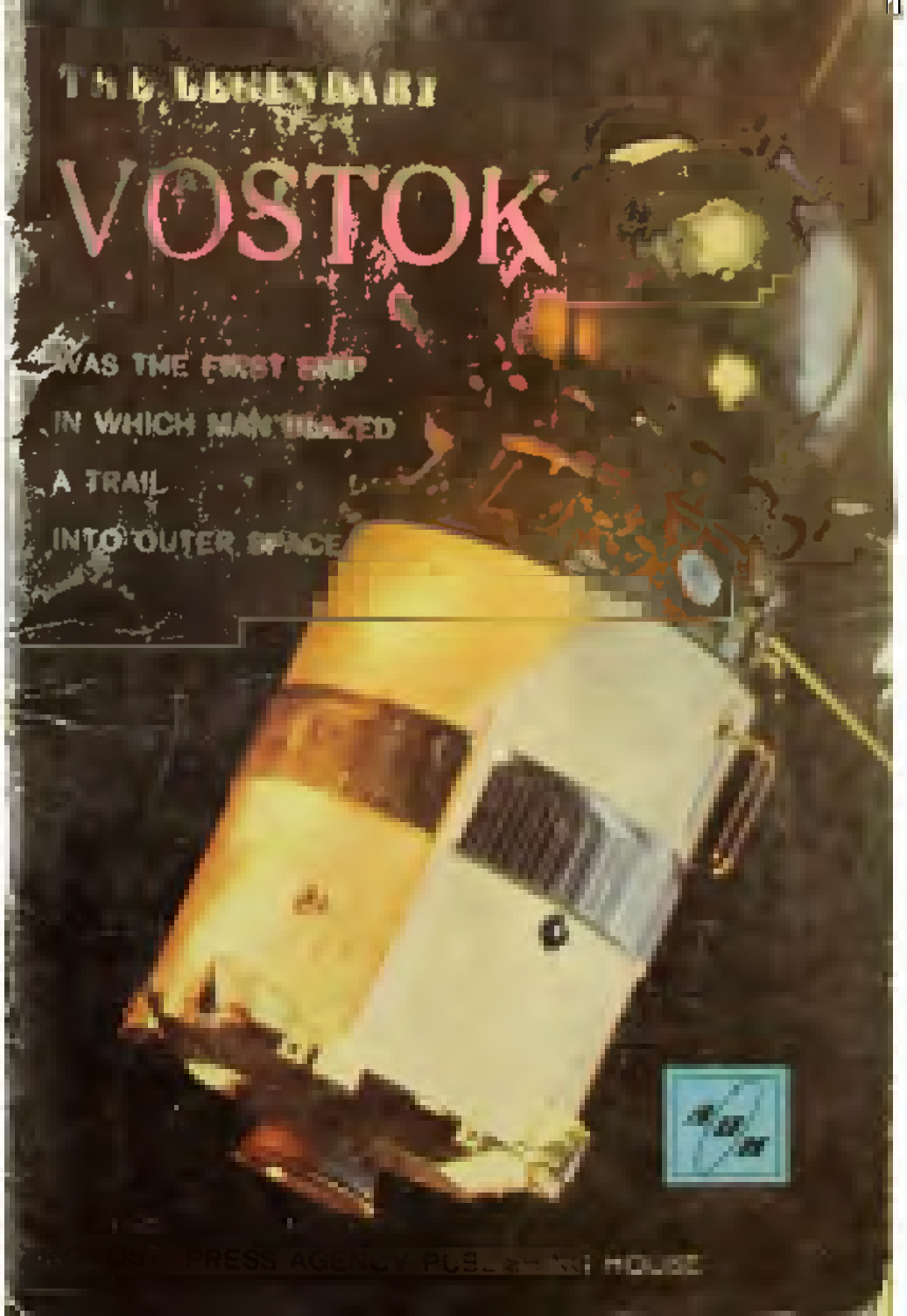

VOSTOK
WAS THE FIRST SHIP
IN WHICH MAN BLAZED
A TRAIL
INTO OUTER SPACE

THE SHIP HAS FINISHED CIRCUITING THE EARTH.
«SHARIK» (SPHERE) IS THE PET NAME
FOR THE CAPSULE OF THE SPACESHIP VOSTOK
USED BY ITS BUILDERS,
LAUNCHING CREW, PILOTS AND
THE PEOPLE WHO WELCOMED IT UPON LANDING.

THE FLIGHT OF YURI GAGARIN, PILOT-COSMONAUT OF THE USSR, USHERED IN A NEW ERA IN HUMAN HISTORY—THE ERA OF SPACE CONQUEST

Yuri Gagarin spent 108 minutes in outer space. These were minutes that shook the world.

At 10.55 hours, on April 12, 1961 the satellite spaceship **Vostok** made a safe landing in a predetermined area.

That memorable day which is now celebrated as a red letter day—Cosmonautics Day—was a day of magnificent triumph of Soviet scientific and technological achievement. This incomparable scientific feat of the Soviet people is the outcome of harmonious advancement of many scientific and technical fields, development of new materials, elaborate electronic and radio equipment, and its successful employment in rocketry and spacecraft construction.

The orbiting of the **Vostok** was preceded by strenuous work conducted on a grand scale. The assignment was to develop a reliable spacecraft which would guarantee the pilot's safety in flight and his return to the Earth, and a powerful multi-stage carrier-rocket which would put the ship into orbit round the planet. The ship and the rocket were finally created by the purposeful efforts and concentrated labour of many Soviet collectives—design bureaus, scientific research institutes and industrial plants.

To send a man into outer space one had to be sure that the flight would not cause essential changes in his organism.

The experimental flights of animals in high altitude rockets and satellite spaceships enabled the scientists to conduct a series of investigations. They studied the main factors bearing on space flight and their effect on the living organism. The main source of anxiety was how the living organism will stand up to the tremendous overloads during the boosting stage of the flight, how it will react to weightlessness and return from weightlessness to overloads during re-entry.

The experiments confirmed the view of the scientists who supposed that the living organism could stand up

Mass turn-outs on Red Square, at the ancient walls of the Kremlin, greeted the Soviet cosmonauts on their return from outer space.

Yuri Gagarin, Gherman Titov, Andrian Nikolayev, Pavel Popovich, Valeri Bykovsky, Valentina Nikolayeva-Tereshkova—the six cosmonauts whose names are now known throughout the world. All of them are plain, ordinary people who enjoy life here on Earth just like anyone else.

to these and other factors of space flight without hazard to health.

It was only after this was ascertained that it was decided to send a man into outer space.

In the course of a period of a little more than two years Soviet cosmonauts carried out six flights in spaceships of the **Vostok** class. They have demonstrated to the whole world the superb quality and reliability of Soviet spacecraft engineering.

The **Vostok** spaceships proved to be real scientific laboratories in outer space. The information collected during their flights is an invaluable contribution to the treasure of human knowledge.

And now the **Vostok** class spaceships have been replaced by their bigger brothers—by the new, more sophisticated spacecraft of the **Voskhod** class. These have enabled the Soviet people to make further progress in space exploration.

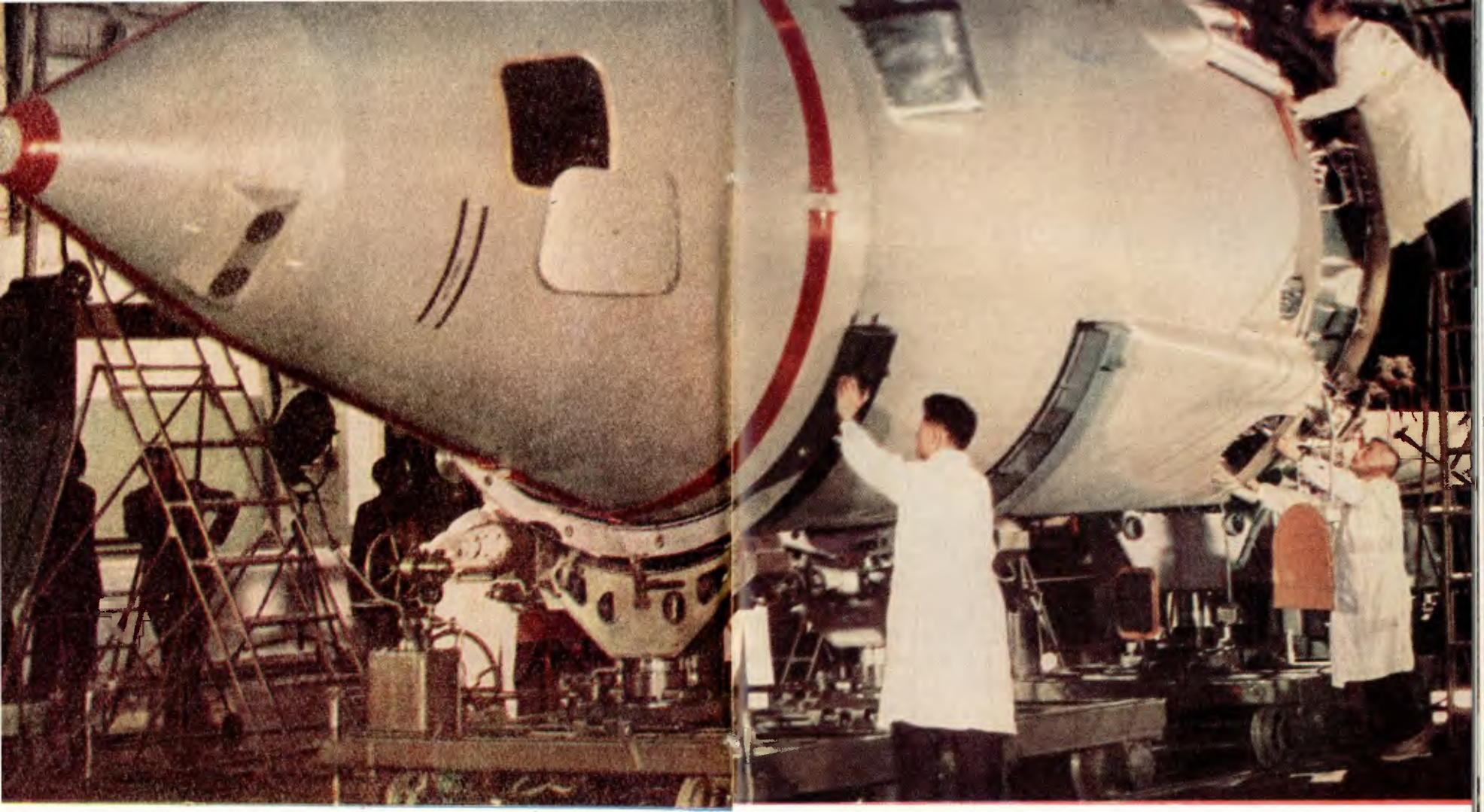
THE VOSTOK IS A SINGLE-SEATER SATELLITE SPACESHIP CONSISTING OF A CAPSULE AND AN INSTRUMENT COMPARTMENT JOINED TOGETHER WITH FOUR BRACING BANDS. THE SPACESHIP HOUSES THE FOLLOWING MAIN SYSTEMS:

Control system. Orientation system. **Vzor** optical device. Life-sustaining system, which includes an air-

conditioning and air-regenerating system, air pressure adjusting system, food supply and sanitary system. Pilot's seat. Thermal regulation system. Self-contained system for registration of inner-capsule parameters. System for registration of pilot's physiological functions. System for measuring the orbital parameters. Telemetering system. Ship-to-Earth radio-communication system. TV system. Power supply units. Braking engines (retro-rockets). Landing system.

On the outside the ship has the orientation system, micro engines, the balloons with oxygen and air to ensure proper breathing for the cosmonaut in case the capsule is depressurised and for the ventilation of the space suit, as well as aerials of the spaceship radio system. The instrument compartment contains the electric power supply units, the piloting and the descent apparatuses, the apparatuses for the telemetering systems and for the radio check-up of the orbit, the TV and the communication devices. The instrument compartment of the spaceship separates from the capsule when it re-enters the dense layers of the atmosphere during descent and burns up.

The weight of the ship with the last stage of the carrier-rocket is 6.17 tons (it is 4.73 tons without the last stage) and its length with the last stage is 7.35 metres.



The ballistic cap being fitted to the spaceship in the assembly shop. Closer to the cone of the ballistic cap is the descent control apparatus which houses the cosmonaut's capsule and an instrument compartment behind it. During the boosting stage of the flight the ballistic cap protects the ship as she passes through the dense layers of the atmosphere. Then the cap is jettisoned.

THE CAPSULE OF THE SATELLITE SPACESHIP VOSTOK IS A SPHERE WITH A DIAMETER OF 2.3 METRES AND A WEIGHT OF 2.4 TONS. THE COSMONAUT'S CABIN IS INSIDE THE CAPSULE.

The outer surface of the sphere is covered with a special heat-proof coating which prevents it from the effects of high temperature when it enters the dense layers of the atmosphere during descent.

The capsule shell has three hatches: the parachute hatch, the technological hatch and the exit hatch. It also has three portholes of refractory glass. Through these portholes the cosmonaut can observe outer space and the Earth and take pictures with ordinary camera and cinecamera. To protect the cosmonaut's eyes from sun rays each porthole has shutters which can close the porthole in case of need. The capsule houses several systems and instruments for effecting control of the ship, supporting the life of the cosmonaut and registration of inner-cabin parameters.

The porthole directly in front of the cosmonaut has a **Vzor** optical device fixed in it. This device is designed for orienting the ship in space when it is piloted by hand controls.

In the fore part of the cabin, over the optical device,

there is the instrument panel, and somewhat below it is a TV camera giving the inside view of the cabin.

The panel has a set of instruments on it, which register the temperature and humidity of the air in the cabin, the content of oxygen and carbon dioxide in it, the air pressure in the cabin, the pressure in the orientation system cylinders and other parameters. The same set includes a clock which is switched on at the time of launching and counts time to the moment of landing. The upper section of the panel has an automatic globe which helps the cosmonaut to determine the point of the Earth over which the ship is flying at a given moment. The same instrument helps to choose the right time for switching on the retrorockets to land in a preset area when use is being made of the handcontrol system for piloting the ship during the descent from the orbit. To the left of the cosmonaut are: the container with the landing system parachutes, a supply of drinking water, the ship's control panel, the emergency heat regulation system, the landing system direction finder and a tape recorder.

In the right-hand side of the cabin are installed: the pilot's control stick, the food container, the air regeneration system apparatuses, the electric clock, the cabin

A last farewell, a last handshake, a few minutes before the rocket takes man into outer space. The first venture was made at 09.07 hrs, Moscow time, on April 12, 1961.

side view TV camera, a radio receiver set, the sanitary system and the electric power supply units.

During his flight in the spaceship **Vostok** the cosmonaut wore a special space suit and sat in the pilot's seat. While in the seat he could freely make observations and pilot the ship. The apparatuses inside the cabin are so arranged as to afford the pilot the utmost convenience during the whole time of the flight either when the pilot is fixed in his seat or when he freely floats in the cabin in a state of weightlessness.

The seat has the built-in space suit ventilation system, the catapult and the pyrotechnic devices and the parachute systems. During catapulting and parachute descent the back of the seat with the strapping system for fixing the position of the cosmonaut's body separates from the rest of the seat. The separating section also includes the emergency stock of food and water, the radio means for communications and direction finding, and a pneumatic dinghy and the kit which the cosmonaut can use on landing.

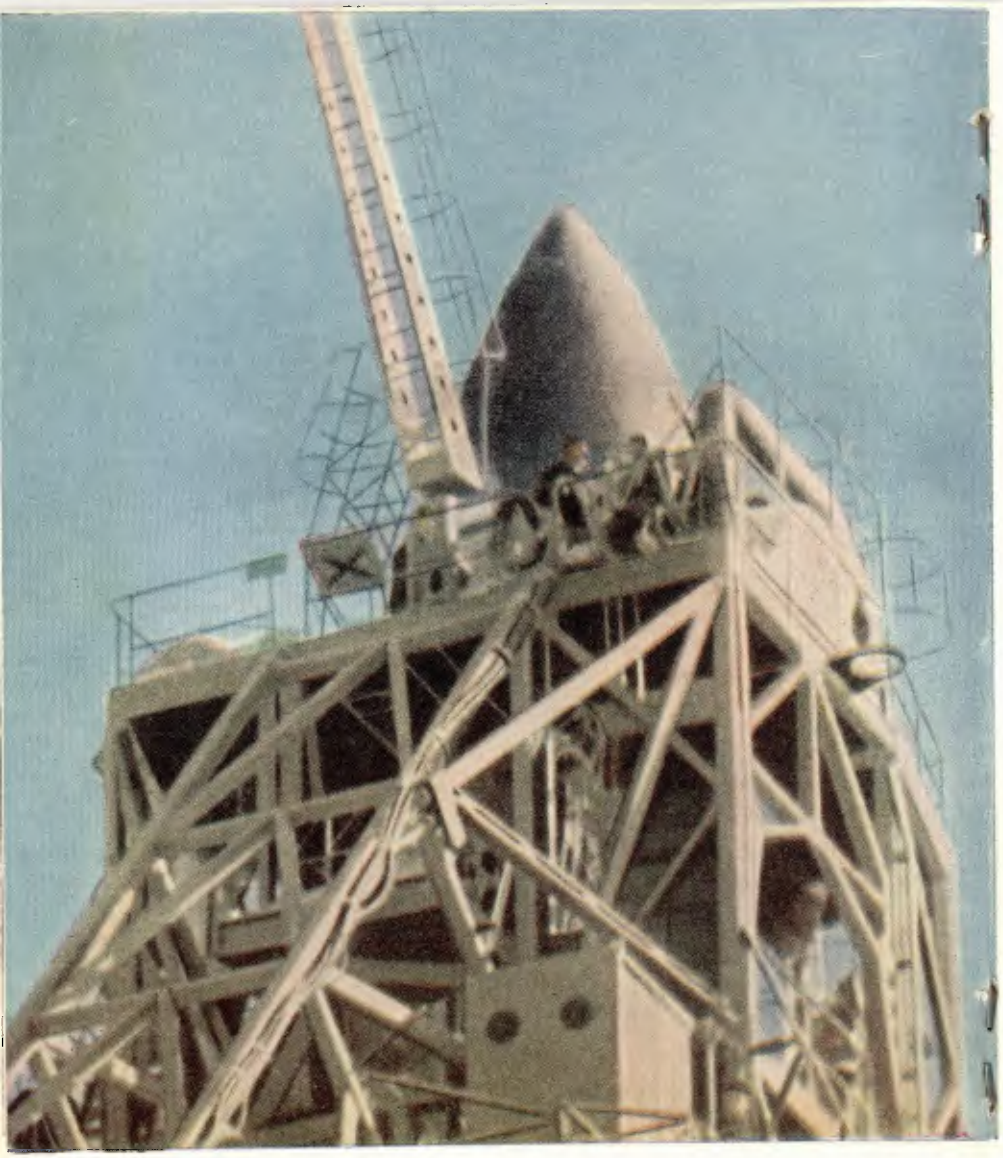
Under the seat the landing system units, the telemetering units and some other elements of the cabin's equipment are installed. The total weight of the apparatuses installed in the capsule is 800 kg.

"ALL THE SHIP'S SYSTEMS ARE FUNCTIONING NORMALLY." ALL THE COSMONAUTS REPEATED THESE WORDS IN THEIR REPORTS FROM THE ORBIT.

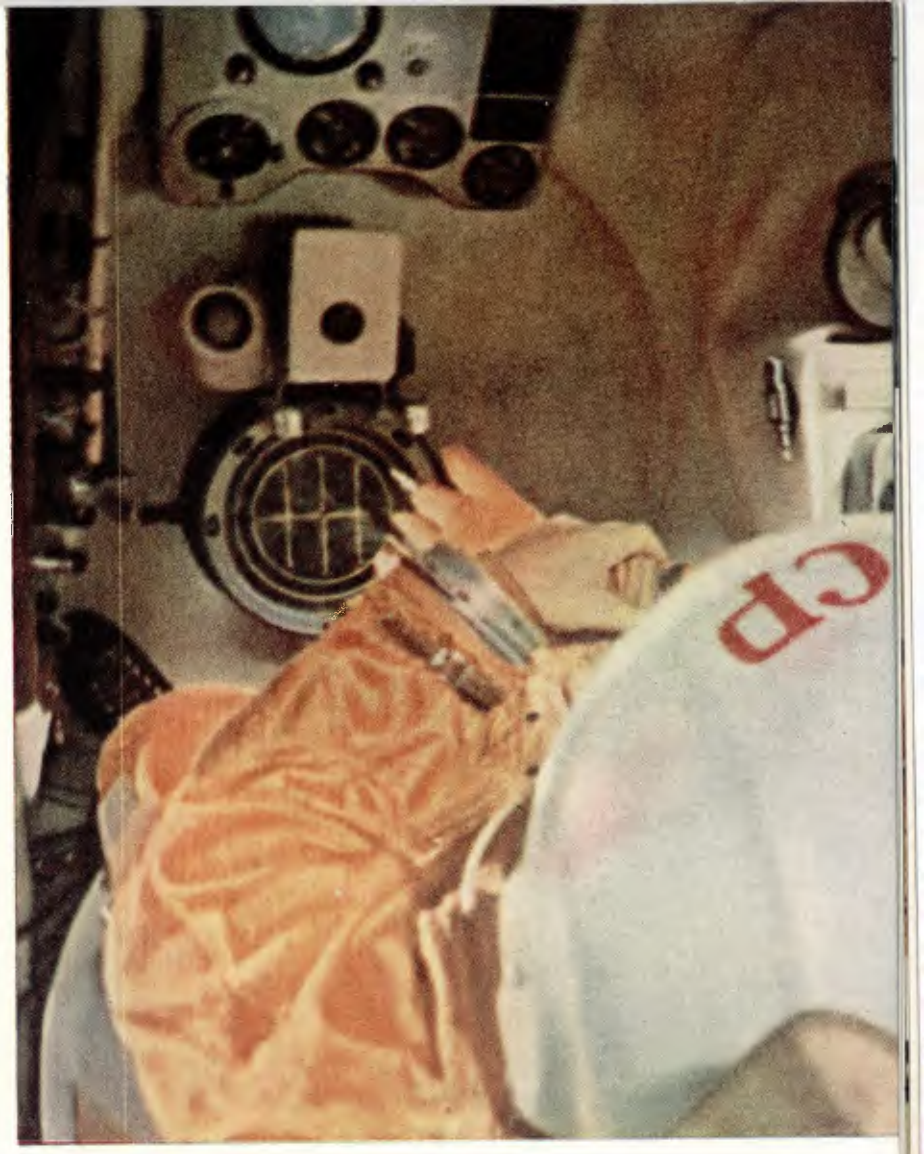
The air conditioning system which maintains in the ship's cabin the normal pressure of about 750 mm (mercury), the right concentration of oxygen, the normal temperature of air and relative humidity of 30-70 per cent.

The air-regeneration system—the absorption of carbon dioxide, water vapour and the generation of the necessary quantity of oxygen is carried out automatically with the help of special chemical compounds. The supply of food, water and regeneration agents aboard the spaceship **Vostok** are good for a 10-day flight.

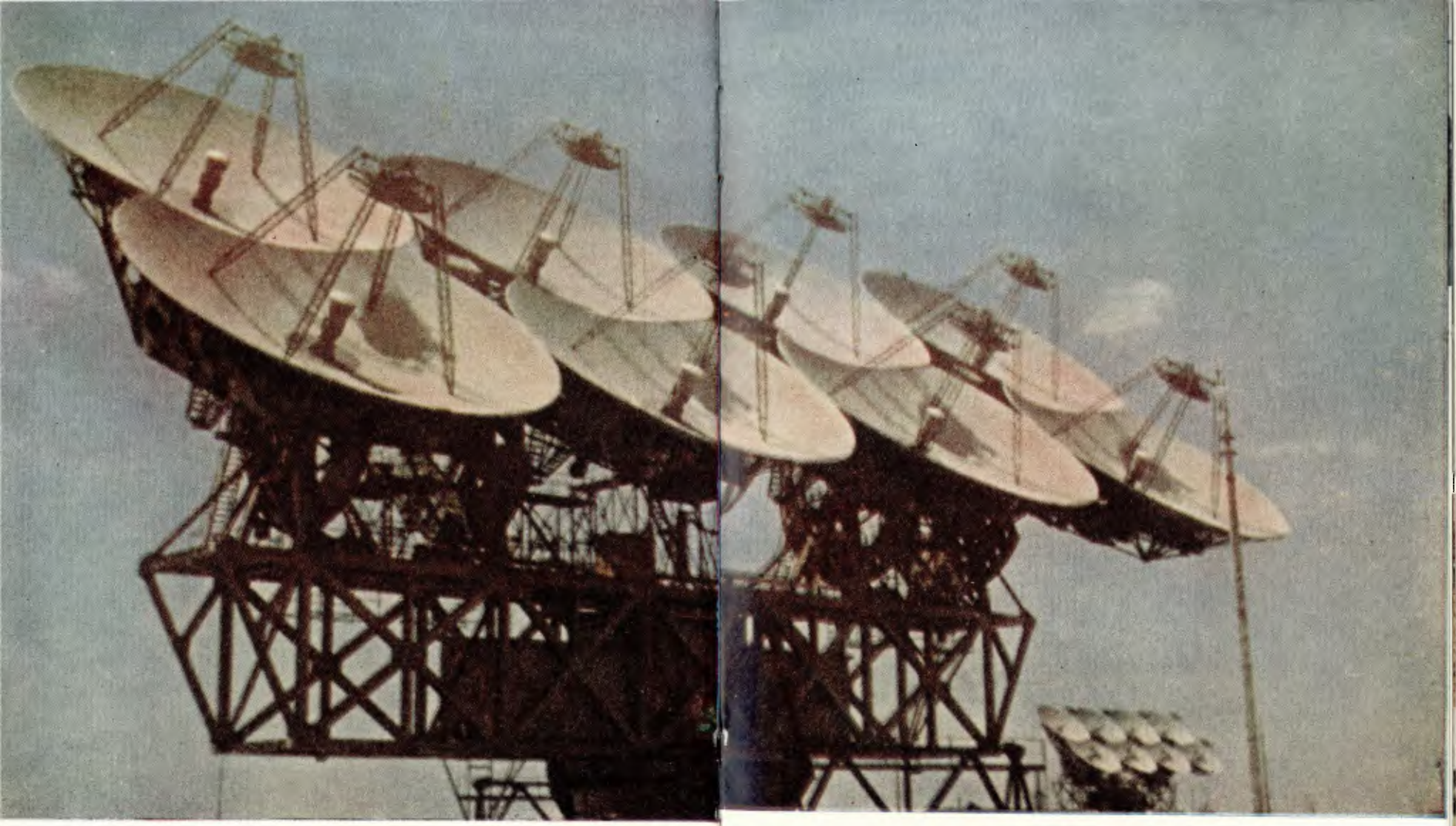
The heat adjusting system also works automatically. It consists of two circuits, an air circuit and a liquid circuit connected to a heat radiator which is installed in the instrument compartment. Both circuits converge in the heat exchange unit which is in the ship's cabin. The cosmonaut adjusts himself the right temperature in the cabin (from 12 to 25°C), which is then maintained automatically. Even during the prolonged heating of the capsule's surface during the braking in the atmosphere, the system precludes the raising of air temperature in the cabin above the set limit.



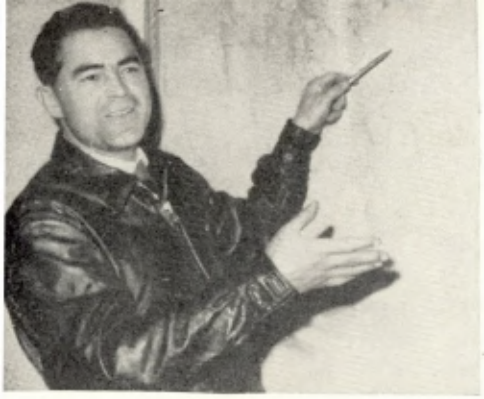
Space rocket before launching.



The count-down begins.



The Earth is ready to listen in to the Cosmos.



The orientation system is used for the orientation of the ship in space when in orbit and during descent. The system can be controlled both automatically and manually. It includes actuating units, sensitive gyroscopic and optical elements and logical devices. The actuating units in the ship's orientation system are the microjet engines installed on the outer surface of the ship.

The radio equipment installed in the ship includes a signal system operating on a frequency of 19.995 megacycles. It serves to determine the position of the ship and to transmit part of telemetric information. There is also apparatus for two-way radio telephone communications on two short-wave channels (9.019 and 20.006 megacycles) and one VHF channel (143.625 megacycles). The latter was used for conversations with ground points at a distance of 1,500 to 2,000 kilometres, while the short-wave channel operated during the entire flight. Among radio systems there is a channel for relaying flight control commands. Its aerials are situated on clamping bands that attach the capsule to the instrument compartment: nearby is a system for the radio control of the orbit. This system measures the parameters of the ship's motion and automatically relays them to Earth to be promptly processed and produce

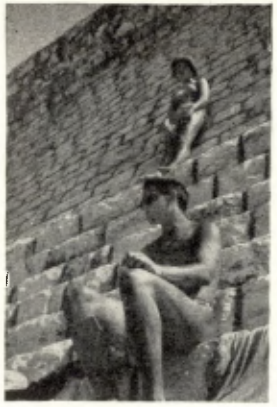
prognostication data on the further flight of the ship.

Installed in the cabin is a receiver with variable tuning in the medium and short wave bands for listening to broadcast programmes and a tape recorder with automatic start from a voice signal and accelerated readout of the recording on command from Earth.

The telemetric system serves to transmit to Earth telemetric information, including: physiological data on the cosmonaut's condition (pulse beat, rate of breathing, blood pressure, cardiogramme, etc.), parameters of the ship's cabin (temperature, pressure, humidity, air composition), data on the functioning of the ship-borne systems and apparatus and a number of other parameters.

The television system with pick-up cameras for viewing the cabin internally ensures observation of the cosmonaut during the ship's flight over the territory of the Soviet Union.

The cosmonaut's protection from radiation is ensured by the ship's body. In addition to this, in case of a sharp deterioration of the radiation conditions and when it is necessary to prevent the exposure effects of radiation the cosmonaut can use special protective chemical agents. For the determination of the radiation



conditions in outer space the ship is fitted with dosimetric apparatus whose readings are automatically transmitted to the Earth.

The sources of power supplies provide with electricity all the ship-borne apparatus and are calculated for a flight duration of 10 days.

THE SPACESHIPS "VOSTOK" WERE PUT BY POWERFUL MULTI-STAGE CARRIER-ROCKETS INTO ORBITS OF ARTIFICIAL EARTH SATELLITES WITH A PERIOD OF REVOLUTION OF ABOUT 89 MINUTES AND THE INCLINATION OF THE ORBITAL PLANE TO THE EQUATOR OF ABOUT 65 DEGREES.

While the ship is being put in orbit the stages of the carrier-rocket are jettisoned upon the burnout of the fuel. When the velocity of the ship reaches the magnitude of orbital velocity (that is about 7.8 kilometres a second at the height of the ship's flight), the engines of the last stage are cut off, and it is detached from the ship.

Gradually, due to the natural drag in the upper layers of the atmosphere, the ship loses its initial velocity, and the parameters of its orbit undergo changes. Thus, for example, during 95 hours of flight the orbit altitude of the **Vostok-3** changed in apogee from 235 kilome-

tres to 210 kilometres, and in perigee from 181 to 168 kilometres. The **Vostok-5** showed the following respective changes: from 222 to 178 kilometres and from 175 to 150 kilometres. The altitude of the orbit chosen for **Vostok** ships enables ships to stay in orbit for up to 10 days, so that even if the braking installation of the ship fails, the ship will enter the denser layers of the atmosphere and with the help of the landing system will make a landing on Earth.

The parameters of the orbit depend in large measure on the accuracy of launching, the functioning of the control system and propulsion units of the rocket during the boosting stage of the flight. Any slightest deviation from the preset conditions during this stage leads to considerable deviations of the actual parameters of the orbit from calculated ones. All six **Vostok** ships were put into their orbits with high accuracy, and their actual orbits were very close to calculated ones. It is worth noting that the **Vostok-4** entered into orbit at a distance of approximately 5 km from the **Vostok-3.** This is indicative of the great reliability and highly precise functioning of all the systems installed in the carrier-rockets that launched the spaceships into flight.

The descent of the spaceship from its orbit for land-

ing in the predetermined area is done strictly at a set time. Upon receiving a command for landing the cosmonaut either lands under manual controls, or an automatic system of the ship's orientation is switched on, which by means of a solar sensor orients the ship in space. Then a retro-engine is switched on, which transfers the ship from the orbit to a trajectory of re-entry.

Upon the completion of the work of the braking rocket unit, the capsule is separated from the instrument compartment. The thermal shield of the capsule ensures its safe transit through the dense layers of the atmosphere, while the instrument compartment burns up there. As the capsule descends, the temperature of the air boundary layer around it rises and attains 10,000 degrees. The aerodynamic drag on the spacecraft also grows and reaches 20 tons.

The landing system of the capsule which envisages the possibility of the cosmonaut landing on Earth either in the capsule itself, or separately by means of individual means, is brought into action as soon as the velocity of the craft becomes subsonic. All cosmonauts who were flying the **Vostok** ships landed separately from the capsule. In that case the following landing procedure was used.

At an altitude of about 7,000 metres the cover of the entrance hatch is automatically opened, and two seconds later by means of a special device the seat with the cosmonaut is ejected. Immediately the pilot's parachute system is put into operation.

At an altitude of 4,000 metres the seat is separated from the cosmonaut and falls freely to the Earth. The cosmonaut in his pressurised space suit continues his descent by parachute. The vertical speed of the cosmonaut's descent is about 6 metres second. The same parachute carries, together with the cosmonaut, an emergency ration, equipment and a dinghy that is automatically inflated in case of a landing on water.

Parallel with the descent of the cosmonaut, at an altitude of 4,000 metres, a system for landing the capsule begins to operate: the cover of the parachute container opens and a braking parachute opens. At an altitude of about 2,500 metres the braking parachute is jettisoned and puts into operation the main parachute.

If the cosmonaut lands in the capsule, the cover of the exit hatch during the flight is not opened, and the cosmonaut opens it himself after landing.

Launching.

Sharik (Sphere) stood up to all the tests—the 20 ton stress, 10,000 temperature which caused it to be enveloped in flames as it passed through the dense layers of the atmosphere. The protective coating performed its function well. Incidentally Sharik is good for another flight.

RECORD FLIGHTS OF SOVIETCOS SPACESHIPS OF THE VOSTOK CLASS:

World Records:

YURI GAGARIN
12 April, 1961
The **Vostok**

1. Duration of flight — 1 hr 48 min
2. Altitude — 327 km
3. Weight in flight — 4,725 kg

World Records:

GHERMAN TITOV
6-7 August, 1961
The **Vostok-2**

1. Duration of space flight — 25 hrs 18 min
2. Range of space flight — 703,150 km
3. Duration of flight in orbital class
4. Range of flight in orbital class

World Records:

ANDRIAN NIKOLAYEV
11-15 August, 1962
The **Vostok-3**

1. Duration of space flight — 94 hrs 09 min 59 sec
2. Range of space flight — 2,639,600 km
3. Duration of flight in orbital class
4. Range of flight in orbital class

Achievements:

PAVEL POPOVICH
12-15 August, 1962
The **Vostok-4**

1. Duration of flight — 70 hrs 43 min 48 sec
2. Range of flight — 1,981,050 km

MONAUTS IN THE SATELLITE

World Records:

VALERI BYKOVSKY
14-19 June, 1963
The **Vostok-5**

1. Duration of space flight — 118 hrs 56 min 41 sec
2. Range of space flight — 3,325,957 km
3. Duration of flight in orbital class
4. Range of flight in orbital class

World Records:

VALENTINA NIKOLAYEVA-TERESHKOVA
16-19 June, 1963
The **Vostok-6**

1. Duration of space flight in orbital class for women — 70 hrs 48 sec40 min
2. Range of space flight in orbital class for women — 1,970,990 km
3. Maximum mass lifted to altitude in orbital class for women — 4,713 kg
4. Maximum altitude of space flight in orbital class for women.

THE SOVIET SPACESHIPS VOSTOK HAVE CARRIED OUT 6 REMARKABLE FLIGHTS. DURING THESE FLIGHTS OUR COSMONAUTS TRAVELLED MORE THAN 10,5 MILLION KILOMETRES, SPENT A TOTAL OF 381 HOURS IN OUTER SPACE, MAKING 259 CIRCUITS ROUND THE EARTH AND ESTABLISHING 21 WORLD RECORDS!

BUT SCIENCE AND ENGINEERING DO NOT STAND STILL.

ON OCTOBER 12,1964 THE MULTI – SEATER SPACESHIP, *VOSKHOD*, WAS LAUNCHED INTO THE EXPANSES OF THE UNIVERSE. ITS CREW INCLUDED AN ENGINEER, A SCIENTIST AND A DOCTOR.

ON MARCH 18, 1965 THE *VOSKHOD–2* WAS FIRED, AND SOVIET MAN WAS THE FIRST TO STEP OUT INTO OPEN SPACE.

THE CONOUEST OF OUTER SPACE CONTINUES.

THE SPACESHIP «VOSTOK»
ON DISPLAY AT THE EXHIBITION
OF SOVIET ECONOMIC ACHIEVEMENTS.