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Soviet Technical Progress

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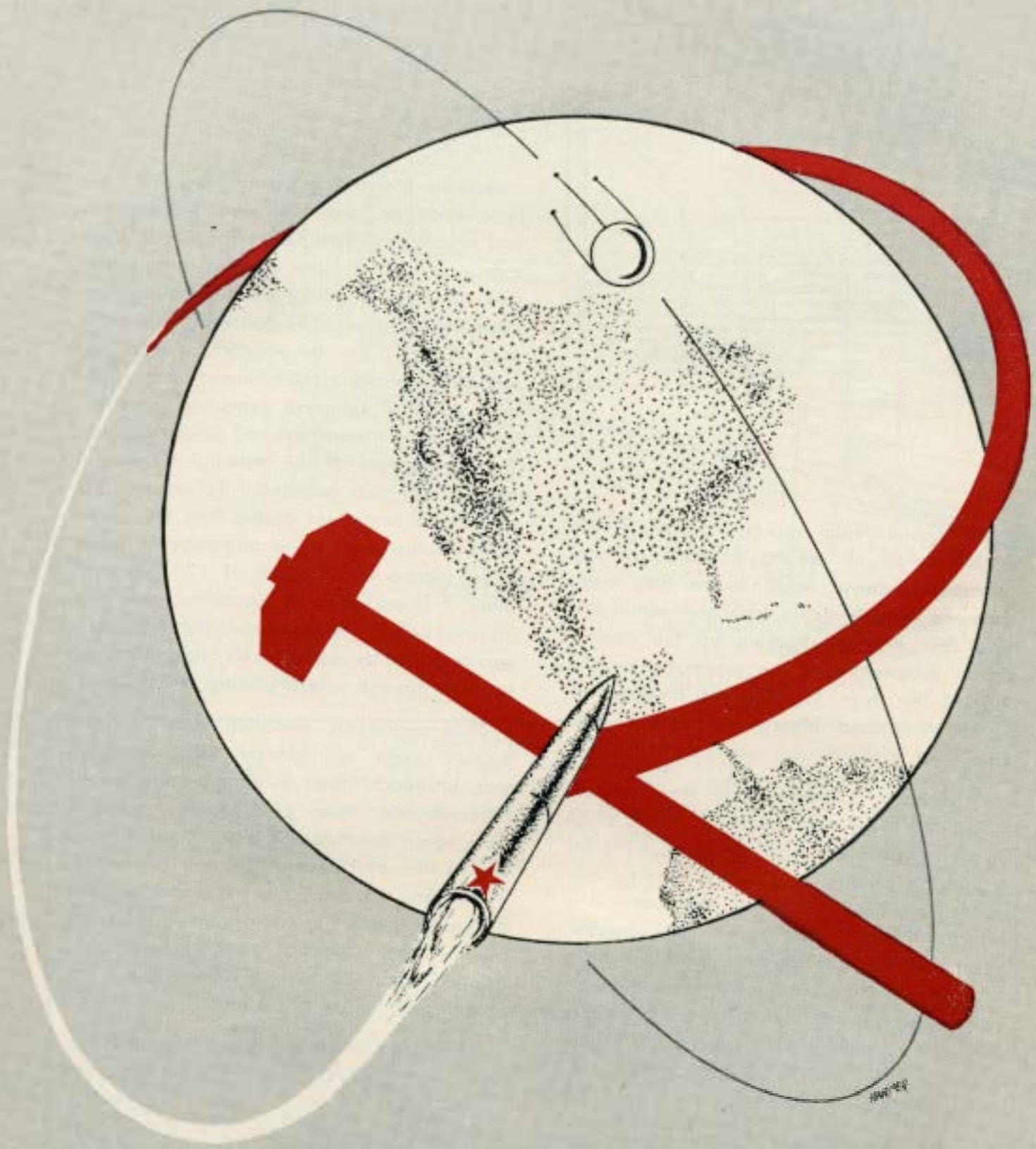

the russian space challenge to the free world

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SPACE SYMPOSIUM

soviet technical progress

By Ronald C. Wakeford

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The Soviet Moon rocket program, which according to all reports is daily gaining momentum, should result in the first interplanetary vehicle being launched within the next few months. Backing up the current Soviet program were the successful launchings of the three Sputniks, the first two of which re-entered dense atmosphere and burned up.

Scientifically informed circles were not surprised that the Russians were far ahead of us in the astronautical field since, at many international meetings and in their press, forecasts had been made of the impending satellite firings. The tremendous booster thrust required to place Sputniks II and III in orbit is indicative of the strides the Soviets have made in creating large rocket motors and new propellant fuels, advancing in the guidance field, and in developing high altitude biological laboratories.

It has been reported that the three-stage booster vehicle which carried the second Soviet satellite into orbit developed a take-off thrust of approximately 660,000 lbs. This figure resulted in an apogee altitude of close to 1,000 miles.

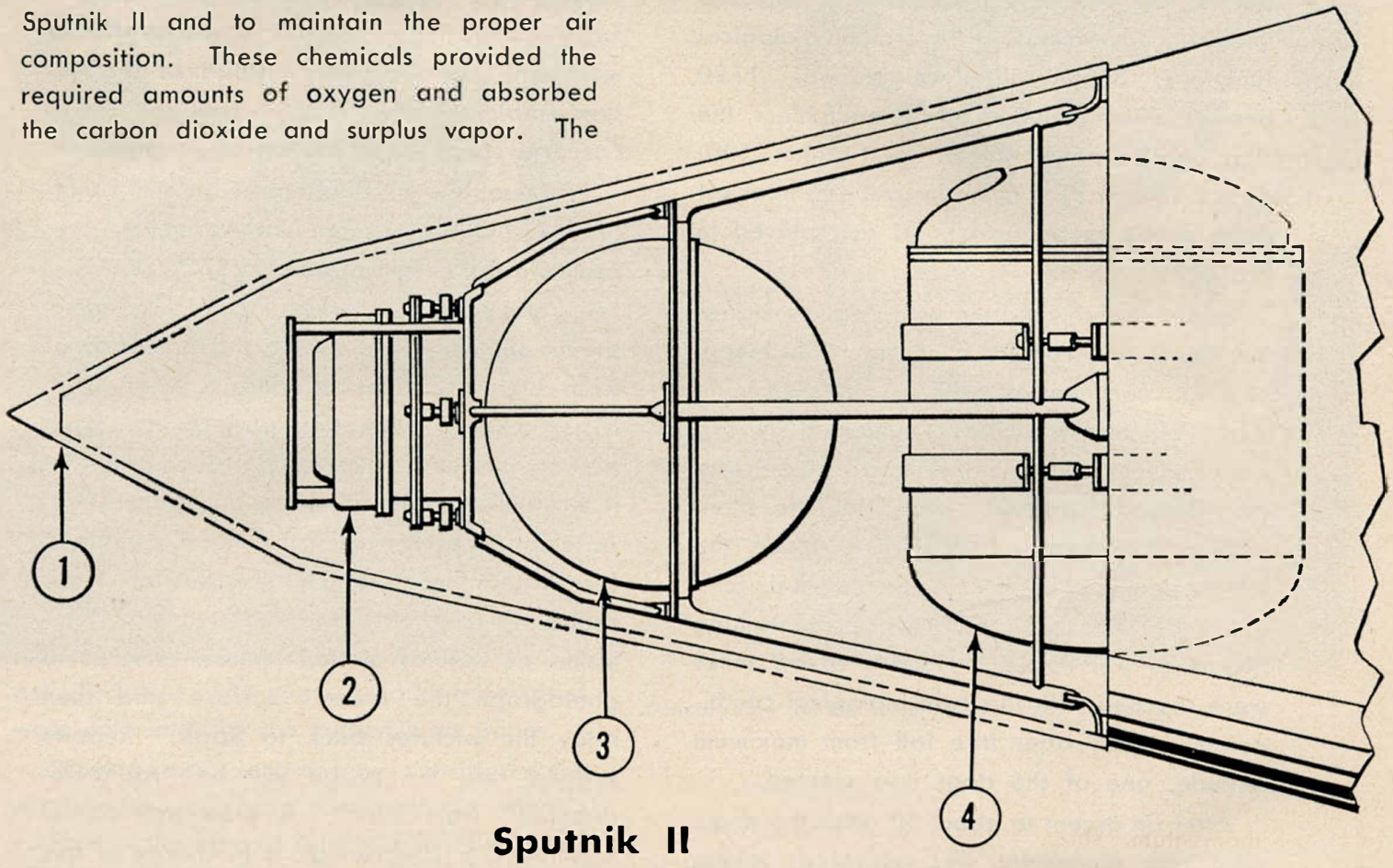
Sputniks I and II gathered much valuable information on ultraviolet and X-radiations, and cosmic ray intensities. Sputnik III, however, carries much more complex instrumentation. Sputnik II contained thermal control equipment and sensitive elements to register such effects as temperature fluctuations and the internal temperature of the orbiting vehicle. A spherical container contained the two radio transmitters and power supplies. The temperature of the external surface of Sputnik was also recorded. To measure the short wave radiations of the Sun, the Soviet Earth probes used three photoelectric multipliers placed at an angle of 120° to each other. These received radiation, and the electric signal generated by the multipliers was amplified by radio circuits and transmitted to Earth through a telemetering device.

Data on cosmic radiation were supplied by two cosmic ray counters. After a signal was broadcast that a definite number of particles had been counted, the particles were again recorded with a new signal broadcast as soon as the same number was reached. By dividing the number of recorded particles by the time taken to count them, the Soviets obtained the number of particles the counter trapped each second. In other words, they found the intensity of radiation.

As for the biological experiment, the dog Laika was the first living organism to travel several days in cosmic space. Important scientific data on reactions to the gravity free, weightless, condition were obtained from this revolutionary biological experiment. In addition, pulse beat, respiration, arterial blood pressure, cario-biopotentials, temperature and pressure in the animal's cabin were

recorded and telemetered to receiving stations.

Highly active chemical compounds were used to regenerate the air in the cabin of Sputnik II and to maintain the proper air composition. These chemicals provided the required amounts of oxygen and absorbed the carbon dioxide and surplus vapor. The amount of compounds in chemical reactions was controlled automatically, and the cabin was equipped with apparatus to feed the dog and eliminate wastes. The dog was



Sputnik II

1. JETTISONABLE NOSE CONE
2. INSTRUMENT FOR MEASURING ULTRAVIOLET AND X-RADIATION FROM THE SUN
3. RADIO TRANSMITTER
4. HERMETICALLY SEALED CHAMBER FOR LAIKA

SATELLITE LAUNCHING VEHICLES

Type	Designation	Length (ft)	Diameter (max. ft)	Weight	Stages	1st Stage Thrust	2nd Stage Thrust	3rd Stage Thrust	Exhaust Speed f.p.s.	Warhead	Status
Sputnik	CH-9	125.6	16.24	211,000	3	451,000	264,000	77,000	9850		
Sputnik	CH-10	112.8	16.24		3	517,000	268,000	78,100			
	SOVIET INTERCONTINENTAL AND INTERMEDIATE RANGE BALLISTIC MISSILES										
ICBM	T-3 (M-104)	88.5	11.5	160,000	3	484,000	268,000	78,100		Thermo Nuclear	Operational
ICBM	T-3 Second Version	108	16	350,000	3						
ICBM	T-3A	91.5	12	176,000	3	517,000	268,000	78,000	9840	Thermo Nuclear	Operational
ICBM	T-3A Second Version	101.5	16	396,000	3						
IRBM	T-4-A	122	10.2	231,000	3	264,000	264,000	77,000	9380		Experimental
IRBM	T-2	65.5	8.5	100,000	2	268,000	78,100		8365	Atomic	Operational
IRBM	T-4 (M-102)	56.1	7.2	70,850	2	170,400	52,800		10,000		Experimental
IRBM	Golem 2	57	7.2	74,800	2	242,000	71,500		7900		Experimental
IRBM	CH-18	42.3	5.9	41,300	1	99,000			7550		Production
IRBM	T-1	62	5.64	37,850	1	78,100			6525		Operational

thoroughly trained prior to making the flight; it was gradually accustomed to protracted stays in the small, hermetically sealed chamber, to the space suit, and to the attached impulse converters that record physiological functions. Sputnik II's weight was 1120 pounds, which included all the equipment, the dog, and the power source. Next to the 2500-pound Sputnik III, it is the largest and heaviest Earth probe to be developed and placed in orbit.

Soviet experimentation with dogs in rockets has been going on for a considerable length of time, commencing with a series of nine dogs, all of which were subjected to the environment of our upper atmosphere and the fringe of Space. Of these initial nine, three (Albina, Kozavka and Malyshka) made the ascent more than once. Subsequent tests utilized 12 dogs with many rockets containing two dogs per rocket. Heights of 68 miles were reached with this twin biological combination; shortly after free fall from maximum altitude, one of the dogs was ejected.

After an ascent to about 50 miles the dog's parachute equipment was activated; taking place three seconds after ejection. The second dog was ejected at altitudes of between 23 and 28 miles; its parachute opening was timed to inflate at a height of approximately two and one/half miles. Professor Pokrovskii, director of the Institute of Experimental Aviation Medicine of the Academy of Sciences of the USSR, stated that all dogs used in the experiments were recovered successfully.

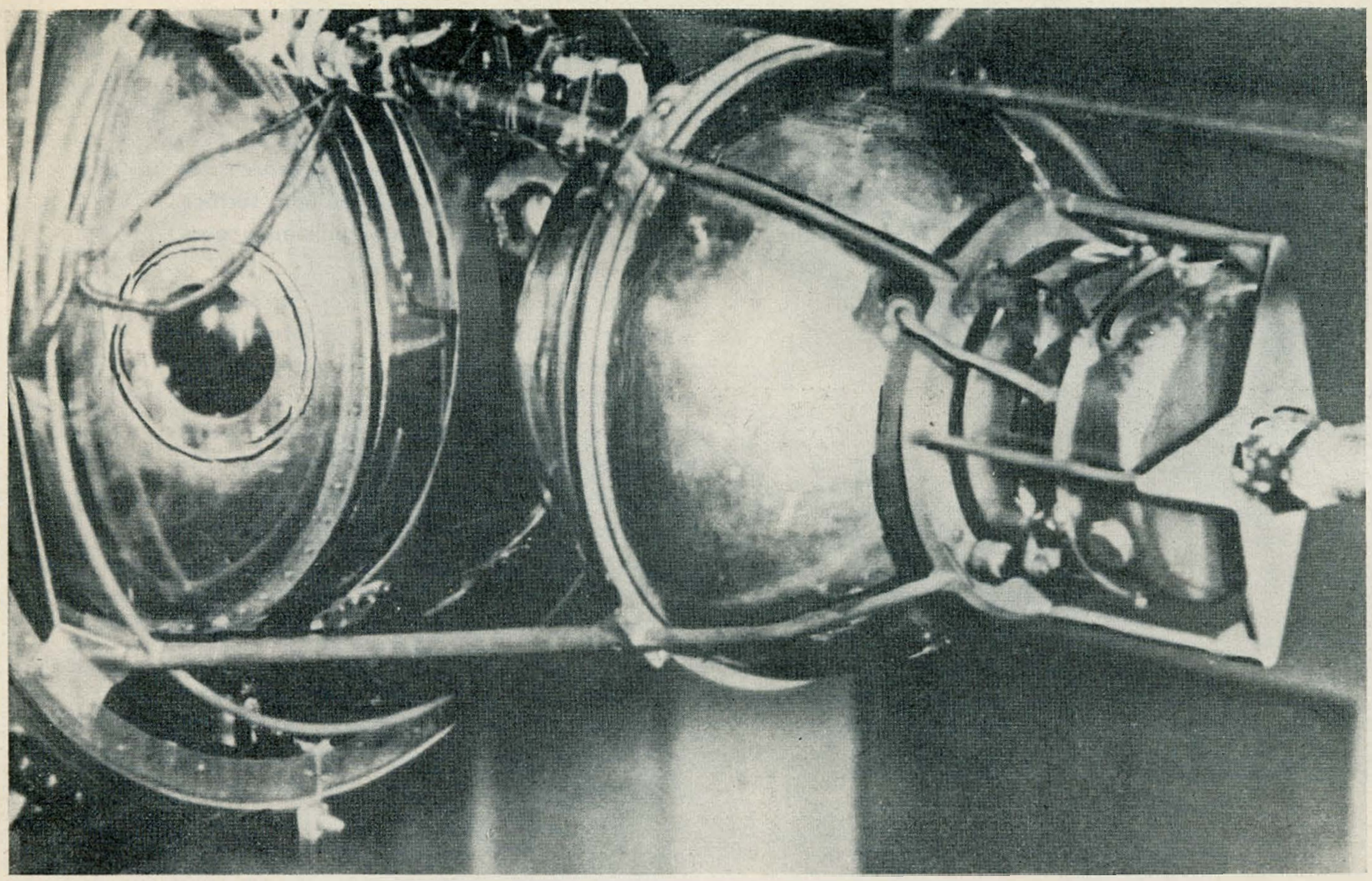
The dogs were trained to endure strain and to resist vibration; the Soviets stated that the dogs behaved normally when ejected and that they bore up well under the weightless state which followed. The data recorded indicate that the condition of the animals was satisfactory throughout the experiment.

The Russian biological achievements are only forerunners of many experiments that must be conducted. Man is one of the next steps in their program, and it is extremely likely that Soviet scientists will have man in Space shortly. Bio-satellite experimentation with human occupants represents the next great probe into the third dimension. For many years the biological approach of Soviet medical scientists has been to utilize dogs as test subjects. This research has paid off, and many authorities in the US would prefer to work with these animals instead of the unpredictable rhesus monkeys which spearhead our own space flight biological programs.

Professor G. A. Chebotarez of the Leningrad Institute of Theoretical Astronomy presented a paper in February 1957 titled "Cosmic Boomerang," which gave technical details on a method of placing payloads of from 110 to 220 pounds into a lunar orbit. It is believed that this project has been actively pursued since its inception and that it is currently approaching the hardware stage. An elliptical orbit around the Moon is planned for Project Boomerang. The Russian lunar probe will probably be equipped with television as well as motion picture cameras to photograph the Moon's surface and then relay the pictures back to Earth. Reports suggest that the probe will be "radiotele-directed" from Earth. A prominent Soviet scientist, I. S. Hlebtsevich, is in charge of this particular aspect of the program.

One study in which the Soviets are particularly interested is the determination of what causes the appearance and disappearance of craters on the Moon. Astronomer S. Y. Ziggel also wants to investigate the white cloud phenoma which are to be found in certain areas of the Moon. The question he raises is: "Do Moon quakes occur; and, if so, do such catastrophes cause crater changes and the mysterious clouds?"

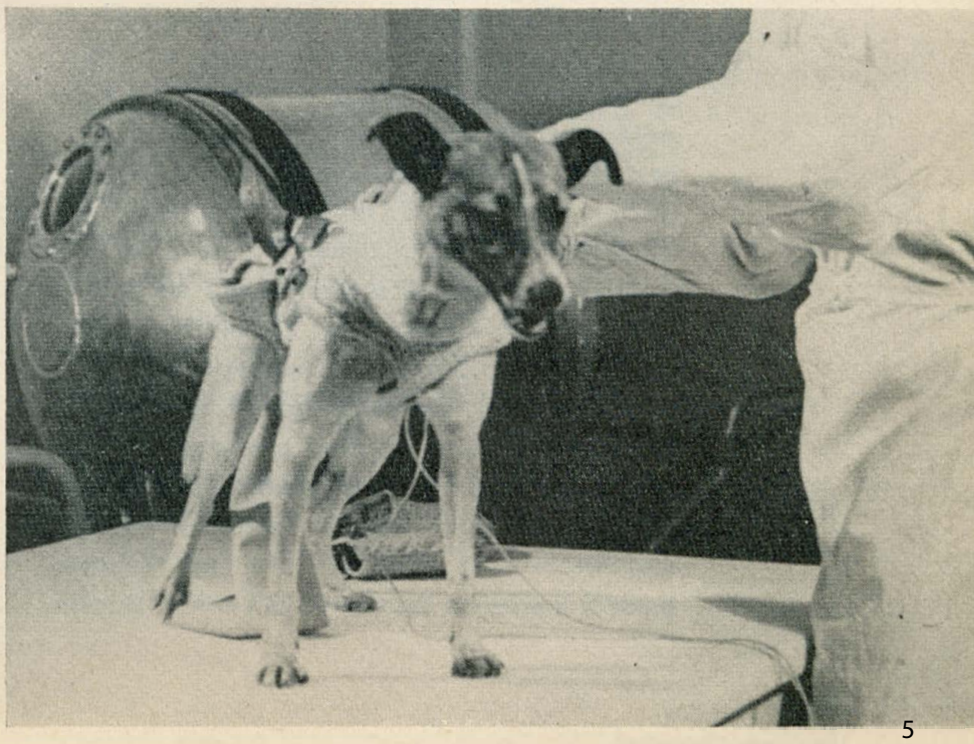
Russian scientist Egerov's paper entitled "Some Questions on the Dynamics of Flights to the Moon" gives some idea of how closely the Russians are studying the subject. In this paper he reviews the many fundamental questions and theories of flight to the Moon. The classification of unpowered trajectories, circumlunar flights, and the possibility of periodic circumflight of the Moon and Earth are examined. The question of impacting on the Moon and also the important question of the dispersion of instrumentation upon impact



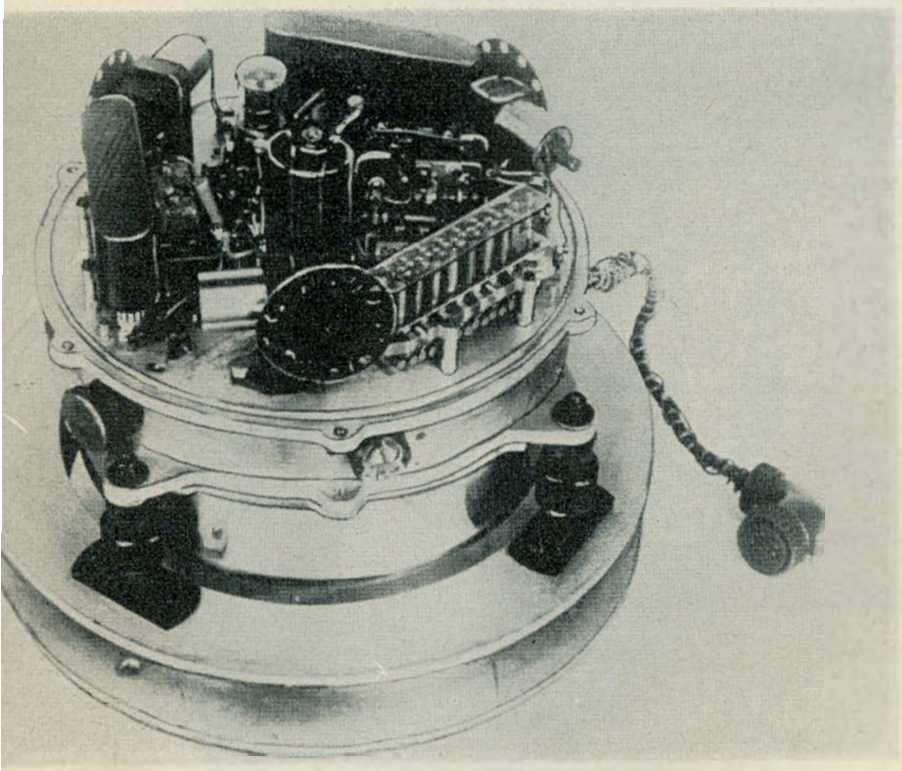
General view of the scientific apparatus in Sputnik II.

are discussed. As many as 600 trajectories were calculated by the author in his paper.

Other Soviet scientists have considered the establishment of base camps on the Moon's surface in the light of all the difficulties which will beset such a program. They have considered the need of frequently sending rocket ships to that body to support a base. The clothing and space suits for participants in such a venture have been designed; their space suits being (according to the press and photographic releases) developed, as in the United States, from high-altitude aircraft suits, and experimentation in pressure chambers.



"Laika" is shown before being installed inside Sputnik II (A still from the film, "First Soviet Earth Satellites").



Apparatus to study solar radiation, installed in Sputnik II.

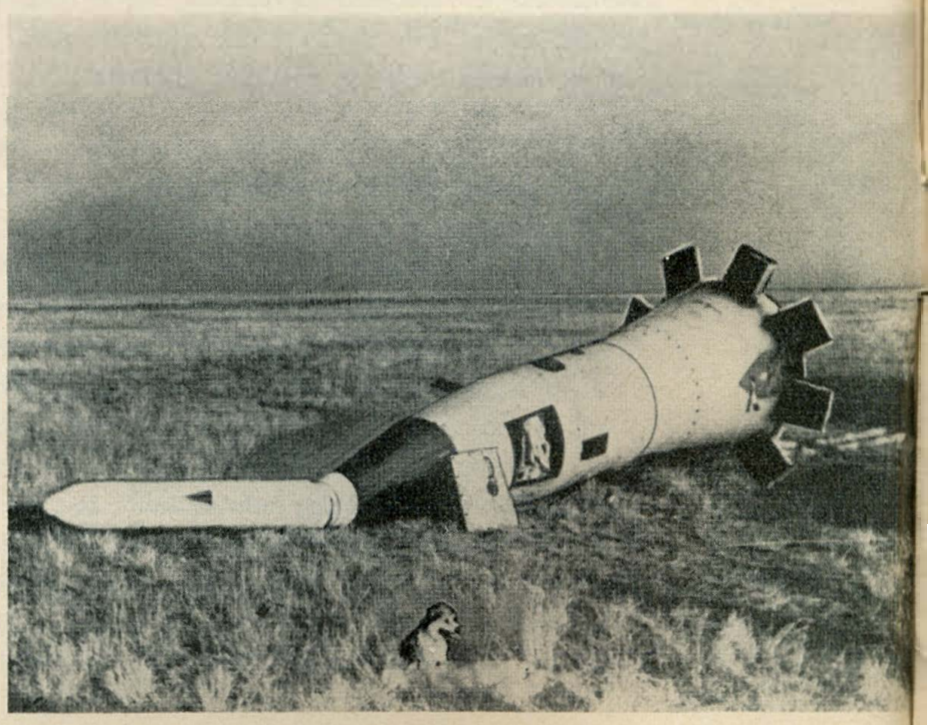
M. K. Pikhanizov some eight years ago wrote a report on a Moon rocket which would weigh approximately 1,000 tons and attain a velocity of 11 kilometers per second. The vehicle would carry a crew of two over a circumlunar trajectory and then return to Earth. A modification to this particular program would result in a vehicle being launched from an Earth-orbiting space station. Such a vehicle would weigh approximately 100 tons and would take off with a velocity of 3.5 kilometers per second. Some reports even suggest that design has already begun on the former vehicle and that its length is 60 meters; it has a maximum diameter of 15 meters. The overall weight would be 1,000 tons, and it would have 20 motors which could build up 350 million horsepower.

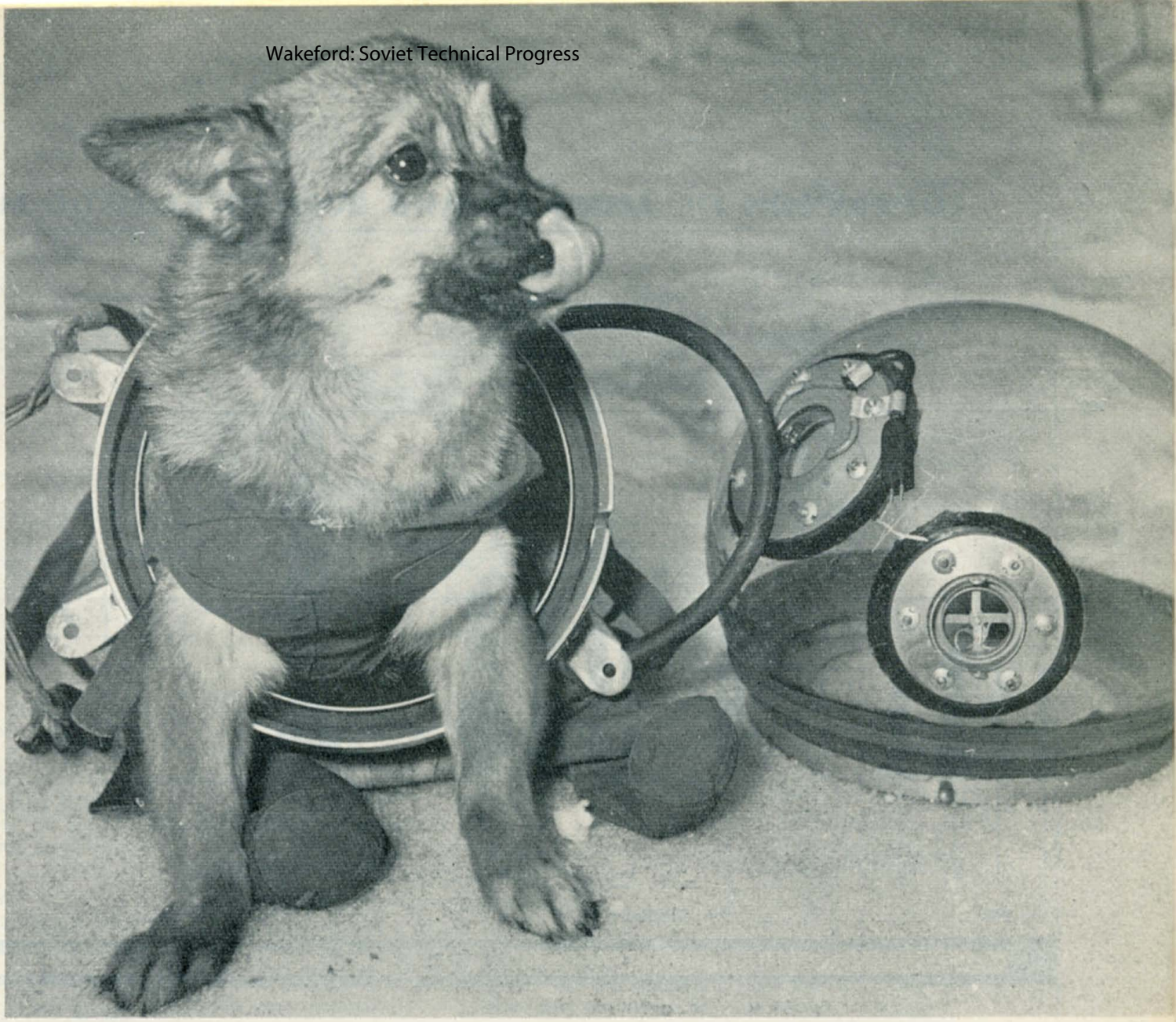
The Russian literature has fully covered lunar landings with all their attendant difficulties—take-off from this type of planetary environment, crew safety, and the various maneuvers of bringing orbiting vehicles around the Moon and back to Earth. Studies on the Moon would include the search for an atmosphere, determinations of surface conditions, and experiments to obtain geological data.

Soviet scientists have devised a scheme whereby the Moon may be explored by a small unmanned tank. The "tankette laboratory" would be landed on the lunar surface by the probe rocket, the former vehicle being radio controlled from Earth. Equipment in the mobile laboratory would include a television camera which would transmit details of the Moon's surface to observers on Earth. Other experiments conducted with this device would be geological sampling, gravity and temperature determinations, etc.

In the background of the Russian Moon program is the Soviet work on guided missiles. In this field they have constructed, and have launched, and have in production, every type of missile that is known from underwater-to-surface through the missile spectrum to surface-to-surface. Their progress in the ICBM and IRBM field is well known since test

The dog "Moduitso", shown in the foreground, supposedly has "just returned safely from the flight." This instrument and animal container section of a Russian experimental rocket was reported to have been parachuted from a height of 212 kilometers. (From "Pravda")





Another "experienced" Russian "astronaut" by the name of "Malyshka" and its space capsule. (Photo by S. Gurary)

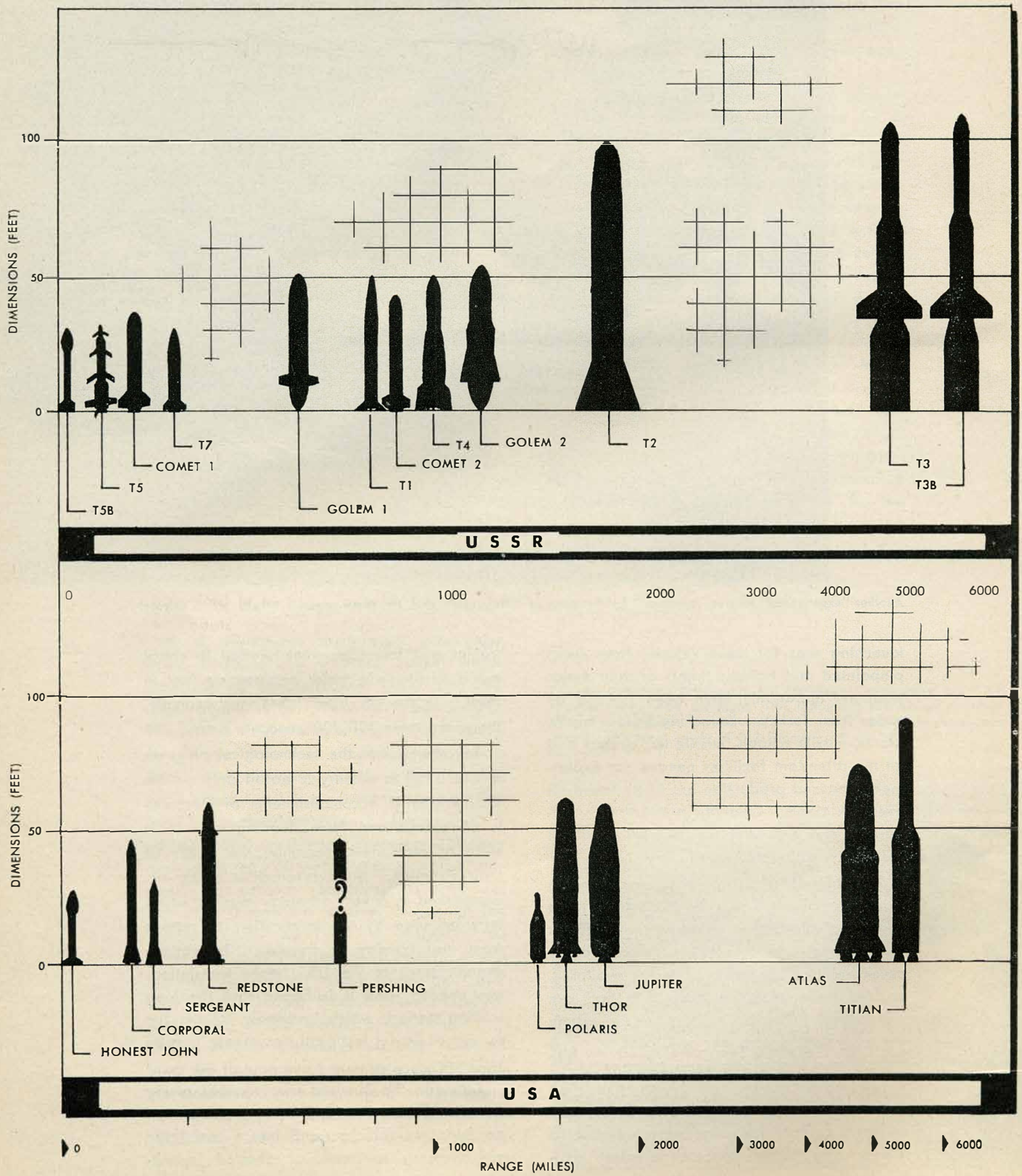
launching sites for these vehicles hove been pinpointed and ballistic flights of their major weapons apparently hove been tracked by radar from Turkey. Launching bases, missile plants, missile schools, missile test centers and all the attendant facilities needed for experimentation and production ore to be found all over the USSR. Quantity production is apparent, and we hove no reason to doubt the quality of the products.

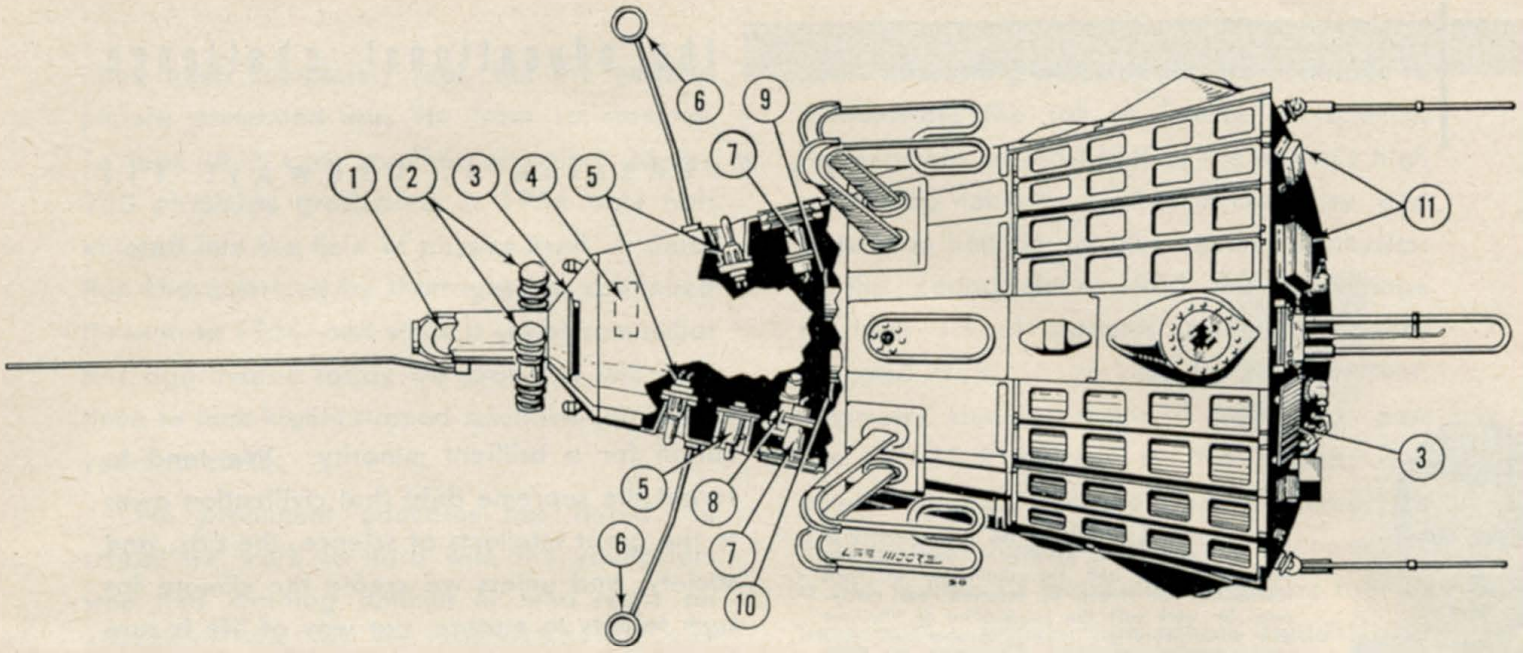
The strength of Soviet advances mode in technological areas may be illustrated by the number of production or operational missiles in evidence. In the IRBM category alone seven vehicles ore believed to be available, and of these probably more than half ore operational. The design of a missile system (as any missile engineer will confirm) is a complicated and exacting procedure requiring the coordination of many highly qualified scientists and engineers. Thousands of complicated components must be integrated to insure compatibility, and the necessary electronics and test equipment needed to check out a missile is a major engineering feat in itself. In the US Atlas ICBM, for example, there ore over 300,000 separate ports.

To assume that the technological progress of the USSR in missilry is based only on the World War II accomplishments of Germany is dangerous and false, leading only to a state of seriously underrating the ability of their scientists. Basic research is being accomplished in a very scholarly manner which may be seen by the publication of reports from that country as translated by various organizations in the US. More translations ore needed, and it is hoped that the long waiting period, which invariably follows the receipt of Soviet technical documents, con be reduced.

Although the Russians wisely ovoid giving advance data on the launching dotes of IGY participation vehicles, and hence avoid the embarrassing spectacle of aborted launch-

COMPARISON OF AMERICAN AND RUSSIAN BALLISTIC MISSILES





Sputnik III

1. MAGNETOMETER
2. PHOTO-MULTIPLIERS FOR THE REGISTRATION OF THE CORPUSCULAR RADIATION OF THE SUN
3. SOLAR BATTERIES
4. DEVICE FOR THE REGISTRATION OF PHOTONS IN COSMIC RAYS
5. MAGNETIC AND IONIZATION MANOMETERS
6. ION CATCHERS
7. ELECTROSTATIC FLUXMETER
8. MASS SPECTROMETRIC TUBE
9. DEVICE FOR THE REGISTRATION OF HEAVY NUCLEI IN COSMIC RAYS
10. DEVICE FOR MEASURING THE INTENSITY OF PRIMARY COSMI RADIATION
11. PICK-UPS FOR THE REGISTRATION OF MICROMETERS

ings, they have given details of the experiments to be conducted. These include:

1. Structure parameters of the upper atmosphere, temperature, pressure, and composition.
2. Movements of the upper atmosphere.
3. Study of the electrical properties of the upper atmosphere (ionosphere).
4. Study of cosmic radiation.
5. Study of the ultraviolet part of the Sun's spectrum.
6. Study of the solid composition of interplanetary material (micrometeorites).
7. Study of corpuscular rays from the Sun.

A recent tour of the USSR by US engineers attending a radio engineers' convention in that country resulted in their obtaining first hand knowledge of Soviet progress in this field. Among the facilities visited was Pulkovo (some ten miles south of Leningrad) where a radio astronomy station is located. The focal length of the radio telescope is 50 meters and it has a diameter of 75 meters. It has a paraboloid section and uses flat mirrors, each of which is adjustable to relate these to the theoretical contour.

Other places visited by this group included the Television Research Institute at Leningrad and the Television Broadcasting Station at Moscow. The latter organization broadcasts on two 8 mc wide channels. Current planning indicates that 60,000 kilometers of wide band microwave circuits will be available by 1960. When this rate of progress is related to the known status of this country in these fields some ten years ago, it may be seen that a great deal of research has been successfully accomplished.

Education is the key to Soviet progress, and this particular basis has been firmly established. From grade school through university, great emphasis has been given to scientific training. This approach has resulted in the graduation of these scholars whose efforts today are successfully keeping the USSR ahead of us in the race to the Moon. Only a complete overhaul of our own school system, programmed to concentrate on the scientific areas in which we are deficient, can result in the negation of this lead.

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