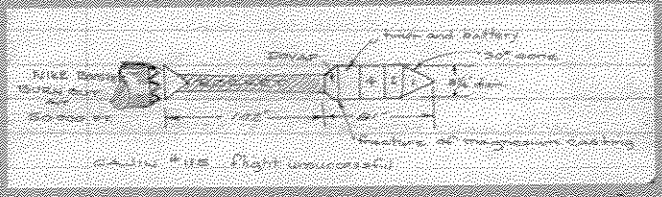
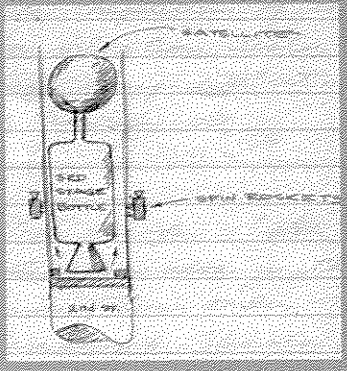
Starr Voyage:

The David W. Starr Notebook

Recently the Department of Special Collections received an illustrated notebook from David W. Starr. Starr had a long military career, serving as a bombardier in the 11th Air Force during World War II. After the war he worked in research and development of aircraft engines and guided missiles. As program manager for the NIKE-ZEUS antimissile missile for Army Ordnance, he was selected to assist Dr. James Van Allen in the design of the ROCK-OON program — that is, rocket instrumentation packages launched from balloons — and in this capacity was present at meetings of the International Geophysical Year Working Committee chaired by Van Allen, the group that supervised the 1957 rocket firings at Fort Churchill on St. Nicholas Island, Canada. These firings immediately preceded the 1958 launch of Explorer I, the first American satellite placed in orbit. Explorer I returned the data on which Van Allen based his discovery of the radiation belts that surround the earth.





Illustrations from the David W. Starr notebook.

Brody, Natalie S., Somers NY
Brown, Patrice J., St. Louis Park MN
Brown, Ronald J., St. Louis Park MN
Brown, Shirley A., Sergeant Bluff IA
Brown, Terry M., Sergeant Bluff IA
Buckley, Barbara Kent, Iowa City IA
Buckley, Charles A., Iowa City IA
Burger, Celia R., Iowa City IA
Burger, William H., Iowa City IA
Burkhalter, Edward L., Cherokee IA
Burkhalter, JoAnne J., Cherokee IA
Burnett, LuVella C., Primghar IA
Burns, Elizabeth A., Grand Forks ND
Bywater, Janet McNeill, Iowa City IA
Cantor, Marjorie M., Iowa City IA
Cech, Annette M., Des Moines IA
Cech, Robert F., Des Moines IA
Chapin, Michael W., St. Paul MN
Christensen, Karen T., Toledo IA
Christensen, William N., Toledo IA
Clark, Sarah J., San Francisco CA
Clarke, Wil, Riverside CA
Clausius, Paul, Williams Bay WI
Clouse, Rebecca L., Iowa City IA
Comer, James M., Edwardsville IL
Comstock, Laurie E., Iowa City IA
Cooper, Donald S., Bowling Green OH
Corman, John M., Bellevue WA
Cowperthwaite, Margaret F., Kent OH
Cranston, David C., Grinnell IA
Cubit, James R., Grayslake IL
Cubit, Laurie J., Grayslake IL
Cumberland, Ingrid, Cedar Rapids IA
Cumberland, William H., Cedar Rapids IA
Currie, Sara A., Roselle NJ
Curry, David S., Iowa City IA
Cutler-Heidman, Karen M., Sioux City IA
Cutway, Elaine L., Chillicothe OH
Cutway, Kenneth S., Greensburg PA
Darland, George W., Jr., Hager City WI
Darland, Mary E., Hager City WI
The Davis Group, Cedar Rapids IA
Davis, Sandra P., Broomfield CO
Davis, Scott J., Pembroke Pines FL
Davis, William H., Broomfield CO
Deadman, Diana Siegel, Bronx NY
Deadman, Robert M., Bronx NY
Deftos, L. J., Del Mar CA
Dencklau, Vernon E., Fort Gratiot MI
Dernier, Ann L., Tucson AZ
Dew, Stephen H., Cedar Rapids IA
Dickerson, Ty T., Syracuse NY
Dieckmann, Betty Jane, Macon NC
Dieckmann, Merwin R., Macon NC
Dierks, David R. S., Iowa City IA
Dierks, Sally B., Iowa City IA
Dietz, Allan B., Chatfield MN
Dietz, Victoria L., Chatfield MN
Discher, Barbara A., West Des Moines IA
Doherty, Kevin G., Chicago IL
Dooley, Jean H., Charlottesville VA
Dooley, Michael P., Charlottesville VA
Doorenbos, Judith G., Iowa City IA
Doyle, John R., Iowa City IA
Drahn, Derek S., Cedar Rapids IA
Drahn, Terri A., Cedar Rapids IA
Dreusicke, Deborah, Coralville IA
Dreusicke, Jim C., Coralville IA
Duane, Julia M., Bedminster PA
Duensing, Diana R., Wheatland WY
Du Mond, Barbara J. H., San Mateo CA
Du Mond, Charles E., San Mateo CA
Dunn, David E., Berkeley CA
Eble, Charles L., Iowa City IA
Edwards, Bonnie A., Rochester MN
Ehrenhaft, J. L., Iowa City IA
Ehrenhaft, Jean L., Iowa City IA
Eklund, Harold E., Urbandale IA
Eldridge, Tammanicia A., Rowlett TX
Eldridge, Todd C., Rowlett TX
English, Ann R., Chatham NJ
Erickson, Christopher L., Shoreview MN
Erickson, John E., Iowa City IA
Evans, Jennifer J., Oak Park IL
Falconer, Joan O., Iowa City IA
Felice, Catherine J., Austin TX
Felice, Stephen J., Austin TX
Ferguson, Rebecca C., Bowling Green OH
Fessler, Myron D., Santee CA
Fieselmann, John F., Iowa City IA
Fieselmann, Randee S., Iowa City IA
Fifield, C. Eugene, Cedar Rapids IA
Fifield, Dorothy O., Cedar Rapids IA
Fitzgerald, Grace A., Coralville IA
Fjelstad, Ruth N., Decorah IA
Flaherty, Luke J., Iowa City IA
Flaherty, Susan S., Iowa City IA
Flatley, Marie E., Del Mar CA
Fletcher, Jonathan M., Des Moines IA
Fletcher, Virginia V., Des Moines IA
Flickinger, R. Richard, Jr., Dousman WI
Foley, James E., Davenport IA
Folsom, Ed, Iowa City IA
Folsom, Pat, Iowa City IA
Fore, Christopher A., Concord NH
Forell, Elizabeth R., Iowa City IA
Forell, George W., Iowa City IA
Forys, John W., Jr., Iowa City IA
Forys, Marsha A., Iowa City IA
Foster, Davis L., Iowa City IA
Francis, Debra A., Scottsdale AZ
Francis, Thomas A., Scottsdale AZ
Frank, Gerry, Alexandria VA
Freiburger, Joseph J., Manchester IA
French, Mary A., San Diego CA
Friedman, Donna C., Iowa City IA

MAJOR PUBLICATIONS WRITTEN

BY

D. W. STARR

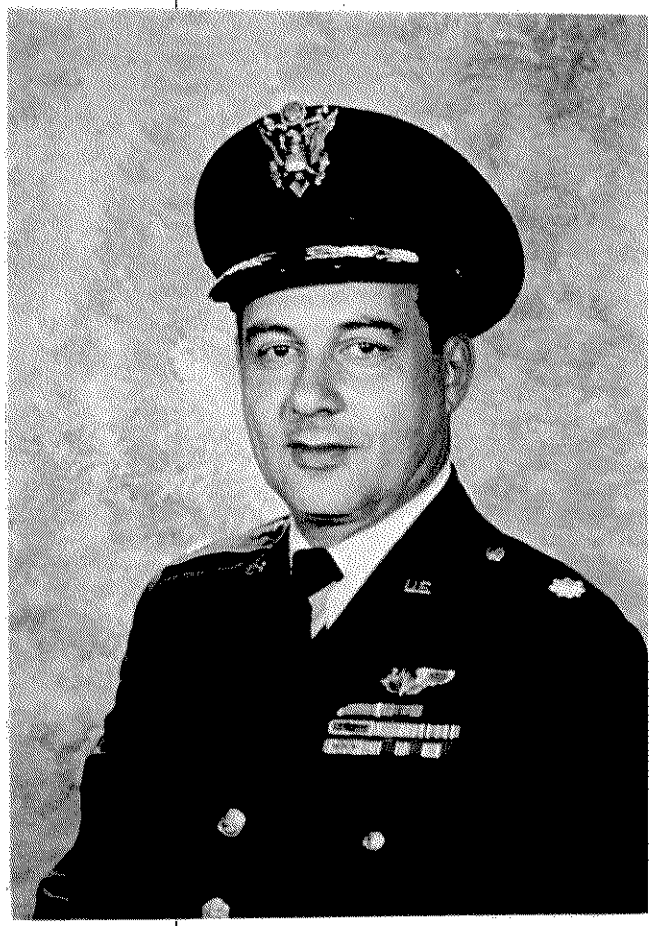
LITTON MELLONICS

	Publication	Date
1.	HARPOON Weapon System Technical Evaluation T/C-1 Phase II Rail and Truck Transportation Tests	August 1974 (Delivered to NSWSES, Port Hueneme)
2.	HARPOON Weapon System Phase II Launcher Reload Tests	October 1974 (Delivered to NSWSES, Port Hueneme)
3.	HARPOON Weapon System Missile Replenishment In Port Appendix C - Detailed Operational Test Procedures TP-36 Phase II TE	September 1974 (Delivered to NSWSES, Port Hueneme)
4.	HARPOON Weapon System Technical Evaluation T/C-1 Phase II Safety Tests Programs	November 1974 (NSWSES, Port Hueneme)
5.	HARPOON Weapon System Technical Evaluation Phase V Launcher Load/Unload Tests (USS STERETT,(DLG-31))	May 1975
6.	Reaction Tests Report Phase II HARPOON Weapon System, DE-1052	May 1975
7.	HARPOON Weapon System Loading/ Unloading Human Factors Questionnaires Phase II	June 1975
8.	HARPOON Weapon System Loading/ Unloading Safety Questionnaires Phase II	June 1975
9.	Phase V Loading/Unloading Test Report	July 1975
10.	HARPOON Restrained Firing Test Plan	March 1977
11.	HARPOON Restrained Firing Test Procedures	March 1977
12.	HARPOON Pre-OPEVAL Test Plan	August 1978
13.	HARPOON Pre-OPEVAL Test Plan for High Capability Ships	September 1978

	Publication	Date
14.	HARPOON Weapon System Pre-OP Testing Scenario Variations	September 1978
15.	Automatic Billing System User's Manual (for NSWSES)	December 1978
16.	Integrated Test and Evaluation Plan (ITEP) for RAM Weapon System, CONFIDENTIAL	May 1979 (Delivered to NSWSES) Charles Pitman, Engr.

D.W. STARR was appointed by LT. GEN. JAMES GAVIN, USA to represent the Chief of Army Ord. on the IGY panel and as a technical consultant for rocketry. He served as program manager for the NIKE ZEUS ABM program and was deputy to Gen Gavin for Army Air Defense Weapon Systems until he resigned in 1959 upon the retreiment of General Gavin.

D.W. STARR
LT COL: USAF (ret)
1997



D. W. STARR
OCO Pentagon
ID380

*** A G E N D A ***

1 - Reports on Fort Churchill firings.

2 - Reports on Arctic Rockoon operation.

3 - Reports on St. Nicholas Island firings.

4 - Progress reports on satellite instrumentation.

5 - Future experiments of special interest.

6 - Next meeting.

~~1 August 1957~~

19 September 1957

Rocket & Satellite Research Panel Meeting

19 Sept 1957 (AF Cambridge Research Center — Laurence G. Hanscomfield, Bedford, Mass.)

Chairman: Dr. J.A. Van Allen - Univ. of Iowa

Sec. : Mr. G.K. Megerian .. G.E. Aircraft Accessory Turbine Dept., 950 Western Ave. Lynn, Mass.

Dr. Stuhlinger ABMA - RSA

Dr. LA'S Dellasasso BRL Dellasso

Dr. Day Geophysics Lab., AF - Cambridge

Dr. Green

O'Sullivan - NACA Langley

I. The meting opened with reports of the various service and laboratory firings conducted during the summer at Fort Churchill Canada. Dr. Van Allen stated that statistical summaries would be sent to all panel members but a detailed technical review was in order.

Lloyd G Ordnance BRL

A Col, Smith (~~Army Signal Corps~~) was reported to be in charge of a group at Ft. Churchill who conducted 9 Aerobee firings; one bad, which had to be cut down by the range safety officer, and eight good ones. A peak altitude of 160 miles was attained.

Five CASIN firings were also conducted by this group; two good and three bad.

The A.F. reported one Aerobee flight & Sept stated to be a good flight to be reported in detail during the meeting.

Of the 2 BRL and 2 U of Iowa CASIN flights the BRL flight reached an altitude of 70 miles. The U. of Iowa reports very limited data on their flights because of failure of the second stage igniter and instrumentation.

Future:

To get density info. we are developing instrumentation for the satellite which will be tested in a rocket similar in concept to CASIN flts.

Data reduction problem being solved by scale model of earth/satellite. Illum. globe. Army Signal Corps contract. Slide only - no demonstration. Globe appeared to be 2' model.

Panel went into Exec. session. End regular meeting.

Main problem now is that aluminum shell falls apart prior to completion of temp. and/or vibration tests.

Final design vibration tests scheduled for Oct.

Probs:

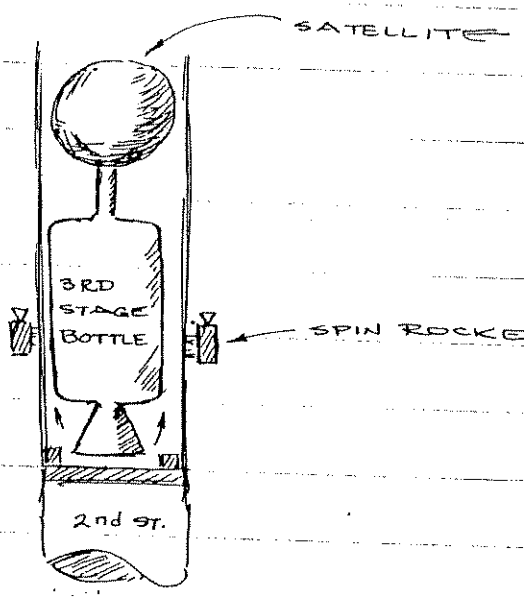
1. Tape recorder skips two steps in advance thereby missing time pulse. They have a fix 'Vibrator'

2. GM tube breakdown caused by trying to get too much out of tube.

3. Now up to 1000 hrs op. life on battery but need more reliability.

Final flt. accept test late Nov. '57.

To eliminate corrosion problem of satellite:



1. Going to spray insulation on satellite
2. Put inhibiting disc on front end
3. Remove $ZnCrO_3$ from inside of rocket

SCEL is testing their satellite
no info on status but they
are scheduled to fly at
WSPG late 1957.

Batteries (RN220 mercury cells)
not working properly. On
magnetometer satellite plan to
use Zn-Ag O2 cells.

Using cadmium sulfide cell
to measure meteor impact down
to a few microns (10-100 micron span).

Contamination of satellite by
spin rocket (via corrosion).
Rocket people looking into a fix.
Atlantic Research "cleaning up"
rocket

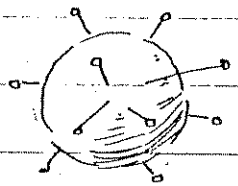
except differential pressure gage and Lyman-α chamber on hand. Lyman-α chamber to be available by Dec.

Vibration tests underway at NEL. Failed shell on 3rd vibration test but instrumentation survived satisfactorily

Group 3 satellite MAGNETOMETER

Only satellite which is not spherical. Varian Associates ~~is~~ testing. Using 2 pair minitrack. Mfgr. of modules to begin in Oct. '57.

Group 4A TEMP. Univ. of Wisconsin



Random notes

A. P/ρ varies (+) season but density is relatively constant even from FT. CHURCHILL to WSPG.

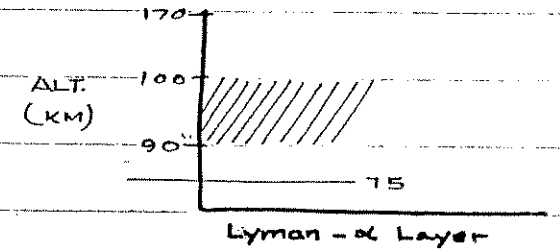
B. Use spectometer as pressure gage by extrapolation of density data.

C. $\frac{\text{Ram velocity}}{\text{Vel. of molecule}} = S$ factor

when sampling with a funnel

D. Day and night variation in density match irrespective of geographic location.

E. Water vapor up to 110 KM. Rocket up to 180 KM.



~~X-Ray~~

100-150 parts/million of H_2O vapor to make Lyman-α correspond.

Water vapor sealed off at stratosphere

Water! theory, once abandoned, now back!

F. It takes 1 atom / cc in Lyman-α layer to give back-scatter. (Hydrogen in atmosphere)

G. Strong magnetic flux found in region of ORION and constellation VIRGO

H. Average flux in Lyman-α layer is 3.8×10^{-3} / sec / cm^2 / sterad

SATELLITE INSTRUMENTATION

April to present (proj is published).

There are 2 satellites. Environmental tests on 3 completed in lab at NRL. Centrifuge, heating and temperature cycling tests nearly completed.

Flight unit no 1 scheduled to be completed by Oct. 1957. Environmental test by 21 Oct. All gages

possible pre-ignition through transient current. (similar prob. in TERRIER & TARTAR squib circuitry)

Extremely difficult to measure aspect (sun/horizon). Yaw starts after second stage ignition.

British were asked to Report on SKYLARK. No firings this period. In about 2 weeks, at the IGY symposium, a full report will be made.

They are working toward 500 000' alt. with new booster and case re-design. Re telemetry troubles. Technical limitations brought about by one design of equipment for a number of years. Now inadequate. They are looking for new TM equip.

A panel member suggested British add the TM capability to their very good Doppler system in the interim.

in ionizing all layers of the atmosphere. 13 rockets fired to date. Only one shot really successful. Rocket at alt.;- x-ray flux penetrated Lyman-alpha layer (2.5 Angstroms wave length). Angle of incidance of solar radiation was grazing. meas. x ray rad. 10^{-2} ergs/cm^2/sec. Also penetrates Lyman-α layer (will ionize).

x-ray 10^{-3} ergs/cm^2/sec. No x-ray below 100 KM.

Many troubles in staging even with these old rockets. Ignition delays galore. Hercules powder Co. squibs blamed. Too much current so put in additional resistor. About 3 pre-ignitions. Do not know why. Squib is 15 sec - 1 Amp. from 110 V. source. Staff suggested redesign to higher amperage to avoid

DAVID H. STAUB
Army Ord. Rep. ISL from Gen. J. GAVIN'S STAFF

It was questionable whether the Aurora had developed at all.

Anderson - Kinsey have over 200 hours instrumented flts. over 105 K' alt. at Ft. Churchill site. Good correlation, relative to intensity, between geiger counter and photometer display of Aurora. Aurora was over Churchill all summer. There is a connection between soft ray radiation and radiation de-intensification.

SAN NICHOLAS I. FIRINGS (Deacon Rockets Used)

Ionization radiations in solar flight. No radiation below 100 KM with sun overhead. Lyman-α ionization - 87 KM penetration by sun's X-ray emission. X-rays are electro-

8-8.5 lb. payload except E & H (below)
which were 11.5 lbs.

	ALT. (MILES)		ALT. (MILES)
A	72 ± 2	F	76
B	73	G	60
C	82	H	55
D	73	I	60
E	48		

noted in data:

1. Sharp knee in altitude curve
2. Total intensity about 2/3rds of last years meas. (Due to sunspot activity) Also noted by other researchers.

Absorbsion data not yet analyzed.
Only one good night flight. Intensity up by a factor of 30 over cosmic ray rate when fired into Aurora. May not have entered Aurora completely. Rocket fired 3 hours before gave 'null' result.

P.M. Session

18 Rockoon firings 5-14 Aug.

made from USS Plymouth Rock

1-20TH Aug. Near Thule between Greenland

and Baffin Is. 55° Lat. firings

Loki - Phase II. rockets used

TYPE A (10 Firings) X-Ray

Intensity of x-rays in Auroral

zone examined up to peak alt

of 75000 ft. Shielded and unshielded

(alum, copper and lead) used.

Photometer looking at Aurora.

Cosmic ray data also obtained.

TYPE B Electron Density Measurement

Spectometer used. Sesium iodide

cryptal. Solenoid switched on and off.

It is, in effect, an electron searcher.

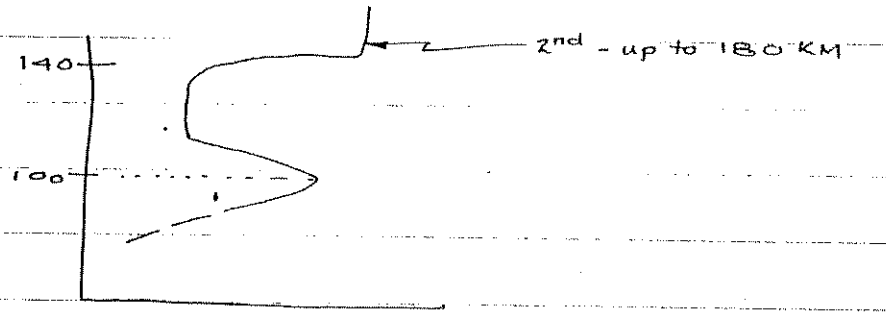
Balloon flights (Raven Industries made them)

took the rockets to altitude.

Data: 13 cases - good throughout balloon phase

17 cases rocket phase

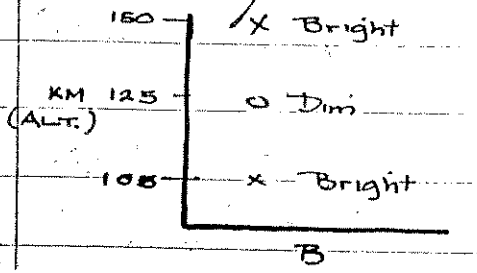
In the sodium (Na) experiment the heat of thermite is used to burn Na.



(Brightness of trail due to Sodium - Na)

Rocket instrumentation data obtained. No seasonal variation apparent from Nov. to Aug.

The nitric oxide experiment involved release of NO in three bursts (95 miles alt.)



note correlation with above Na experiment. Reason... low density of free atoms? Atomic N max. at 105 KM? More

#78 & 79

Reached over 120 miles alt. Object was electron density measurement. no data reduction has been made on these flights as yet. 3-space receiver technique used to give fine measurement of ionosphere. n.g. on recovery.

#82 6 Aug Arobee

93.1 miles alt. reached. Good flight with recovery. No data reduction but picture at 93 miles.

#83 & 84 19 Aug Arobee

(84) nitric oxide experiment

(83) Sodium experiment (111 miles alt.)

Good in all respects.

At Holloman — 8 Aerobee firings

3 assigned to micro-meteorite detection.

(one sustainer failed).

9 April AF #77

premature release of nose tip

Reported measured impact abrasiveness

for micro meteors.

16 July — AF #91

Good flight. Attained 80 miles alt.

Test was study of impact rate and

abrasiveness as well as distribution

of micrometeorites (impact abrasion

method.) at 50 KM alt. eject tip

(40" long) and analyze cone on

recovery. Polished plate - emulsion

camera to measure radioactivity -

cosmic ray tracks. A microscopic

examination (order of 20 microns depth) of

craters is made.

5. Magnetic aspect

Measures angle between Aurora and magnetic heading of missile. The instrument is canted off of the centerline of the missile.

Nose section (46#) broke off at 32 sec. The CANIN continued to fly after instrumentation broke off (Bad coupling). Nylon bolts sheared. Field fix, substituted stl. bolt (one). 5 nylon bolts remain.

Aurora analysis:

X-Ray – no appreciable x-ray

nucleonic – no pulses

electron detector – late in flt. some detection but nothing above noise level.

Photometer – Good data – Sensitivity correct.

Aurora apparently has 3 periods. More data needed to examine these periods.

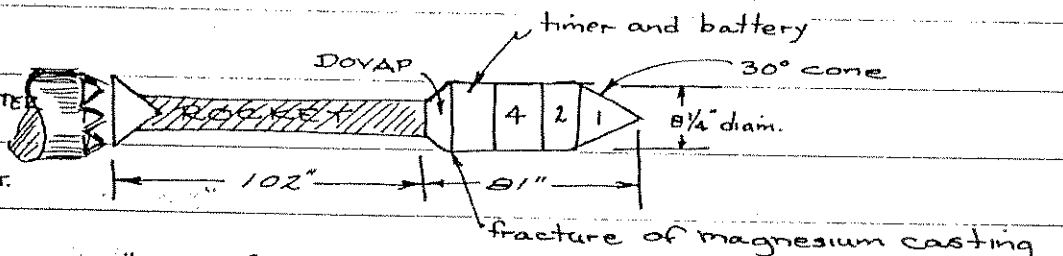
2 CAJINS assigned to Aurarал Experiments

1. X-Ray detector (geiger counter)
2. Nucleonic detector (mainly proton detector)
   Sesium iodide crystal
   amplifier (pulse discrimination) Detector
   is open after fiberglass cone has blown off.
   The is correlation with visual measurements
   (measures particles exceeding 100 KW).
3. Electron detector
   Measures from 10KV up to 200 KV, 5 sec. cycle
   It has a solenoid wound axis parallel
   to axis of the missile.
   6199 multipliers
   Determines average light flux.
   D C operation
   Crude spectometer.

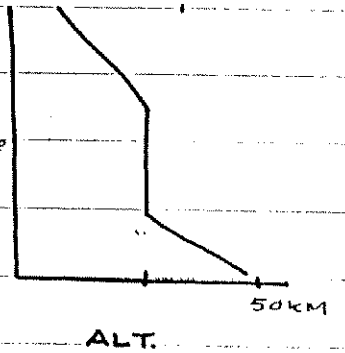
4. Visual Photometer
   Measures 5° half-angle Location of
rocket relative to Aurora.

AM 6.32 30 July CAJIN firing.
3 alphatrons instrumentation (DOVAP)
Peak altitude – 14 miles. incomplete ignition.
Unsatisfactory flight. Analysis;– blew firing
cable when booster ignited. or conceivable
trouble with NIKE booster which prohibited
ignition of CAJIN.

BRL report. High temp causes
mismatching and tuning problems
with antennas even though they
only protrude 1" from missile
structure. Temp measurements
in excess of 1000°F were recorded.
note. BTL should have this data for
our project so as to give DAC
environmental data.



CAJIN #115 flight unsuccessful



Grenade explosions

AEROBEE FIRINGS (GRENADE)

Missile #	Date	Peak Alt. (miles)	Grenades (each carries 14)	Sound Arrival	Data Range	Ballistic Camera
SM 1.02	21 July	58	14	13	26-87 KM	X
1.03	23 "	55	9	9	25-82	X
1.04	12 Aug.	46	1,7	all	22-70	
1.05	19 Aug.	58	14	up to 16th	26-76	
AJ 2.06	25 Aug.	85	all exploded	up to 13TH	30-90	

Grenade is ejected. Lanyard pulls pin.

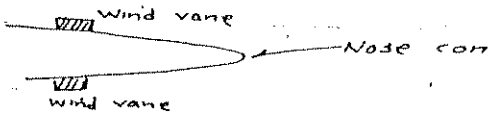
Good DOVAP data on all flights. Ballistic cameras used to check DOVAP instrumentation. The time of explosion is obtained by ground flash detectors. Balloon data has been obtained up to 100,000 ft alt on each of the firings. There are about 4 more firings scheduled to complete the year.

The U of Mich. (under Sig Corps auspices) reported on their grenade firings. Plots of firings beginning 12 Nov. 1956 (SM 1.01) were shown but too small to see. The object was to gather wind data at altitude. Generally, the data showed wind speed increases up to 150 meters per sec. NSPG data has shown speeds up to 100 meters per sec at altitudes.

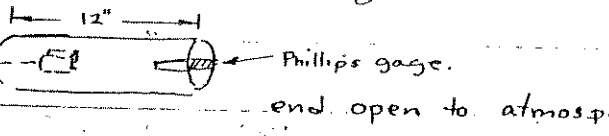
Five Aerobees carrying grenade experiment were fired this summer. The object was temp. measurement at the velocity of sound and plots of wind fields at high altitude. Two and four pound grenade charges were used and it was found that the maximum alt of 90 KM was the highest from which ground return could be recorded, irrespective of the charge.

10 feet from the rocket on a line but it only went out 2 feet. The rocket had a 20 sec. roll period which generated insufficient centrifugal force to kick the prob out the full 10 feet.

Wind vanes on the nose record, instantaneously, wind flow over the nose cone.



Pressure measurements were taken with a Phillips' gage which has a transmitter (FM) oper. .1 watt power. It is ejected from the rocket at an altitude of 70 miles. The signal strength was down but the data good nevertheless.



Pressure, temps. and density were measured up to 200 KM peak with low altitude points down to 40 KM. with an Arobee-hi. Pressure is taken by pitot tube. (131 mi alt.) Rocket spin was 1.7 rpm;- it was calculatid to be 1.5 rpm, so there was a good crossover between mechanical gages and ionization gages. Minitrack was used. A beep note was recorded from a crystal to obtain crude Doppler data.

A.F. Arobee AM 4.01 launched 1 Sept equipped with 5 alphatrons. (each is 6-in-1) $P_A \cdot 10^{-3}$ (90 KM) measured. but temperature measurements were spotty.

The ionosphere probe is a 3½" diameter sphere which is ejected from the rocket. The sphere is supposed to ride

Dr Van Allen stated that the next firings would be extremely important as they would be investigation of the Aurora.

On 4 July '57 an Aerobee-hi was launched in an ionosphere experiment. It reached an altitude of 160 miles and was launched during a TOTAL POLAR BLACKOUT.

Findings: The D region is thick and has a low extension; down to 50 KM.