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FINAL REPORT

SKYHOOK Churchill 1964

Performed under Contract Nonr 3390(12)

for

Office of Naval Research
Washington 25, D. C.

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Sioux Falls, South Dakota

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Office of Naval Research
Washington 25, D.C.

31 December 1964

Report No. 2164

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ABSTRACT

Contract Nonr 3390 (12) dated 1 March 1964 and awarded to Raven Industries, Inc. on 25 June 1964, covers a series of high altitude SKYHOOK balloon flights from Ft. Churchill, Manitoba, Canada.

The task called for furnishing personnel and facilities necessary to conduct flights during the period of mid-June to mid-August and included:

1. Fabrication and supply of balloons and balloon safety, destruct, and flight control instrumentation.

2. Performance of necessary launching, aircraft tracking and recovery operations for each flight.

3. Establishment and maintenance of close liaison with the scientific investigators, base officials, and Canadian authorities.

4. Provision of advice and assistance, as necessary, to the scientific experimenters responsible for the payloads.

The background of the selection of Ft. Churchill as launch site and a description of present facilities there, are covered in the Introduction (Section I). A description of the program, including launch procedures,

tracking and recovery techniques, and a description of the flight control instrumentation are covered in Section II. An analysis of the 1964 program is presented in Section III, while flight data are presented in Section IV.

A total of 32 balloons were inflated during the period of 16 June 1964 to 17 August 1964.

I. INTRODUCTION

SKYHOOK Churchill 1964 called for 25 flights which were under the cognizance of the Office of Naval Research plus 3 flights for the United Kingdom Atomic Energy Authority which were contracted directly to Raven Industries, Inc., but were provided with SKYHOOK services.

The SKYHOOK Churchill program was initiated in 1959 and consisted of 5 flights for Dr. James Earl of the University of Minnesota. Since that time the program has been conducted each summer with increasingly demanding requirements.

Ft. Churchill was originally selected as a launch site because of its proximity to the geomagnetic North Pole and because of the services which were available through the Canadian Army on the base.

On 1 July 1962 the Churchill Research Range was established by the Office of Aerospace Research, USAF. The management, operation, and maintenance of the range was subcontracted to Pan American Airways.

Through OAR and PAA, the balloon contractor is able to obtain many services and supplies such as vehicles and shipping and transportation services necessary to conduct the balloon operation.

Messing and housing facilities are obtained through the Canadian Department of Public Works. Flight clearances and preflight weather data are available through the Department of Transport.

II. PROGRAM DESCRIPTION

The SKYHOOK Churchill 1964 program included many individual flight requirements and variables which had to be taken into consideration.

Sites were set up at Ft. Churchill for launching and Stony Rapids, Saskatchewan for recovery. The flight operations launch group stationed at Ft. Churchill consisted of the following men:

D. Johnson -	Program Coordinator and Launch Supervisor
A. Tomnitz -	Tracking Pilot
J. Webster -	Co-pilot
C. Cravaack -	Instrumentation Engineer*
W. Tschetter -	Instrumentation Technician*
G. Lindner -	Instrumentation Technician*
R. Ramstad -	Launch Technician
F. Vandersnick -	Launch Technician
B. Hofer -	Launch Technician

The operations center was set up in the RCAF hangar. This hangar provided ample work space, an area to park the C-47 on a non-interference basis with PAA, storage facilities, and a high roof for antennas. It also housed the Meteorological Office. The Ft. Churchill launch crew was supported by a C-47 which was furnished as GFE and operated by Raven crew members and two Air Force H-21 helicopters which are leased and operated by PAA.

The recovery crew at Stony Rapids had two Cessna 185's on floats which were flown by Raven personnel and a leased Bell 47 G

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* Rotated one man at a time to the communications center in Stony Rapids.

helicopter operated by a contract crew. The recovery group was composed of the following men:

F. Heidelbauer -	Chief Recovery Pilot
P. McFall -	Recovery Pilot (July, August)
R. Schafroth -	Recovery Pilot
D. Kilde -	Recovery Pilot
R. Jacobsen -	Recovery Pilot (June)
J. McKenzie -	Leased Helicopter Pilot
W. Miller -	Leased Helicopter Mechanic (June, July)
M. Diaz -	Leased Helicopter Mechanic (July, Aug.)

Stony Rapids is located on the east end of Lake Athabaska on the Fond Du Lac River. The site provides landing facilities for the float planes on the river and the C-47 on a 3,680 foot, nonlighted, gravel runway.

The float planes are serviced with gas by recovery crew members from a supply purchased in Stony Rapids. Oil is flown in from Ft. Churchill. The C-47 is serviced at Ft. Churchill by either Trans Air or Shell Oil. This aircraft is also serviced at Uranium City, Saskatchewan after a tracking assignment. The strip at Uranium City has a 5,000 foot hard surface runway.

The recovery crew members rent housing and dock facilities for the float planes from local citizens in Stony Rapids. Housing for the telemetry and communications center there was leased from the Hudson Bay Company.

The payloads varied in weight from about 100 pounds to over 500 pounds, and in size from small compact payloads to large spheres or foam boxes over 72 cubic feet in volume.

The balloons ranged in size from 175,000 cubic feet to 9,000,000 cubic feet, with film thicknesses from 1/2 mil to 1 1/2 mil.

Weather conditions at both Ft. Churchill and the recovery station at Stony Rapids, Saskatchewan are erratic and lack of surrounding meteorological reporting stations makes even short range forecasts difficult. The scarcity of days with good launching conditions and good recovery weather makes the conduct of the flight series in a short period of time mandatory.

In order to provide for the many variables involved, Raven attempted to remain flexible. Both heavy-duty carts for anchor line launches and a truck for complete dynamic launching were made available. The launch crew was supplied with all the equipment necessary to rig payloads of different weights and volumes. Three of the launch crew technicians were men with previous balloon production experience and a thorough knowledge of field inspection and handling of balloons of all sizes and material thicknesses.

The launch supervisor was expected to spend considerable time in weather briefings to compensate for the lack of data.

The flight control instrumentation was calibrated and stored prior to flight to provide "off the shelf" type service and to decrease delay time between multiple flights. Due to limitation of ground electronics equipment and the number of approved frequencies, a limit of three airborne payloads at the same time was imposed upon the operation.

The large payloads presented recovery problems; however, the helicopter which was used again this year was helpful in reducing the distance that payloads had to be carried out of the bush. The biggest recovery problem this year, as in previous seasons, was the effort necessary to track balloons in marginal flying weather and finding suitable lakes in which to land the aircraft while recovering a payload.

In previous years electrical interference caused by thunderstorms adversely affected the low frequency telemetry system used for tracking balloons during flight and locating the parachute on descent. Other problems which threatened reliability with the low frequency system include:

1. The long wire antenna which could become entanged at launch or foul the parachute during descent.

2. The large cone of silence under the balloon.

3. Interference from other signals.

Therefore for the 1964 program, Raven developed a telemetry system which in addition to solving the above problems, also provides a more rugged, accurate, and stable instrument and has a lower power requirement.

The new system employs a solid-state FM/FM VHF transmitter on the balloon and Collins VHF-ADF units in all the aircraft for direction finding. It incorporates sensors and modulation circuitry for altitude data telemetry. Operationally, the new system provides better high altitude data, can be located while on the ground, and has a greater effective range.

In addition to the steady carrier signal for direction finding, the system telemeters altitude data and other measurements such as temperatures and voltages.

The high altitude sensor is a thermal conductivity vacuum gauge which provides an altitude measurement in the range from 75,000 to 225,000 feet. The unit is lightweight, accurate, and reliable. The gauge is incorporated into a temperature compensated bridge circuit and provides a 0-10 millivolt output to a millivolt voltage controlled oscillator in the FM/FM VHF system.

The FM signal is transmitted from the balloon and received by either the ground or airborne receiving stations. The main telemetry station at Ft. Churchill and the Stony Rapids station are equipped with precision electronic counters which display the transmitted data. In addition, the data is printed out on paper for a permanent record at the Ft. Churchill station.

A typical flight operation at Ft. Churchill is conducted as follows: The balloon is released about sunrise. During the previous day all preparations such as helium cascading from railroad tank cars, metering of gas, rigging and weighing payloads in the hangar, instrumentation check out, and weather briefings are performed. As the time for launch approaches, all the necessary equipment is moved to the launch site, which is about 3 miles from the operation center. The launch site is on the old SAC alert ramp.

In addition to the advantage of a hard surface, this site is clear of any obstructions. Also, CRR provided a van at the site with a phone and a hard line link to DOT for final flight clearance. The van is heated, has a desk and provides shelter during periods of standby for inclement weather conditions.

The balloon is laid out on a ground cloth with the top section upwind from the payload. The bubble area is passed through the launch spool which is mounted to the front end of a helium tractor. The parachute is tied in at the base of the balloon, and the anchor line and payload are tied in at the base of the parachute.

Inflation is started after all elements of the balloon system are checked by the launch director. After the proper amount of helium has been introduced into the balloon, the inflation tube is tied off and all launch crew members are assigned stations to assist in the launch. When surface wind conditions provide an optimum launch condition, the bubble is released and the wind carries the balloon down the layout direction toward the payload. Depending upon the launch technique used, the cart or truck on which the payload is carried is moved to place the payload directly under the balloon as it comes overhead.

During the early periods of ascent, the balloon moves in an easterly direction, but by the time the balloon has reached 60,000

to 80,000 feet, it will begin to move back toward the west. Radar support by CRR provides tracking information early in the flight. The time at which the C-47, which tracks the balloon from Ft. Churchill to Stony Rapids, takes off is not rigidly set. However, the aircraft usually intercepts the balloon shortly after it reaches ceiling. When drop packages are carried, they are also located by the C-47. Most of the flights are also visually followed by theodolite when weather permits.

The central telemetry station for the project is located in a contractor furnished instrument van (bus). During the first few hours of flight, all altitude data are acquired and radio command functions are issued from this station. The ground station at Stony Rapids is able to receive the telemetry data after the balloon reaches about 100,000 feet, but control of the flight is normally retained by the Ft. Churchill station and the C-47 until the balloon is near Stony Rapids.

As the balloon nears Stony Rapids, the two Cessna 185's intercept the balloon and take several fixes to determine the trajectory. Normally, the C-47 is then free to proceed to Stony Rapids to wait for the return trip to Ft. Churchill after recovery. In periods of inclement weather, however, the C-47 will assist by staying at higher altitudes until the parachute penetrates any overcast.

Prior to cutdown, the helicopter is called out. Because of the limited range of the helicopter, its arrival at the impact site is generally timed to coincide approximately with impact time.

After termination, the 185's follow the parachute down and spot the payload. Suitable landing lakes are found and an area cleared near the impact site for the helicopter to land.

Generally, the helicopter carries back the main gondola while the 185's return with detachable items such as instrument boxes and photobarographs.

After the payloads are returned to Stony Rapids, the equipment is loaded on the C-47 and returned to Ft. Churchill.

III. RESULTS

A. General Results

During the period of 16 June to 17 August, a span of 63 days, 32 balloons were inflated and 30 were launched for the SKYHOOK Churchill 1964 program. The results of the launches can be categorized as follows:

19 successful flights
1 end fitting destruct device detonated prematurely.
1 early termination because the payload was not orientated properly after becoming entangled in rigging apparatus.
1 flight could not be terminated.
8 bursts.

The 19 successful flights represent over 230 hours of flight time at ceiling. Table I shows the launchings made, successful flights and approximate time at ceiling for each scientific agency.

TABLE I

Scientific Agency	Launchings	Successful Flights	Time at Ceiling
Goddard Space Flight Center	5	4	43 hr.
Naval Research Laboratory	2	1	12 hr.
United Kingdom Atomic Energy Auth.	3	3	35 hr.

University of Chicago	13	6	83 hr.
University of Minnesota			
Dr. Earl	1	1	3 hr.
Dr. Waddington	2	2	19 hr.
Southwest Center for Advanced Studies	3	2	38 hr.
Case Institute	1	0	0 hr.

The fact that such a large number of balloons was launched in a relatively short period of time, considering weather conditions, again reflects the capability for multiple launches by the Raven team. Eight times this season two balloons were launched in less than twenty-four hours. Twice, three balloons were launched in less than twenty-four hours. On still another occasion, three flights were launched in a period of less than 8 hours.

Twenty balloons successfully reached ceiling. One flight, No. 1114-N for Dr. Meyer of the University of Chicago, could not be terminated. Two flights, No. 1096-N and 1097-N for U.K.A.E.A. were recovered by PAA helicopters stationed at Ft. Churchill, and No. 1119-N for Dr. Earl

of the University of Minnesota was recovered by truck from Ft. Churchill. The remaining 16 flights were all successfully recovered by the group stationed at Stony Rapids.

A problem which was evident before the operation started and which caused a great deal of concern during the program was the flight schedule as called out in the Operations Requirements. The arrival dates of scientists and technicians at Ft. Churchill were unfortunately such that a light work load would be carried early in the program and an extremely heavy load in the final stages of the operation. The problem was magnified by the fact that weather conditions favorable for launching balloons were much more common in mid and late June than in late July and early August.

Shown below is a table of anticipated arrival dates of the scientific groups and the actual dates of arrival.

TABLE II

Scientific Organization	ETA per Operational Requirements	Actual Arrival Dates
GSFC	10 June	11 June
U. of Minnesota	20 June	
Dr. Waddington		13 July
Dr. Earl		20 July
NRL	28 June	27 June
UKAEA	29 June	29 June
U. of Chicago	15 July	14 July
Case Institute	20 July	20 July
SWCAS	20 July	20 July

The period between 24 June, when the last GSFC balloon was flown, and 18 July when the University of Chicago was launched is 23 days. During this time only the two ONR SKYHOOK flights for NRL and the three UKAEA low-altitude flights were launched. Any flights which could have been scheduled during this period would have helped to alleviate the heavy schedule during August.

The operation was improved in 1964 by the addition of a C-47 aircraft. With the increased load-carrying capability provided, the activation and deactivation of the down-wind station at Stony Rapids was accomplished with fewer trips from Ft. Churchill. The large cargo doors allowed all payloads to be transported by vehicles directly assigned to the project.

Each year has found an increase in the services available at Ft. Churchill. This season 11 recoveries of main payloads or drop packages were accomplished by PAA H-21 helicopters. This service has saved many payloads from being lost permanently or for extended periods of time. The H-21 provides for land recoveries within a 50 mile range of Ft. Churchill. All of the SKYHOOK payloads were well within the load capability of the aircraft.

Almost all flights this season were tracked by the station radar systems. This service also saved many hours of aircraft tracking time. In most cases this year, when payloads came down on a parachute near Ft. Churchill, the radar personnel were able to direct the PAA helicopter directly to the payloads.

The SKYHOOK group was again provided with surface vehicles when required, regardless of the hour of day.

In addition, billeting and messing facilities were excellent. Also the services received and the cooperation of the U.S. Air Force, Pan American, Department of Transport, Department of Public Works and the Canadian Army were of great help to the contractor. Without the services provided by these groups, many of the program operations could be performed only with tremendous hardship, and in certain cases could not be accomplished at all.

B. Balloon Performance

Of the 32 inflations, 28 balloons were in the air long enough to evaluate balloon performance. The other four include two which ruptured on the ground, one on which the destruct device fired prematurely, and one which was terminated

shortly after launch because the payload became fouled in the rigging and was not orientated properly for flight. The 28 flights can be broken down to 20 in which the balloon performed as required and 8 which burst. The balloon on Flight 1114-N performed well and in fact was still at 105,000 feet over 40 hours after launch, but the payload could not be released. No balloons were classified as leakers.

Table III shows a breakdown of pertinent data on the 8 balloon that burst.

TABLE III

Flight No.	Date	Balloon Type	Average rate of rise to Burst Alt. (ft. per min.)	Burst Alt. (feet)
1088-N	16 June	9KK 3/4 mil SVT	520	35,000
1099-N	18 July	3KK 3/4 mil Tapeless	789	37,000
1106-N	27 July	9KK 3/4 mil Taped	887	34,000
1108-N	28 July	3KK 1/2 mil Tapeless	714	95,000
1111-N	8 Aug.	3KK 3/4 mil Tapeless	802	60,000
1112-N	8 Aug.	9KK 3/4 mil Taped	728	24,000
1115-N	12 Aug.	6KK 3/4 mil Taped	746	65,000
1116-N	13 Aug.	9KK 3/4 mil Taped	633	41,000

As can be seen from the table, no balloon which failed was subjected to an extreme rate of rise, nor is there an obvious correlation of burst altitudes and failures. The balloon

failures are not limited to specific sizes, material thicknesses, or balloon construction. One common element was the Mil Spec polyethylene balloon material which was used. On no flight was the recorded tropopause temperature excessively low; in fact, the temperatures did not approach the certified cold brittleness temperature of the film.

The production and inspection records on all the balloons which failed have been reviewed individually and do not reveal any indication of problems in construction. The balloons are not limited to a particular production or inspection crew and are not limited to a particular lot of film.

Several of the 1964 flights exhibited low ascent rates above 100,000 feet. This low-ascent-rate characteristic of balloons launched from Ft. Churchill was noted previously in 1961 and 1962, but was countered by employing more than the normal amount of drive-up ballast and 10 or 11 percent free lift. In 1963 low ascent rates were not as prevalent; in fact, rates above 1,000 feet per minute were common. Therefore, Raven and the ONR field representatives agreed to launch a majority of the flights in the 1964 program with 8% free lift

and about 60 pounds of ballast.

A review of ballast drops on ascent of the 1963 and 1964 flights reveals that the average drive-up ballast used per flight to ceiling in 1963 was 57 pounds. In 1964 the average drive-up drops were 41 pounds. While the difference of 16 pounds may not appear to be significant, it might have helped to sustain a more constant ascent rate.

Also, the majority of the inflations in 1963 were given 11 percent free lift, while in 1964 8 or 9 percent was used. Thus 1964 flights were launched with from 2 to 3 percent less free lift. The effect of less ascent ballasting in 1964 plus the initial lower inflation resulted in an average of 3 to 5 percent less free lift in the 1964 flights than 1963.

C. Launch Performance

All flights were launched by the bubble-up-wind anchor line method. All launches were considered successful with the exception of Flight No. 1094-N on which the payload became entangled in the rigging and had to be

terminated shortly after launch. A few launches were conducted under rather windy conditions, which makes the operation considerably harder; however, considering the prevailing launch-site weather, it is remarkable that this does not happen more often.

For the most part, the launches were extremely smooth with a resultant small shock load on the payload and balloon.

The number of operational personnel assigned to the launch crew was adequate. In future programs of this size, however, the addition of a clerk would be of considerable value.

D. Recovery Performance

A total of 16 balloon flights were terminated by the recovery crew based at Stony Rapids and all 16 payloads were successfully recovered and returned to Ft. Churchill. One more flight, No. 1114-N, overflew Stony Rapids, but could not be terminated and tracking and recovery operations had to be cancelled because of bad weather, a weak signal, and impending new flights from the launch site.

The recovery conditions in general were poor. Frequent thunderstorms and low ceilings made flying conditions very hazardous this year.

A large number of forest fires during the first month blanketed the recovery area with varying conditions of haze and dense smoke. One recovery required the float plane to fly through 250 miles of dense smoke to reach the impact site.

The recovery of Dr. Meyers' spark chamber on Flight No. 1107-N was extremely difficult. The impact site was over 200 miles from Stony Rapids and in an area requiring extensive clearing. The area was inaccessible to float planes and in a deep ravine which cut off the wind currents required for the helicopter to fly the payload out. Eventually, the package was flown out in pieces and taken by boat to a landing strip suitable for the C-47.

Almost all recoveries were made by the leased helicopter while being supported by either one or both float planes. The flying hours of float planes while actively engaged on a recovery was reduced slightly by the use of the helicopter. However, the bad weather and smoke required more and closer support from the float planes. The absence of a

significant decrease in float aircraft hours demonstrated that both float planes are required for an operation of the scope involved during this year's program.

The range of the helicopter is quite limited and frequently required both float aircraft to haul loads of canned gasoline on extended recoveries. This problem becomes exceptionally complex with impacts beyond two hundred miles from the recovery station. There are no other sites, including Uranium City, better located than Stony Rapids for an overall center of recovery activity.

In addition to the extra helicopter gasoline load, the float planes are required on some recoveries to transport scientists and technicians to the impact site for the purpose of dismantling some of the larger and more complex research loads. In this event, special wooden packing cases must be transported to the recovery site for packaging of the various components following their removal from the research vehicle.

In past seasons up to three successful flights have been in the air simultaneously with terminations scheduled at short intervals. The long, sustained periods of bad weather

make these multiple launches mandatory when the infrequent good balloon launching conditions do occur at Ft. Churchill. With less than two float-equipped aircraft, tracking and recovery of such multiple balloon flights would be extremely difficult, if not impossible.

Despite the fact that the float aircraft have received thorough inspection by excellent mechanics each spring before leaving for Canada, engine trouble has occurred in one or the other of the two float-equipped airplanes during each of the past three seasons. This situation has, on occasion, "grounded" one of the float planes for a sustained period until replacement parts could be obtained from Winnipeg via Churchill. A considerable inventory of spare parts, instruments, etc., for these aircraft is carried at the recovery station, but it is virtually impossible to anticipate a total need.

While the addition of the helicopter has nearly eliminated float plane landings in marginal waters, the possibility of sustaining damage during a landing in this remote area cannot be eliminated.

Frequently the aircraft must fly under very marginal weather conditions involving low ceilings, limited visibility, and high surface wind velocities.

In the event of a flying accident, the second float-equipped aircraft, always equipped with mated radio liaison gear, would be invaluable for the immediate evacuation of injured personnel.

Even though a record of four years of recovery operations without a flying accident has been established, each season has provided near brushes with disaster. The necessity to bring balloon loads to earth in extremely marginal weather must still be rated as very hazardous.

A total of 586 hours of aircraft flying time was compiled during the 1964 program. Table IV below gives an approximate breakdown by the type of aircraft and the type of mission on which the aircraft was employed including the round trip to the Canadian base sites.

TABLE IV

Aircraft Type	Tracking and Recovery (hrs.)	Logistics (hrs.)	Total (hrs.)
C-47	160	51	211
Raven Cessna 185	90	22	112
Leased Cessna 185	89	20	109
Bell 47G Helicopter	110	44	154

The number of people assigned to the recovery crew was adequate.

E. Instrumentation Performance

1. VHF ADF Performance

The new element in tracking operations in 1964 was the introduction of a Collins DF-301 Direction Finder. This unit converts an ordinary receiver (in the VHF frequency range) to a direction-finding system. The performance of this VHF ADF system was generally very satisfactory. As with all new systems, a few minor problems were encountered. One of these was the receiver in the C-47 aircraft. This is an old-style military transceiver (ARC-27) which did not prove reliable.

Despite the fact that two additional units of this type were taken along for spares and that additional repairs

were made on all units in the field, they still failed with alarming regularity. In no case did these failures affect the success of the program. The C-47 pilot was able to maintain visual contact and/or to extrapolate the flight positions until the Stony Rapids aircraft took over.

The receivers used in the light aircraft (Collins 718-B) were of new design and worked perfectly in all cases.

Despite the fact that the tracking pilots were not accustomed to this new system, very few operational problems arose.

Many parachute descents were brought through extremely adverse conditions such as low ceiling visibility and in proximity to large thunderstorms. Under these conditions, the narrow cone of silence and insensitivity to atmospheric static inherent in this system proved their worth.

Homing distances with this system, even under adverse conditions, were well over 100 miles. Barring water

impacts, homing was often possible after impact at moderately long range, depending on the position and condition of the small transmitting antenna on the payload.

An altitude readout device for the 185 aircraft was designed, but not used due to a shortage of time and mating difficulties. This did not adversely affect the balloon program since the experienced tracking pilots were familiar with descent rates, and were in each case successful in intercepting the descending payloads.

2. Base Station Telemetry

The telemetry receiving systems on both ground stations performed extremely well. The antenna systems were quite adequate physically and electrically, and it was found that an elevation rotor is superfluous in most instances. If set up properly, an accurate azimuth reading can be obtained from the antenna headings, further aiding in balloon tracking.

Telemetry ranges of 450 miles were commonplace and in some cases, reception was possible at Stony Rapids before the balloons reached maximum altitude.

3. Communications

By the addition of a trained radio/electronic technician at the downrange site and by choosing a more favorable radio location there, more reliable HF and VHF communications and excellent telemetry data reception were achieved in 1964.

Still communications are impossible after dark on 6 mc due to the increased skip distance. Had it not been for the informal exchange of information by the radio amateurs of the crew using their own personal SSB equipment, communications would have been impossible at night and on 50% of the days during the program.

An approved ONR frequency of about 3 mc and the addition of SSB equipment would greatly improve the communication between Ft. Churchill and Stony Rapids. The 6 mc frequency should be retained and SSB be added for improved daytime communications.

The standard VHF command/voice transceiving gear was very dependable as usual and the range was improved by optimizing antenna locations. The only serious

equipment malfunction was the failure of the 24-12 volt convertor supplying power to the VHF transceiver in the C-47. The trouble was found and temporary repairs made to finish the program.

4. Balloon Instrumentation

a. Silver Cells

The use of silver cells as a primary power source for standard balloon instrumentation was highly successful. No battery pack failures were experienced throughout the program.

The pack design was slightly conservative. Some packs still operated after drains in excess of 30 hours due to difficult or delayed recoveries. The runaway flight 1114-N provided an extreme test of battery life, the pack finally failing after 42 hours continuous drain. Reduction in cell size, from 20 ampere-hours to 10 ampere-hours, would save 12 pounds in weight, but this would be insufficient to power the unit for the requirements of the 1964 Churchill program. Even after subjecting

some packs to severe impacts and lengthy water submersion, proper re-charging restored them to flying status. Only one pack, submerged for 4 days on 1100-N, could not be revived.

The dry cell portion of the pack which powered the radio command receiver and radio command termination squibs was satisfactory in all cases and quite adequate. This redundant supply was engineered to permit flights to be terminated independently of silver cell condition.

b. Beacon/Telemetry Transmitter

The transmitter performed very well. The unit was too well insulated on the first few flights and some transmitter frequency drift was noted due to excessive heat. No further problems were encountered after the insulation was reduced. Three transmitters were lost and several are being repaired after submersion in brackish water.

c. Millivolt Voltage Controlled Oscillator

These units caused a few problems during the program. Shipment from manufacturer was delayed and quite a

few were received with signs of poor quality control by the manufacturer. One was dead upon arrival. Severe impacts and some submersions reduced the number of good units. Altogether, 6 units were returned to the United States for repair. Three of these were returned to service at Churchill.

d. High Altitude Transducer

The high altitude transducer used with the system is a thermal conductivity gauge operating in a temperature compensated bridge circuit. The D.C. supply voltage to the transducer electronics is zener regulated. Absolutely no malfunction of the unit was experienced and calibration was accurately maintained from flight to flight. Part of this stability is due to the fact that no moving parts are used.

At extremely high altitudes the resolution and accuracy of the unit far surpassed that of the aneroid-driven pressure gauges previously used.

e. Low Altitude Transducer

This unit is an aneroid bellows-driven potentiometer. Simple circuitry was added to make it compatible with the FM system.

This part of the instrument package caused some problems. At first the transducer itself was suspected but discussions with the factory, further study, and continued experimentation proved that the transducer was not entirely at fault. Findings indicate that some of the difficulty was temperature induced and a portion of the errors encountered was attributable to the associated circuitry.

Strategic insulation of the suspect components in the field provided a definite improvement in accuracy.

The problems which were occasioned by this difficulty did not affect the success of any flight.

f. Sensors

Several auxiliary sensors were incorporated in the package. These were used to check on the operation of the package during flight.

There were two temperature probes, internal and external. Both operated quite well. Physically, the external probe suffered frequent damage because of its fragility, despite protective measures which were taken.

The battery voltage indicator worked quite well and provided a vivid picture of silver cell performance.

The ballast dropping sensors worked reasonably well but were prone to launch and impact damage. On two occasions launch-damaged ballast sensors restricted ballast flow by being bent into the ballast valve orifice. On other flights the particles of dropping ballast had a tendency to jam the sensor, reducing its sensitivity.

g. Commutator

A twelve position electro-mechanical rotary stepping switch was used. It cycles through its twelve positions only upon command. The various sensor

outputs are fed to the commutator which selects them for telemetering. The normal position is the altitude sensor position. In addition to the sensors already mentioned, several references and customer function indications were on selected positions.

Thermal runaway in the drive transistor was experienced in several instances, causing the commutator coil to burn out. Commutation was, therefore, performed only when absolutely necessary.

h. Radio Command Receiver and Decoder

The same reliable VHF system initially developed by Raven Industries, Inc. several years ago was incorporated in the new system. Over 200 command functions were performed successfully without a failure directly attributable to the R/C system itself. Some failures of the private line transistor were noted this year, but since this is a fail-safe circuit, no detrimental effects were noted.

Because of multiple flight requirements and requests of various customers, it became necessary to use all six channels on several occasions, and more could have been used had they been available. A maximum capability of twelve (12) channels can be incorporated in this R/C system.

i. Termination Timer

The termination timer used was primarily the same as used in previous years. Some minor wiring and packaging changes were made to adapt it to the 1964 integrated package. The only trouble encountered was the failure of one of the dual (redundant) motors during Flight No. 1117-N, but the timer was still capable of terminating the flight. Silver cell voltage per cell is initially higher than that of dry cells, but the 7 volts supplied is well within the control range of the motors.

The cause of failure of Flight 1114-N to terminate was deduced to be external to the instrument package.

Failure of both timer motors is highly improbable. Long after programmed cut-down, ballast could be dropped on command and even more significantly, the beacon was operating normally indicating an adequate power supply for the radio command. Since neither the timer nor the radio command termination effected cut down, the source of trouble appears to be elsewhere.

j. Instrument Package

The overall performance of the instrument package was quite satisfactory.

Waterproofing of the instrument container is of prime importance in future programs. Several attempts at waterproofing in the field met with varying degrees of success. The best of these was poly tape sealing of the metal cover. This, however, gave no protection to the silver cells.

Some research on various insulation techniques was also carried out during this program. At present, indications are that the system requires some insulation at night while none is needed in the daytime.

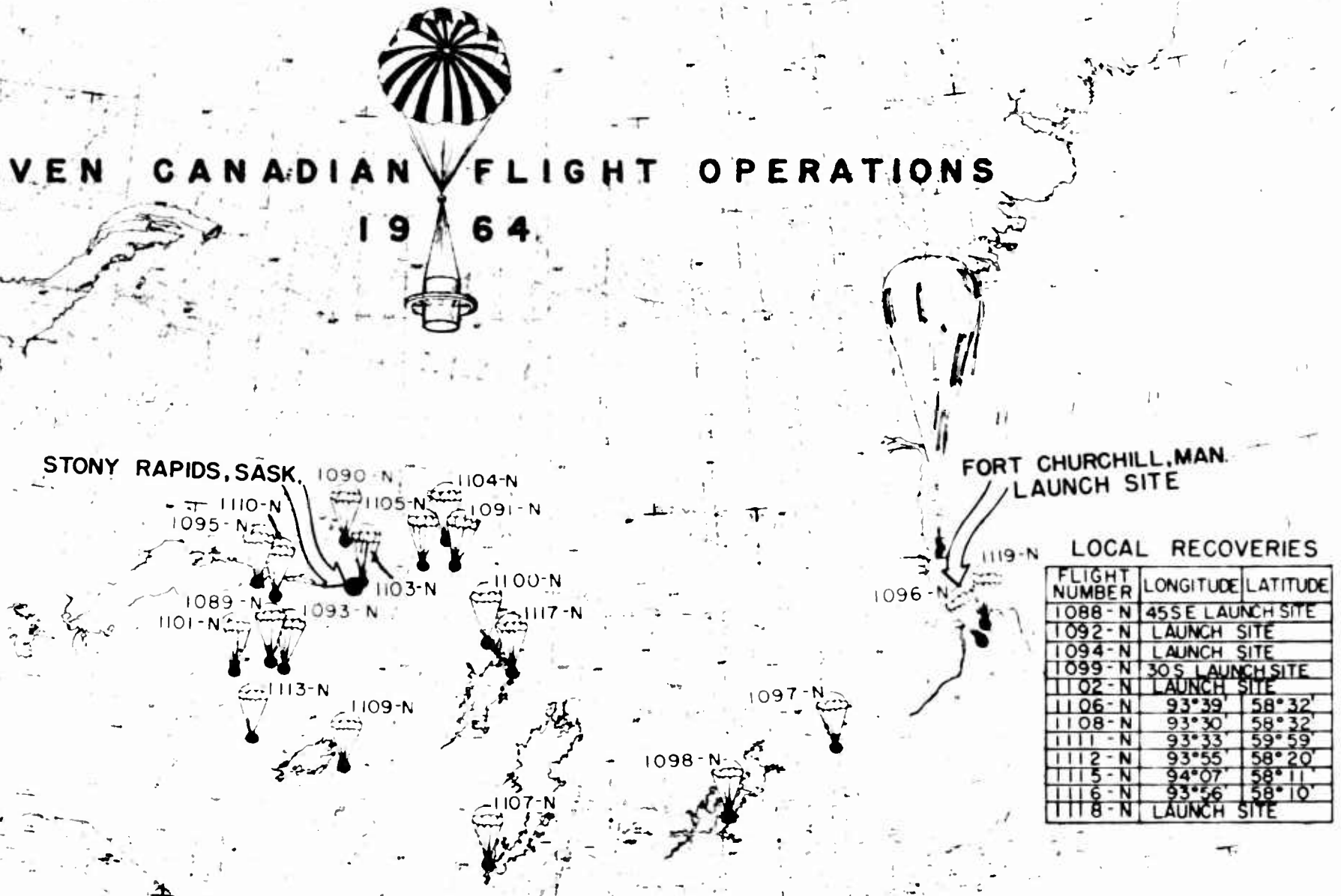
IV. FLIGHT DATA

Table of Flights

Flight No.	Scientist and Agency	Balloon Vol.cu.ft.	Page No.
1088-N	Drs. McDonald & Guss/NASA	9 million	41
1089-N	Drs. McDonald & Guss/NASA	9 million	44
1090-N	Drs. McDonald & Guss/NASA	9 million	46
1091-N	Dr. Guss/NASA	1 million	48
1092-N	Dr. Guss/NASA	9 million	50
1093-N	Drs. McDonald & Guss/NASA	9 million	52
1094-N	Mr. Stiller/NRL	9 million	55
1095-N	Mr. Stiller/NRL	9 million	57
1096-N	Mr. Yeo/UKAEA	175,000	59
1097-N	Mr. Yeo/UKAEA	175,000	61
1098-N	Mr. Yeo/UKAEA	175,000	63
1099-N	Dr. Meyer/U. of Chicago	3 million	65
1100-N	Dr. Meyer/U. of Chicago	9 million	67
1101-N	Dr. Waddington/U. of Minnesota	6 million	70
1102-N	Dr. Meyer/U. of Chicago	3 million	72
1103-N	Dr. Waddington/U. of Minnesota	9 million	75
1104-N	Dr. Meyer/U. of Chicago	3 million	77
1105-N	Dr. Meyer/U. of Chicago	3 million	79
1106-N	Dr. Meyer/U. of Chicago	9 million	81
1107-N	Dr. Meyer/U. of Chicago	9 million	83
1108-N	Dr. Frye/Case Institute	3 million	86
1109-N	Dr. Meyer/U. of Chicago	3 million	88
1110-N	Dr. McCracken/SW Center for Advanced Studies	3 million	90
1111-N	Dr. Meyer/U. of Chicago	3 million	92
1112-N	Dr. Meyer/U. of Chicago	9 million	94
1113-N	Dr. Meyer/U. of Chicago	3 million	96
1114-N	Dr. Meyer/U. of Chicago	3 million	98
1115-N	Dr. McCracken/SW Center for Advanced Studies	6 million	101
1116-N	Dr. Meyer/U. of Chicago	9 million	103
1117-N	Dr. McCracken/SW Center for Advanced Studies	3 million	105
1118-N	Dr. Earl/U. of Minnesota	3 million	107
1119-N	Dr. Earl/U. of Minnesota	3 million	109

RAVEN CANADIAN FLIGHT OPERATIONS

1964



LOCAL RECOVERIES

FLIGHT NUMBER	LONGITUDE	LATITUDE
1088-N	45 S E LAUNCH SITE	
1092-N	LAUNCH SITE	
1094-N	LAUNCH SITE	
1099-N	30 S LAUNCH SITE	
1102-N	LAUNCH SITE	
1106-N	93°39'	58°32'
1108-N	93°30'	58°32'
1111-N	93°33'	59°59'
1112-N	93°55'	58°20'
1115-N	94°07'	58°11'
1116-N	93°56'	58°10'
1118-N	LAUNCH SITE	

IMPACT MAP

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1088-N

2. Scientist Dr. McDonald/Dr. Guss Organization GSFC-NASA

3. Launch: Site Ft. Churchill Date/Time 16 June 1964/0558 Z

Technique Anchor line Director D. Johnson

4. Weather: Clear 40°F - SSW 6-8 Tropopause: Height 34K Temp -55 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 2.05 Mbs 141K ft. Actual: 35K ft. 280 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 520 fpm. Tropopause to ceiling _____ fpm.

7. Flight duration: Total 1 hrs. 8 min. At ceiling _____ hrs. _____ min. _____

8. Termination: Time 0706 Z Altitude 35K ft. Cause Burst

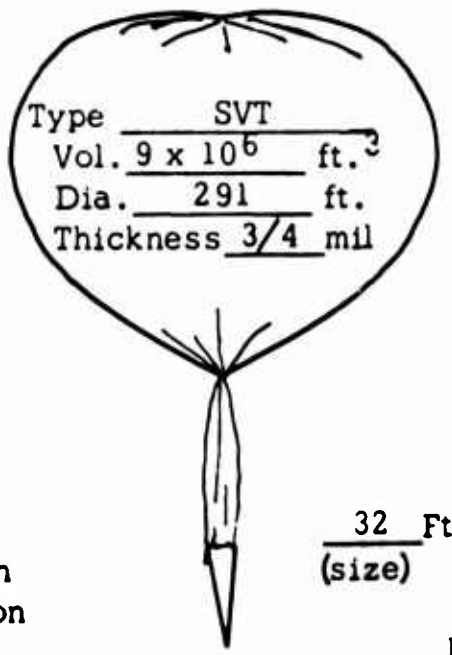
9. Balloon destruction - confirmed visual
(visual - unknown - etc.)

10. Impact: Date/Time 16 June/0727 Z Location 45 mi @ 130° Ft. Churchill

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 mcs	Beacon	1.5 hr.
255.1 mcs	Drop beacon	0.5 hr.
149.4 mcs	Radio command	6 min.

12. Balloon: Code number 2353-541-8291 Serial number 137



32 Ft. chute
(size)

Complete sketch showing location of equipment

WEIGHT

Balloon	933 lbs.
FAA Termination Timer	
Parachute	17
Instrumentation	
Ballast	
Scientific package	
Other	420
Gross Weight	1,370
Free Lift	109
Gross Inflation	1,479
Helium used	24,000 cu. ft.

Remarks: Recovery of the scientific payload was made from the ice on Hudson's Bay, by PAA helicopter. The parachute was destroyed and all Raven instruments were lost except the drop beacon and the silver cells.

Copy to:
NR/FldRep/Minn
NR/Code 421

Flight 1088-N

Remarks:

During inflation the surface winds were 4 to 5 mph. Release was delayed about 12 minutes by a Trans Air flight and at launch time surface winds were 6 to 8 mph and about 20^{o} off the layout direction. The extreme bottom section of the balloon was pulled off the ground cloth during launch but the payload was picked up vertically with very little shock.

The balloon rose slowly for about 200 feet, then floated level. Twenty seven pounds of ballast were dropped to get the balloon moving again and all seventy pounds on board were dropped below 30,000 feet to keep the balloon ascending.

The balloon stopped at about 34,800 feet and the emulsion drop package was released to decrease the load. At about this time, Cmdr. Martin sighted a burst from the C-47. The burst was also reported by the PAA radar range.

Both the drop package and the main gondola were spotted down on a large section of ice in Hudson Bay.

The C-47 returned to Ft. Churchill, and then returned to the impact site, leading back two PAA helicopters for recovery. Ray Ramstad of

the Raven crew was lowered to tie the payload into the helicopter winch system. The first recovery attempt failed when the line broke and succeeding attempts were hampered by parachute billowing due to "prop wash". The scientific equipment was eventually recovered; however, one complete set of Raven flight control instrumentation was lost.

PRESSURE IN MILLIBARS

.6
.8
1
2
4
6
8
10
20
40
60
80
100
200
400
600
800
1000

ALTITUDE IN THOUSANDS OF FEET (APPROX. ATMOS.)

170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10

▲ = VHF FM/FM BEACON
▲ = BALLAST

THEORETIC

TE
R.
EX
SE

R/R = 920 FT. MIN.
TO 34,900 FEET

LAUNCH SITE
FT. CHURCHILL, CA.
0530 GMT

TIME (G M

FLIGHT NO. 1088-N

DATE 16 JUNE 1964

FOR NASA-GODDARD
DR McDONALD
DR GUSS

BALLOON

TYPE 2353-541-8291 S/N 137

VOL 9 MILLION CU FT

MATL 75 MIL POLY

WT 9330 LBS.

LOAD FACTORS

PAYLOAD 4370 LBS

GROSS LD 13700 LBS

FREE LIFT 1090 LBS = 8%

BALLAST 70 LBS

SCIENTIFIC EXPERIMENT:
COUNTERS AND EMULSIONS

ICAL CEILING

TEMPERATURE SENSOR INSIDE
R.I. GONDOLA, 89°F
EXTERNAL TEMPERATURE
SENSOR - 42°F, 0702 GMT.

RELEASE DROP
PACKAGE (0706.5 GMT)

BALLOON BURST
0705.8 GMT

TERMINATION BY
RADIO COMMAND
0706.3 GMT

IMPACT AREA 45 MI AT 137°
FROM FT. CHURCHILL, CA.

M T)

RAVEN
industries, inc.

DR. DONK 24 JUNE 1964

CHK.

APPR.

B 02079

ADD TO ANAMO THIS SIDE ONLY

SKYHOOK BALLOON FLIGHT INFORMATION
AVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1089-N

2. Scientist Dr. McDonald/ Dr. Guss Organization GSFC-NASA

3. Launch: Site Ft. Churchill Date/Time 18 June 1964/0832 Z

Technique Anchor line Director D. Johnson

4. Weather: Clear - calm Tropopause: Height 32.5 Temp -53 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 2.2 Mbs 139K ft. Actual: 135K ft. 2.6 Mbs
How altitude determined photobarograph

6. Ascent: Surface to tropopause 598 fpm. Tropopause to ceiling 400 fpm.

7. Flight duration: Total 13 hrs. 57 min. At ceiling 9 hrs. _____ min.

8. Termination: Time 2229 Z Altitude 130 K ft. Cause Radio Command

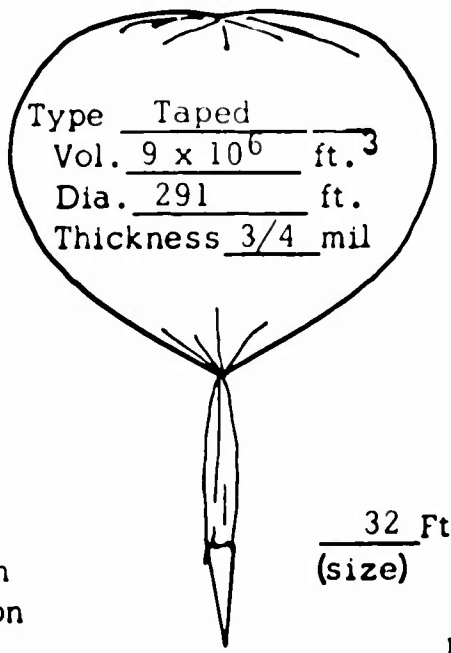
9. Balloon destruction - confirmed visual
(visual - unknown - etc.)

10. Impact: Date/Time 18 June/2307 Z Location 107° 17' W/58° 30' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 mcs	Beacon	15 hr.
255.1 mcs	Drop beacon	5.5 hr.
149.4 mcs	Radio command	4 min.

12. Balloon: Code number 2323-541-8291 Serial number 127



32 Ft.chute
(size)

Complete sketch showing location of equipment

WEIGHT

Balloon	959 lb.
FAA Termination Timer	
Parachute	18
Instrumentation	
Ballast	
Scientific package	
Other	412
Gross Weight	1389
Free Lift	111
Gross Inflation	1500
Helium used	24,000 cu. ft.

Remarks: Good flight

Copy to:
CNR/FldRep/Minn
CNR/Code 421

Flight 1089-N

Remarks:

The surface conditions at launch were ideal and the launch was very smooth.

The ascent rate was low and averaged only 453 feet per minute.

The flight was terminated at 2229 G.M.T. resulting in a duration of about 14 hours. The payload was recovered on the shores of Livingstone Lake by the Raven helicopter and float planes.

The payload was returned to Ft. Churchill by 0815 G.M.T. which was less than 24 hours after launch.

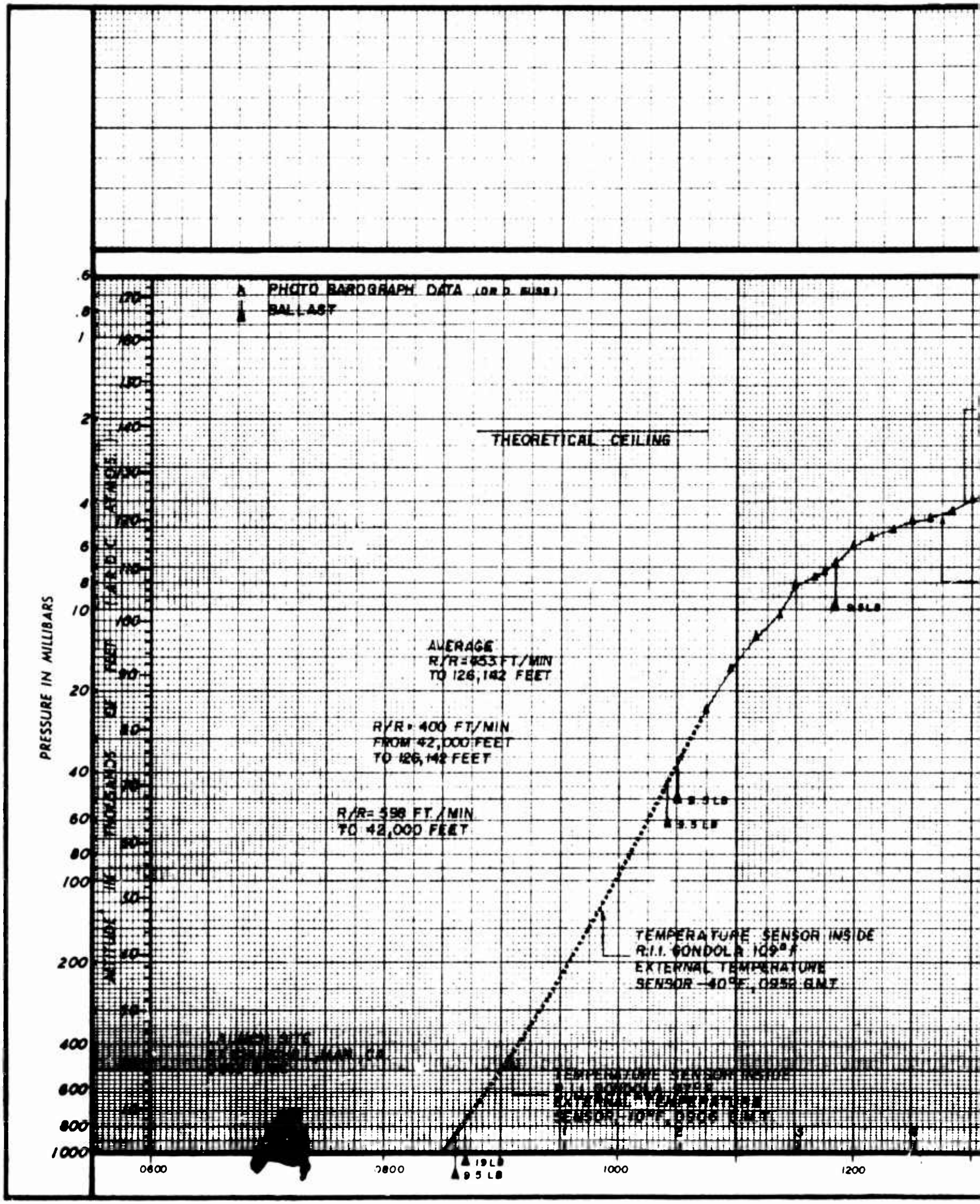
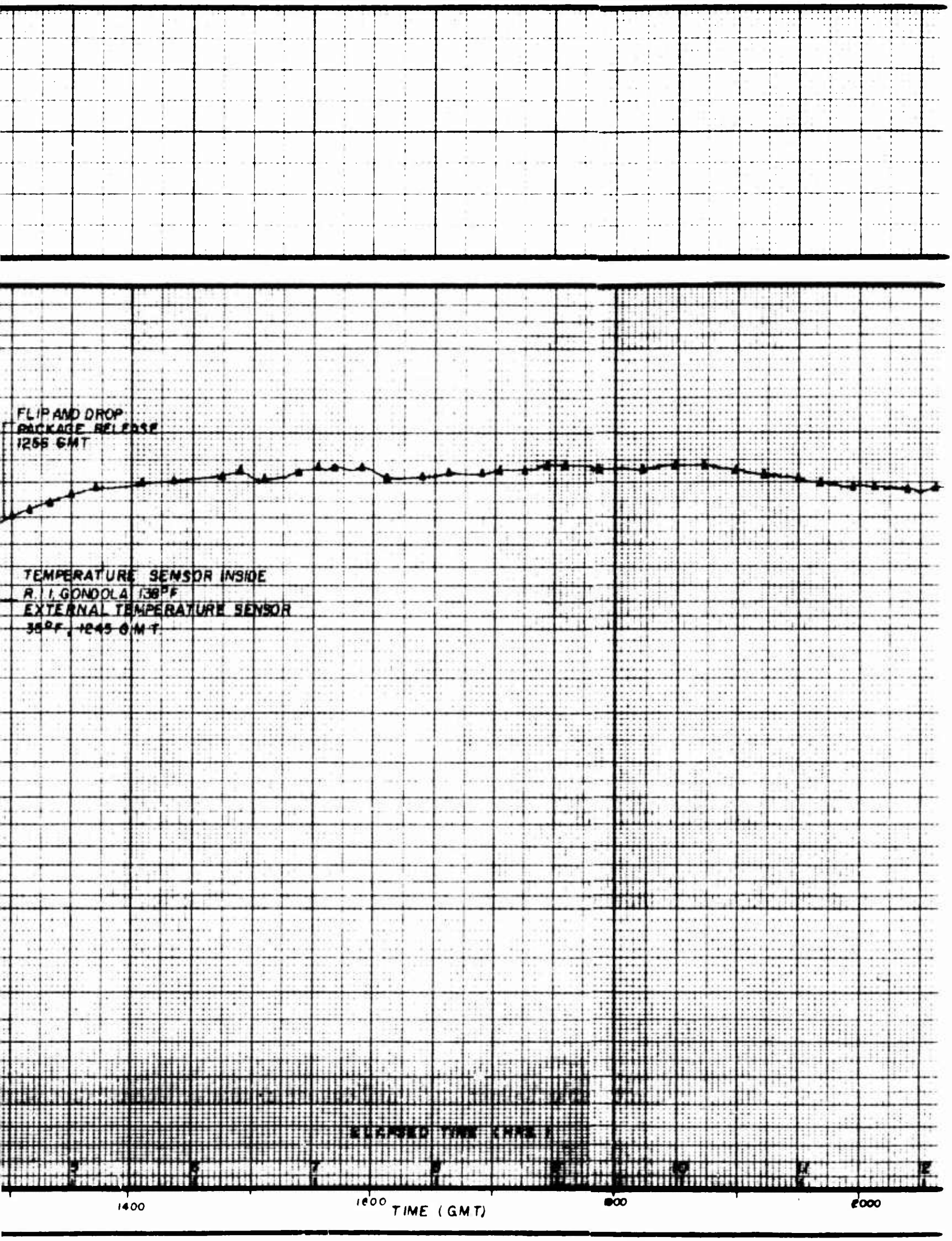
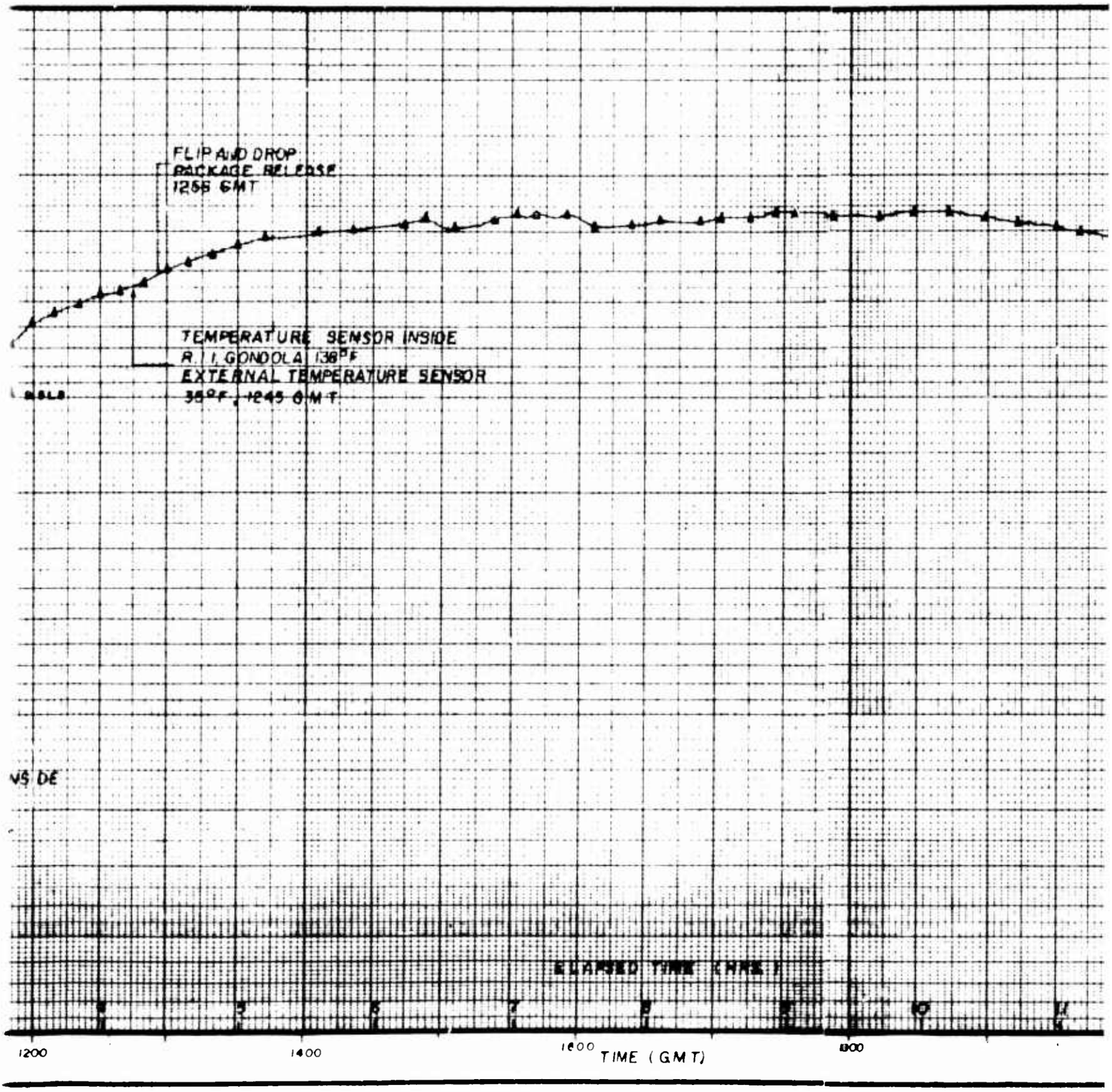
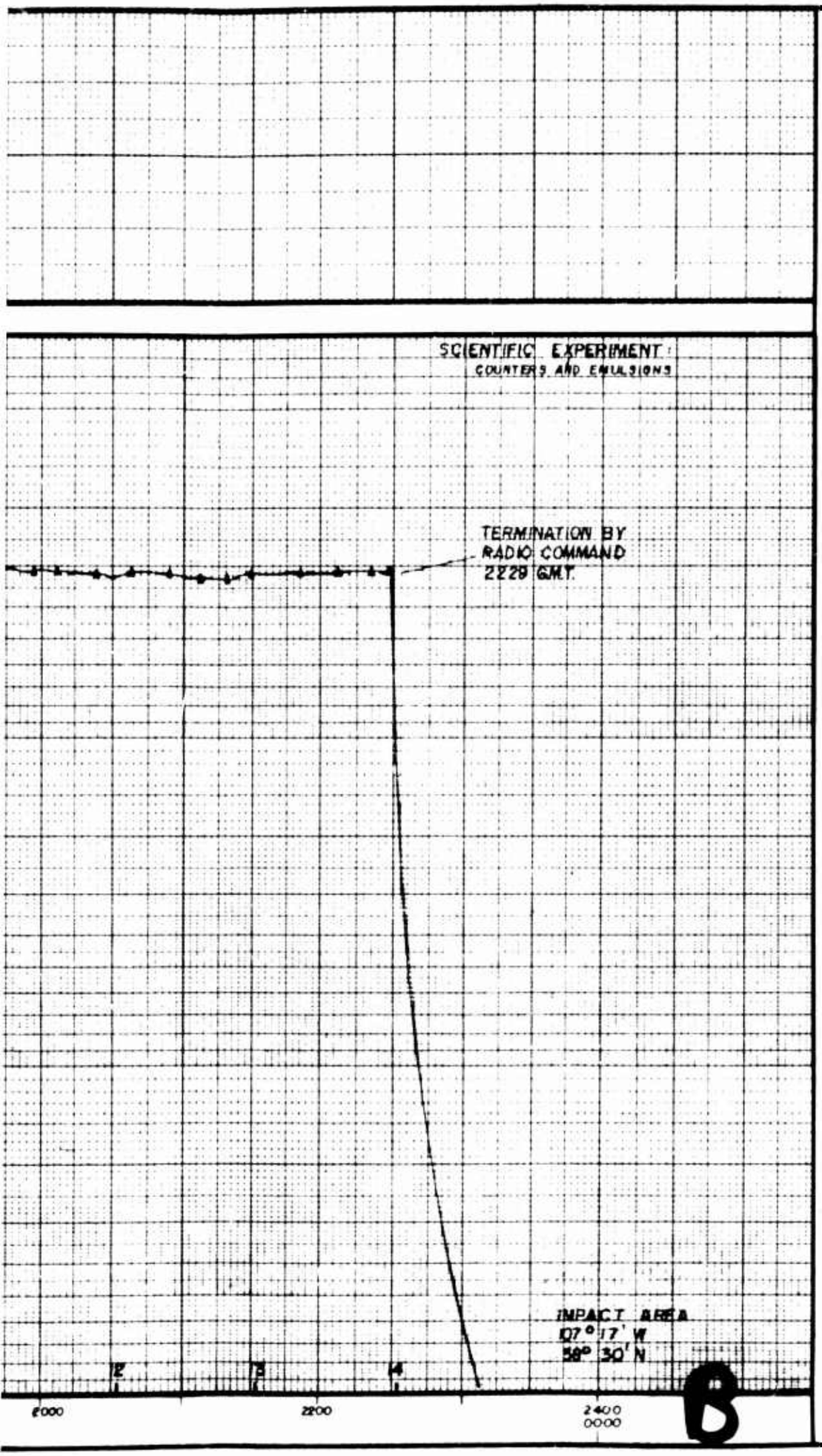


PHOTO BAROGRAPH DATA (DR D. BLISS)
BALLAST
THEORETICAL CEILING
AVERAGE
R/R=653 FT/MIN
TO 126,142 FEET
R/R = 400 FT/MIN
FROM 42,000 FEET
TO 126,142 FEET
R/R= 598 FT./MIN
TO 42,000 FEET
TEMPERATURE SENSOR INSIDE
R.I.I. GONDOLA 109°F
EXTERNAL TEMPERATURE
SENSOR -40°F, 0958 G.M.T.
TEMPERATURE SENSOR INSIDE
EXTERNAL TEMPERATURE
SENSOR: 10°F, 0906 G.M.T.
19 LB
9.5 LB
0600
0800
1000
1200
PRESSURE IN MILLIBARS
ALTITUDE IN FEET


FLIP AND DROP
PACKAGE RELEASE
1255 GMT
TEMPERATURE SENSOR INSIDE
R. I. GONDOLA 138°F
EXTERNAL TEMPERATURE SENSOR
35°F, 1245 G M T
ELAPSED TIME (HRS.)
1400
1600
TIME (GMT)
1800
2000


FLIP AND DROP
PACKAGE RELEASE
1256 GMT
TEMPERATURE SENSOR INSIDE
R. I. GONDOLA 138°F
EXTERNAL TEMPERATURE SENSOR
35°F, 1245 G M T
ELAPSED TIME (HRS.)
1200
1400
1600
TIME (GMT)



FLIGHT NO. 1089N

DATE 18 JUNE 1964

FOR N A S A.
DR McDONALD
DR GUSS

BALLOON

TYPE 2323-541-8291 S/N 127

VOL 9 MILLION CU FT

MATL .75 MIL POLY

WT 959.0 LBS

LOAD FACTORS

PAYLOAD 430.0 LBS

GROSS LD 1389.0 LBS

FREE LIFT 111.0 LBS = 8%

BALLAST 70.0 LBS

RAVEN

industries, inc.

DR. DONK 6 AUGUST 1964

CHK.

APPR.

X03061

EASTMAN KODAK, THIRD SIDE GRADMATE

CYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1090-N

2. Scientist Dr. McDonald/Dr. Guss Organization GSFC-NASA

3. Launch: Site Ft. Churchill Date/Time 21 June 1964/0638 Z

Technique Anchor line Director D. Johnson

4. Weather: Clear SW 2-3 Tropopause: Height 34 Temp -54 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 2.15 Mbs 139K ft. Actual: 139K ft. 2.15 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 822 fpm. Tropopause to ceiling 472 fpm.

7. Flight duration: Total 14 hrs. 17 min. At ceiling 10 hrs. ____ min. ____

8. Termination: Time 2055 Z Altitude 137 ft. Cause Radio Command

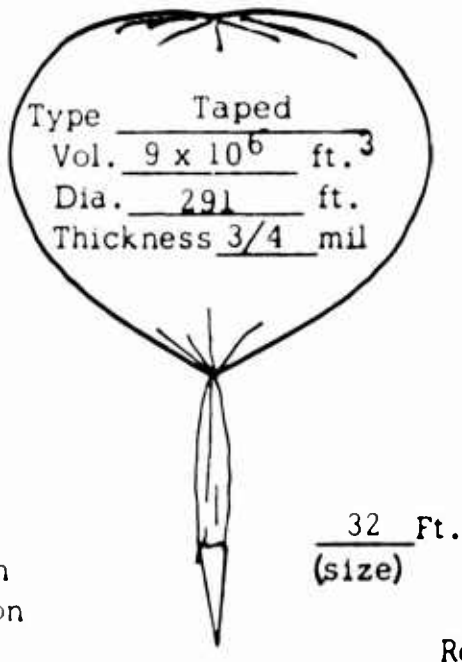
9. Balloon destruction - confirmed visual
(visual - unknown - etc.)

10. Impact: Date/Time 21 June/1503 Z Location 106° 04'W/59° 43'N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
253.1 Mcs	Beacon	15 hr.
255.1 Mcs	Drop Beacon	4 hr.
149.4 Mcs	Radio command	7 min.

12. Balloon: Code number 2323-541-8291 Serial number 129



32 Ft.chute
(size)

Complete sketch showing location of equipment

WEIGHT

Balloon	943 lb.
FAA Termination Timer	
Parachute	18
Instrumentation	
Ballast	
Scientific package -	
Other	435
Gross Weight	1396
Free Lift	112
Gross Inflation	1508
Helium used	24,000 cu. ft.

Remarks: The drop package beacon and silver cells were not recovered.
Good flight.

Copy to:
C R/FldRep, Minn
C. R/Code 421

Flight 1090-N

Remarks:

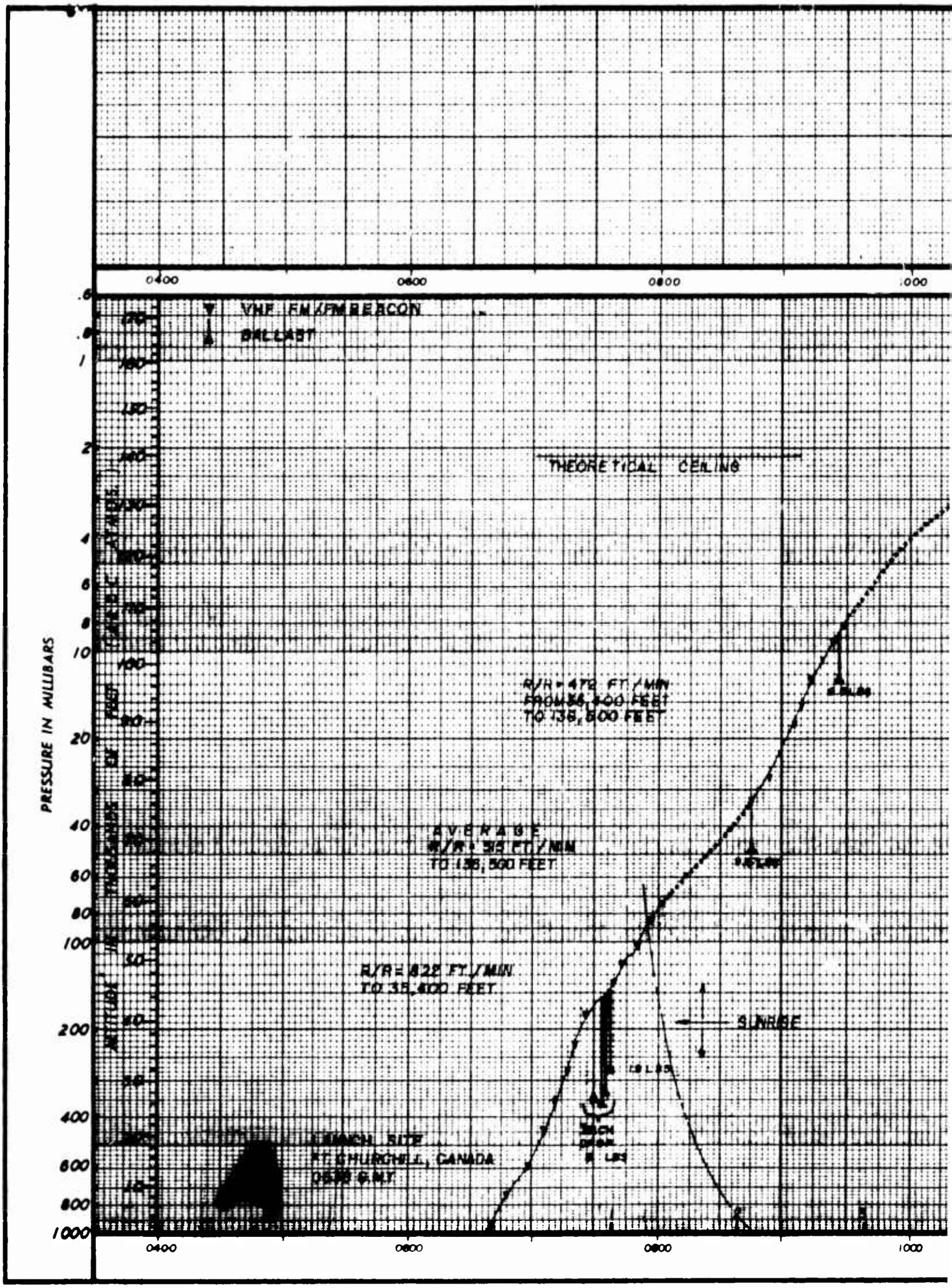
The surface conditions at launch were good.

The launch proceeded smoothly until the anchor line squibs were fired prematurely. The balloon pulled the payload off the cart and dragged the payload about 50 feet. The crush pad and two legs were torn off the gondola, but no further damage was noted.

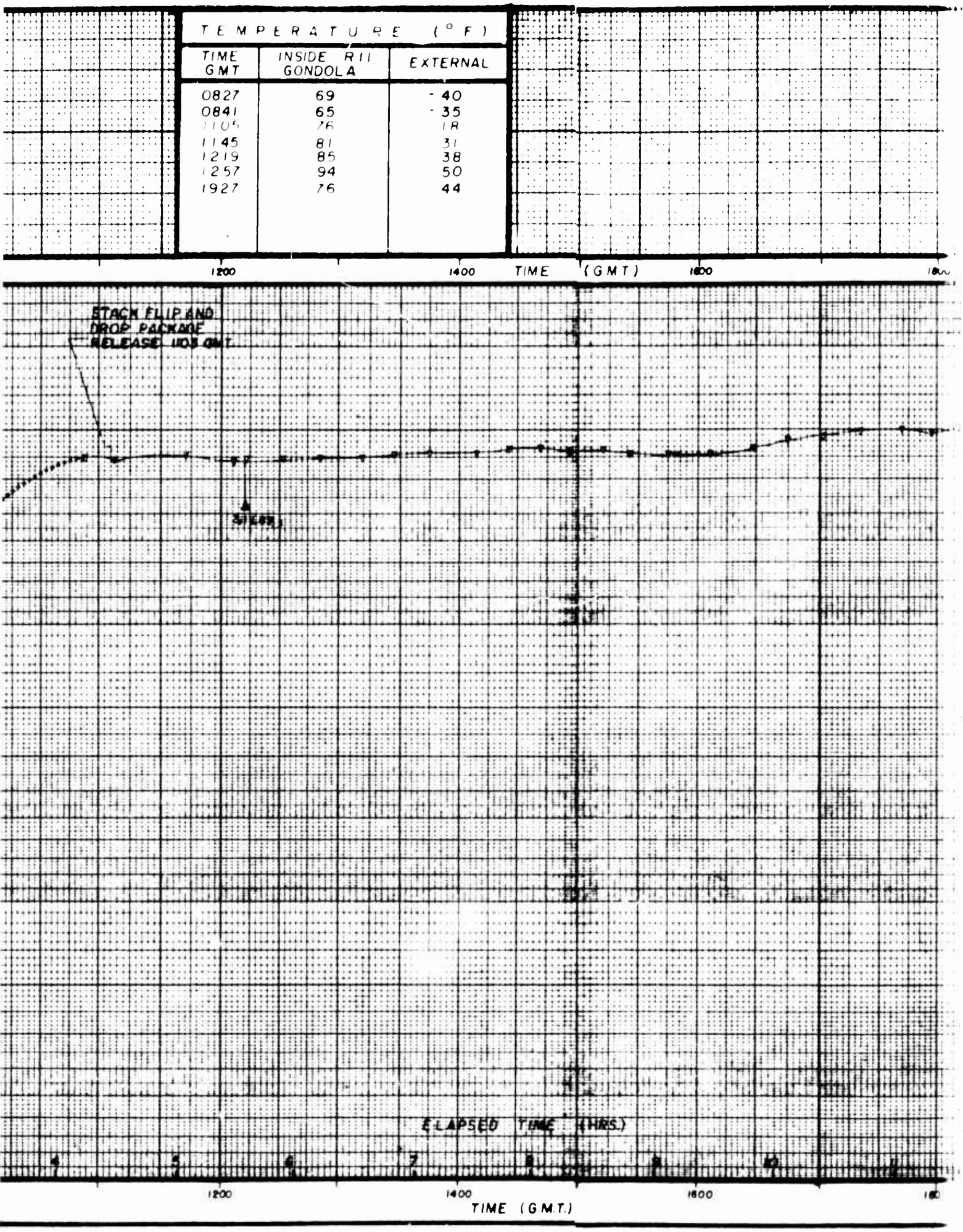
The balloon had an average rate of rise of 515 feet per minute and floated at about 136,000 feet for 10 hours.

The flight was terminated at 2055 G.M.T. The payload was recovered by the Raven helicopter.

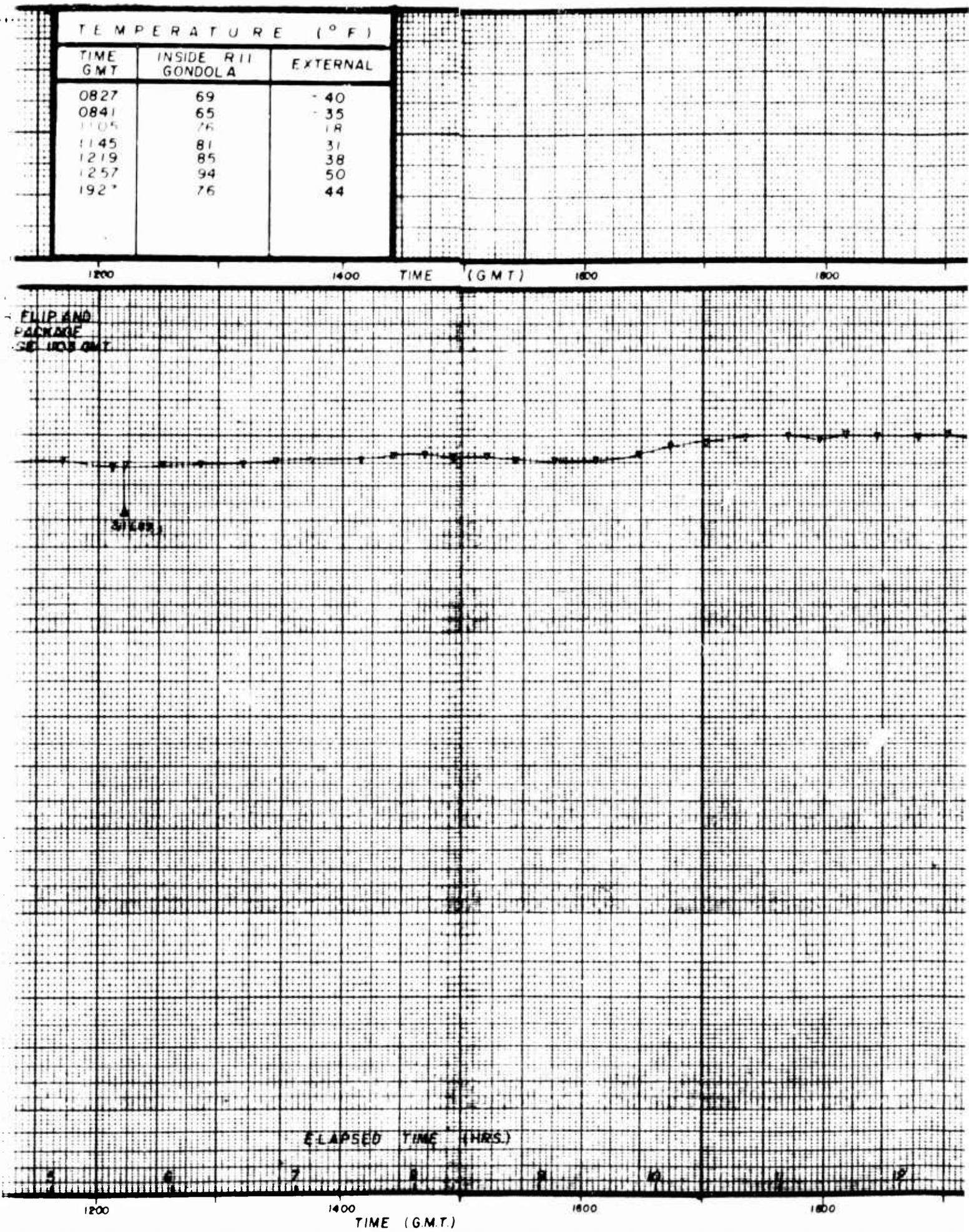
The ONR drop package beacon ceased operating on ascent, possibly as a result of launch damage. The drop package could not be found after it was released from the main flight after reaching ceiling.

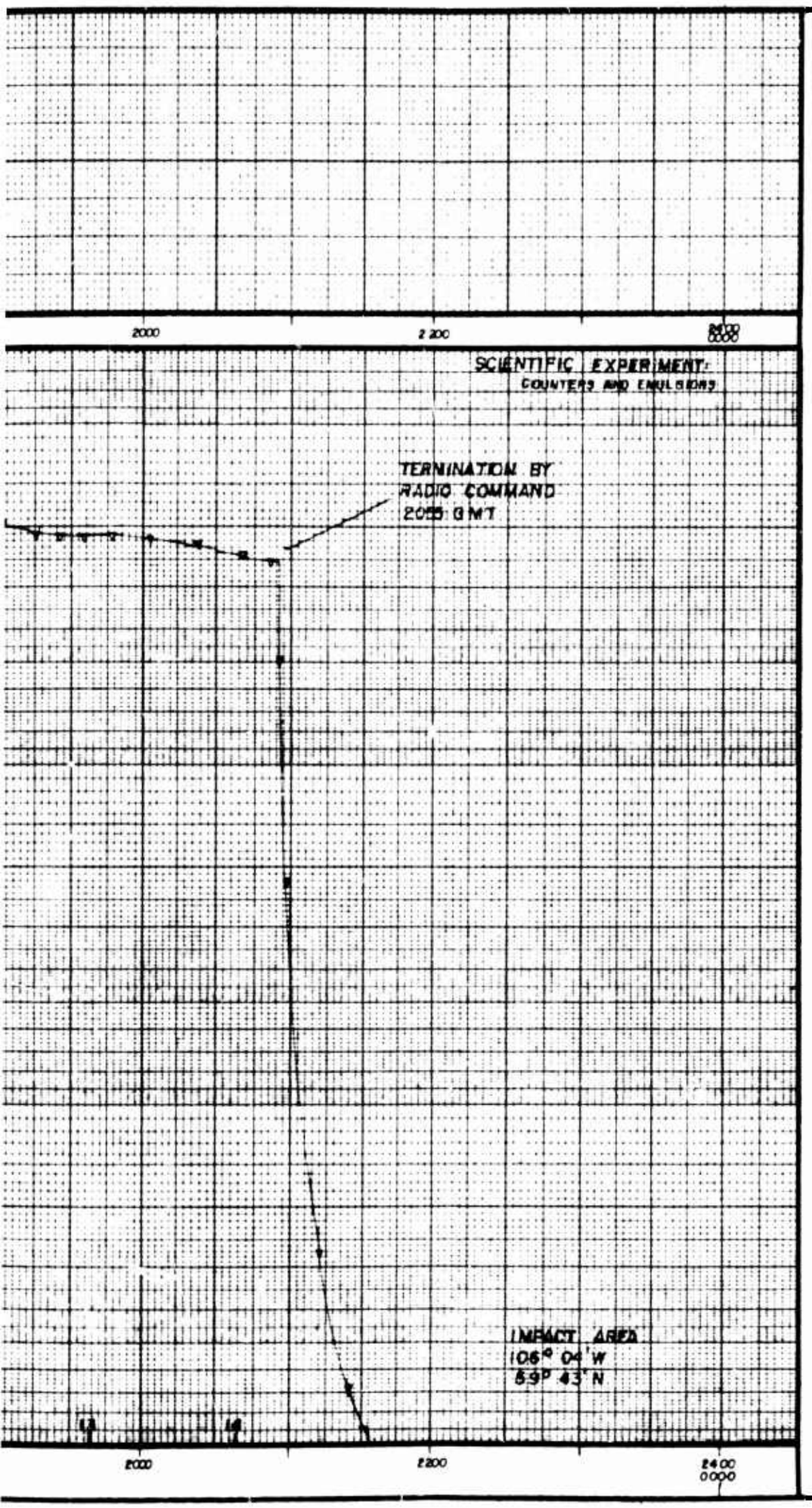

0400
0600
0800
1000
VHF FM/FM BEACON
BALLAST
THEORETICAL CEILING
R/R = 472 FT./MIN
FROM 34,900 FEET
TO 38,500 FEET
AVERAGE
R/R = 355 FT./MIN
TO 38,500 FEET
R/R = 822 FT./MIN
TO 35,400 FEET
SUNRISE
LAUNCH SITE
FT. CHURCHILL, CANADA
PRESSURE IN MILLIBARS

TEMPERATURE (°F)		
TIME GMT	INSIDE R11 GONDOLA	EXTERNAL
0827	69	-40
0841	65	-35
1105	76	18
1145	81	31
1219	85	38
1257	94	50
1927	76	44



TEMPERATURE (°F)		
TIME GMT	INSIDE R11 GONDOLA	EXTERNAL
0827	69	-40
0841	65	-35
1105	76	18
1145	81	31
1219	85	38
1257	94	50
192*	76	44





FLIGHT NO. 1090-N

DATE: 21 JUNE 1964

FOR: N A S A / GODDARD
DR. Mc DONALD
DR GUSS

BALLOON

TYPE: 2323-541-8291 S/N 129

VOL: 9 MILLION CU FT

MATL: 75 MIL POLY

WT: 943.0 LBS

LOAD FACTORS

PAYLOAD: 453.0 LBS.

GROSS LD: 1396.0 LBS

FREE LIFT: 112.0 LBS. = 8 %

BALLAST: 70.0 LBS.

RAVEN
industries, inc.

DR. DONK 1 JULY 1964

CHK.

APPR.

X 02093

B

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

. Company Raven Industries, Inc. Flight Number 1091-N

2. Scientist Dr. Guss Organization GSFC-NASA

3. Launch: Site Ft. Churchill Date/Time 21 June 1964/0943 Z

Technique Anchor line Director D. Johnson

4. Weather: Broken - Calm at launch Tropopause: Height 34K Temp -54 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 6 Mbs 114 ft. Actual: 116 ft. 5.4 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause _____ fpm. Tropopause to ceiling 765 fpm.

Flight duration: Total 15 hrs. 42 min. At ceiling 14 hrs. _____ min.

8. Termination: Time 0125 Z Altitude 114K ft. Cause Radio Command

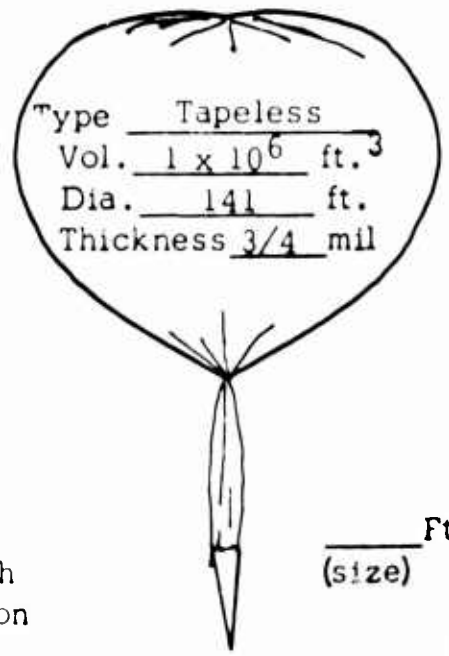
9. Balloon destruction - confirmed visual
(visual - unknown - etc.)

10. Impact: Date/Time 22 June/0209 Z Location 103° 58' W/59° 28' N

1 Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 Mcs	Beacon	16 hr.
149.4 Mcs	Radio Command	4 min.

1 Balloon: Code number 2333-541-8141 Serial number 126



_____Ft.chute
(size)

complete sketch showing location equipment

WEIGHT

Balloon	210 lb.
FAA Termination Timer	
Parachute	14
Instrumentation	
Ballast	
Scientific package	
Other	215
Gross Weight	439
Free Lift	40
Gross Inflation	479
Helium used	7,700 cu.ft.

Remarks: Good flight

Copy to:
NR/FldRep/Minn
ONR/Code 421

Flight 1091-N

Remarks:

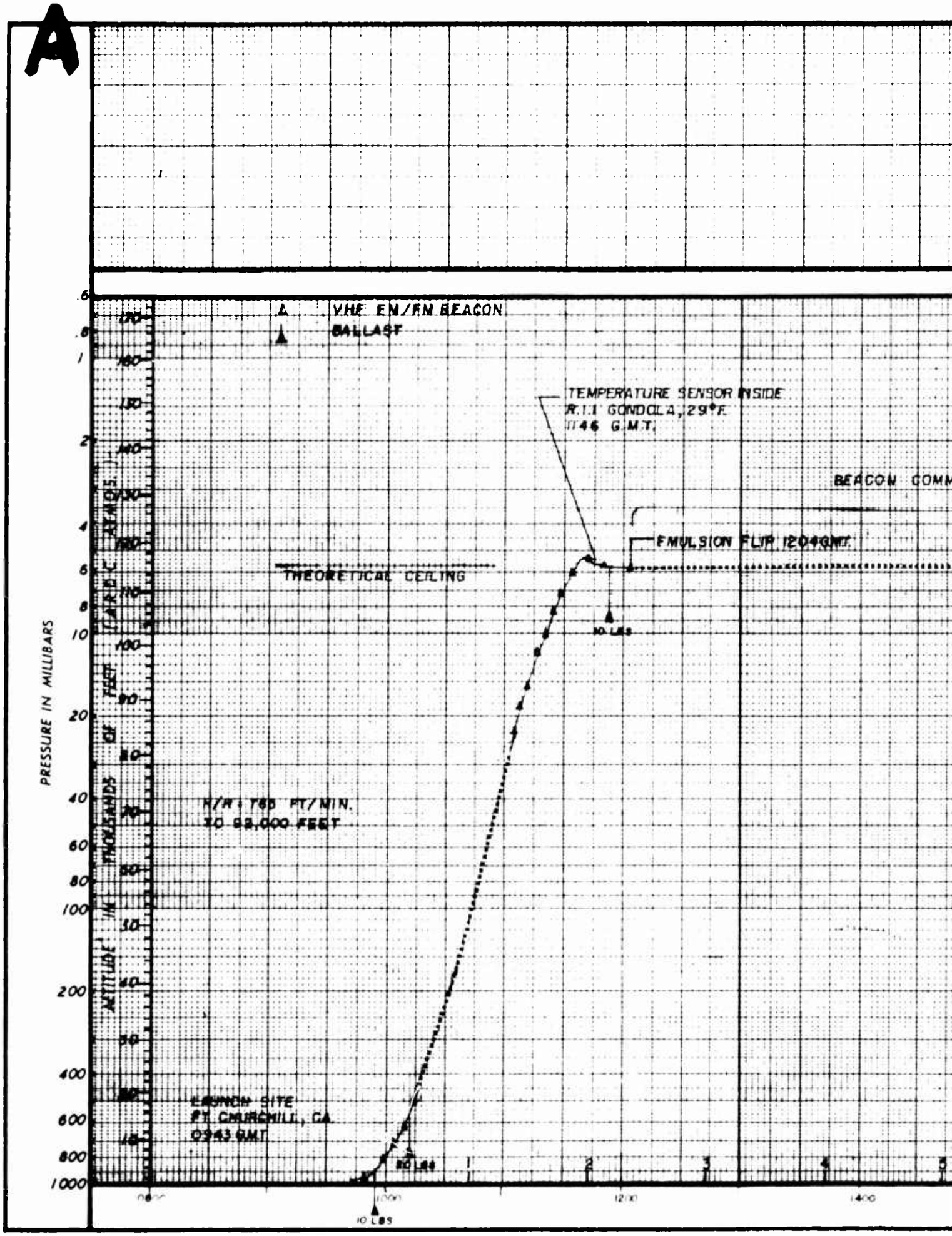
The surface winds were up to about 10 mph and conditions were not ideal for launch, but this flight was required to be launched shortly after Flight 1090-N.

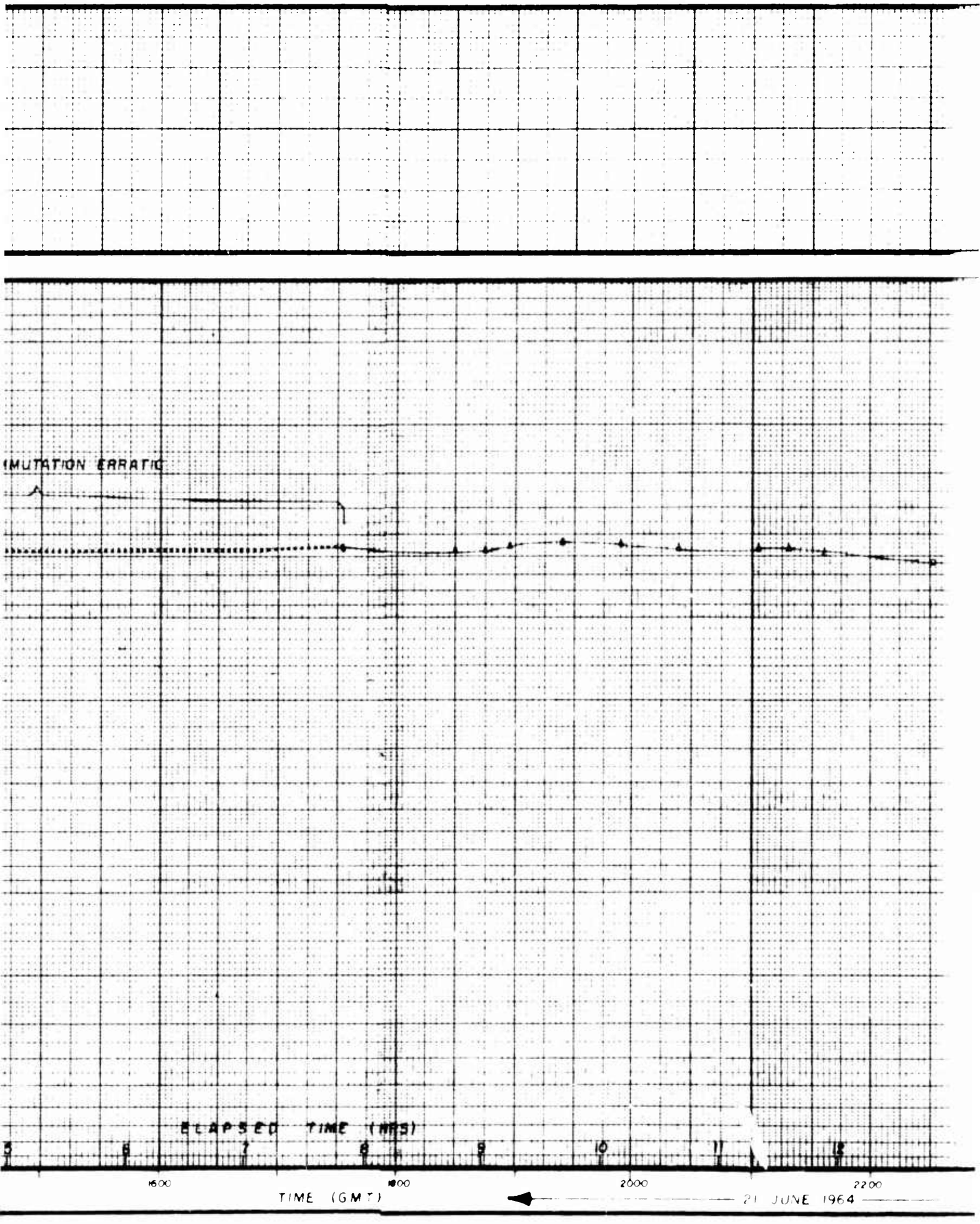
The winds remained at 10 mph during inflation, but subsided to almost calm at launch time. The balloon came directly over the payload and picked it up with very little shock.

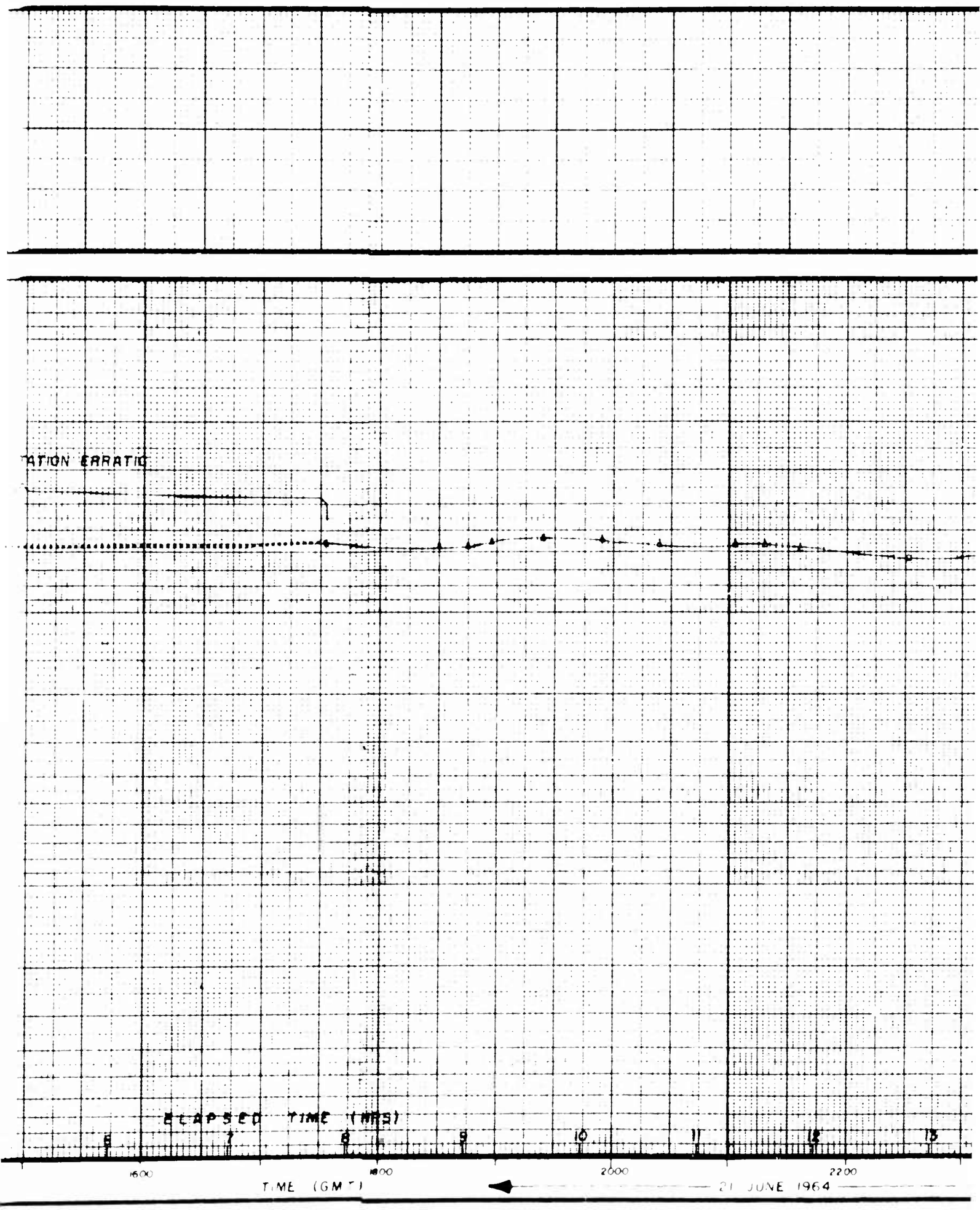
The balloon rose at 765 feet per minute and floated at about 116,000 feet for 14 hours.

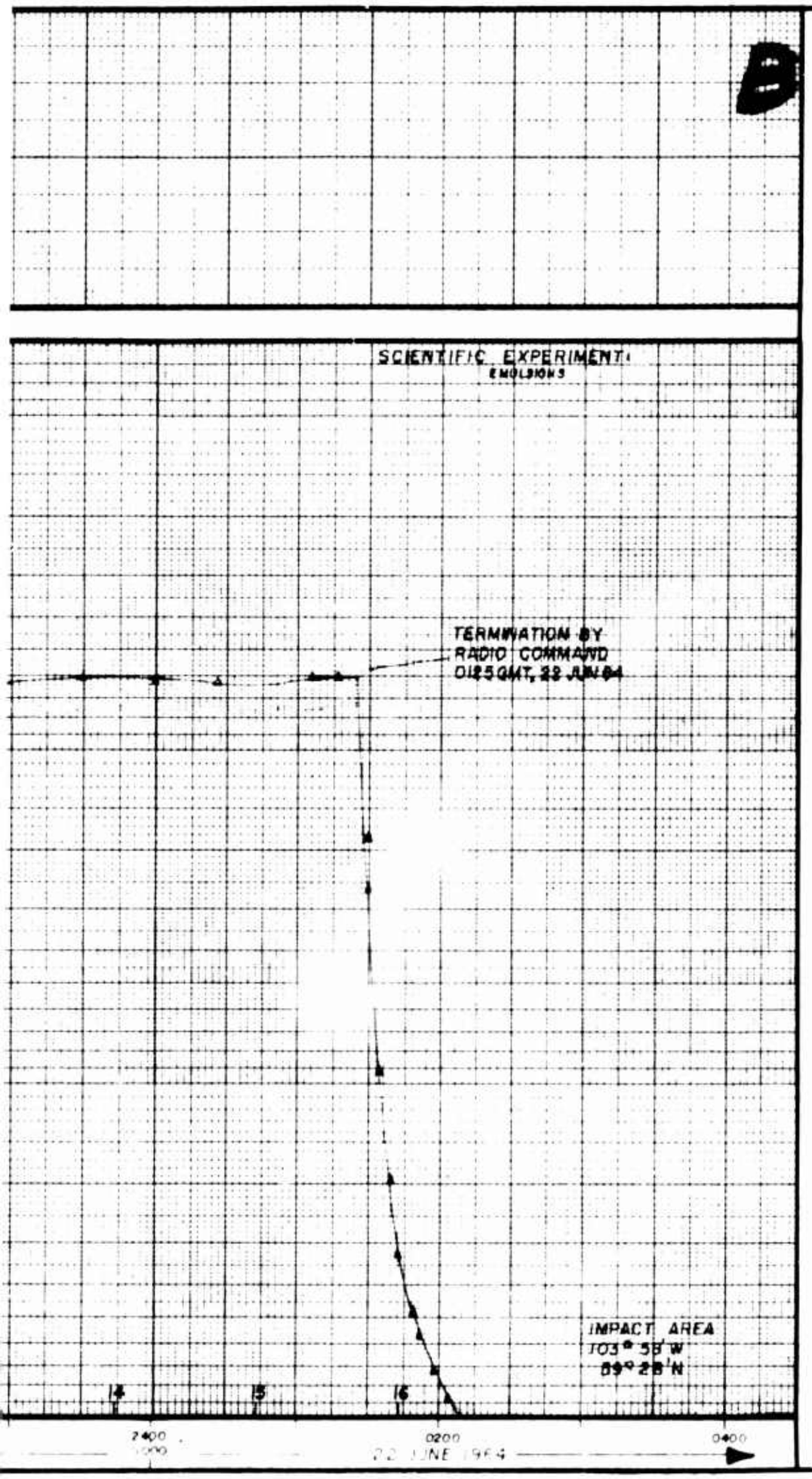
The flight was terminated at 0125 G.M.T. and was recovered the following day by the Raven helicopter supported by a float plane.

A


VHF FM/FM BEACON
BALLAST
TEMPERATURE SENSOR INSIDE
R.I.I GONDOLA, 29°F.
1146 G.M.T.
BEACON COMM
EMULSION FLIP 1204GMT
THEORETICAL CEILING
10 LBS
R/A : 760 FT/MIN.
TO 98,000 FEET
LAUNCH SITE
FT. CHURCHILL, CA.
0943 G.M.T.
10 LBS
10 LBS
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET
1000
800
600
400
200
100
80
60
40
20
10
8
6
4
2
1
.8
.6
1000
1200
1400


MUTATION ERRATIC
ELAPSED TIME (HRS)
5
6
7
8
9
10
11
12
1600
1800
2000
2200
TIME (GMT)
21 JUNE 1964


ATION ERRATIC
ELAPSED TIME (HRS)
6
7
8
9
10
11
12
13
1600
1800
2000
2200
TIME (GMT)
21 JUNE 1964



FLIGHT NO. 1091-N

DATE 21 JUNE 1964

FOR NASA / GODDARD

DR GUSS

BALLOON

TYPE 2333-5 41-8141 S/N 126

VOL 1 MILLION CU FT

MATL 75 MIL POLY

WT 210 (LBS

LOAD FACTORS

PAYLOAD 229 0 LBS

GROSS LD 439 0 LBS

FREE LIFT 40 0 LBS = 9%

BALLAST 60 0 LBS

RAVEN industries, inc.

DR. [illegible] JULY 1964

CHK.

APPR.

X 02098

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1 Company Raven Industries, Inc. Flight Number 1092-N

2 Scientist Dr. McDonald Organization GSFC-NASA

3. Launch: Site Ft. Churchill Date/Time 23 June 1964/0719 Z

Technique Anchor line Director D. Johnson

4 Weather: Clear SW 5 Tropopause: Height ____ Temp ____ °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 2.15 Mbs 140K ft. Actual: ____ ft. ____ Mbs
How altitude determined ____

6. Ascent: Surface to tropopause ____ fpm. Tropopause to ceiling ____ fpm.

7 Flight duration: Total ____ hrs. ____ min. At ceiling ____ hrs. ____ min. ____

8 Termination: Time ____ Z Altitude ____ ft. Cause ____

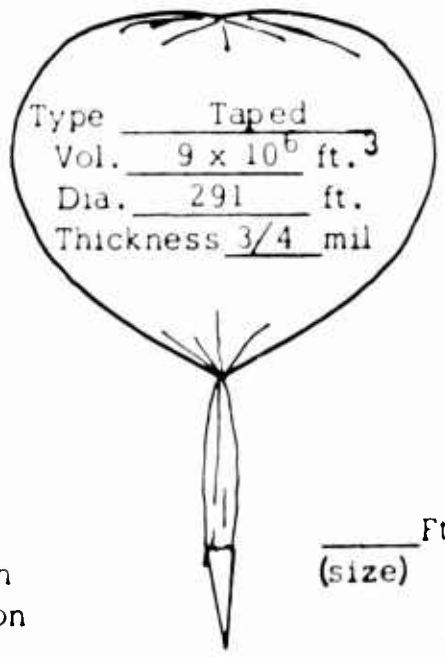
9. Balloon destruction - confirmed ____
(visual - unknown - etc.)

10. Impact: Date/Time ____ Z Location ____

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)

12 Balloon: Code number 2323-541-8291 Serial number 131



____ Ft. chute
(size)

complete sketch showing location of equipment

WEIGHT	
Balloon	959 lb.
FAA Termination Timer	
Parachute	17
Instrumentation	
Ballast	
Scientific package	
Other	350
Gross Weight	1,326
Free Lift	107
Gross Inflation	[illegible]
Helium used	[illegible] cu. ft.

Remarks:
The balloon [illegible] shortly after the bubble was [illegible] the spool.

Copy to:
ONR/FldRep/Minn
ONR/Code 421

Flight 1092-N

Remarks:

The surface winds were 3 to 6 mph during inflation and 5 mph at release.

After release, the bubble came straight down the layout direction for about 100 feet, then moved off slightly toward the payload side of the balloon. When all but about 20 feet of the balloon was in the air, the balloon began to descend While descending, the balloon rotated and a large split in the upper balloon wall could be seen.

The payload was not moved during the launch attempt.

SYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1093-N

2. Scientist Dr. McDonald/Dr. Guss Organization GSFC-NASA

3. Launch: Site Ft. Churchill Date/Time 24 June 1964/0415 Z

Technique Anchor line Director D. Johnson

4. Weather: Clear - 31°F - SSE 6-8 Tropopause: Height 34K Temp -54 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 2 Mbs 142K ft. Actual: 136K ft. 2.5 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 780 fpm. Tropopause to ceiling 303 fpm.

7. Flight duration: Total 15 hrs. 17 min. At ceiling 10 hrs. _____ min.

8. Termination: Time 1932 Z Altitude 126K ft. Cause Radio Command

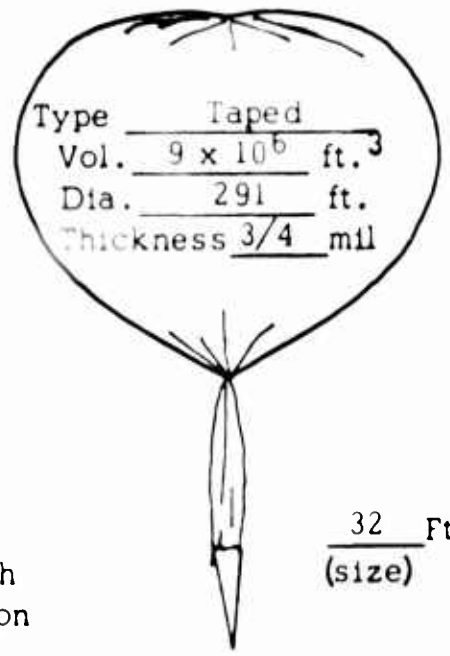
9. Balloon destruction - confirmed Unknown
(visual - unknown - etc.)

10. Impact: Date/Time 24 June/2015 Z Location 107° 07' W/58° 23' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 Mcs	Beacon	16.5 hr.
149.4 Mcs	Radio Command	9 min.

12. Balloon: Code number 2323-541-8291 Serial number 128



32 Ft.chute
(size)

Compare sketch showing location of equipment

WEIGHT

Balloon	964 lb.
FAA Termination Timer	
Parachute	17
Instrumentation	
Ballast	
Scientific package	
Other	350
Gross Weight	1,331
Free Lift	107
Gross Inflation	1,438
Helium used	24,000 cu. ft.

Remarks: Good flight

Copy to:
( ) VR/FldRep/Minn
( ) VR/Code 421

Flight 1093-N

Remarks:

The surface winds were about 6 mph when inflation started, but had increased to 10 to 15 mph and about 45° off the layout direction by launch time.

The balloon came down the layout direction for about 100 feet, then veered off sharply. The men on the payload cart had to push the cart about 150 feet to get the payload under the balloon. The payload became temporarily entangled in the suspension lines after lift off, but righted itself when only a few feet off the ground.

The balloon rose at about 730 feet per minute during the early portion of the flight, and averaged 418 feet per minute to about 130,000 feet.

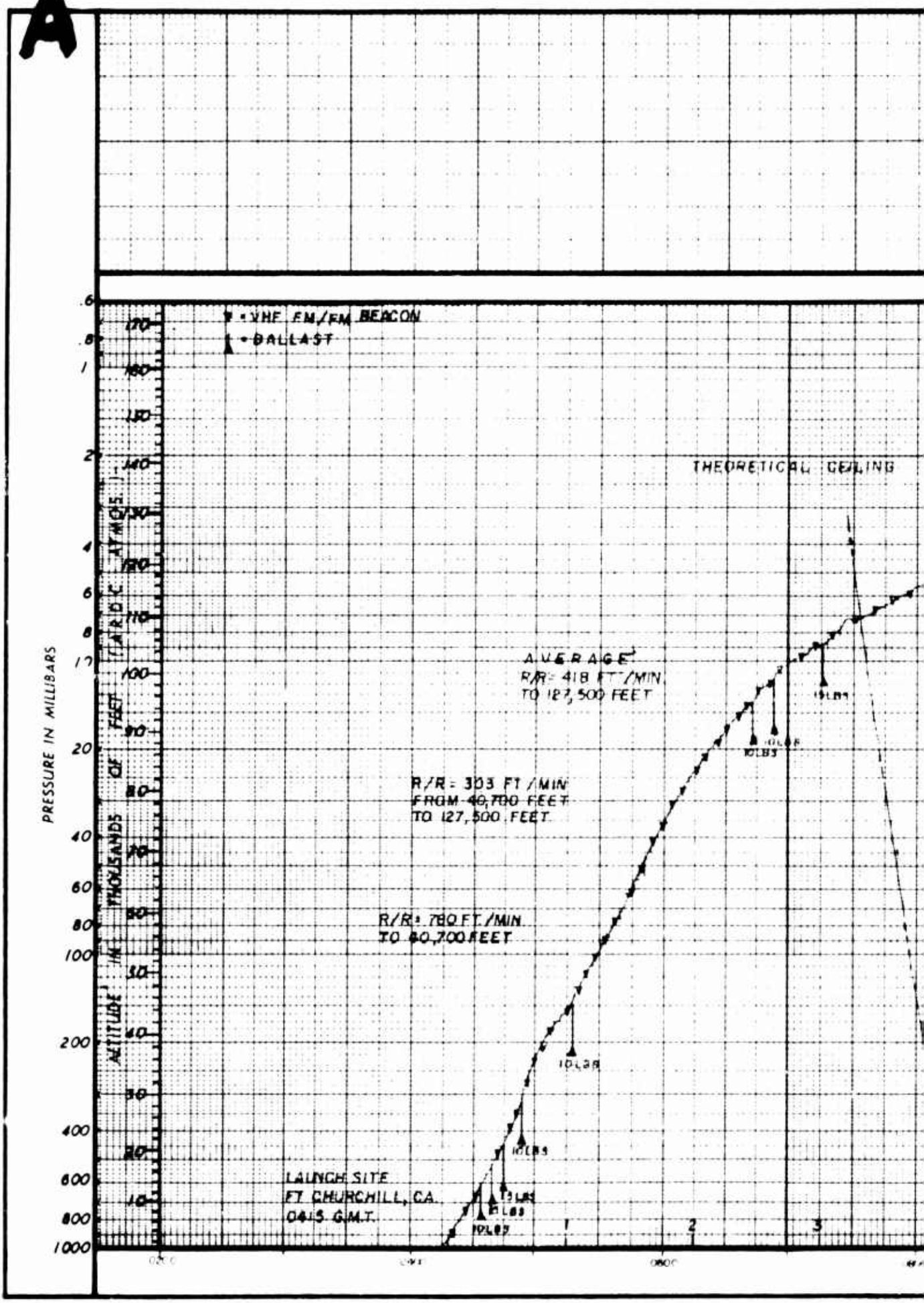
The flight was terminated at 1932 G.M.T. after being above 130,000 feet for about 6 hours and above 125,000 feet for over 11 hours.

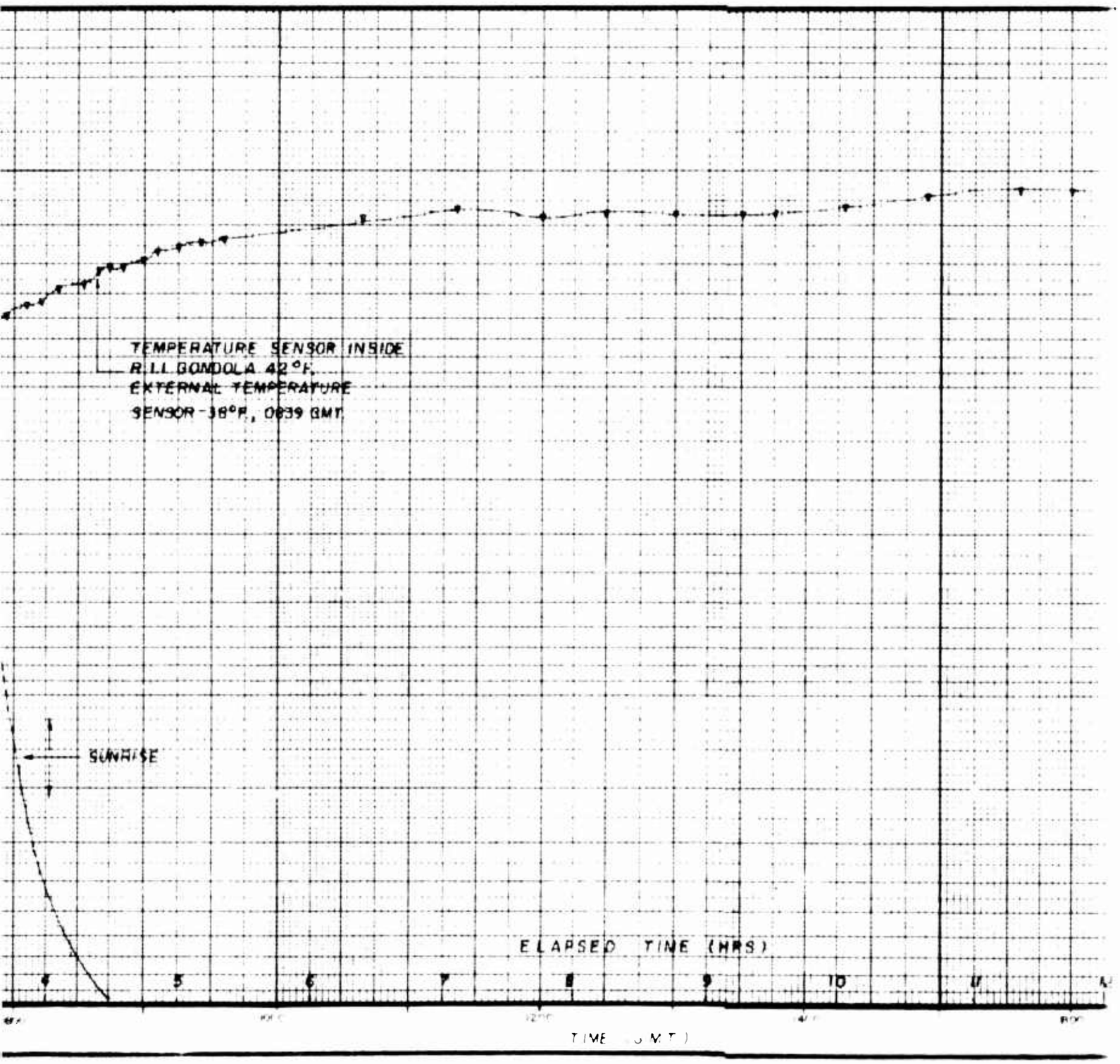
The weather in the recovery area was overcast, and this was the first recovery of the year in bad weather. The ceiling varied from 300 to 2,000 feet. There were heavy rain showers and visibility varied from 2 to 5 miles.

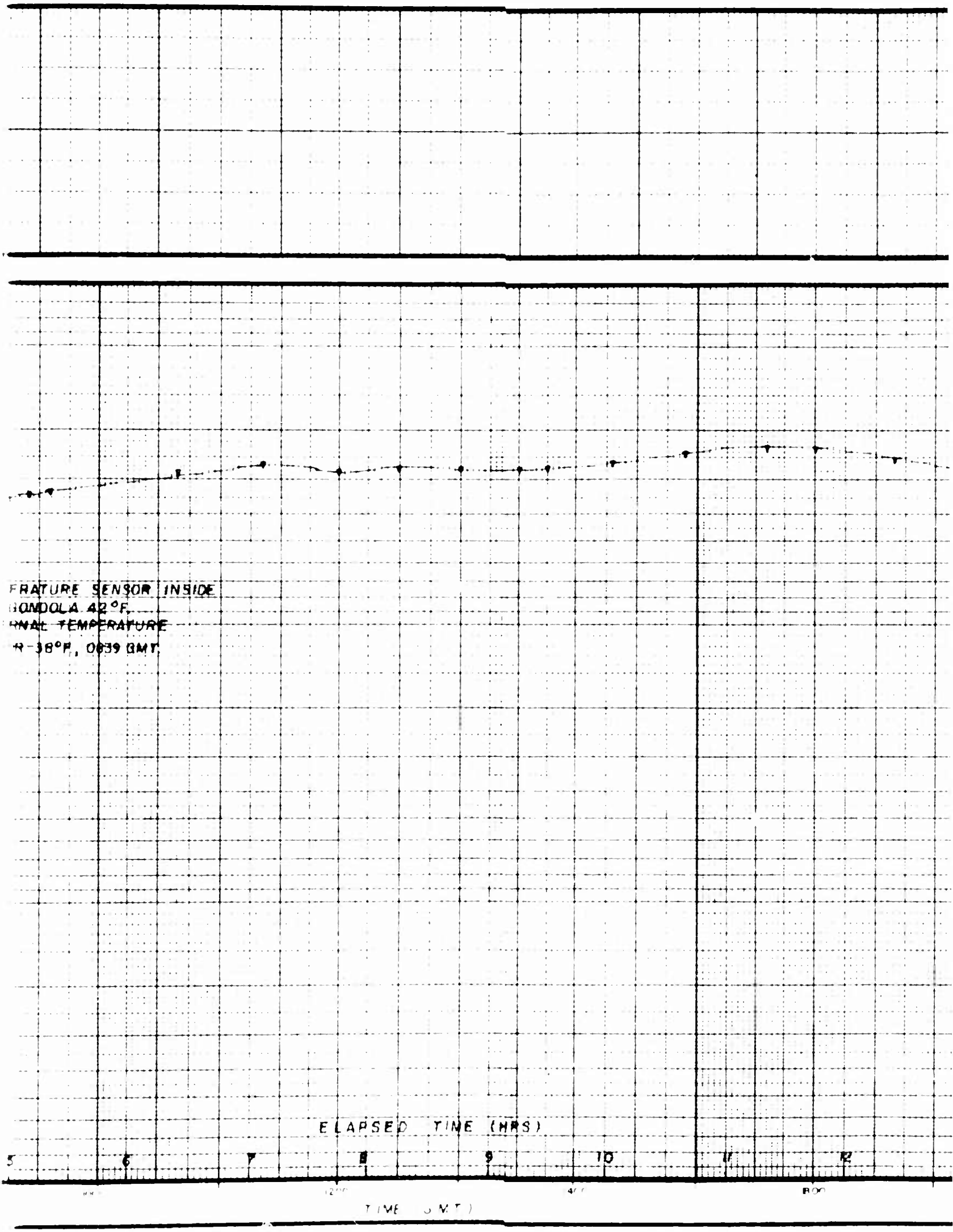
The aircraft recovery square had been tightened down to 1/2 mile when the parachute penetrated an 800 foot ceiling.

The payload was recovered by the Raven helicopter supported by a float plane.

A


V = VHF FM/FM BEACON
B = BALLAST
THEORETICAL CEILING
AVERAGE R/R = 418 FT/MIN TO 127,500 FEET
R/R = 303 FT/MIN FROM 40,700 FEET TO 127,500 FEET
R/R = 780 FT/MIN TO 60,700 FEET
10LB3
10LB8
10LB9
10LB7
LAUNCH SITE FT CHURCHILL, CA. 04:15 G.M.T.
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET
ALTITUDE IN KILOMETERS


TEMPERATURE SENSOR INSIDE
R.I.L GONDOLA 42°F,
EXTERNAL TEMPERATURE
SENSOR - 38°F, 0839 GMT
SUNRISE
ELAPSED TIME (HRS)
4
5
6
7
8
9
10
11
TIME (G.M.T.)


FRATURE SENSOR INSIDE
GONDOLA 42°F.
INAL TEMPERATURE
R-38°F, 0639 GMT
ELAPSED TIME (HRS)
5
6
7
8
9
10
11
12
TIME (G.M.T.)

B

SCIENTIFIC EXPERIMENT:
COUNTERS AND EMULSIONS

TERMINATION BY
RADIO COMMAND
1932 GMT

IMPACT AREA
107° 07' W
58° 23' N

FLIGHT NO. 1093-N

DATE 24 JUNE 1964

FOR NASA GODDARD
DR McDONALD
ER GISS

BALLOON

TYPE 2323-541-8291 S/N 128

VOL 9 MILLION CU FT

MATL 75 MIL POLY

WT 9640 LBS

LOAD FACTORS

PAYLOAD 767 0 LBS

GROSS LD 1331 0 LBS

FREE LIFT 102 0 LBS = 8%

BALLAST 90 0 LBS

RAVEN
industries, inc.

DR. [illegible] JULY 964

CHK.

APPR. [illegible]

X02094

EASTMAN KODAK THIRD SOJO GRADMATE

KYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

. Company Raven Industries, Inc. Flight Number 1094-N

. Scientist Mr. Stiller Organization NRL

3. Launch: Site Ft. Churchill Date/Time 1 July 1964/0315 Z

Technique Anchor line Director D. Johnson

. Weather: Clear 55°F W 8 Tropopause: Height 34K Temp -50 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical _____ Mbs _____ ft. Actual: _____ ft. _____ Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause _____ fpm. Tropopause to ceiling _____ fpm.

Flight duration: Total _____ hrs. _____ min. At ceiling _____ hrs. _____ min. _____

Termination: Time _____ Z Altitude _____ ft. Cause _____

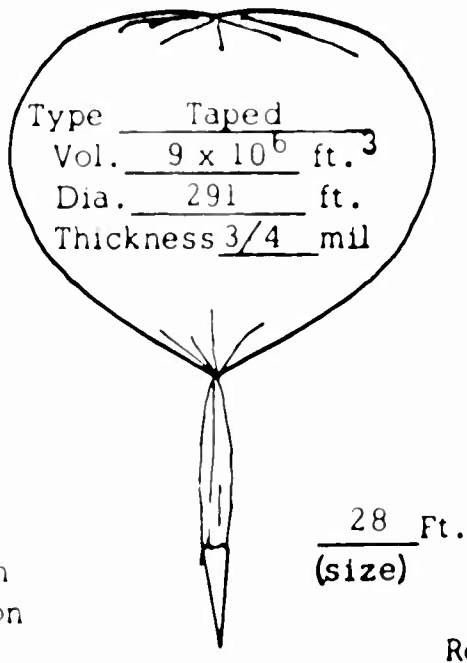
9. Balloon destruction - confirmed Unknown
(visual - unknown - etc.)

10. Impact: Date/Time 1 July/0320 Z Location East side of N-S runway

1.. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 Mcs	Beacon	5 min.
149.5 Mcs	Radio Command	30 sec.

1. Balloon: Code number 2323-541-8291 Serial number 132



Type Taped
Vol. 9 x 10^6 $ft.^3$
Dia. 291 ft.
Thickness 3/4 mil

28 Ft.chute
(size)

complete sketch
showing location
(equipment

WEIGHT

Balloon	948 lb.
FAA Termination Timer	
Parachute	15
Instrumentation	
Ballast	
Scientific package -	
Other	261
Gross Weight	1,224
Free Lift	100
Gross Inflation	1,324
Helium used	21,000 cu. ft.

Remarks:
The emulsion stack flipped during a rough launch. The flight was terminated five minutes after launch. The instruments suffered some water damage.

Copy to:
(NR/FldRep/Minn
ONR/Code 421

Flight 1094-N

Remarks:

The surface winds were about 8 mph at launch time, but a severe crosswind hampered this flight.

During lift off the flight gondola got enta..gled in the rigging and was hanging upside down as the balloon ascended.

The flight was terminated after the balloon reached a safe parachute descent altitude.

KYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1095-N

2. Scientist Mr. Stiller Organization NRL

3. Launch: Site Ft. Churchill Date/Time 3 July 1964/0915 Z

Technique Anchor line Director D. Johnson

4. Weather: Scattered 50°F SW 6-8 Tropopause: Height 34K Temp -55 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 1.85 Mbs 144K ft. Actual: 144 ft. 1.85 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 806 fpm. Tropopause to ceiling 625 fpm.

7. Flight duration: Total 15 hrs. 31 min. At ceiling 12 hrs. ____ min. ____

8. Termination: Time 0046 Z Altitude 136 ft. Cause Radio Command

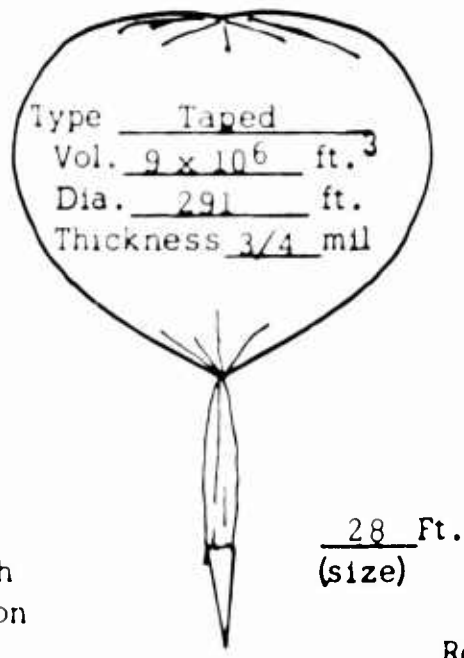
9. Balloon destruction - confirmed visual
(visual - unknown - etc.)

10. Impact: Date/Time 4 July/0133 Z Location 107° 37'W/59° 14'N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
253.1 Mcs	Beacon	17 hr.
149.4 Mcs	Radio Command	10 min.

12. Balloon: Code number 2323-541-8291 Serial number 133



28 Ft.chute
(size)

Complete sketch showing location of equipment

WEIGHT

Balloon	946 lbs.
FAA Termination Timer	
Parachute	15
Instrumentation	
Ballast	
Scientific package	
Other	256
Gross Weight	1,217
Free Lift	98
Gross Inflation	1,315
Helium used	21,000 cu. ft.

Remarks: Good flight

Copy to:
CNR/FldRep/Minn
CNR/Code 421

ht 1095-N

arks:

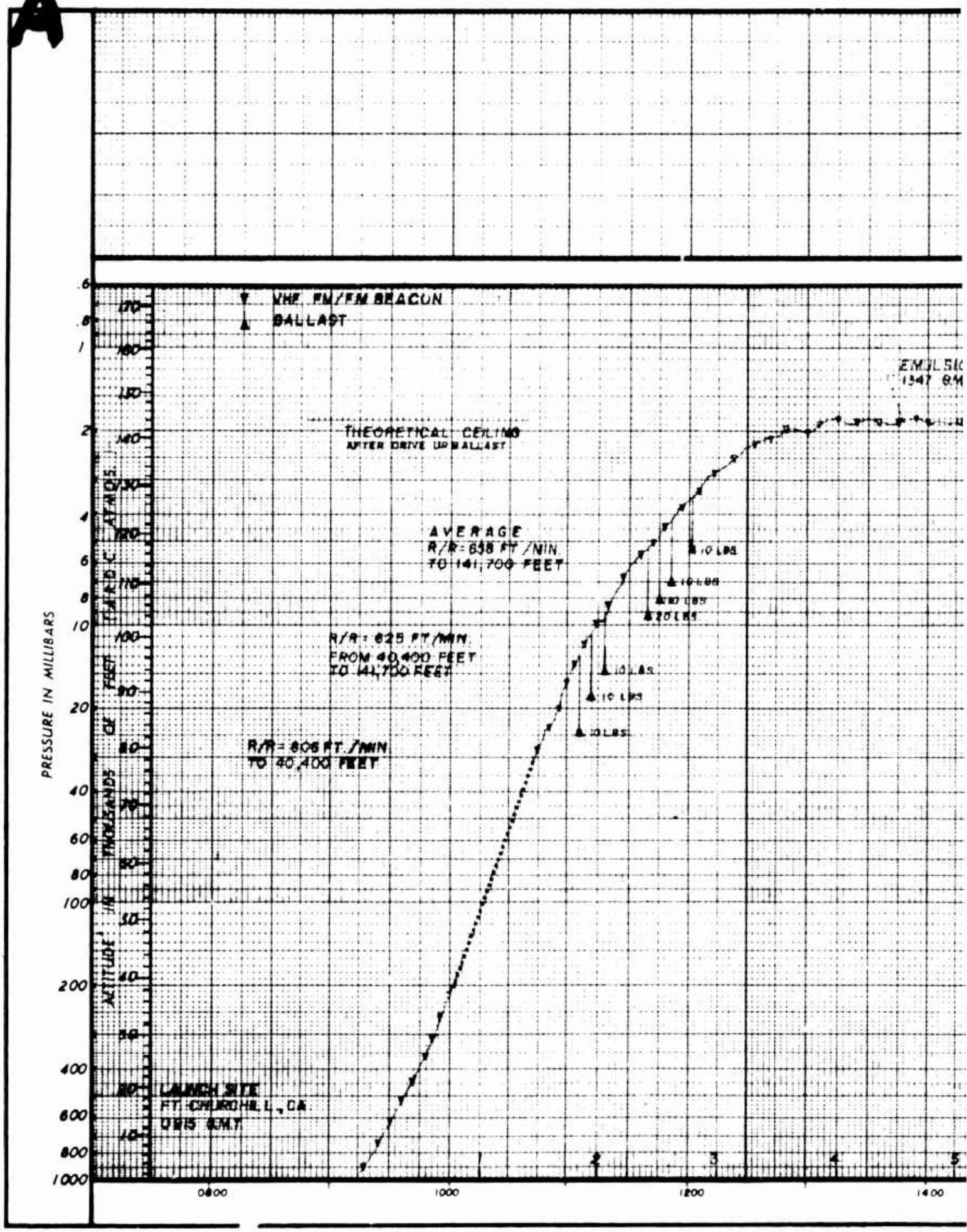
ace winds at launch were 6 to 8 mph.

balloon rose at an average rate of 658 feet per minute to about
,000 feet and floated for 12 hours.

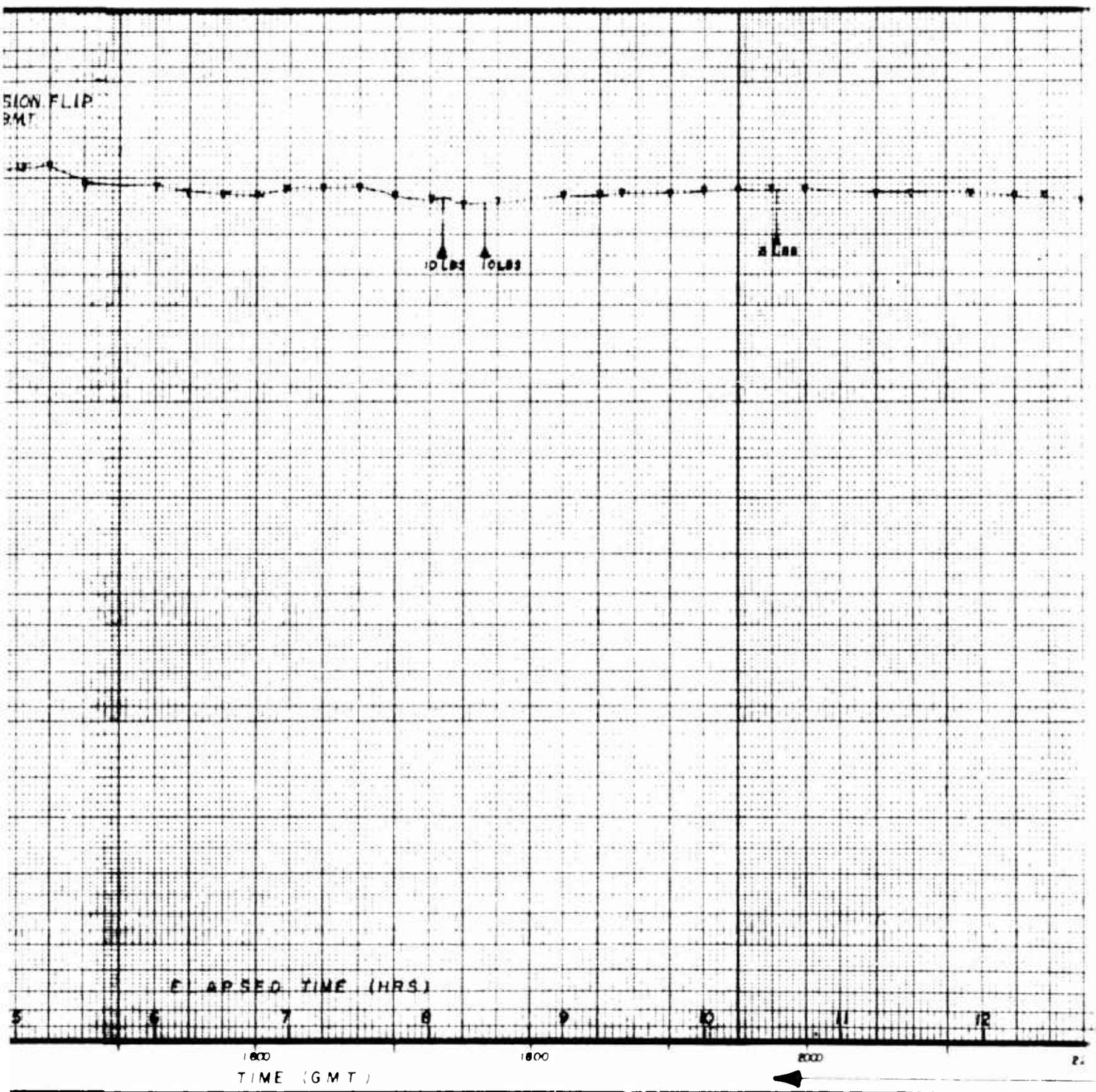
flight was terminated at 0046 G. M.T. Impact was about
nles west of Stony Rapids.

ayload was recovered by the Raven helicopter supported by
float planes and returned to Ft. Churchill by the C-47 the
e day.

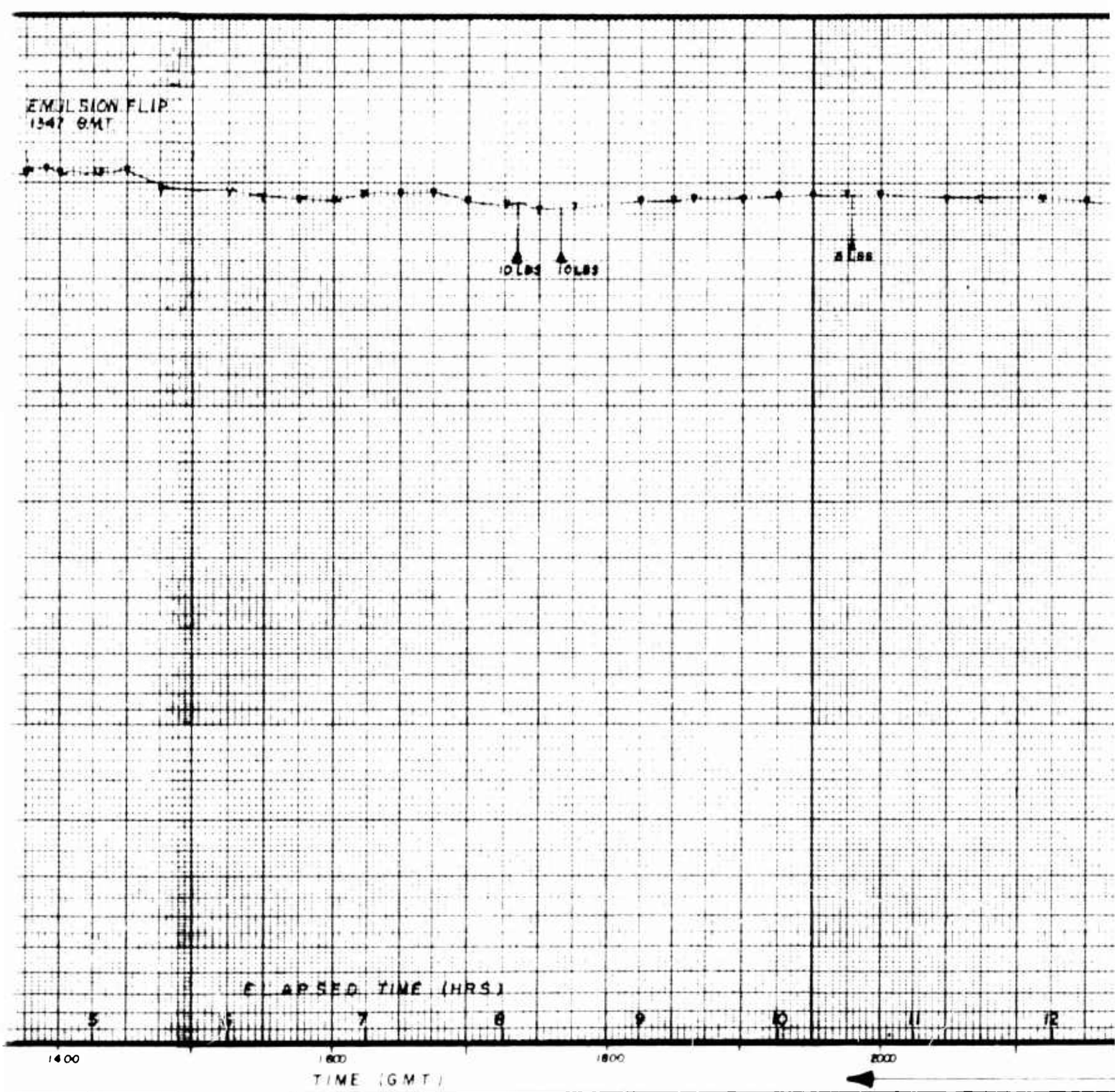
A

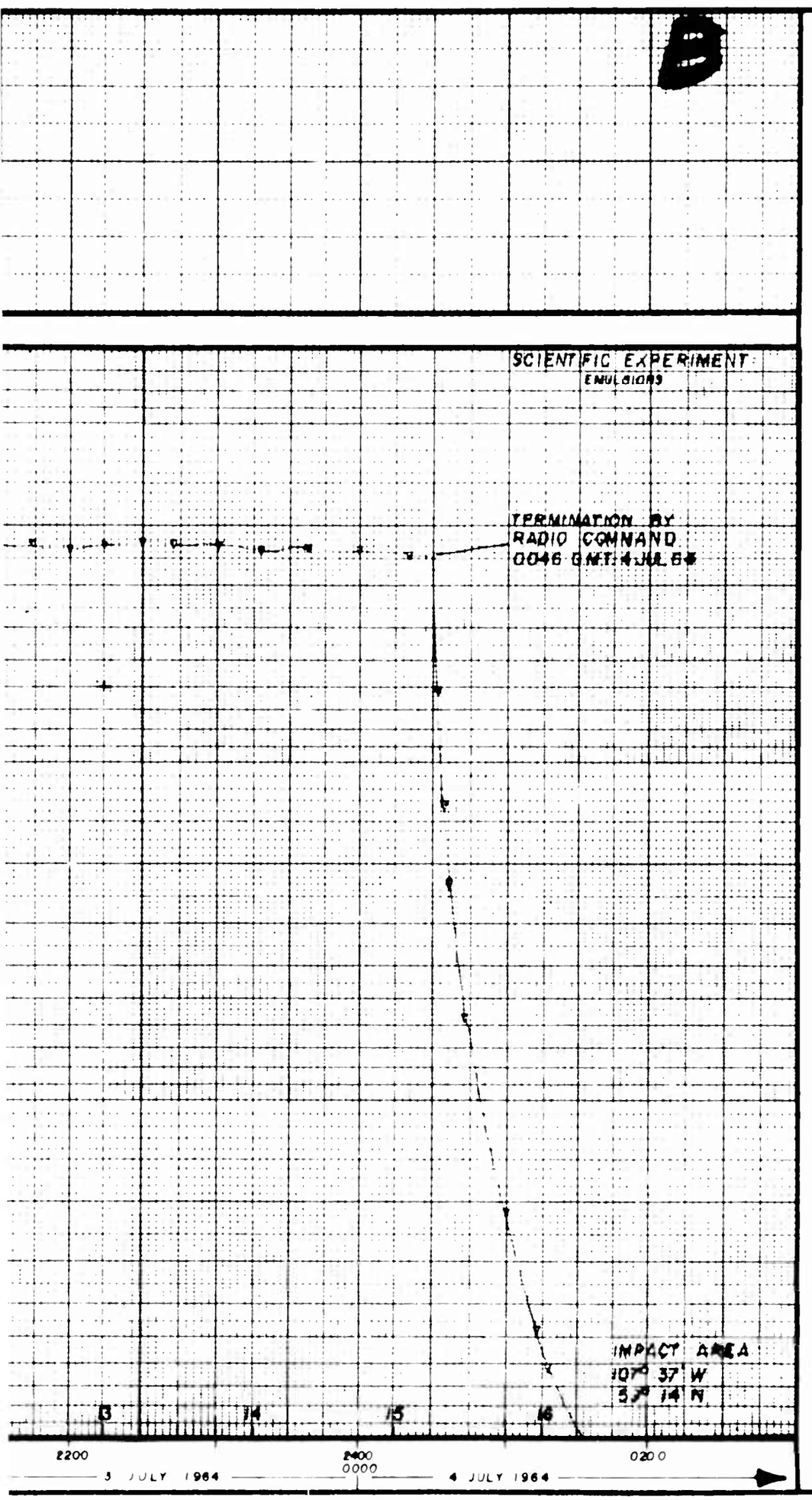

VHF FM/FM BEACON
BALLAST
THEORETICAL CEILING
AFTER DRIVE UP BALLAST
AVERAGE
R/R = 638 FT/MIN
TO 141,700 FEET
R/R = 825 FT/MIN
FROM 40,400 FEET
TO 141,700 FEET
R/R = 806 FT/MIN
TO 40,400 FEET
10 LBS
10 LBS
10 LBS
10 LBS
20 LBS
LAUNCH SITE
FT. CHURCHILL, CAN.
0815 G.M.T.
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET
0800
1000
1200
1400

TEMPERATURE (°F)		
TIME GMT	INSIDE RIT GONDOLA	EXTERNAL
1112	65	
1244	62	
1248	3.	
1347	0.	
1436		



TEMPERATURE [illegible]		
TIME GMT	INSIDE GONDOLA	EXTERNAL
1112	65	
1244	52	
1248	51	
1347	50	
1436		





FLIGHT NO. 1095-N

DATE 3 JULY 1964

FOR N R L
MR STILLER

BALLOON

TYPE 2323-541-829[illegible] N 33

VOL 9 MILLION CU FT

MATL .75 MIL POLY

WT 946.0 LBS.

LOAD FACTORS

PAYLOAD 271.0 LBS

GROSS LD 1217.0 LBS

FREE LIFT 98 LBS = 8 %

BALLAST 100.0 LBS.

RAVEN industries, inc.

DR. [illegible] 15 JULY 1964

CHK.

APPR.

X03040

EASTMAN ANAMO THIRD SUB GRADMATE

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1096-N

2. Scientist Mr. E. Yeo Organization U.K.A.E.A.

3. Launch: Site Ft. Churchill Date/Time 4 July 1964/0928 Z

Technique Anchor line Director D. Johnson

4. Weather: Scattered - 54°F SW 2-4 Tropopause: Height 35K Temp -59 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 56 Mbs 65.5K ft. Actual: 64K ft. 60 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 888 fpm. Tropopause to ceiling 7[illegible] fpm.

7. Flight duration: Total 11 hrs. 55 min. At ceiling 11 hrs. ____ min. ____

8. Termination: Time 2123 Z Altitude 58K ft. Cause Radio Command

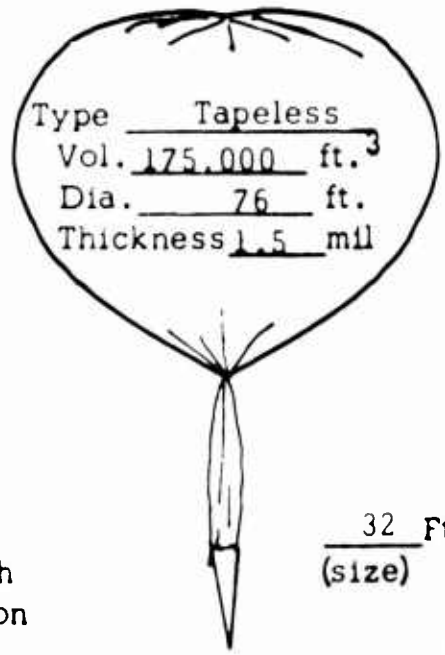
9. Balloon destruction - confirmed visual
(visual - unknown - etc.)

10. Impact: Date/Time 4 July/2154 Z Location 93° 52'W/58° 28'N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 Mcs	Beacon	13 hr.
149.4 Mcs	Radio Command	9 min.

12. Balloon: Code number 2333-561-476 Serial number 131



32 Ft. chute
(size)

Complete sketch showing location equipment

WEIGHT

Balloon	146 lb.
FAA Termination Timer	
Parachute	17
Instrumentation	
Ballast	
Scientific package	
Other	634
Gross Weight	797
Free Lift	80
Gross Inflation	877
Helium used	14,100 cu. ft.

Remarks: Good flight

Copy to:
ONR/FldRep/Minn
ONR/Code 421

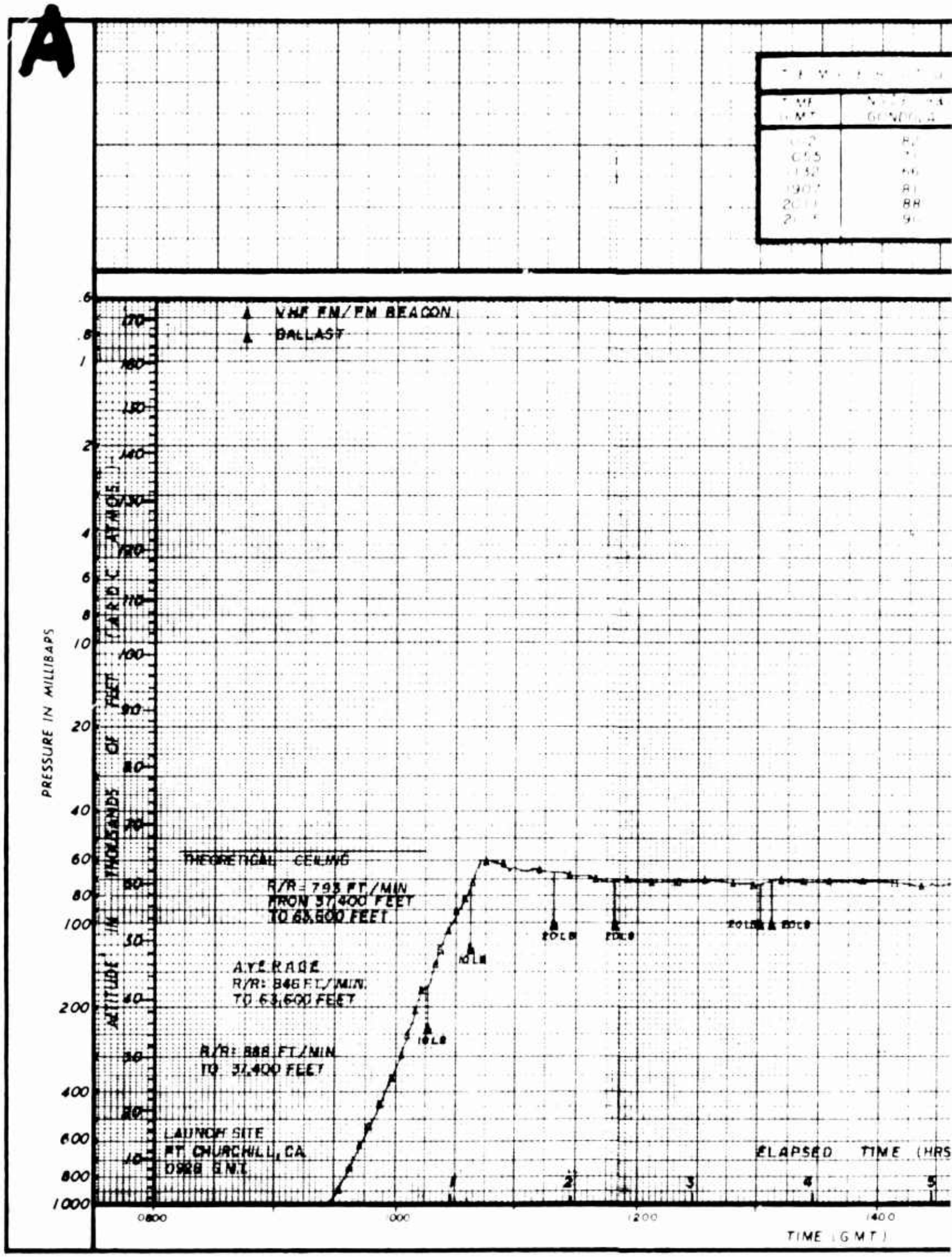
Flight 1096-N

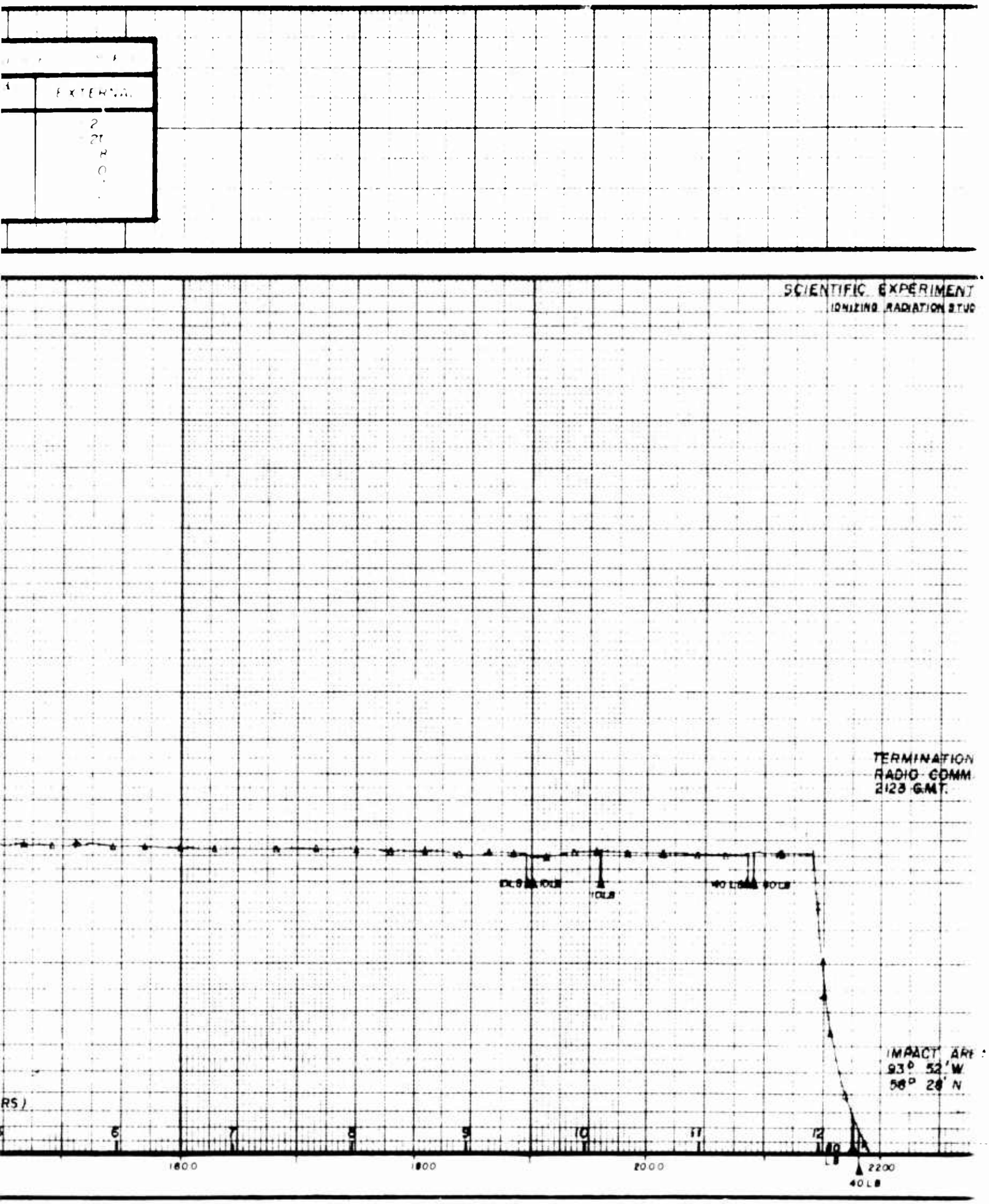
Remarks:

The surface conditions were ideal and the launch was smooth. The balloon came directly over the payload and picked it up with very little shock.

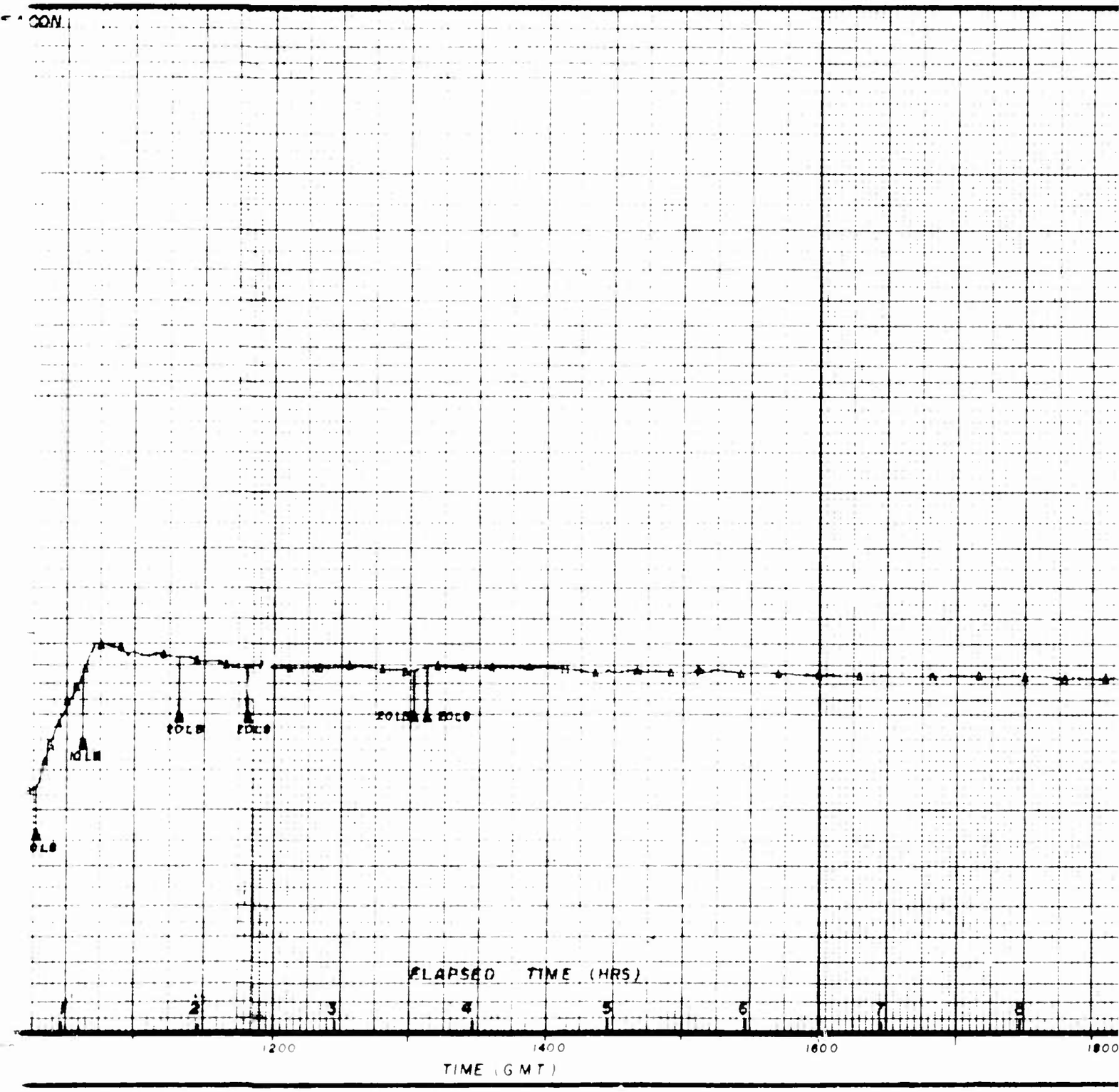
The balloon drifted out over Hudson Bay on ascent, then began to move back very slowly toward land after reaching ceiling. At 2123 G.M.T., the flight was terminated. The payload landed 20 miles south of Ft. Churchill and was recovered with the help of a PAA helicopter.

A


VHF FM/FM BEACON
BALLAST
THEORETICAL CEILING
R/R = 795 FT/MIN
FROM 37,400 FEET
TO 63,600 FEET
AVERAGE
R/R: 846 FT/MIN.
TO 63,600 FEET
R/R: 888 FT/MIN
TO 37,400 FEET
LAUNCH SITE
FT CHURCHILL, CA.
0928 G.M.T.
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (APPROX. ATMOS.)
ELAPSED TIME (HRS
TIME (G.M.T.)
0800
1000
1200
1400

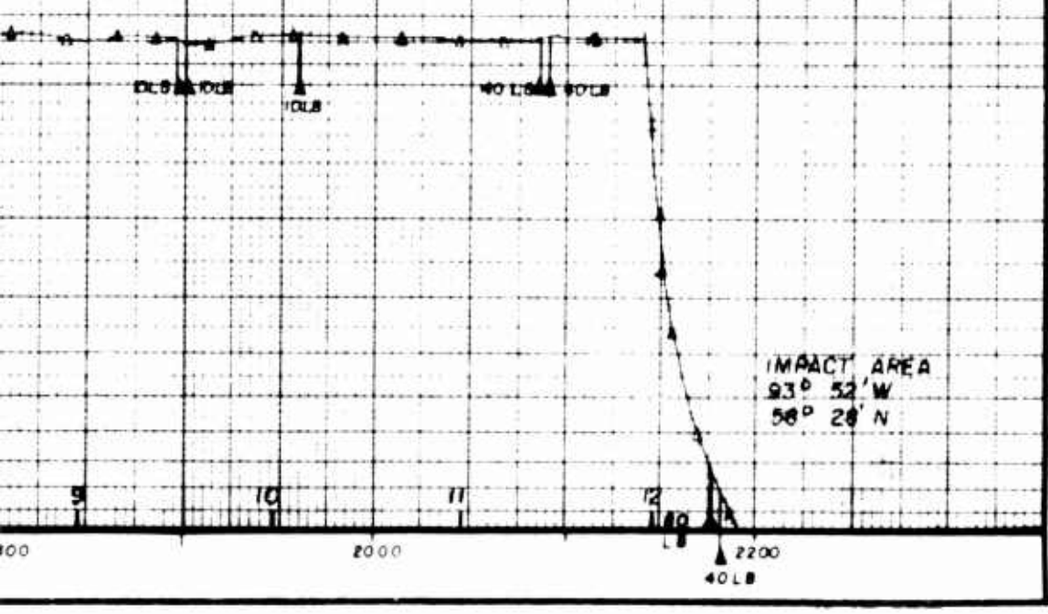

SCIENTIFIC EXPERIMENT
IONIZING RADIATION STUD
TERMINATION
RADIO COMM
2123 G.M.T.
10 LB
IMPACT AR
93° 52' W
58° 28' N
1800
1900
2000
2200
40 LB

TIME (GMT)	GENERAL	EXTERNAL
[illegible]	[illegible]	21
[illegible]	[illegible]	20
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0
[illegible]	88	
[illegible]	91	



B

SCIENTIFIC EXPERIMENT:
IONIZING RADIATION STUDY



FLIGHT NO. 1096-N

DATE 4 JULY 1964

FOR UNITED KINGDOM
U K A E A
ERIC YEO

BALLOON

TYPE 2233-561-476 S/N 131

VOL [illegible] CU FT

MATL 1.5 MIL POLY

WT 476 LBS

LOAD FACTORS

PAYLOAD 651 LBS

GROSS LD 797 LBS

FREE LIFT 80 LBS = 10%

BALLAST 300 LBS

RAVEN industries, inc.

DR. JONK 15 JULY 1964

CHK.

APPR.

X 03041

EASTMAN AHAMO THIRD SUB GRADMATE

CYHOOK BALLOON FLIGHT INFORMATION
AVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1097-N

2. Scientist Mr. E. Yeo Organization U.K.A.E.A.

3. Launch: Site Ft. Churchill Date/Time 8 July 1964/0824 Z

Technique Anchor Line Director D. Johnson

4. Weather: Scattered 37°F NE 6 Tropopause: Height 38.5K Temp -57 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 60 Mbs 64K ft. Actual: 64K ft. 60 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 997 fpm. Tropopause to ceiling 928 fpm.

7. Flight duration: Total 11 hrs. 45 min. At ceiling 10 hrs. 45 min.

8. Termination: Time 2009 Z Altitude 64K ft. Cause Radio Command

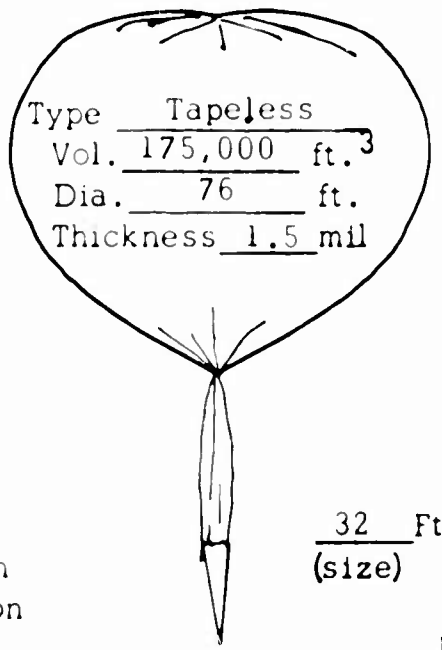
9. Balloon destruction - confirmed Visual
(visual - unknown - etc.)

10. Impact: Date/Time 8 July/2033 Z Location 96° 47' W/57° 32' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
255.1 Mcs	Beacon	13 hr.
149.4 Mcs	Radio Command	5 min.

12. Balloon: Code number 2333-561-476 Serial number 132



32 Ft.chute
(size)

Complete sketch showing location of equipment

WEIGHT

Balloon	147 lb.
FAA Termination Timer	
Parachute	17
Instrumentation	
Ballast	480
Scientific package	192
Other	
Gross Weight	836
Free Lift	92
Gross Inflation	928
Helium used	15,000 cu. ft.

Remarks: Good flight

Copy to:
CNR/FldRep/Minn
CNR/Code 421

Flight 1097-N

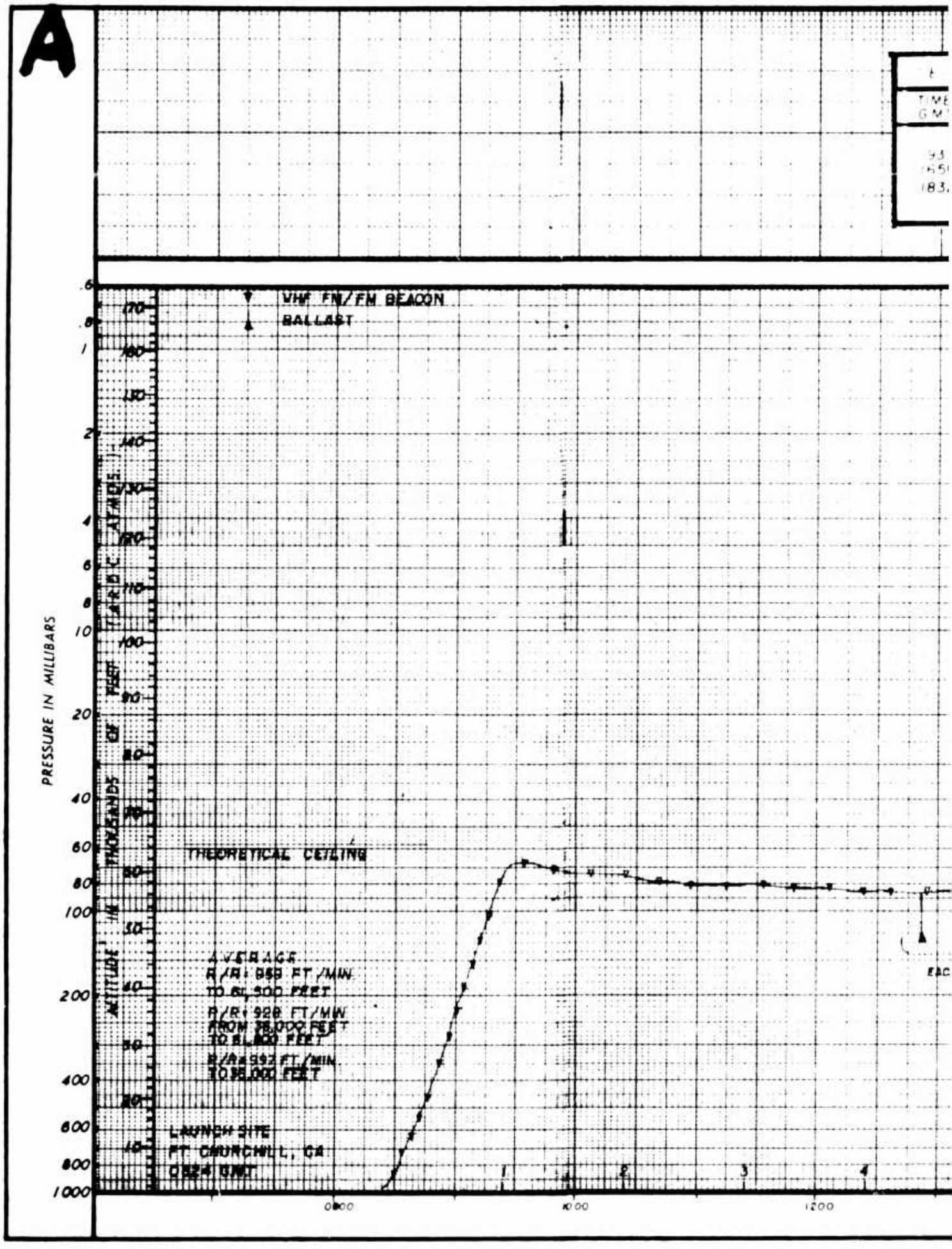
Remarks:

Surface winds were 6 mph at launch.

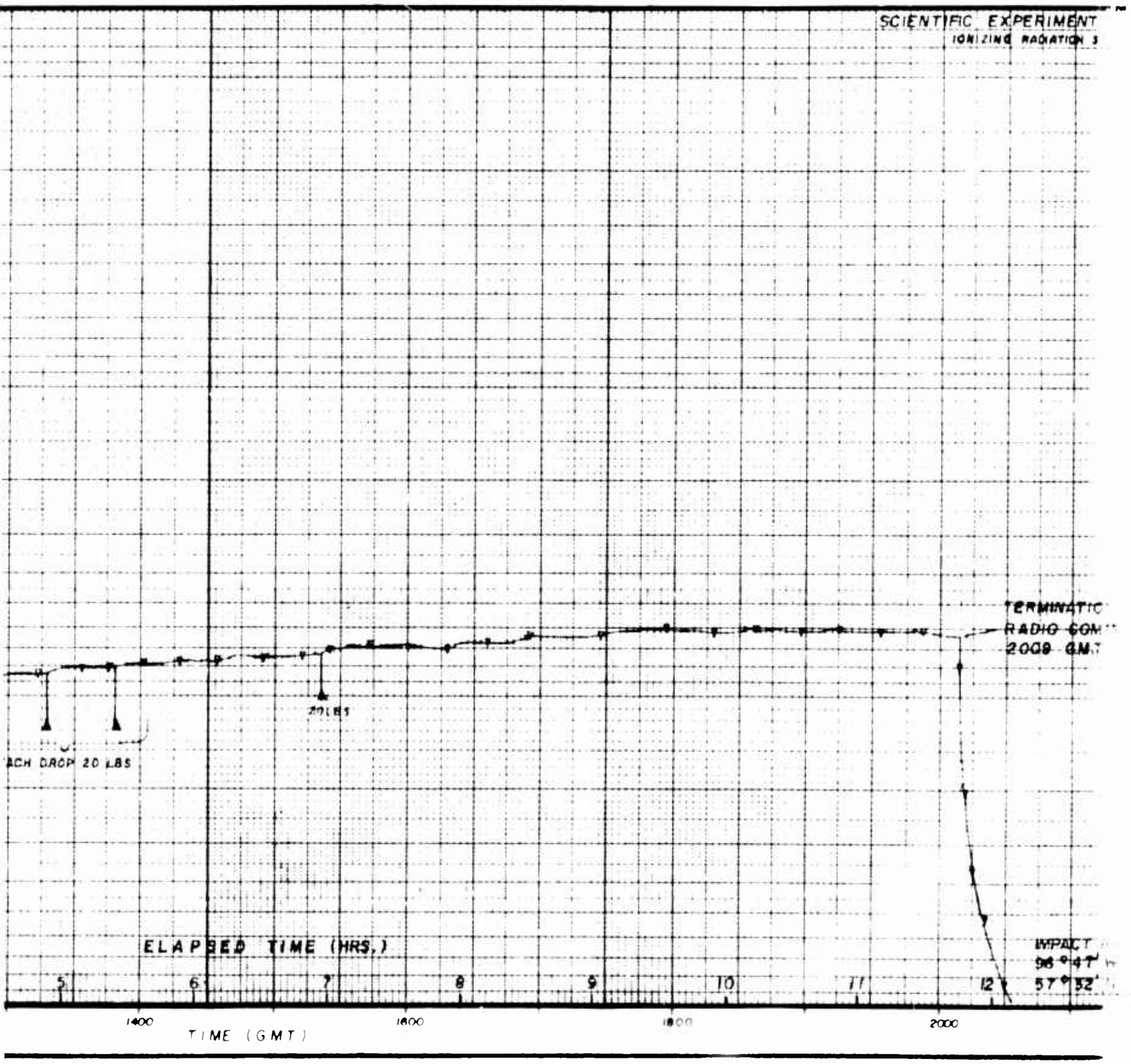
The balloon rose at an average rate of 959 feet per minute after a good launch and floated at about 60,000 feet for 11 hours.

The flight was terminated at 2009 G.M.T. Impact was 100 miles SW of Ft. Churchill.

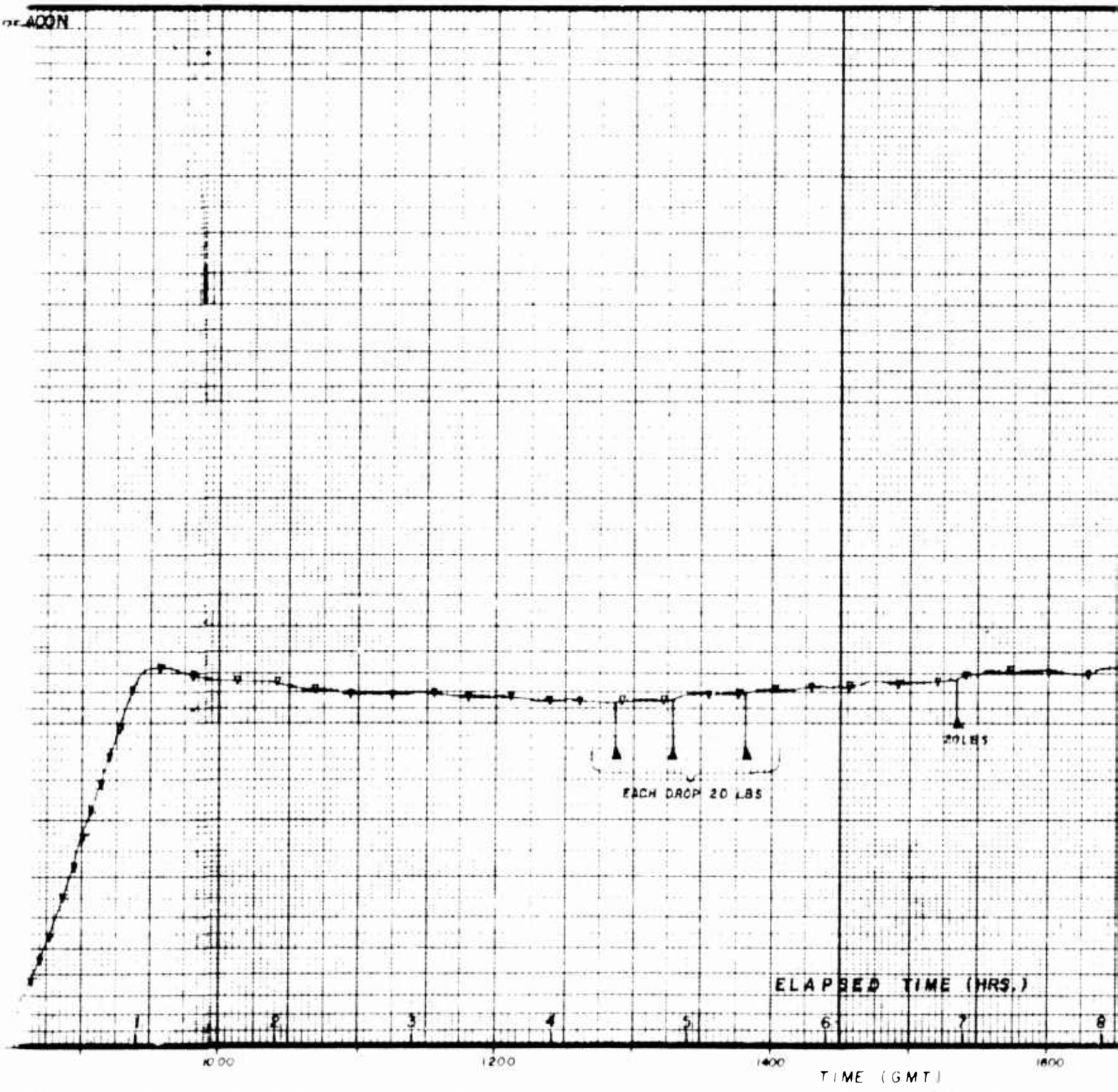
The payload was recovered by a PAA helicopter.

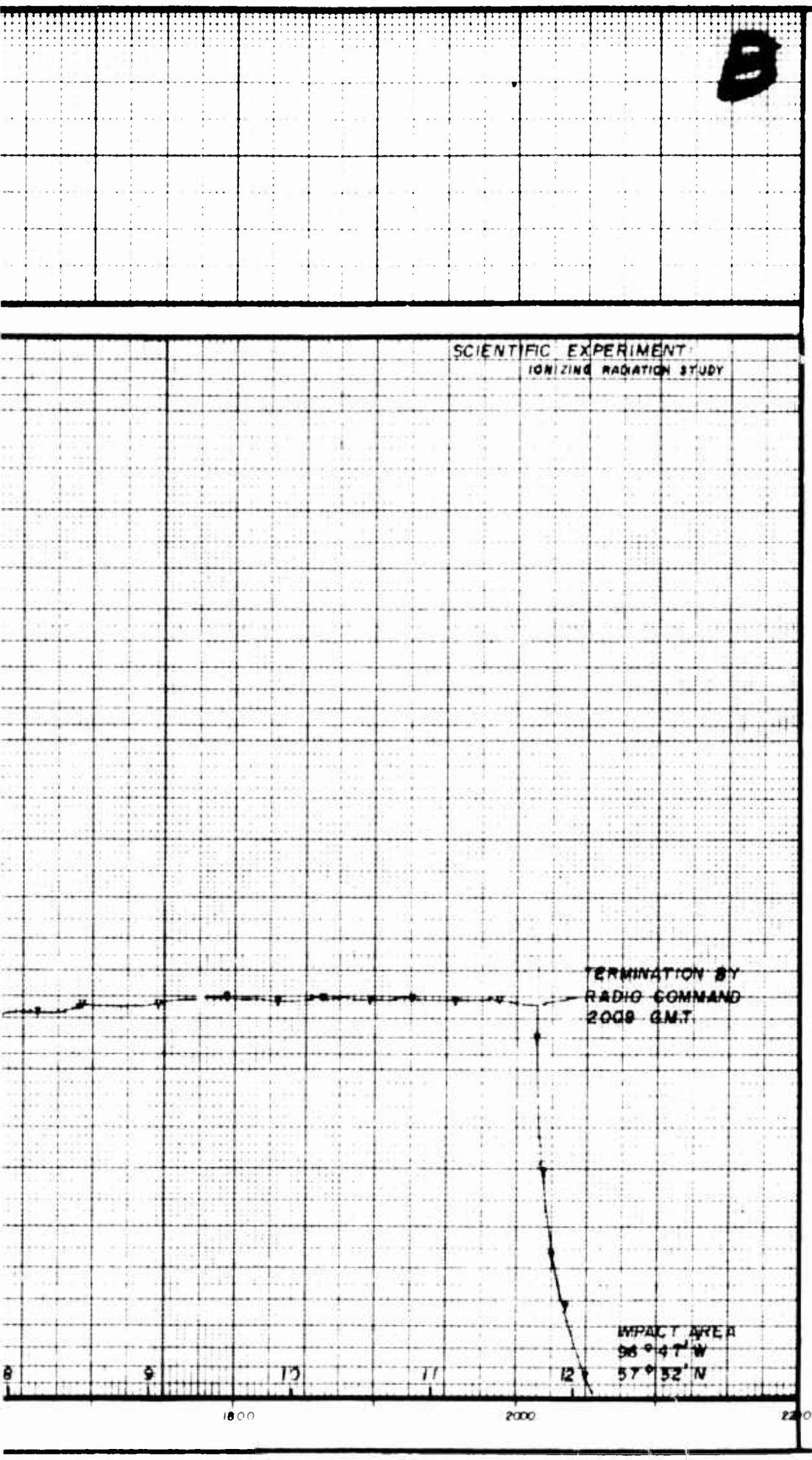

A
VHF FM/FM BEACON
BALLAST
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (APPROX. ATMOS.)
THEORETICAL CEILING
AVERAGE
R/R+ 958 FT/MIN
TO 61,500 FEET
R/R+ 928 FT/MIN
FROM 36,000 FEET
TO 61,500 FEET
R/R+ 992 FT/MIN
TO 36,000 FEET
LAUNCH SITE
FT CHURCHILL, CA
0824 GMT
0800
1000
1200

E M P E R A T U R E (° F)		
ME M.T	INSIDE RIG GONDOLA	EXTERNAL
1330	[illegible]	
1350	76	
1332	82	



TEMPERATURE (°F)		
TIME GMT	INSIDE RIB GONDOLA	EXTERNAL
933	[illegible]	
1650	76	
1832	82	





FLIGHT NO. 1097-N

DATE 8 JULY 1964

FOR UNITED KINGDOM
UKAEA
EPSTEC

BALLOON

TYPE 2333-561-476 S/N 132

VOL 175,000 CU FT

MATL 1.5 MIL POLY

WT 1470 LBS

LOAD FACTORS

PAYLOAD 6895 LBS

GROSS LD 8365 LBS

FREE LIFT 92 LBS = 11 %

BALLAST 2500 LBS

RAVEN industries, inc.

DR. DONK 15 JULY 1964

CHK.

APPR.

X03042

EASTIN AHAMD THIRD SUJE GRADMATE

NYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

. Company Raven Industries, Inc. Flight Number 1098-N

. Scientist Mr. E. Yeo Organization U.K.A.E.A.

3. Launch: Site Ft. Churchill Date/Time 10 July 1964/0420 Z

Technique Anchor Line Director D. Johnson

. Weather: Broken 40°F NNE 6 Tropopause: Height 34K Temp -53 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 58 Mbs 65K ft. Actual: 64K ft. 60 Mbs
How altitude determined VHF FM/FM Beacon and Churchill Radar

6. Ascent: Surface to tropopause 950 fpm. Tropopause to ceiling 825 fpm.

. Flight duration: Total 13 hrs. 42 min. At ceiling 12 hrs. 30 min.

. Termination: Time 1802 Z Altitude 64K ft. Cause Timer

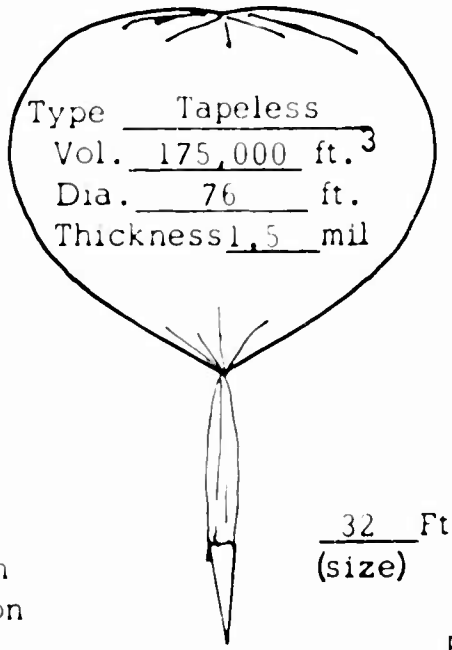
9. Balloon destruction - confirmed Unknown
(visual - unknown - etc.)

10. Impact: Date/Time 10 July/1830 Z Location 98° 55' W/56° 52' N

1 . Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 Mcs	Beacon	14.5 hr.
149.4 Mcs	Radio Command	15 min.

1 . Balloon: Code number 2333-561-476 Serial number 133



32 Ft.chute
(size)

complete sketch
showing location
f equipment

WEIGHT

Balloon	141 lb.
FAA Termination Timer	
Parachute	17
Instrumentation	61.5
Ballast	390
Scientific package	222.5
Other	
Gross Weight	832
Free Lift	84
Gross Inflation	916
Helium used	14,750 cu. ft.

Remarks: The instruments sustained some water damage.
Good flight.

Copy to:
)NR/FldRep/Minn
)NR/Code 421

Flight 1098-N

Remarks:

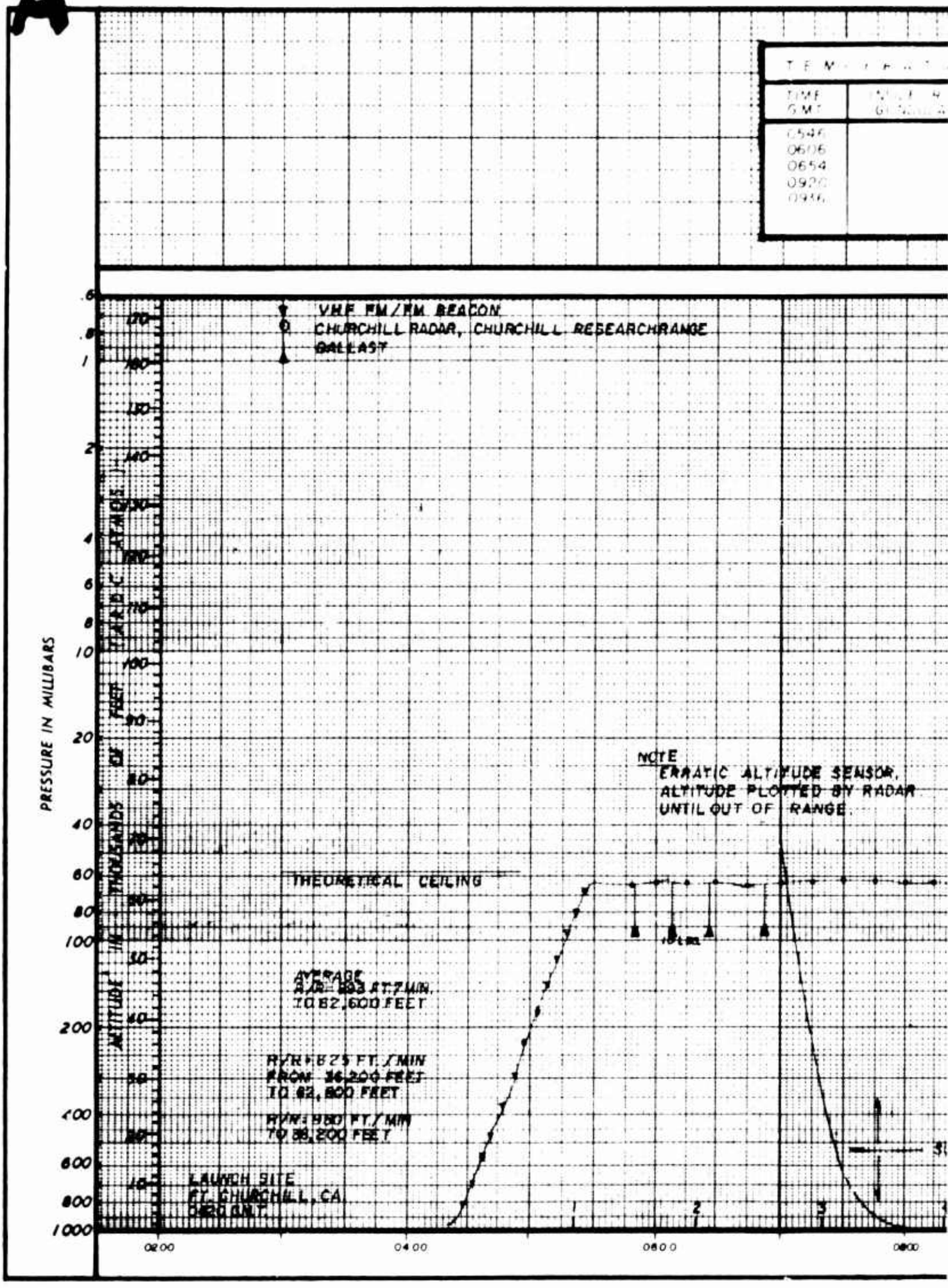
The surface winds at launch were 6 mph. The launch was smooth and the balloon rose at 893 feet per minute to 62,000 feet.

The balloon floated at ceiling for about 13 hours. The flight was terminated at 1802 G.M.T. by the timer.

The weather in the recovery area was fair, but visibility was down to 1.5 miles due to smoke from many forest fires. The recovery was accomplished by one float plane which flew through 250 miles of dense smoke enroute to the impact area.

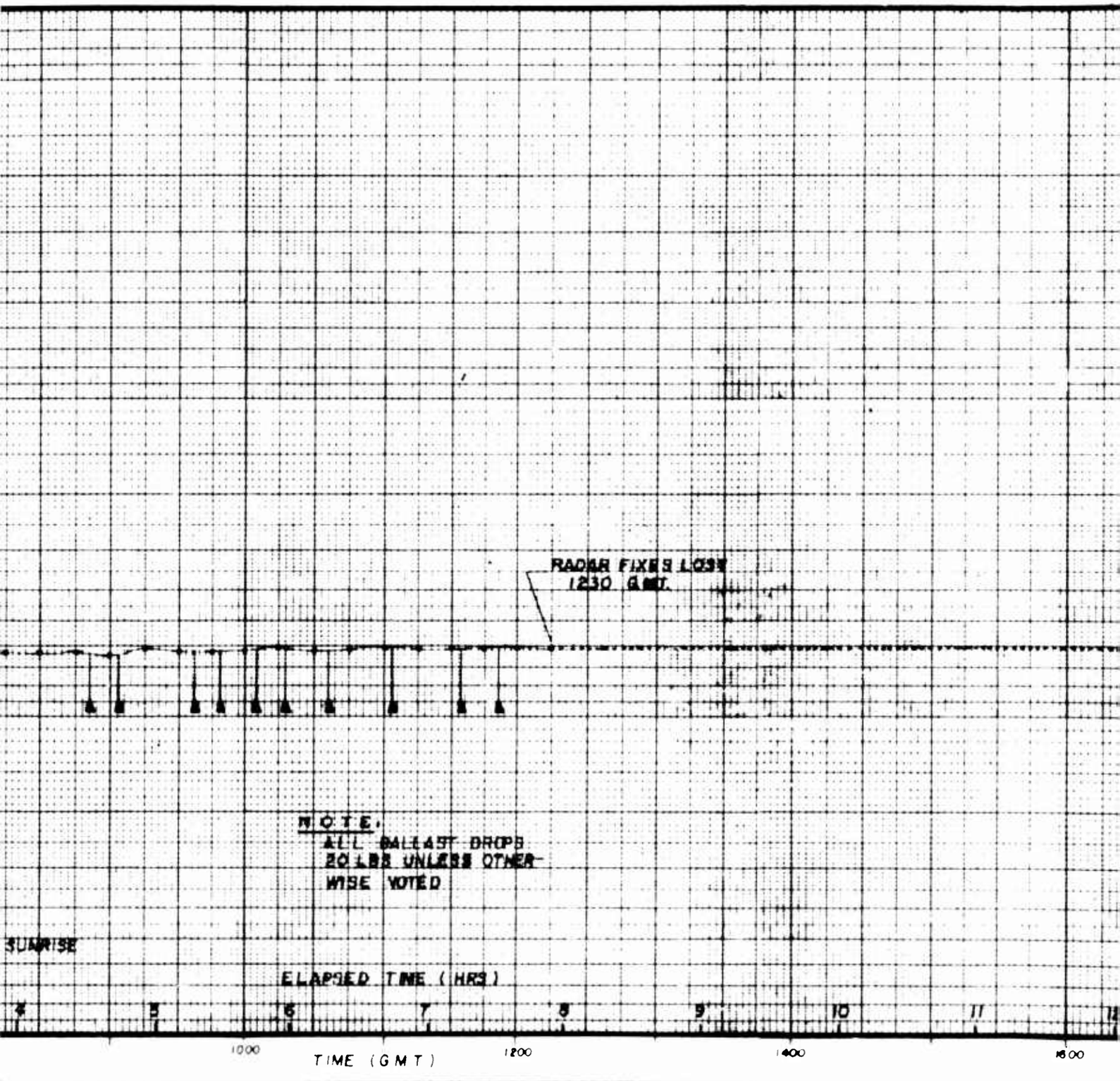
The recovery was made from Indian Lake which is about 90 miles east of Lynn Lake.

A


VHF FM/FM BEACON
CHURCHILL RADAR, CHURCHILL RESEARCHRANGE
BALLAST
NOTE
ERRATIC ALTITUDE SENSOR.
ALTITUDE PLOTTED BY RADAR
UNTIL OUT OF RANGE.
THEORETICAL CEILING
AVERAGE
R/R: 803 FT./MIN.
TO 82,600 FEET
R/R: 825 FT./MIN
FROM 36,200 FEET
TO 82,800 FEET
R/R: 950 FT./MIN
TO 36,200 FEET
LAUNCH SITE
FT. CHURCHILL, CA.
0620 G.M.T.
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET
0200
0400
0600
0800

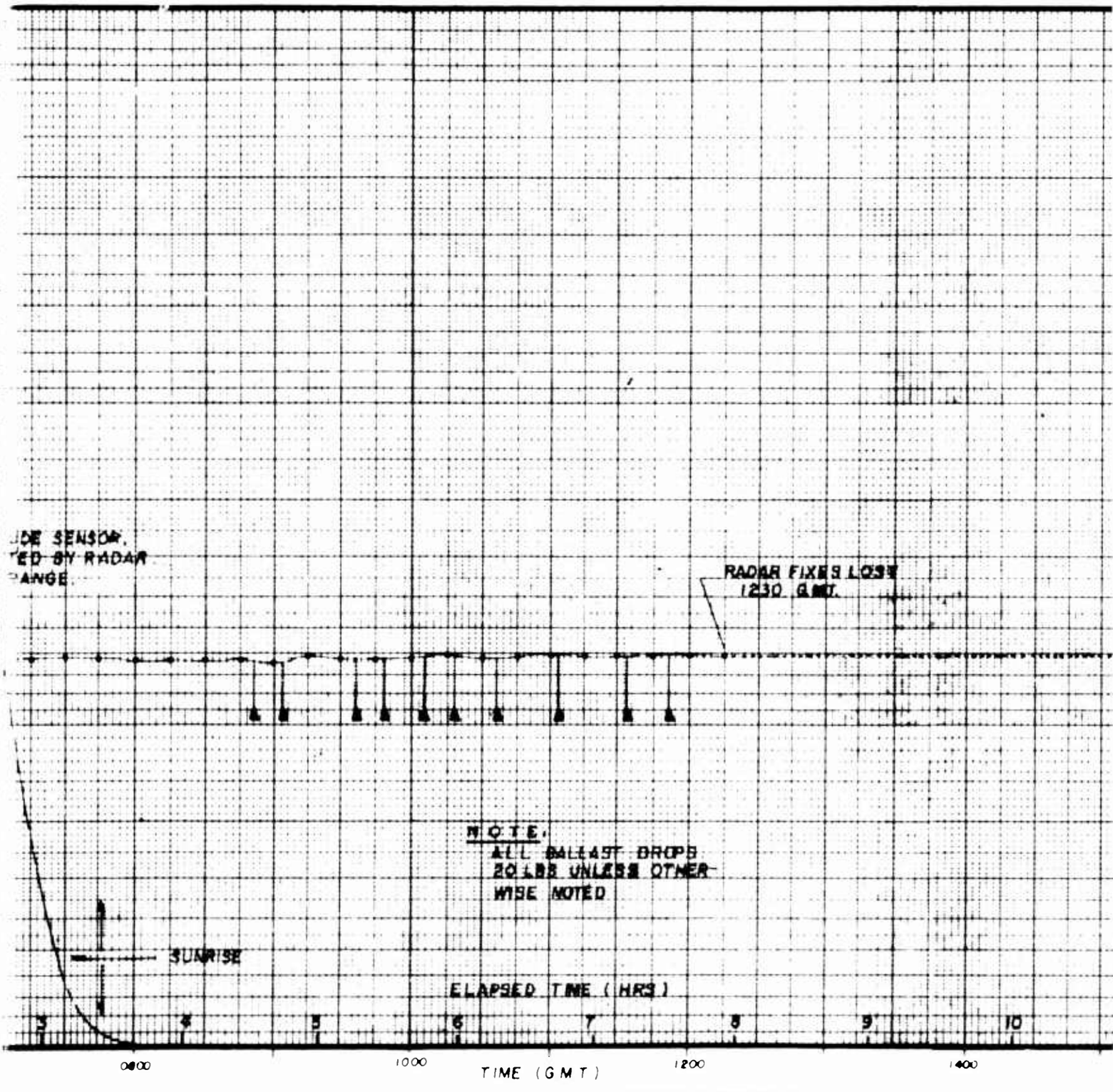
	EXTERNAL
	-16
	-15
	-40
	-40
	-35

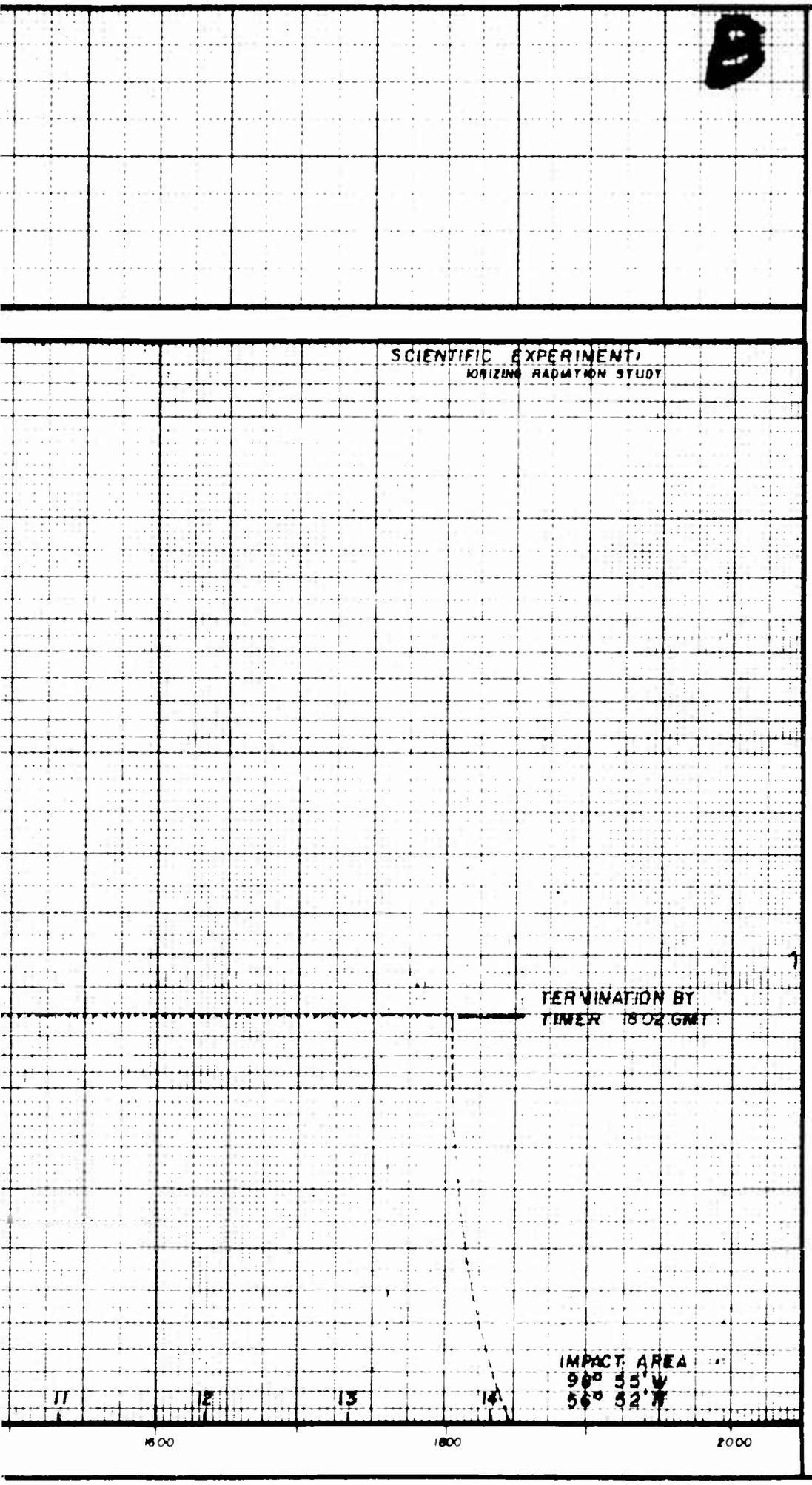
TIME GMT	INSIDE RIT GONDOLA	EXTERNAL
1022		-35
1055		-30
1136		-24
1155		-22
1235		-2



E M [illegible]		
ME M T	[illegible] G [illegible] A	EXTERNAL
546		16
606		13
654		4 [illegible]
720		4 [illegible]
746		35

T I M E [illegible]		
TIME GMT	INSIDE RIT GONDOLA	EXTERNAL
1022		35
1055		30
1136		-24
1155		22
175		2





FLIGHT NO. 1098-N

DATE 10 JULY 1964

FOR UNITED KINGDOM
U K A E A
ERIC YEO

BALLOON

TYPE 2333-561-476 S/N 133

VOL 175,000 CU.F.T.

MATL 1.5 MIL POLY

WT 141.0 LBS

LOAD FACTORS

PAYLOAD 691.0 LBS.

GROSS LD 832.0 LBS.

FREE LIFT 84 LBS. = 10%

BALLAST 280.0 LBS.

RAVEN
industries, inc.

DR. DONK 16 JULY 1964

CHK.

APPR.

X03047

TYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

Company Raven Industries, Inc. Flight Number 1099-N

2. Scientist Dr. P. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 18 July 1964/0832 Z

Technique Anchor Line Director D. Johnson

4. Weather: Scattered 55°F SE 6-8 Tropopause: Height 35.5K Temp -53 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.9 Mbs 124K ft. Actual: 37K ft. 250 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 789 fpm. Tropopause to ceiling _____ fpm.

7. Flight duration: Total _____ hrs. 46 min. At ceiling _____ hrs. _____ min.

8. Termination: Time 0918 Z Altitude 37K ft. Cause Burst

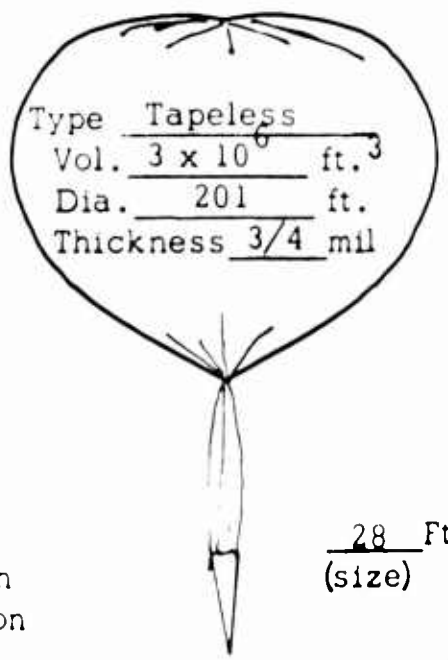
9. Balloon destruction - confirmed Visual
(visual - unknown - etc.)

10. Impact: Date/Time 18 July/0933 Z Location 30 mi. S Ft. Churchill

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 Mcs	Beacon	1 hr.
149.4 Mcs	Radio Command	30 sec.

12. Balloon: Code number 2333-541-8201 Serial number 188



28 Ft. chute
(size)

complete sketch showing location of equipment

WEIGHT

Balloon	444 lb.
FAA Termination Timer	
Parachute	15
Instrumentation	60
Ballast	100
Scientific package	184
Other	
Gross Weight	803
Free Lift	73
Gross Inflation	876
Helium used	14,000 cu. ft.

Remarks:

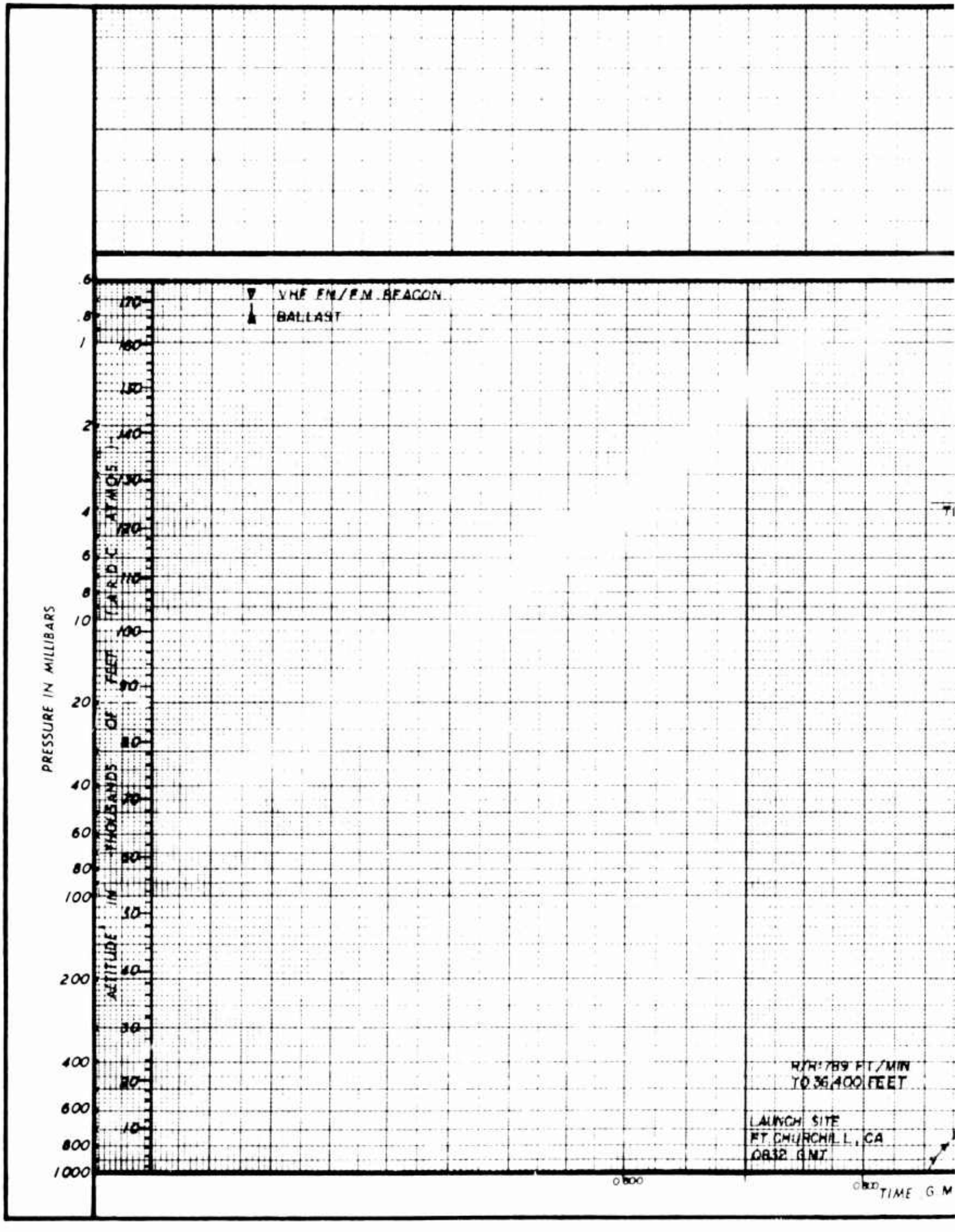
Copy to:
NR/FldRep/Minn
ONR/Code 421

Flight 1099-N

Remarks:

Surface winds were 6 to 8 mph at launch. The launch was smooth and the balloon rose at 789 feet per minute to 36,400 where the balloon burst.

The payload was recovered undamaged by the PAA helicopter.


VHF FM/P.M. BEACON
BALLAST
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (STANDARD ATMOS.)
R/R: 789 FT/MIN
TO 36,400 FEET
LAUNCH SITE
FT CHURCHILL, CA
0832 GMT
TIME G M

FLIGHT NO. 1099-N

DATE [illegible] JULY 1964

FOR U[illegible] OF CHICAGO
JIM MEYER

BALLOON

TYPE 2333-541-8201 S/N 188

VOL 3 MILLION CU FT

MATL .75 MIL POLY

WT 3441 LBS

LOAD FACTORS

PAYLOAD 359[illegible] LBS

GROSS LD 803[illegible] LB

FREE LIFT 73[illegible] LBS [illegible]

BALLAST 100 0 LBS

SCIENTIFIC EXPERIMENT:
SCINTILLATION COUNTER

THEORETICAL CEILING

BALLOON BURST
PAYLOAD RELEASE
BY RADIO COMMAND
0918 GMT

IMPACT AREA
30 S. FT. CHURCHILL, CA.

MT

[illegible] LB
[illegible] B

1000

1200

RAVEN
industries, inc.

DR. DONC 30 JULY 1964

CHK.

APPR

B 03067

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1100-N

2. Scientist Dr. P. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 16 July 1964/0834 Z

Technique Anchor line Director D. Johnson

4. Weather: Scattered Tropopause: Height 38.5K Temp -59 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 2.75 Mbs 134K ft. Actual: 131K ft. 3.0 Mbs
How altitude determined VHF FM/FM Beacon and Photobarograph

6. Ascent: Surface to tropopause 688 fpm. Tropopause to ceiling 361 fpm.

Flight duration: Total 14 hrs. 16 min. At ceiling 10 hrs. ____ min. ____

7. Termination: Time 2250 Z Altitude 124K ft. Cause Timer

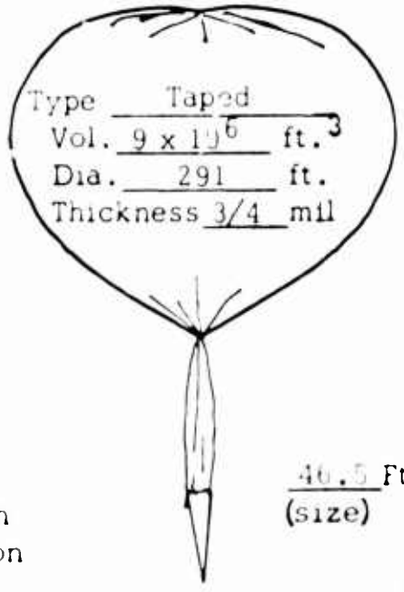
9. Balloon destruction - confirmed Unknown
(visual - unknown - etc.)

10. Impact: Date/Time 16 July/2226 Z Location 103° 18' W/58° 44' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
253.1 Mcs	Beacon	14.5 hr.
149.4 Mcs	Radio Command	5 min.

12. Balloon: Code number 2323-541-8291 Serial number 141



46.5 Ft. chute
(size)

Complete sketch showing location of equipment

WEIGHT

Balloon	954 lb.
FAA Termination Timer	
Parachute	35
Instrumentation	60
Ballast	100
Scientific package	595
Other	
Gross Weight	1,744
Free Lift	157
Gross Inflation	1,901
Helium used	30,000 cu. ft.

Remarks: The instruments sustained severe water damage.

Copy to:
NR/FldRep/Minn
ONR/Code 421

Flight 1100-N

Remarks:

The surface winds were 4 to 6 mph. The launch was smooth.

The balloon rose at an average rate of 426 feet per minute to about 130,000 feet and floated at near this altitude for 12 hours.

The flight was terminated by timer two hours earlier than anticipated. There was no aircraft tracking the balloon at the time of termination.

The weather was rainy with a low overcast. A search area was mapped out using the information from fixes by the C-47 on the balloon prior to cutdown, and the trajectory. The two float planes searched the area while flying at 90^{O} to each other.

The balloon was located on the afternoon of 17 July and the payload located about noon of 18 July.

The payload was recovered by the Raven helicopter with support from the float planes.

Before launch of this balloon, the launch crew was prepared for three flights. F. Heidelbauer had contacted the launch crew and

requested that the timers be extended from 15 hours to 17 hours to get the balloon past the forest fires which were plaguing operations at this time.

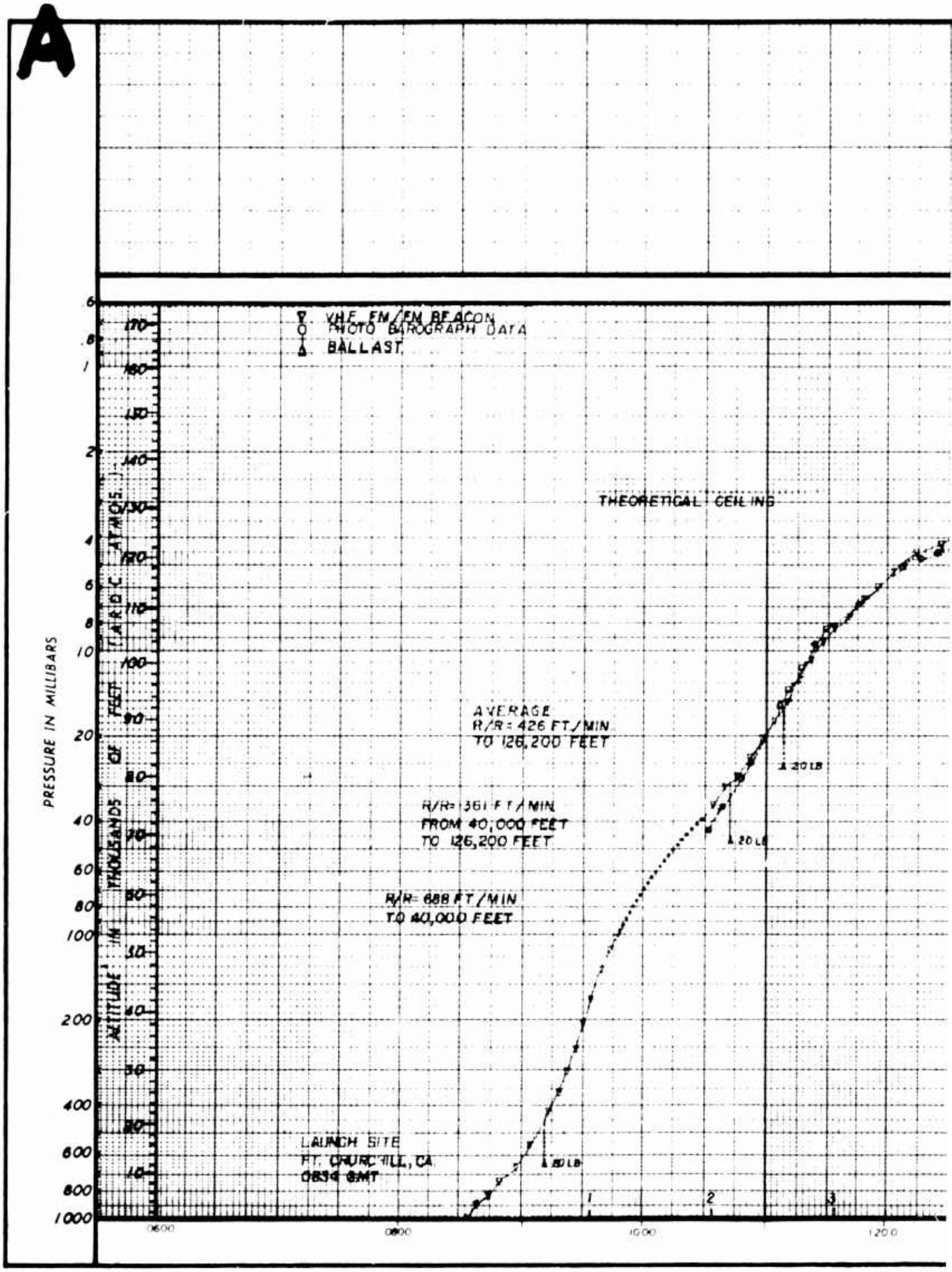
The timer for the first balloon to be flown was changed, but a failure in a scientific experiment caused this flight to be cancelled. All preparations were immediately made for another flight in an effort to fly while good weather was still available. Everything was completed except the planned resetting of the timer in the new control system from 15 to 17 hours.

After launch, the tracking aircraft followed the balloon toward Stony Rapids. However, under the operations plan, the tracking aircraft left the balloon to take the University of Chicago technicians to Stony Rapids, from which base they were to accompany the recovery crew and assist in field disassembly of the payload sphere.

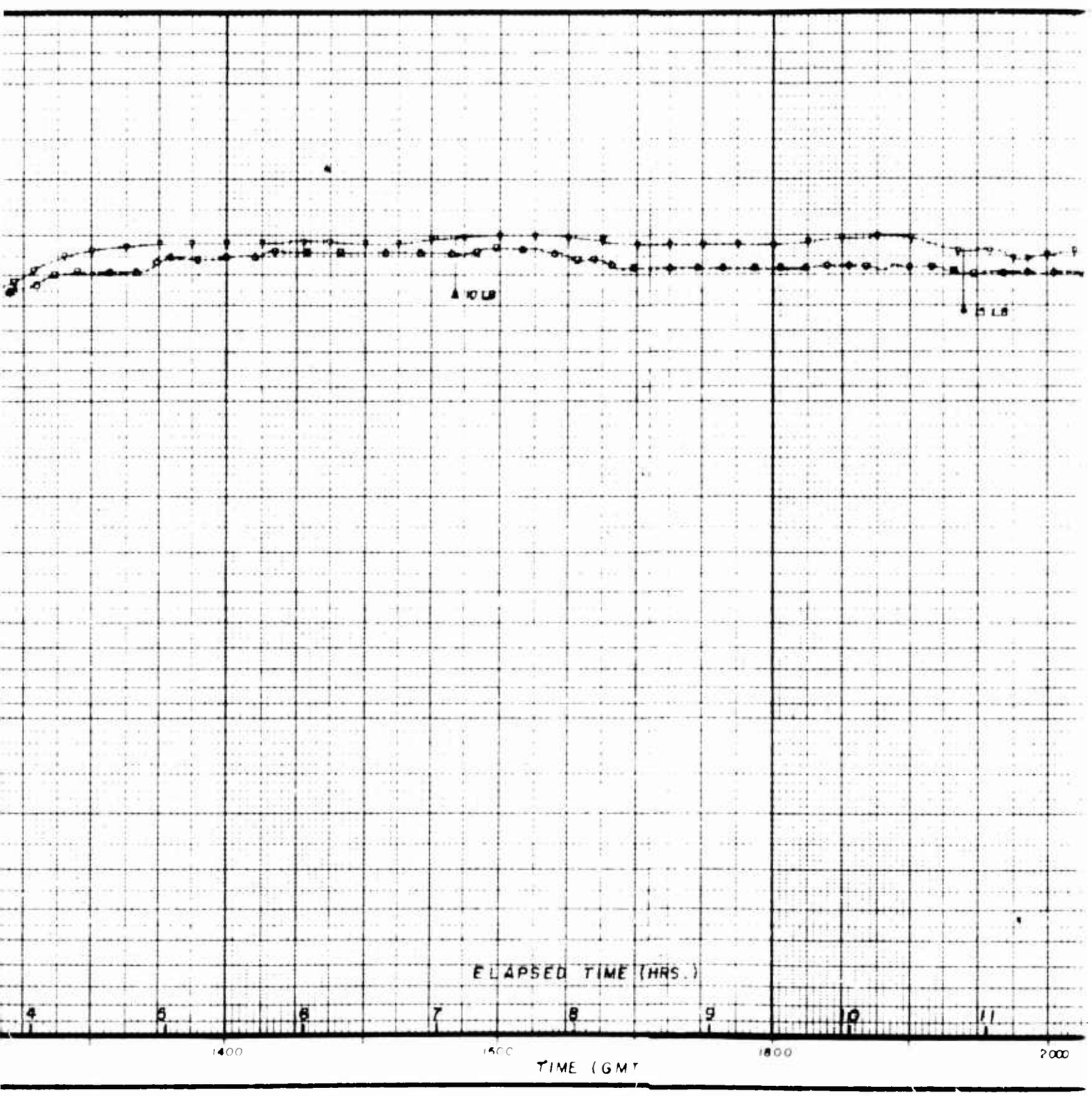
After dropping off the technicians at Stony Rapids, the escort aircraft returned to Ft. Churchill in anticipation of another flight. The aircraft took another fix on the balloon and radioed this information to the recovery crew.

In the time period after the escort aircraft left the balloon for Ft. Churchill and before the float planes could reach the balloon, the timers terminated the flight.

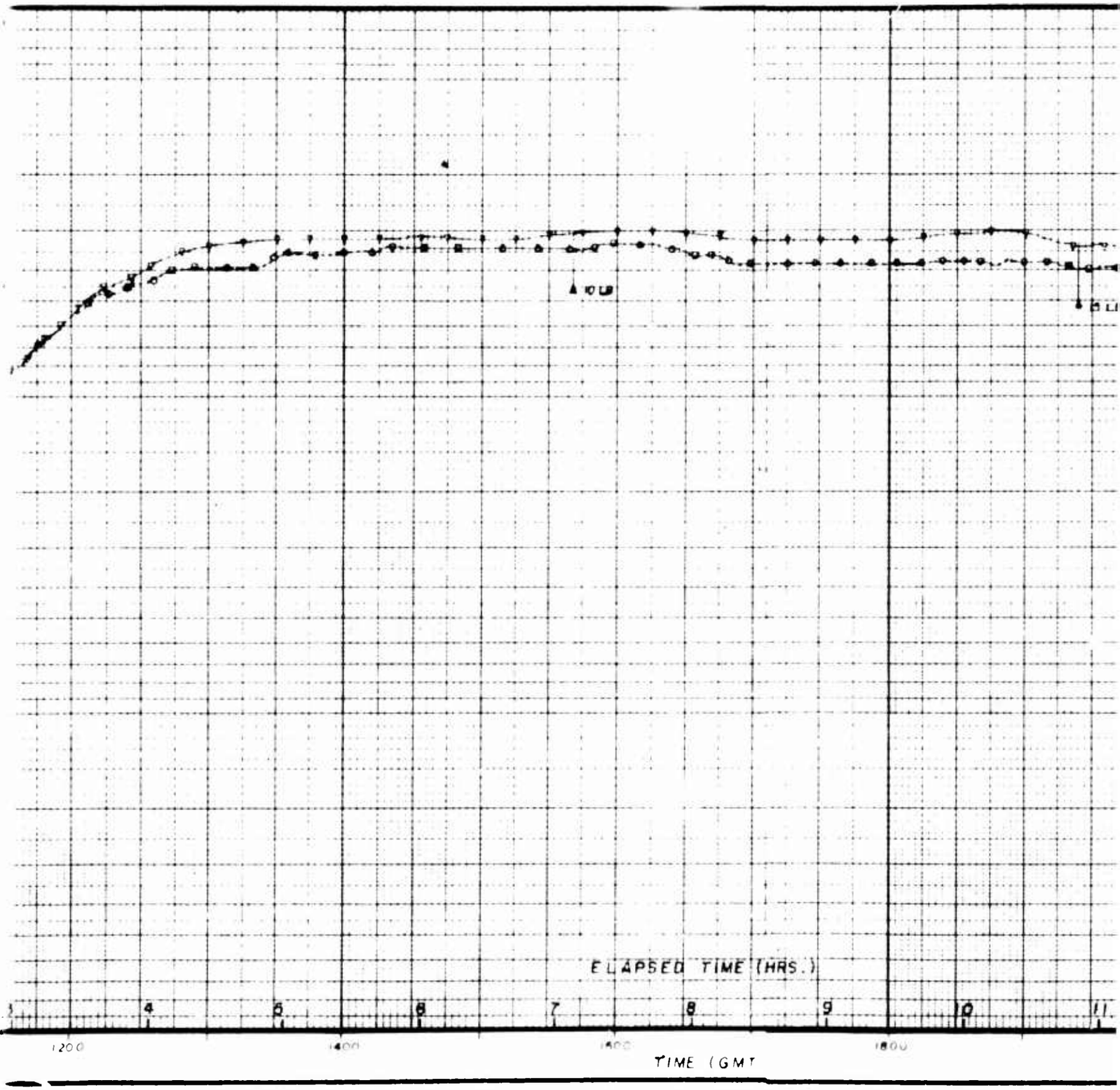
A

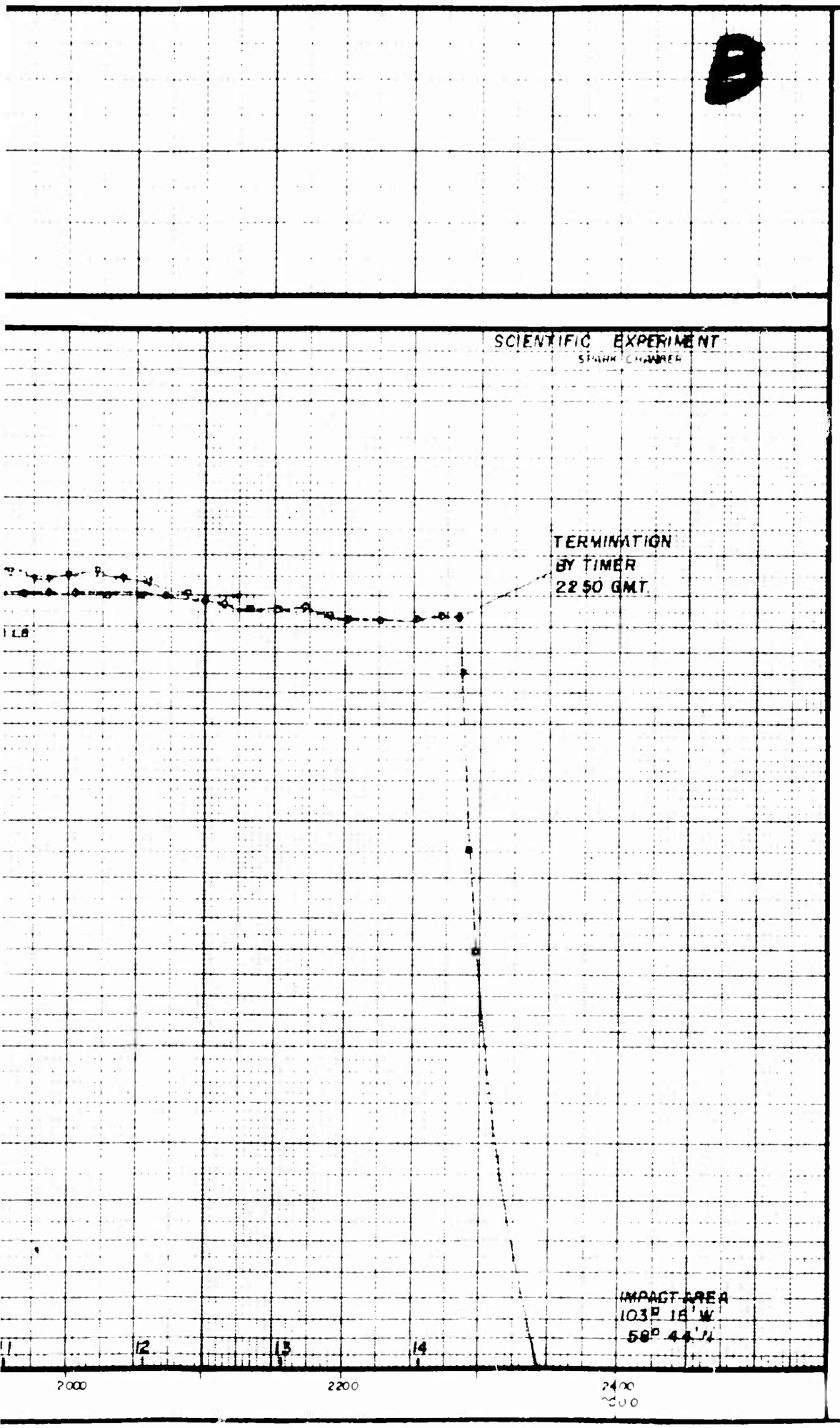

VHF FM/FM BEACON
PHOTO BAROGRAPH DATA
BALLAST
THEORETICAL CEILING
AVERAGE
R/R = 426 FT/MIN
TO 126,200 FEET
R/R = 361 FT/MIN
FROM 40,000 FEET
TO 126,200 FEET
R/R = 688 FT/MIN
TO 40,000 FEET
20 LB
20 LB
30 LB
LAUNCH SITE
FT. CHURCHILL, CA
0834 GMT
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (ARDC ATMOS.)
0600
0800
1000
1200
1
2
3

TEMPERATURE (°F)		
TIME GMT	INSIDE GONDOLA	EXTERNAL
1330	47	9
1431	47	7
1330	82	29
1433	130	30
[illegible]	105	48
2000	129	59
1840	129	44
1920	124	39
2024	129	47
2120	126	[illegible]



TEMPERATURE (°F)		
TIME GMT	INSIDE GONDOLA	EXTERNAL
1130	47	9
1231	47	7
1330	82	29
1433	80	30
[illegible]	[illegible]	48
20[illegible]	[illegible]	[illegible]
84	[illegible]	44
[illegible]	24	[illegible]
2024	[illegible]	[illegible]
2120	[illegible]	[illegible]





FLIGHT NO. 1100-N

DATE 16 JULY 1964

FOR UNIV OF CHICAGO
DR MEYER

BALLOON

TYPE 2323 541 8. 91 S.N. 141

VOL 9 MILLION CU FT

MATL 75 MIL POLY

WT 9540 LBS

LOAD FACTORS

PAYLOAD 7900 LBS

GROSS LD 17440 LBS

FREE LIFT 1570 LBS = 9 %

BALLAST 1000 LBS

RAVEN
industries, inc.

DR. DOMK 30 JULY 1964

CHK.

APPR

X 03068

KYHOOK BALLOON FLIGHT INFORMATION
AVEXOS 3900/2 (Rev. 11-63)

. Company Raven Industries, Inc. Flight Number 1101-N

2. Scientist Dr. Waddington Organization University of Minnesota

3. Launch: Site Ft. Churchill Date/Time 19 July 1964/0324 Z

Technique Anchor line Director D. Johnson

4. Weather: Scattered 60°F 6-8 Tropopause: Height 34K Temp -55 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 2.7 Mbs 137K ft. Actual: 137K ft. 2.7 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 681 fpm. Tropopause to ceiling 571 fpm.

. Flight duration: Total 14 hrs. 33 min. At ceiling 8 hrs. ____ min. ____

8. Termination: Time 1757 Z Altitude 137K ft. Cause Radio Command

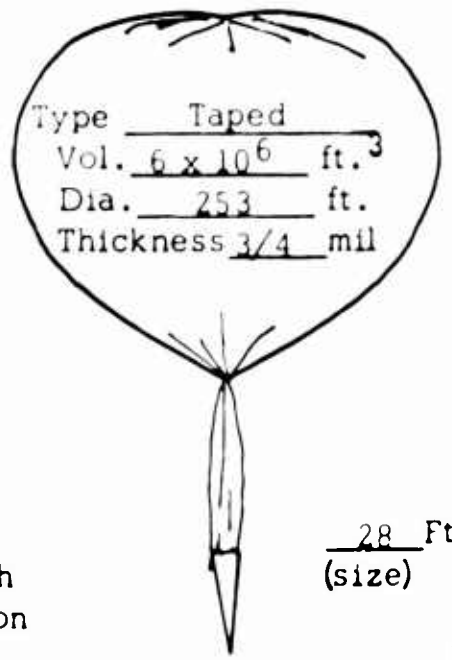
9. Balloon destruction - confirmed Unknown
(visual - unknown - etc.)

10. Impact: Date/Time 19 July/1845 Z Location 108° 00' W/58° 22' N

1 . Frequency used: (Kcs, Mcs) (Purpose) (Total Time)

253.1 Mcs	Beacon	15.5 hr.
149.4 Mcs	Radio Command	10 min.

1 . Balloon: Code number 2323-541-8253 Serial number 120



28 Ft. chute
(size)

omplete sketch showing location f equipment

WEIGHT

Balloon	744 lb.
FAA Termination Timer	
Parachute	15
Instrumentation	
Ballast	135
Scientific package	
Other	160
Gross Weight	1,054
Free Lift	84
Gross Inflation	1,138
Helium used	18,000 cu. ft.

Remarks: Good flight

Copy to:
NR/FldRep/Minn
ONR/Code 421

Flight 1101-N

Remarks:

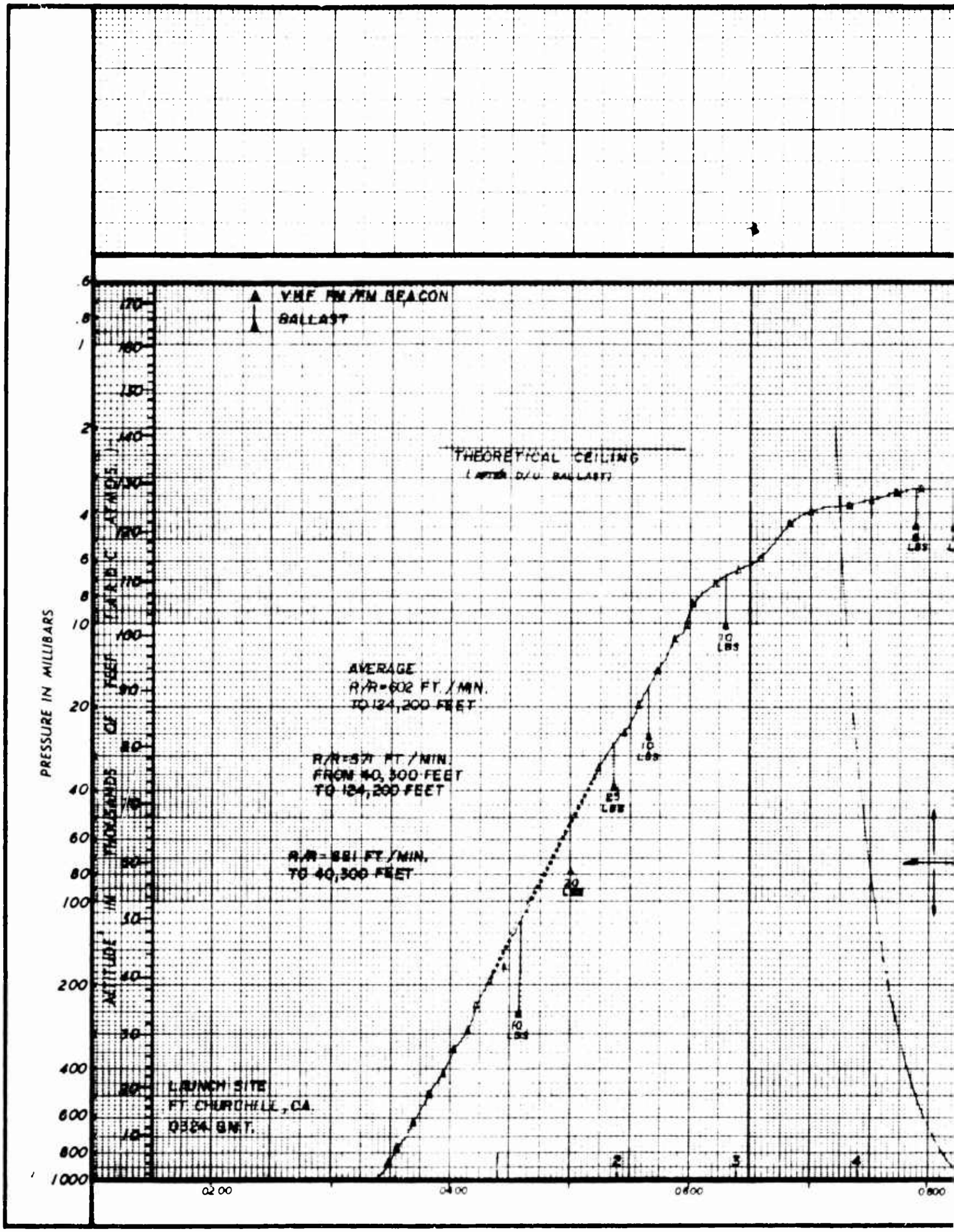
Surface winds were 4 to 6 mph at launch time.

The balloon rose at an average rate of about 602 feet per minute to 137,000 feet. The flight was terminated by radio command after 8 hours at ceiling.

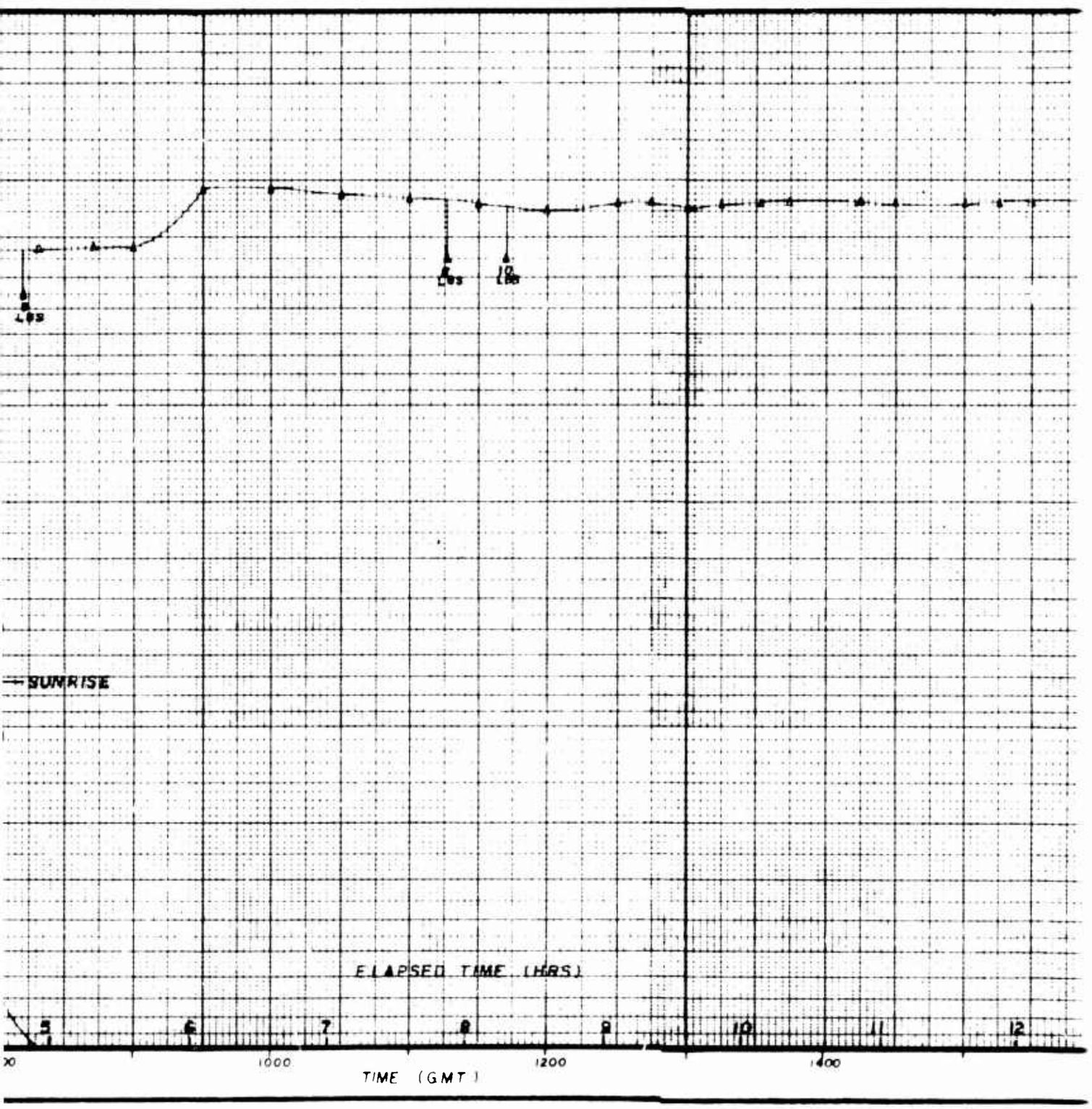
Weather in the recovery area was poor. Ceilings were 150 to 200 feet with visibility of 1/2 to 1 mile.

Impact was 85 miles southwest of Stony Rapids. The payload was recovered by the Raven helicopter with support from the float planes.

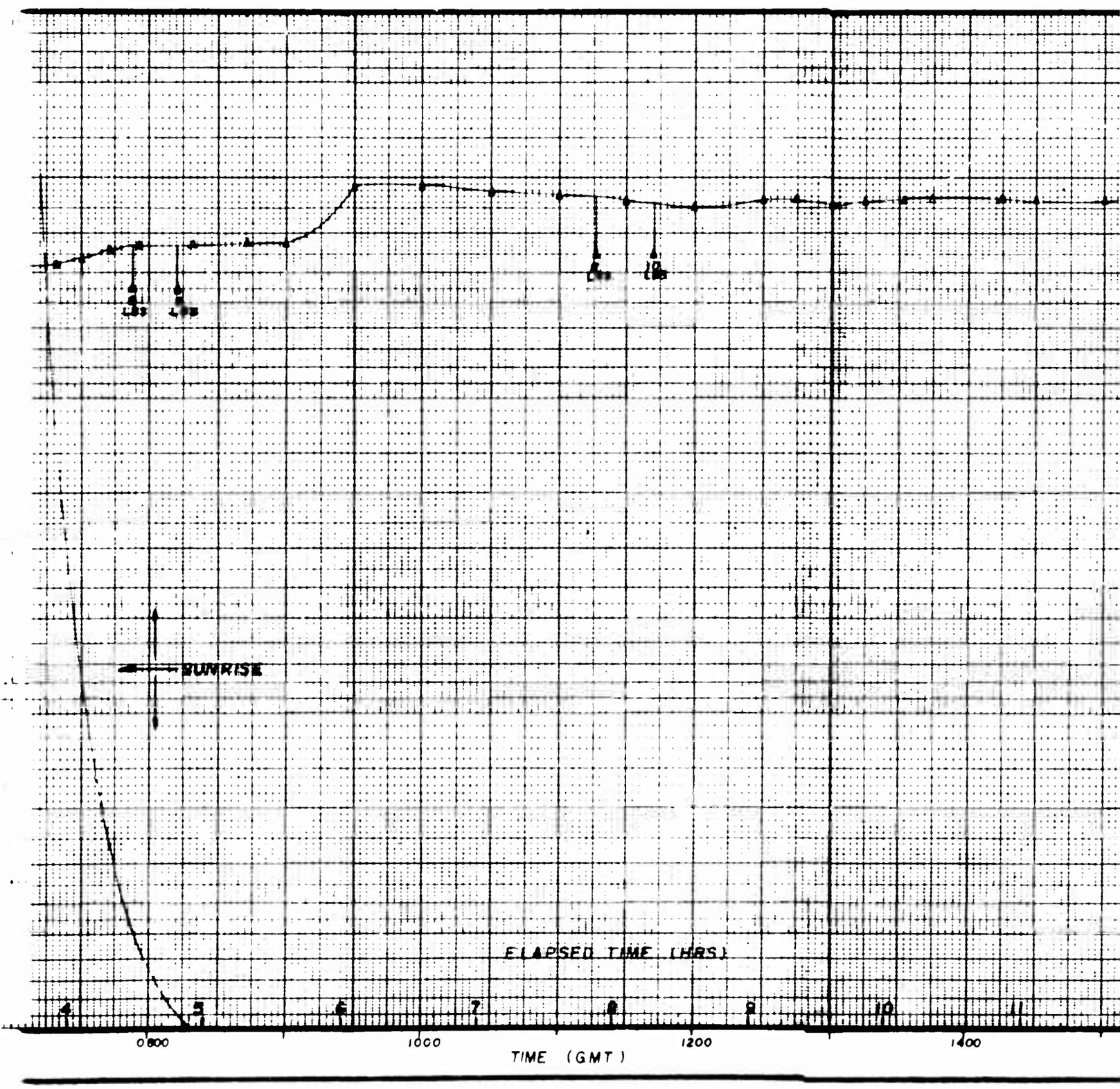
A

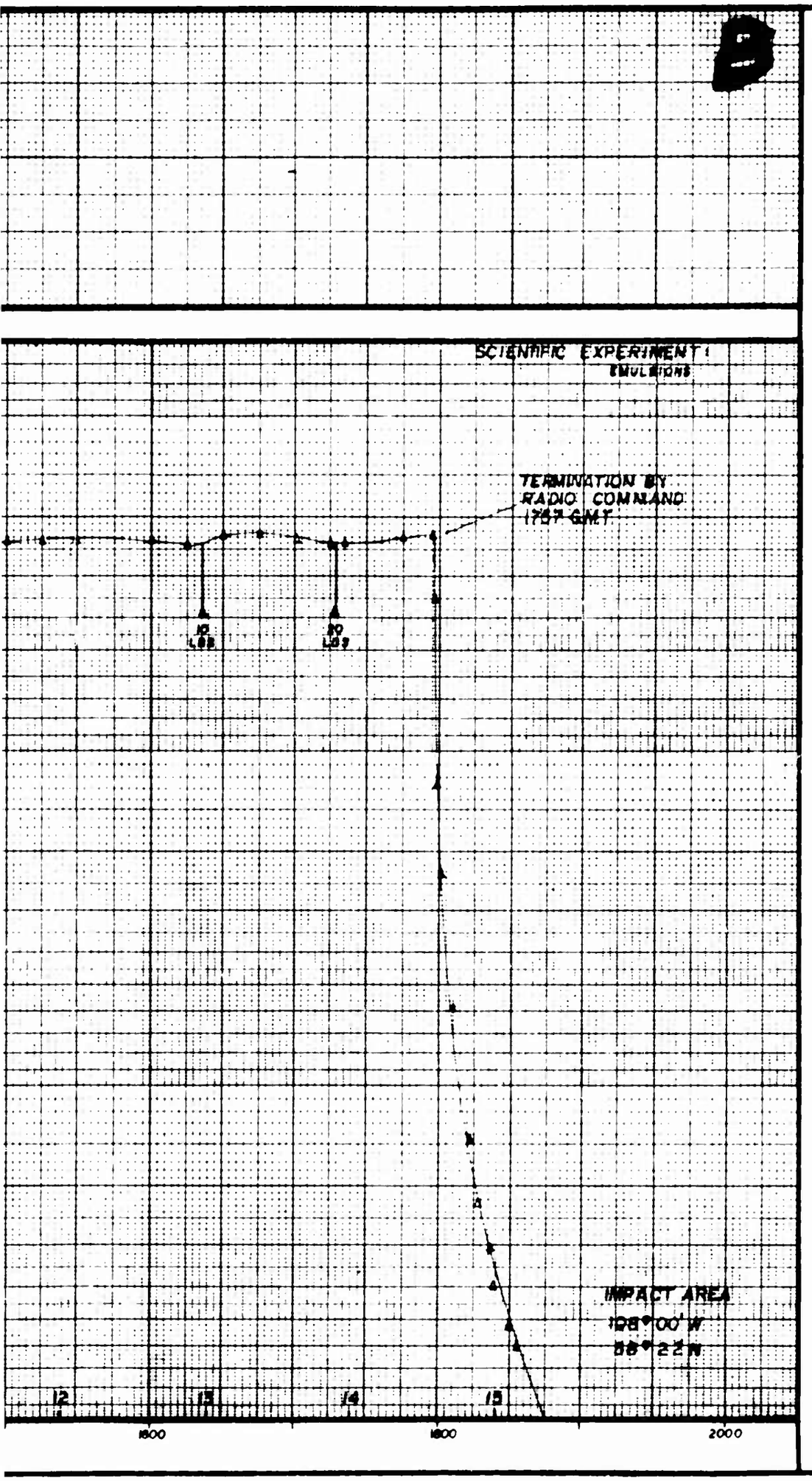

VHF FM/FM BEACON
BALLAST
THEORETICAL CEILING
AVERAGE
R/R=602 FT./MIN.
TO 124,200 FEET
R/R=571 FT./MIN.
FROM 40,300 FEET
TO 124,200 FEET
R/R=881 FT./MIN.
TO 40,300 FEET
LAUNCH SITE
FT. CHURCHILL, CA.
0324 G.M.T.
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (APPROX. STATIC AT MOS.)
02 00
04 00
06 00
08 00

TEMPERATURE (°F)		
TIME GMT	INSIDE R11 GONDOLA	EXTERNAL
0650	78	-26
1250		27
1611		[illegible]
1717	103	92



TEMPERATURE (°F)		
TIME GMT	INSIDE R11 GONDOLA	EXTERNAL
0650	78	-26
1250		27
1611		70
1717	103	92





FLIGHT NO. 1101-N

DATE: 19 JULY 1964

FOR UNIV. OF MINNESOTA
DR WADDINGTON

BALLOON

TYPE 23 23-541-8253 S/N 120

VOL. 6 MILLION CU. FT

MATL 75 MIL POLY

WT 7440 LBS

LOAD FACTORS

PAYLOAD 3100 LBS

GROSS LD 1054 0 LBS

FREE LIFT 84 LBS = 8%

BALLAST 135.0 LBS

RAVEN
industries, inc.

DR. DONK 7 AUGUST 1964

CHK.

APPR.

X03089

KYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1102-N

2. Scientist Dr. P. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 22 July 1964/0132 Z

Technique Anchor line Director D. Johnson

4. Weather: Broken 39°F E 4 Tropopause: Height 36.5K Temp -51 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.75 Mbs 125 ft. Actual: _____ ft. _____ Mbs
How altitude determined _____

6. Ascent: Surface to tropopause _____ fpm. Tropopause to ceiling _____ fpm.

Flight duration: Total _____ hrs. _____ min. At ceiling _____ hrs. _____ min. _____

8. Termination: Time 0132 Z Altitude _____ ft. Cause Destruct device fired

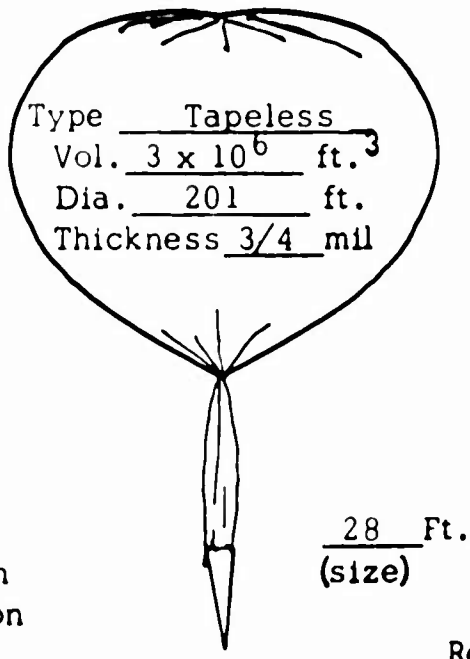
9. Balloon destruction - confirmed _____
(visual - unknown - etc.)

10. Impact: Date/Time _____ Z Location _____

11. Frequency used: (Kcs, Mcs) (Purpose) (Total Time)

_____ _____ _____
_____ _____ _____
_____ _____ _____

12. Balloon: Code number 2333-541-8201 Serial number 179



28 Ft. chute
(size)

complete sketch showing location of equipment

Remarks:

WEIGHT

Balloon	439 lb.
FAA Termination Timer	
Parachute	15
Instrumentation	
Ballast	100
Scientific package	275
Other	
Gross Weight	829
Free Lift	75
Gross Inflation	904
Helium used	14,500 cu. ft.

Copy to:
NR/FldRep/Minn
ONR/Code 421

Flight 1102-N

Remarks:

The surface winds at release time were 4 mph.

The balloon came directly down the layout direction and picked the payload up. The anchor line squibs were fired and immediately afterwards the end fitting destruct device fired.

The scientific package and the control instrumentation were dropped about one foot. Neither system was damaged.

Inspection of the rigging revealed that the termination line cutting squibs which are wired in parallel with the destruct device did not fire. A check with a voltmeter revealed that voltage was not present across the squib wires. The squibs were checked for continuity and were found to be correct. The line cutting squibs were also fired to check for malfunction, but they functioned normally.

Further investigation into the premature firing did not produce a positive cause of failure. However, the most probable cause was determined to be buildup of static charge on the end fitting.

As a preventive measure, a grounding circuit was designed and a grounding procedure was established to prevent further premature firings. However, a decision was made in the field to deactivate the device on the remaining Churchill 1964 flights.

CYHOOK BALLOON FLIGHT INFORMATION
AVEXOS 3300/2 (Rev. 11-63)

. Company Raven Industries, Inc. Flight Number 1103-N

2. Scientist Dr. Waddington Organization University of Minnesota

.. Launch: Site Ft. Churchill Date/Time 22 July 1964/0717 Z

Technique Anchor line Director D. Johnson

4. Weather: Broken 39°F E 3 Tropopause: Height 39K Temp -60 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 2.2 Mbs 140K ft. Actual: 140K ft. 2.2 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 1009 fpm. Tropopause to ceiling 660 fpm.

7. Flight duration: Total 14 hrs. 16 min. At ceiling 11 hrs. ____ min. ____

8. Termination: Time 2133 Z Altitude 142K ft. Cause Radio Command

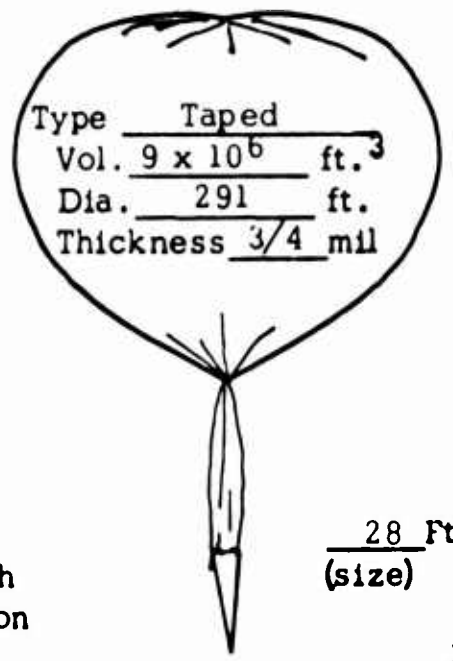
9. Balloon destruction - confirmed visual
(visual - unknown - etc.)

10. Impact: Date/Time 22 July/2218 Z Location 105° 40' W/59° 16' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 Mcs	Beacon	15 hr.
149.4 Mcs	Radio Command	11 min.

12. Balloon: Code number 2323-541-8291 Serial number 140



28 Ft. chute
(size)

WEIGHT

Balloon	951 lb.
FAA Termination Timer	
Parachute	15
Instrumentation	
Ballast	
Scientific package	
Other	320
Gross Weight	1,286
Free Lift	103
Gross Inflation	1,389
Helium used	22,200 cu. ft.

Complete sketch showing location of equipment

Remarks: Good flight

Copy to:
ONR/FldRep/Minn
ONR/Code 421

Flight 1103-N

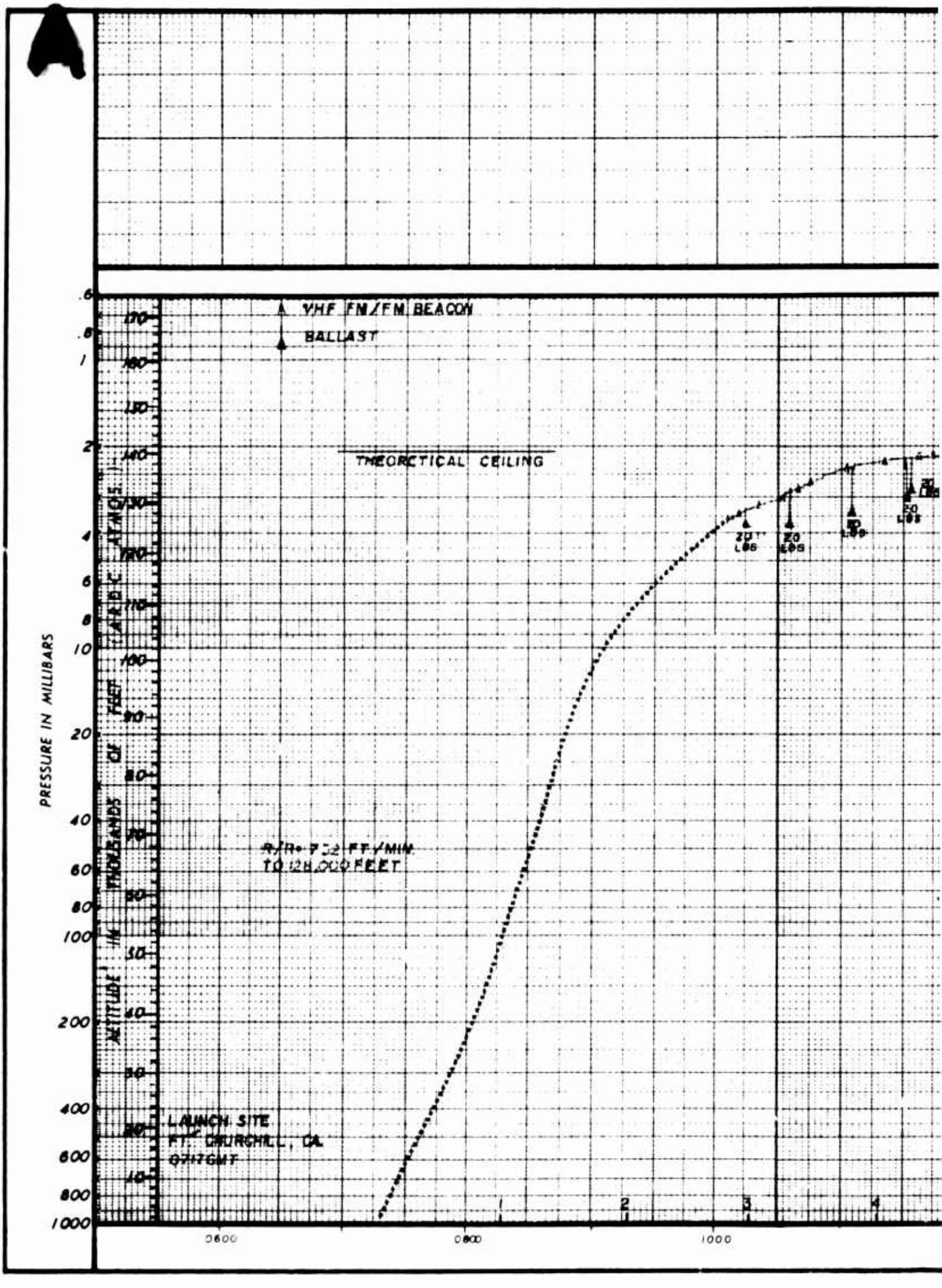
Remarks:

Surface winds were 3 mph. The launch was smooth, but the control instrumentation box scraped slightly on the runway. No damage was sustained.

The balloon rose at 765 feet per minute to ceiling. The balloon floated at about 140,000 feet for 11 hours.

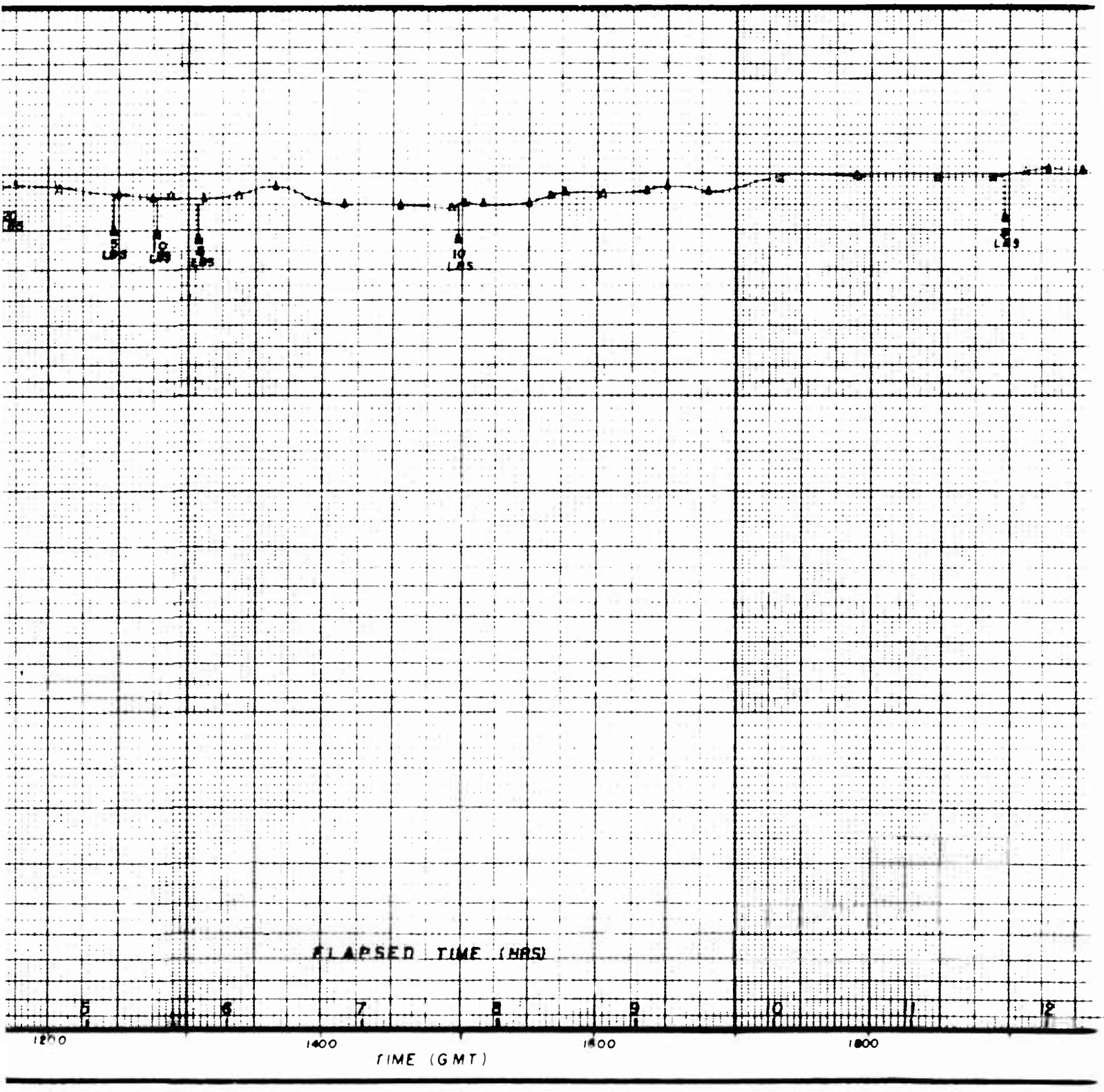
The flight was terminated by radio command at 2133 G.M.T. The payload landed 8 miles east of Stony Rapids, which is the closest to the recovery center that any payload has landed.

The payload was recovered by the Raven helicopter.


VHF FM/FM BEACON
BALLAST
THEORETICAL CEILING
R/R= 732 FT/MIN
TO 128,000 FEET
LAUNCH SITE
FT. CHURCHILL, CA.
0717GMT
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (ARDC ATMOS.)
0600
0800
1000

TEMPERATURE (°F)		
TIME GMT	INSIDE RIT GONDOLA	EXTERNAL
1008	65	
1021	67	
1040	71	
1103	76	
1155	8[illegible]	
1230	91	
1302	93	
1339	97	
1500	104	
[illegible]	[illegible]	

TEMPERATURE (°F)		
TIME GMT	INSIDE RIT GONDOLA	EXTERNAL
1720	113	
1856	116	
1900	119	

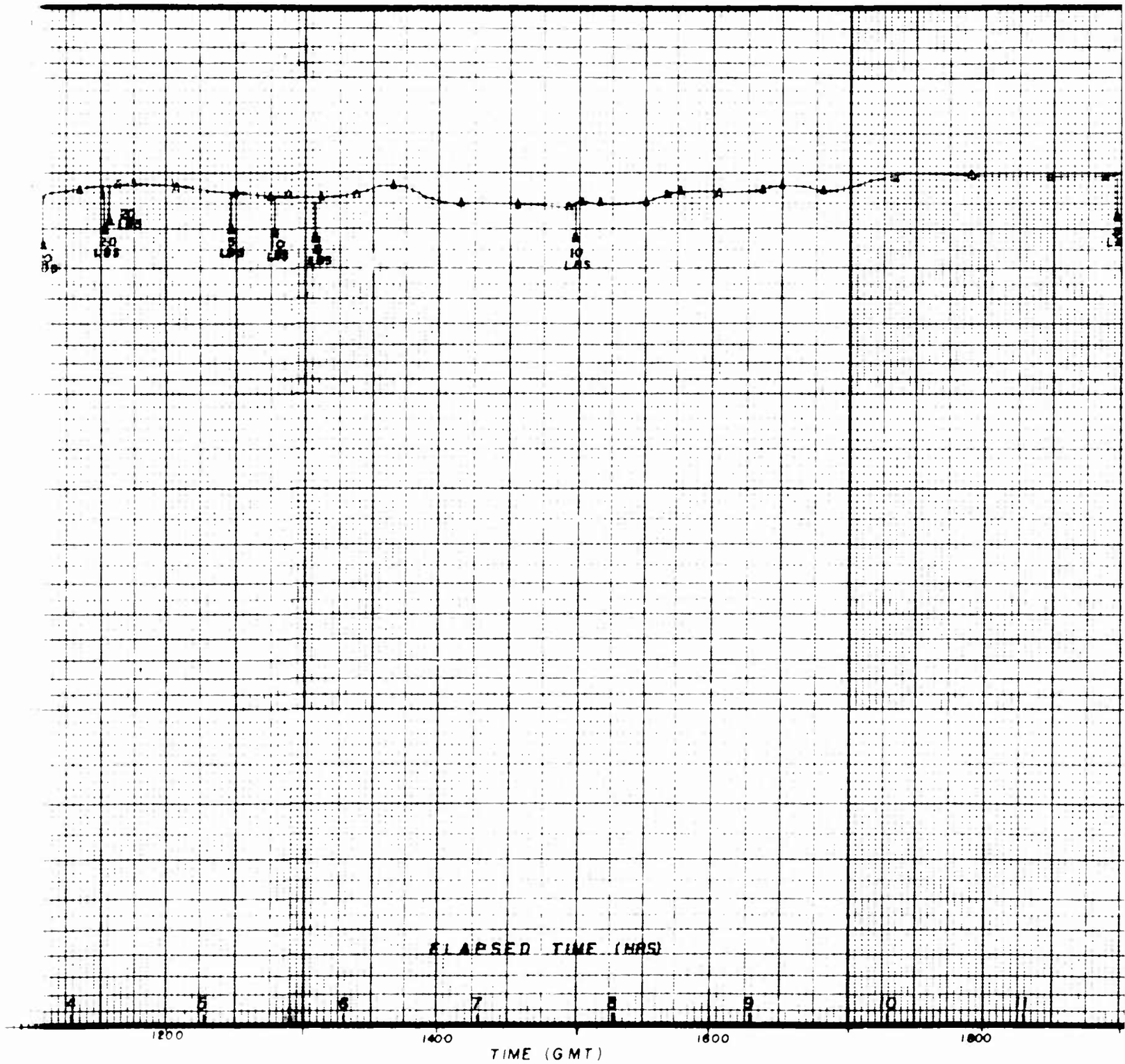


TEMPERATURE (°F)

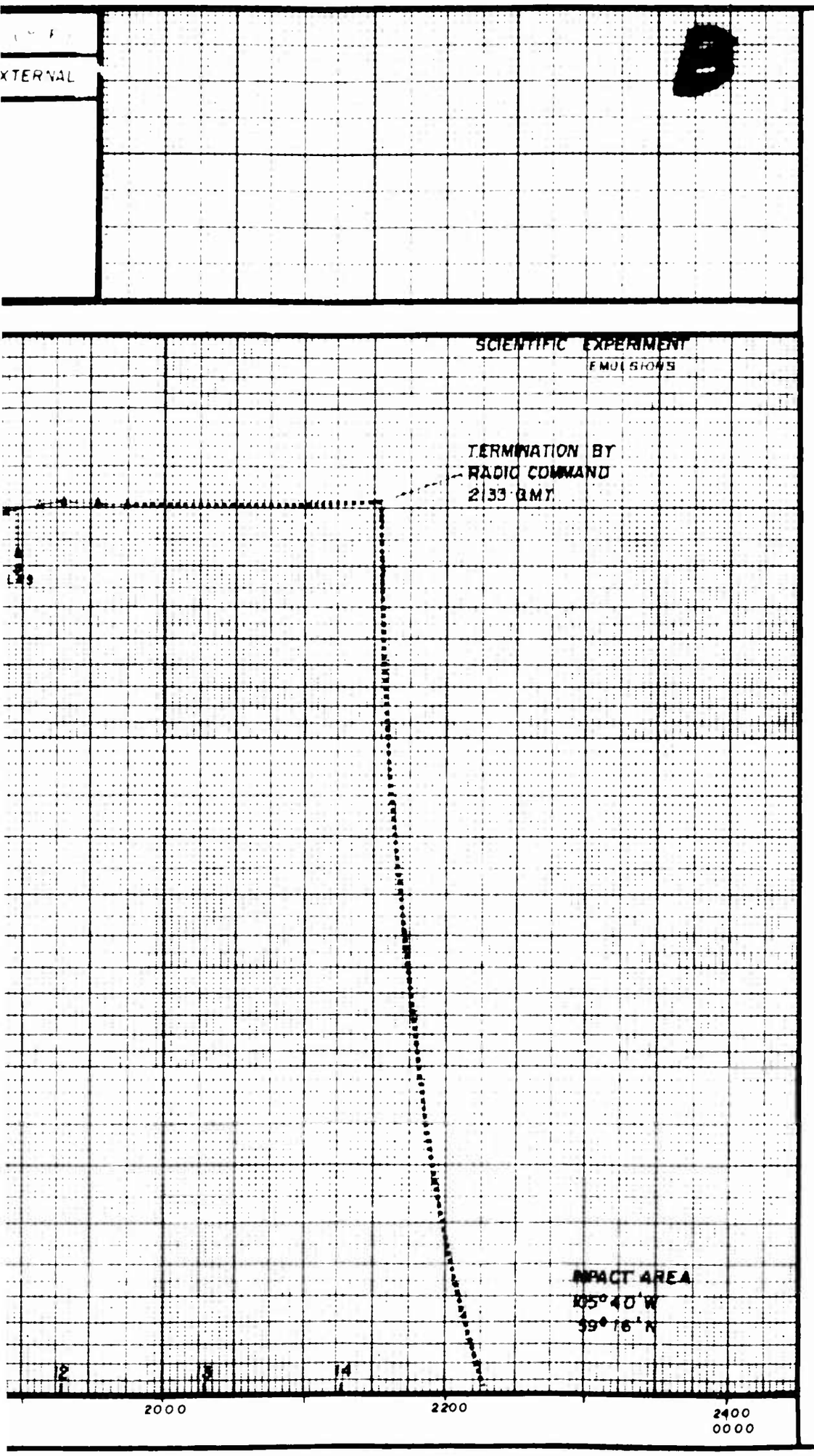
TIME GMT	INSIDE RIT GONDOLA	EXTERNAL
1008	65	
1021	67	
1040	71	
1103	76	
1155	87	
1230	91	
1302	93	
1349	97	
1500	104	
1600	[illegible]	

TEMPERATURE (°F)

TIME GMT	INSIDE RIT GONDOLA	EXT
1720	113	
1858	116	
1900	119	



XTERNAL



FLIGHT NO. 1103-N

DATE 22 JULY 1964

FOR UNIV OF MINNESOTA
DR WADDINGTON

BALLOON

TYPE 2323-541-8291 SN 140

VOL 9 MILLION CU FT

MATL .75 MIL POLY

WT 9510 LBS

LOAD FACTORS

PAYLOAD 3350 LBS

GROSS LD 1286 0 LBS.

FREE LIFT 103 LBS = 8 %

BALLAST 1500 LBS

RAVEN
industries, inc.

DR. DONK 7 AUGU. 1964

CHK.

APPR.

X03090

TYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1104-N

2. Scientist Dr. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 22 July 1964/0918Z

Technique Anchor Line Director D. Johnson

4. Weather: Scattered 38°F E 7 Tropopause: Height 39.8K Temp -60 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.7 Mbs 125K ft. Actual: 122K ft. 4.4 Mbs
How altitude determined VHF FM/FM Beacon and Photobarograph

6. Ascent: Surface to tropopause 828 fpm. Tropopause to ceiling 700 fpm.

7. Flight duration: Total 16 hrs. 51 min. At ceiling 14 hrs. ____ min. ____

8. Termination: Time 0209 Z Altitude 122 ft. Cause Radio Command

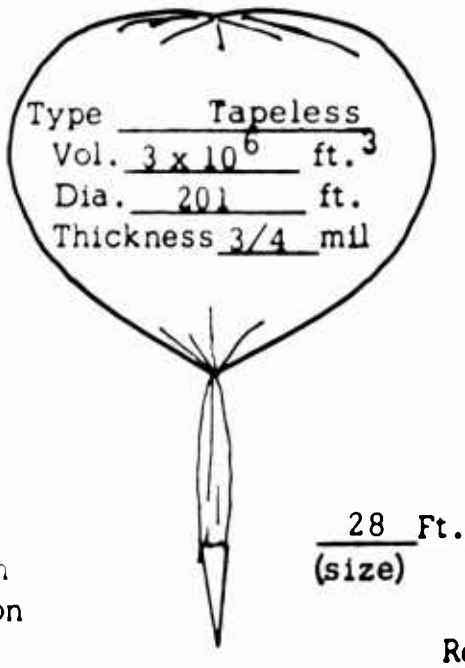
9. Balloon destruction - confirmed Unknown
(visual - unknown - etc.)

10. Impact: Date/Time 23 July/0245 Z Location 104° 03' W/59° 45' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
253.1 Mcs	Beacon	18 hr.
149.4 Mcs	Radio Command	7 min.

12. Balloon: Code number 2333-541-8201 Serial number 180



28 Ft.chute
(size)

Complete sketch showing location of equipment

WEIGHT

Balloon	450 lb.
FAA Termination Timer	
Parachute	15
Instrumentation	65
Ballast	100
Scientific package	210
Other	
Gross Weight	840
Free Lift	75
Gross Inflation	915
Helium used	14,600 cu. ft.

Remarks: Good flight

Copy to:
(NR/FldRep/Minn
C.NR/Code 421

Flight 1104-N

Remarks:

Surface winds were 7 mph at launch. The launch was smooth.

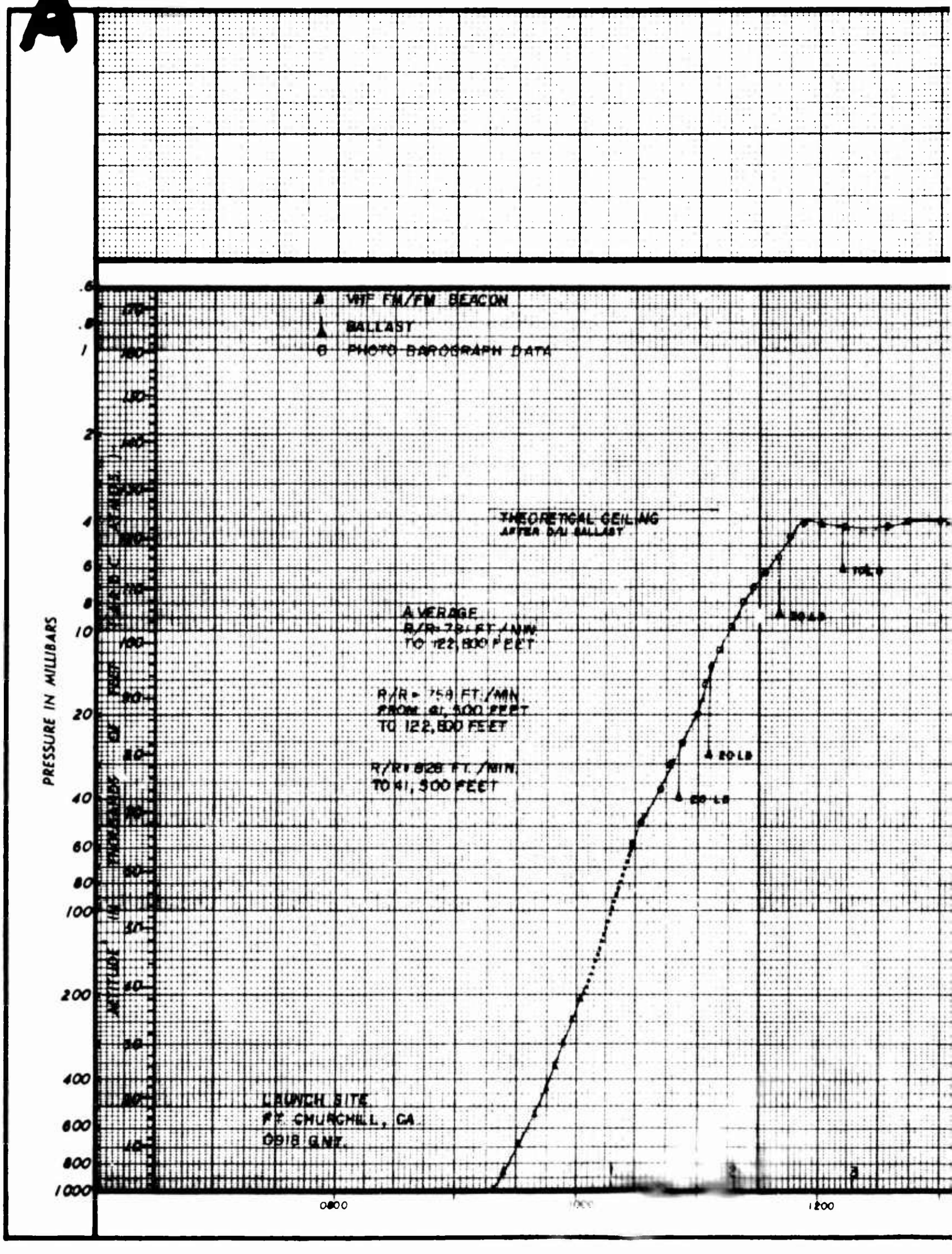
The balloon rose at an average rate of about 781 feet per minute to 122,800 feet and floated for 14 hours.

The flight was terminated at 0209 G.M.T. and the payload landed 110 miles from Stony Rapids.

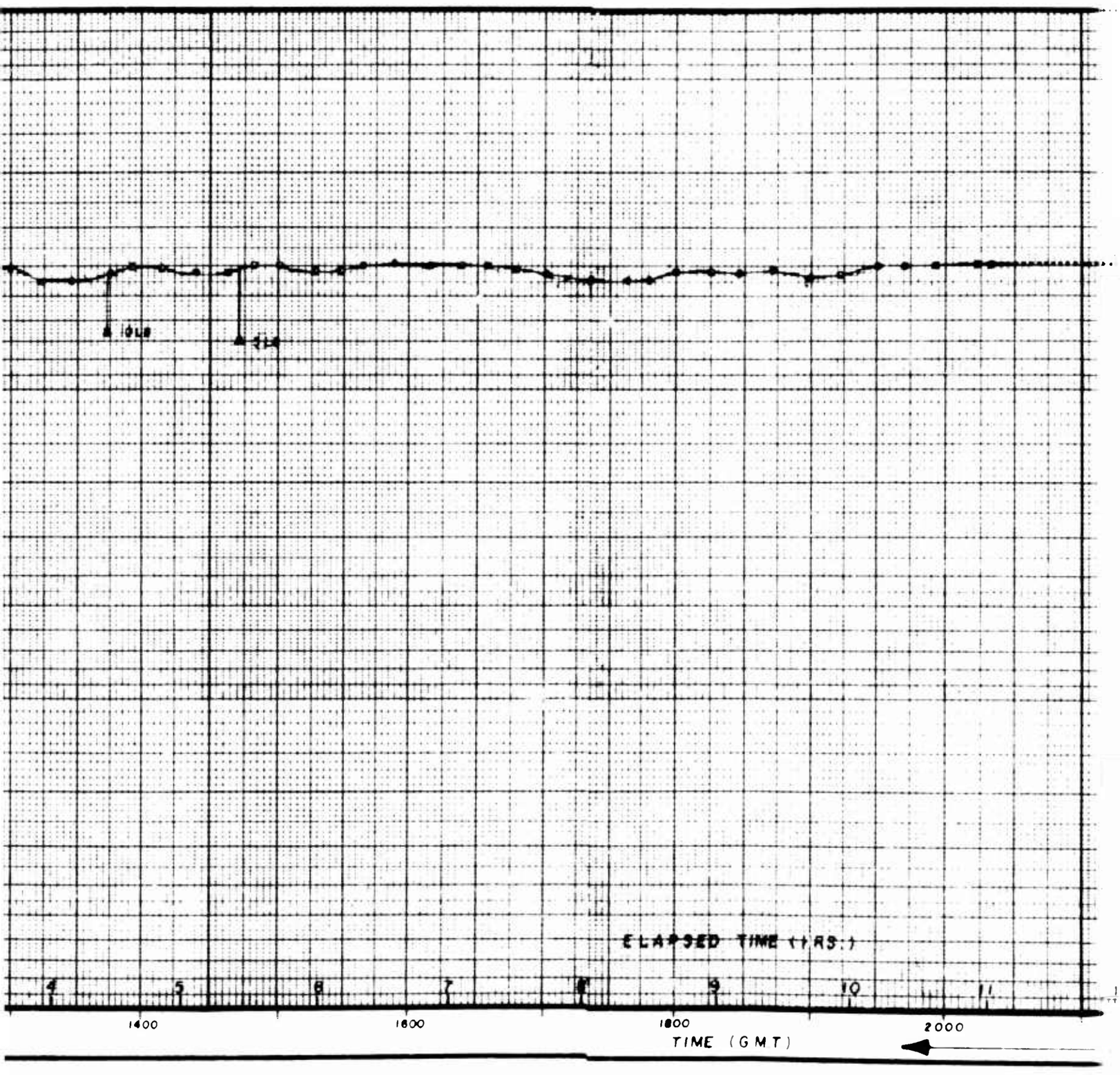
The weather in the recovery area was poor. Ceilings were about 60 feet, and visibility was less than one mile.

The payload was recovered by the Raven helicopter, supported by a float plane.

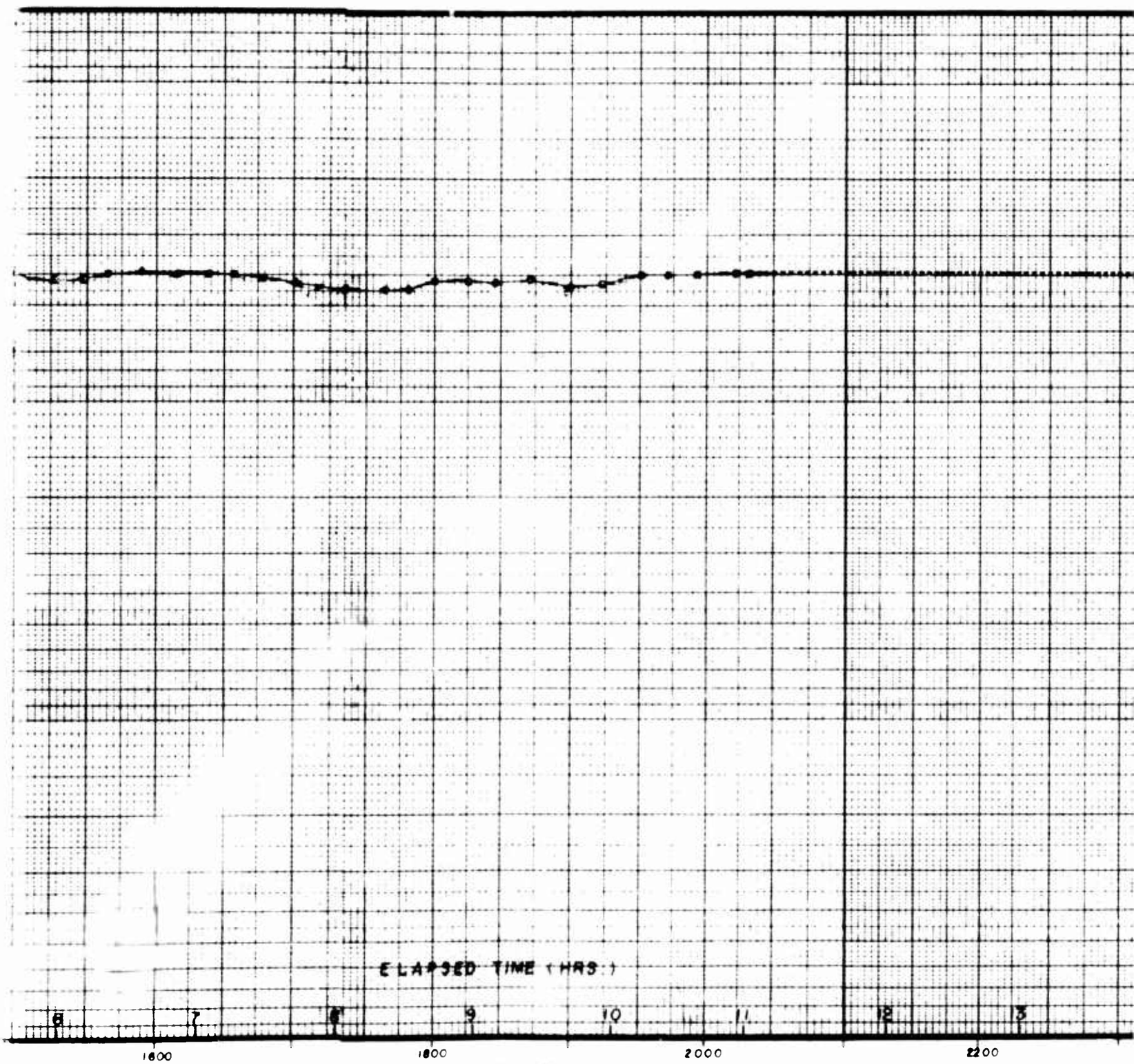
A

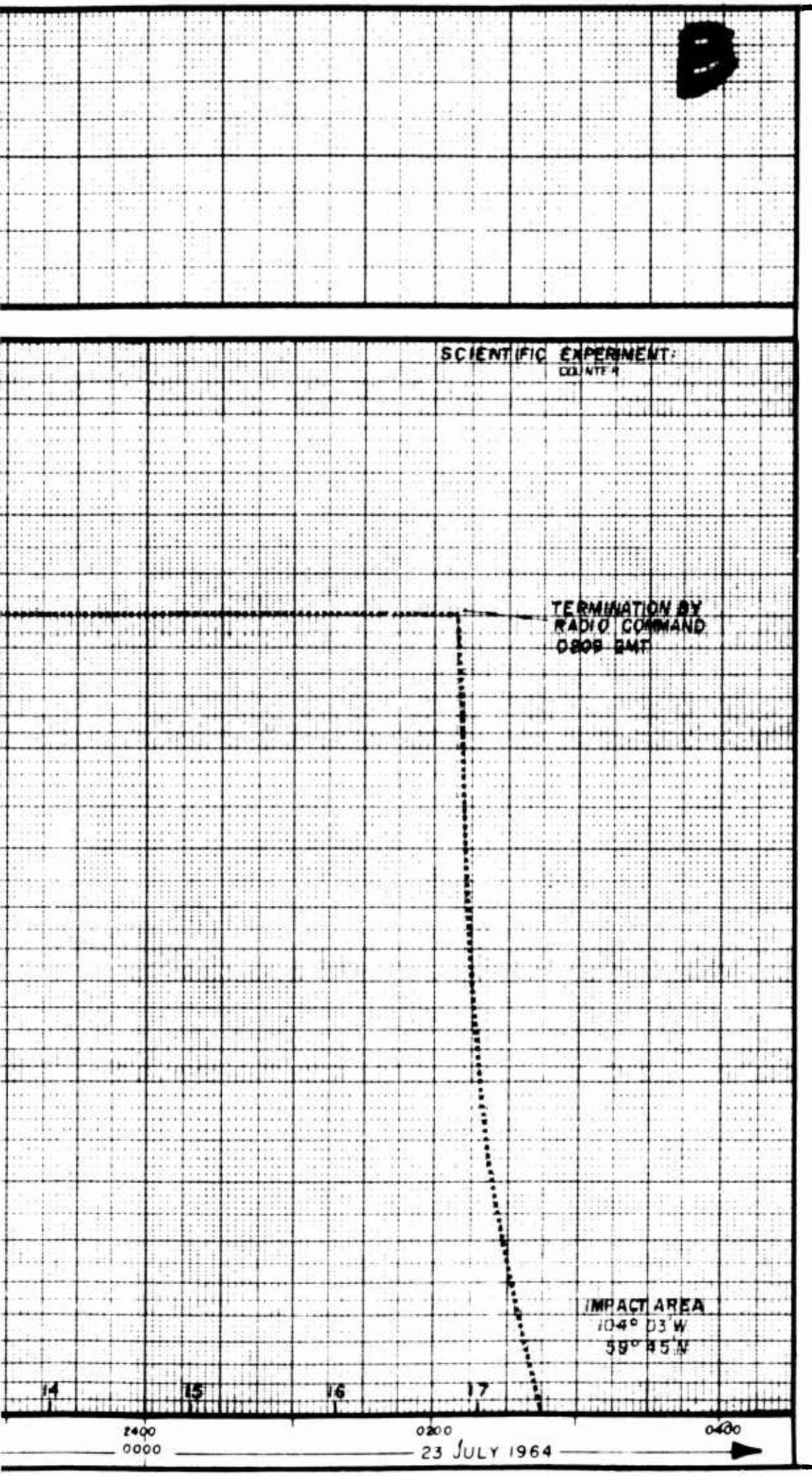

A VHF FM/FM BEACON
BALLAST
B PHOTO BAROGRAPH DATA
THEORETICAL CEILING AFTER DAI BALLAST
AVERAGE R/R= 781 FT./MIN. TO 122,800 FEET
R/R = 754 FT./MIN. FROM 61,500 FEET TO 122,800 FEET
R/R = 828 FT./MIN. TO 41,500 FEET
80 LB
60 LB
LAUNCH SITE FT. CHURCHILL, CA 0918 G.M.T.
PRESSURE IN MILLIBARS
0800
1200

TEMPERATURE (°F)		
TIME GMT	INSIDE RII GONDOLA	EXTERNAL
1207	78	9
1232	82	50
1252	87	38
1415	105	45
1500	110	73
1900		70



- A T U 4 E (° F)	
SIDE R11 NDOLA	EXTERNAL
78	9
82	50
87	38
105	45
110	73
	70





FLIGHT NO. 1104-N

DATE 22 JULY 1964

FOR UNIV OF CHICAGO
DR MEYER

BALLOON

TYPE 2333-541-8201 S/N 180

VOL 3 MILLION CU FT

MATL .75 MIL POLY

WT 4500 LBS

LOAD FACTORS

PAYLOAD 390 0 LBS

GROSS LD 840. 0 LBS

FREE LIFT 75.0 LBS = 9%

BALLAST 100.0 LBS

RAVEN
industries, inc.

DR. DONK 30 JULY 1964

CHK.

APPR.

X03069

BOOTH ANAMO THIRD BLUE GRADUATE

SYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1 Company Raven Industries, Inc. Flight Number 1105-N

2 Scientist Dr. P. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 26 July 1964/0345 Z

Technique Anchor line Director D. Johnson

4 Weather: Scattered 42°F SSE 6-8 Tropopause: Height 34.6K Temp -56 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.7 Mbs 126K ft. Actual: 122K ft. 4.3 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 552 fpm. Tropopause to ceiling 449 fpm.

7 Flight duration: Total 16 hrs. 58 min. At ceiling 11 hrs. ____ min. ____

8 Termination: Time 2043 Z Altitude 122 ft. Cause Radio Command

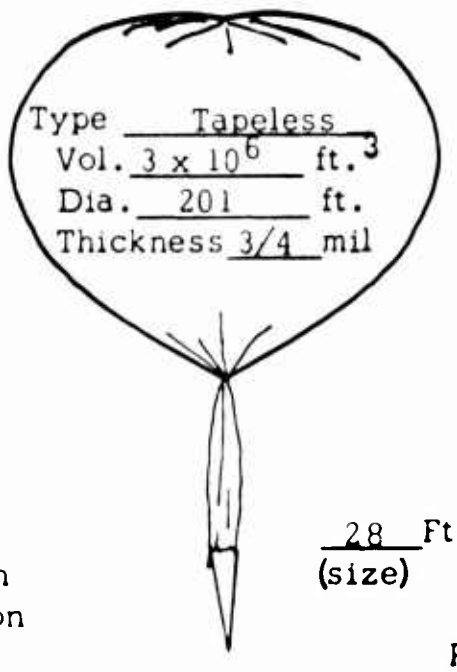
9. Balloon destruction - confirmed Visual
(visual - unknown - etc.)

10. Impact: Date/Time 26 July/2117 Z Location 104° 29' W/59° 28' N

11 Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 Mcs	Beacon	17 hr.
149.4 Mcs	Radio Command	5 min.

12 Balloon: Code number 2333-541-8201 Serial number 181



28 Ft. chute
(size)

complete sketch showing location of equipment

WEIGHT

Balloon	447 lb.
FAA Termination Timer	
Parachute	15
Instrumentation	60
Ballast	60
Scientific package	231
Other	
Gross Weight	813
Free Lift	74
Gross Inflation	887
Helium used	14,300 cu. ft.

Remarks: Good flight

Copy to:
ONR/TIdRep/Minn
ONR/Code 421

Flight 1105-N

Remarks:

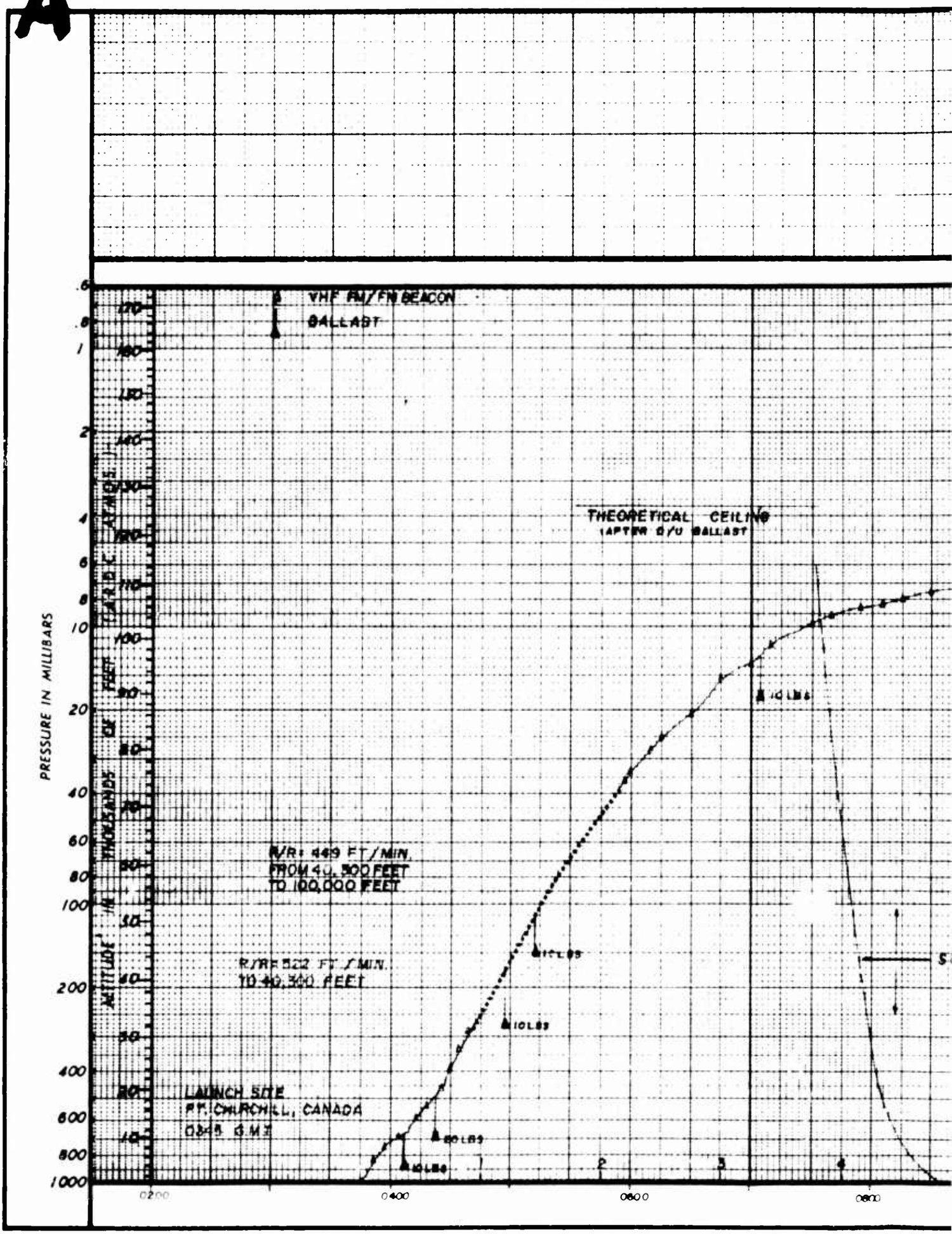
The surface winds were 6 to 8 mph during inflation, but were almost calm at launch. The launch was very smooth and the payload was subjected to almost no shock.

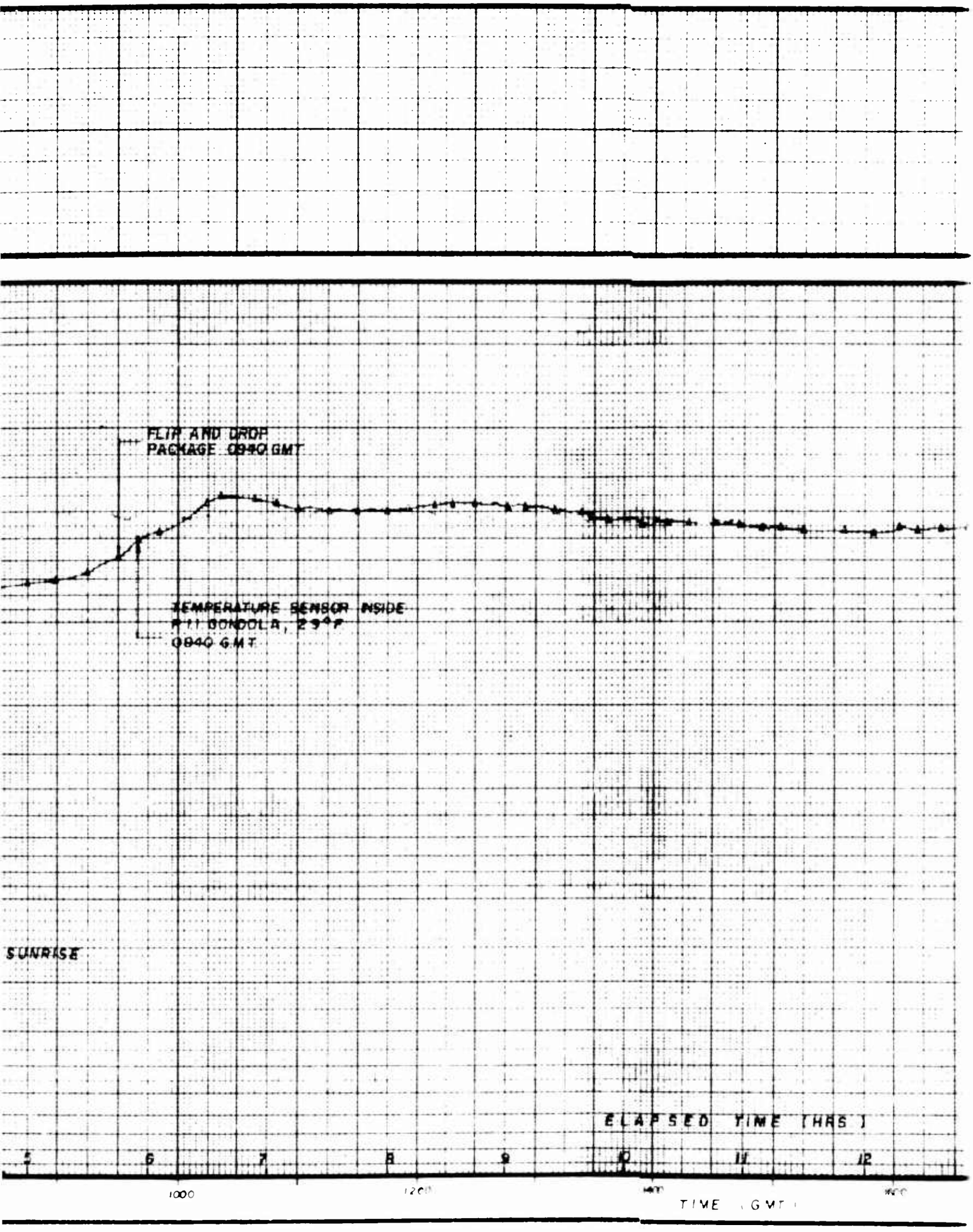
The ascent rate was low and averaged only 449 feet per minute. The balloon floated at 122,000 feet for 11 hours.

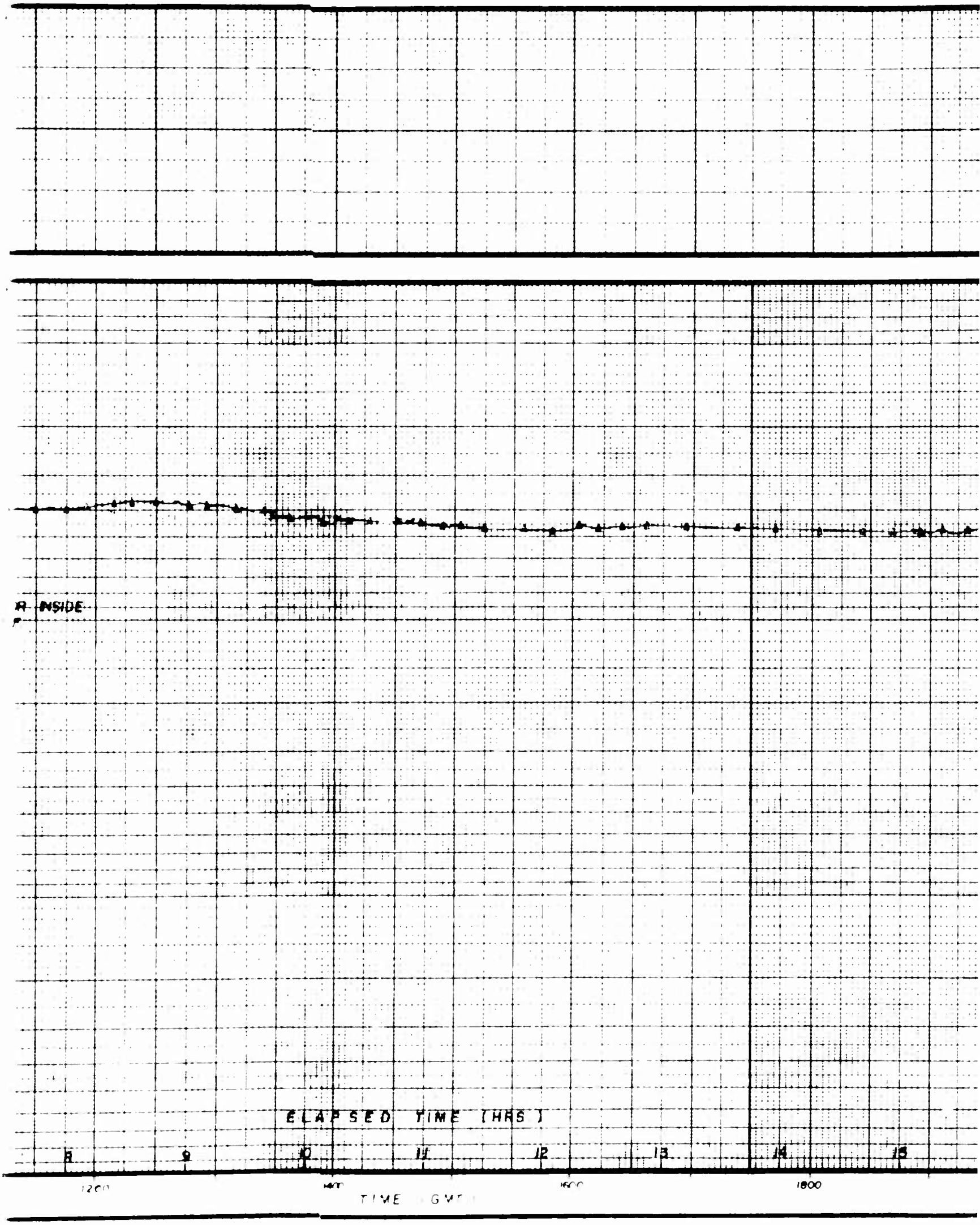
The flight was terminated by radio command at 2043 G.M.T. and landed 65 miles northeast of Stony Rapids.

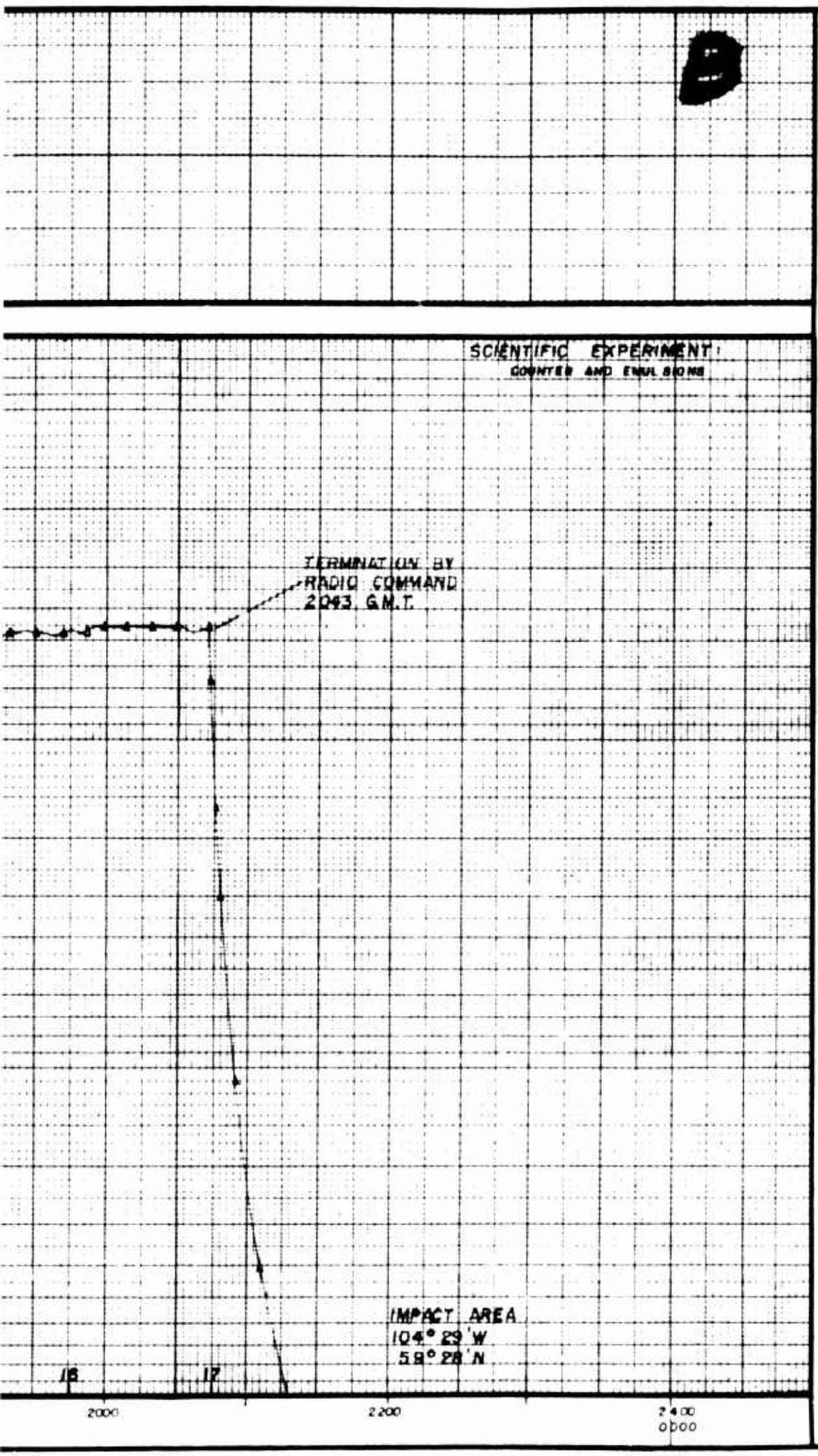
The payload was recovered by Raven helicopter with support by both float planes.

A


VHF FM/FM BEACON
BALLAST
THEORETICAL CEILING
(AFTER C/U BALLAST
10 LBS
10 LBS
10 LBS
10 LBS
10 LBS
R/R= 469 FT/MIN.
FROM 40,300 FEET
TO 100,000 FEET
R/R= 522 FT/MIN.
TO 40,300 FEET
LAUNCH SITE
FT. CHURCHILL, CANADA
0845 G.M.T.
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (ARDC ATMOS.)
0200
0400
0600
0800


FLIP AND DROP
PACKAGE 0940 GMT
TEMPERATURE SENSOR INSIDE
P-11 GONDOLA, 29°F
0840 G.M.T.
SUNRISE
ELAPSED TIME (HRS)
5
6
7
8
9
10
11
12
1000
TIME (GMT)


R INSIDE
ELAPSED TIME (HRS)
8
9
10
11
12
13
14
15
1200
1400
1600
1800
TIME GMT



FLIGHT NO. 1105-N

DATE 26 JULY 19[illegible]

FOR UNIV OF CHICAGO
DR MEYER

BALLOON

TYPE	2333-541-B2 [illegible] SN 181
VOL	3 MILLION CU FT
MATL	75 MIL POLY
WT	447.0 LBS

LOAD FACTORS

PAYLOAD	366.0 LBS
GROSS LD	813.0 LBS
FREE LIFT	74 LBS = 9%
BALLAST	60.0 LBS

RAVEN
industries, inc.

DR. DLNK 5 AUGUST 1964
CHK.
APPR.

X03086

EDITIO ANTEA THIS SUPERSEDES

KYHOOK BALLOON FLIGHT INFORMATION
AVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1106-N

2. Scientist Dr. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 27 July 1964/0338 Z

Technique Anchor line Director D. Johnson

4. Weather: Overcast 48°F SE 4 Tropopause: Height 35.5K Temp -59 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3 Mbs 131K ft. Actual: 34K ft. 250 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 887 fpm. Tropopause to ceiling _____ fpm.

Flight duration: Total _____ hrs. 38 min. At ceiling _____ hrs. _____ min. _____

8. Termination: Time 0416 Z Altitude 34K ft. Cause Burst

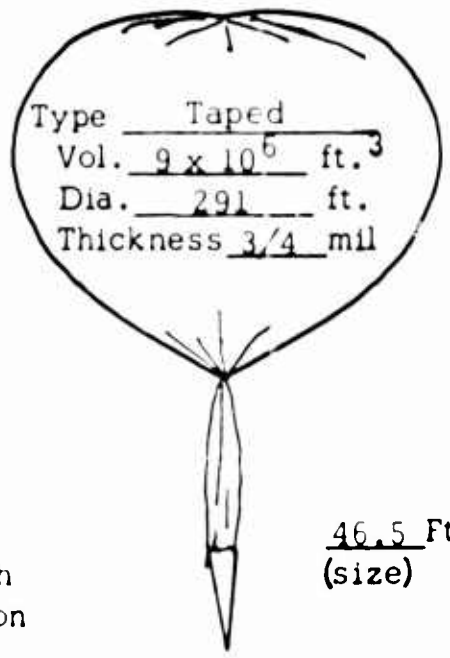
9. Balloon destruction - confirmed Unknown
(visual - unknown - etc.)

10. Impact: Date/Time 27 July/0433 Z Location 93° 39' W/58° 32' N

11 Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
253.1 Mcs	Beacon	1 hr.
149.4 Mcs	Radio Command	5 min.

12 Balloon: Code number 2323-541-8291 Serial number 142



46.5 Ft. chute
(size)

Complete sketch showing location equipment

WEIGHT

Balloon	948 lb.
FAA Termination Timer	
Parachute	35
Instrumentation	60
Ballast	110
Scientific package	630
Other	29
Gross Weight	1,817
Free Lift	163
Gross Inflation	1,980
Helium used	31,600 cu. ft.

Remarks:

Copy to:
NR/FldRep/Minn
NR/Code 421

Flight 1106-N

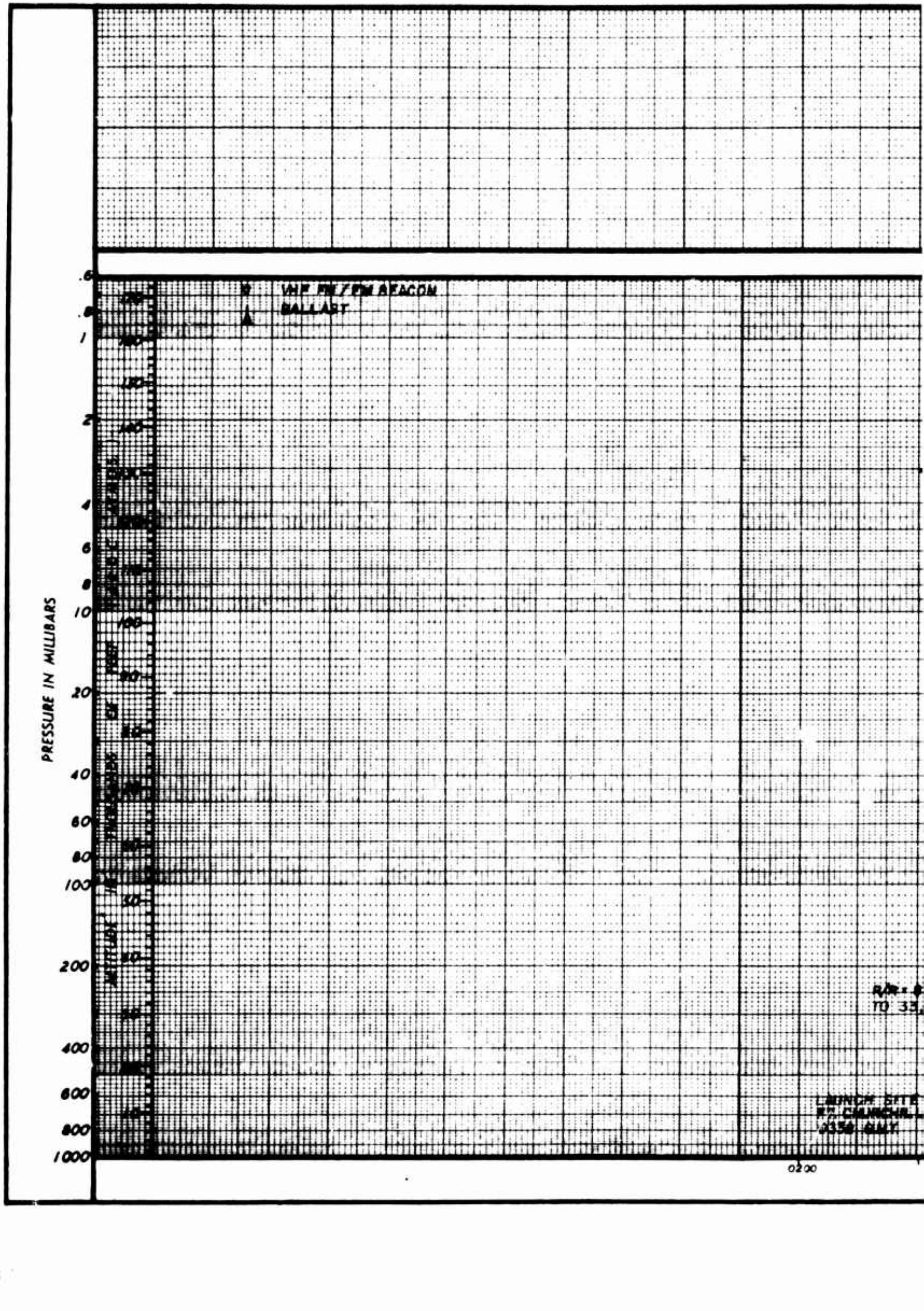
Remarks:

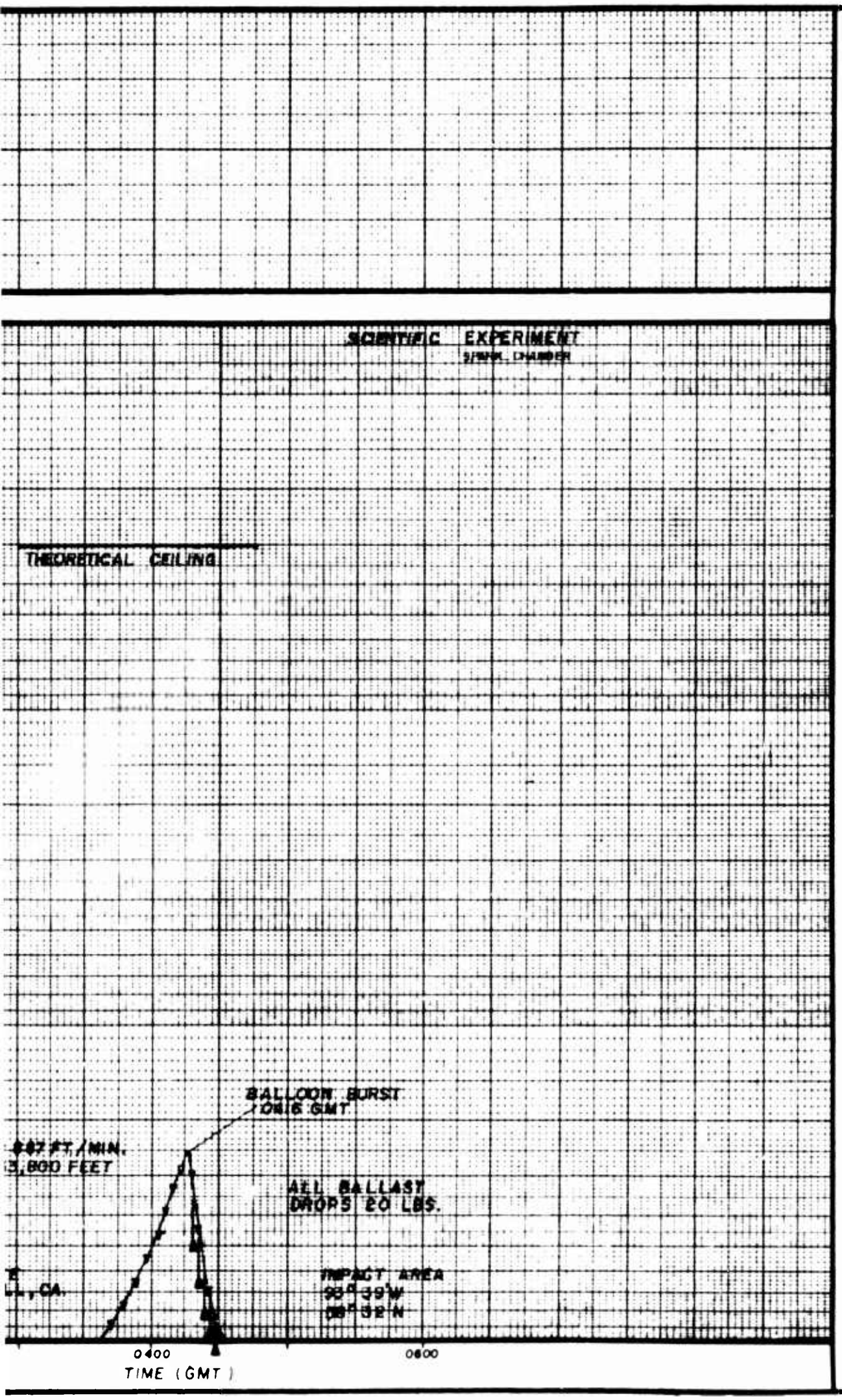
Surface winds were 4 mph at launch. The gondola scraped the runway slightly at launch damaging one ballast container.

The balloon rose at 887 feet per minute to 34,000 feet where a burst occurred.

The payload was recovered undamaged by a PAA helicopter.

Part of the balloon was tangled in the gondola.


VHF FM / FM BEACON
BALLART
PRESSURE IN MILLIBARS
.6
.8
1
2
4
6
8
10
20
40
60
80
100
200
400
600
800
1000
0200



FLIGHT NO. 1106-N

DATE 27 JULY 1964

FOR UNIV OF CHICAGO
DR MEYER

BALLOON

TYPE 2323-541-8291 S/N 142

VOL 9 MILLION CU FT

MATL .75 MIL POLY

WT 948.0 LBS.

LOAD FACTORS

PAYLOAD 869.0 LBS

GROSS LD 1817.0 LBS

FREE LIFT 163.0 LB = 9%

BALLAST 110 LBS

RAVEN industries, inc.

DR. DONK 6 AUGUST 1964

CHK.

APPR.

B 03087

SEE ITEM AHEAD. THIS SIDE GRADUATE

TYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1107-N

2. Scientist Dr. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 28 July 1964/0817 Z

Technique Anchor line Director D. Johnson

4. Weather: Scattered 42°F NW 6-8 Tropopause: Height 33.5K Temp -55 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 2.95 Mbs 132K ft. Actual: 127K ft. 3.5 Mbs
How altitude determined Photobarograph and VHF FM/FM Beacon

6. Ascent: Surface to tropopause 786 fpm. Tropopause to ceiling 590 fpm.

7. Flight duration: Total 16 hrs. 46 min. At ceiling 13 hrs. ____ min.

8. Termination: Time 0103 Z Altitude 124K ft. Cause Radio Command

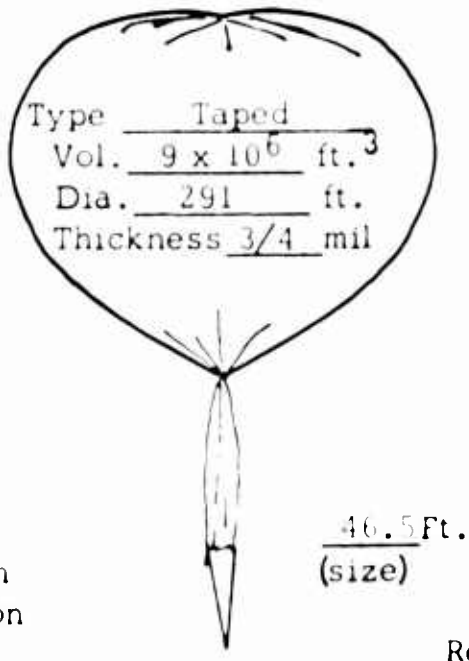
9. Balloon destruction - confirmed Visual
(visual - unknown - etc.)

10. Impact: Date/Time 28 July/0135 Z Location 103° 14' W/56° 27' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 Mcs	Beacon	18 hr.
149.4 Mcs	Radio Command	5 min.

12. Balloon: Code number 2323-541-8291 Serial number 138



46.5 Ft. chute
(size)

Complete sketch showing location of equipment

WEIGHT

Balloon	955 lb.
FAA Termination Timer	
Parachute	35
Instrumentation	60
Ballast	125
Scientific package	670
Other	
Gross Weight	1,845
Free Lift	166
Gross Inflation	2,011
Helium used	32,100 cu. ft.

Remarks: Good flight

Copy to:
NR/FldRep/Minn
ONR/Code 421

Flight 1107-N

Remarks:

Surface winds were 6 to 8 mph at launch.

The balloon was released at 0817 G.M.T. and rose at 786 feet per minute to the tropopause, and less than 600 feet per minute above that to floating altitude of 127,000 feet.

The flight was terminated by radio command after floating at ceiling for 13 hours.

The payload landed on the south end of Reindeer Lake about 215 miles from Stony Rapids. The payload was located in a deep ravine and was in very heavy timber, which required 3 days to clear in order for the helicopter to land safely.

The sphere was disassembled and the parts flown out to a fishing camp by helicopter. From there they were flown to Lynn Lake by float plane.

The main section of the gondola, which consisted of a sphere and magnets and weighed about 400 pounds, was flown out in two parts to the fishing camp.

It was originally planned to fly the large sphere halves to an airstrip about 50 miles from the camp, but they were finally delivered to the airstrip by boat.

The C-47 tracking aircraft then returned all sections back to Ft. Churchill.

A

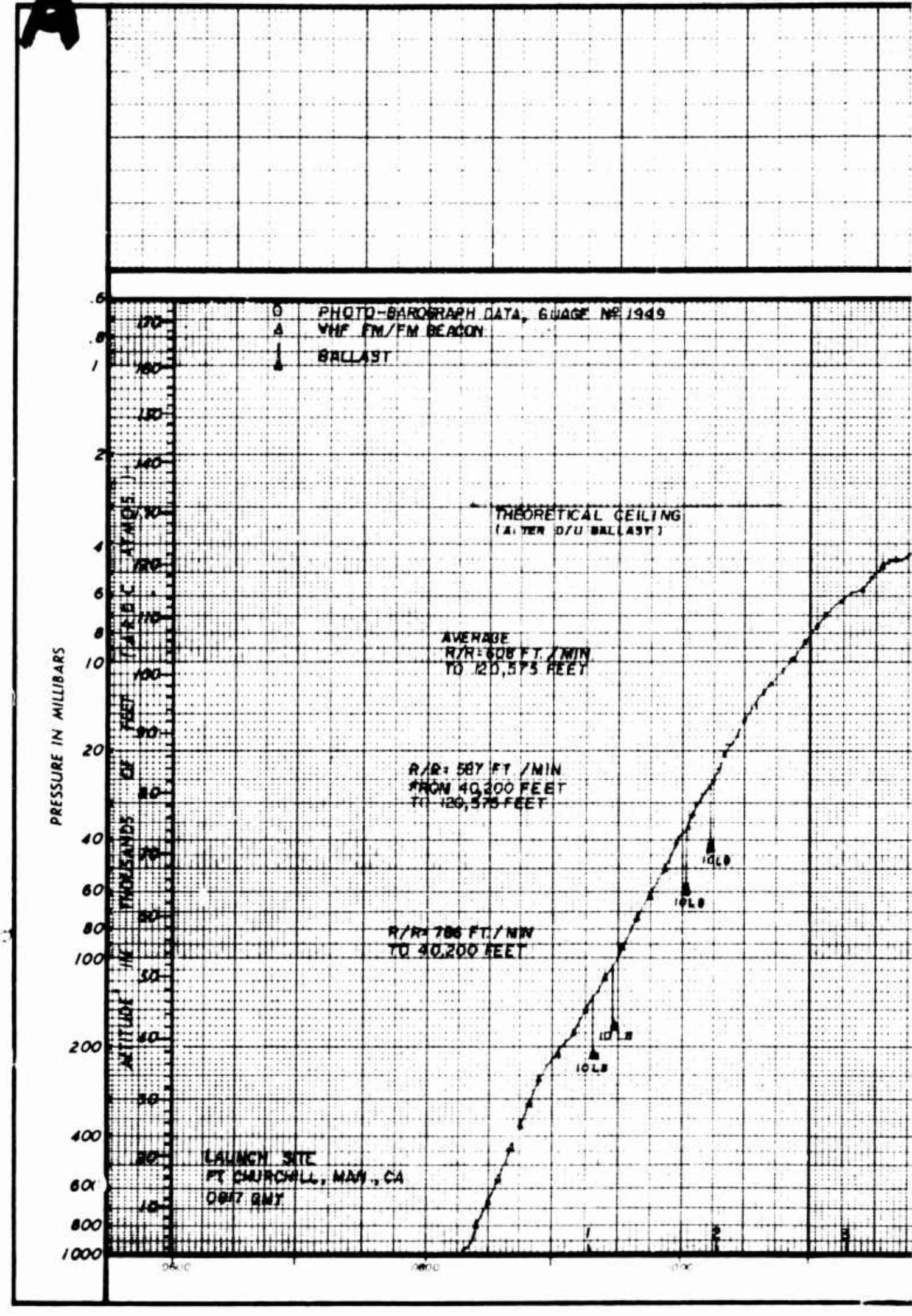
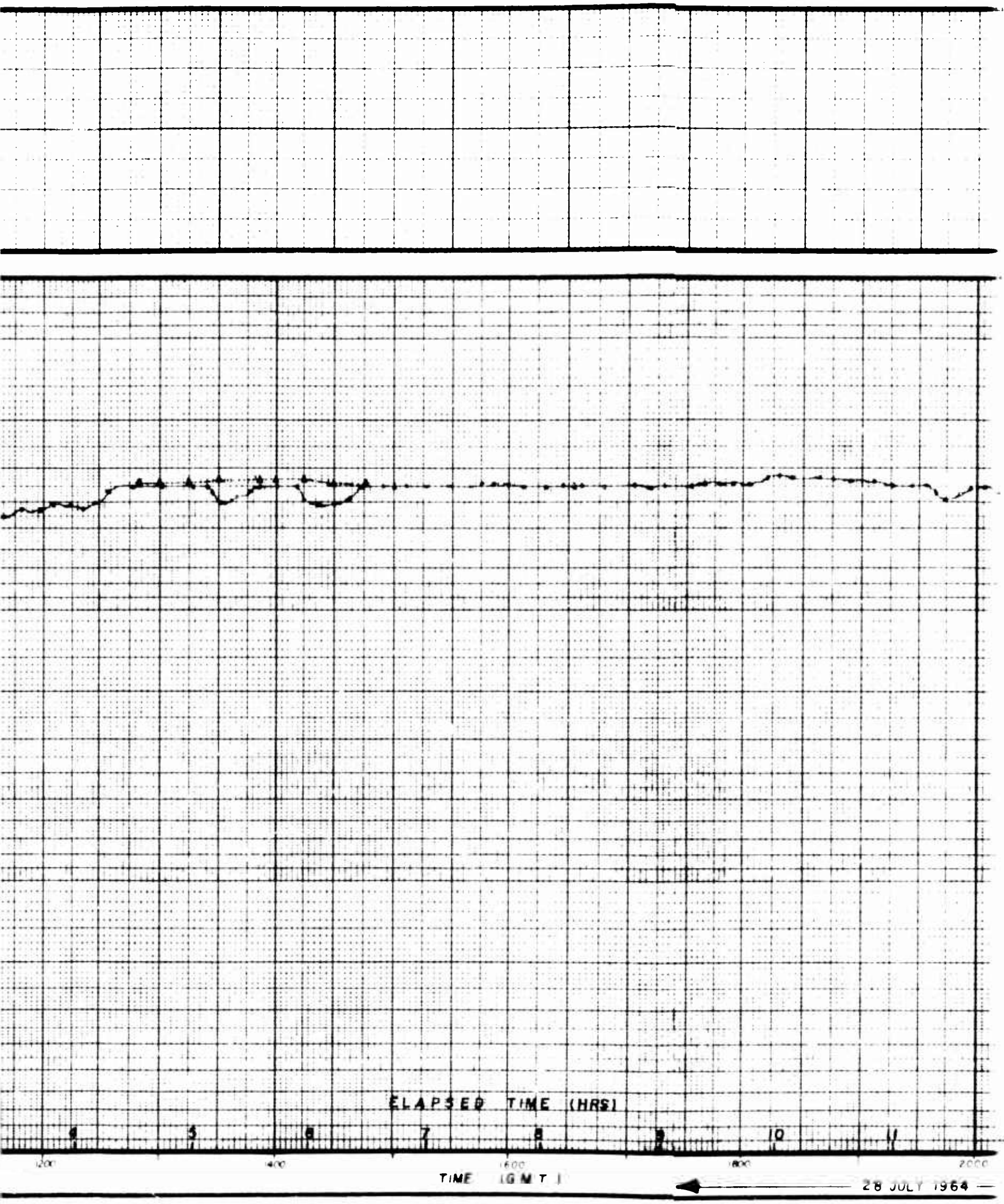
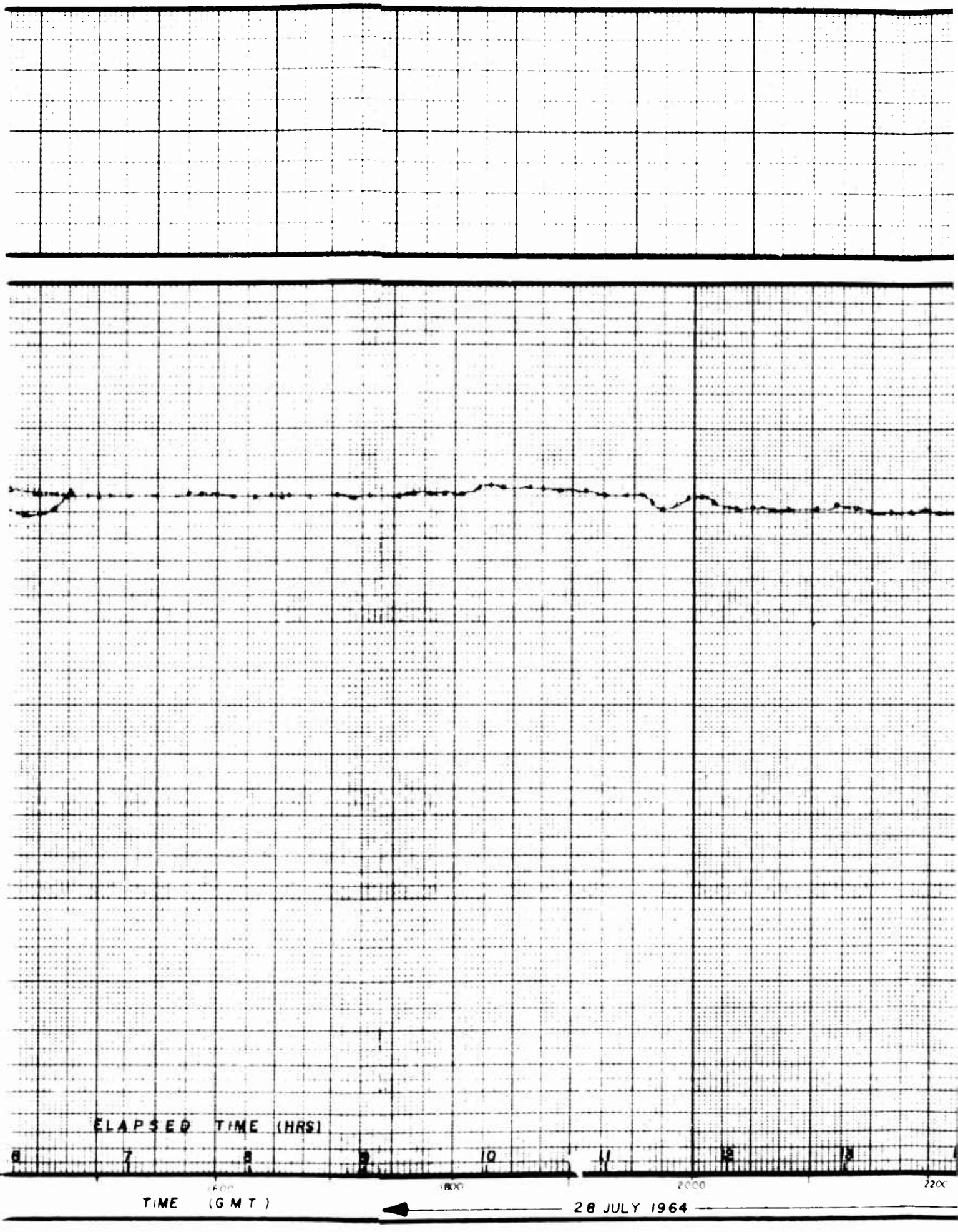
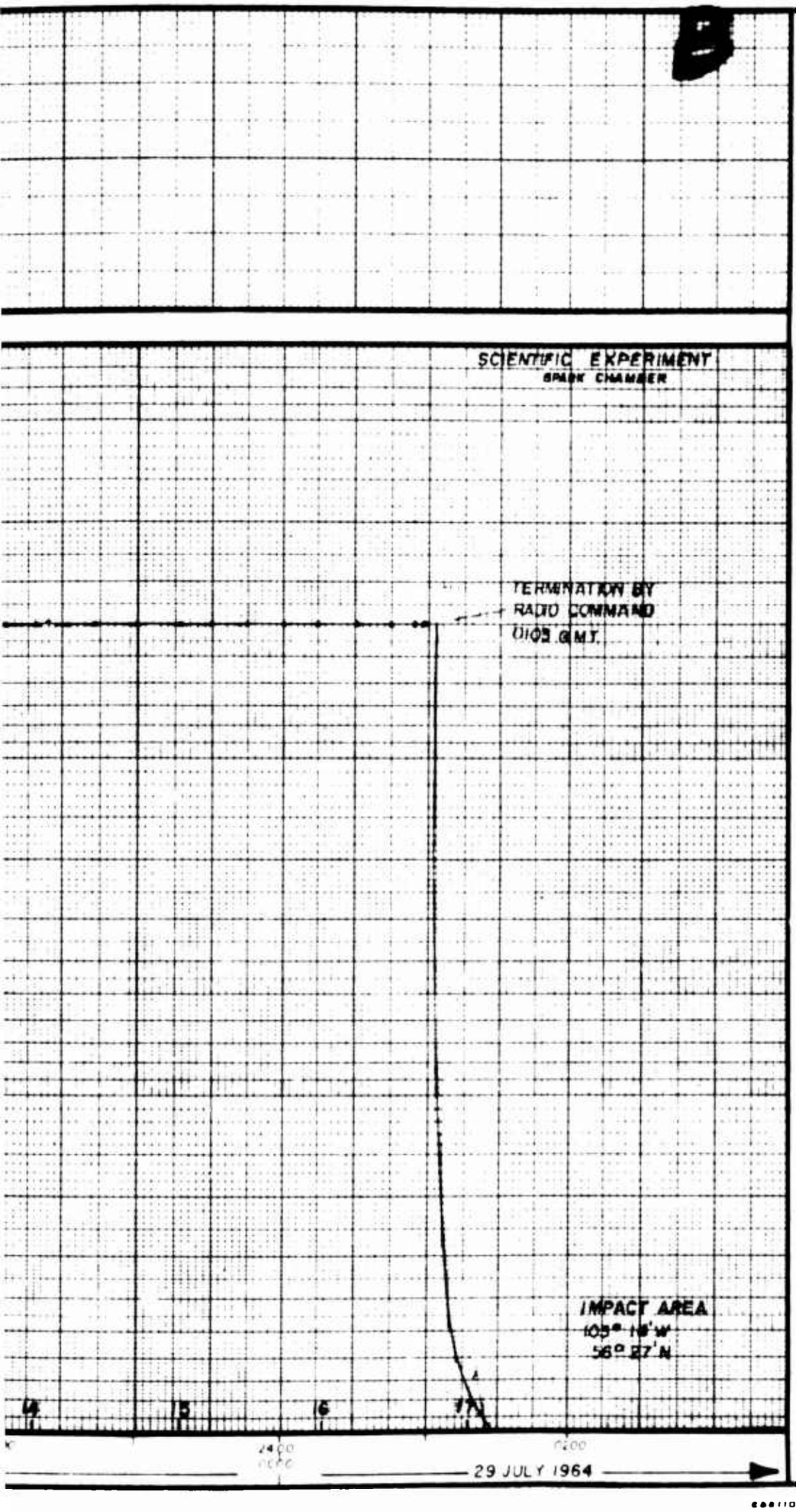


PHOTO-BAROGRAPH DATA, GUAGE Nº 1949
VHF FM/FM BEACON
BALLAST
THEORETICAL CEILING
(AFTER D/U BALLAST)
AVERAGE
R/R=608 FT./MIN
TO 120,575 FEET
R/R= 587 FT /MIN
FROM 40,200 FEET
TO 120,575 FEET
R/R= 786 FT./MIN
TO 40,200 FEET
10LB
10LB
10LB
10LB
LAUNCH SITE
FT CHURCHILL, MAN., CA
0917 GMT
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET
ATMOS.


ELAPSED TIME (HRS)
4
5
6
7
8
9
10
11
1200
1400
1600
1800
2000
TIME (G M T)
28 JULY 1964


ELAPSED TIME (HRS)
7
8
9
10
11
12
13
TIME (GMT)
28 JULY 1964



FLIGHT NO. 1107-N

DATE 28 JULY 1964

FOR UNIV OF CHICAGO
DR MEYER

BALLOON

TYPE 2323-541-8291 S/N 138

VOL 9 MILLION CU FT

MATL 75 MIL POLY

WT 955 0 LBS

LOAD FACTORS

PAYLOAD 890 0 LBS

GROSS LD 1845 0 LBS

FREE LIFT 166 LB = 9 %

BALLAST 125 0 LBS

RAVEN
industries, inc.

DR. [illegible] 14 AUGUST 1964

CHK.

APPR.

X 03108

SYNOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1108-N

2. Scientist Dr. Frye Organization Case Institute

3. Launch: Site Ft. Churchill Date/Time 28 July 1964/1059 Z

Technique Anchor Line Director D. Johnson

4. Weather: Broken 42°F NNE 4-6 Tropopause: Height 35K Temp -56 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.1 Mbs 130K ft. Actual: 95K ft. 14 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 714 fpm. Tropopause to ceiling _____ fpm.

7. Flight duration: Total 2 hrs. 12 min. At ceiling _____ hrs. _____ min.

8. Termination: Time 1311 Z Altitude 95K ft. Cause Burst

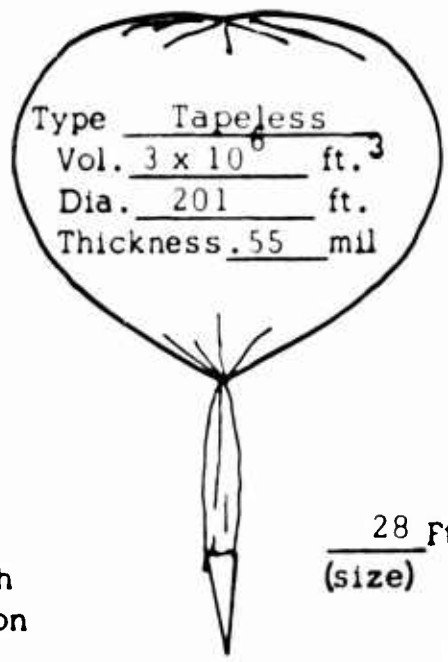
9. Balloon destruction - confirmed Visual
(visual - unknown - etc.)

10. Impact: Date/Time 28 July/1340 Z Location 93° 30' W/58° 32' N

11. Frequency used: (Kcs, Mcs) (Purpose) (Total Time)

253.1 Mcs	Beacon	3 hr.
149.4 Mcs	Radio Command	5 min.

12. Balloon: Code number 2333-531-8201 Serial number 184



28 Ft. chute
(size)

complete sketch showing location of equipment

WEIGHT

Balloon	330 lb.
FAA Termination Timer	
Parachute	17
Instrumentation	60
Ballast	80
Scientific package	200
Other	
Gross Weight	687
Free Lift	68
Gross Inflation	755
Helium used	12,100 cu. ft.

Remarks:

Copy to:
ONR/FldRep/Minn
ONR/Code 421

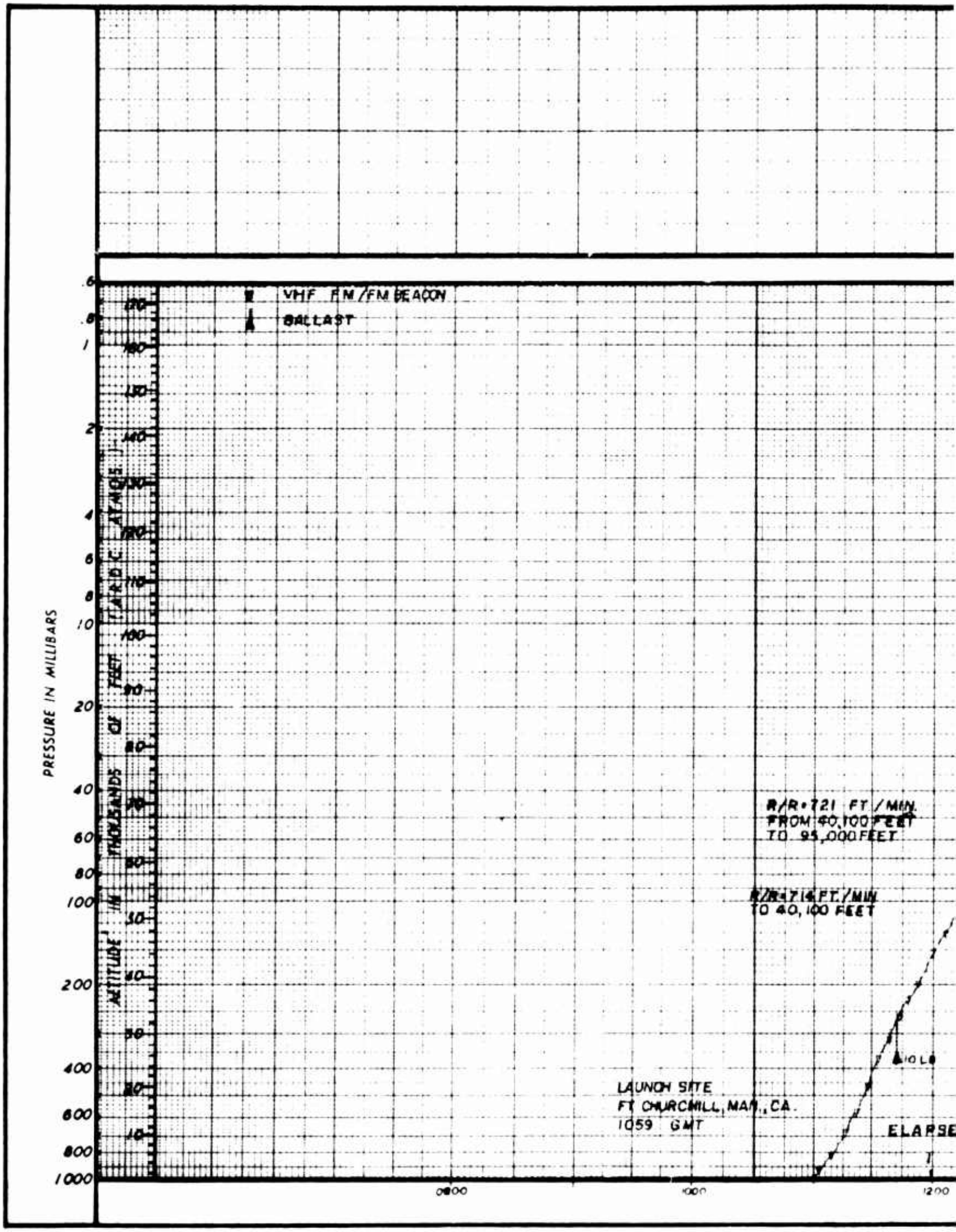
Flight 1108-N

Remarks:

Surface winds were 4 to 6 mph at launch.

The balloon ascended at about 700 feet per minute to 95,000 feet where a burst occurred.

The payload was recovered undamaged by a PAA helicopter.


VHF FM/FM BEACON
BALLAST
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET
STANDARD 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
R/R=721 FT/MIN.
FROM 40,100 FEET
TO 95,000 FEET
R/R=714 FT./MIN
TO 40,100 FEET
LAUNCH SITE
FT CHURCHILL, MAN., CA.
1059 GMT
ELAPSE
0800
1000
1200

SCIENTIFIC EXPERIMENT

THEORETICAL CEILING
(AFTER D/V BALLAST)

BALLOON BURST
TERMINATION BY
RADIO COMMAND
1311 G.M.T.

12 LB

20 LB

IMPACT AREA
93° 30' W
58° 32' N

SED TIME (HRS)

TIME (GMT)

1600

1800

FLIGHT NO. 1108-N

DATE 28 JULY 1964

FOR CASE INSTITUTE
DR FRYE

BALLOON

TYPE 2333-531-8201

VOL 3 MILLION CU FT

MATL .55 MIL POLY

WT 330.0 LBS.

LOAD FACTORS

PAYLOAD 357 0 LBS

GROSS LD 687 0 LBS

FREE LIFT 68LB : 9 8 %

BALLAST 80 0 LBS

RAVEN
industries, inc.

DR. DONK 11 AUGUST 1964

CHK.

APPR.

B03004

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1109-N

2. Scientist Dr. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 29 July 1964/0422 Z

Technique Anchor Line Director D. Johnson

4. Weather: Scattered 48°F NNE 8 Tropopause: Height 30.4K Temp -47 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.7 Mbs 126K ft. Actual: 124K ft. 4.0 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 890 fpm. Tropopause to ceiling 700 fpm.

7. Flight duration: Total 20 hrs. 38 min. At ceiling 18 hrs. ____ min.

8. Termination: Time 0100 Z Altitude 124K ft. Cause Radio Command

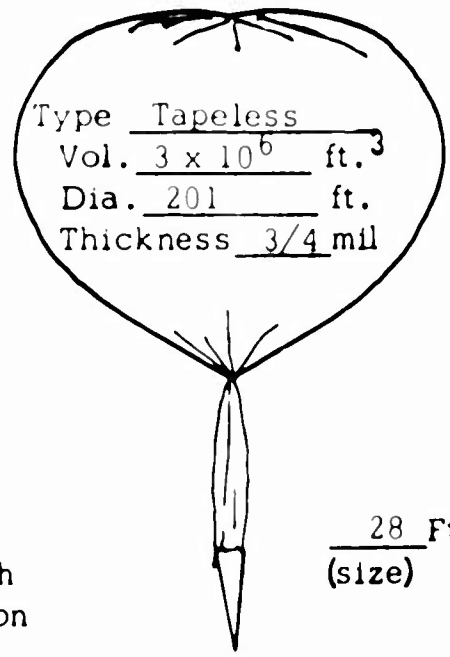
9. Balloon destruction - confirmed Unknown
(visual - unknown - etc.)

10. Impact: Date/Time 30 July /0140 Z Location 105° 54' W/ 57° 25' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
251.5 Mcs	Beacon	22 hrs.
149.4 Mcs	Radio Command	13 min.

12. Balloon: Code number 2333-541-8201 Serial number 177



28 Ft. chute
(size)

complete sketch showing location of equipment

WEIGHT

Balloon	445 lb.
FAA Termination Timer	
Parachute	15
Instrumentation	60
Ballast	100
Scientific package -	227
Other	
Gross Weight	847
Free Lift	77
Gross Inflation	924
Helium used	14,900 cu. ft.

Remarks: Good flight

Copy to:
ONR/FldRep/Minn
ONR/Code 421

Flight 1109-N

Remarks:

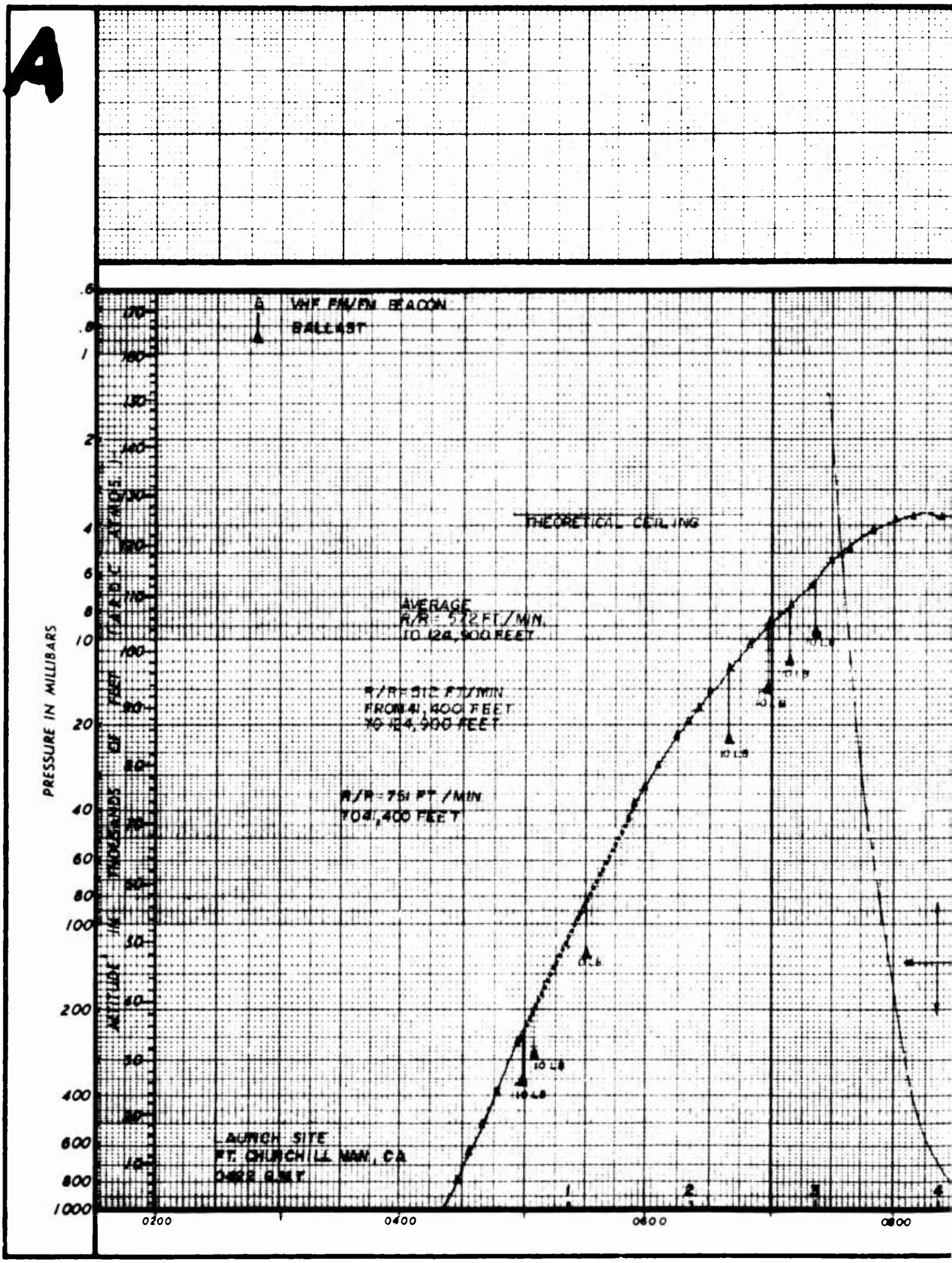
Surface winds were 8 mph at an angle of 45° from the balloon. The launch was good considering the crosswind.

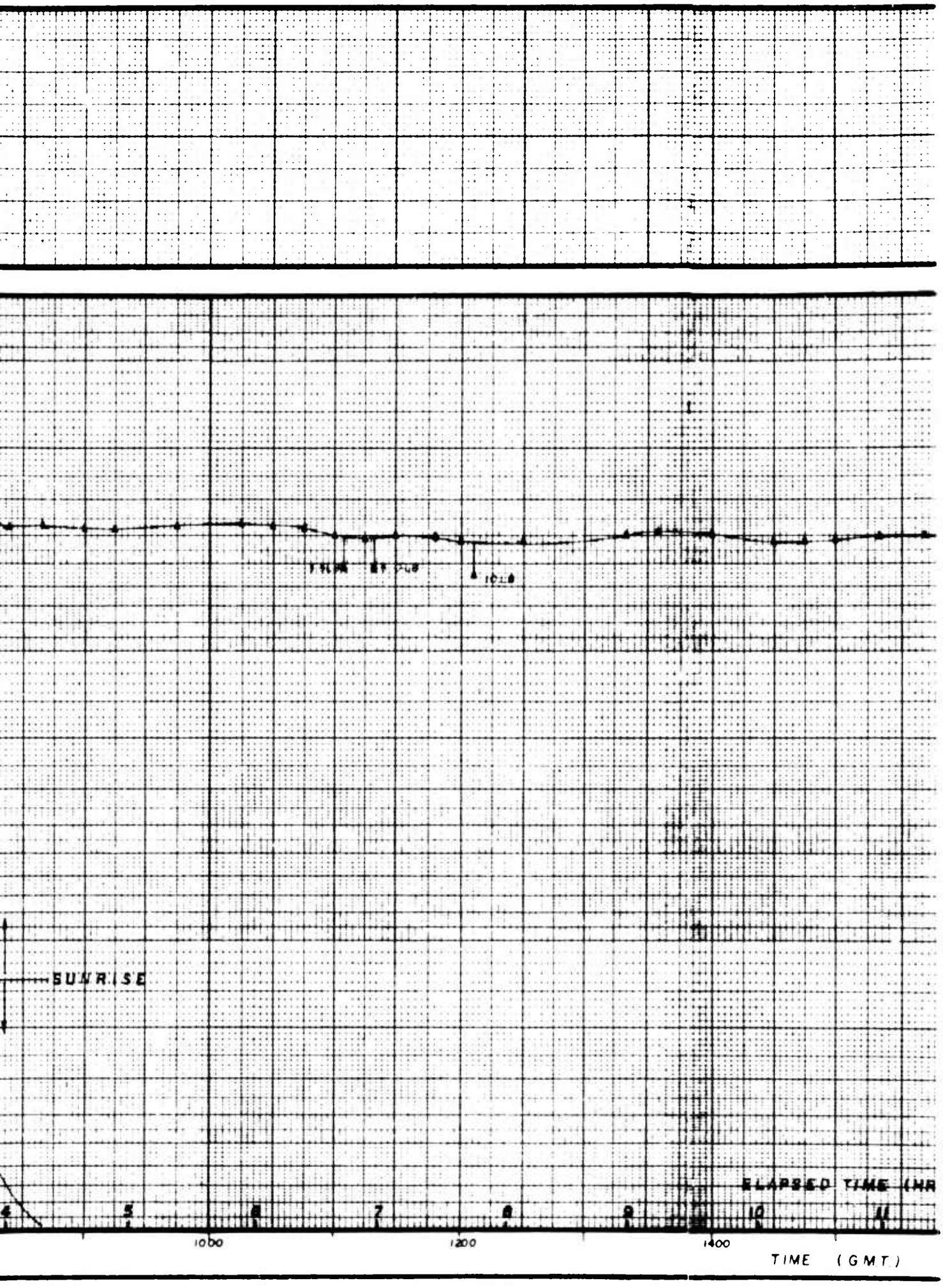
The balloon rose at 751 feet per minute to the tropopause and 512 feet per minute above that to ceiling. The balloon floated at 124,000 feet for 18 hours.

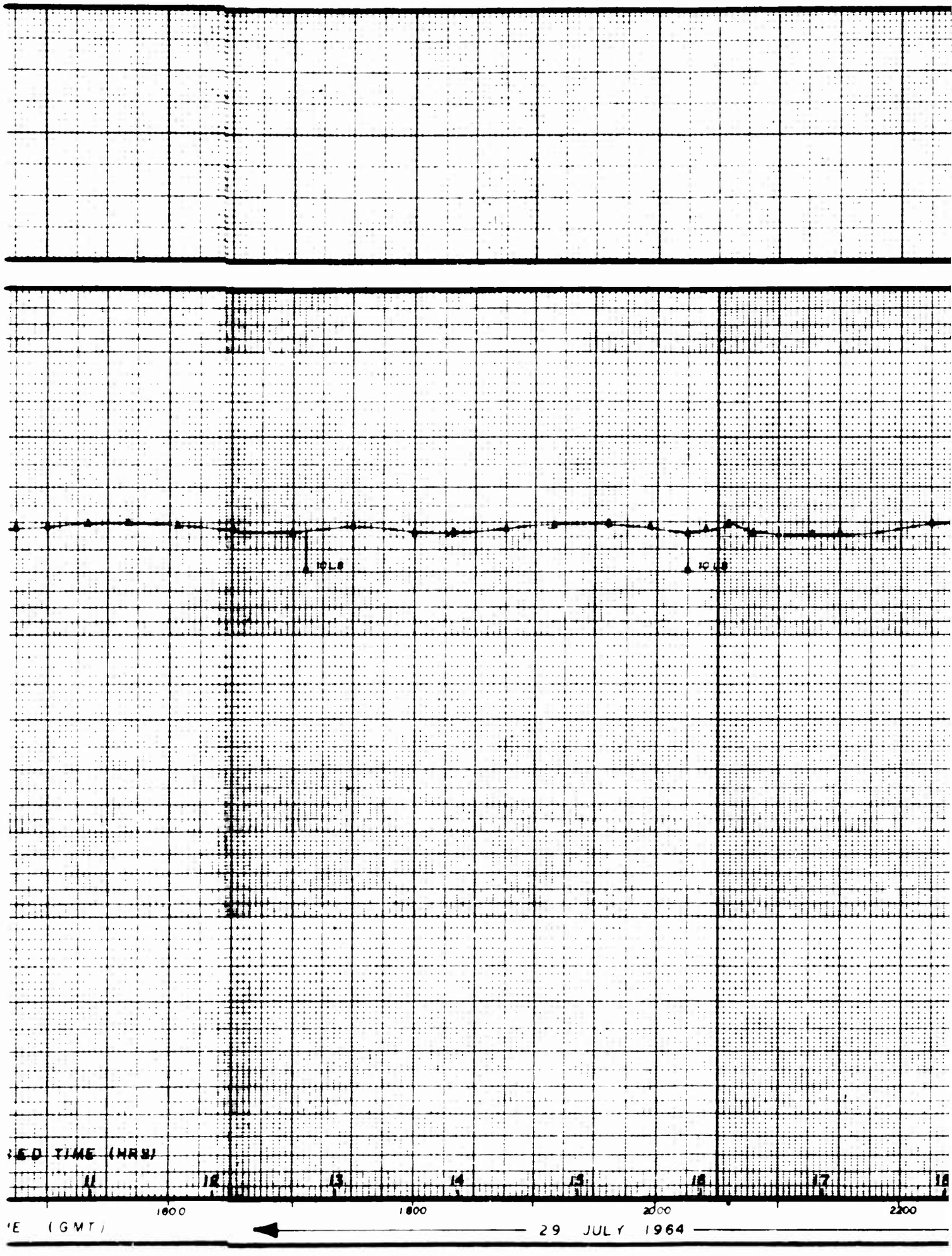
The flight was terminated by radio command and impact was on a lake shore 130 miles south of Stony Rapids.

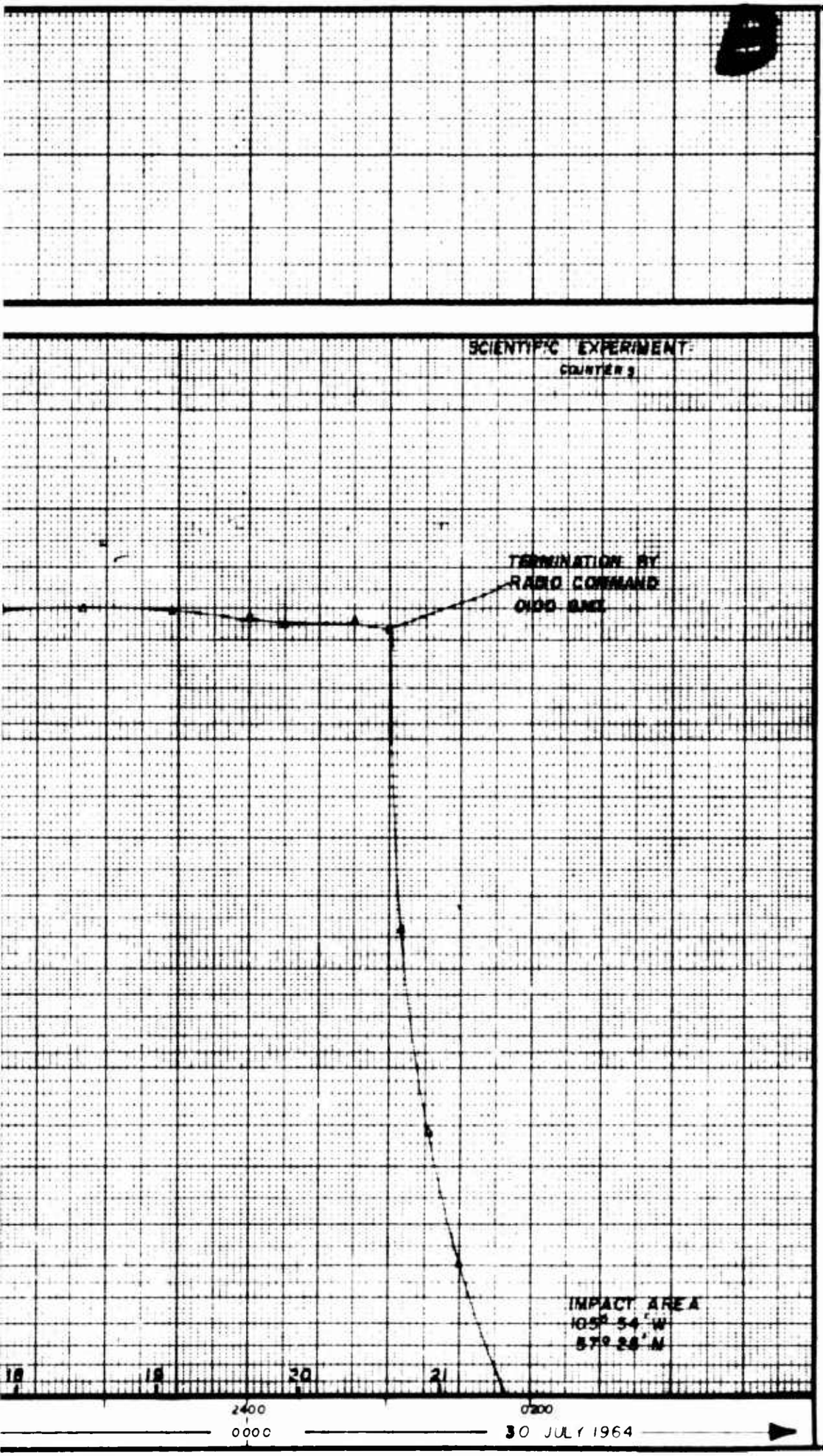
The payload was recovered by a float plane.

A


VHF FM/FM BEACON
BALLAST
THEORETICAL CEILING
AVERAGE
R/R = 572 FT./MIN.
10,124,900 FEET
R/R = 512 FT/MIN
FROM 41,400 FEET
TO 124,900 FEET
R/R = 751 FT/MIN
704,400 FEET
AURICH SITE
FT. CHURCHILL MAN., CA
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (APPROX.)
0200
0400
0600
0800


SUNRISE
ELAPSED TIME (HR
1000
1200
1400
TIME (GMT)


IOLS
IO LS
ED TIME (HRS)
11
12
13
14
15
16
17
1600
1800
2000
2200
E (GMT)
29 JULY 1964



FLIGHT NO. 1109-N

DATE 29 JULY 1964

FOR UNIV OF CHICAGO
DR MEYER

BALLOON

TYPE 2333-541-8201 S/N 177

VOL 3 MILLION CU FT.

MATL .75 MIL POLY

WT 445.0 LBS.

LOAD FACTORS

PAYLOAD 402.0 LBS

GROSS LD 847.0 LBS.

FREE LIFT 77 LB. = 9%

BALLAST 110.0 LBS.

RAVEN
industries, inc.

DR. DONK 11 AUGUST 1964

CHK.

APPR.

X03096

EASTMAN AMANO TWIN 300 GRADMATE

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1110-N

2. Scientist Dr. McCracken Organization SW Center for Advanced Studies

3. Launch: Site Ft. Churchill Date/Time 4 August 1964/2148Z

Technique Anchor Line Director D. Johnson

4. Weather: Clear 54°F N 4-6 Tropopause: Height 33.6K Temp -54 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.9 Mbs 124K ft. Actual: 124K ft. 3.9 Mbs
How altitude determined LF Beacon and Churchill Radar

6. Ascent: Surface to tropopause 1226 fpm. Tropopause to ceiling 778 fpm.

7. Flight duration: Total 21 hrs. 1 min. At ceiling 19 hrs. _____ min. _____

8. Termination: Time 1849 Z Altitude 124K ft. Cause Radio Command

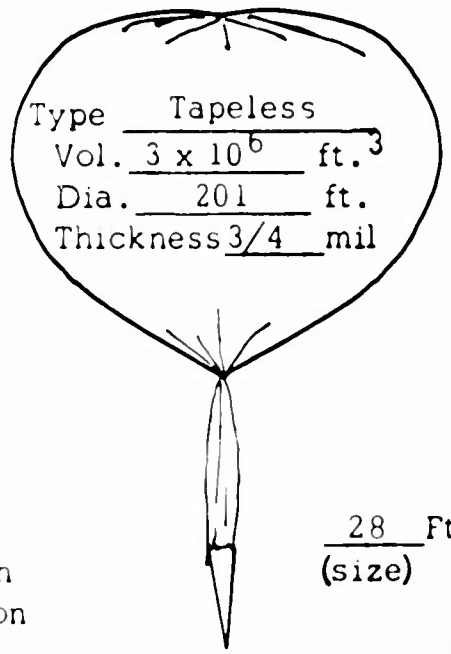
9. Balloon destruction - confirmed Visual
(visual - unknown - etc.)

10. Impact: Date/Time 5 August/1930 Z Location 107° 22' W/59° 08' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
1667 Kcs	Beacon	22 hr.
149.4 Mcs	Radio Command	10 min.

12. Balloon: Code number 2333-541-8201 Serial number 182



28 Ft.chute
(size)

Complete sketch showing location of equipment

WEIGHT

Balloon	446 lb.
FAA Termination Timer	
Parachute	17
Instrumentation	65
Ballast	100
Scientific package	200
Other	
Gross Weight	828
Free Lift	81
Gross Inflation	899
Helium used	14,500 cu. ft.

Remarks: Good flight

Copy to:
NR/FldRep/Minn
ONR/Code 421

Flight 1110-N

Remarks:

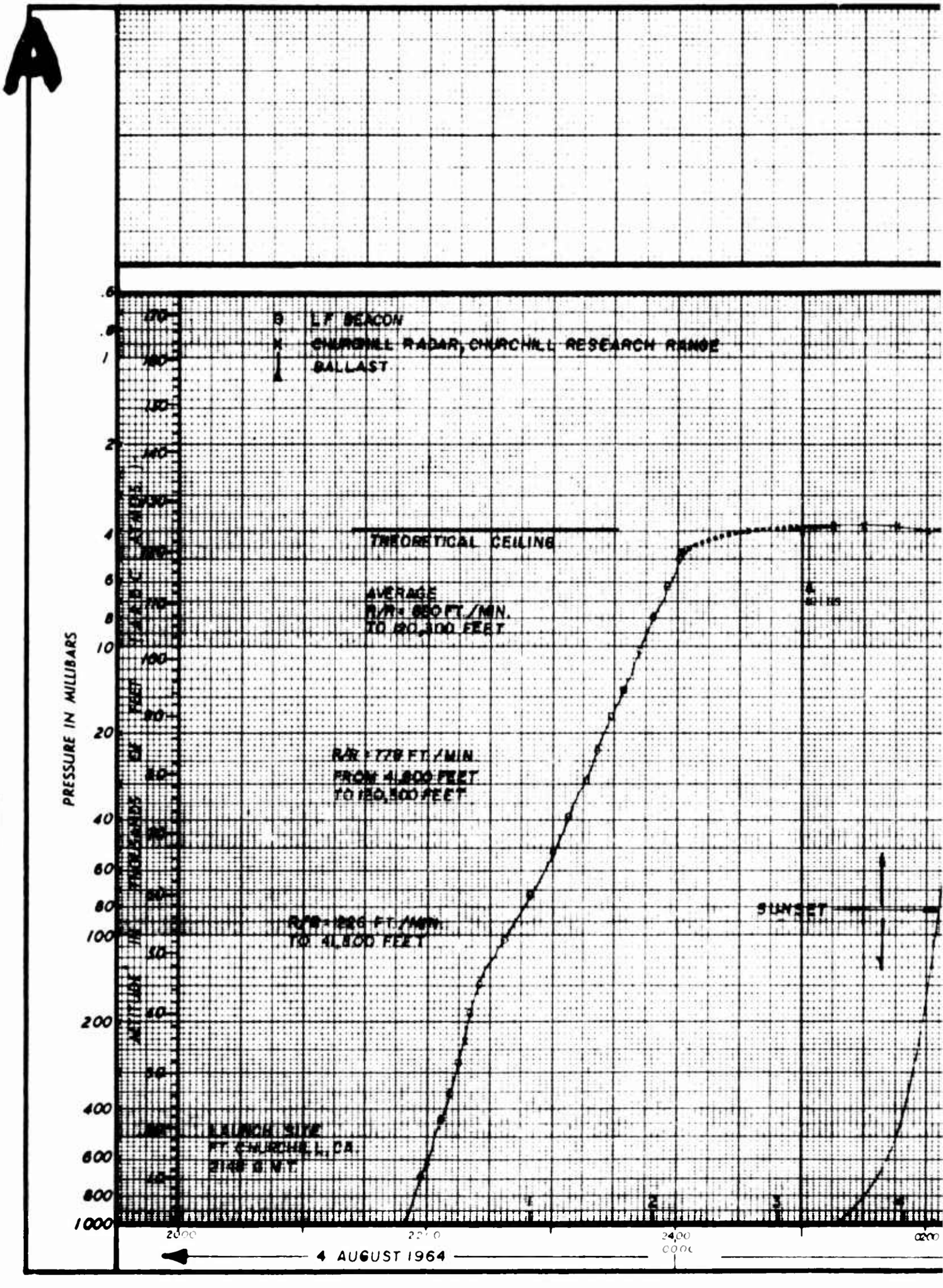
The surface winds were 4 to 6 mph. The launch was very smooth.

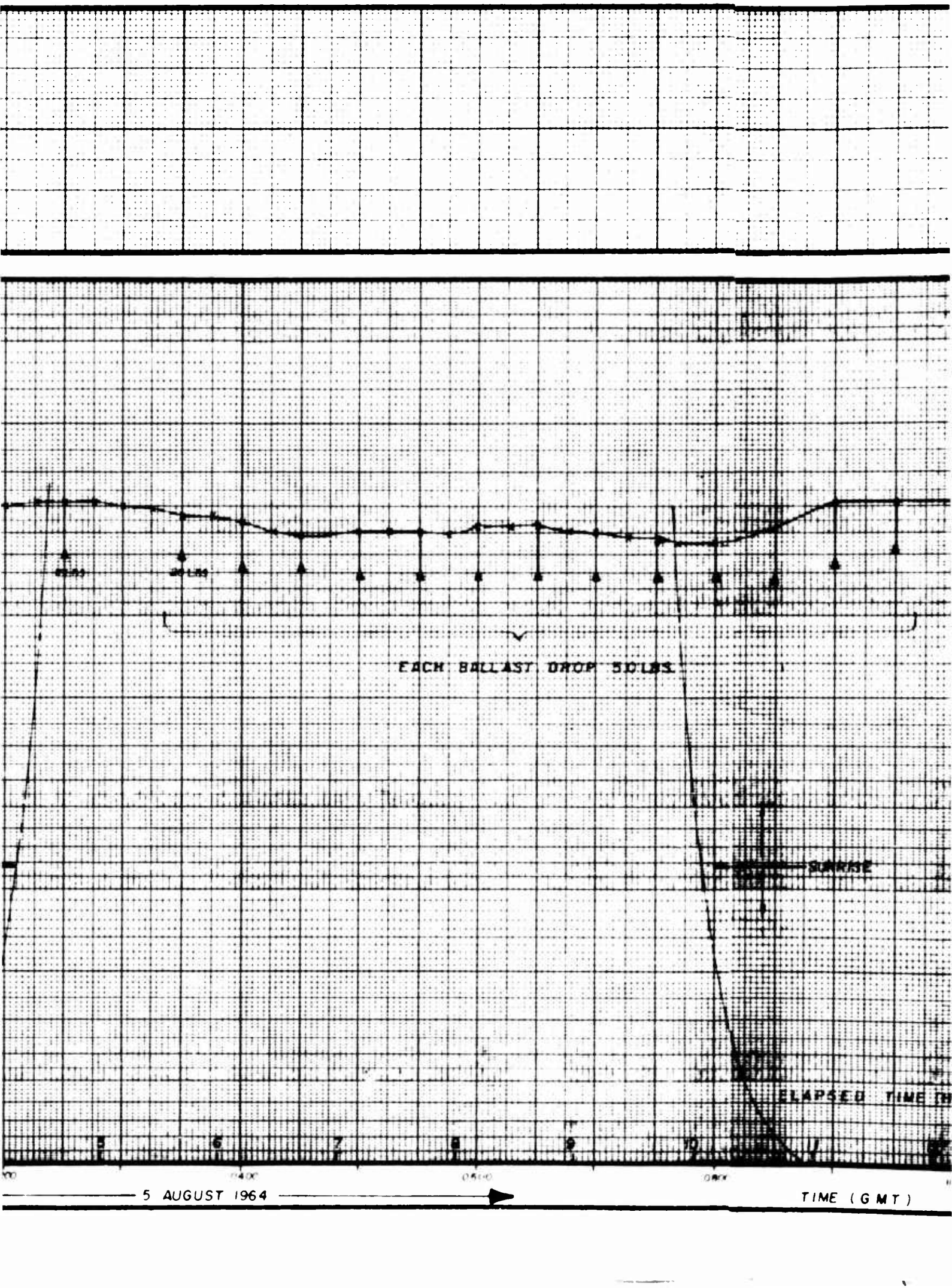
The balloon rose at 1226 feet per minute to the tropopause and 778 feet per minute above that to ceiling.

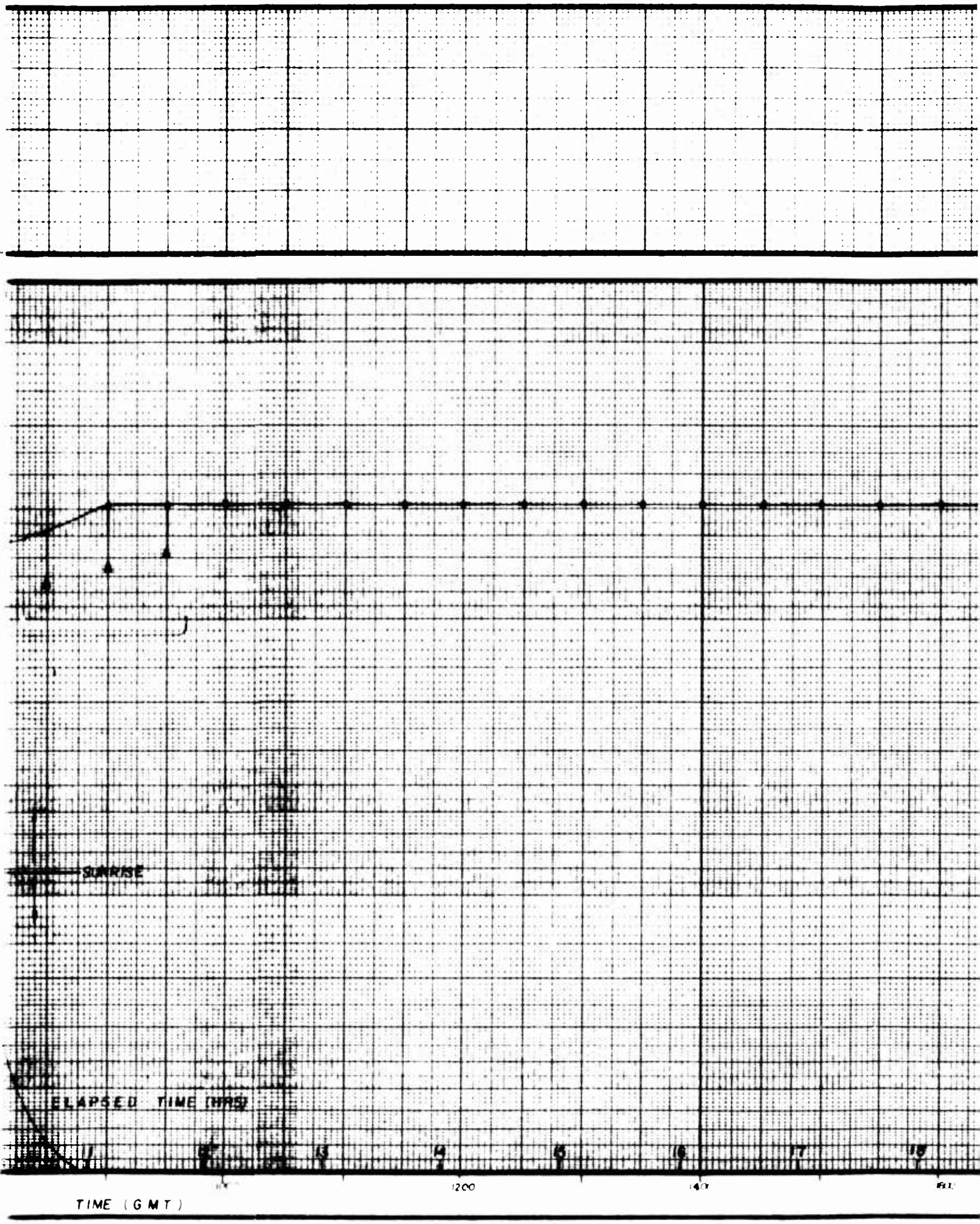
The flight was terminated after 19 hours at ceiling.

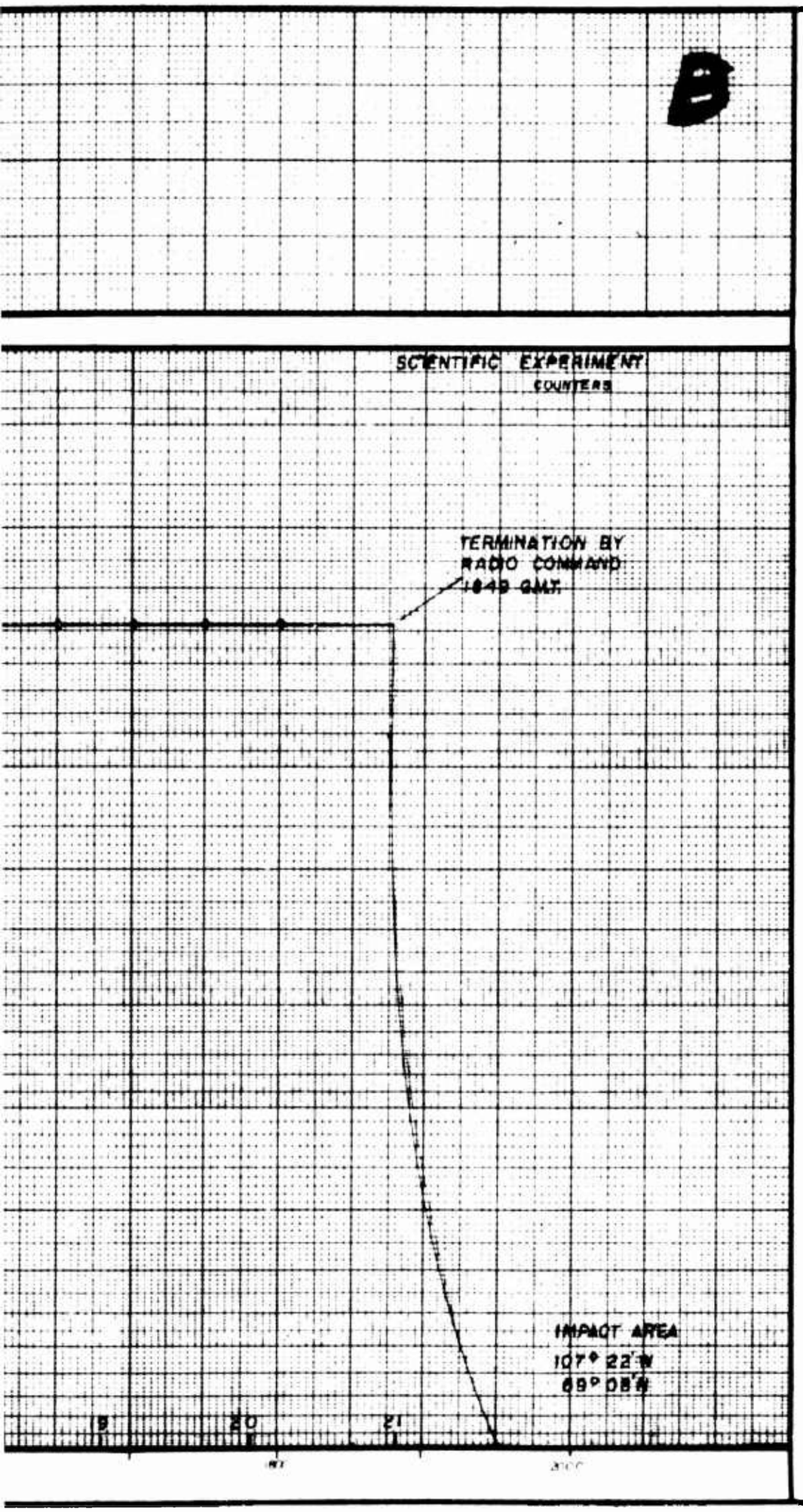
The payload was recovered 60 miles southwest of Stony Rapids.

This flight was the first in an anticipated series of four flights in one day. The low frequency beacon was employed because only three VHF frequencies were available.


B LF BEACON
H CHURCHILL RADAR, CHURCHILL RESEARCH RANGE
BALLAST
THEORETICAL CEILING
AVERAGE R/R = 680 FT./MIN. TO 80,300 FEET
R/R = 778 FT./MIN. FROM 41,800 FEET TO 120,500 FEET
R/R = 226 FT./MIN. TO 41,800 FEET
SUNSET
LAUNCH SITE FT. CHURCHILL, CA. 2148 G.M.T.
PRESSURE IN MILLIBARS
4 AUGUST 1964


EACH BALLAST DROP 50 LBS.
SUNRISE
ELAPSED TIME (H
5
6
7
8
9
10
5 AUGUST 1964
TIME (GMT)


SUNRISE
ELAPSED TIME (HRS)
TIME (GMT)



FLIGHT NO. 1110-N

DATE 4 AUGUST 1964

FOR S.W CENTER FOR ADVANCED STUDIES
DR Mc CRACKEN

BALLOON

TYPE 2333-541-8201 s/N 182

VOL 3 MILLION CU. FT

MATL 75 MIL POLY

WT 446 0 LBS

LOAD FACTORS

PAYLOAD 382 0 LBS

GROSS LD. 828 0 LBS

FREE LIFT: 81 0LB = 9.78 %

BALLAST 100.0 LBS

RAVEN industries, inc.

DR. DONK 20 AUGUST 1964

CHK.

APP'D

X 03120

STANFORD UNIV. PRINT SHOP GRADMATE

SYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1 Company Raven Industries, Inc. Flight Number 1111-N

2 Scientist Dr. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 8 August 1964/0249 Z

Technique Anchor Line Director D. Johnson

4 Weather: Scattered 36°F SE 4-6 Tropopause: Height 34.6K Temp -50 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.75 Mbs 125 K ft. Actual: 60K ft. 72 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 802 fpm. Tropopause to ceiling _____ fpm.

7 Flight duration: Total 1 hrs. 21 min. At ceiling _____ hrs. _____ min. _____

8 Termination: Time 0410 Z Altitude 60K ft. Cause Burst

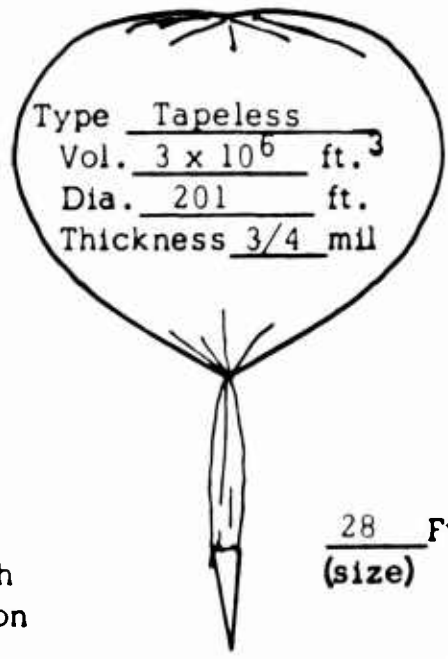
9. Balloon destruction - confirmed Visual
(visual - unknown - etc.)

10. Impact: Date/Time 8 Aug./0436 Z Location 93° 33'W / 59° 59' N.

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
253.1 Mcs	Beacon	2 hrs.
149.4 Mcs	Radio Command	6 min.

12 Balloon: Code number 2333-541-8201 Serial number 185



Type Tapeless
Vol. 3×10^6 ft.^{3}
Dia. 201 ft.
Thickness 3/4 mil

28 Ft. chute
(size)

WEIGHT

Balloon	436 lb.
FAA Termination Timer	
Parachute	15
Instrumentation	60
Ballast	100
Scientific package	188
Other	
Gross Weight	799
Free Lift	80
Gross Inflation	879
Helium used	14,000 cu. ft.

complete sketch showing location of equipment

Remarks:

Copy to:
ONR/FldRep/Minn
ONR/Code 421

Flight 1111-N

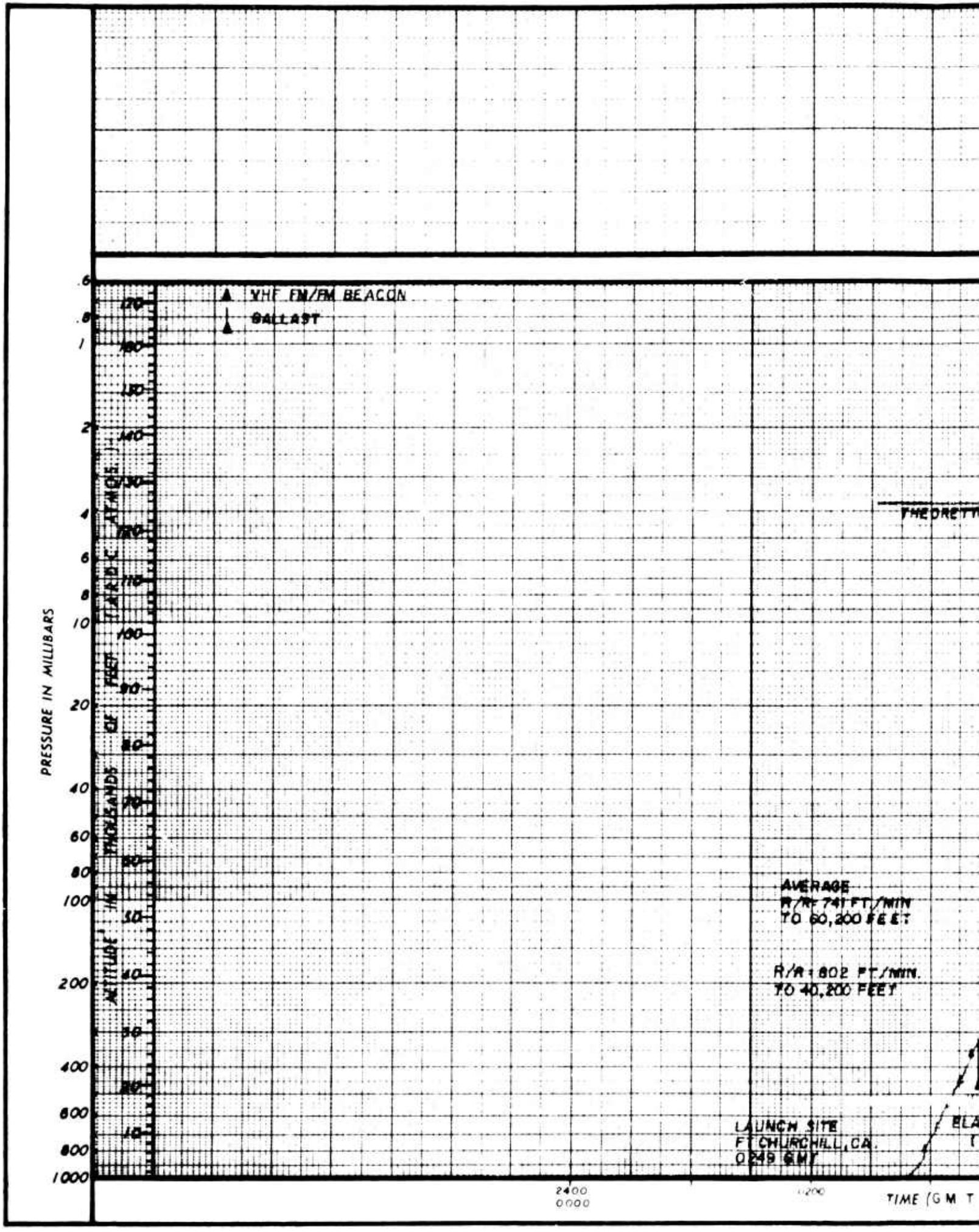
Remarks:

Surface winds were 4 to 6 mph and across the layout direction.

The extreme lower section of the balloon was pulled off the ground cloth.

The balloon rose at about 800 feet per minute to 60,000 feet where a burst occurred.

The payload was recovered undamaged by a PAA helicopter.


VHF FM/FM BEACON
BALLAST
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (APPROX. ATMOS.)
AVERAGE
R/R = 741 FT./MIN
TO 60,200 FEET
R/R = 802 FT./MIN.
TO 40,200 FEET
LAUNCH SITE
FT CHURCHILL, CA.
0249 GMT
2400
0000
TIME (G M T

FLIGHT NO. IIII-N

DATE AUGUST 1964

FOR UNIV OF CHICAGO
DR MEYER

BALLOON

TYPE 2333-541-8201 VN 185

VOL 3 MILLION CU FT

MATL 75 MIL POLY

WT 436.0 LBS

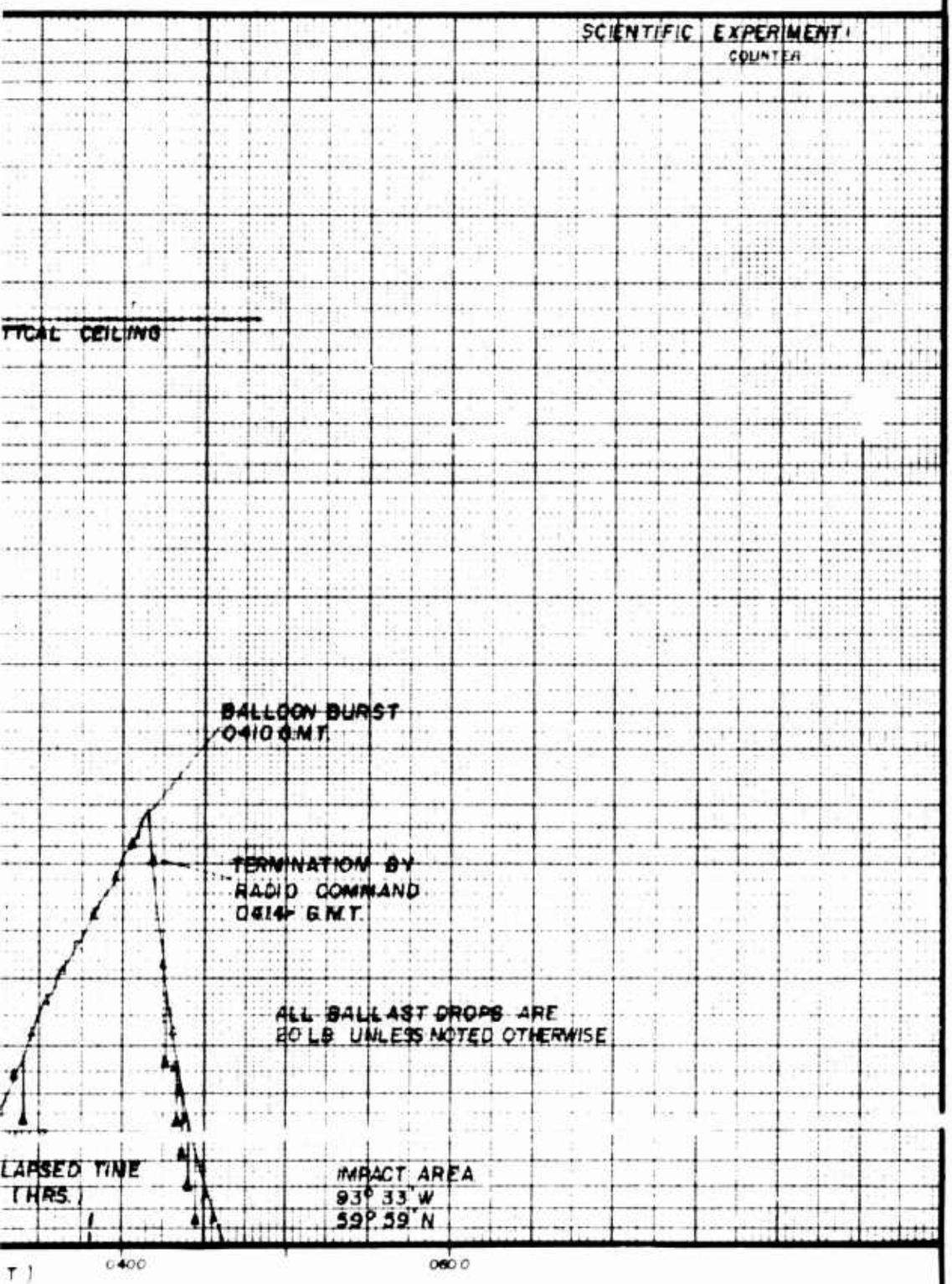
LOAD FACTORS

PAYLOAD 363.0 LBS

GROSS LD 799.0 LBS

FREE LIFT 800LB : 10 %

BALLAST 100.0 LBS



RAVEN industries, inc.

DR. JONK... 18 AUGUST 1964

CHK.

APPR.

B03118

EDITIO ANTEA THIS SUPERSEDES

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1112-N

2. Scientist Dr. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 8 August 1964/1019 Z

Technique Anchor Line Director D. Johnson

4. Weather: Scattered 37°F SE 4-6 Tropopause: Height 32.5K Temp -50 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 2.9 Mbs 132K ft. Actual: 24K ft. 400 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 800 fpm. Tropopause to ceiling _____ fpm.

7. Flight duration: Total _____ hrs. 32 min. At ceiling _____ hrs. _____ min. _____

8. Termination: Time 1051 Z Altitude 24K ft. Cause Burst

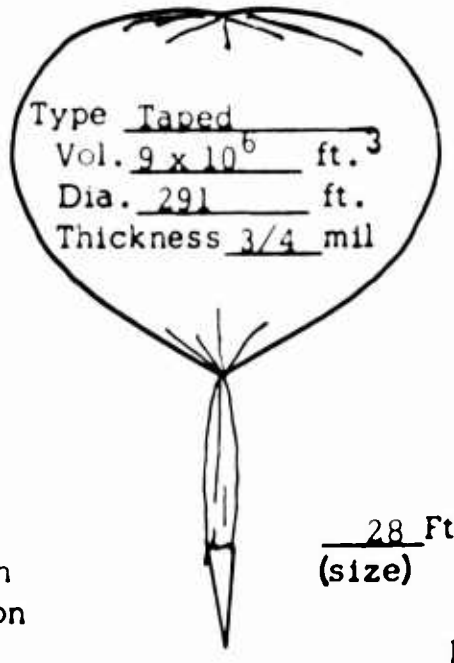
9. Balloon destruction - confirmed Visual
(visual - unknown - etc.)

10. Impact: Date/Time 8 August/1106 Z Location 93° 55' W/ 58° 20' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
253.1 Mcs	Beacon	1 hr.
149.4 Mcs	Radio Command	5 min.

12. Balloon: Code number 2323-541-8291 Serial number 143



28 Ft. chute
(size)

Complete sketch showing location of equipment

WEIGHT	
Balloon	952 lb.
FAA Termination Timer	
Parachute	36
Instrumentation	60
Ballast	100
Scientific package	624
Other	
Gross Weight	1772
Free Lift	159
Gross Inflation	1931
Helium used	31,000 cu. ft.

Remarks:

Copy to:
ONR/FldRep/Minn
ONR/Code 421

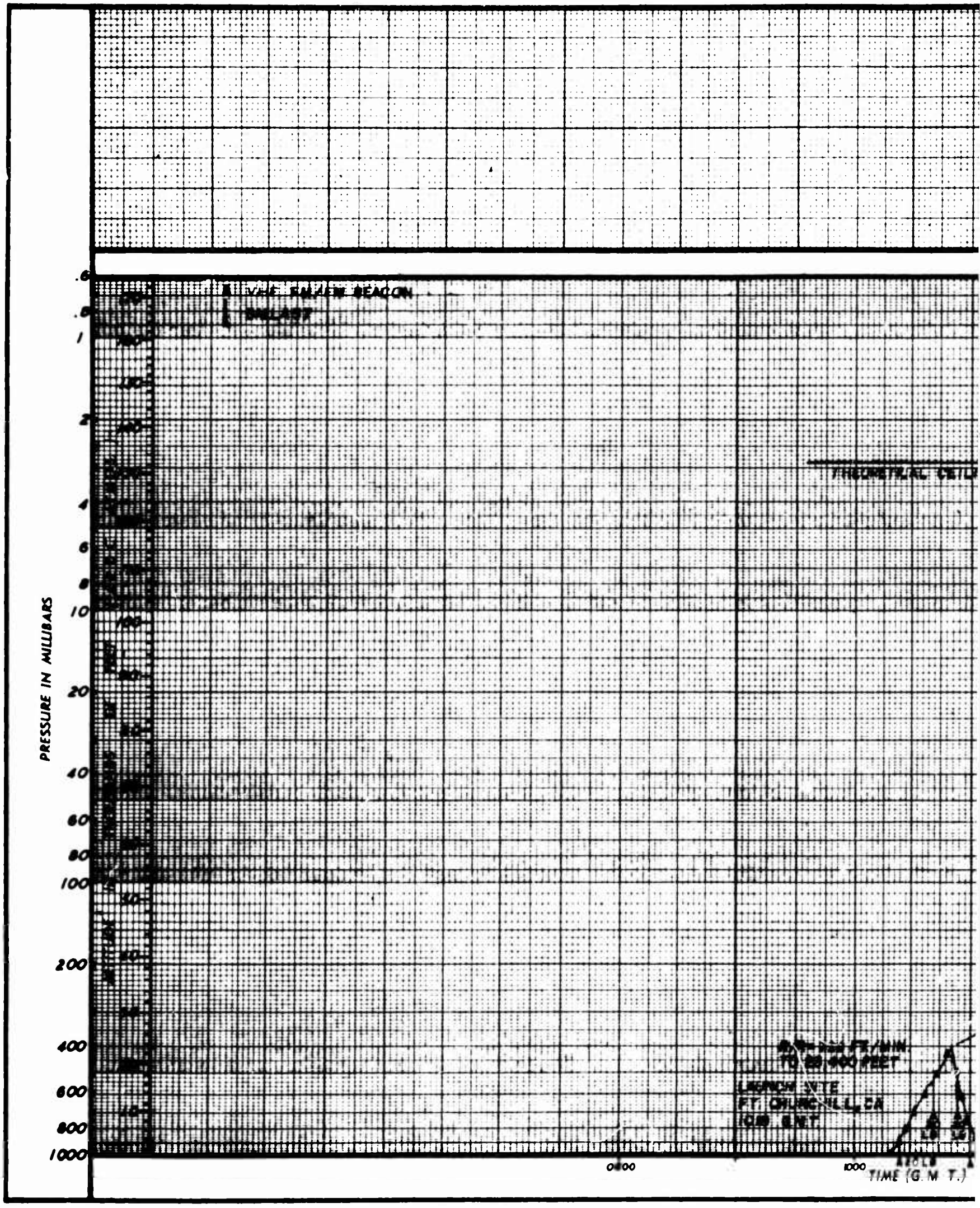
Flight 1112-N

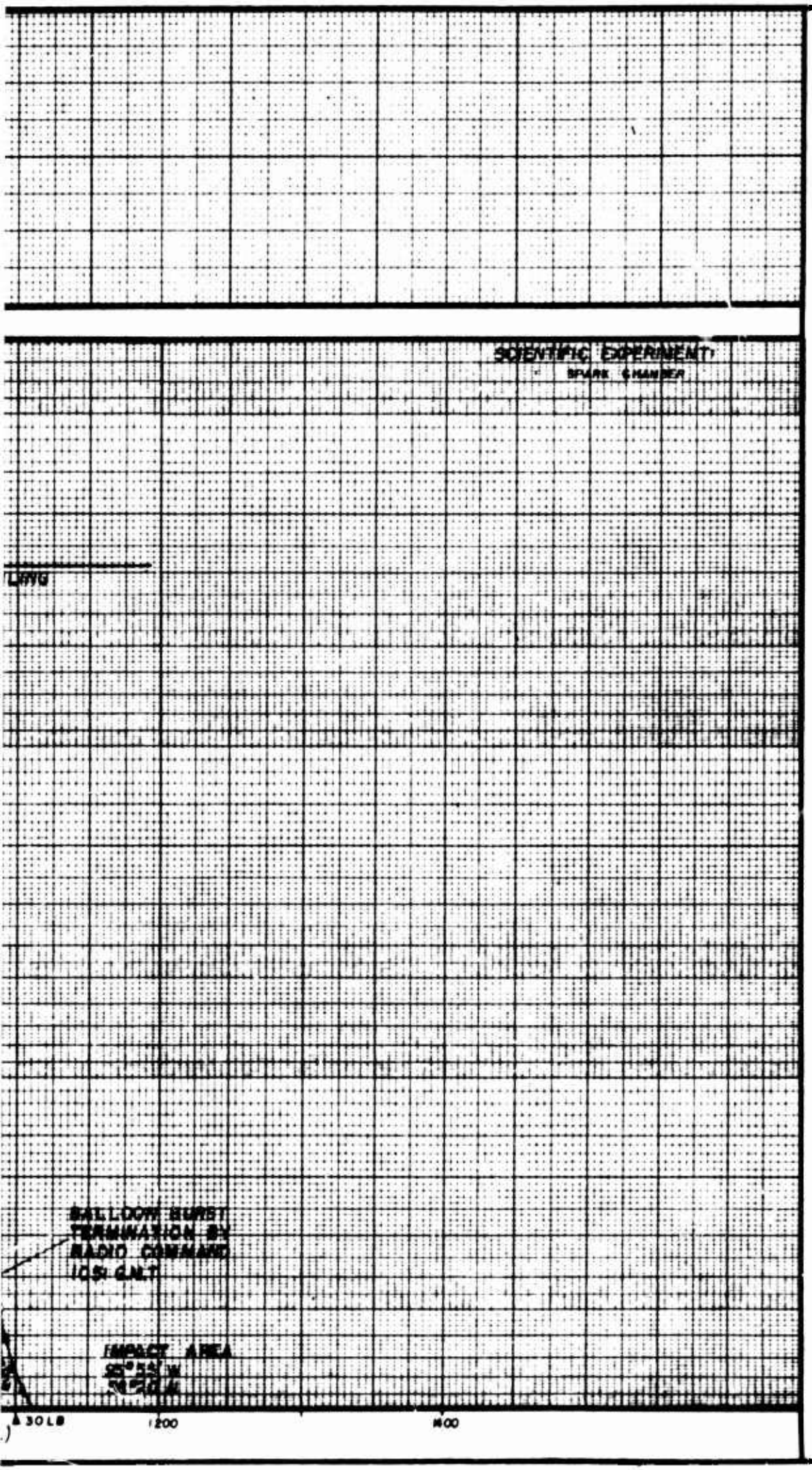
Remarks:

Surface winds were 4 to 6 mph at launch. The launch was smooth in a slight crosswind.

The balloon rose to 24,000 feet at 728 feet per minute and burst.

The payload was recovered undamaged by a PAA helicopter.


.6
.8
1
2
4
6
8
10
20
40
60
80
100
200
400
600
800
1000
PRESSURE IN MILLIBARS
0000
1000
TIME (G.M.T.)



FLIGHT NO. 1112-N

DATE: 8 AUGUST 1964

FOR: UNIV OF CHICAGO
DR. MEYER

BALLOON

TYPE: 2323-541-8291 S/N 143

VOL: 9 MILLION CU FT

MATL: .75 MIL POLY

WT: 952 0 LBS.

LOAD FACTORS

PAYLOAD: 820 0 LBS.

GROSS LD: 1772 0 LBS.

FREE LIFT: 159.0 LB= 8 97 %

BALLAST: 100.0 LBS.

RAVEN
industries, inc.

DR. DOMK 18 AUGUST 1964

CHK.

APPR.

B 03119

KYHOOK BALLOON FLIGHT INFORMATION
AVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1113-N

2. Scientist Dr. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 9 August 1964/0256 Z

Technique Anchor Line Director D. Johnson

4. Weather: Overcast 36° F NNW 6-8 Tropopause: Height 34.3K Temp -56 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.7 Mbs 126K ft. Actual: 126K ft. 3.7 Mbs
How altitude determined VHF FM/FM Be

6. Ascent: Surface to tropopause 997 fpm. ause to ceiling 470 fpm.

7. Flight duration: Total 21 hrs. 4 min. At ceiling 17 hrs. 30min.

8. Termination: Time 0000 Z Altitude 124K ft. Cause Radio Command

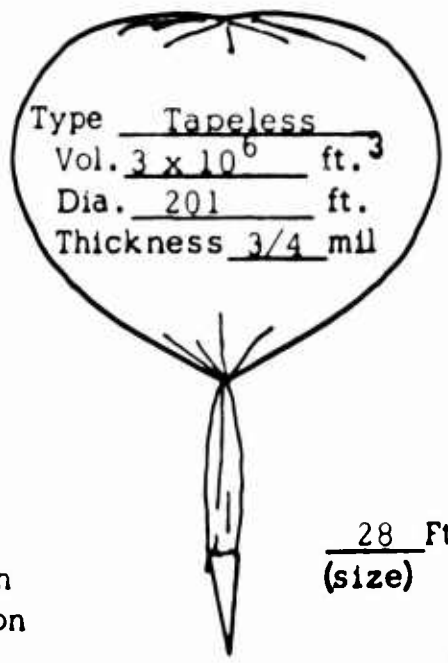
9. Balloon destruction - confirmed Unknown
(visual - unknown - etc.)

10. Impact: Date/Time 10 August /0043 Z Location 107° 35' W/57° 40'N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
253.1 Mcs	Beacon	22 hr.
149.4 Mcs	Radio Command	13 min.

12. Balloon: Code number 2333-541-8201 Serial number 200



28 Ft.chute
(size)

Complete sketch showing location equipment

	WEIGHT
Balloon	441 lb.
FAA Termination Timer	
Parachute	16
Instrumentation	60
Ballast	120
Scientific package	225
Other	
Gross Weight	862
Free Lift	86
Gross Inflation	948
Helium used	15,200 cu. ft.

Remarks: Good flight

Copy to:
NR/FldRep/Minn
NR/Code 421

Flight 1113-N

Remarks:

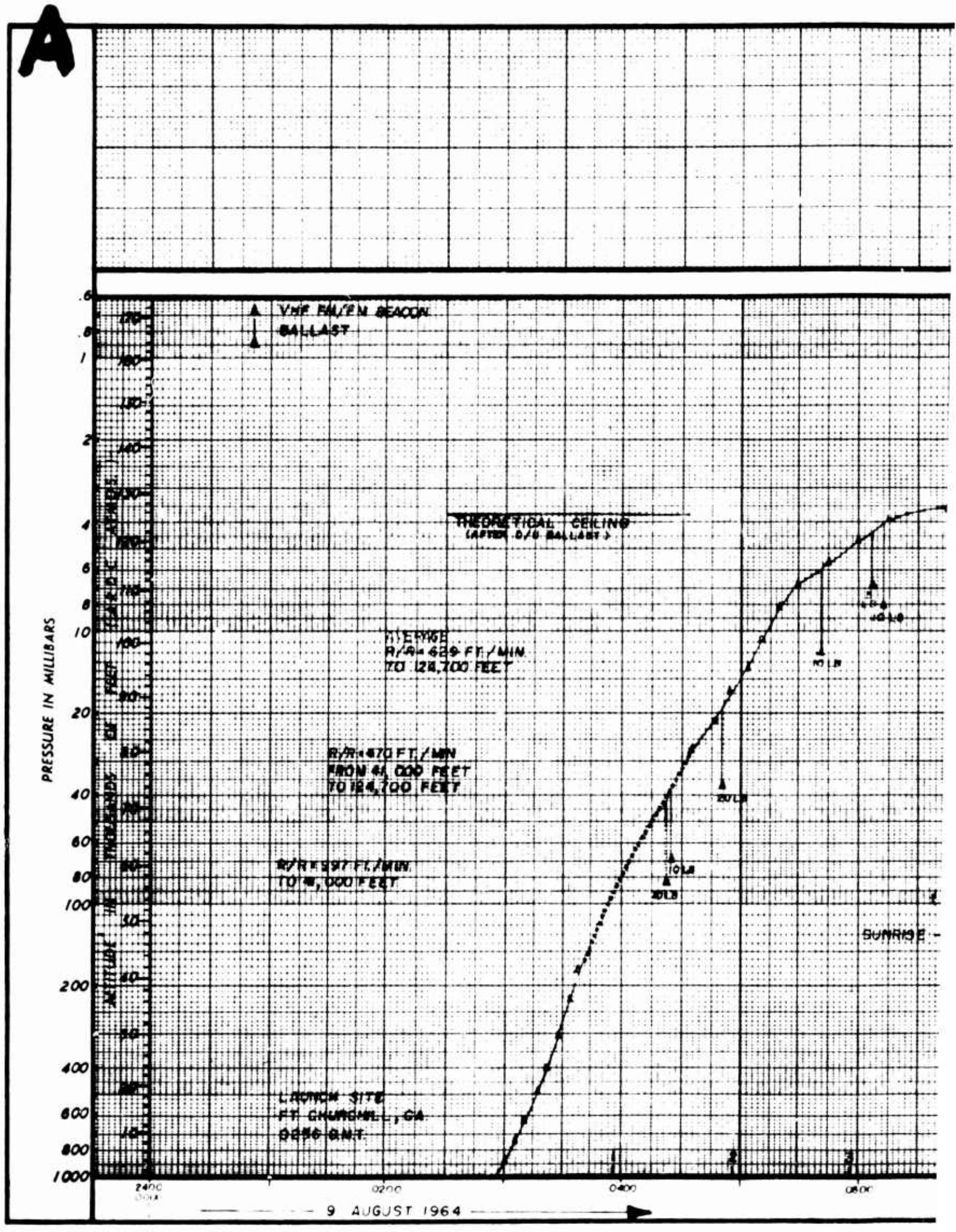
Surface winds were 6 to 8 mph at launch. The launch was perfect.

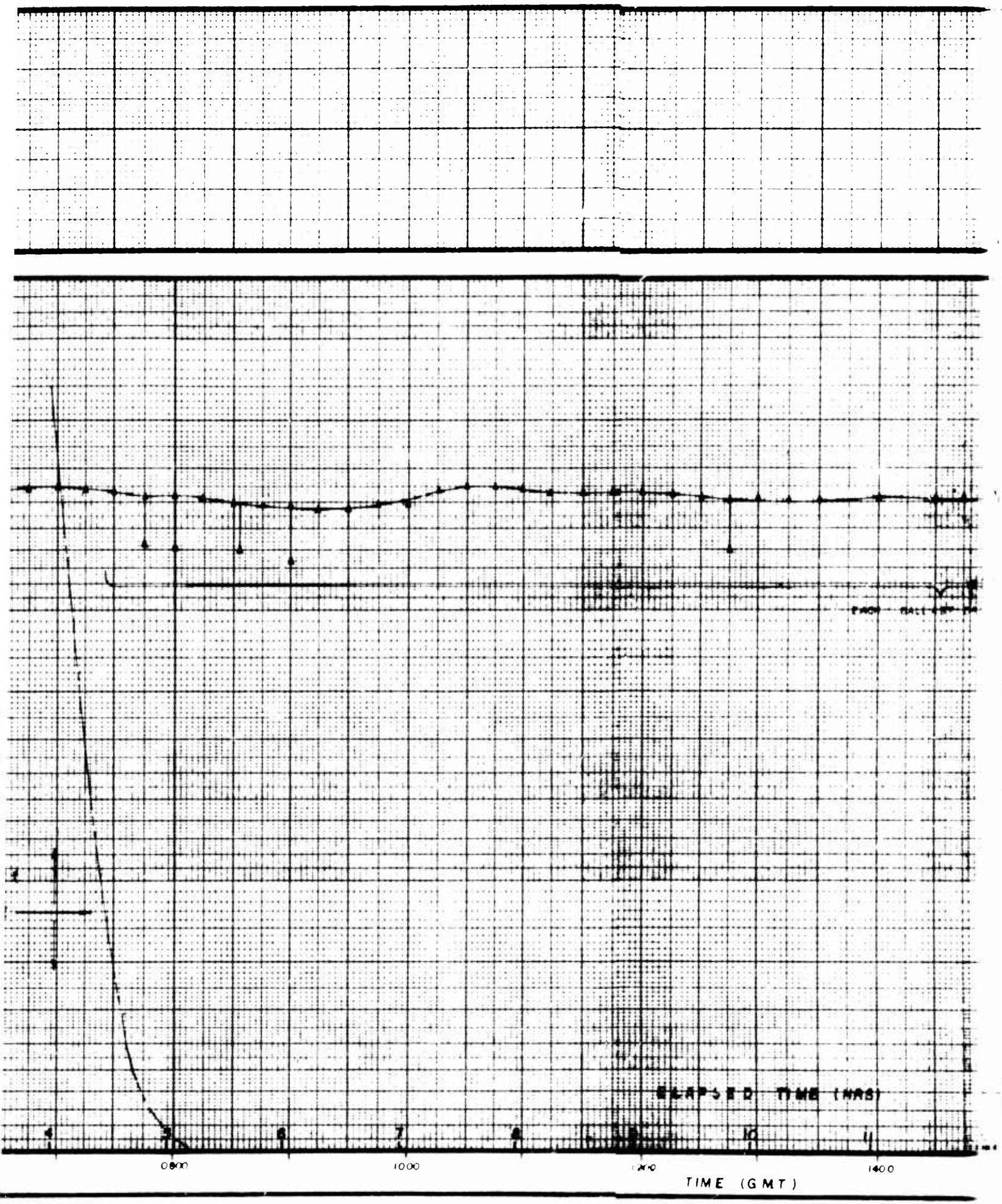
The balloon rose at 997 feet per minute to the tropopause and 470 feet per minute above that.

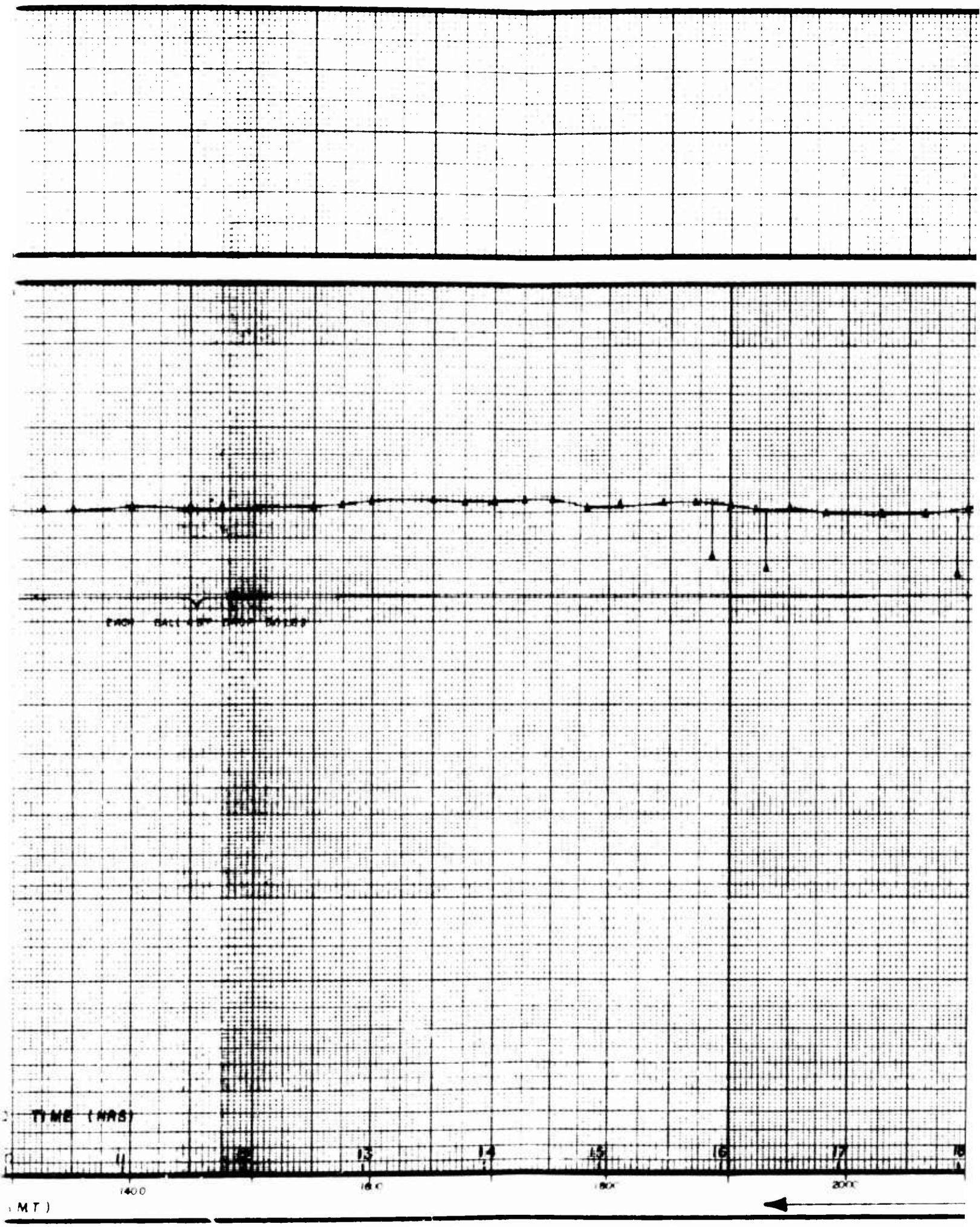
The flight was terminated by radio command after 17.5 hours at ceiling. Impact was 130 miles southwest of Stony Rapids.

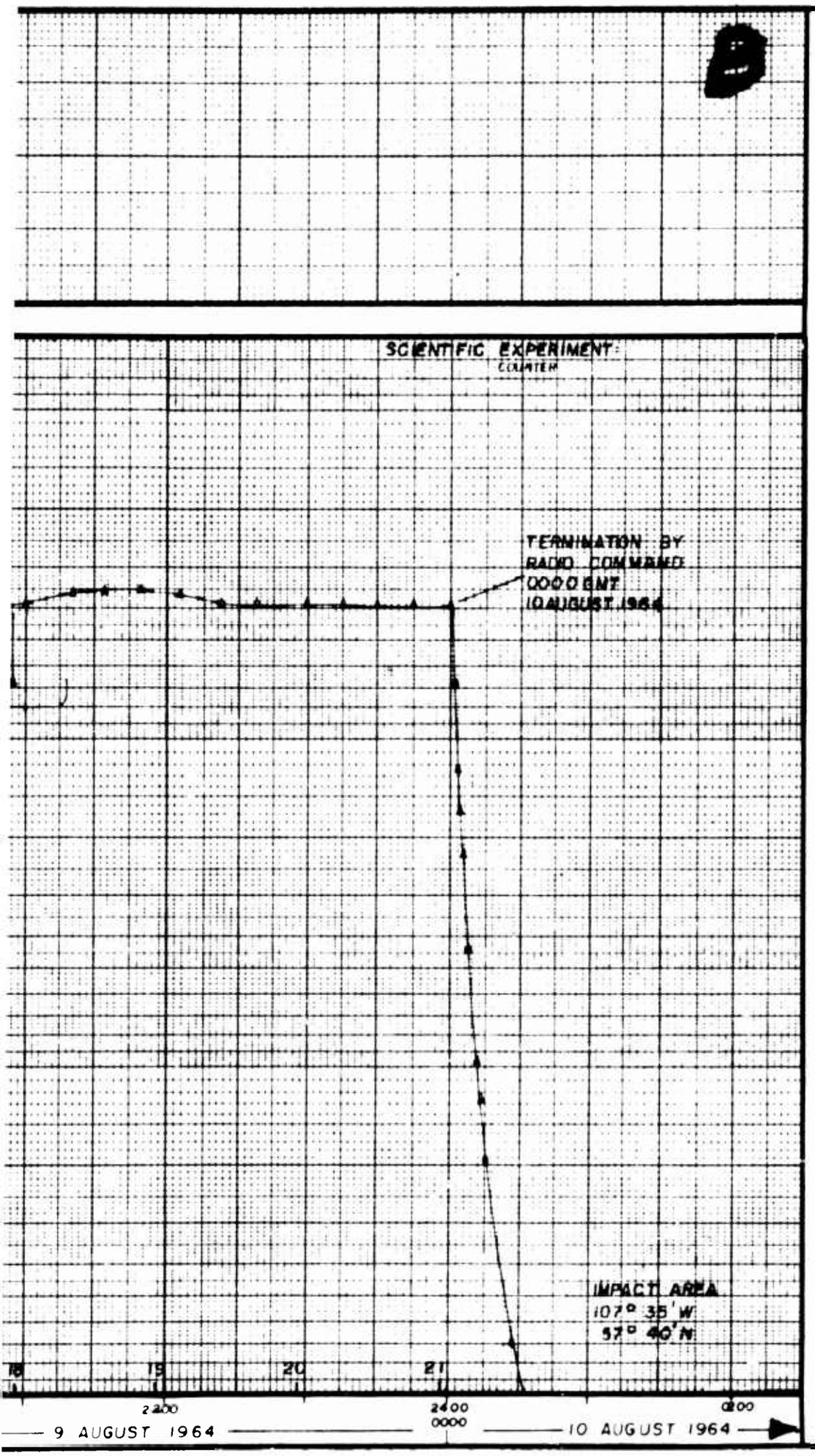
The weather in the recovery area was poor. Ceilings varied down to 300 feet and visibility from 2 to 3 miles.

The payload was spotted down in the evening and recovered in the morning by the Raven helicopter which was supported by both float planes.


A
VHF FM/PM BEACON
BALLAST
THEORETICAL CEILING
(AFTER D/B BALLAST)
R/R=629 FT./MIN
TO 124,700 FEET
R/R=670 FT./MIN
FROM 41,000 FEET
TO 124,700 FEET
R/R=297 FT./MIN.
TO 41,000 FEET
10 LB
20 LB
SUNRISE
LAUNCH SITE
FT. CHURCHILL, CAN
0056 G.M.T.
PRESSURE IN MILLIBARS
2400
0200
0400
0600
9 AUGUST 1964


ELAPSED TIME (HRS)
4
5
6
7
8
9
10
11
0800
1000
1200
1400
TIME (GMT)


TIME (HRS)
14
15
16
17
18
1400
1800
2000
MT)



FLIGHT NO. 1113-N

DATE 9 AUGUST 1964

FOR UNIV OF CHICAGO
DR. MEYER

BALLOON

TYPE 2333-541-8201 S/N 200

VOL 3 MILLION CU FT

MATL .75 MIL POLY

WT 4410 LBS

LOAD FACTORS

PAYLOAD 4210 LBS

GROSS LD 8620 LBS

FREE LIFT 86 LBS = 10 %

BALLAST 1200 LBS

RAVEN industries, inc.

DR. DONK 21 AUGUST 1964

CHK.

APPR.

X03126

EASTMAN CHART, THIRD BLUE GRADUATE

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1114-N

2. Scientist Dr. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 12 August 1964/0328 Z

Technique Anchor Line Director D. Johnson

4. Weather: Scattered 40° F N 8-12 Tropopause: Height 34.3K Temp -56 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.8 Mbs 126K ft. Actual: 126K ft. 3.8 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 630 fpm. Tropopause to ceiling 500 fpm.

7. Flight duration: Total 41+ hrs. ____ min. At ceiling ____ hrs. ____ min.

8. Termination: Time ____ Z Altitude ____ ft. Cause Could not be terminated

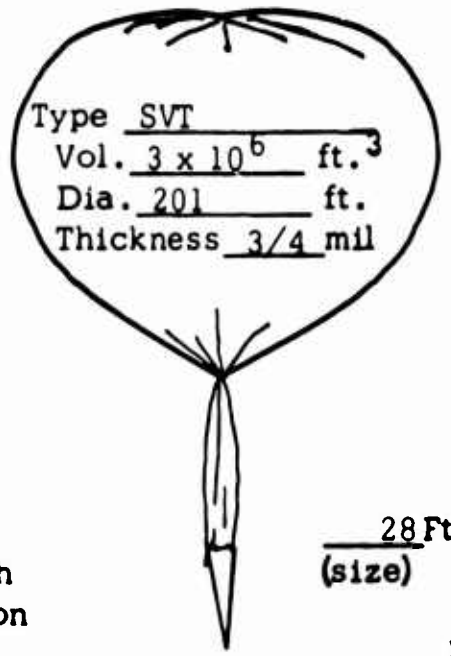
9. Balloon destruction - confirmed ____
(visual - unknown - etc.)

10. Impact: Date/Time ____ Z Location ____

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
253.1 Mcs	Beacon	41 hr.
149.4 Mcs.	Radio Command	25 min.

12. Balloon: Code number 2353-541-8201 Serial number 187



28 Ft. chute
(size)

complete sketch showing location of equipment

WEIGHT

Balloon	449 lb.
FAA Termination Timer	
Parachute	17
Instrumentation	60
Ballast	80
Scientific package	195
Other	
Gross Weight	801
Free Lift	80
Gross Inflation	881
Helium used	14,100 cu. ft.

Remarks: The parachute and all instrumentation was not recovered.

Copy to:
ONR/FldRep/Minn
ONR/Code 421

Flight 1114-N

Remarks:

The surface winds were from the north at 8 to 12 mph during inflation but were down to 5 to 8 mph by launch time. At 200 feet, however, the wind was 20 mph from the same direction.

After release, the balloon came straight down the layout direction at a rapid rate. The payload was taken off the cart abruptly and with some shock. The ability of the envelope (SVT Design) to sustain this shock provided evidence of an excellent balloon.

The balloon rose at 632 feet per minute through the tropopause and 360 feet per minute above that to ceiling.

The balloon floated at about 124,000 feet for 18 hours. The timer was set for termination at about 0115 G.M.T., 13 August 1964. When the timer did not terminate the flight, a radio command was issued but the parachute was not released.

Several subsequent commands were issued by both the recovery aircraft and ground station at Stony Rapids but to no avail.

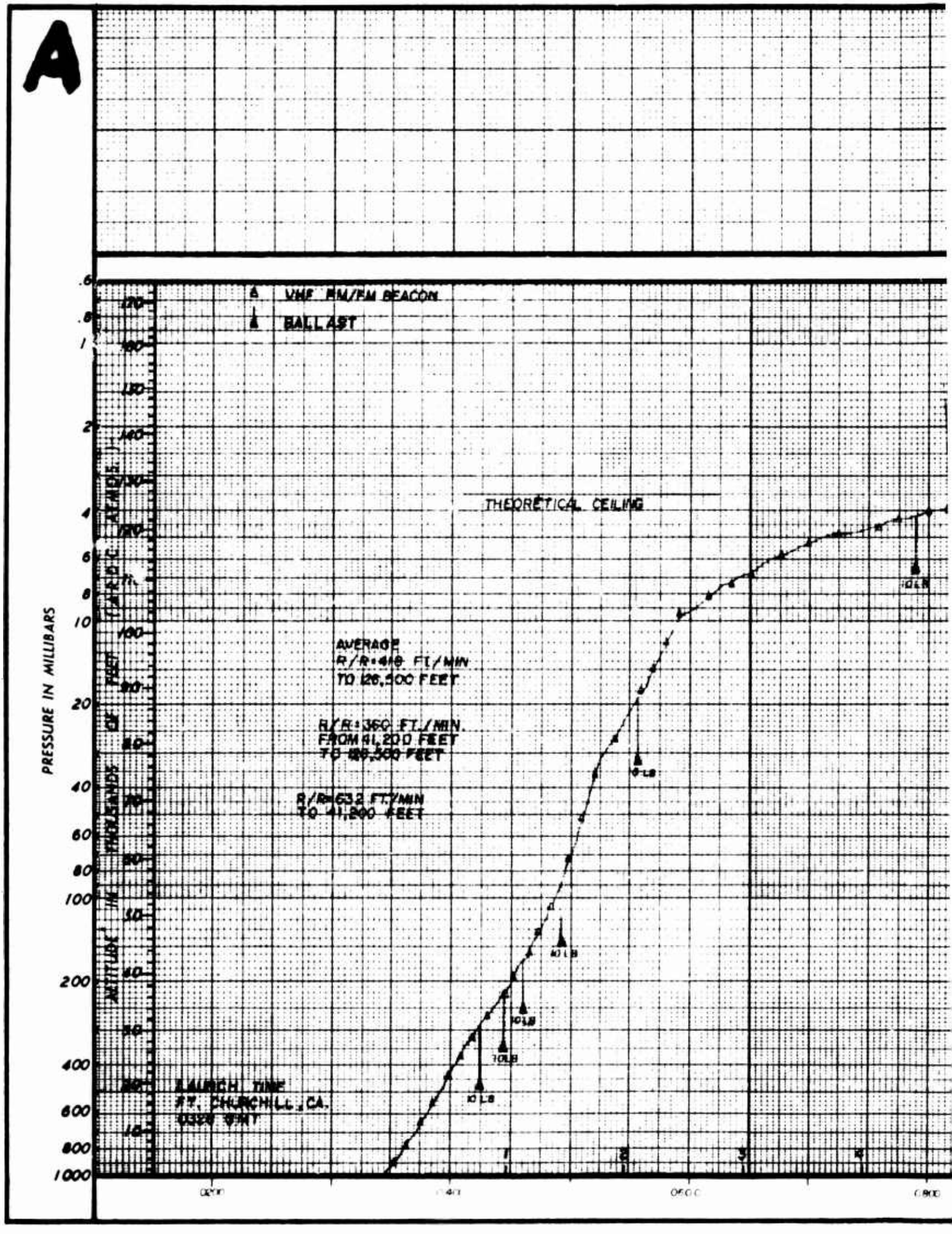
The recovery plane followed the balloon for another hour and frequently attempted to terminate the flight. Several ballast commands were issued

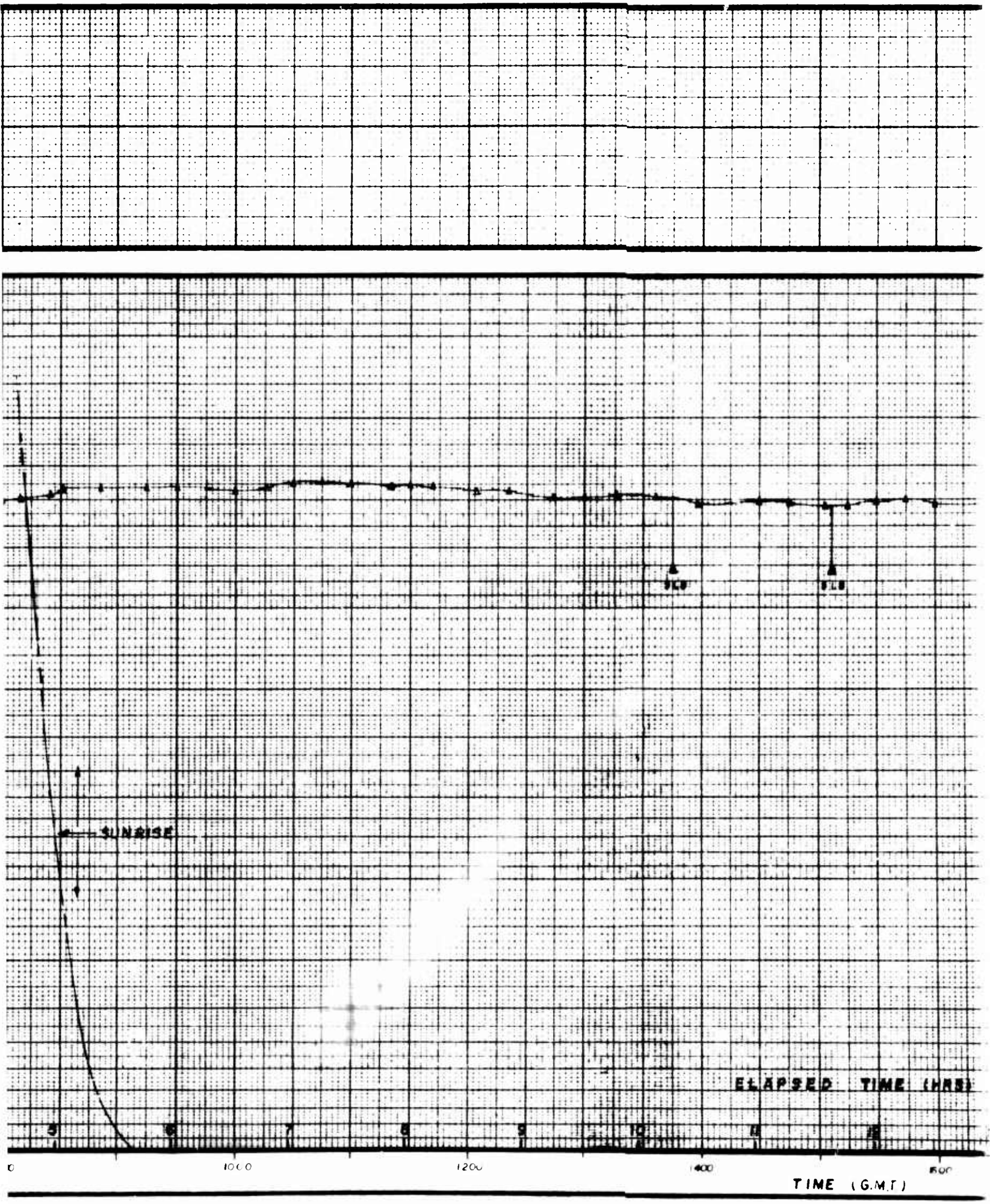
and verified,insuring that that the radio command link was operative. At 2000 G.M.T. the plane was forced to leave the balloon and return to Stony Rapids because of darkness.

The following morning the recovery plane attempted to reach the balloon; however, the signal in the aircraft was getting too weak to get a direction indication and an overcast prevented the balloon from being spotted visually.

Telemetry was recived at the ground station until 2000 G.M.T. on 13 August at which time the balloon was at 105,000 feet.

The Department of Transport was notified of the termination failure on 13 August 1964.


A
VHF FM/FM BEACON
BALLAST
THEORETICAL CEILING
AVERAGE
R/R=418 FT/MIN
TO 126,500 FEET
R/R=360 FT./MIN.
FROM 41,200 FEET
TO 126,500 FEET
R/R=632 FT/MIN
TO 41,200 FEET
10 LB
40 LB
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET (APPROX. ATMOS.)
LAUNCH TIME
FT. CHURCHILL, CA.


SUNRISE
ELAPSED TIME (HRS)
5
6
7
8
9
10
11
12
0
1000
1200
1400
1600
TIME (G.M.T)

B

SCIENTIFIC EXPERIMENT COUNTER

FLIGHT WAS NOT TERMINATED BY TIMER AS PROGRAMMED 0115 GMT, 12 AUGUST 1964.

THE FLIGHT COULD NOT BE TERMINATED BY RADIO COMMAND. NUMEROUS ATTEMPTS WERE MADE.

NOTE:
LAST RECORDED SIGNAL INDICATED BALLOON AT AN ALTITUDE OF 105,400 FEET AT 2000 HOURS GMT.

9 LB

9 LB

5 LB

SUNSET

ELAPSED TIME (HRS)

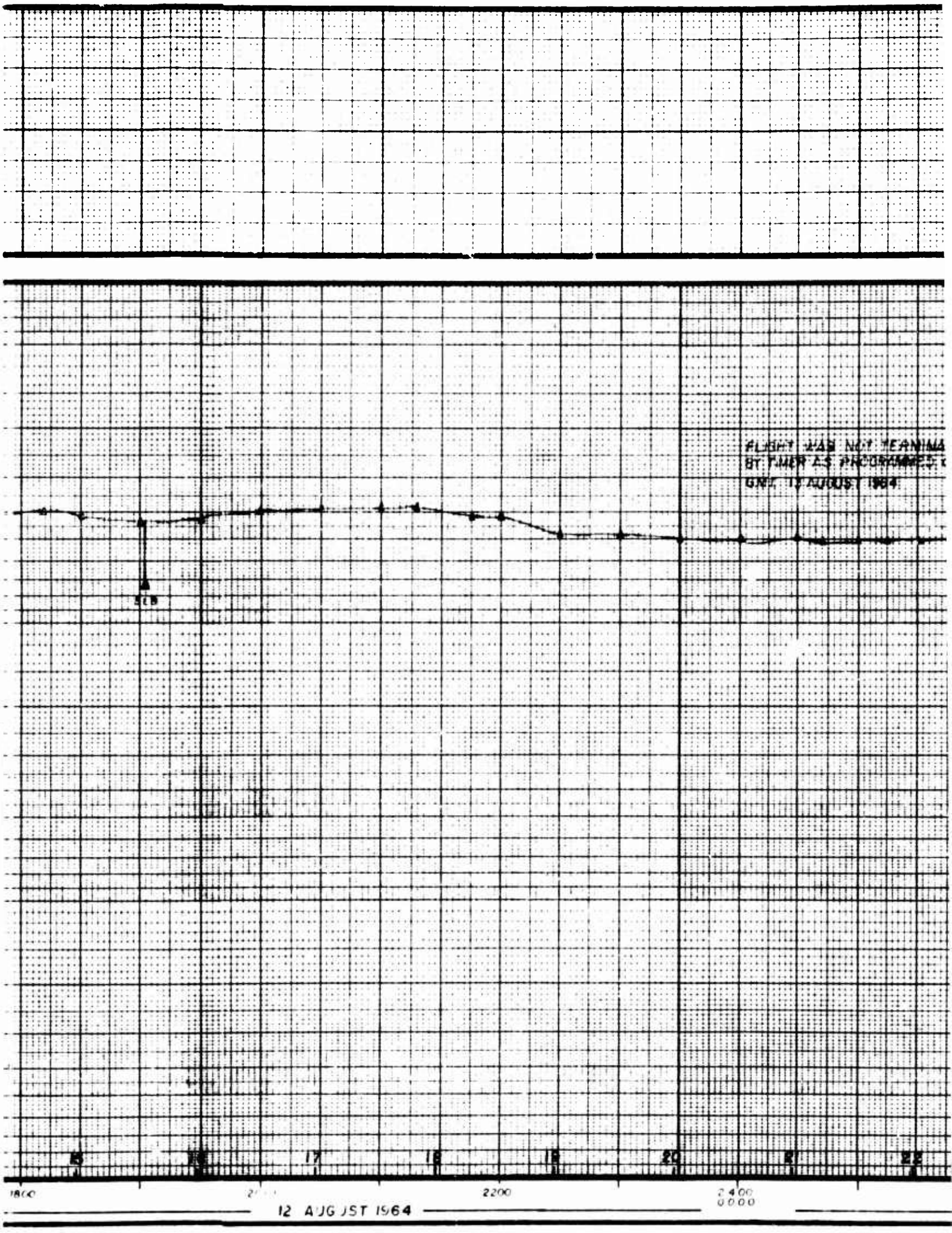
11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

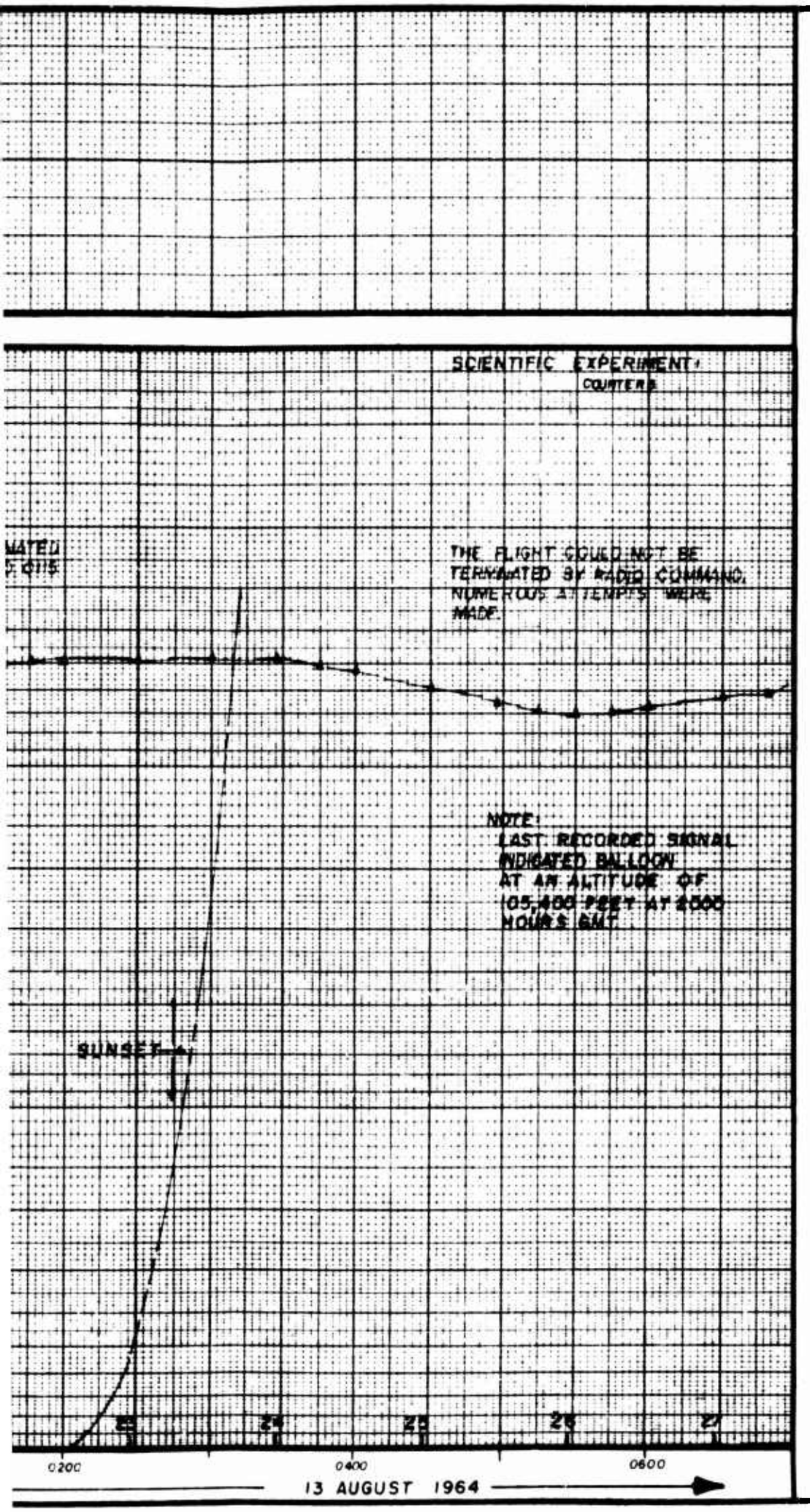
1800 2200 0000 0200 0400 0600

TIME (G.M.T.)

12 AUGUST 1964

13 AUGUST 1964


SEB
2200
12 AUGUST 1964



FLIGHT NO.1114-N

DATE: 12 AUGUST 1964

FOR: UNIV. OF CHICAGO
DR. MEYER

BALLOON

TYPE: 2353-541-8201 S/N187

VOL: 3 MILLION CU. F.T.

MATL: .75 MIL POLY

WT. 449.0 LBS.

LOAD FACTORS

PAYLOAD: 352.0 LBS.

GROSS LD: 801.0 LBS.

FREE LIFT: 80 LBS = 10 %

BALLAST: 80.0 LBS

RAVEN industries, inc.

DR. DONK 27 AUGUST 1964

CHK.

APPR. Jmf

X03151

C

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1115-N

2. Scientist Dr. McCracken Organization SW Center for Advanced Studies

3. Launch: Site Ft. Churchill Date/Time 12 August 1964/2316Z

Technique Anchor Line Director D. Johnson

4. Weather: _____ Tropopause: Height 34.3K Temp -56 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.2 Mbs 130K ft. Actual: 65K ft. 62 Mbs
How altitude determined VHF FM/FM Beacon and Churchill Radar

6. Ascent: Surface to tropopause 746 fpm. Tropopause to ceiling _____ fpm.

7. Flight duration: Total 1 hrs. 37 min. At ceiling _____ hrs. _____ min. _____

8. Termination: Time 0053 Z Altitude 65K ft. Cause Burst

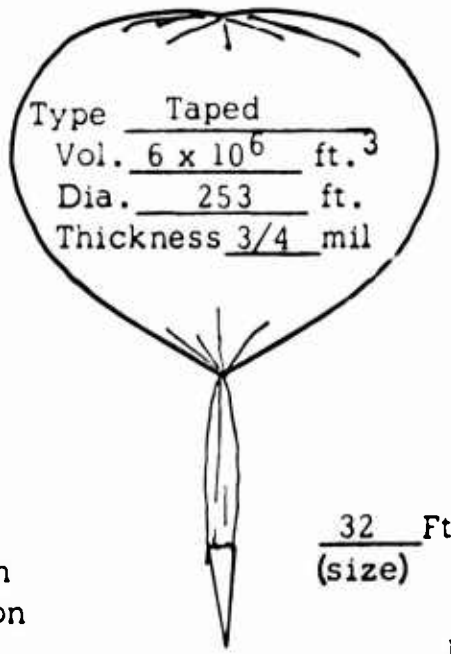
9. Balloon destruction - confirmed Visual
(visual - unknown - etc.)

10. Impact: Date/Time 13 August/0112 Z Location 94° 07' W/58° 11' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
253.1 Mcs	Beacon	2 hr.
149.4 Mcs	Radio Command	1 min.

12. Balloon: Code number 2323-541-8253 Serial number 130



32 Ft. chute
(size)

complete sketch showing location of equipment

WEIGHT

Balloon	717 lb.
FAA Termination Timer	
Parachute	15
Instrumentation	60
Ballast	112
Scientific package	123
Other	
Gross Weight	1,027
Free Lift	92
Gross Inflation	1,119
Helium used	18,000 cu. ft.

Remarks:

Copy to:
NR/FldRep/Minn
ONR/Code 421

Flight 1115-N

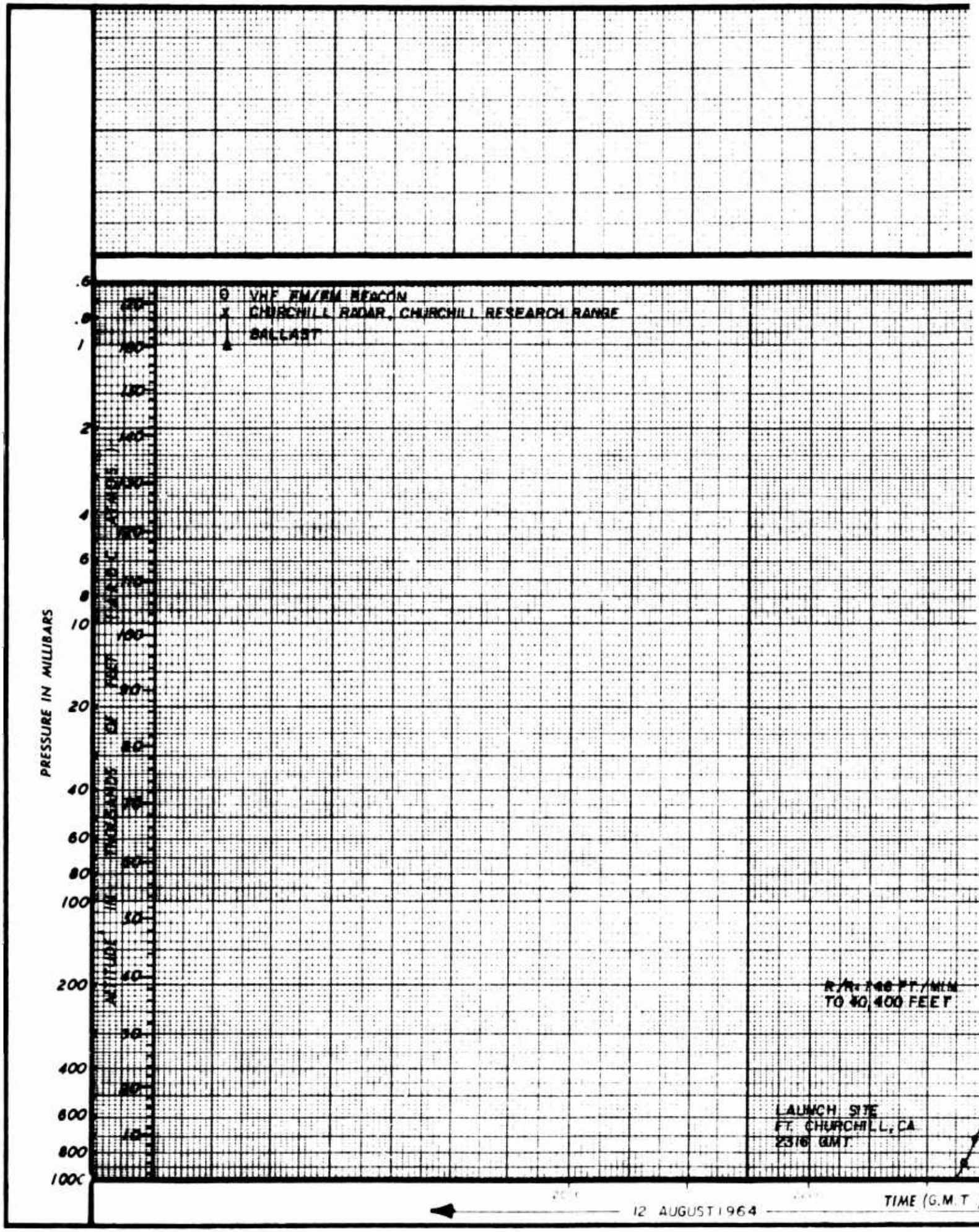
Remarks:

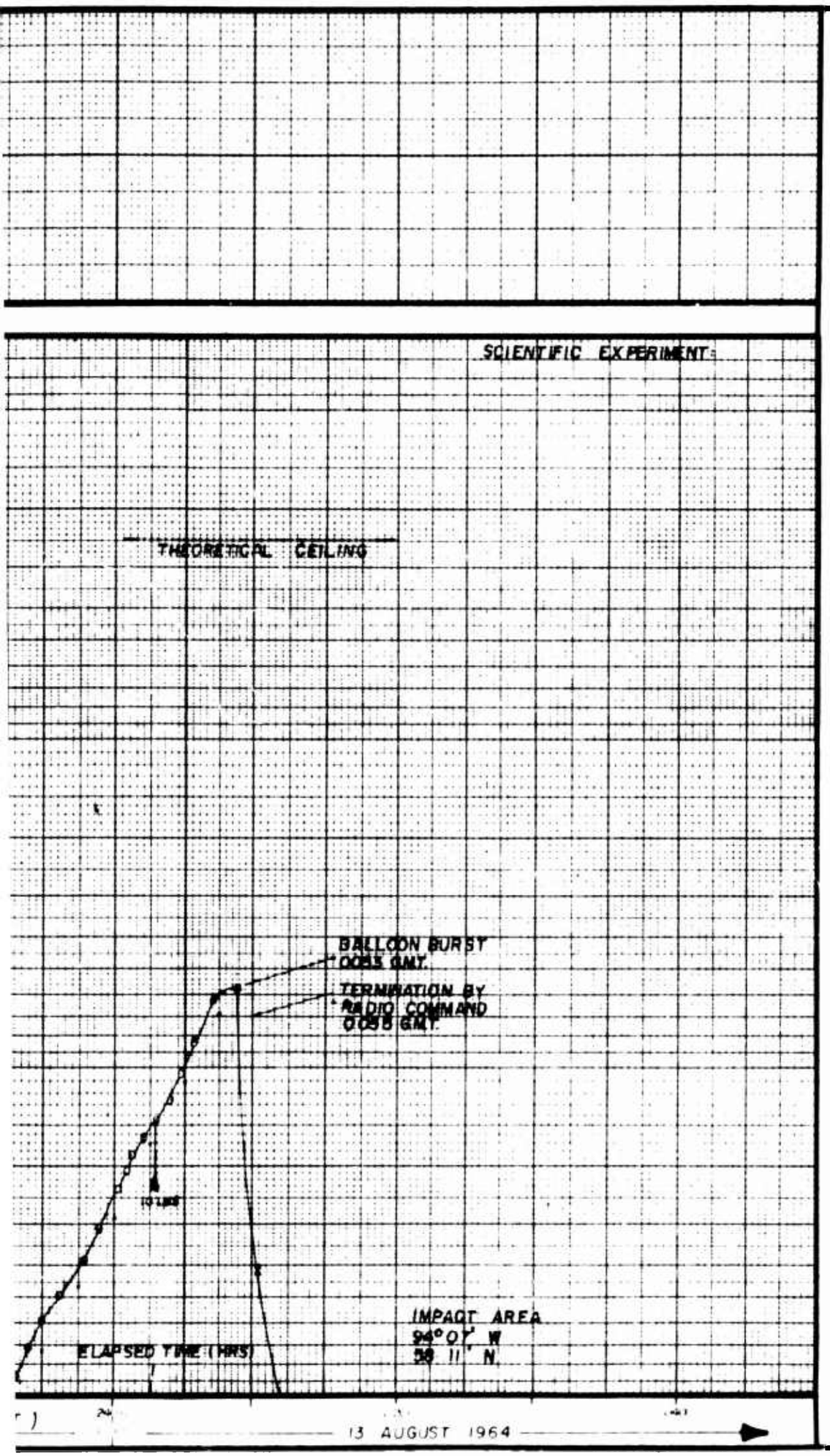
Weather conditions on the surface were clear and calm. The launch was very smooth.

The balloon rose at about 700 feet per minute to 65,000 feet where a burst occurred.

The parachute was released from the balloon to prevent fouling.

The payload was recovered by a PAA helicopter. The payload sustained limited damage on impact.


Θ VHF FM/FM BEACON
X CHURCHILL RADAR, CHURCHILL RESEARCH RANGE
BALLAST
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET
R/R: 440 FT./MIN.
TO 40,400 FEET
LAUNCH SITE
FT. CHURCHILL, CA.
2316 GMT
12 AUGUST 1964
TIME (G.M.T.)



FLIGHT NO. 1115-N

DATE [illegible] AUGUST 1964

FOR SW CENTER FOR
ADVANCED STUDIES
DR. McCRACKEN

BALLOON

TYPE [illegible]

VOL [illegible] CU FT

MATL [illegible]

WT [illegible]

LOAD FACTORS

PAYLOAD 310.[illegible]

GROSS LD 1027.[illegible]

FREE LIFT [illegible] %

BALLAST [illegible]

RAVEN industries, inc.

DR. [illegible]

CHK.

APPR. [illegible]

B 03131

CAUTION AHAMO THIS BUSS GRADMATE

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1116-N

2. Scientist Dr. Meyer Organization University of Chicago

3. Launch: Site Ft. Churchill Date/Time 13 August 1964/ 0313 Z

Technique Anchor Line Director D. Johnson

4. Weather: _____ Tropopause: Height 35K Temp -52 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 2.9 Mbs 132K ft. Actual: 41K ft. 180 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 633 fpm. Tropopause to ceiling _____ fpm.

7. Flight duration: Total 1 hrs. 4 min. At ceiling _____ hrs. _____ min.

8. Termination: Time 0417 Z Altitude 41K ft. Cause Burst

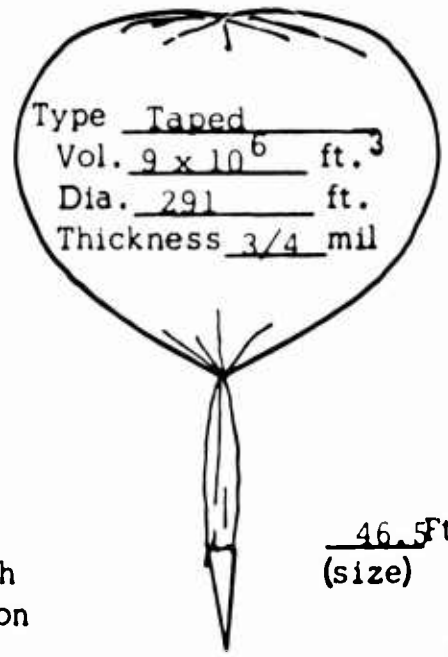
9. Balloon destruction - confirmed Visual
(visual - unknown - etc.)

10. Impact: Date/Time 13 August/0435 Z Location 93° 56'W/ 58° 10'N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
255.1 Mcs	Beacon	2 hr.
149.4 Mcs	Radio Command	3 min.

12. Balloon: Code number 2323-541-8291 Serial number 139



46.5 Ft. chute (size)

complete sketch showing location of equipment

WEIGHT

Balloon	955 lb.
FAA Termination Timer	
Parachute	
Instrumentation	
Ballast	
Scientific package	
Other	823
Gross Weight	1778
Free Lift	160
Gross Inflation	1938
Helium used	31,000 cu. ft.

Remarks:

Copy to:
NR/FldRep/Minn
ONR/Code 421

Flight 1116-N

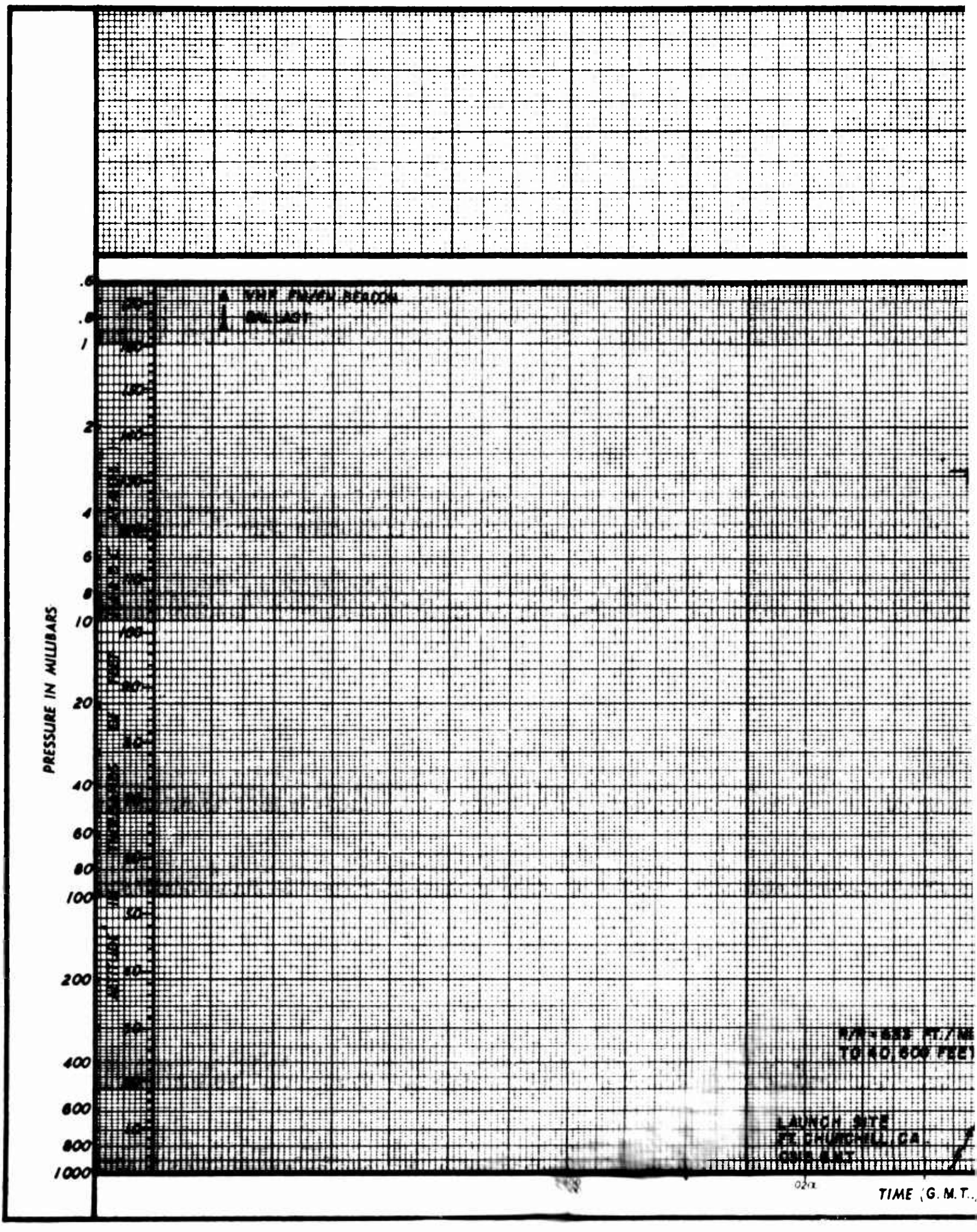
Remarks:

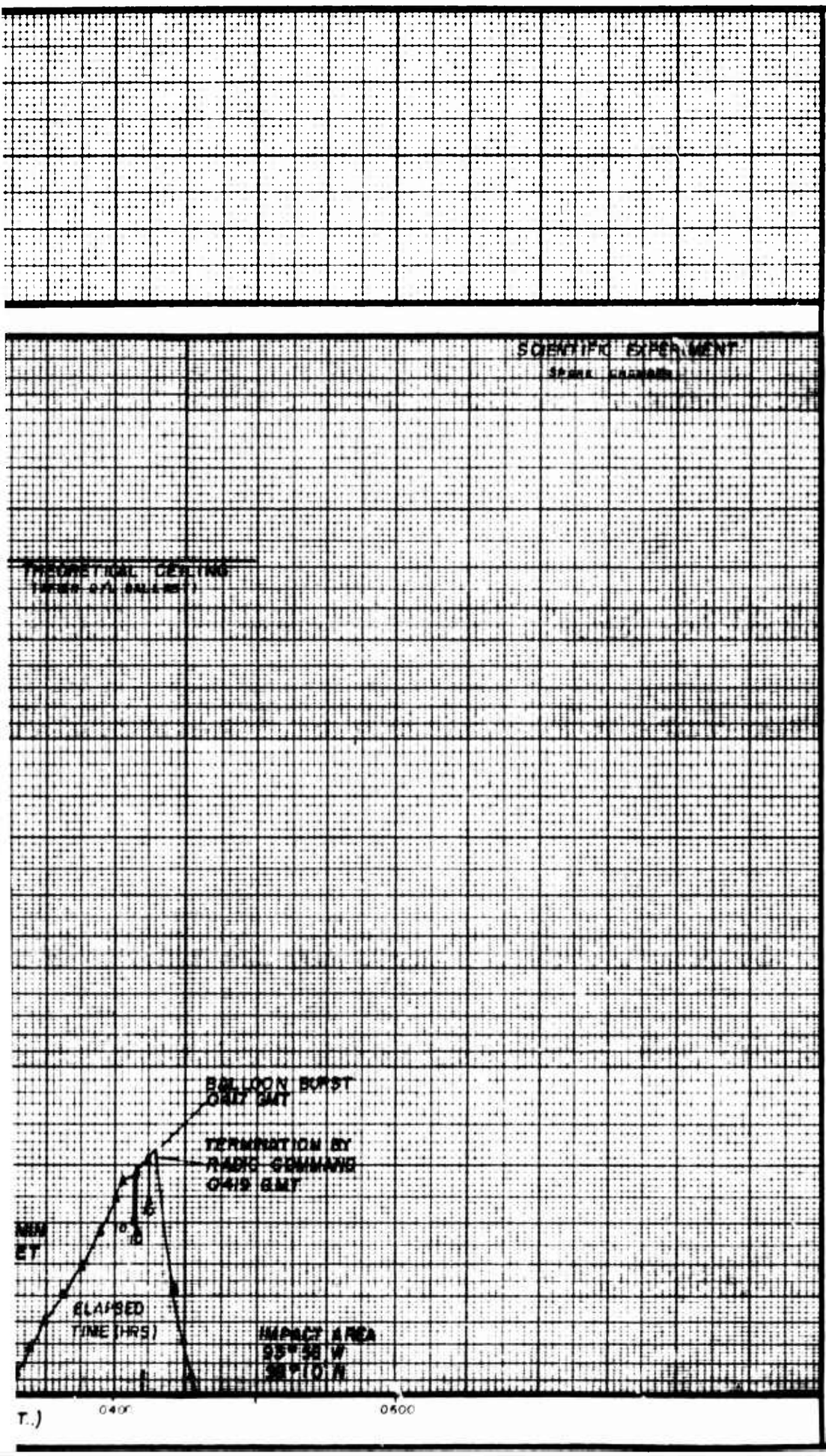
The balloon was released from the spool at 0313 G.M.T; the launch was smooth.

The balloon rose at 633 feet per minute to 40,600 feet where a burst occurred.

The parachute was released from the balloon to preclude a fouling. Parachute impact was at 0434 G.M.T.

The payload was recovered by a PAA helicopter. The scientific gondola suffered extensive damage at impact.


PRESSURE IN MILLIBARS
.6
.8
1
2
4
6
8
10
20
40
60
80
100
200
400
600
800
1000
02Z
TIME (G.M.T.,



FLIGHT NO. 1116-N

DATE: 13 AUGUST 1964

FOR: UNIV. OF CHICAGO
DR. MEYER

BALLOON

TYPE: 2323-541-8291 S/N 139

VOL: 9 MILLION CU. FT.

MATL: .75 MIL POLY

WT: 955.0 LBS.

LOAD FACTORS

PAYLOAD: 823.0 LBS.

GROSS LD: 1778.0 LBS.

FREE LIFT: 160.0 LBS = 9%

BALLAST: 90 LBS.

RAVEN industries, inc.

DR. DONK 24 AUGUST 1964

CHK.

APPR.

B 0 3 1 3 2

TYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

Company Raven Industries, Inc. Flight Number 1117-N

2. Scientist Dr. McCracken Organization SW Center for Advanced Studies

3. Launch: Site Ft. Churchill Date/Time 14 August 1964/0156 Z

Technique Anchor Line Director D. Johnson

4. Weather: _____ Tropopause: Height 32.5K Temp -49 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.73 Mbs 126K ft. Actual: 126K ft. 3.73 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 1125 fpm. Tropopause to ceiling 400 fpm.

7. Flight duration: Total 22 hrs. 48 min. At ceiling 19 hrs. _____ min.

8. Termination: Time 0044 Z Altitude 126 ft. Cause Radio Command

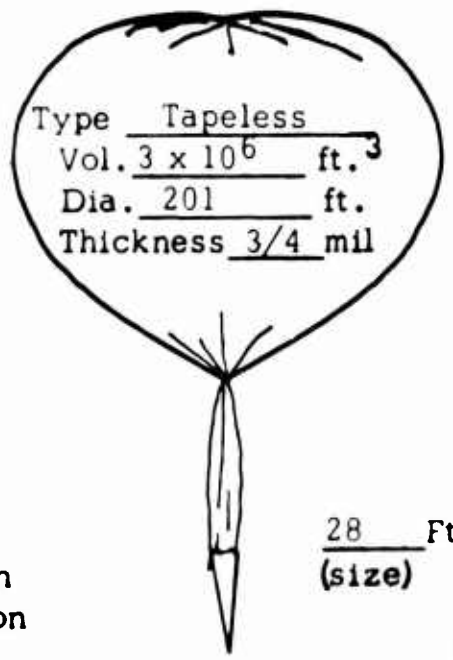
9. Balloon destruction - confirmed Unknown
(visual - unknown - etc.)

10. Impact: Date/Time 15 August/0118 Z Location 102° 49' W/ 58° 28' N

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
253.1 Mcs	Beacon	24 hr.
149.4 Mcs	Radio Command	10 min.

12. Balloon: Code number 2333-541-8201 Serial number 186



28 Ft. chute
(size)

complete sketch showing location equipment

WEIGHT

Balloon	443 lb.
FAA Termination Timer	
Parachute	17
Instrumentation	
Ballast	
Scientific package	
Other	327
Gross Weight	787
Free Lift	78
Gross Inflation	865
Helium used	13,900 cu. ft.

Remarks: Good flight

Copy to:
NR/FldRep/Minn
ONR/Code 421

Flight 1117-N

Remarks:

The balloon was released in light winds; the launch was very smooth.

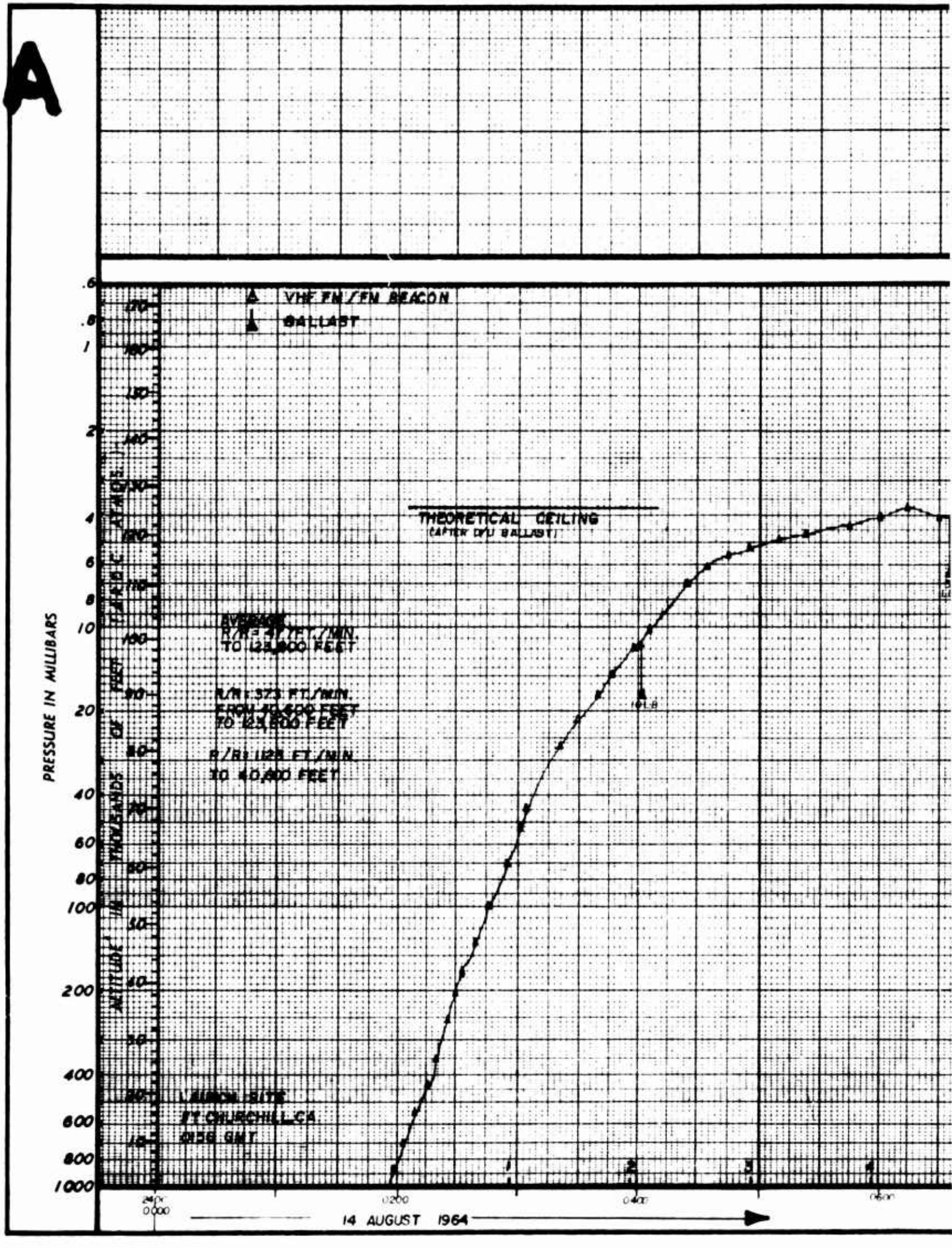
The balloon rose at 1125 feet per minute to the tropopause and about 400 feet per minute above that to ceiling.

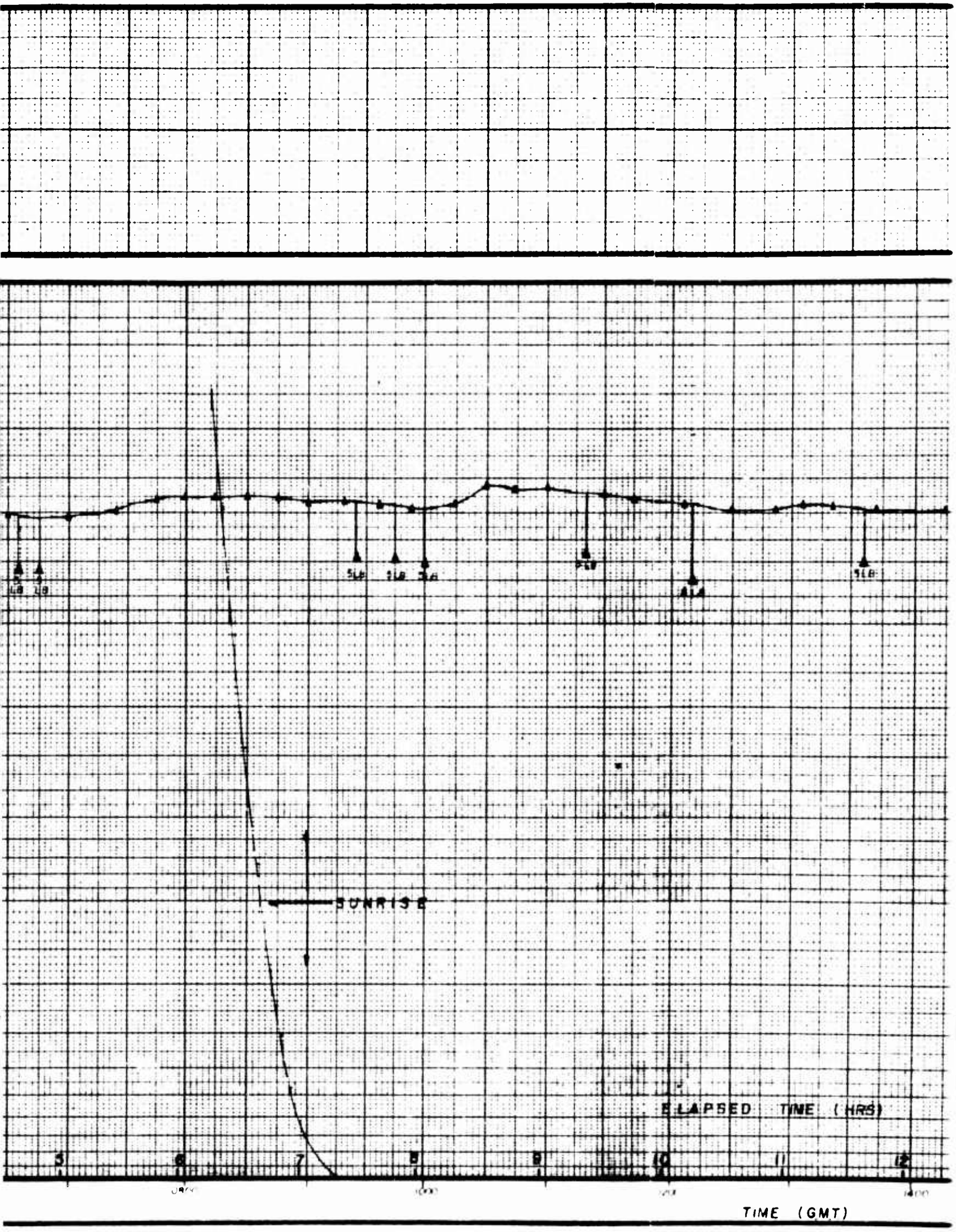
The balloon floated at about 126,000 feet for 19 hours. The average balloon velocity at altitude was 15 mph which indicated that the time of the upper-wind change-over was approaching.

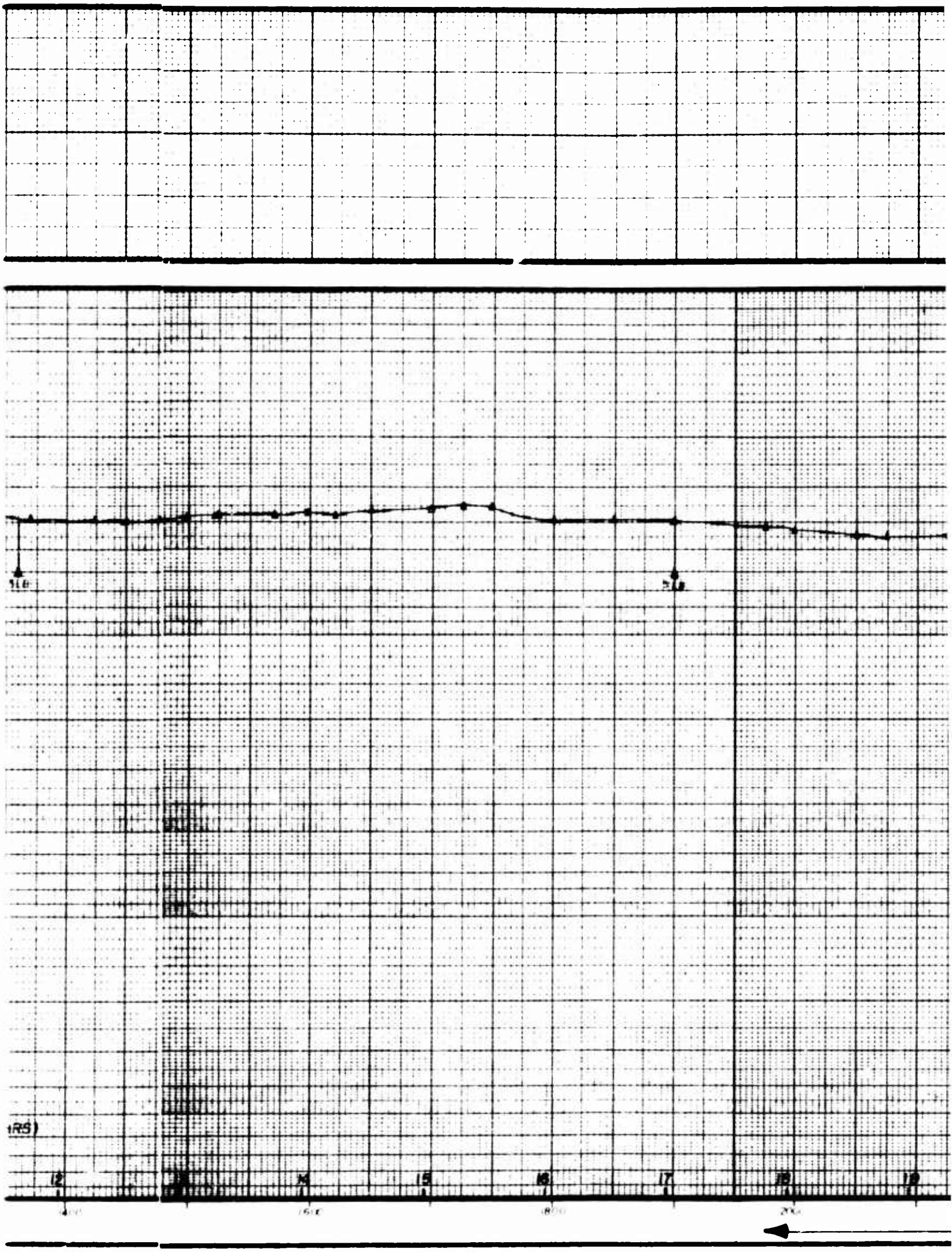
The flight was terminated at 0044 G.M.T., 15 August by radio command. Impact was 130 miles east southeast of Stony Rapids.

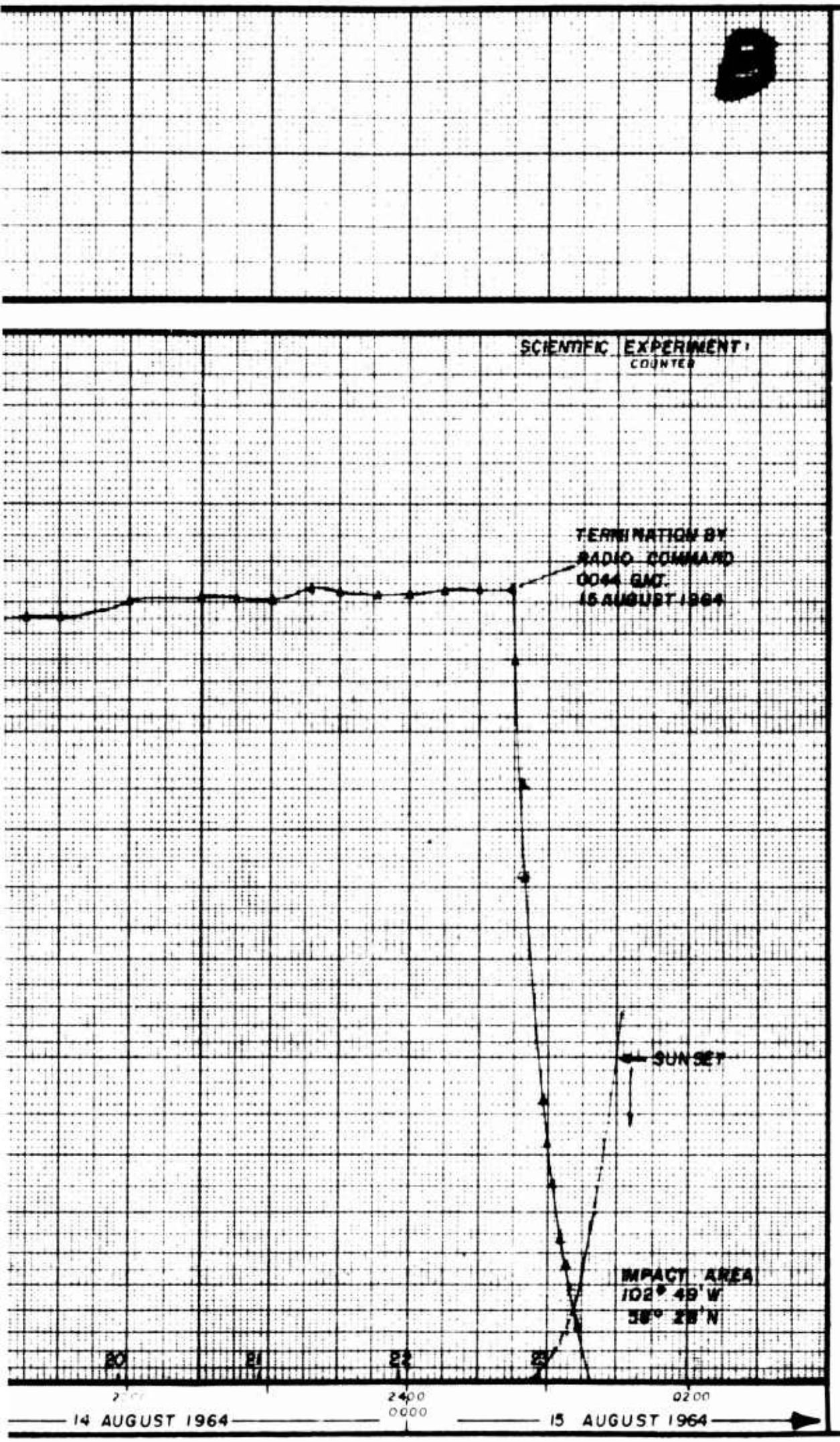
The weather in the recovery area was poor. The sky was overcast and the ceiling varied from 0 to 200 feet. Visibility was 0 to 4 miles.

The payload was recovered by the Raven helicopter which was supported by a float plane.


A
VHF FM/FM BEACON
BALLAST
THEORETICAL CEILING
(AFTER D/U BALLAST)
AVERAGE
R/R: 871 FT./MIN.
TO 123,900 FEET
R/R: 373 FT./MIN.
FROM 40,600 FEET
TO 123,600 FEET
R/R: 128 FT./MIN.
TO 40,800 FEET
101.8
PRESSURE IN MILLIBARS
ALTITUDE IN THOUSANDS OF FEET
VAISON SITE
FT CHURCHILL CA
0156 GMT
14 AUGUST 1964
0000
0200
0400


SUNRISE
ELAPSED TIME (HRS)
TIME (GMT)





FLIGHT NO. 1117-N

DATE 14 AUGUST 1964

FOR S.W CENTER FOR ADVANCED STUDIES
DR Mc CRACKEN

BALLOON

TYPE 2333-541-8201 S/N 188

VOL 3 MILLION CU FT

MATL .75 MIL POLY

WT 443.0 LBS.

LOAD FACTORS

PAYLOAD 344.0 LBS.

GROSS LD 787.0 LBS

FREE LIFT 78 LBS = 10 %

BALLAST 55.0 LBS

RAVEN industries, inc.

DR.

CHK.

APPR.

X 03135

E88110 AHAMO .THIRS 3UJS ORACHATS

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1118-N

2. Scientist Dr. Earl Organization University of Minnesota

3. Launch: Site Ft. Churchill Date/Time 16 August 1964

Technique Anchor Line Director D. Johnson

4. Weather: _____ Tropopause: Height _____ Temp _____ °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical _____ Mbs _____ ft. Actual: _____ ft. _____ Mbs
How altitude determined _____

6. Ascent: Surface to tropopause _____ fpm. Tropopause to ceiling _____ fpm.

7. Flight duration: Total _____ hrs. _____ min. At ceiling _____ hrs. _____ min. _____

8. Termination: Time _____ Z Altitude _____ ft. Cause Balloon ruptured during inflation.

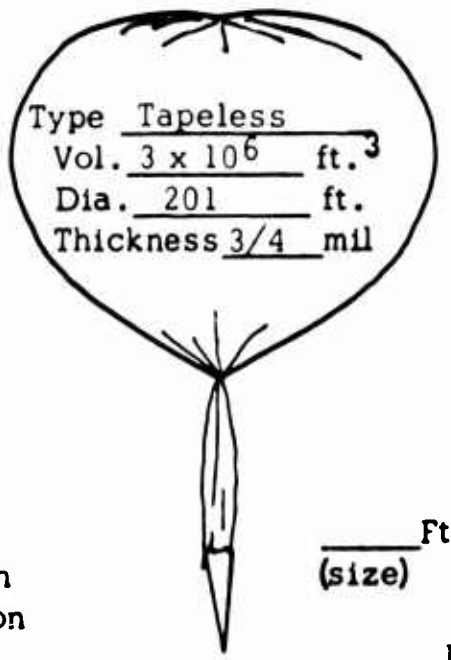
9. Balloon destruction - confirmed _____ _____
(visual - unknown - etc.)

10. Impact: Date/Time _____ Z Location _____

11. Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)

12. Balloon: Code number 2333-541-8201 Serial number 183



_____ Ft. chute
(size)

Complete sketch showing location of equipment

WEIGHT

Balloon	447 lb.
FAA Termination Timer	
Parachute	16
Instrumentation	60
Ballast	60
Scientific package	145
Other	
Gross Weight	728
Free Lift	72
Gross Inflation	800
Helium used	12,500 cu. ft.

Remarks:

Copy to:
(NR/FldRep/Minn
CNR/Code 421

Flight1118-N

Remarks:

The balloon was laid out in a period of light surface winds; however, during inflation the winds increased to about 10 mph.

After the balloon was fully inflated, the inflation tube was tied off and held by a launch crew member to reduce bubble twisting in the spool while final preparations were made for launch.

During this short period, the balloon ruptured, in an area remote from the inflation tube.

SKYHOOK BALLOON FLIGHT INFORMATION
NAVEXOS 3900/2 (Rev. 11-63)

1. Company Raven Industries, Inc. Flight Number 1119-N

2. Scientist Dr. Earl Organization University of Minnesota

3. Launch: Site Ft. Churchill Date/Time 17 August 1964/1957 Z

Technique Anchor Line Director D. Johnson

4. Weather: _____ Tropopause: Height 35.5K Temp -54 °C
(Sky - Temp - Wind - Press)

5. Balloon Ceiling: Theoretical 3.5 Mbs 127K ft. Actual: 125K ft. 3.8 Mbs
How altitude determined VHF FM/FM Beacon

6. Ascent: Surface to tropopause 803 fpm. Tropopause to ceiling 462 fpm.

7 Flight duration: Total 6 hrs. 18 min. At ceiling 3 hrs. _____ min. _____

8 Termination: Time 0215 Z Altitude 125K ft. Cause Radio Command

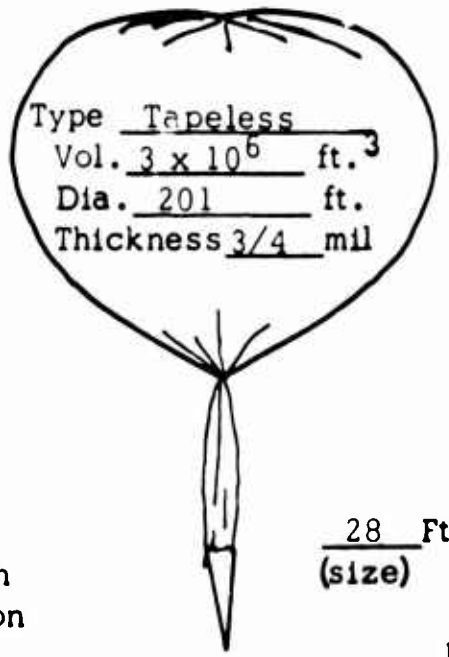
9. Balloon destruction - confirmed Visual
(visual - unknown - etc.)

10. Impact: Date/Time 18 August/ 0257 Z Location 93° 50' W / 58° 37' N

11 Frequency used:

(Kcs, Mcs)	(Purpose)	(Total Time)
255.1 Mcs	Beacon	7 hr.
149.4 Mcs	Radio Command	3 min.

12 Balloon: Code number 2333-541-8201 Serial number 201



28 Ft.chute
(size)

complete sketch showing location o equipment

WEIGHT

Balloon	447 lb.
FAA Termination Timer	
Parachute	16
Instrumentation	60
Ballast	60
Scientific package -	145
Other	
Gross Weight	728
Free Lift	72
Gross Inflation	800
Helium used	12,600 cu. ft.

Remarks: Good flight

Copy to:
C R/FldRep/Minn
C R/Code 421

Flight 1119-N

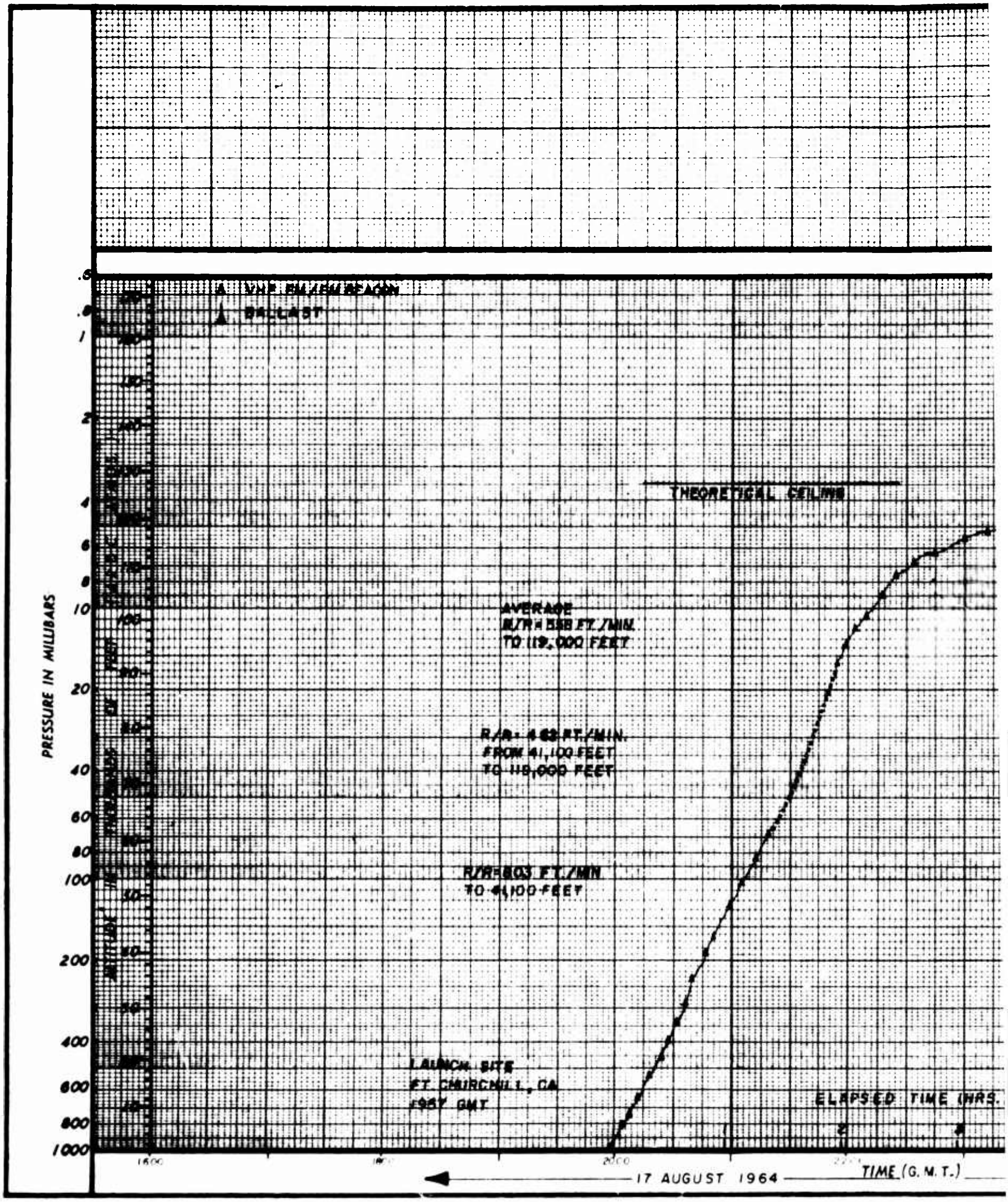
Remarks:

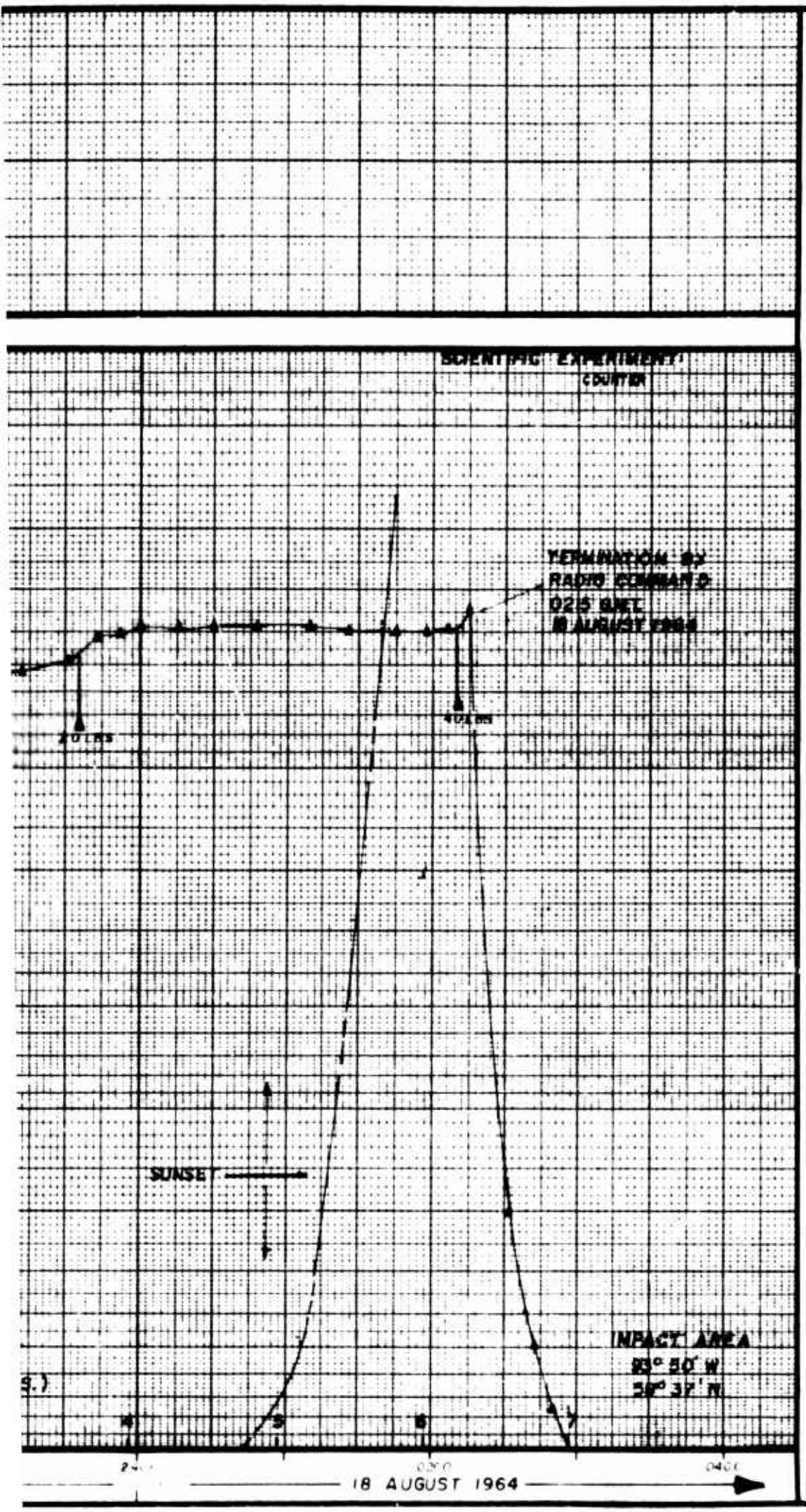
The balloon was inflated and launched in a period of light surface winds.

The balloon rose at 803 feet per minute to about 40,000 feet and 462 feet per minute above that to ceiling.

During the period of ascent, the balloon went west and after reaching ceiling, moved slowly back east toward Ft. Churchill and Hudson Bay.

The flight was terminated after 3 hours at 125,000 feet and was recovered near Ft. Churchill by truck.


A VHF EMISSION BEACON
▲ BALLAST
PRESSURE IN MILLIBARS
.5
.8
1
2
4
6
8
10
20
40
60
80
100
200
400
600
800
1000
THEORETICAL CEILING
AVERAGE
R/R = 558 FT./MIN.
TO 119,000 FEET
R/R= 463 FT./MIN.
FROM 41,100 FEET
TO 119,000 FEET
R/R=803 FT./MIN
TO 41,100 FEET
LAUNCH SITE
FT. CHURCHILL, CA.
1957 GMT
ELAPSED TIME (HRS.
2
4
1600
2000
17 AUGUST 1964
TIME (G.M.T.)



FLIGHT NO. 1119-N

DATE: 17 AUGUST 1964

FOR: UNIV OF MINNESOTA
DR. EARL

BALLOON

TYPE: 2333-541-8201 S/N 201

VOL: 3 MILLION CU FT

MATL: .75 MIL POLY

WT 4470 LBS.

LOAD FACTORS

PAYLOAD: 281.0 LBS

GROSS LD: 728.0 LBS

FREE LIFT: 72 LB = 10 %

BALLAST: 60.0 LBS

RAVEN industries, inc.

DR. DONK 24 AUGUST 1964

CHK.

APPR.

B 03133

688110 AHAMO .THIRD BLUE PRINT GRADMATE

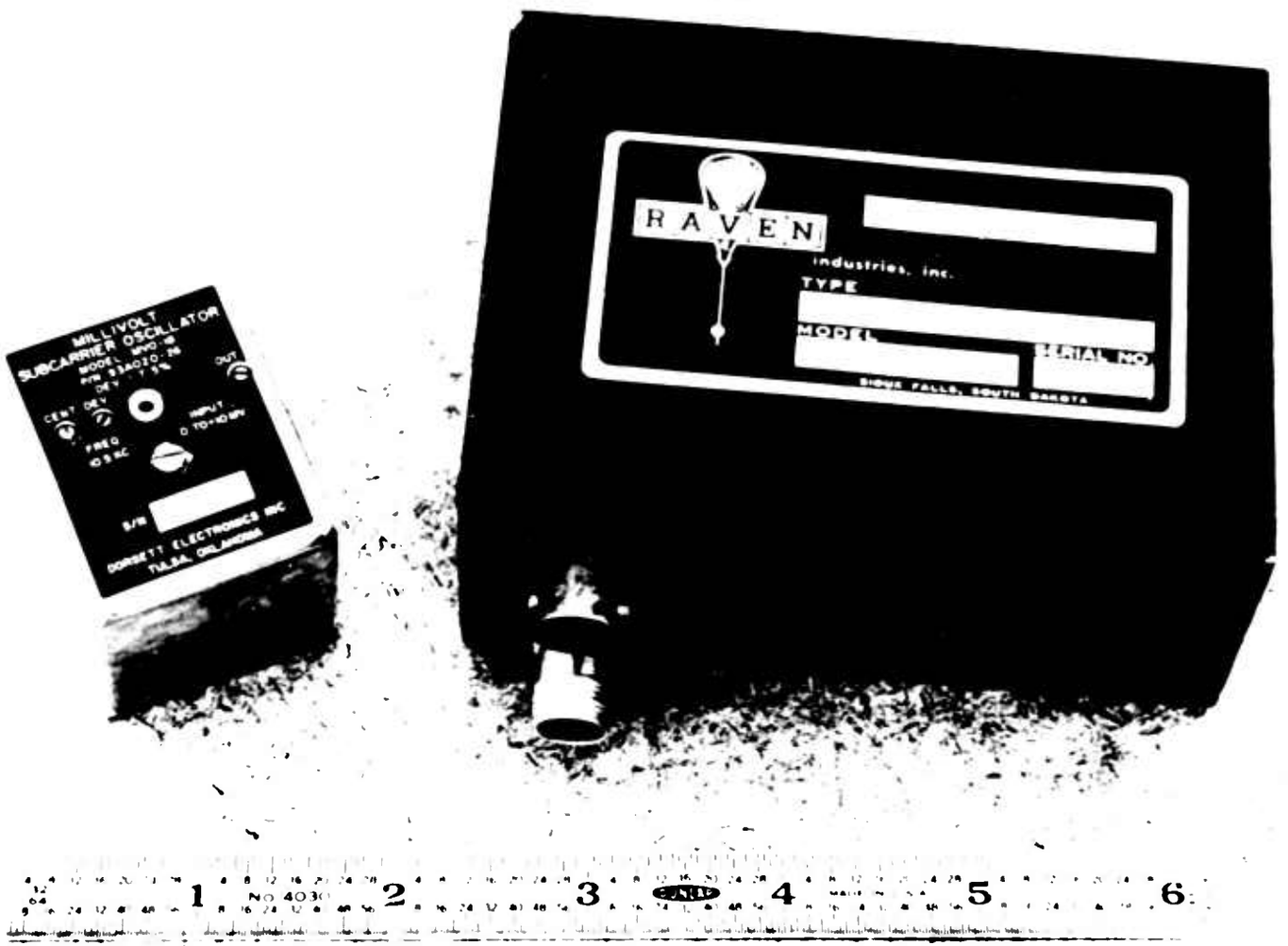
APPENDIX A

Illustrations

C-47 TRACKING AIRCRAFT

PAA HELICOPTER

RECOVERY AIRCRAFT



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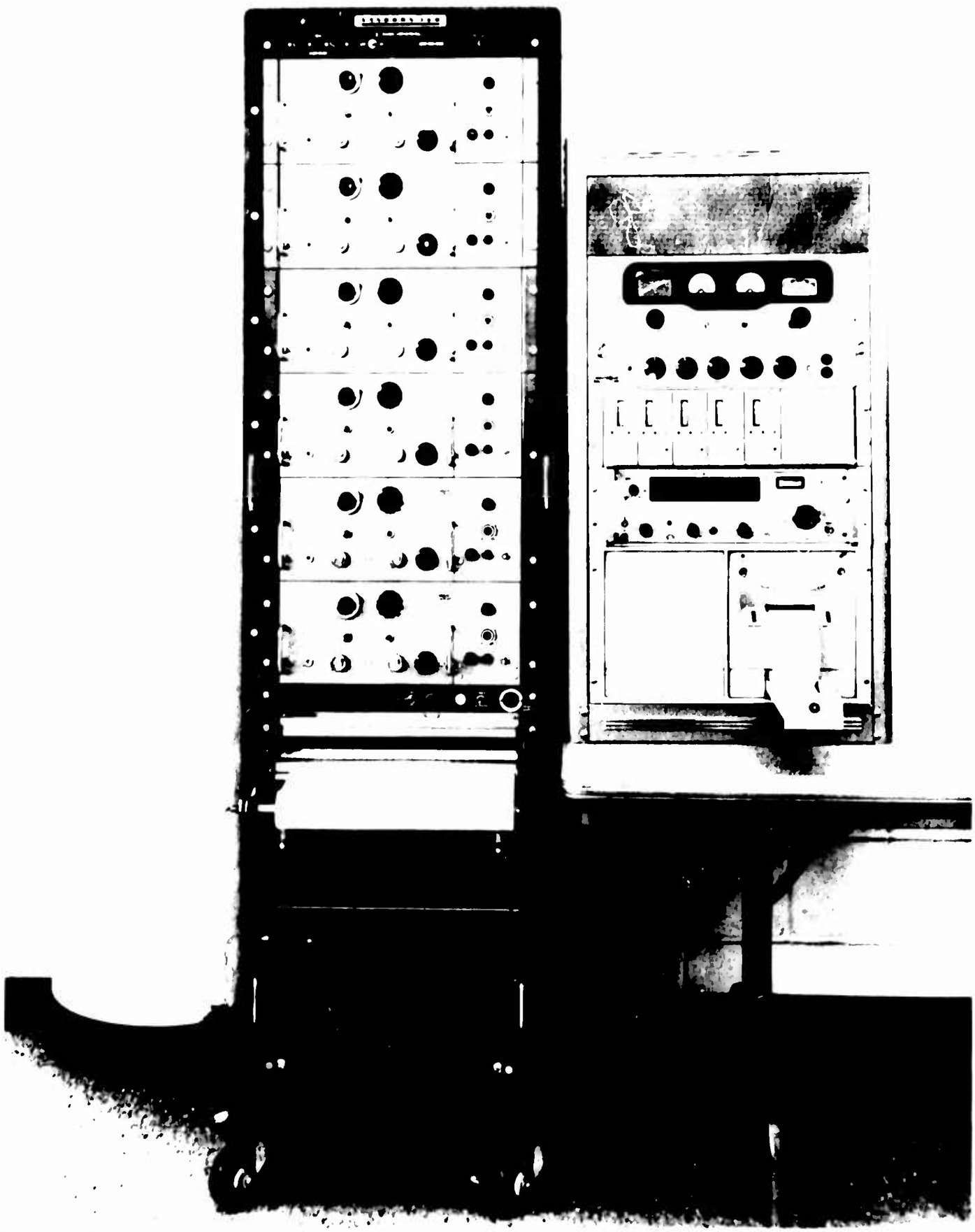
VOLTAGE CONTROLLED OSCILLATOR AND TRANSMITTER

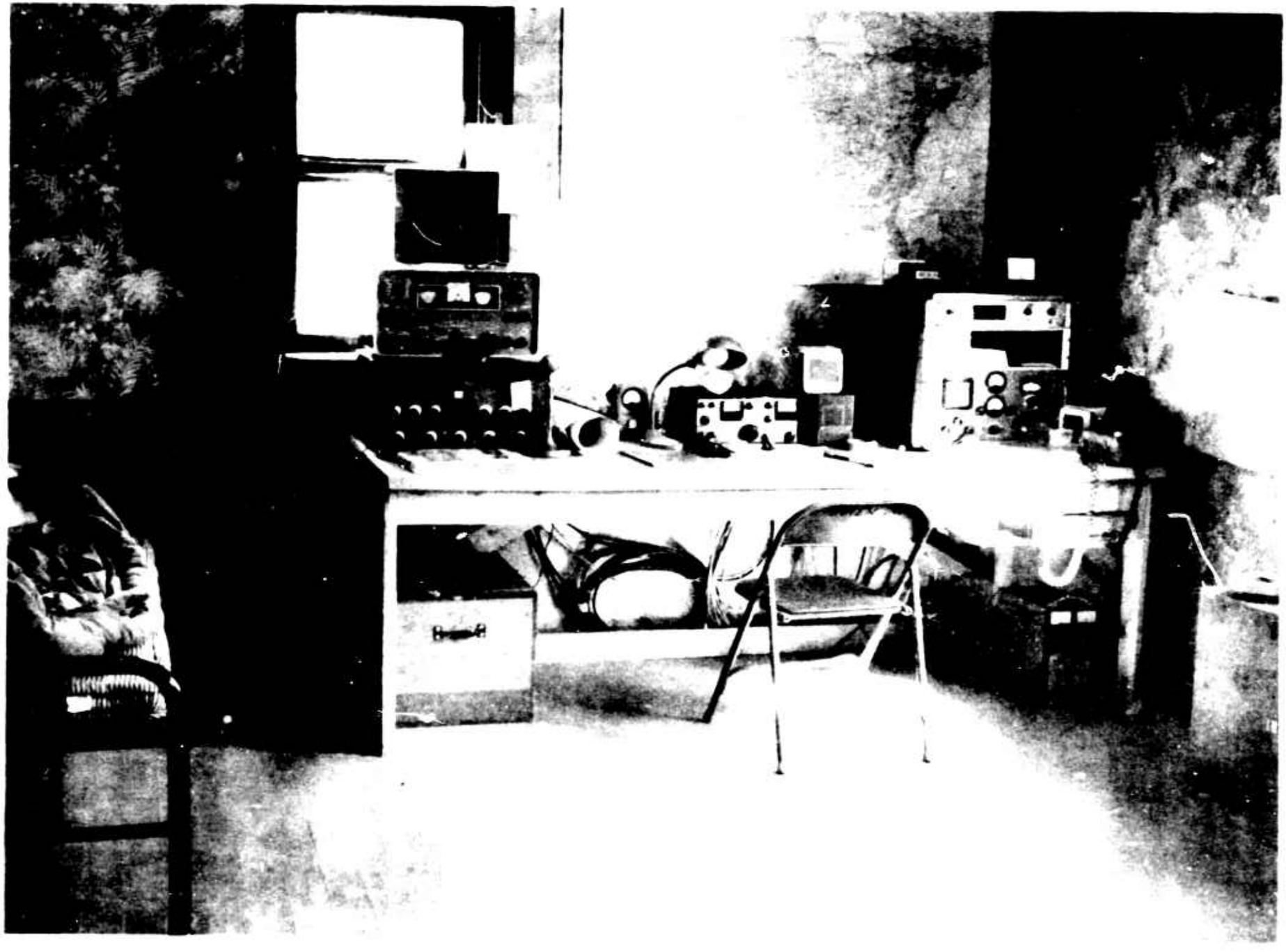


RAVEN
industries, inc

TELEMETRY DISPLAY AND RECORDING APPARATUS

TELEMETRY AND COMMUNICATIONS CENTER AT FT. CHURCHILL

TELEMETRY AND COMMUNICATIONS BUILDING AT STONY RAPIDS



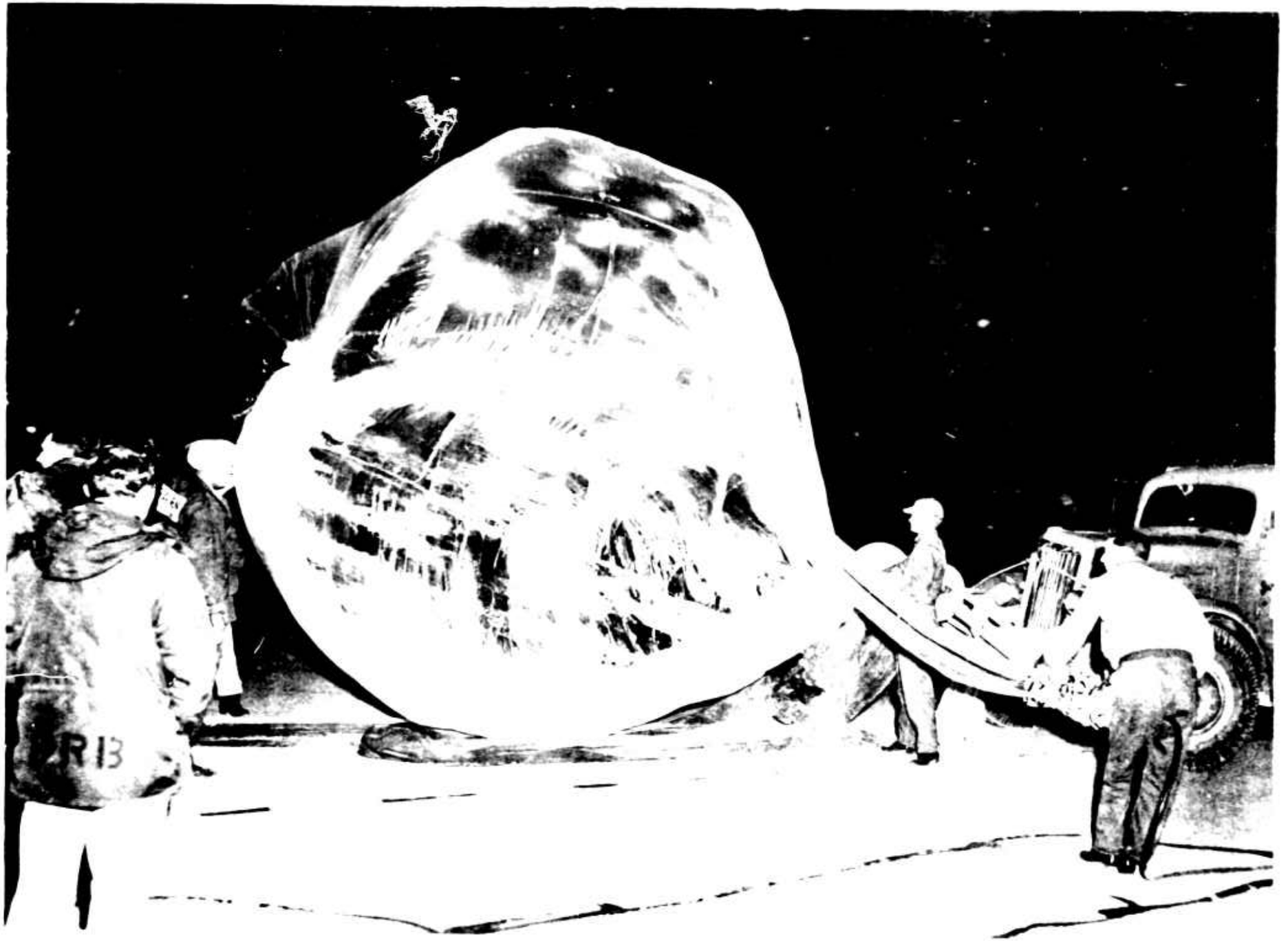
TELEMETRY AND COMMUNICATIONS CENTER AT STONY RAPIDS

PREFLIGHT WEATHER BRIEFING

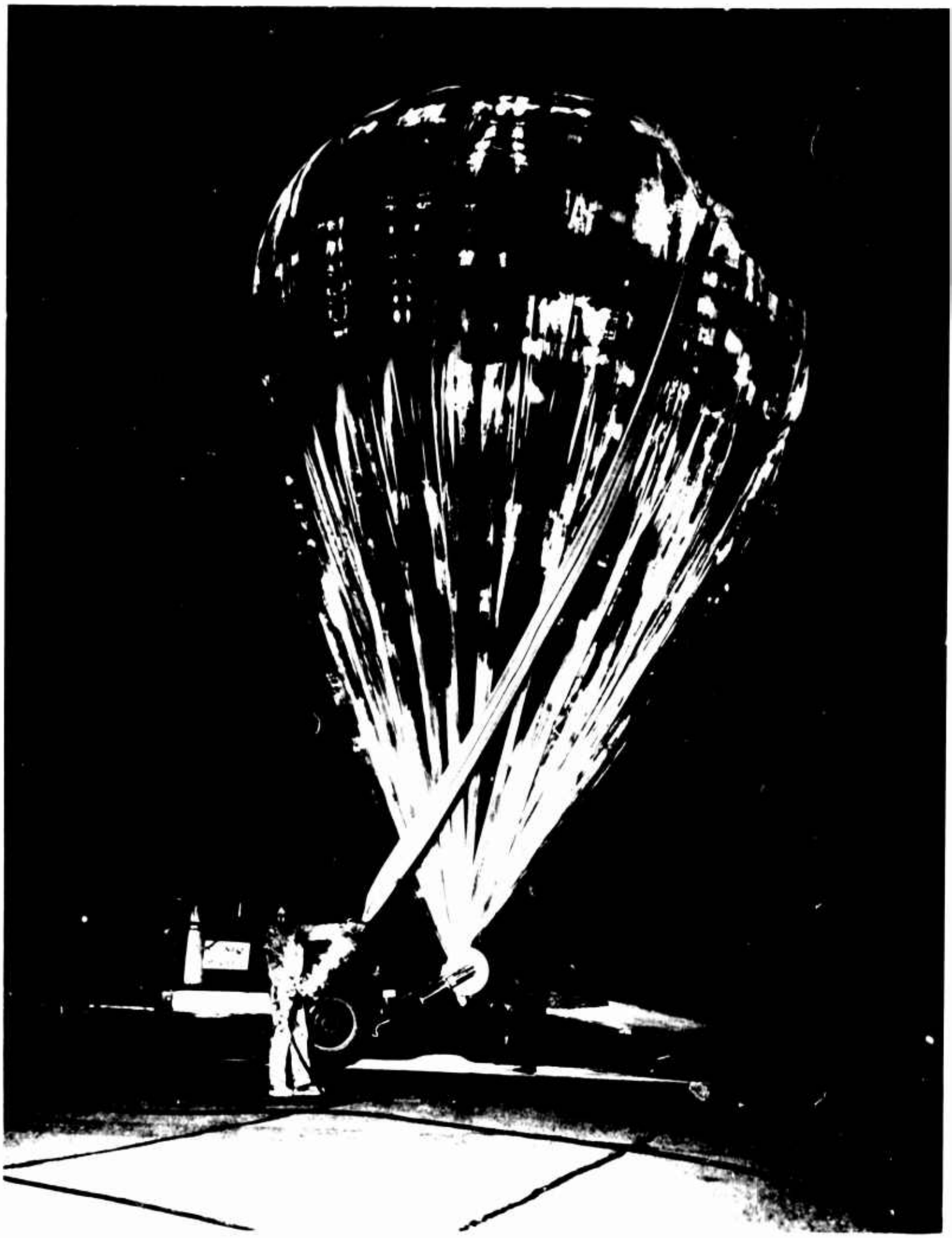
PREPARATION OF DR. MEYER'S GONDOLA FOR A FLIGHT

LAYOUT OF THE BALLOON

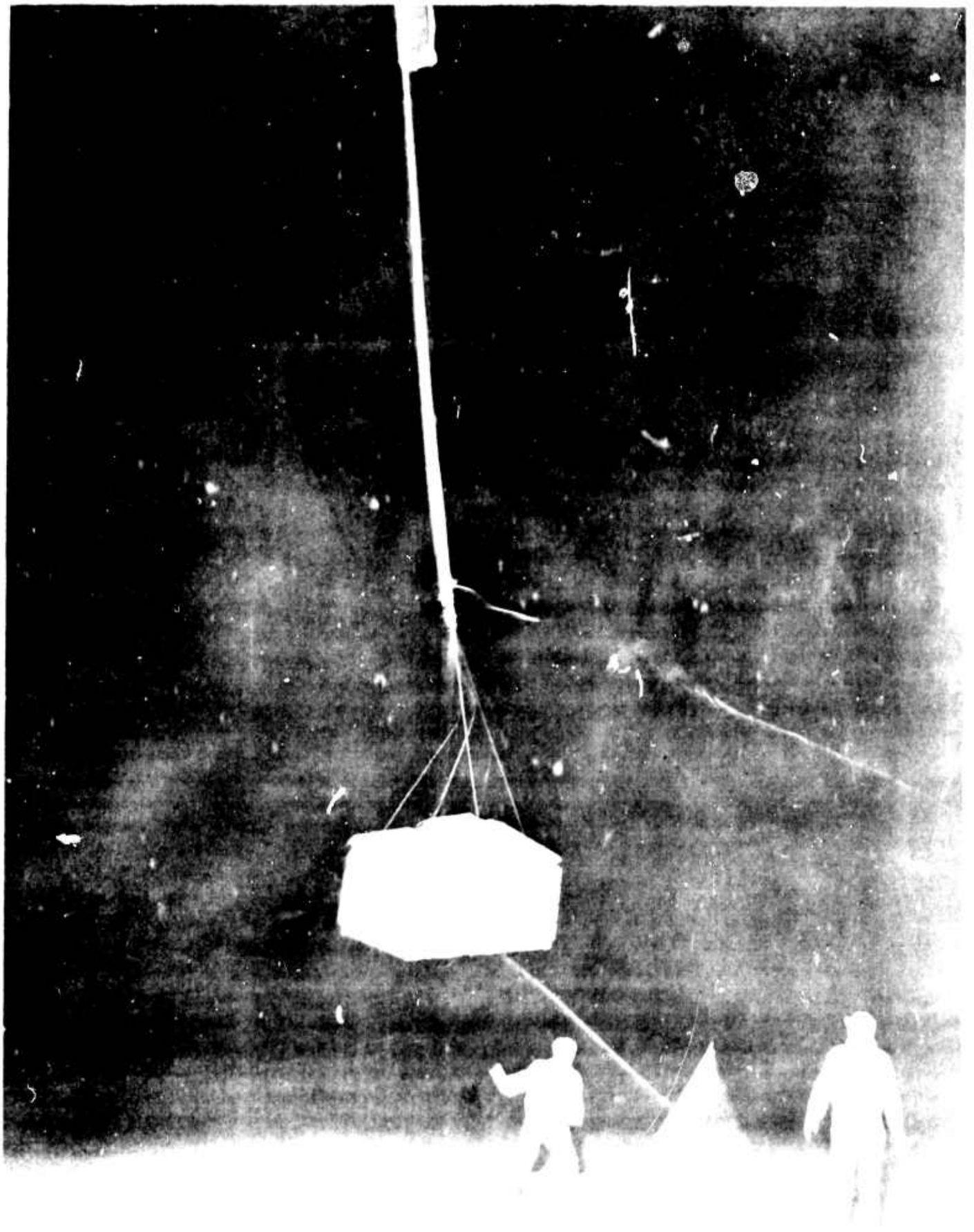
PREFLIGHT CHECKOUT OF THE BALLOON SYSTEM



START OF INFLATION



BALLOON BUBBLE DURING INFLATION



LIFT OFF

APPENDIX B

Aircraft Radio Equipment

Aircraft Radio Equipment

CESSNA 185 9822X

Narco Mark 12 VHF Transceiver with VOA-4 Omni Indicator
ARC 21A Automatic direction finder radio-receiver
Collins VHF DF 301C Automatic direction finder radio-receiver
Motorola Motrac Transceiver (25 watt) with remote control head

CESSNA 185 N5853T

VHT-3 Narco Superhomer
ARC 21A Automatic direction finder radio-receiver
Collins VHF DF 301C Automatic direction finder radio-receiver
Motorola Motrac Transceiver (25 watt) with remote control head

C-47 A N4682T

180 Channel VHF Receiver with Glide Path
ARC-3 VHF Transmitter
ARC-7 Automatic direction finder radio-receiver
ARC-27 VHF Transceiver with VHF Automatic direction finder
Tunable HF Transceiver
Motorola Motrac Transceiver (25 watt) with remote control head

APPENDIX C

Approved Radio Frequencies

Approved Radio Frequencies for SKYHOOK Churchill 1964

Beacon and Altitude Telemeter	251.5 mc
	253.1 mc
	255.1 mc
*Beacon and Altitude Telemeter	1710.0 kc
	1724.0 kc
	1746.0 kc
	1750.0 kc
Telemetry of Scientific Data	73.0 mc
Radio Command and Communications	149.4 mc
Communications between Launch Site, Tracking Aircraft and Stony Rapids	6700.5 kc
	3123.0 kc

* To be used as backup to the VHF Beacons.

APPENDIX D

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