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CANADIAN AVIATION

SATELLITES

Evaluating Man's Sorties

Since the launching of the "space age," on Oct. 4, 1957, there have been three successful U.S.S.R. and five successful U. S. satellite launchings, apart from various lunar probes.

The size and weight of the Russian satellites are extremely impressive when compared to those of the U. S., and this leads to the conclusion that the U.S.S.R. must certainly be ahead by several years in rocket motor design.

On the following pages appears a tabulated compilation of the data that has been reported in news releases and scientific papers, on the different satellites. Details of the most recent USAF launching of an Atlas ICBM are omitted from the table, but are reviewed on this page. Details of the Russian rockets are meagre, hence the values given in the table can only be taken as reasonable estimates.

First Sputnik Results

The instrumentation, if any, contained in Sputnik I is not known. Its spherical shape did allow accurate calculation of the upper atmosphere density. The air density data released by the Russians indicated that it was much higher than had been previously supposed. Some reports claim that the Sputnik I satellite broadcast data on density and temperature.

The death of the Sputnik I satellite was detected by a technique developed by Dr. Kraus of the Ohio State University Radio Observatory, Columbus, Ohio. He utilized the reflection of WWV signals by the satellite as it passed overhead as a means of detection. During January 3 to January 8, 1958, the number of reflected signals increased, indicating a progressive break-up of the satellite.

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Sputnik II was well publicized due to the space traveling dog "Laika." The U.S.S.R. has released information on this experiment which indicates that, with the exception of an increase of three times in the heart beat, the dog survived the accelerations into orbit very well, and was not affected adversely by the weightless condition while in orbit. The Russians claim that the dog lived normally until poisoned by a final food packet.

The final moments of Sputnik II are well known. Members of the Canadian Astronautical Society in the Toronto area and personnel at the David Dunlap Observatory just missed viewing the glowing satellite as it passed between Toronto and Kingston at 8.45 p.m. EST on April 13, 1958, in a southeasterly direction.

The satellite did not become self-luminous until latitude 41 deg. 40 minutes, which from Toronto would be low in the southeast sky and therefore difficult to see. It finally burnt up in the Atlantic Ocean northwest of Georgetown, British Guiana.

Sputnik III is impressive from the weight of the satellite and the vast amount of instrumentation that it contains. The instrumented portion of Sputnik III is still in orbit but the rocket casing disintegrated in the earth's atmosphere on or about December 6 or 7, 1958. The exact date of its death is not known by the author and, unlike Sputnik II, very little has appeared in print with regard to its death.

Explorer I was the first U. S. satellite to be placed in orbit. This project was sponsored by the U. S. Army using their Jupiter-C missile with numerous solid propellant rockets for the second, third and fourth stages. This launching was, not doubt, accelerated by the U.S.S.R. launching of Sputniks I and II.

Data from Explorers I and III has revealed an intense belt of cosmic radiation some 600 miles out in space. The Explorer IV satellite was specially instrumented to obtain data on this radiation.

In the U. S. Navy-sponsored Vanguard project, seven launchings have been attempted to date with only one completely successful effort. The last launching, 15.38 Universal Time, September 26, is believed to have made only a few passages around the earth before burning up.

On December 18, 1958, the U. S. Air Force launching of the Atlas ICBM into orbit was a considerable advance for the U. S. Its 4½-ton total weight in orbit is impressive but falls short of the Russian achievement in Sputnik III since this weight is mainly structure. Some of the particulars which have been released are given in the accompanying table.

Still In Orbit

The satellites that are still in orbit are:

a. Instrumented Satellite Sputnik III.
b. Explorer I.
c. Vanguard I Rocket Casing (lost).
d. Vanguard I Instrumented Satellite.
e. Explorer IV.
f. Atlas.

Of these only the Vanguard I instrumented satellite is transmitting radio signals which can be picked up by persons possessing a 108 megacycle receiver.

The Explorer IV high power 108.03 megacycle transmitter is still functioning but only during periods of interrogation by telemetry stations.

Times for visual observations of Sputnik III are occasionally reported

ATLAS ICBM LAUNCH DETAILS

Launched:	6.02 E.S.T. Dec. 18, 1958
Orbit inclination:	32 deg.
Period at launch:	100.8 minutes
Period on Dec. 29:	99.68 minutes
Perigee height at launch:	118 miles
Apogee height at launch:	625 miles
Diameter:	10 feet
Length:	75 feet
Total weight:	8,800 lb.
Predicted life:	25-30 days
Speed:	17,000 mph.

Instrumentation: Transmitter-receiver with tape recorder enabling recording and rebroadcasting of messages sent from the ground. Frequency used 108 mcs.

In Space

By Howard S. Kerr

in the newspapers and additional information can be obtained from the Civil Air Patrol (CAP) transmitted satellite predictions. The schedule of CAP broadcasts is given below:

Command Station (VP ϕ)
4275 Kc., at 1900, 2000, and 2100 EST.

Rebroadcasts
Northeast: 2030 EST 2374 Kc or 4585 Kc (to be determined).
Middle East: 2030 EST 4467.5 Kc
Southeast: 2030 EST 4467.5 Kc (after middle east transmission)
Great Lakes: 2030 EST 4507.5 Kc
North Central: 2030 EST 2374 Kc
Southwest: 2030 CST 4507.5 Kc
Rocky Mountain: 2030 MST 4507.5 Kc or 4585 Kc (to be determined)
Pacific: 2030 PST 4585 Kc

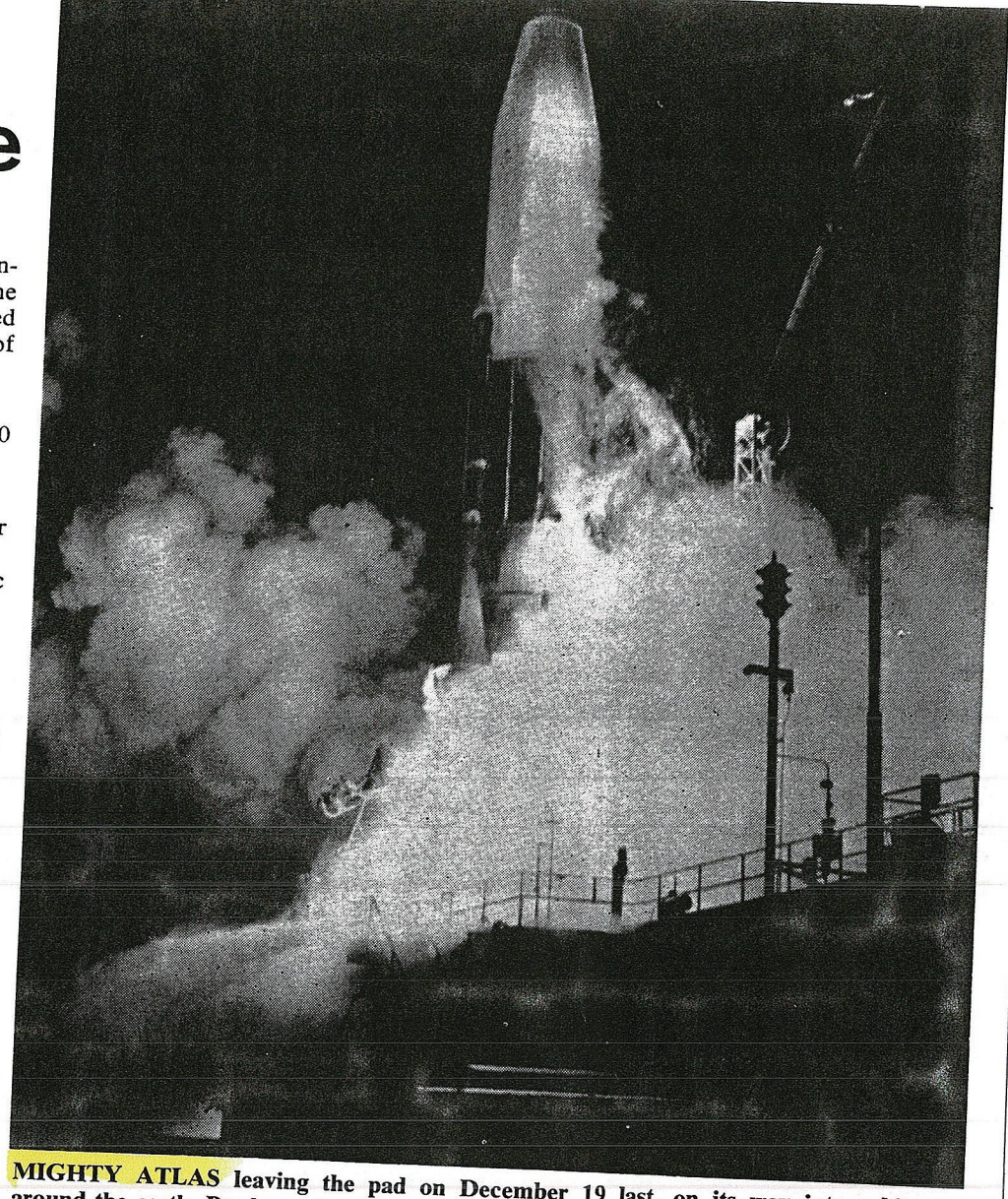
The messages are sent in abbreviated form, listing the date of the prediction, the satellite, the height, the condition of viewing, the inclination and period, the heading across the 40th parallel and information (if any) on the transmitting frequency. This is then followed by longitude of crossing the fortieth parallel, the time, and the conditions of viewing.

The conditions of viewing are described as follows:

(1) **Black** — Satellite in earth's shadow.

(3) **White** — Background too bright for observer directly beneath satellite.

(3) **Green** — Transition zone between condition black and white. This is the condition when the satellite will be visible, to the eye or to the optically assisted eye.



MIGHTY ATLAS leaving the pad on December 19 last, on its way into orbit around the earth. Produced by Convair, it has Rocketdyne liquid propellant engines.

(4) **Red** — Self luminous satellite.

For those interested in viewing the satellite, condition green, or, on rare occasions, red, is necessary for visual observation.

Lunik Achievement

The lunar probes have not been covered in the comparison table. However, the recent lunar probe success of the Russians should be mentioned. It is the first rocket to successfully attain escape velocity and become a small solar planet.

The launching of "Lunik" took place at approximately 1 p.m. E.S.T. Jan. 2, 1959, and made, the Russians claim, its closest approach (4,660 miles) to the moon at 9.57 E.S.T. Jan. 3.

Whether impact with the moon, orbiting the moon, or orbiting the moon with eventual return to earth was intended is not known. The accuracies required in guidance makes anyone of these feats difficult to attain. Some of the particulars released by the Russians are given in the accompanying table.

Preliminary data released on the Lunik vehicle temperatures (50-68 deg. F. inside and 50-59 deg. F. on its surface) indicates an environment quite agreeable to humans.

SOVIET LUNIK LAUNCH DETAILS

Orbit: ..... Around the sun in an Elliptical Path
Apogee: ..... 122,534,000 miles from the sun
Perigee: ..... 90,968,000 miles from the sun
Period: ..... Approximately 15 months
Speed when passing the moon: ..... 5,480 mph.
Total weight of Lunik: ..... 3,238 lb.

Instrumentation (Weight 795 lb.): (1) Moon's Magnetic Field, (2) Moon's Radioactivity, (3) Cosmic Radiation, (4) Gaseous Composition of Interplanetary Dust, (5) Meteorites, (6) Sun's Corpuscular Radiation.

Transmitters: 6 reported, some on 20 mcs., others on 71.2, 212, and 183.6 mcs. Dead or too weak for earth reception after Jan. 5, 1959.

Trajectory: Launched 1 p.m. E.S.T., Jan. 2. 4,660 mi. from moon 9.57 p.m. E.S.T., Jan. 3. 317,000 mi. from the earth 2 p.m. E.S.T., Jan. 4.

SATELLITE	SPUTNIK I ROCKET	SPUTNIK I SATELLITE	SPUTNIK II	SPUTNIK III ROCKET	SPUTNIK III SATELLITE
Date and Time of Launch	Oct. 4/57		Nov. 3/57 4:40 U.T.	May 15/58	
Number of Parts in Orbit	3 with nose cone		2	5 parts of nose cone	
Place of Launch	Kapustin Yar-NW Caspian Sea Area		Same as Sputnik I	Same as Sputnik I and II	
Launch Period	96.2 min.		103.7 min.	106 min.	
Predicted Life		.....	.....	8 - 9 months	12 - 14 months
Date of Death	Dec. 1 or 2/57	Jan. 3 to 6/58	Apr. 14/58 1:55 U.T.	Dec. 6-7, 1958	Still Orbiting
Location of Death	Unknown	Gradual Break-up	N. W. of Georgetown British Guiana	Not known	Still Orbiting
Length of Life	60 days	92-98 days	162 days	206-7 days	Still Orbiting
Attitude After Launch	?	.....	?	?	?
Final Attitude	?	.....	Rotating at 2 Rev./min. about axis perp. to cylindrical axis.	Rotating about axis perp. to long axis at 8 rev./min.	Tumbling at 4½ rpm.
Total No. of Rev.	?	1400 approx.	2370	.....	.....
Orbit Inclination	65°	65°	63.4°	65°	65°
Eccentricity	?	0.0487	0.105 at start	?	0.11
Semi-Major Axis (R = Earth's Radius)	.....	1.0884 R	1.147 R	.....	1.167 R
Precession of Orbit Plane	?	?	2°/day approx.	2.56°/day	?
Height of Apogee at Launch	560 mi.	560 mi.	1017 mi. 2 weeks after launch.	1000 mi. on Aug. 1 1109 at start	1167.5 mi. at start, 1100 on Aug. 1
Height of Perigee at Launch	150 mi.	150 mi.	140 mi.	120 mi. on Aug. 1	133 on Aug. 1 155 at start
Speed at Perigee	18,000 mph	26,700 ft/sec.	26,700 ft/sec.		26,700 ft/sec.
Speed at Apogee	.....	23,700 ft/sec.	22,250 ft/sec.		21,450 ft/sec.
Visual Magnitude (Perigee)	.....	.....	.....	—1.5	2.1
Visual Magnitude (Apogee)	.....	.....	.....	3.6	6.7
Launching Vehicle	Russian ICBM		Russian ICBM 1st Stage	Russian ICBM 1st Stage	
Length of Launch Vehicle	97 ft.		?	?	
Number of Stages	3		3	Est. 3	
Satellite Weight	156 lbs.	184 lbs.	1120.29 lbs.	630 lbs.	2920 lbs. (2140 lbs. of batteries)
Shape of Satellite	Cylindrical	Spherical Polished Aluminum Alloy	Cylindrical with Cone at end—Aluminum Alloy	Cylindrical	Conical
Satellite Length	?	.....	(Est.) 50 ft.	?	11 ft. 7 inches
Satellite Diameter	?	23 inches	(Est.) 5 to 6 ft. ?	?	Base 5 ft. 8 inches
Launch Weights and Sizes 1st Stage 2nd Stage 3rd Stage 4th Stage	140,000 lbs. 8 ft. dia. 50 ft. long 41,500 lbs. 5.6 ft. dia. 35 ft. long 700 lbs. 12 ft. long, 30 in. dia. ..... TOTAL 182,000 lbs.		(Estimated) 140,000 lbs. 41,500 lbs. 5,000 lbs.	? ? ? ..... TOTAL 190,000 lbs.	
Rocket Motor Thrusts 1st Stage 2nd Stage 3rd Stage 4th Stage	(Estimated) 264,000 lbs. 77,000 lbs. 3,800 lbs. to 10,000 lbs.		(Estimated) Same as Sp. I Higher than I Higher than I ..... 25% greater than I	264,000 lbs. ? ?	
Fuel 1st Stage 2nd Stage 3rd Stage 4th Stage	(Estimated) Kerosene-Lox Combination Kerosene-Lox Combination Solid Propellant		(Estimated) Possibly high energy type Kerosene-Lox Combination ?	Possibly High Energy type ? ?	
Total Burning Time (secs.)	239		.....	.....	
Instrumentation	None other than the transmitter and batteries. Its spherical shape gave excellent data for air density calculations. (Some reports claim that air density and temperature were broadcast.)		U.V. and X-Ray solar radiation, cosmetic rays, temperature, pressure. Dog—pulse beat, breathing, blood pressure and electrocardiogram.	Pressure, composition of atmosphere, concentration of positive ions, electric charge of satellite, tension of earth's electrostatic field, magnetic field strength, cosmic radiation, distribution of photons, heavy nuclei.	
Transmitter Frequency	20.007 megacycles 40.002 megacycles		20 megacycles 40 megacycles	20.005 megacycles 40.01 megacycles possibly a harmonic of the 20.005 mc.	
Transmitter Power	?		?	?	
Type of Transmission	Beep every .3 seconds		On 20 — Beep every .3 sec. On 40—Continuous tone.	Morse Code Letter "L" in CW	
Last Date of Transmission	Not known		7 days after launch.	End of October 1958	

EXPLORER I	VANGUARD I ROCKET	VANGUARD I SATELLITE	EXPLORER III	EXPLORER IV
Jan. 31/58 10:48 p.m. E.S.T.	Mar. 17/58 7:26 a.m. E.S.T.		Mar. 26/58 12:38 p.m. E.S.T.	July 26/58 15:00 U.T.
1	2		1	1
Cape Canaveral	Cape Canaveral		Cape Canaveral	Cape Canaveral
114.8 min.	134.29 min. on Mar. 27		115.87 min. at launch 114.56 min. on Apr. 3	110.2 min.
3 - 5 years (1,596 days)	10 - 20 years	20 - 30 years	3 months	2 years
Still Orbiting	Now Lost	.....	June 29/58	Still Orbiting
.....	Still Orbiting	Still Orbiting	Not known	Still Orbiting
.....	Still Orbiting	Still Orbiting	95 days	Still Orbiting
Rotating About Long Axis at 750 Rev./min.	?	.....	Same as Exp. I	Same as Exp. I
Flat Spin (about axis perp. to long axis) 7½ Rev./min.	?	.....	Same as Exp. I	Same as Exp. I
.....	Still Orbiting	Still Orbiting	.....	Still Orbiting
34°	35°	35°	35°	50.13°
0.1387	.....	0.191	0.1661	?
1.2276 R	.....	1.368 R	1.2344 R	.....
4.34°/day	?	?	.....	—3.76 degrees/day on Oct. 28/58.
1500 mi., 1510 on Aug. 1	2460 mi. on Aug. 1	2513 at launch 2460 mi. on Aug. 1	1741 mi. at start 1677 mi. on Apr. 3	1373, 1365 on Aug. 1
230 mi., 219 on Aug. 1	408 mi. on Aug. 1	408 mi. on Aug. 1	119 mi. on Apr. 3	163 mi., 163 mi. on Aug. 1
24,300 ft/sec.	?	27,100 ft/sec.	23,700 ft/sec.	?
22,550 ft/sec.	?	18,200 ft/sec.	23,000 ft/sec.	?
5.6	6.2 Lost	10.0	.....	5.1
9.8	10.1	13.9	.....	9.6
Jupiter-C 1st Stage	Vanguard		Jupiter-C 1st Stage	Jupiter-C 1st Stage
69 feet	72 ft.		69 ft.	69 ft.
4	3		4	4
31 lbs. (11 lbs. Payload)	53.7 lbs.	3.4 lbs. of instruments	32.4 lbs. (20.13 lbs. of instruments)	38 lbs. 26 lbs. of instrumentation
Cylindrical	Cylindrical	Spherical Magnesium Skin	Cylindrical	Cylindrical
80 inches	Approx. 7 ft.	.....	80 inches	80 inches
5 inches	20 inches	6 in. dia.	5 inches	5 inches
1. 100,000 lbs., 56 ft., 6 ft. dia. 2. ? 3. ? 4. As above (Satellite)	17,300 lbs. 44 ft. long, 3 ft. 9 in. dia. 4,800 lbs. 24 ft. long, 2 ft. 8 in. dia. 900 lbs. 7 ft. long, 20 in. dia. TOTAL WEIGHT 22,600 lbs.		65,000 lbs. 56 ft., 6 ft. dia. ? ? 80 inches (Satellite)	Same as Explorer I but more efficient Solid Propellant used.
1. 83,000 lbs. 2. ? 3. ? 4. ?	27,000 lbs. 75000 - 8000 lbs. 1440 lbs.		83,000 lbs. ? ? ?	83,000 lbs. ? ? ?
1. Kerosene-Lox 2. 11 Scaled down Sergeant Solid Propellant Rockets. 3. 5 Solid Propellant Rockets. 4. Single Sergeant Solid Propellant.	Lox/Gasoline Unsymmetrical Dimethylhydrazine Solid Propellant		As listed for Exp. I	As listed for Exp. I with a more efficient Solid Propellant.
168	338		168	168
Cosmic ray intensity, density of meteorites, and temperature inside and outside satellite.	Temperature, internal and external. Mercury batteries used on the 108.00 mc transmitter and solar batteries for the 108.03 transmitter.		Same as Explorer I but with tape recorder. The latter reports data in 5 seconds that was gathered over 135 min. Omnidirectional cosmic ray intensity.	Cosmic ray intensity in particular measurements on the high intensity cosmic rays which were found in Explorers I and III. Two Geiger Mueller tubes and two Scintillation counters.
108.00 megacycles 108.03 megacycles	108.00 mc., 108.03 mc.		Same as Expl. I	108.00 mc., 108.03 mc.
Low Power — 108 mc - 10 mw. High Power — 108.03 mc - 50 mw.	10 mw. - 108.00 mc. 5 mw. - 108.03 mc.		Same as Expl. I	10 mwatt at 108.00 mc. 30 mwatt at 108.03 mc.
Low Power — Continuous Phase Modulation.	108.00 - continuous wave		Low Power—Continuous Phase Modulation High Power—Interrogated from ground.	Low Power—Continuous Phase Modulation High Power—Interrogated from ground.
Feb. 28/58	High Power — April 15/58 Low Power — Still Functioning		Not known but now dead.	108.00 Sept. 8/58 108.03 mc still transmitting.

to distributors are expected early in the fall. Distributors report keen interest among prospects for the airplane which has a U.S. target price for the standard model of $13,500. Canadian price should be 10% higher due to Canadian sales tax.

TCA Needs Pilots

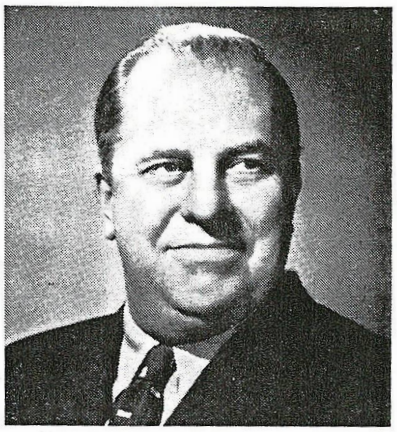
A call for additional pilots to meet anticipated operational requirements, has been issued by TCA. Simultaneously, it was announced that the maximum age limit for pilot applicants had been raised to 28.

TCA says it expects it will need a considerable number of pilots in the next year. They will be hired in groups of 24 at seven week intervals.

Basic requirements to be met by applicants include possession of a current Canadian Commercial Pilot license and a Canadian Radio Telephone (Restricted) license. New pilots must also have a high school education or equivalent university entrance.

Delay On Satellite

According to news reports, the first launching of the U.S.'s instrumented earth satellite, which was originally slated for this September, will be delayed anywhere up to a year. In a report to the House Appropriations Committee, Richard Porter, chairman of technical panel on the Vanguard Project, said: "There is a probability of at least one successful launching before the end of 1958." The overall program calls for the firing of six satellites.



SWEDISH OCCASION: Gunnar Wester, Canadian SKF president, attended the recent 50th anniversary celebrations in Sweden of the worldwide SKF organization, pioneer manufacturers of ball and roller bearings.

QUEBECAIR

(Continued from page 38)

sively on chartered services, and independently of its parent company.

It will be necessary also to expand the landing strips, in view of the F-27 coming into service in the early part of 1958.

A crucial problem, which is the same for every aviation company, is in recruiting competent personnel for both air and ground crews. To ease the present situation—a situation that could be corrected more easily if provincial governments, which are responsible for public education, would consider the launching of flying and maintenance schools—Quebecair has started a training class for its own employees, and this at every level of the organization. The first course graduated at the end of June and many of those who qualified will be in a position to become the leaders of tomorrow in the aviation field.

Rimouski, center and base of the operations of the company, besides the main building which houses the administration, waiting room and restaurant