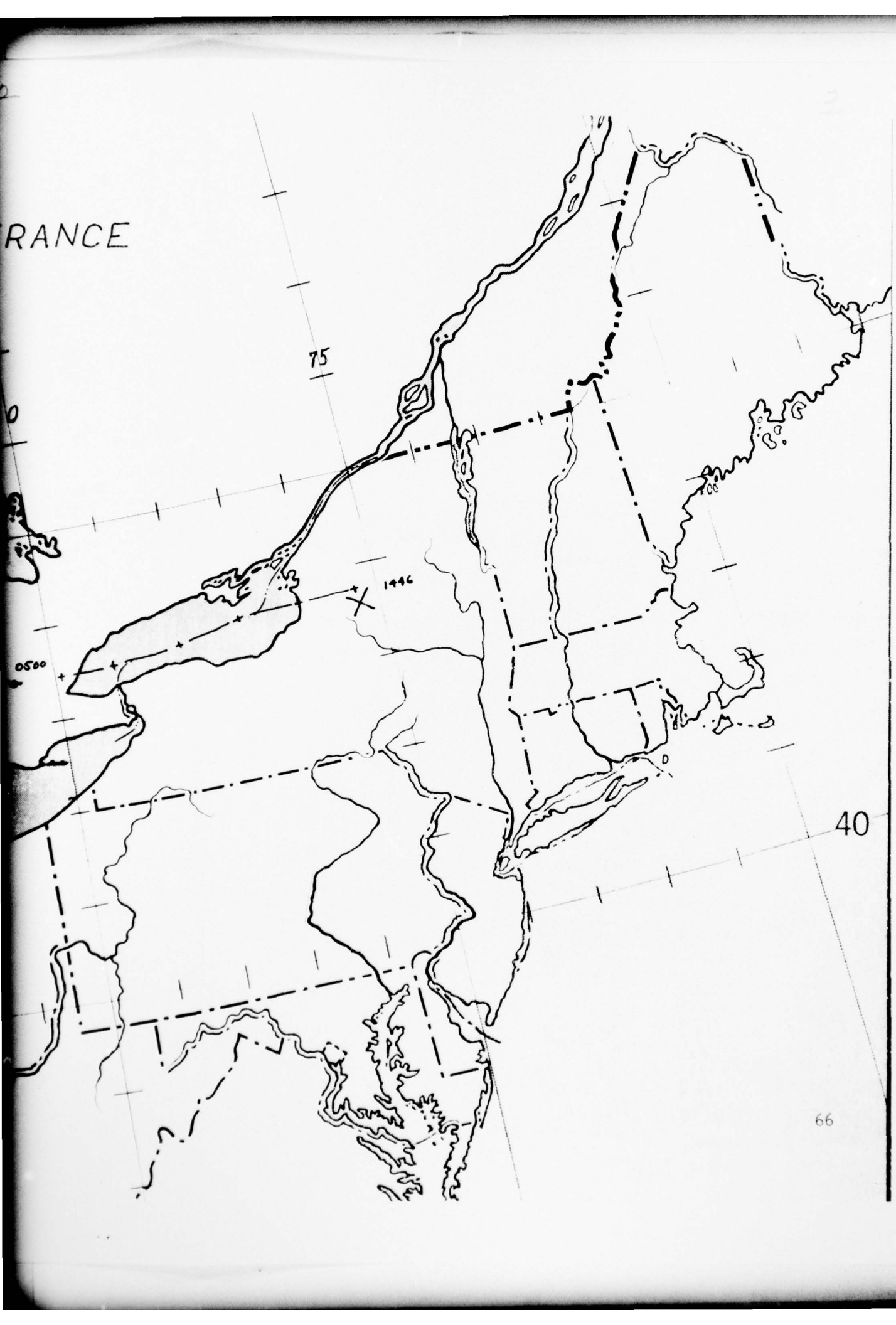

FLT. 1392
C.E.N. SACLAY, FRANCE
DR. L. KOCH
85
80
75
1400
1500
1600
1700
1800
1900
1930
2030
2100
2300
0100
0330
0400
0500
ELKHART

Figure 12

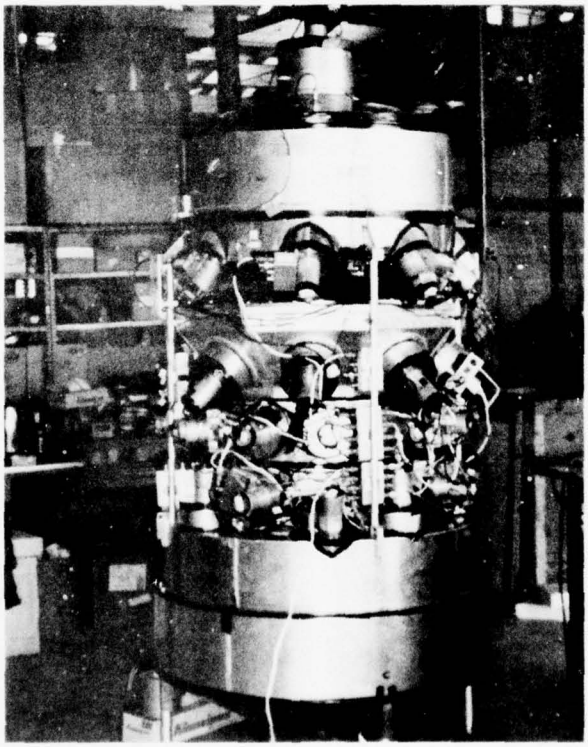

RANCE
75
1446
0500
40

FLIGHT 1394 - FLIGHT DESCRIPTION

UNIVERSITY OF NEW HAMPSHIRE
Dr. William Webber

The experiment was a telescope of multi-element design utilizing plastic scintillators in conjunction with both solid and gaseous Cerenkov detectors; an arrangement which provides information for both de/dx x E and C x E mode of analysis for nonpenetrating particles.

The 1976 instrument configuration was a completely new unit utilizing only photomultiplier tubes from the experiment damaged in 1975. The experiment was considerably lighter than before, however, with the use of automotive type batteries the overall weight was marginal for the balloon provided.



Project directors from Wallops Island, Virginia provided a Silver Cell power supply which could provide a duration of 60 hours while reducing the weight considerably. Due to cancellation of another scientific flight a balloon of 20.1 mcf volume was made available by NASA.

Electronic interface was simple. A standard TRAC package provided all the normal balloon control functions plus commands for transponder identification, and heater switching "On" and "Off". An auxillary "L" band transmitter and battery pack was provided for scientific data telemetry.

While prepared for a long flight duration it was evident the flight would be less than 60 hours.

The flight was launched on the 24th of September, reaching a theoretical ceiling of 3.50 mbs, approximately six and a half hours after launch.

The wind velocity aloft varied from 25 knots to 60 knots. The Sioux Falls tracking station lost the telemetry signal as the balloon passed over Lake Michigan. Telemetry and balloon control was passed off to the Elkhart station which recorded data for an additional three hours. At 2000Z, the signal was lost again.

The C-47 station was in position downrange and acquired an additional five hours of data, through the use of Raven's 48 inch portable telemetry antenna.

On the morning of 25th September, the flight was terminated 60 miles from the Atlantic Coast over Maine. The parachute and equipment landed gently south of Rockland, Maine.

The gondola was recovered and stored with a local firm and was picked up a week later by scientists from the University of New Hampshire.

A total of 24 hours of data was obtained from the flight. The aircraft returned from Maine to Sioux Falls via Elkhart the following day to track the next flight.

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1394 Director Fulkerson

2. Scientist Webber Group U of N.H. Date/Time 9-25-76 /01:57 Z

3. Launch: Site Sioux Falls, SD Technique/Launch Veh. Dynamic - Crane

4. Balloon Performance: Theoretical Ceiling 3.18 mb, 40.4 km
   Actual Ceiling 3.19 mb, 40.36 km

5. Ascent Rate: Surface to Ceiling, Average 1.48 mps

6. Flight Duration: Total 35 hr 38 min At ceiling 27 hr 28 min

7. Termination: Date/Time 9-26-76 / 12:50 Z. Method R/C - C-47

8. Balloon Destruction: Confirmed, visually, etc. Visual

9. Landing: Date/Time 9-26-76 / 13:35 Z. Location 69°13' - 44°12'

10. NOTAM Close out: Date/Time 9-26-76 / 13:20 Z. Activity Boston Center

11. Frequencies Used:

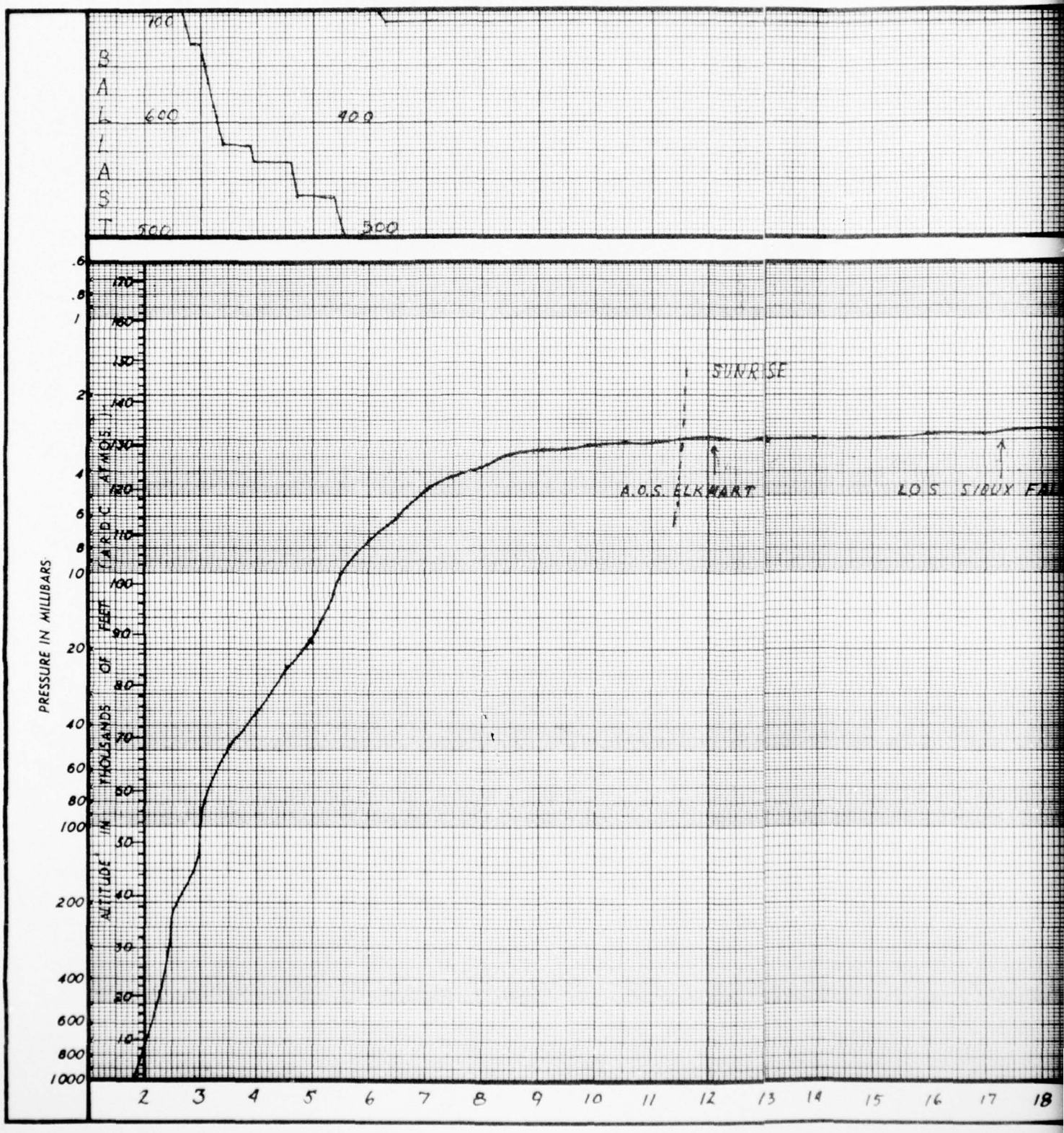
(MHz)	Emission	Purpose	Power	Time
1531.5	1000F9	U of N.H.	2-W	37
1525.5	1000F9	Telemetry	2-W	37
149.4	30F9	Command & Comm.	80-W	37
7.465	3A3J	Communications	100-W	37

12. Balloon Specs: SE379.91-050-NSC-07 Serial No. 18

    Material SE Vol. 20:11 MCF Gauge 0.5 mil. 2 ea. 0.6 caps

Balloon	1607
Parachute (Dia 25.6 m)	134
Raven Instrumentation	75
Ballast	713
Scientific Package	1075
Cable Ladder & Transponder	56
Timers, Strobe & Crush Pad	44
Extra Batt, Xmitter Batt. & Cables	87
Gross Weight	3791
Free Lift	531
Gross Inflation	4322

13. Comments


BALLAST
700
600
400
500
500
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (ARDC ATMOS.)
.6
.8
1
2
4
6
8
10
20
40
60
80
100
200
400
600
800
1000
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
SUNRISE
A.O.S. ELKHART
LOS SIOUX
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

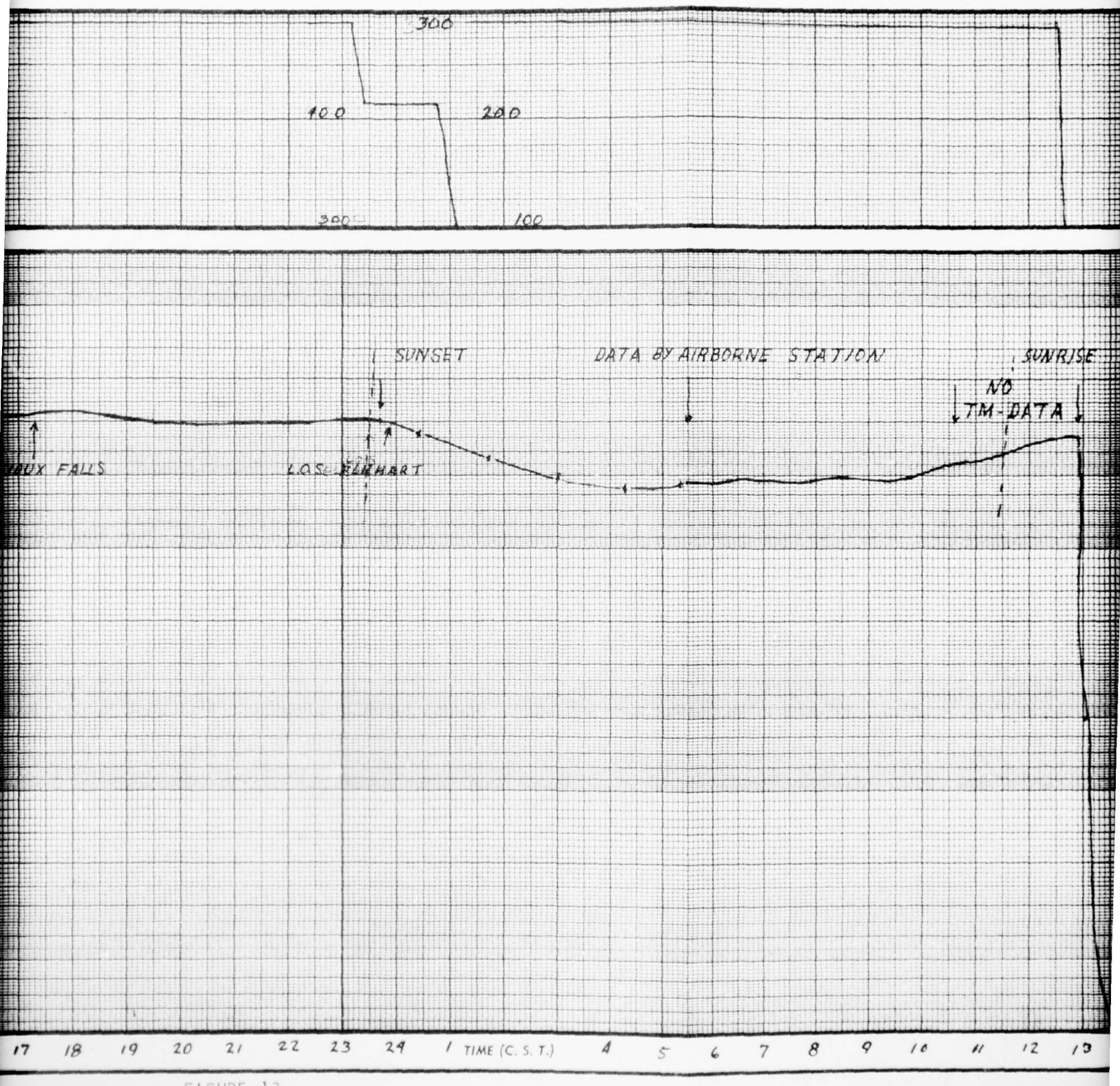
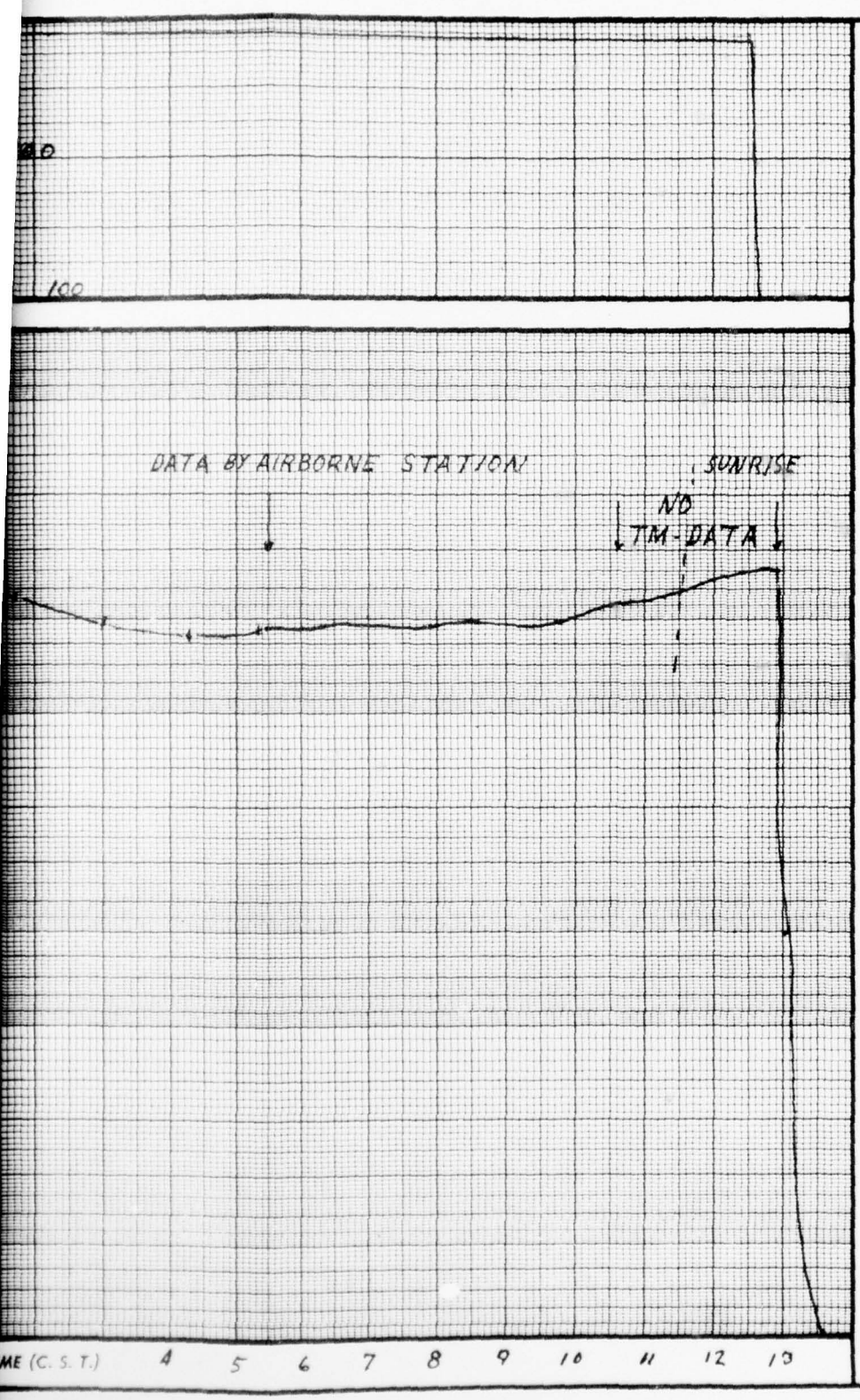

300
100
200
300
100
SUNSET
DATA BY AIRBORNE STATION
SUNRISE
NO
TM-DATA
17
18
19
20
21
22
23
24
1
TIME (C. S. T.)
4
5
6
7
8
9
10
11
12
13

FIGURE 13



FLIGHT NO. 1394

DATE: 24 SEPT 76

FOR: U OF NEW HAMP.
W. WEBBER

BALLOON

TYPE: NSC

VOL: 21.1

MATL: 0.5-0.6/0.6

WT: 1607

LOAD FACTORS

PAYLOAD: 2184

GROSS LD: 3791

FREE LIFT: 531

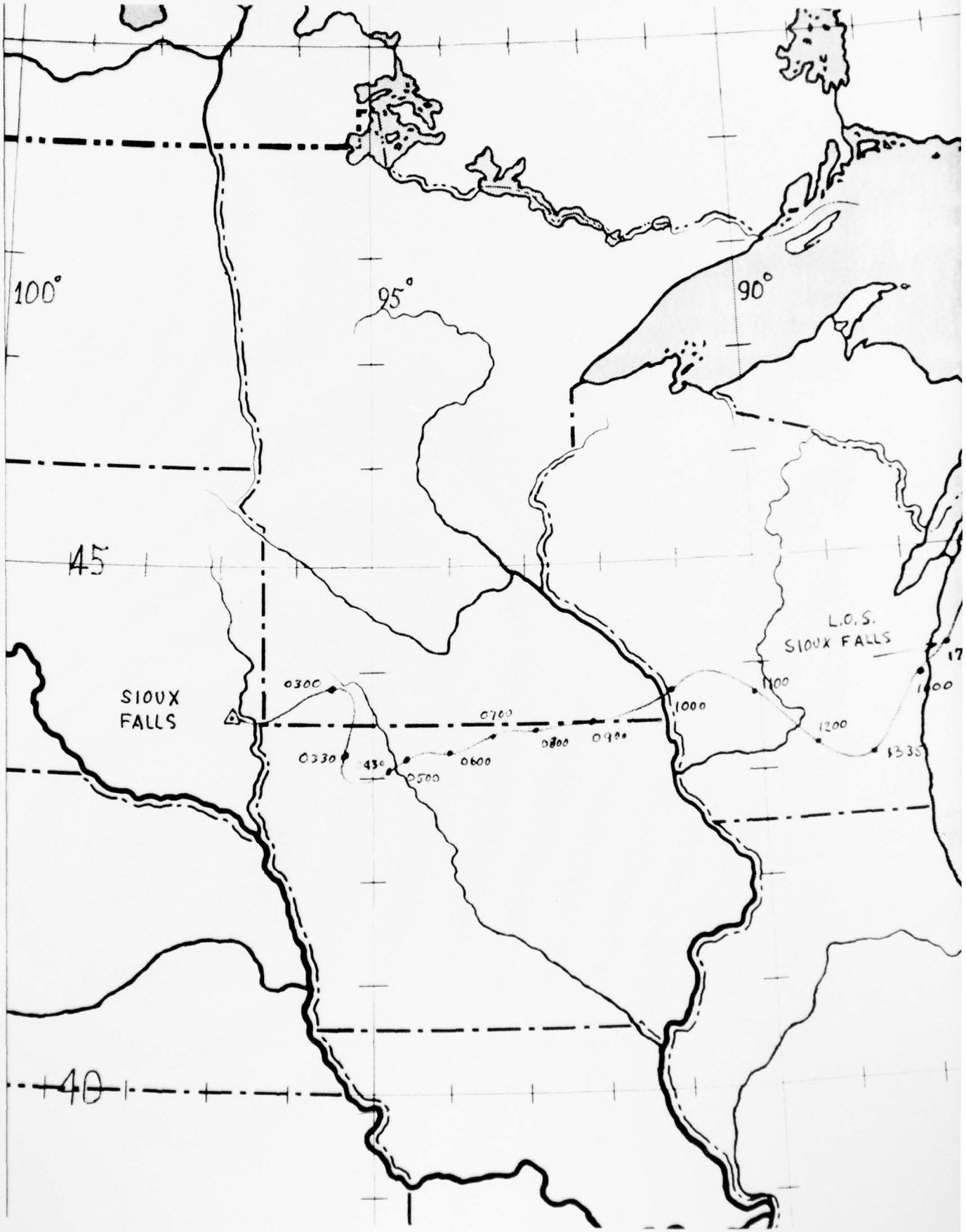
BALLAST: 700

RAVEN industries, inc.

DR.

CHK.

APPR.


100°
95°
90°
45
40
SIOUX
FALLS
0300
0330
0430
0500
0600
0700
0800
0900
1000
1100
1200
1330
L.O.S.
SIOUX FALLS

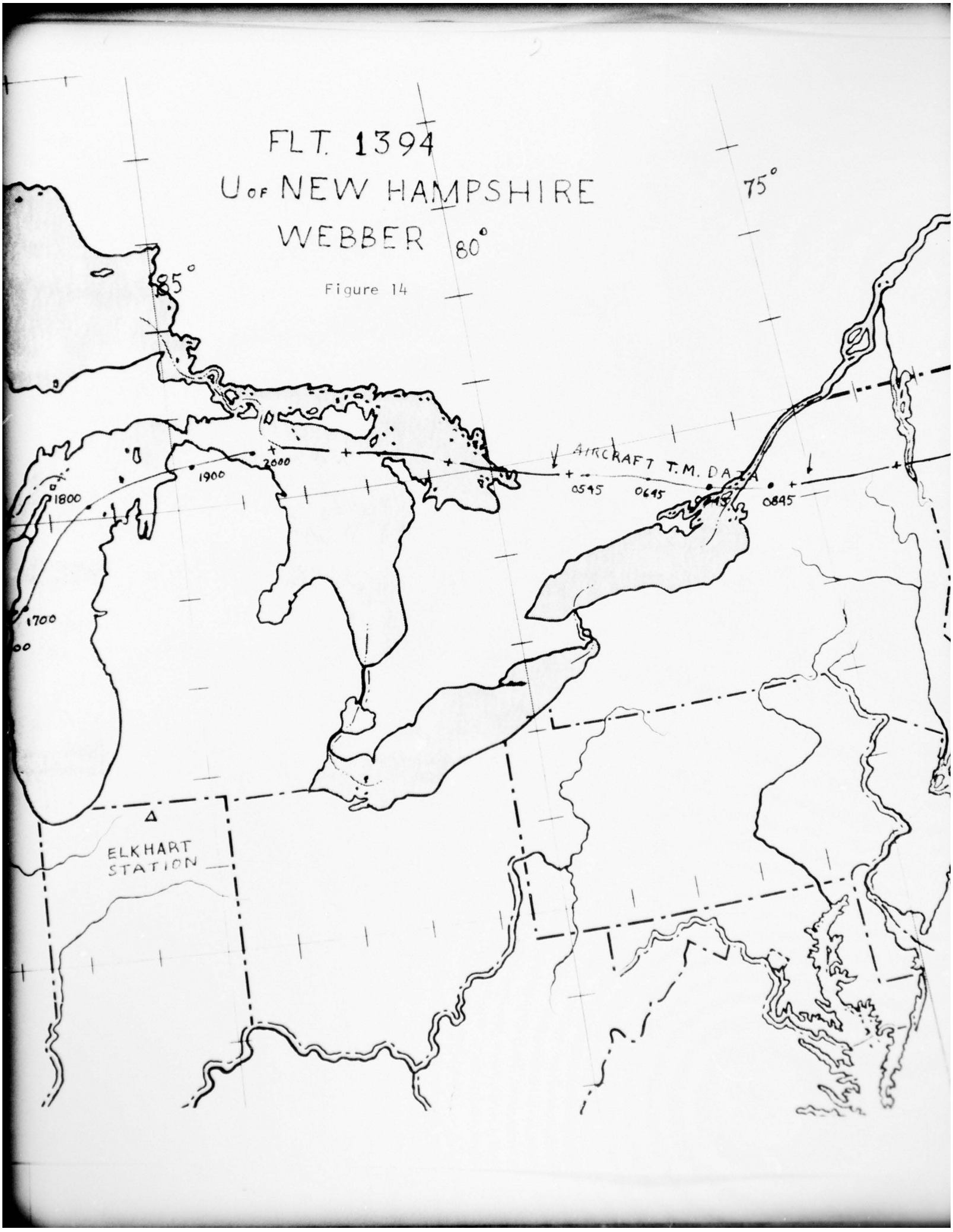
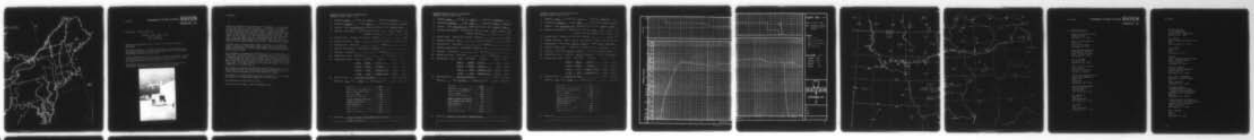

FLT. 1394
U OF NEW HAMPSHIRE
WEBBER
75°
80°
85°
AIRCRAFT T.M. DATA
1800
1900
2000
0545
0645
0845
1700
ELKHART
STATION

Figure 14

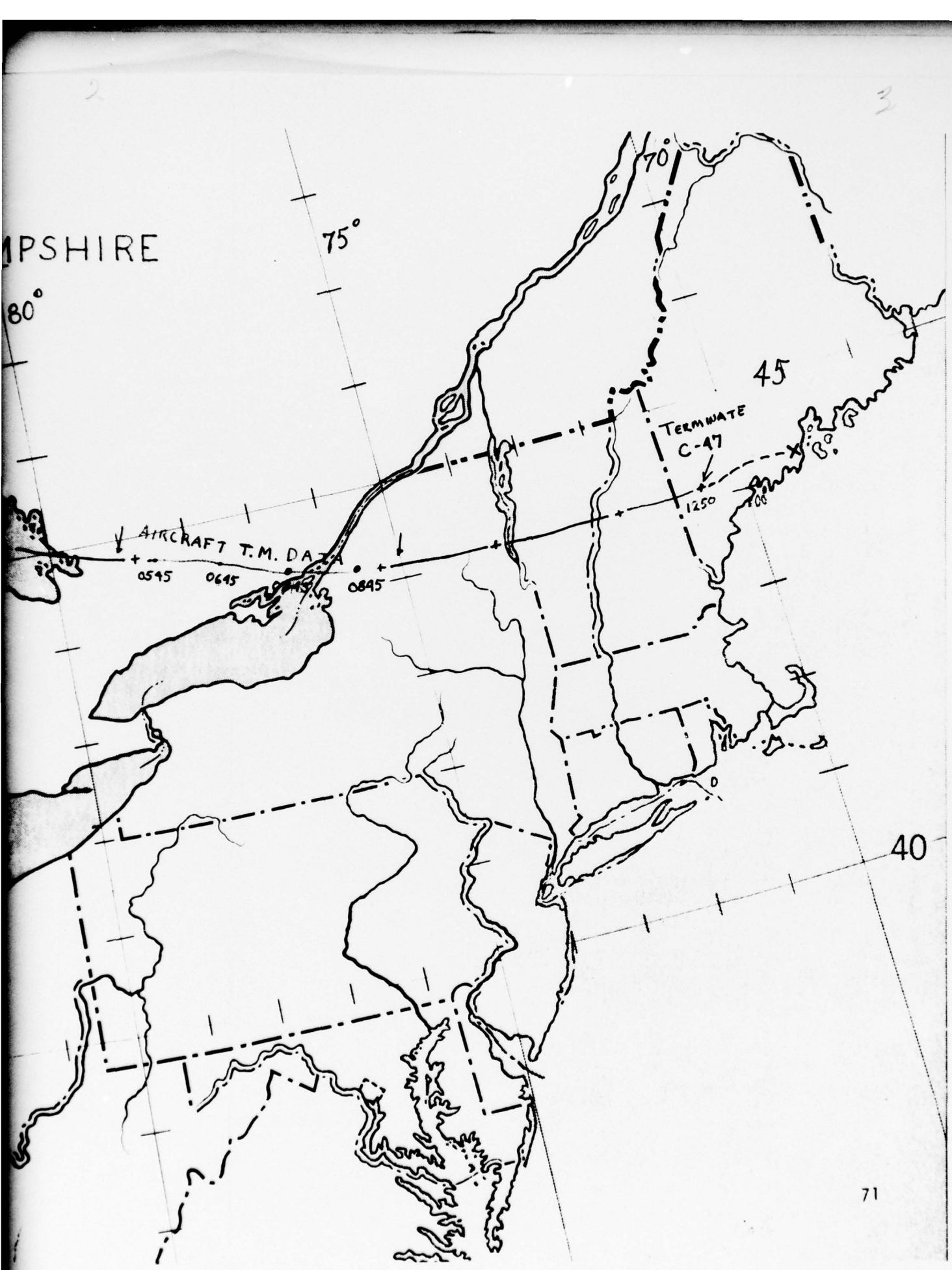
AD-A037 419 RAVEN INDUSTRIES INC SIOUX FALLS S DAK FLIGHT OPERA--ETC F/G 1/2
SKYHOOK 1976.(U)
JAN 77 T PAPPAS
UNCLASSIFIED R-1276007 N00014-76-C-0731
NL

2 OF 2
ADA037419



END

DATE
FILMED
4-77


MPSHIRE
80°
75°
70°
45
40
TERMINATE
C-47
1250
AIRCRAFT T.M. DATA
0545
0645
0845

FLIGHT 1395 - FLIGHT DESCRIPTION

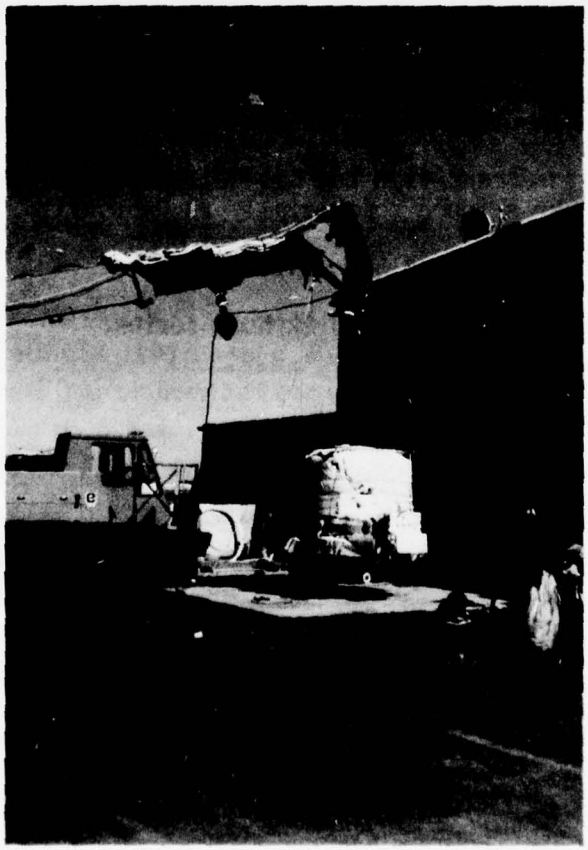
MARSHALL SPACE FLIGHT CENTER
Dr. T. Parnell
James Derrickson

Basically the experiment was the same as on Flight 1387 flown in the spring.

Due to the failure of the single transmitter on Flight 1395, a dual transmitter system was incorporated on Flight 1395. One transmitter was provided by MSFC and one by Raven.

A total flight duration of 40 hours was originally requested. However, due to late arrival of the experimenters and the short "turn-around" it became evident that a long flight was not possible.

The balloon provided for this flight was a Raven built 21.1 million cubic foot. The balloon was one of two built for NCAR/NSBF.



Launch was scheduled for the evening of 29 September. A slight delay was incurred due to a fowled parachute. As inflation was begun the surface wind was gusting causing the bubble to flutter and rotate. For this reason the bubble was held slightly tighter than normal until it was filled enough to withstand the wind, which had subsided. The bubble was then raised to 95 feet with approximately 90% gross inflation. Later the bubble was put up approximately ten feet at which time the balloon became damaged as it deployed above the spool. The damaged area was approximately ten feet long. The flight was aborted.

Two hours later a second attempt launch on another 21.1 mcf balloon ended in an aborted flight when release squibs failed to release the gondola from the crane. Miswired squib cables were found that had not been properly checked.

The experiment was launched the following day on a 15 mcf balloon. The flight took an easterly track at a reasonable speed of 20 to 30 mph. It appeared that the flight would be longer than previously anticipated so it was decided to switch from the Raven telemetry transmitter to the MSFC transmitter which required less power thus increasing the overall flight time. The signal, however, was considerably weaker so the Raven transmitter was switched back on.

The tracking station at Flint, Michigan took over the last part of the flight and, with the C-47 tracking aircraft, brought the balloon down on the Michigan penninsula, five miles southwest of Alpena.

The gondola was in good condition and was delivered to a local trucking firm where it was then shipped commercially to Huntsville.

The experiment was aloft for 16.5 hours.

This was the last flight of the 1976 Skyhook series.

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1395-A Director Fulkerson

2. Scientist Parnell Group MSFC Date/Time 9-29-76 /19:26 Z

3. Launch: Site Sioux Falls, SD Technique/Launch Veh. Dynamic-Crane

4. Balloon Performance: Theoretical Ceiling 3.1 mb, 40.55 km
   Actual Ceiling _____ mb, _____ km

5. Ascent Rate: Surface to Ceiling, Average _____ mps

6. Flight Duration: Total _____ hr _____ min At ceiling _____ hr _____ min

7. Termination: Date/Time _____/_____Z. Method _____

8. Balloon Destruction: Confirmed, visually, etc. _____

9. Landing: Date/Time _____/_____Z. Location _____

10. NOTAM Close out: Date/Time _____/_____Z. Activity _____

11. Frequencies Used:

(MHz)	Emission	Purpose	Power	Time
1533.5	1000F9	Parnell	2-W	4.0
1527.5	1000F9	Telemetry	2-W	4.0
149.4	30F9	Command & Comm	80-W	4.0
7.465	3A3J	Communications	100-W	4.0

12. Balloon Specs: N.40S-15/15/15T-600.0 Serial No. 101

Material SF Vol. 600M^3 Gauge 0.6 mil. 2 ea. 0.6 cabs

Balloon	1888
Parachute (Dia 30.5 m)	218
Raven Instrumentation	76
Ballast & Bag	620
Scientific Package	1728
Timers, Strobe & Crush Pad	48
Ladder & Pin Fitting	74
Extra Batteries	28
Gross Weight	4680
Free Lift 12%	562
Gross Inflation	5242

13. Comments Balloon sustained damage during final inflation, flight was aborted.

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1395-B Director Fulkerson

2. Scientist Parnell Group MSFC Date/Time 9-30-76 / 02:45 Z

3. Launch: Site Sioux Falls, SD Technique/Launch Veh. Dynamic - Crane

4. Balloon Performance: Theoretical Ceiling 3.37 mb, 39.9 km
   Actual Ceiling _____ mb, _____ km

5. Ascent Rate: Surface to Ceiling, Average _____ mps

6. Flight Duration: Total _____ hr _____ min At ceiling _____ hr _____ min

7. Termination: Date/Time _____/_____ Z. Method _____

8. Balloon Destruction: Confirmed, visually, etc. _____

9. Landing: Date/Time _____/_____ Z. Location _____

10. NOTAM Close out: Date/Time _____/_____ Z. Activity _____

11. Frequencies Used:

(MHz)	Emission	Purpose	Power	Time
1533.5	1000F9	Parnell	2-W	4.0
1527.5	1000F9	Telemetry	2-W	4.0
149.4	30F9	Command & Comm.	80-W	4.0
7.465	3A3J	Communications	100-W	4.0

12. Balloon Specs: SF379.91-050-NSC-07 Serial No. 19

Material _____ Vol. 20:11 MCF Gauge 0.5 mil. 2 ea. 0.6 caps

Balloon	1598
Parachute (Dia 30.5 m)	218
Raven Instrumentation	80
Ballast & Bag	320
Scientific Package	1728
Timers, Strobe & Crush Pad	48
Cable Ladder & Pin Fitting	74
Extra Batteries	24
Gross Weight	4090
Free Lift 14%	572
Gross Inflation	4662

13. Comments Release system failed - Flight Aborted

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (REV. 9/73)

1. Company Raven Flight No. 1395-C Director Fulkerson

2. Scientist Parnell Group MSFC Date/Time 10-1-76 / 02:23 Z

3. Launch: Site Sioux Falls, SD Technique/Launch Veh. Dynamic - Crane

4. Balloon Performance: Theoretical Ceiling 4.66 mb, 37.5 km
   Actual Ceiling 4.66 mb, 37.5 km

5. Ascent Rate: Surface to Ceiling, Average 2.86 mps

6. Flight Duration: Total 21 hr 03 min At ceiling 16 hr 27 min

7. Termination: Date/Time 10-1-76 / 22:38 Z. Method R/C - Flint Mich.

8. Balloon Destruction: Confirmed, visually, etc. Visual

9. Landing: Date/Time 10-1-76 / 23:26 Z. Location 83°40' - 45°01'

10. NOTAM Close out: Date/Time 10-1-76 / 23:15 Z. Activity MPS-Center

11. Frequencies Used:

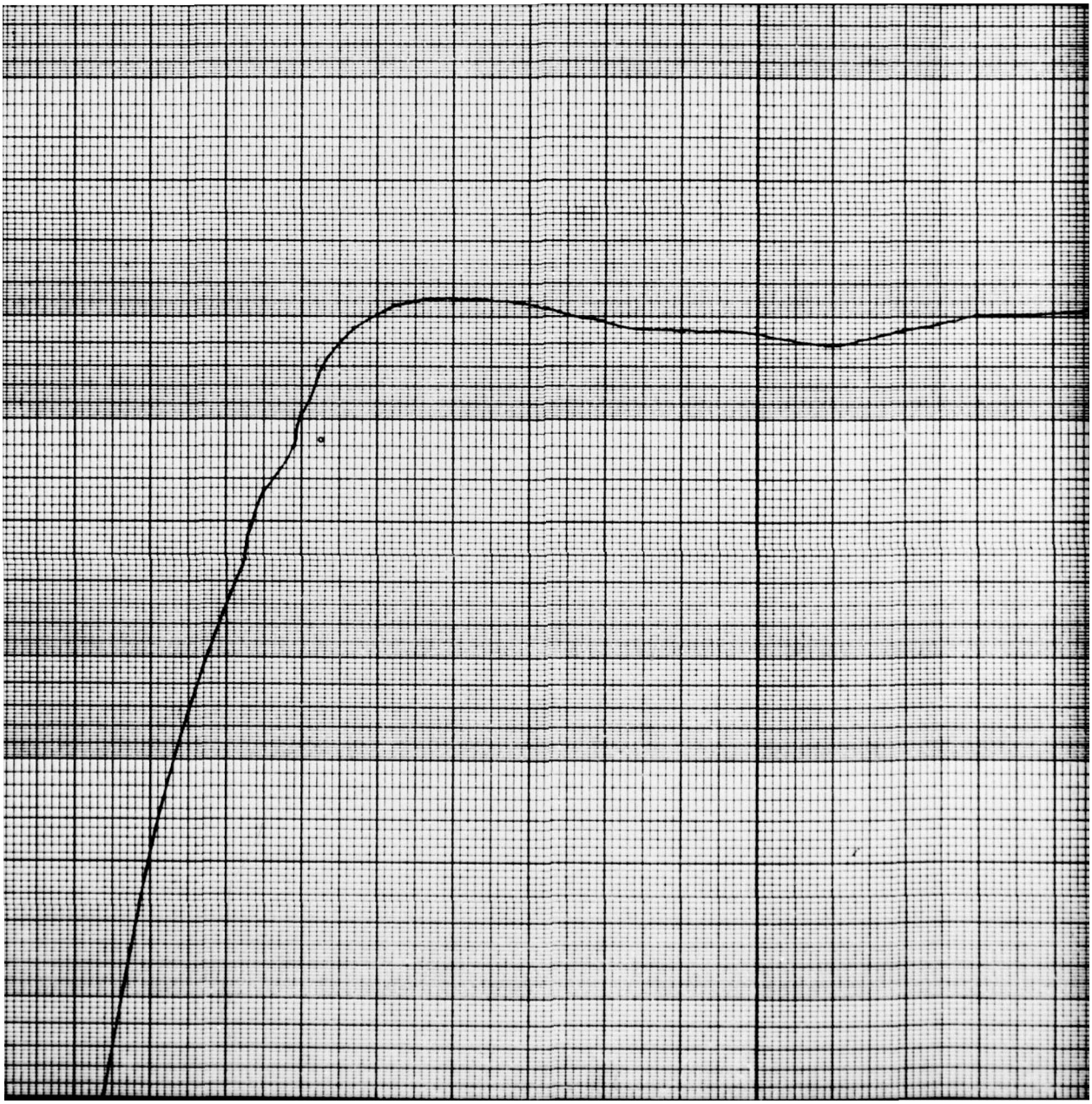
(MHz)	Emission	Purpose	Power	Time
1533.5	1000F9	Parnell	2-W	24.0
1527.5	1000F9	Telemetry	2-W	24.0
149.4	30F9	Command & Comm.	80-W	24.0
7.465	3A3J	Communications	100-W	24.0

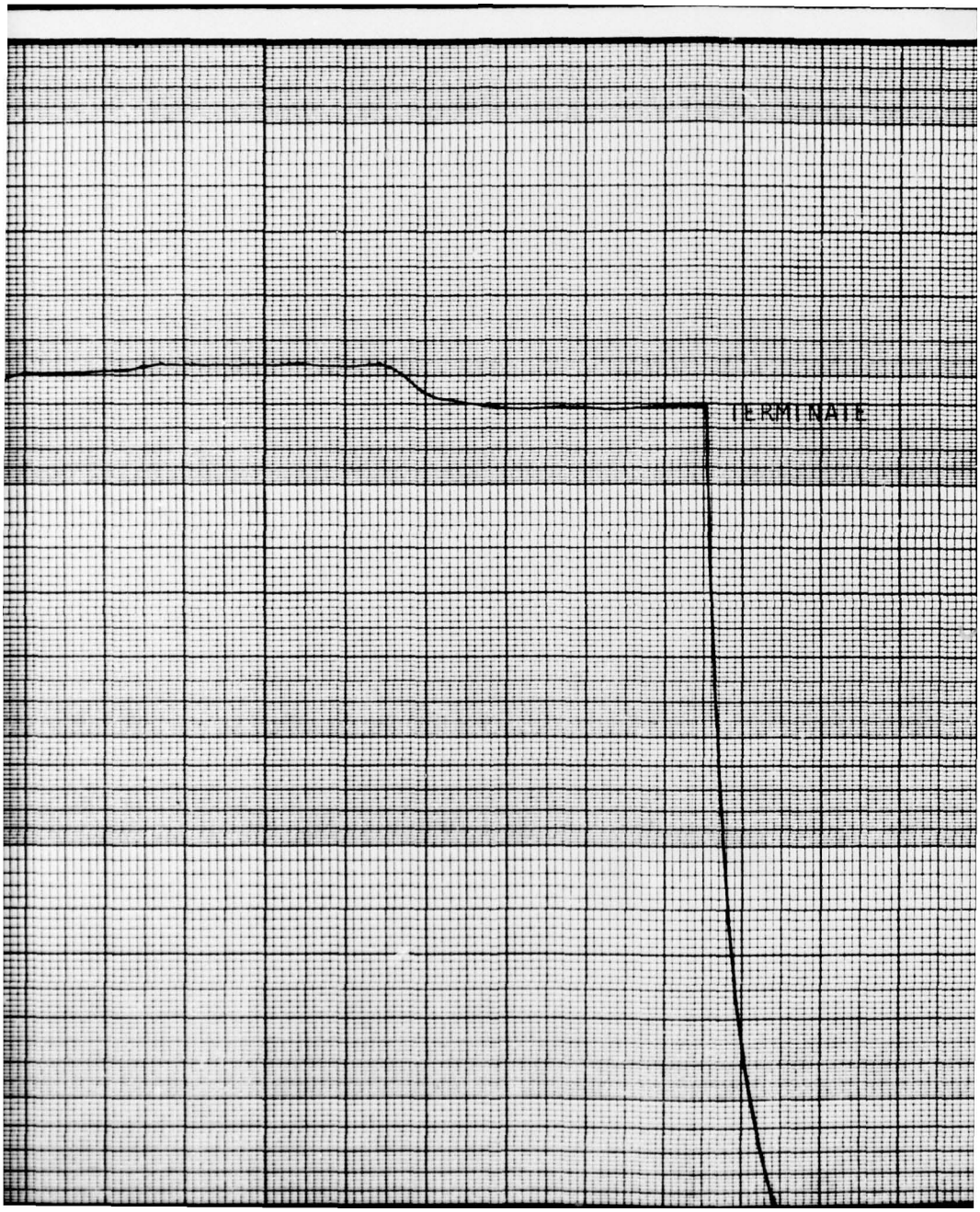
12. Balloon Specs: SF334.85-070-NSC-02 Serial No. 12

    Material SF Vol. 15 MCF Gauge 0.7 mil. 2 ea. 0.6 caps

Balloon	1872
Parachute (Dia 30.5 m)	218
Raven Instrumentation	80
Ballast & Bag	320
Scientific Package	1728
Timers, Strobe & Crush Pad	48
Ladder & Pin Fitting	74
Extra Batteries	24
Gross Weight	4364
Free Lift .....14%.....	611
Gross Inflation	4975

13. Comments

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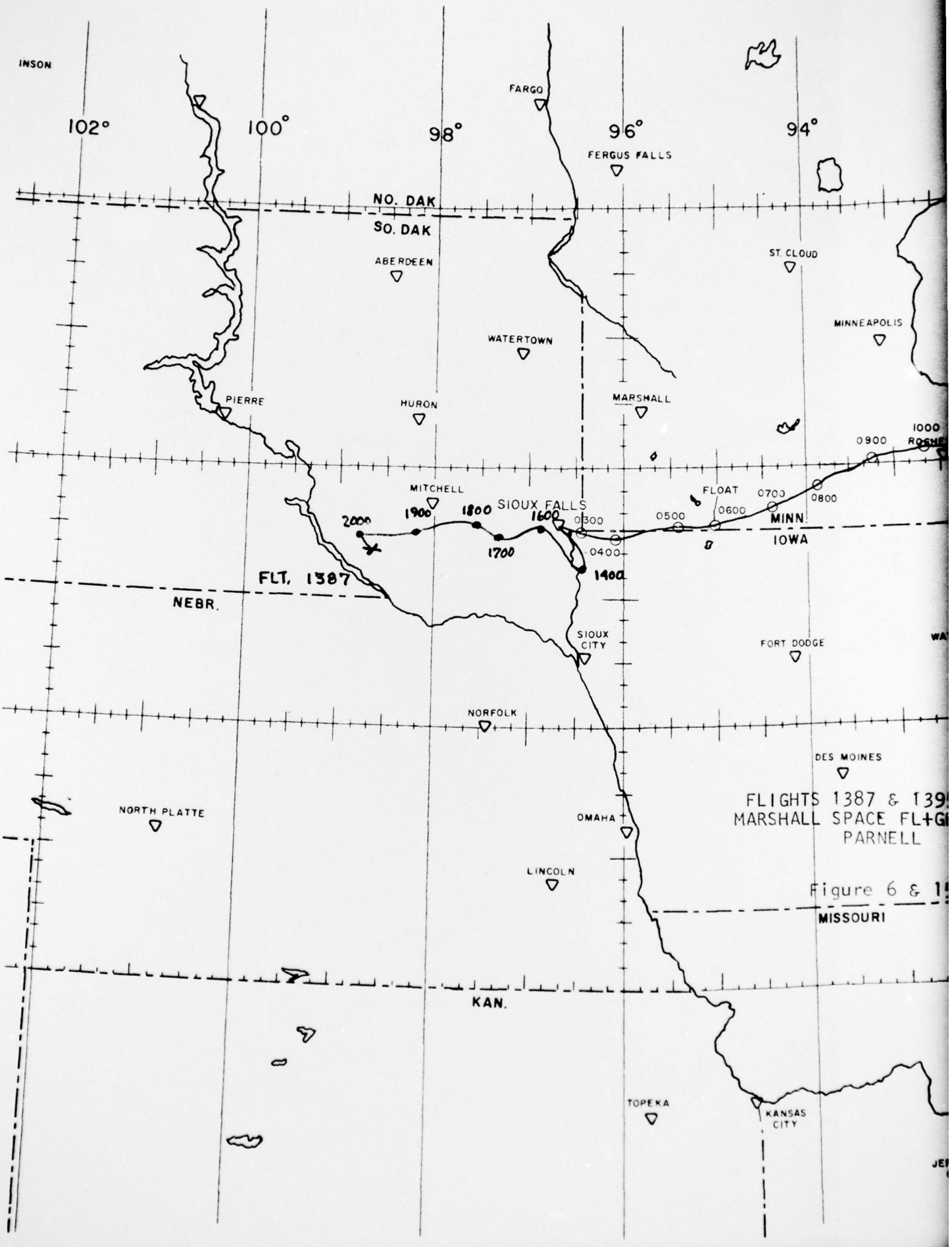
INSON
FARGO
102°
100°
98°
96°
94°
FERGUS FALLS
NO. DAK
SO. DAK
ABERDEEN
ST. CLOUD
MINNEAPOLIS
WATERTOWN
PIERRE
HURON
MARSHALL
0900
1000
MITCHELL
SIOUX FALLS
FLOAT
0700
0800
2000
1900
1800
1600
0300
0500
0600
MINN.
IOWA
1700
0400
1400
FLT. 1387
NEBR.
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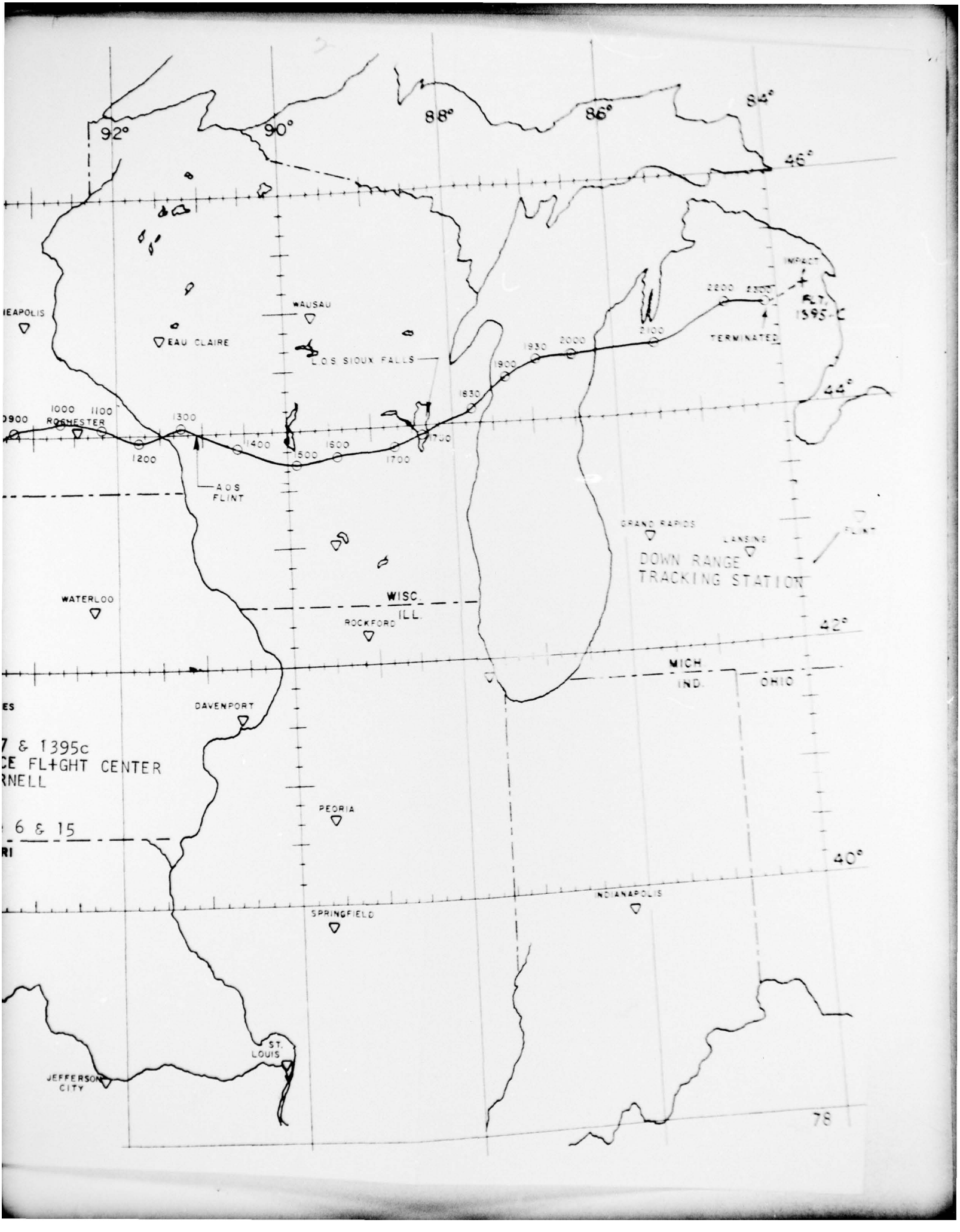
FORT DODGE
NORFOLK
DES MOINES
NORTH PLATTE
OMAHA
FLIGHTS 1387 & 139
MARSHALL SPACE FL+G
PARNELL
LINCOLN
Figure 6 & 1
MISSOURI
KAN.
TOPEKA
KANSAS CITY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90°
88°
86°
84°
46°
44°
42°
40°
WAUSAU
EAU CLAIRE
LOS SIOUX FALLS
ROCHESTER
1000
1100
1300
1200
1400
1500
1700
1830
1900
1930
2000
2100
2200
2300
IMPACT
ELT, 1395-C
TERMINATED
A.O.S. FLINT
GRAND RAPIDS
LANSING
FLINT
DOWN RANGE TRACKING STATION
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R-1276007 **ELECTRONICS SYSTEMS DIVISION** RAVEN industries, inc.

ADDENDUM

It is with great sadness and a very keen sense of loss to have to announce that Raven will no longer be able to offer its' Flight Operation services to those many groups and individuals we have served since the company's founding in 1956. The economics of private industry ballooning is a luxury our Government feels it can no longer provide.

It was only a few years ago that Winzen Research's operations crew met its' demise through the same mechanism we are now experiencing. Now, it is our turn. How many free enterprise industries have disappeared in the last ten years because the tendency of government is to impose, grow and then, depose?

Raven has sincerely enjoyed working with you, the scientist, engineer and technician in the past twenty years and wish you success in your scientific endeavors. We also wish to thank the Office of Naval Research with whom we have been working these many years. It was the Office of Naval Research who nurtured scientific ballooning and funded its early development.

Good luck in the future!

Sincerely,

Paul S. White, Vice President
Electronic Systems Division

16 December 1976

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REPORT DOCUMENTATION PAGE

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Balloons
Stratospheric Research

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The 1976 Skyhook program provided sufficient funding and balloons for an attempted twelve flights from the Sioux Falls, S.D. and Watertown, S.D. areas. Eight flights were successfully launched but a telemetry transmitter failed on one, reducing scientific exposure to seven flights. These seven flights provided over 196 hours at float altitude for the various experiments. This report describes individual flights, equipment used, flight data, and other program information.

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