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SOVIET ROCKET FORCES

by

P. T. Astashenkov

SEP 20 1968



GOLDEN ANNIVERSARY

FOREIGN TECHNOLOGY DIVISION

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By: P. T. Astashenkov

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ABSTRACT A genuine technical revolution has occurred in the Soviet Armed Forces under the leadership of the Communist Party. Our Army, Air Force, and Navy are now equipped with rocket-nuclear weapons which basically have changed the complexion of all types of forces. The Strategic Rocket Forces have become the main firepower of the country. The country's antiaircraft defense is now based on the might of zenith rocket forces in conjunction with new fighters. Units have appeared in the ground forces which are equipped with tactical rockets. Rockets have become the basic weapon of the Navy and Air Force. In this book it is shown how our Socialist country was able to pass the developed capitalist countries in the newest fields of science, technology, and production, including rocket construction. The book tells of the creation of Soviet Space rockets and the victories of our people in space research. It presents the basic chapters in the biography of Soviet military rockets - strategic, tactical, zenith, aviation, and shipboard rockets; it also gives data on their operation. The author gave great attention to the scientific principles of rocket construction showing the effect of rockets on the character of modern warfare and the military capacities of various types of forces. He tells of our best rocketeers who have achieved great successes in the mastery of the new weapons. The book tells of the love and respect of the Soviet people for the rocketeers and of the high honor of serving in the Soviet Rocket Forces. In order to acquaint readers with the development of rocket technology abroad, the author used data published in the foreign press. The book is intended for a broad audience interested in the development of modern military science and new types of armed forces. The book is divided into three chapters: 1. Combat Technology of Soviet Rocket Forces. How It Developed - 1; 2. Rocket Forces Today, Their Successes in Combat Training - 69; 3. Conditions of Nuclear Missile Warfare and Requirements of the Training of Missilemen - 208. English Translation: 256 pages.

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P. T. Astashenkov

Soviet Rocket Forces. Second revised and supplemented edition. Editor: Colonel-General V. F. Tolubko. M., Military Publishing House, 1967.

344 pp. ("Popular Science Library"),
11,000 copies, 68 k.

→ The author tells of the mightiest form of Soviet Armed Forces – the Strategic Rocket Forces. The book shows new features and possibilities gained by all armed forces after being equipped with nuclear missile weaponry. Operational-tactical missile weaponry, surface-to-air rockets, antiaircraft rockets, aircraft and ships-rocket carriers are discussed in detail. Clear examples are given of the excellent mastery of new weapons by land troops, soldiers of the antiaircraft defense, sailors and aviators; these weapons can strike the target without failing in any of the most complex conditions. The book describes love and respect of Soviet people for missilemen, and the high honor of serving in the Soviet Rocket Forces. In those sections of the book dealing with the development of rocket technology abroad, the author used data published in foreign publications. ()_K

EDITOR'S PREFACE

The contemporary military revolution caused by the appearance of nuclear missile weaponry and its wide introduction into the forces, causes growing interest not only for military researchers, but also for a wide circle of Soviet readers.

Any contemporary phenomenon can be deeply studied and understood only if it is examined comprehensively, in the plane of its appearance, formation and development.

The primary value of the book "Soviet Rocket Forces" is that in popular form, using rich actual and illustrative material, the story is told of the creation of domestic nuclear missile weaponry — the basis of the invincible combat power of the armed forces of the Soviet Government.

The old generation remembers when after the Second World War the rulers of the United States, using a temporary monopoly on atomic weaponry, openly and impudently proclaimed their target of world supremacy and tried to talk with the Soviet Union in the language of an atomic dictatorship.

But this policy very rapidly and shamefully collapsed.

The Communist Party, in the midst of the complexities of repairing the heavy consequences of war with the fascist aggressors, took all measures to eliminate the monopoly on the atomic bomb, boasted of by the American imperialists.

Thanks to the heroic labor of Soviet scientists, engineers, technicians and workers, an especially short period was required to master methods of liberation and use of intranuclear energy, and different samples of atomic weaponry were created. Theoretical research on the atomic nucleus and nucleonics in the Soviet Union attained the highest level in the world. This is conclusively shown by the fact that thermonuclear weapons were developed considerably earlier in our country than in the United States.

Along with work on the creation and improvement of nuclear weapons, thanks to the tireless care of the Communist Party and of all the Soviet people, missile technology explosively advanced.

Our country is the native land of jet propulsion theory and contemporary rocket building. The names of Tsiolkovsky, Kibal'shich, Tsander, Korolev and other pioneers of missile technology in gold letters are forever inscribed in the history of world science.

Missiles for the most diversified purposes have been developed. The most important boundary in the development of missile technology was 1957. This year was marked by the appearance of the inter-continental ballistic missile, able inevitably to reach any point of the earth.

Rockets became the major carrier of nuclear charges. They entered all areas and branches of the armed forces, causing radical qualitative changes in the whole structure of their life and activity, views on their combat use and on the conduct of war as a whole.

Nuclear missile weaponry became the basis of the fire power of land forces, considerably increased their effectiveness and expanded the scale of problems decided in the course of combat.

Antiaircraft Defense Forces became an independent branch of the armed forces. Their rocket complexes and interceptors are superior to even the best antiaircraft artillery and fighter aviation of the Second World War.

Our Air Force was converted. It used weapons formidable to the enemy — supersonic fighters and bombers, armed with rockets with nuclear charges.

The basis of the Navy came to be ships armed with rockets for various purposes, and first of all atomic submarine-rocket carriers having great underwater mobility and crushing striking power.

With special force the wise perspicaciousness of our Party was demonstrated when the Central Committee created a new branch of the Soviet Armed Forces — the Strategic Rocket Forces, ensuring the most effective application of the most threatening weapon in the world today — intercontinental strategic rockets. Now this is the main branch of Soviet Armed Forces, able to decide directly strategic problems and with other branches of forces to ensure fast and full destruction of any aggressor.

The story of the Soviet Rocket Forces is inseparably connected with the titanic work of the Party, of all Soviet people in the creation of the material and technical basis of Communism. Therefore the attention of the author is regularly concentrated on showing the huge advantages and successes of socialist economics, achievements of Soviet science and technology, serving as the basis for

creation and constant improvement of domestic nuclear missile weaponry.

The book convincingly shows the tireless care of the Communist Party to maintain the combat power of the Soviet Armed Forces constantly on a level ensuring reliable protection of our country and the entire socialist commonwealth from the encroachments of imperialist aggressors.

Thanks to this our forces continuously receive new weaponry and combat materiel, including orbital rockets, small solid propellant intercontinental rockets on self-propelled launchers, and also completely automated complexes of strategic rockets, characterized by especially high reliability and combat readiness.

We must not forget those who nurture plans of loosing a new world war and who, irresponsibly juggling figures, are tortured to extract from the rubbish pit of history the notorious policy of atomic blackmail.

The Soviet Union has and will have everything necessary to resolutely and in good time suppress the criminal projects of aggressors and to inflict on them a death blow.

Relatively recently our everyday usage has adopted a short, but very meaningful word - missilemen. These are the soldiers of a new heroic profession born by the military revolution. The highest law of their daily life and activity is to be in constant combat readiness to protect the sacred boundaries of the Soviet Fatherland.

The military labor of soldiers-missilemen profits by the love and respect of the Soviet people. Showing it in popular literature is an important and noble matter.

Therefore the attempt of Engineer-Colonel P. T. Astshenkov to relate how the Soviet Rocket Forces were created, how their technology was developed, and how the soldiers-missilemen live and work deserves all possible approval.

His book is useful for both veterans of the Rocket Forces and our young people - all who are interested in new phenomena in contemporary military matters, and in the life of the Soviet Armed Forces.

Colonel-General V. Tolubko

1. COMBAT TECHNOLOGY OF SOVIET ROCKET FORCES.
HOW IT DEVELOPED...

Reviewing the troops lined up for military parade on Red Square in honor of the 40th anniversary of Great October Socialist Revolution, the Minister of Defense of the USSR stopped before the ranks of soldiers on the Manege area and turned to them with the greeting:

— How do you do, comrade missilemen! I congratulate you with a holiday...

Comrade missilemen... To the whole world then spread these words and immediately they became beloved and near to the Soviet people.

Shortly before this, 27 August 1957, on the pages of our newspapers there appeared a report of TASS about the testing of an absolutely new weapon. Within a few days, said the report, our country will see the launching of a super-range, intercontinental, multistage ballistic missile.

And here on the day of the fortieth anniversary of Soviet power over Red Square passed rockets from the smallest to the very powerful, from the "Katyusha rocket launchers" to ballistic rockets. The Soviet people with pride viewed the rocket weaponry, knowing that this is the most contemporary material basis of our defensive capability and of the inaccessibility of the borders of our native land. Maintaining in combat readiness this new armament, created by the labor of scientists, designers, engineers and workers under the wise leadership of the Communist Party, required radical changes in the structure of Soviet Armed Forces. There came into existence a new force — the rocket forces. The leading profession in the army and navy was in rockets.

...9 May 1965 on Red Square occurred a military parade in honor of the twentieth anniversary of the victory of the Soviet people over fascist Germany. It clearly demonstrated what successes we have attained in the development of rocket forces after eight years. Again, as in the first time, past the



GRAPHIC NOT
REPRODUCIBLE

Soviet rockets, shown during military parade on Red Square in Moscow in honor of the twentieth anniversary victory of the Soviet people over fascist Germany.

mausoleum of V. I. Lenin, past enthusiastic rostrums passed operational-tactical, antiaircraft, strategic rockets. In parades in 1965 and 1966 passed rocket units equipped with weapon which were not in the parade of 1957. Wide response from the whole world caused the perfection and might of Soviet combat materiel.

This new mighty combat materiel appeared on the strong foundation of achievements of Soviet economics, science, technology, and the enormous experience of many generations of our artillery men, missilemen...

The Biography of Soviet Rockets

Distant ancestors. A person relating his own autobiography frequently starts by mentioning his ancestors. If a rocket could tell its own story, it undoubtedly would also mention its military predecessors, which played an essential role in military affairs in Russia's past.

The appearance of the first rockets pertains to ancient times and is connected with the invention of powder. The Soviet scientist N. G. Chernyshev expresses, in our opinion, an absolutely correct thought that the invention of solid-propellant rockets and their application in each country is a direct result of the appearance of powder, that the "idea of a rocket, inevitably and independently was born everywhere where the art of manufacturing powder penetrated, outstripping the appearance of the idea of a firing weapon."¹ There are many literary sources indicating that in the XIVth century in Europe the use of powder and rockets already was sufficiently widely known. The same applies to reliable data about combat employment of rockets, or, as they were called, "fire arrows." The early period of development of rockets in Russia has been little investigated.

More detailed information about the distant ancestors of contemporary rockets appeared in print at the beginning of the XVIIth century. It is interesting that in 1607-1621 the gun master Onisim Mikhaylov even composed special regulations in which he generalized what was published abroad, and described rockets in detail - "nuclei, which burn and burn" - and methods of their manufacture. This document is a basis for assuming that even 300 years ago and more Russian masters "excellently knew" all "secrets" of rocket production and that they indeed were used as combat weapons. In the XVIIIth century even more was printed about rockets. In 1762 Artillery Major Mikhaylo Danilov wrote two works in which he thoroughly stated the technology of rocket production and methods of their application. He told of a sergeant of the bombardier company of Preobrazhenskiy regiment Vasilii Korchmine, who for outstanding service was promoted to General-Major by Peter I.

Production of rockets in the XVIIth century grew. In Moscow a special rocket institution was created. Later similar institutions appeared in other cities of Russia; in only one Petersburg laboratory more than 100 different models of this weapon were

¹N. G. Chernyshev. The role of Russian scientific and technical thought in the development of the fundamentals of rocket flight. Izd. Moscow Higher Technical School im. Baumana, 1949.

produced. Production of rockets increased. This helped to equip troops. Documents indicate that toward the end of the XVIIIth century the Russian Army possessed signal rockets.

At the beginning of the XIXth century Russian troops were also armed with demolition rockets. They were created and persistently introduced by the remarkable designer, Hero of the Patriotic War of 1812 A. D. Zasyadko. He understood well that the increasing number and maneuverability of armies required such combat weapons which in ease of transport approached a hand weapon, but in effectiveness of fire - artillery. Zasyadko's rocket satisfied these requirements.

The rocket Zasyadko developed was made of iron cylinders filled with powder. These cylinders, or cases, as they were called, had a wooden tail to ensure stability in flight. To the front section of the case were fastened a grenade or a container with an igniting mixture. Zasyadko developed launching machines to give the rocket its initial direction. One of the models contained a directing pipe on a wooden tripod. It is necessary to note as an achievement the fact that the machines created by the talented designer made it possible to launch simultaneously up to six rockets.

Many ordeals were endured by the remarkable Russian artillery man before he saw the triumph of his ideas. Much time lapsed while bureaucrats of the tsarist court decided the question about testing of the Russian operational rockets. Experimental combat firing took place in Mogilev, where the Second Army led by Field-Marshal Barclay de Tolly was based. Specialists and the commander himself praiseworthy responded to the weapon. This marked the beginning of the use of rockets of Zasyadko's design. In the beginning they were made at the Petersburg pyrotechnic institution, but as early as 1826 their production was taken over by a special rocket institution, built near Petersburg at Volkovoye Pole. Regarding combat employment, rockets were used in the Caucasus in 1825 against cavalry. In 1828-1829, during the Russian-Turkish war, rockets were fired against the strongholds at Varna, Shumla, Silistriya, Brailov.

Participants of the war left a description of one of the episodes of action by the Russian missilemen. In the attack on Silistriya it became necessary to raise a bridge, but Turkish ships prevented this. Then missilemen on barges approached the Turkish ships and fired a salvo. The squadron commander ship of the enemy caught fire and exploded. The remaining ships hastily departed. Combat engineers of the Russian army could calmly proceed to raise the bridge.

One of the participants of the Russian-Turkish war wrote on the successful rocket launchings: "such miracles have now happened, for example, to the French, and they probably shout about them by means of their own prints and memoirs throughout all five continents of the world. But we... we remain hushed, as though the Russians were everywhere and always preordained to be heroes..."

In subsequent years native scientists and designers worked much on improvement of rockets. General A. A. Shil'der in 1834 constructed and tested the first submarine in the world, armed with rockets. Rockets could be launched even from under the water.

An outstanding contribution in the development of rocketry was introduced by the great Russian scientist of the XIXth century, K. I. Konstantinov. He was a many-sided specialist, occupied with questions of electrical engineering, pyrotechnics, powders, aeronautics. But the main merit of Konstantinov was a solution - bold and progressive for his time - to a number of problems in rocket technology.

In 1846 Konstantinov constructed an electroballistic pendulum, which he used widely for experiments. Using this pendulum, he established the law of the change in rocket propulsive force in time. In the course of his experiments Konstantinov also determined the influence of form and construction of a rocket on its ballistic properties. Thus the scientist developed the scientific basis of the calculation and design of rockets.

Konstantinov successfully stepped into the role of a designer of rocket weaponry. To him belongs the authorship in development of many operational rockets and launchers. A great deal of his work was with the improvement of rocket production. He developed the basic machines for this branch of production, proposed technology of the manufacture of rockets with application of automatic control and direction by separate operations.

In England in the first half of the XIXth century there was much excitement because of improvements of the English officer Congreve in rocketry. Publicity was so wide that the rockets of Congreve drew the interest of the ruling circles of Russia. Konstantinov was dispatched to England in order to arrange Russia's acquisition of the Congreve plant and its secrets. However Konstantinov was disappointed by the excessive admirers of everything foreign which were so prevalent among tsarist government officials. He reported from Europe that the Congreve plant was a most decrepit enterprise, and the "secrets" of Congreve are no secret to Russian artillery men.

So once again it was convincingly proven that Russian scientists and designers confidently lead in the development of not only specific models of rockets, but also problems of their mass production.

However, the days of rockets in military science were already numbered. The fact is that rockets had serious faults. Gases from the nozzle of the engine were ejected nonuniformly. As a result the direction of the tractive force of the engine was inaccurate and the rocket was deflected from the needed direction. For example, one artillery man, watching the launching of English rockets, wrote that they "flew in all directions except the proper one; certain rockets returned even to us, fortunately, doing no harm..." About Russian rockets opinions were better, but they also in principle suffered from such faults.

In the 1870's rifled artillery began to exceed considerably the smooth-bore in range and accuracy. Rifled artillery began to fulfill successfully many firing problems. Interest toward operational rockets dropped off; gradually their production was ceased. The level of science, technology and industry of that time did not allow essential improvement of characteristics of rockets and their motors.

This finishes the distant ancestors of our contemporary rockets. And where are its close "kin"? How did they appear and develop?

Rebirth. First of all one should note that the rebirth of rockets is connected with the idea of interplanetary flights. In 1881 the known revolutionary N. I. Kibal'chich, then in prison, literally on the eve of his execution developed the scheme of aircraft with a jet engine. In the idea of the perspicacious designer, the tractive force of the motor allows the aircraft to surmount gravity and to go beyond the limits of atmosphere into space.

N. I. Kibal'chich firmly believed in this idea. He noted in own writings: "Now imprisoned, with but a few days till my death I write down this scheme. I have faith in realization of my idea, and this faith supports me in my terrible position. If, however, my idea, after thorough discussion by scientists-specialists, will be recognized as feasible, then I will be happy by the fact that it will render a great service to my native land and to humanity."

But the scheme did not get into the hands of scientists; it was buried in police archives. And only in 1918 did the public of our country learn about the scheme of Kibal'chich; it was first published in the journal "Byloye." Thereafter this scheme became an inalienable and glorious landmark in the story of scientific thought in the region of rocket-building and interplanetary communication.

Conditions and laws of rocket flight were investigated by I. V. Meshcherskiy. He set forth the fundamental equations of rocket dynamics in the articles "Dynamics of the Point of Variable Mass" (1897), "Equations of Motion of the Point of Variable Mass in General" (1904) and "Problem from Dynamics of Variable Masses" (1918).

A number of questions essential for the development of rocket technology, found a solution in the early works of the father of Russian aviation of N. Ye. Zhukovskiy. In 1882 and 1885 he published a work "On the Reaction of Outflowing and Inflowing Liquid" and in 1908 - "A Theory of Vessels Driven by the Force of Reaction of Effluent Water."

The scientific basis for ideas of interplanetary flights was established by the famous Russian scientist K. E. Tsiolkovsky. Prior to him only solid-fuel rockets were studied and developed. Konstantin Eduardovich proposed rockets having a liquid engine and designed for very long-range flights. But the scientist not only



Konstantin Eduardovich
Tsiolkovskiy (1857-1935).

solved theoretical questions connected with an engine for space rockets, he developed the theory of rocket flight, and analyzed their possibilities. K. E. Tsiolkovskiy was the first in the world to show what laws control the flight of a rocket as a body of variable mass. He indicated the ways to calculate its flight and range, and determined conditions of escaping the gravitational field of the earth. The scientist accomplished all this in the period when the sunset of rockets even as combat occurred.

Even in 1883 Tsiolkovskiy arrived at the bold conclusion as to the great future of rockets as a means of flying. He expressed thoughts about this as a teacher of arithmetic, geometry and physics in the Bohr district school, Kaluga province. In subsequent years Tsiolkovskiy worked much on the creation of a strictly mathematical theory of jet propulsion.

Truly it was necessary to possess brilliance and a great capacity for work, so that far from the scientific centers of Russia, relying only on his own knowledge and intuition, he prepared a work on rocket technology by which a generation of enthusiasts of interplanetary flights was educated in our country, introducing priceless contribution to the cause of development of Soviet rocket-building and outer space travel. We speak about the well-known article of Tsiolkovskiy "Investigation of Outer Space by Rocket Instruments," published in 1903. In this work and later ones Konstantin Eduardovich was the first in the world to expound the theory of rocket flight taking into account the change of its mass during motion, and also advance and justify the idea of using of rockets for interplanetary communication. In this and subsequent works he developed the basis of the theory of liquid-fuel jet engines, and also advanced proposals on their design.

Tsiolkovskiy began with the assumption, now called Tsiolkovskiy's hypothesis, that the relative thrust-back speed of particles is constant. On the basis of this the scientist derived the mathematical

dependence, well-known under the name of Tsiolkovskiy's formula. This formula determines the speed of a rocket including the maximum attained at the end of the powered-flight trajectory.

Also well-known is the theorem of Tsiolkovskiy which states: if the mass of a rocket and the mass of explosives in the rocket increase in geometric progression, the speed of the rocket increases in arithmetical progression. The value of this theorem is that it indicates the most profitable means of increasing the maximum speed of a rocket, which is not an increase of the relative reserve of fuel, but an increase of relative speeds of particles rejected from the nozzle. Thus, Tsiolkovskiy's theoretical proposition became a powerful weapon in rocket-building.

The Soviet people with pride remember the name of Tsiolkovskiy when they learn of the remarkable flights of our multistage rockets. A modest mathematics teacher from Kaluga, he was the first in the world to propose the use of multistage rockets to achieve cosmic speeds of flight.

Konstantin Eduardovich examined two types of multistage rockets — series and parallel. In the first case rockets burned out and separated in turn. The head rocket reaches the target with a speed determined by the "forces" of all the previously separated stages. The other type of multistage rocket has parallel connection of rockets. In this case, as the scientist had conceived, all of them act simultaneously up to the moment when half the fuel burns out. Then the fuel of the outer rockets flows into the tanks of the others, and upon emptying they separate. There finally remains one head rocket, also attaining a very high speed. The thoughts of Tsiolkovskiy about multistage rockets have not yet lost their timeliness. Creation of the most effective multistage rocket to this day plays an important role in rocket-building.

A very essential contribution of Tsiolkovskiy was a solution to the problem of motion of a rocket in a uniform field of gravitation and the quantity of fuel necessary to overcome the earth's gravity. Tsiolkovskiy considered the influence of atmosphere and determined the reserve of fuel necessary to enter vacuum.

Regarding the theory of interplanetary flights, Tsiolkovskiy has indisputable first place. He proved the possibility of such flights, and first examined the question about artificial earth satellites and space stations — bases of interplanetary communication. Tsiolkovskiy did much to clarify conditions of man's existence inside a spaceship, satellite and interplanetary station.

The constructive proposals of Tsiolkovskiy turned out to be very long-term. Contemporary ideas in rocket design consider the thoughts of Tsiolkovskiy about the use of steering wheels from refractory materials, placed in the stream of outgoing gases (jet vanes) for flight control in vacuum and thoughts about gyroscopic stabilization of a rocket. Contemporary rocket engines employ his proposal about cooling combustion chamber walls by fuel components. Tsiolkovskiy expressed also the necessity of forced fuel feed into the combustion chamber of a liquid-fuel rocket engine.

The scientist investigated in detail possible fuels and oxidizers for liquid-fuel jet engines, from which he selected as the most promising: liquid hydrogen and liquid oxygen, alcohol and liquid oxygen, hydrocarbons and liquid oxygen (in every pair of substances the first is the fuel, the second is the oxidizer).

In his earliest project with liquid-fuel rocket engine Tsiolkovskiy specified liquid hydrogen as the fuel and liquid oxygen as the oxidizer. These thoughts are reflected in the ideas of jet vanes, cooling the combustion chamber by liquid fuel, and the use of automatic units to stabilize the rocket in flight.

Subsequently Tsiolkovskiy continuously improved the design of his proposed rocket and investigated possibilities of using even more effective fuel components.

Tsiolkovskiy's preeminence in the development of problems of rocket technology and theory of interplanetary flights is recognized not only in our country but also abroad. As confirmation we note the expression of the well-known German engineer G. Oberth, also working in this area. "You have struck a match and we will work until the greatest dream of humanity is realized... I, of course, am the very last to dispute your preeminence and your merits in rockets."

Especially fruitful for the scientist was the period of life after the Great October victory. The Communist Party and the Soviet Government showed great attention to the activity of the scientist; he received a personal pension and work conditions were created. In response to the care, love and attention of the Party and the whole nation, the scientist-patriot worked with tripled energy. It is sufficient to say that from 1925 to 1932 he published 60 scientific works. In all after the post-October period of his life (1917-1935) Tsiolkovskiy published four times as many books and articles than during the years of activity prior to the Great October socialist revolution.

Tsiolkovskiy spared no efforts on propagandizing his own ideas. In the spring of 1924 at the Air Force Academy imeni N. Ye. Zhukovskiy a department of interplanetary communication was created by the Military Science Society. From this department grew the first Society for the Study of Interplanetary Communication in the world. The problems of the society included:

"...work on realization of outer space flights using rockets and other scientifically proven means... investigation of high-altitude layers of atmosphere, flight at high altitudes, improvement of rockets, development of an engine with a high coefficient of economy..."

Tsiolkovskiy immediately reacted to the creation of a Society for the Study of Interplanetary Communication. "Dear comrades," he wrote, "I rejoice openly about the department for interplanetary communication. I will do (as I have done) whatever I can." The society existed only a year, but did much for wide popularization of the ideas of jet propulsion and interplanetary communication.

Tsiolkovskiy already was not a scientist alone, but an inspirer of a whole pleiad of enthusiasts in rocket technology. Engineer F. A. Tsander — one of those who in the 1930's actively worked in a group for the study of jet propulsion (GIRD) — wrote to Tsiolkovskiy on his 75th birthday: "The enthusiasm which is felt when reading your books has filled me from childhood, and here at GIRD a number of inspired people working in harmony continue the search in the happy region of stellar voyages, in which your work has split the age-old ice separating man from his goal."

Among the names of pioneers in Soviet rocket-building we should mention one more — Yu. V. Kondratyuk. He was born in 1900, and began to study the problems of jet propulsion when he was 16 years old. In 1916-1919 he generalized his thoughts in the work "For those who Read to Build." Becoming a mechanic, he still more actively carried out work in the new area of science and technology. In 1929 in Novosibirsk he published a talented and rich original theoretical research. His book was called: "Conquest of Interplanetary Space." In it Kondratyuk examined a number of questions of rocket dynamics and rocket-building. And what is especially curious, Yuriy Vasil'yevich was not acquainted with the work of Tsiolkovskiy. He independently derived the fundamental equations of rocket motion. His calculations of the most advantageous trajectories of space flights, proposals of multistage rockets, intermediate interplanetary rocket bases in the form of earth satellites, economic rocket landing on a planet using atmospheric deceleration were extraordinarily bold for his time. Kondratyuk proposed also the use of metalloids and their hydrogen compounds, for example boron hydride, as fuel metals.

The high scientific level of Kondratyuk's book "Conquest of Interplanetary Space" is seen from the appraisal given it by the well-known scientist Professor V. P. Vetchinkin, who wrote that it "presents the most complete investigation of interplanetary journeys of all that has been written in Russian and foreign literature until recently."

The final item in the life of the researcher-patriot is his service in the Soviet Army during the years of war with Hitler's Germany and his selfless behavior on the front. He died the death of the brave in 1942.

The beginning of embodiment of gradiose ideas. F. A. Tsander was a great scientist and talented inventor, an ardent patriot of the Soviet Fatherland. Throughout his life he was dedicated to the engineering solution of problems of future flights of man in outer space and to other planets.

The author of this book in the summer of 1963, in the days of the remarkable team flight of the Soviet astronauts Valentina Tereshkova and Valeriy Bykovskiy, happened to be in Kislovodsk. Inspecting the curiosities of the city, I visited the regional study museum. Near one of the exhibits it was especially crowded. The excursion guide could not answer questions, emotional words were



Fridrikh Artyrovich.
Tsander (1887-1933).

heard, exclamations of surprise. This exhibit, so touching to the visitors, was the biography of F. A. Tsander...

...On the outskirts of Kislovodsk, on one of the surrounding hills among graves of fallen heroes of the Great Patriotic War is a proud monument. On a gray granite base are two vertical marble plates - gray and black - as though shading one another. On the gray marble is the bas-relief of a man who deeply ponders some question. In the upper projection stands a gleaming light metal rocket.

Who is immortalized by this monument, who with the rocket towering above him? This is a bas-relief of F. A. Tsander, and with him one of the first Soviet rockets (GIRD-Kh), built by a group on the study of jet propulsion under his leadership. The untiring inventor did not assist at the rocket takeoff, since literally on the eve of this significant event his health sharply worsened and he was sent by physicians for therapy at Kislovodsk. On the way to the resort he contracted typhus and died, but his rocket soon finished a successful flight. The ideas of Tsander are embodied in the work of his pupils and successors, glorifying now our country with unparalleled space triumphs.

A thankful Native Land sacredly preserves the memory of its selfless son who did so much for the development of rocket technology. He lived and worked in the very initial period of its birth, when the road of this new branch of science and technology happened to lay in tireless struggle with difficulties. And it seems symbolic that Tsander as a fighter for the new is buried at a military cemetery, among those who gave up their lives fighting for the best future of man, for the freedom and honor of their country.

Under the bas-relief, recreating the inspired face of Tsander, is written: "Pioneer of Soviet rocketry, enthusiast for

interplanetary flights." On the side of the black marble in gold are his catchwords: "Forward, comrades, and only forward! Raise the rocket higher, higher and higher, nearer to the stars!"

What was his life and what are the most significant works of Tsander? First of all one should note that his idea of interplanetary flights appeared when humanity had only started its fight for the mastery of air. It is possible to say that this happened unconditionally under the influence of Tsiolkovskiy's work. Even in 1908 Tsander, a student at the Riga Polytechnical Institute, came before his comrades with a report about the prospects of flight to other planets. In this period he closely studied the possibilities of overcoming the forces of the earth's gravity and made calculations on the efflux of gases from vessels.

In the 1920's Tsander developed an aircraft design for flight into outer space. Takeoff in upper layers of the atmosphere had to be carried out with the help of a special piston engine, and then the rocket engine was switched on.

An inspiring beginning in the work of Tsander was an encounter with Vladimir Ilyich Lenin in Moscow. According to Tsander, Vladimir Ilyich at the end of the conversation wished him success in his work and promised support. And indeed, the support of Lenin, and the whole Soviet public was felt constantly by the enthusiast of interplanetary flights. This promoted his achievement of such high results in the unknown and complex branch of science and technology.

The well-known Soviet aerodynamicist, nearest pupil of N. Ye. Zhukovskiy Professor V. P. Vetchinkin in 1927 characterized the place of the works of F. A. Tsander in the development of rocket technology and space voyages thusly: "The work of F. A. Tsander on the calculation of interplanetary journeys and his scheme of an interplanetary ship undoubtedly has one of the first places in literature in the world concerning this question..."

Following the path of Tsiolkovskiy were the foreign scientists Esnault-Peltrie, Goddard, Oberth and Valle, who, truly, repeated the work of Tsiolkovskiy... Essentially new material in this difficult question was introduced by Tsander..."

The apparatus of Tsander for space flights had wings for flight in the atmosphere and a gliding descent. To penetrate the low layers of the atmosphere Tsander proposed to take off with the help of a light engine, adapted for a half hour of work, and only in the upper layers of the atmosphere to go to the rocket engines. At the same time Tsander proposed to burn solid fuel in the rockets, in particular metals, as a supplement to the conventional propellant in order to increase the combustion temperature. He even considered using as fuel the unnecessary parts of the actual rocket.

In his autobiography, written in 1927, Tsander indicates nine points in which he has preeminence, but above them he still modestly

enumerates works on the construction of an interplanetary ship, its engines, rockets, etc. But the work he listed at the end came to the forefront in the last years of his life. In 1929¹ he completed calculations and designed a jet engine OR-1 (first experimental rocket) with a thrust of 5 kg. It contained the basic elements of a contemporary jet engine: combustion chamber, cooling by components of fuel mixture, fuel feed system, electrical firing. Tsander conducted experiments with the OR-1 from 1930. By 1932 he had carried out more than fifty test firings. The fuel was gasoline, the oxidizer - compressed air. Experiments on the use of metal as fuel in the OR-1 were conducted.

In that same period a liquid-fuel jet engine was developed at Leningrad, in the Gas-Dynamics Laboratory (GDL). Research in rocket technology was conducted there, and experimental work on rocket engines began in May 1929. During this time a special research-design organization appeared in the GDL. In 1929-1930 the fundamental efficiency of an electrical jet engine (EJE) was theoretically and experimentally proven there. The working substances in it were conductors, detonated by an electrical current in a nozzled chamber.

Of the further work of the Gas-Dynamics Laboratory, it is necessary to note the foundation of the possibility of using as oxidizers for liquid-jet engines nitric acid, nitrogen tetroxide, hydrogen peroxide, chloric acid, tetranitromethane and their solutions in one another. As fuel beryllium and other substances were proposed. These proposals were expressed in 1930. In that same year and in 1931 the Gas-Dynamics Laboratory built the liquid-jet engines ORM-1 (first experimental jet engine) and ORM-2. Both these engines worked on nitrogen tetroxide with toluene and gasoline. At the same time 50 static firings of these liquid-fuel rocket engines were carried out. It is interesting to note that even the first of these engines, working on gasoline and liquid oxygen, developed a 20 kg thrust.

Other achievements of workers in the Gas-Dynamics Laboratory include the invention in 1931 of hypergolic fuels and chemical ignition. In 1932 engines with the ORM-2 to the ORM-22 were developed. They had a type of ignition, method of starting and system of mixing when operating on different fuels. It is very interesting to note that even during bench tests in 1932 the oxidizers were liquid oxygen, nitrogen tetroxide, nitric acid, solutions of nitric tetroxide in nitric acid, and the fuel was gasoline, benzene, toluene, kerosene.

¹This date is taken from a manuscript, however the shorthand notes of Tsander 1922-1929 (not yet deciphered) contain formulas on the calculation of the engine OR-1. A more exact date for these calculations of the engine OR-1 will be established after deciphering his work.

1933 was a new mark in the creative searches of workers at the Gas-Dynamics Laboratory. In only this one year engines from the ORM-23 to the ORM-52 were developed and tested. In that same year the ORM-50 with a 150 kg thrust and the ORM-52 with a 300 kg thrust passed official tests, such as state tests. The following is curious: people working on liquid-fuel jet engines were at Petropavlovsk stronghold, not far from the tomb of the monarchs who kept back the idea of Kibal'chich and Tsiolkovskiy.

In the summer of 1932 and in January, 1933, took place the first meetings of representatives of Mosgird and GDL. These meetings occurred in Leningrad. Guests were shown the operation of the first liquid-fuel jet engines. It is clear that these demonstrations occurred not on flying rockets but on bench tests. Engines were secured and started. In the process of operation thrust, pressure and other parameters were measured.

In that same 1932 during bench tests of liquid-fuel rocket engines the well-known scientist aerodynamicist V. P. Vetchinkin assisted. He gave a very high appraisal of the new engine. At the beginning of 1933 at tests of the liquid-fuel rocket engine the Chief of Armament of the Red Army Marshal of the Soviet Union M. N. Tukhachevskiy was present. He gave a positive opinion about work conducted by colleagues of the Gas-Dynamics Laboratory on liquid-fuel jet engines.

The value of investigations and practical experiments of the Gas-Dynamics Laboratory in our press was characterized so: "At the GDL from 1929-1932 our first domestic liquid-propellant rocket engines, working on liquid oxygen, nitrogen tetroxide, nitric acid and toluene, gasoline, kerosene were created and successfully tested in action. The first one, the ORM-1 was quite small - an engine developing a 20 kg thrust in all. But this was only the beginning, and later the collective growing from the GDL created many other engines, for example the already-mentioned ORM-52, and then more powerful ones and, finally, their direct descendants - the most powerful contemporary engines for the mighty Soviet rocket-carriers, laying the road into space."

1931 is significant for the prehistory of Soviet rockets. This year the Osoaviakhim created a Central Group on the study of jet propulsion, the technical council of which was headed by F. A. Tsander. In the group participated engineers, technicians, students. Subsequently from the initiative of enthusiasts of rocket technology at the GIRD an industrial group was created.

In autumn 1931 in Leningrad a group on the study of jet propulsion (LenGIRD) was also founded. In the LenGIRD under the leadership of Vladimir Vasil'yevich Razumov from 1931-1933 several rockets were designed and built, part of which were at the same time tested in flight. Rockets of V. V. Razumov were called recording rockets; they were the predecessors of contemporary meteorological rockets.

By that time in Moscow Tsander had turned to the creation of his new jet engine design, the OR-2. It was designed for installation on the glider RP-1 a design of B. I. Cheranovskiy.

In the new engine as fuel was used gasoline, and the oxidizer - liquid oxygen. This engine can be put in the class of liquid-fuel rocket engines. It had a thrust of 50 kg. The test firing of the OR-2 were made in the spring of 1933, when the ill designer was in the hospital. Tests of the rocket GIRD-Kh, built under the leadership of Tsander, were made after his death, in the autumn of 1933. Engineer L. K. Korneyev, directly working with Tsander, describes this event: "...on November 25, 1933, one of the first Soviet liquid-fuel rockets, made according to the concept of F. A. Tsander, was set up on a launcher in the environs of Moscow.

Final preparations were completed, tanks filled with fuel and oxidizer, closed rocket hatches. Pressure in the tanks began to grow to the rated value. All went normally. Finally the emotion-filled voice called out:

- Contact!

The rocket was immediately fired. The jet engine was actuated. The GIRD-Kh left the launcher and, strongly gathering speed, swiftly rushed upwards, into a clear blue sky, glorifying the name of the greatest Soviet scientist, ardent Soviet patriot, pioneer of rocket-building in the USSR - F. A. Tsander."

Unconditionally, it is impossible to think that the entire idea in the GIRD originated only from Tsander and with his death activity of the GIRD ceased. No, an especially able-bodied engineering-design collective, the prototype of our contemporary design bureaus was formed. For this collective enthusiasm in the solution of new problems, creative indefatigability and a spirit of collectivism were characteristic. Participants in the first endeavors verify that the GIRD workers lived as one family. All work on design and production of rockets was so interconnected that sometimes the designer "adjusted" a part with a file, and the mechanic adjusted the drawings if parts were not connected at the attachment.

Of a still earlier rocket, the GIRD-Kh, the first Soviet liquid-fuel rocket, having index "09," was flight tested 17 August 1933. The overall initial weight was 19 kg, length - 2.5 m, diameter - 18 cm, engine thrust - 52 kg. The engine operated about 15 seconds. The rocket was launched at 1900 hours. It rose to an altitude of several hundred meters, tilted and fell to the ground. The cause of this deflection from vertical flight was a penetration of gases near one of the flanges, due to which a lateral force appeared, "tumbling" the rocket. The industrial defect which in the first flight prevented attaining the assigned altitude, was easy to remove. All those assisting had a proud sense of victory. In principle the path to new successes in rocket technology was open.

Events of that time are related by an interesting document - a wall newspaper of the GIRD "Raketa" No. 8. It was made up by the

designers, engineers and technicians themselves, all those enthusiasts who participated in tests. And they, witnesses of the first launching, tell of it in their own impressions.

For a long time only copy of this newspaper was saved by one of our leading scientists-rocket builders. He amiably told us about this interesting historical document. The newspaper was published on the fourth day after the first launching - 21 August 1933.

The newspaper opened with the prophetic words of the leader of the GIRD, later twice Hero of Socialist Labor Sergey Pavlovich Korolev, who confidently predicted that "starting from this moment Soviet rockets will fly above the Union of Republics." He also formulated the subsequent problem of the collective of enthusiasts: "To master and send into the air other types of rockets as fast as possible in order to... master comprehensively technical rocketry."

And it is very indicative that the first thought of rocket creators was to use it for defense of their favorite Native Land. Sergey Pavlovich expressed this thought in the form of a labor of love: "To apply all efforts so that even this year calculation data of the rocket are attained and it will be put into use in the Workers' and Peasants' Red Army."

Reading these lines, one involuntarily is put in mind of the comparison with the present day, when rockets became the main fire power of our army. This is the sources of this force!

The liquid-fuel rocket - no longer a fantasy, is affirmed in the newspaper. And in detail how it became reality is shown.

"In the damp, gloomy chamber of a tsarist prison - writes one author - sentenced to capital punishment, the best representative of his time, the revolutionary Kibal'chich hurries in his last hours to shape his thoughts about flight on the principle of direct reaction. However his scheme, first proposed to the world, saw only the walls of police archives.

From that time a great many people advanced this thought, but it was considered a fantasy of the idle. Only in relatively recent years has this idea met a certain support, and in technology questions about its solution been posed.

The GIRD in its work rose against the inertia of those considering the rocket problem to be a mirage and a fantasy. A year of persistent work of the entire GIRD, and in particular today's hero of the day - the second brigade, on August 17 proved that our work went beyond the area of preliminary tests and was on the way to launching real flying rockets.

Now, after the launching of the first Soviet liquid-fuel rocket, the air space is cut into the shortest time by the swift apparatuses.

To all those still doubting on the basis of obtained results we say: "We are on the true path. New, improved technology of flying began its own bright swift path of development."

Our achievement, completed 17 August and obtained in such a short period, confirms that in this region for the Land of the Soviets their achievements and successes know no inaccessible strongholds!"

The details in the wall newspaper of how the first liquid-fuel rocket was designed and constructed are moving. Here is what one colleague of the GIRD related.

"Work was difficult. Accomodations were so bad that, arriving from the hot sunny street, we were shivering in an hour, pierced by the infernal cold and dampness. We had to run out into the street to get warm or to finish work.

Then wooden floors covered by plywood began to appear, and walls pasted over by bleached wallpaper. It became warmer, and we could work instead of an hour or two, four-five hours each. Our drawings were made faster and were put on rolls.

Then the first group of drawings was sent to the plants. Slowly, but surely the GIRD began to grow. It got its own machines and its own workers. We grew and became stronger.

On 17 August at 1900 hours the rocket "09" was in the air, the rocket born from the idea of designers and joint work of the brigade. We experienced great happiness. With the takeoff of our rocket it was as if we also grew by that altitude... And we indeed grew. Our GIRD will quickly occupy a place among the state institutes."

Eyewitnesses describe the launch and flight of the first rocket with great emotion.

"In August," writes one of them, "in the first hours of the day the rocket "09" was prepared for launching.

"The launching had been set for the 9th, but for certain reasons was moved to the 11th. That had arrived. Nearly 30 people went to the proving ground. The mood was somewhat nervous. A group of people stood near the stand. Each found it necessary to give advice. With or without it converged the most unfavorable circumstances.

"Everything was ready. Everyone hid in the dugout. Oxygen was flooded... but the cock was slack...

"The correction required a minimum of forty minutes. Finally everything was in good condition. Everyone took his place. A second failure. The igniter plug did not fire.

"This day mortified us, although the unsuccessful flight had simple explanations. This did not at all mean that our work was incorrect and that rocket would not fly.

"13 August. Second launch day. Much fewer people. Some had lost faith the first day. This day brought us no joy. Again the failures had simple answers. We ourselves were guilty. We recognized our errors. But we were none the better for it. The rocket was not in the air. And certain other hearts lost faith. The rainy day was completed by the fact that our car overturned in a ditch. Tired, cold and hungry, we did not get home until midnight.

"The third day of the rocket launching there was a rumor at the workshops of the GIRD that the rocket would not fly; the time and effort would be to no purpose.

"Then on the 17th at one in the afternoon almost only the 2nd brigade left for the proving ground, thirsting to prove the productivity of their work. Only 3-4 people did not lose interest toward our work and went with us.

"Calmly and quietly the rocket was prepared. Hearts contracted at the thought of whether anything would happen this time...

"The leader spoke: 'Be not of faint heart. The rocket will fly, otherwise off with my head.'

"Everything was ready. Several times he glances at the manometer and signs shows the increase of pressure. The safety fuse (Bickford fuse) is already ignited. We know that a minute more, only one minute... will something happen?

"Hearts are terribly crushed. Silence is all around. This minute seems infinite and terribly long. But what is this? Noise, fire. Eyes turn unblinking, and the rocket seems to be extended. Only when it slowly and smoothly rose above the stand did we comprehend that it was flying.

"After all this our rocket, proudly and absolutely vertically, with growing speed cut into the blue sky. The flight lasted 18 seconds, but these seconds seemed hours...

"The whole evening we poured out our joy to one another. It was such a pity that during this time Tsiolkovskiy, whose ideas were embodied in reality, was not with us, a pity that he did not experience these seconds of gripping and great happiness with us."

Let us give the story of the rocket flight from one more eyewitness - B. Shedko:

"The day of August seventeenth will always remain in my memory because on this day I saw the first Soviet rocket rise into the air.

"I was assigned to photograph the rocket during flight. When all malfunctions were settled and the rocket was on the stand, oxygen was fed in. We took our places. I stood behind the dugout, three meters from the launch place, and awaited the moment it would

rise, in order to photograph it. When all was ready for launching, they shouted to us, so that we would be prepared.

Then with a roar and a cone-shaped flame, the rocket left the stand and rose into the air. It left at high speed and rose to five hundred meters, not less, then, going along the horizontal, fell into a woods, near a fence.

At that moment for us and everyone the mood was such that we were all ready to shout from joy. I literally went out of my mind, and instead of the rocket photographed the woods."

"Now the filling is finished," writes another participant of the event, "the tank is removed, and everyone except those hidden behind the dugout with a camera, moved off.

On top of a pine swayed Ikonnikov and Matysik. Pressure in the cylinder of the rocket rose evenly, each minute increasing by one atmosphere. The pins showed 12 atm. Now 13.5. The command "Contact" sounded, the cock was opened. "Contact!" The magneto was actuated, and... from the nozzle appeared a fire cone, and simultaneously, smoothly sliding along the guides, a brilliant cigar rose into the air. Emerging from the stand, the rocket, as though sensing itself in its native element, accelerated its flight. Now, already half its size, it stood out, silvery, against the background of the blue sky and began to turn towards us. From the nozzle flew fiery drops - metal; we ducked under cover and, sticking out our heads, watched the flight.

After moving horizontally for a time, it began to descend, finally touching the tree tops and slipping among the branches, buried its nose in the ground.

All of this lasted 18 seconds, but for we observers time had stopped. We all ran to the fence behind which the breathing of the rocket still was heard.

The brigade workers one after another vanished after it. We, climbing to a wire, found to our dismay that this was not a matter for our legs, and, jumping back, started to investigate the fence, noting a board missing in one place... increased it to two boards. With full approval of the authorities we climbed through too and hurried to the place where the rocket "fell."

Continues the story of one more participant of the first rocket launching.

"Everyone was by the rocket, lying on the ground, faces were excited, joyful - talk was in chorus, difficult to sort out, but it was not necessary, everything was understandable without words - the too joyful faces.

Gayly we gathered together for home. The whole path to Moscow resounded with songs, interrupted by gripping recollections; excitation and joy do not slacken. The joy is not without cause;

after all on this day in our country a new unknown branch of technology was mastered.

The notes in the wall newspaper are similar to legend. How little time was required for our rocket technology to reach an authentic blossoming.

In 1933 the enthusiasts of the GIRD designed a rocket, designated "07," with an engine working on ethyl alcohol and liquid oxygen. It is interesting that the rocket had very large stabilizers and was in shape similar to a swallow in flight. In the stabilizers were fuel components. Rocket length was 2 m, wing span - 1 m, engine thrust 80-85 kg, initial weight - 35 kg, design range - 4 km. Testing began 17 November 1934.

In 1934 collectives of the Leningrad Gas-Dynamics Laboratory and Mosgird combined into one organization - the Jet Propulsion Scientific Research Institute. The collective of the institute with great enthusiasm worked on the creation of experimental rocket engines, experimental winged and ballistic missiles for different tasks. Scientists from the Gas-Dynamics Laboratory continued the development of liquid-fuel jet engines. From the beginning of 1934 to the spring of 1938 a series of engines from ORM-53 to ORM-102 was created. Part from passed bench, ground, on-board and flight tests.

Designers created in that period a rocket called the "Aviavnito." It was streamlined, its engine is worked on liquid fuel - ethyl alcohol and liquid oxygen. Length was more than 3 m, diameter - up to 30 cm, initial weight - near 100 kg, engine thrust - 300 kg. Rated altitude of flight - 10 km. On 24 April 1936 and 15 August 1937 two launchings of this rocket took place.

In interests of accumulating experience two other rockets, the R-03 and the R-06, were developed. Both were made from 1934-1935; one had an altitude of three meters, the other - one and a half meters. Both had engines working on ethyl alcohol and liquid oxygen. For only the first thrust was 100 kg, and for the second - 40 kg. The first launching of these rockets took place 11 April 1937 near Moscow. After this launching followed flight tests of rockets of type 10, 48, 216, 217 and others.

In 1939 the Soviet winged rocket 212 was flight tested; it was designed by S. P. Korolev with the engine ORM-65. It had automatic control. The rocket was made in 1936 and on 29 April 1937 its first ground firing test was conducted. Flight experiments were carried out 29 January and 8 March 1939. Reports of these tests verify that the launching and work of the engine ORM-65 were satisfactory.

Another winged rocket created in the 1930's was the first Soviet rocket aircraft, also designed by S. P. Korolev. On the 25th anniversary of the first flight of rocket aircraft in the USSR this author conversed with Colonel K. Trunov, veteran of Soviet aviation. Here is what he said:

- The first half of the 1930's was marked by the beginning of large-scale work in rocket technology. A great number of collectives of young enthusiasts of rocketry pursued the creation of rocket engines. Following the first liquid-fuel rocket engine, developed and made in the Gas-Dynamics Laboratory in the USSR during the first half of the 1930's several tens of rocket engines of different diagrams and constructions were built. It is true that these engines were far from perfect, some exploded, but still they worked and, naturally, affirmed the idea of using them on aircraft. One such attempt by a group of rocketry enthusiasts deserves special attention, since it was the beginning of great successes in the development of rocket technology.

For the first experiment it was decided to place Sander's Rocket Engine on B. I. Cheranovskiy's glider, the RP-1 of the "Flying wing" type, built in 1932. However, this work was not completed, as a consequence of which the flight could not take place. In this period the SK-9 turned out to be the only glider suitable for installation of a rocket engine. It was built in 1935 by the designer S. P. Korolev for the installation of a rocket engine. The glider even provided a place for the fuel tanks of the rocket engine.

In the beginning it was decided to install on the glider the engine ORM-65, developed by workers at the GDL, but then it was decided to put this engine on a winged rocket, and to make another engine for the glider. The new engine required one and a half years to build. It was ready in 1939 and had the designation RDA-1-150 No. 1.

In view of the age of the glider SK-9 it was subjected to a thorough inspection; its strength was analyzed. Defects were removed. Additionally a winter ski and streamlined cowling were installed on the rocket engine.

To check the control data of the glider, four check flights were made on it. The engine went through five ground tests, after which it was installed on the glider. The engine was braced on a special frame, fuel lines passed through the tail section, tanks were placed behind the pilot's seat and where the second seat would be. Receiving tanks were placed in the mid section, and storage batteries - in the nose. The instrument panel included control instruments for the rocket engine. It was necessary also to change even the external shape of the glider, in particular the shape of the rudder. The equipped glider had all the elements of a rocket airplane.

The testing of the rocket aircraft was assigned to one of the best glider pilots of that time - Vladimir Pavlovich Fedor. He was warned that the flight could be quite dangerous. Fedor agreed to make the tests. Then he so liked the work of a test pilot that he completely dedicated himself to this profession.

The preliminary test report has been preserved. Although it is printed on stiff yellow wrapping paper, it fixes the day of the great achievement of the Soviet Union, 28 February 1940 - the first free flight of a glider with a rocket engine.

"Before the flight a special commission gave flight clearance with the cut in of the rocket engine in the air.

"The rocket aircraft after a tug by a P-5 took off at 17 h 28 minutes and climbed 2800 m in 31 minutes. Then Fedor started independent flight and proceeded to carry out his assignment."

After the flight Fedor told of his impressions: "After uncoupling set the flight direction at a speed of 80 km/h. Awaiting the approach of the aircraft which would observe me, I began to cut in the rocket engine.

"All was done in accordance with instructions. The firing proceeded normally. All monitoring instruments worked well. The engine was cut in at 2600 m. Immediately an even, indistinct noise was heard.

"Approximately 5-6 seconds after the engine was cut in the flight speed rose from 80 to 140 km/h. After that I set the flight conditions, climbing to 120 m, and held that altitude to the end of the engine's operation. According to readings of the rate of climb indicator the rise was 3 m/s. In 110 s climbed 300 m. After using up the fuel, I covered the fuel values and took a pressure reading at 2900 m.

"After the engine was cut in, I gained speed very smoothly. Throughout the operation of the engine I noticed no influence on controllability of the aircraft. It behaved normally, I sensed no vibrations.

"The gain in speed from the working engine and the use of it in climbing for me, as for a pilot, left a very pleasant sensation. After cutting off the engine, the descent was normal. During the descent I made a number of deep spirals and chandelles at speeds from 100 to 165 km/h. Calculation and landing were normal."

Here is what the crew of the P-5 Fikson, Shcherbakov and Pailo said after watching the flight of the rocket aircraft:

"When the pilot Fedor cut in the engine we noticed a small cloud of smoke from the igniting grain, then there appeared a flame from the starting jets, leaving behind itself a trace in the form of light gray stream. Soon the flame from the starting jets vanished and there appeared a tongue of flame up to a meter and a half long due to the operation of the engine on basic components. In this case too there remained a light trace in the form of a light gray stream, which rapidly dispersed. Combustion of fuel components was complete.

After the engine was cut in the rocket aircraft rapidly increased its speed and climbed away from us. All attempts to

continue our observation were unsuccessful. In spite of a maximum increase in rpm, the P-5 hopelessly lagged behind the rocket aircraft."

So this firstling in rocket technology gave an object lesson to propeller driven aircraft, developing a speed it could not match. This lesson was significant for the aviation of not only our country but also the whole world.

When the rocket aircraft smoothly landed at the designated point, a group of enthusiasts of the new technology surrounded the pilot. Everyone wanted to ask personally how the flight proceeded and how the glider and engine behaved. After all, this was the first controlled flight on an aircraft with a liquid-fuel jet engine. It began a new era in the development of flight technology.

The successful flight of the Soviet rocket aircraft RP-318-1 was also important for the creation of new Soviet rocket engines and the development of future ballistic missiles and rocket-carriers. Everyone was convinced with his own eyes that the time of practical application of rocket engines had arrived. The flight of 15 May 1942, the pilots G. Ya. Bakhchivandzhi on an aircraft with a liquid-jet engine, designed as a combat fighter (the BI-1), confirmed this. Afterwards there followed remarkable achievements of the Soviet people in the development of jet propulsion, and then rockets and spacecraft.

In the 1940's scientists at the Gas-Dynamics Laboratory created a series of auxiliary aviation liquid-fuel jet engines with pump feed of nitric acid and kerosene, with chemical ignition, an unlimited number of repeated, fully automated starts with controllable thrust and maximum ground thrust of from 300 to 900 kg.

Official tests of the first engine of this series, the RD-1, took place in 1943. The RD-3, a three-chamber engine with a 900 kg thrust, underwent the same tests. From 1943-1946 nearly 400 test firings were conducted on Petlyakov bombers and on Lavochkina, Yakovlev and Sukhoy fighters.

In 1946 the engine RD-2 with a thrust of 600 kg underwent state tests. Now, all these firstlings of rocket-building can be seen in museums. In them the ideas of our scientists were developed, and experience stored away which allowed the creation of engines and rockets which were striking to the world in their possibilities and perfection.

Simultaneously in our country experimental work was conducted on the development of other types of engines - air-breathing jet engines. Even in 1923 the Soviet specialist V. I. Bazarov obtained a patent on an air-breathing jet engines with centrifugal compressor and gas turbine. In 1937 engineer A. M. Lyul'ko advanced the first scheme of a ducted fan jet engine. Air-breathing jet engines subsequently became the basis of development of rocket aviation. A. M. Lyul'ko

was the author of a number of remarkable designs of contemporary engines, including one for the famous aircraft designed by A. N. Tupolev.

In subsequent years air-breathing jet engines occupied a dominating position in aviation, making it possible to reach unparalleled altitudes, speeds, distances. And liquid-fuel jet engines together with other types of rocket engines became reliable hearts of contemporary operational rockets.

First Soviet combat solid-propellant rockets. Simultaneously with the investigation of liquid-fuel rockets Soviet scientists and designers carried out intense work on solid-propellant rockets, which became the first contemporary combat rockets. Their designing began immediately after the Great October Socialist Revolution. Experiments on solid-propellant combat rockets at the Petrograd artillery proving ground were conducted by the Soviet scientist V. A. Artem'yev. It was he who initiated the creation of a rocket missile with high firing accuracy. Engineer N. I. Tikhomirov took fervent participation in the development of this missile. These two specialists by their joint efforts surmounted many difficulties and in the middle 1920's created missiles able to fly 700 m, and then up to one and a half kilometers.

But enthusiasts understood that they were making only the first step. They mainly strived to create a fuel which burned uniformly. And such a sufficiently stable fuel was obtained (trotyl-pyroxilin powder). On this basis it was decided to proceed to the creation of two types of missiles: 82 and 132 mm.

Much effort from the designers was required to safeguard the stability of missiles in flight. This was solved by rotation of the missile in flight due to the escape of hot gases from the combustion chamber or preliminary spin-up before launching using an electric motor or an internal-combustion engine.

On 3 March 1928 the new missile was tested at a proving ground near Leningrad. The fuel was trotyl-pyroxilin smokeless powder. A characteristic feature of the missile was that the fin assembly did not go beyond its overall dimension. As we see below, this circumstance fatally affected possibilities of increasing firing accuracy. During the test the range reached 1300 m; error at the target was rather large. Yet, this was a serious step forward.

Tests inspired enthusiasts. The number of participants of experiments multiplied because of the scientists, teachers and graduates of higher educational institutions who joined. The circle of colleagues of the Gas-Dynamics Laboratory expanded. There arrived talented engineers, among which were B. S. Petropavlovskiy, G. E. Langemak, L. E. Shvarts, and F. N. Poyda. Improvement of the experimental base also promoted progress.

As a result of the efforts of the harmonious collective, the range of missiles sharply increased. It was calculated already at

many kilometers. However the Achilles heel as before remained accurate in striking the target. The solution came in 1933, when I. T. Kleymenov advanced the idea of changing the fin assembly - of bringing it beyond the dimensions of the missile. Artem'yev jumped at this valuable idea. Under his leadership the 82 and 132 mm missiles were reconstructed. First tests confirmed that the striking accuracy increased and the range essentially did not change. This was already victory!

It is impossible, of course, to think that our designers worked only on models of missiles of these two calibers. For the first time in the world in 1932 collectives headed by B. S. Petropavlovskiy created a 76 mm rocket missile. This missile was designed to combat tanks.

For the first time combat employment of rocket missiles was used in aviation. But first we will tell how rockets came to be used on aircraft. Experiments on the use of missiles from aircraft started at the beginning of the 1930's, when an 82 mm missile was mounted in and launched from the U-2 trainer (later Po-2) and I-4 fighters.

1937. Bombers took to the air carrying 82 mm rocket missiles. First firings, first tests.

1938. One more check in the air for the 82 and 132 mm missiles. G. Ya. Bakhchivandzhi, the very one who four years earlier had made the first flight of the first jet fighter in the world, made tests in firing a rocket missile from a fighter. During the tests a number of attendant circumstances in firing was revealed, in particular, the influence of low temperature. Ways to improve both the missiles themselves and also the launching racks were found.

In the summer of 1939 combat rocket missiles were used from aircraft in fights with Japanese troops on the Khalkhin-Gol River in Mongolia. Use of the new weapon literally stunned the enemy. This weapon turned out to be effective. Toward the end of 1939 rocket missiles were mounted on the I-16 and I-153 fighters (eight 82 mm missiles each), on the Il-2 attack planes (eight 82 or 132 mm missiles), and on SB bombers (ten 132 mm missiles).

During the years of the Great Patriotic War a system of rocket missiles was used by land troops. It was the BM-13 ground mobile rocket launchers, romantically named by the people "Katyushi." Every launcher was assembled on the triaxial truck and was sixteen-charge, i.e., on one truck were 16 missiles ready to launch. They could be launched in 8-10 seconds. Such a high rate of fire allowed a considerable increase in intensity and effectiveness of fire in combat conditions.

The idea of a multicharge launcher belongs to a remarkable collective of Soviet designers. It obtained official acknowledgement even in 1938. Three years were taken up with an intense search for

the best structural design. Launchers designed for a different number of missiles were tried. The most reassuring results were already shown in the summer of 1939 by the 16-charge launcher.

The missiles themselves were improved. This work was conducted by the ever untiring Artem'yev in collaboration with L. E. Shvarts and F. N. Poyda. Much energy was given to the development of the launching rack design and to methods of the fastest and most reliable ignition of powder charges by technicians A. P. Pavlenko and A. S. Popov. The joint efforts of designers and production workers created a type of weapon new in principle — multicharge rocket launchers.

In the spring of 1941 the "Katyusha rocket launcher" was shown to Marshals of the Soviet Union S. K. Timoshenko and S. M. Budenny. For the "Katyusha rocket launcher" a target situation was prepared corresponding to a company on the offensive. The designers, according to recollections of participants, thoroughly checked the equipment and ranged the "Katyusha rocket launcher." The "Katyusha" appeared last. Marshal of the Soviet Union Timoshenko decided to be in the dugout which was in the target area.

When a salvo was fired at the target, the dugout started to settle, earth fell in. The impression was created that the dugout had been struck directly. To the question of Marshal Timoshenko: "What happened?" — the proving ground crew answered that the new weapon had fired a normal salvo on the target. Timoshenko, convinced that the target had been struck, gave the order to cease firing and together with Budenny headed towards the target. The shot had been excellent. The target was completely covered; of the wooden box-like targets there remained only slivers and what is more, in the form of cobweb white threads they hung on the nearest trees. All were struck by the might of the new weapon.

S. K. Timoshenko gave an order for no more firing and went back to the battery.

The designers did not know why the firing had been ceased and very were agitated. When Timoshenko and Budenny came over to them, their good spirits were transmitted to the designers.

S. K. Timoshenko and S. M. Budenny first of all clarified who had made the firing. Becoming acquainted with the arrangement of the launcher and rocket missiles, S. K. Timoshenko ordered several single and group shots at a target he indicated. This firing was carried out successfully.

As a result in the spring of 1941 a decision was made to incorporate the "Katyusha rocket launchers" into the armament of the army. They were presented for inspection to leaders of the Party and government literally on the eve of the Great Patriotic War — 21 June 1941. After that they were put into mass production.

During the war years the rocket launchers continuously improved. Already at the end of the summer of 1941 the armament was joined by

self-propelled launchers for firing salvos of 36 and 24 82 mm missiles. By the summer of 1942 the armies had obtained 120 mm and 300 mm high-explosive missiles with a respective range of 5 and 2.8 km. For launching the 300 mm missiles special launchers were designed, accomodating simultaneously 4 missiles each. Subsequently it was possible to pack "three hundreds" in two rows, and the salvo increased to 8 missiles. Salvos by powerful missiles were able to destroy defense installations and to destroy fire means and enemy troops directly in shelters.

In that same 1942 plants at Leningrad mastered the production of 280 mm high-explosive spinner rockets. They were a mighty means for protecting the city on the Neva from enemy attacks. It is also remarkable that Leningrad missiles were prototypes of contemporary spinner rockets.

The beginning of 1943 marked new success for designers of formidable weaponry. A modification of the 300 mm missile had an increased distance - 4.3 km. A salvo of 82 mm missiles was a new step forward. Soviet specialists created a mountain variant of the launcher, able to fire a salvo of 8 82 mm missiles.

One of the most important problems of designers of rocket weaponry was increasing the density of hits. With this goal the spring of 1944 two types of missles were developed with ranges of 4 and 7.9 km. In accordance with the construction of the missiles the launcher was also modified, having 12 launching racks. As a result of all these improvements dispersion of missiles considerably decreased and other combat characteristics of rocket weaponry were improved. At the very end of the war specialists made happy their Native Land by a new success. They created a 132 mm long-range missile. Its range exceeded 11 km. Moreover, it ensured a high density of hits.

It is necessary to note that our missiles during the Great Partiotic War had record-breaking range as compared to missiles of other nations in war. The 158.5 mm missile of the fascist army had a range of 6.7 km, the American 114.3 mm - 4.2 km, the English 127 mm - 7.3 km. Even the multicharge launchers of foreign countries, modeled on the Soviet "Katyusha rocket launchers," yielded to ours in mobility and maneuverability.

The splendid way in which Soviet industry coped with mass production of the "Katyusha rocket launchers" in the difficult conditions of war is shown by the fact that during those years many self-propelled launchers and missiles of various calibers were produced. Many millions of fiery arrows were released on the enemy. At that time not one army in the world had as much new weaponry. During the years of the heroic struggle of the Soviet people with the Hitlerite aggressors rocket artillery was used in all branches of the armed forces - land forces, Navy and Air Force. We will tell about the first Soviet missilemen in military science. Here we would want to note that this was first combat employment of rocket technology in the Twentieth Century. Our use of rocket weaponry promoted victories over the enemy.

How the nuclear missile shield was forged. After the great victory gained by the Soviet people under the leadership of the Communist Party over German-Fascist aggressors and Japanese imperialists, Soviet economics, science and technology rapidly moved forward. The Soviet Union solved the great problem of the creation of guided rockets of all forms and purposes. Our scientific cadres and production workers successfully settled the production of powerful rocket engines, special fuels and heat-resistant alloys.

Our first controlled operational rockets appeared immediately after the Great Patriotic War. Their range already was calculated at several hundred kilometers. In the year of the thirtieth anniversary of Soviet power, a series of successful launchings was conducted. Subsequently the power of the engine grew continuously and the control system, range of operation and load capacity were improved. In the year of the fortieth anniversary of Soviet power a report of TASS about successful launching of a super-range intercontinental multistage rocket was published.

Radio electronics and rockets. It would be inconceivable to create weaponry for the rocket forces without the widest use of achievements of radio electronics. Especially intense application of radio electronics is the most characteristic trait of the rocket forces, distinguishing them from the many kinds of forces of the most recent past.

In those decades which determined the great successes in the development of our rockets, radio electronics also experienced rapid progress. The "intelligent" machines, the most complex automatic machines, telemetering, communication and television systems created by it helped to "write" the most glorious pages of the biography of our rockets.

Without the "miracles" of radio electronics the contemporary guided rocket as the highest type of automatic weapon would be impossible. The times required it. Transition to more automated means of combat is historically regular; it results from the continuously growing power of weaponry and the complication of combat employment. With increasing frequency requirements on the use of a weapon in combat and the physical and psychological possibilities of man come into conflict.

Let us show this in an aviation example. The necessity of introducing automatic devices on aircraft appears, in particular, because the required reaction speed becomes back-breaking to a person. Imagine that during an air encounter with the enemy a plane climbs to an altitude of 20 thousand meters with a total speed of 3000 m/hr [sic] in a space having absolutely no reference points. In these conditions it is inconceivable to see ahead of time with the naked eye an enemy on the same type of craft, to make a decision, transmit it through the muscles to the control system of the plane, aim, release a missile and, not colliding, withdraw from action. Automatic units should come to the rescue, replacing human reaction which lags the lightning-like development of events in the air.

Indeed, aircraft at first were mechanized, then semiautomated (a person is on board to control the automatic machines) and finally went to full automation.

Thus, automatic units, without the interference of a person, are able to guide a missile to its target - the inalienable and most important part of a nuclear missile. The basis of all contemporary automatic systems, as a rule, is the achievements of radio engineering and electronics, combined usually into one idea - radio electronics. As is obvious from a description of flights of Soviet space rockets, in their control systems the most essential are radar, radio communications, electronic computers and other advances from radio electronics.

The first rocket control systems in our country were proposed many years ago. There is information in print that the first projects for controlled operational rockets appeared at the end of the 1920's both in our country and abroad. In the book V. P. Petrov and A. A. Sochivko Rocket Control one such project of Engineer A. G. Ovizheniya is described. In this project, as also in many others, it was proposed to hold the rocket on the needed trajectory with the help of a searchlight ray, illuminating the target. The author himself called his own control system "A muzzle attached to the breast."

What made up this system? It combined a searchlight and launching tube in the center through which the rocket was launched. Taking off, the rocket all the same remains in the "power" of the searchlight beam, which "attentively watches" the target, always illuminating it and as it were, "conducts" it where it is necessary in its own "light muzzle." Actually, the searchlight beam has the form of a ring or a muzzle.

And photocells are provided in the tail section of the rocket. If the rocket flies within the "light muzzle" they are not illuminated. But as soon as the rocket deviates from the true path, the photocells fall under a ray of light and produce a signal which influences the controls in such a way that the rocket again returns inside the muzzle and flies in it.

However, such projects with "searchlight control systems" did not lead and could not lead to the creation of guided missiles. And the level of development of rocket technology in the twenties was still insufficient, and even the path "laid by the searchlight," is not clear and not distant.

Only in the forties and especially in the fifties of the XXth century were conditions created for properly combining perfected rockets with radioelectronic means of control. In the first practically used control system for elimination of rocket drift instead of a searchlight a radio transmitter which created a radio beam was used.

Subsequently radars were recognized as the most successful device for creation of radio beams. With good reason the Soviet people are proud of the fact that it was in our country that the principle of radar was discovered and the main components of radars produced. The inventor of the radio, A. S. Popov, who astonished the world in May 1895 with the creation of the first radio receiver, in the course of further experiments in the Baltic Fleet discovered the effect of shadowing radio waves, that is their reflection from metallic objects (ships). The possibility to determine the position of objects is based on this.

A little more than a decade later another Russian scientist, B. L. Rozing, proposed the use of electron-beam tubes for the reception of images. Today these are encountered frequently in the rocket forces. On 9 May 1911 B. L. Rozing demonstrated to a group of Petersburg scientists the reception of images with the help of an electron-beam tube. This was an important historical event for radar, television, and later for controlling the flight of rockets.

However, for the full realization of the principle of radar in radioengineering it was necessary to travel a long road. Scientists had to create perfected radioelectronic devices and investigate the laws of propagation of radio waves of different lengths, including the shortest, which turned out to be the most suitable for detection of moving objects. It is significant that precisely during the study of propagation of ultrashort waves Soviet radio specialists B. A. Vvedenskiy, Yu. P. Simanov, B. V. Khalezov, and A. G. Arenberg were the first in the world to come to the conclusion concerning the expediency of the application of these waves for radar.

The first approach to the idea of radar was the creation of a pulse ionospheric station by M. A. Bonch-Bruyevich, the oldest Soviet radio specialist, who in his time carried out the direct

instructions of V. I. Lenin. The essence of operation of this station was that at definite intervals of time its pulse transmitter sent out signals straight upwards. Upon "striking" the ionized layer of air, in which, just as in metal, there are many free electrical charges, the radio signal was reflected from it. The echo signal was picked up by a receiver. This took place at the time when the transmitter was "silent." Based on the transmission time for the signal (and the propagation velocity of radio waves was measured with a high degree of accuracy by Ye. Ya. Shchegolev and N. N. Ryazin and comprised 300,000 km/s) the altitude of the ionized layer was determined. It is interesting that the Bonch-Bruyevich station operated on short waves. The first Soviet radars also worked on these waves.

Something else is remarkable here. A thought arose: what if an aircraft is assumed in place of the ionosphere? This means that by the same method it is possible to detect it and measure the distance to it. Work on the creation of pulse radars for detection of aircraft began in the USSR in 1934. This work was headed by Yu. B. Kobzarev, P. A. Pogorelko, and N. Ya. Chernetsov. By 1938 a radar station was completed and received the name "Redut," or RUS-2. It had a rotatable antenna and could detect aircraft at distances up to 150 km. The first locators passed their baptism of fire in 1939-1940, in the Soviet-Finnish War.

Subsequently the "Redut" stations were improved and received a new name - "Pegmatit." With these stations our soldiers in the PVO (Antiaircraft Defense) entered the Great Patriotic War. Also on the eve of war, at approximately the same time, aviators received the aircraft radar "Gneys." It was used successfully during the years of the war under combat conditions.

In honor of Soviet radar men it is necessary to say that they found design solutions which in many respects were more successful than those of their foreign colleagues. Soviet radars in the period of the past war differed from foreign models by the simplicity of radio technical and electrical circuits, lesser power supply, small weight, and dimensions. Radars were used for detection of aircraft, fire control of antiaircraft artillery, and guiding of fighters to targets.

In the foreign press recently it is frequently possible to encounter descriptions of continuous-wave radars. In them the transmitter does not fall silent, and determination of data about moving objects is based not on time of movement, but on frequency shift following summation of radiated and reflected signals. This so-called interference method of determination of distance is claimed to be a novelty by some specialists. However, it was introduced long ago by Soviet Academicians L. I. Mandelshtam and N. D. Pappleksi. As early as in 1933 extensive work was being conducted in the USSR on the production of continuous-wave radars. It ended in the creation of the first models of stations for the detection of aircraft. In 1939 such radars entered our arsenal. They revealed enemy aircraft on a front of 80-100 km. Locators of this type were also used in the Soviet-Finnish War.

In the course of the Great Patriotic War our scientists, designers, and technicians ensured the serial production of radar equipment, which to a great degree promoted the strengthening of combat power of our armed forces. After the war radar technology in the USSR developed continuously. This played a major role in providing a new weapon - rockets - with reliable control systems.

Radar devices, wrote Colonel-General of Artillery A. Gerasimov in one of our newspapers, have been enlisted for the resolution of problems in accordance with the new requirements faced by forces due to the appearance of rocket and nuclear weaponry in the arsenals of armies. A very responsible role is played by the radar devices in anti-aircraft rocket installations. In surface-to-air missile complexes radar devices detect the target and determine exactly the position of the target and the rocket in the air. On electronic devices these data are used to calculate the flight path of the rocket to engagement with the target.

In the press it is also stressed that for destruction of the target it is possible to use automatic detonation of a surface-to-air missile at specific deviations of it from the target. This is carried out by a radar detonator. In some surface-to-air missiles the radar principle is the basis for the layout of their homing guidance systems. These ensure the automatic determination of target position data and a hit by the rocket without ground control.

Radar technology is finding more extensive application not only in surface-to-air rocket forces, but also in ground rocket units and on rocket carriers of the air force and fleet. With the help of radar correction of firing by ground rockets is conducted. An airborne radar system makes it possible to detect a target, establish its coordinates, and over a distance of several hundred kilometers guide the rocket to a ground target or a ship. On submarines radars also help to control firing of rockets on air and surface targets.

The realization of antimissile defense is absolutely impossible without the application of various radar devices for long-range detection of enemy rockets and for guiding of antimissile missiles to a point of encounter with the enemy rocket.

A specific value of radar is that it, just as a catalyst in chemistry, has and is accelerating the development of other branches of radioelectronics - radionavigation, radiometeorology, semiconductor technology. It was namely the development of radar which promoted the progress of pulse technology and the mastering of decimeter, centimeter, and now even millimeter radio waves.

But unconditionally, in providing rockets with reliable control systems other branches of radioelectronics are also important. This is clearly apparent from what has been written about the creation and launching of Soviet space rockets and satellites, raising the prestige of our science and technology high in the world. In the Soviet press information about the value of radio communications, television, and telemetry has been published extensively.

Telemetry permits scientists on the ground to measure all the values on board rockets, satellites and ships which interest them. It is done in this manner. Let us assume that it is necessary for us to know what is happening with the temperature in this or that part of a rocket in flight. A pickup is set up there; it converts data about the temperature into electrical signals and they, with the help of radio waves, are transmitted to earth and here deciphered. In exactly the same way remote measurements of pressure, indices characterizing the state of an organism in flight, etc., are carried out. For transmission of a large number of data simultaneously, several channels of radio transmission from aboard the rocket are provided. Thanks to telemetry Soviet scientists have obtained much valuable information from aboard test rockets and from space.

The list of radioelectronic assistants of our scientists in the development of rocket technology and the mastering of space would be incomplete if we did not mention the electronic computer. In these machines, as is known, all arithmetic operations are reduced to operations on electrical signals, which are produced by special semiconductor circuits and electronic counting relays, joined into the circuit. The counting relays operate in millionths of a second. This explains the grandiose speeds of calculations on electronic computers.

Computers operate on a program which is supplied to them by man. Such a program is entered into the input device in an encoded form, that is, in the form of electrical signals. The problem is "stored" and a special device performs all the actions necessary for its solution. The output device deciphers - translates - the results of the calculations from the language of electrical signals into the language of figures. For strict observance of the program a control unit in the machine follows it. Only with the help of such machines did it become possible to "process" the huge quantity of information obtained during tests of rockets and space investigations. Electronic computing automation is also acutely necessary in the designing and production of rockets.

The high degree of effectiveness of electronic computers in the designing of rockets was noted. The solution of ten variations of this problem on desk calculators can tie up dozens of mathematicians for seven months. At the same time with the help of electronic models and electronic computers 100 variants of this problem can be solved by a lesser number of specialists in one week.

Achievements of the USSR in the development of operational rockets and the mastering of space speak convincingly of the successful solution by Soviet scientists - radioelectronics specialists - of problems of accurate control of pilotless and piloted rocket-space vehicles.

Nuclear charges on rockets. However the biography of weaponry in our rocket forces would be incomplete if mention is not made of the birth of nuclear charges for rockets.

Initially the main carriers of nuclear charges were considered to be bomber aircraft. Powerful and perfected rockets have their own advantages over aircraft as carriers of nuclear charges. Rockets with nuclear charges are the basic weaponry of the rocket forces and the main means for conducting contemporary warfare. Rockets with nuclear charges combine the tremendous energy of nuclear explosions with great range of flight, accuracy, and invulnerability.

Let us imagine that we are in a nuclear arsenal. The spacious accommodations put in mind halls for nuclear reactors at atomic electric power stations. Serious people in white robes pass by us. From time to time they stop at special devices for the storage of nuclear charges.

It is easy to imagine the feeling which would be experienced by any Soviet person, visiting the arsenal where the mightiest nuclear charges in the world are stored.

As is known, at first nuclear charges were created in which the explosive was fissionable uranium or plutonium. It is calculated that 1 kg of pure nuclear substance of uranium or plutonium will, with the complete fission of its nuclei, release the same energy as an explosion of 20 thousand tons of ordinary explosive - trotyl. Here it is impossible to forget the person who made a huge contribution in the creation of the first Soviet nuclear charges - the outstanding Soviet scientist I. V. Kurchatov.

Igor Vasil'yevich Kurchatov was born on 12 January 1903 in the settlement of Sim in Ufimskaya Oblast. His father was a forester's assistant and his mother was a teacher. In 1909 the Kurchatov family moved from the Urals to Simbirsk, and in 1911 - from Simbirsk to the Crimea. I. V. Kurchatov was an excellent student and in 1923 graduated from the Physical and Mathematical Department of the Crimean University ahead of schedule. Then he entered the Shipbuilding Department of the Polytechnical Institute in Petrograd.

Inclination for scientific work showed up early in I. V. Kurchatov. While still a student at the Polytechnical Institute he showed himself to be a most skillful experimenter by carrying out research on the radioactivity of snow at the Pavlov Magnetometeorological Observatory. Since then physics had undivided possession of his thoughts. In 1925 he started to work at the Leningrad Physical and Technical Institute, where he was absorbed in investigations in the area of physics of dielectrics. He created the science of ferroelectricity, that is, of electrical phenomena in materials which possess spontaneous polarization.

In 1933 in the conference hall of the First All-Union Conference of Physicists and Atomic Scientists, Soviet scientists working in the area of the atomic nucleus became acquainted with interest with the young, energetic organizer of the conference, I. V. Kurchatov. He was already actively interested in problems of nuclear physics.

Right here it would be desirable to expose the incorrect affirmation of the western press that in the thirties of the XXth Century the development of problems of nuclear physics was being conducted in only three scientific centers of the world: in England (Cambridge), in Denmark (Copenhagen), and in Germany (Göttingen). It is necessary to add Kharkov and Leningrad to the list of cities where serious investigations were going on in the area of nuclear physics, and among the names of atomic scientists, such as Rutherford, Bohr, and others, it is only right to add the name of I. V. Kurchatov.

Indeed, already at that time Kurchatov with his inherent enthusiasm was engaged in searching for sources of fast particles which would be able to start nuclear reactions. Initially under his leadership at the Kharkov Physico-Technical Institute high-voltage installations for splitting of nuclei were built. Then at the Leningrad Radium Institute he gave a start in life to the first cyclotron not only in the USSR, but also in Europe, and then to a more powerful cyclotron at the Physical and Technical Institute. This second cyclotron was also the most powerful in Europe.



Igor Vasil'yevich
Kurchatov (1903-1960).

When now we become acquainted with the life of Kurchatov, the exceptional productivity of his labor is astonishing. Every year there was a big success.

...1934. I. V. Kurchatov by way of experiments establishes the fact of branching of reactions during fast neutron bombardment of nuclei of phosphorus and aluminum, which, as is known, exist in the form of one isotope (monoisotopic elements).

1935. I. V. Kurchatov with a group of colleagues manages to discover a surprising property of bromine. It turns out that the artificially obtained nucleus of this element with an atomic weight of 80 has radioactivity of two types: with periods of half-life of 4.5 hours and 18 minutes. This phenomenon was called nuclear isomerism of artificially activated substances. The value of this discovery became especially important recently, but even in the thirties the success of I. V. Kurchatov was assessed as a remarkable achievement.

Finally, the nearer the goal came, the clearer it became that the particles which would "open" the nuclear fission reaction were the neutrons. In 1940 on the initiative and under the leadership of I. V. Kurchatov investigations were carried out which lead to the remarkable discovery of spontaneous nuclear fission of uranium. By this time the scientist was already examining the problem of investigation of fission of heavy nuclei from many sides, under the impact of both fast and also slow neutrons.

In the autumn of 1940 I. V. Kurchatov was no longer simply a participant in the 3rd All-Union Conference of Atomic Scientists. He came forward in it with a review paper about nuclear reactions and the practical possibilities of nuclear fission. From Kurchatov's report it was evident that our specialists were on the level of the latest concepts concerning these questions in world science. The scientist had already stressed that in principle it is possible to lay down the problem of three possibilities of the realization of a chain reaction. It was confirmed experimentally in the Leningrad Laboratory by I. V. Kurchatov that during nuclear fission of uranium 2-3 free neutrons are yielded. These can cause subsequent divisions - that is, the possibility of a nuclear chain reaction was demonstrated.

By the order of I. V. Kurchatov, scientists Ya. B. Zdl'dovich and Yu. B. Khariton for the first time in the world carried out a basic calculation of chain reactions of nuclear fission.

I. V. Kurchatov made the proposal in the Presidium of the USSR Academy of Sciences about the development of extensive scientific research in the practical realization of nuclear chain reactions. But the war imposed on us by the Hitlerites for the time stopped the realization of the scientist's plans. He volunteered for service in the Navy and put out much effort for the improvement and organization of antimine protection of ships. He was at Sevastopol, Murmansk, Baku, Poti, and Tuapse. At the very climax of the war he was recalled by the Soviet government in order to head work on nuclear reactions. At that time it was clear that on the basis of achievements in nuclear physics Hitlerite Germany was desperately aspiring to the creation of a new weapon. Yes and in deep secret the allies were intensively "forging" their own atomic sword.

"We started war," I. V. Kurchatov recalled later, "on the practical use of atomic energy in the severe days of the Great Patriotic War, when the native soil was flooded with blood, when our cities and villages were destroyed and burned, and when there was no one who would not experience a sense of deep sorrow from the death of close and dear ones."

"We were alone," narrated I. V. Kurchatov. "Our allies in the struggle with fascism, the English and the Americans, who at that time were ahead of us in scientific and technical problems on the use of atomic energy, conducted their work in the strictest secrecy and gave us no help."

American military circles managed especially prudently. Making use of the weakening of countries of Western Europe, the Americans shipped out the most well-known atomic scientists to the United States. During transport one of them was even placed in the bomb-bay door of a bomber. This "traveller" did not even know that the crew was ordered at the first sign of capture by the Hitlerites to drop him into the ocean.

Intensive work on nuclear weapons began in the atomic centers at Oak Ridge (production of uranium-235), Hanford (production of plutonium), and Los Alamos (production of the atomic weapon). Thus, for example, the gaseous diffusion plant in Oak Ridge was built in April 1945. The nuclear fissionable material - uranium-235 - which was made there was used for the filler of the bomb, blasphemously called by the affectionate name "Little Boy." Plutonium produced at the Oak Ridge plants served as the filler of another bomb which was given the name "Fat Man." In August 1945 both of these, without any military necessity, were dropped on the Japanese cities of Hiroshima and Nagasaki.

"At the end of the war," said I. V. Kurchatov, "when Germany had already capitulated and the military power of Japan had collapsed, American aircraft dropped two atomic bombs on the Japanese cities of Hiroshima and Nagasaki. More than 300 thousand persons perished from the explosions and fires, and 200-250 thousand peaceful inhabitants were injured and contaminated with radiation."

"These sacrificial victims were required by American military policies in order to form the basis for unprecedented atomic blackmail and "cold war" against the USSR."

"Soviet scientists considered it their sacred duty to ensure the safety of Mother Russia..."

Our atomic scientists, and mainly I. V. Kurchatov, worked selflessly and devoted themselves to this matter. They understood that it was necessary not only to develop the working principles of a nuclear weapon, but also to create powerful atomic industry, without which it is impossible to produce the new weapon on a mass scale.

The Central Committee of the Party and the Government of the USSR made the decision to create a modern atomic industry in a short period. The scientific leader of this grandiose matter was I. V. Kurchatov. Here in all their brilliance were manifested the range of vision of the scientist and the remarkable grip of a great organizer of production. In a short period of time under his

observation it was possible to expand research, to put it into practice, to put uranium deposits into operation, and to reconstruct for atomic production a multitude of plants, institutes, and laboratories.

When this gigantic work was going on, abroad, as always, sceptical expressions resounded. American General Groves, for example, categorically affirmed that the creation of atomic charges in the USSR would require "at the best... 15-20 years." But under the direction of the Party scientist-patriots upset all calculations of the enemy and accomplished a real scientific feat. Thanks to their labors, to the labors of Academician and Communist I. V. Kurchatov, and to the work of production workers, in 1947 the Soviet Government could already state to the whole world that the secret of atomic charges was no longer a secret. But the thick heads abroad did not believe this report. They continued to repeat that this could not be.

And then in August 1949 an American aircraft delivered sample of radioactive air. Only then were the military circles of the United States convinced that in USSR a nuclear explosion had been carried out. On 23 September 1949 President Harry Truman came forward with acknowledgement of this distressing fact.

Under the leadership of the Communist Party Soviet scientists independently and in a short period of time solved the most complex problems in the development of methods for obtaining nuclear energy and creation of nuclear charges. Our scientists worked with success in the area of technology of obtaining nuclear fissionable material. An atomic industry has been created in the Soviet Union. This made it possible to ensure the wide use of atomic energy in the interests of the safety of our Fatherland and for peaceful purposes.

We will now become acquainted in greater detail with physical principles for the construction of nuclear charges. Atomic nuclei of the majority of substances are so durable that it is very difficult to divide them into parts. But there are substances in which the atomic nuclei disintegrate themselves. These are radioactive substances. Disintegration of atomic nuclei of such substances is accompanied by energy release. Atomic nuclei of radioactive substances do not disintegrate all at once, but gradually. Therefore the amount of nuclear energy liberated during natural radioactive decay in a unit of time is very small. By artificial means it is possible to create conditions under which heavy atomic nuclei of certain radioactive substances (uranium, plutonium) disintegrate into parts (fragments) in millionths of a second, that is, practically simultaneously. In this case a huge amount of nuclear energy is liberated instantly - a nuclear explosion occurs.

If one were to be more specific about a nuclear reaction, then it would be necessary to note that it is achieved as if in two stages. The first stage is characterized by the formation of an excited nucleus under the impact of an incident particle - a neutron. In the second stage disintegration of the excited compound nucleus takes place.

Many types of nuclear reactions are known to modern science, but the most important for nucleonics turned out to be the fission reaction of heavy nuclei of uranium isotopes with mass numbers of 235 and 233 and of the plutonium isotope with a mass number of 239.

Under influence of neutrons the nuclei of uranium-235 or plutonium are each split into two approximately equal fragments. Simultaneously 2-3 new secondary neutrons are emitted and a large amount of energy is released. The main share of it - 83% - belongs to kinetic energy of the fission fragments. Radiation carries off 5% of the energy. The remaining 12% of the energy belongs to radioactive decay of fragments of the nucleus.

Thus, during fission of each heavy nucleus 2-3 secondary neutrons are emitted. It is namely in this phenomenon where lies the key to the realization of a chain (avalanche-type) fission reaction of heavy nuclei. The fission of one nucleus leads to the appearance of new fast neutrons, and they cause further acts of fission. And so follows act after act with ever greater amplitude. A chain avalanche-type process is formed. In a very short time a vast amount of energy is released.

In the course of nuclear fission neutron multiplication occurs. This process is usually characterized by a criticality factor. When it is less than unity the number of neutrons decreases in the course of the reaction; when it is larger than unity the number increases; and when it is equal to unity the number is maintained constant. This last condition is called critical.

It is necessary to note that in the mass of fissionable material from which atomic charges are made, part of the neutrons is lost unproductively. They are seized by harmful impurities, from which they try in all possible ways to get free. A certain part of neutrons escapes outside of the charge and these will deviate from further participation in the reaction. Leakage of neutrons outside is reduced by a decrease of the ratio of area of the charge to its volume - after all, the smaller the surface, the fewer the possibilities for neutrons to escape outside. Most "inconvenient" for neutrons in this respect is the spherical form of the charge. This is why charges of such a form have the least critical mass, that is in this case the very least fissionable material necessary in order to obtain critical conditions at which the number of neutrons no longer decreases.

The value of critical mass depends not only on the form of the charge, but also on density and purity of the fissionable material used. Values of critical masses have appeared in print for practically pure uranium-235 and plutonium-239 with normal density. They comprise respectively 16.5 and 10.5 kilograms.

The value of critical mass of a charge can be artificially decreased, if it is surrounded by a layer of substance which is a good neutron reflector, just as a mirror is of light rays.

Beryllium, tungsten, iron, and other substances can be used in the preparation of neutron "mirrors." As a result of the use of a reflector, critical mass can be decreased by two and more times as compared to the mass without a reflector.

But of course, critical mass does not guarantee conditions for avalanche-type development of chain reaction; after all the number of neutrons in it does not increase. This is why for obtaining an explosion the mass of the charge should be appreciably greater than critical. It is just so in real atomic ammunition.

A nuclear explosion is also possible by means of fusion light atomic nuclei (for example, atomic nuclei of hydrogen, lithium). However, the reaction of fusion of light nuclei is possible only at very high temperature, measured in tens of millions of degrees. In connection with this the reaction of fusion of light nuclei is called a thermonuclear reaction, and the explosion - a thermonuclear explosion. As the source of high temperature which is necessary for the realization of a thermonuclear explosion, a nuclear explosion, based on the fission of heavy atomic nuclei, is used.

And here the mechanism of reaction includes the process of the emergence from two nuclei of one excited compound nucleus and its disintegration with the radiation of protons, neutrons and other particles. It is known that atomic nuclei have like electrical charges and repulsive forces between them. For them to approach to a distance at which nuclear attractive forces start to act it is necessary to expend considerable energy.

Most suitable for the fusion reaction turned out to be the nuclei of light elements, and in particular hydrogen, or more correctly its isotopes - deuterium and tritium. During nuclear fusion of deuterium and tritium in a calculation per kilogram of reactants, 4 times more energy is released than during the fission reaction of nuclei.

It was not accidental that we mentioned the reaction of nuclear fusion of deuterium and tritium. These components are obligatory for every thermonuclear charge, since only they are capable of "igniting" an atomic detonator. And the very reaction with the participation of deuterium and tritium causes a further process of nuclear fusion in the whole volume of charge. The question may arise: why still use some substances if deuterium and tritium are completely suitable for this purpose? The fact is that tritium is an extraordinarily expensive and short-lived isotope.

Foreign literary sources name as the most suitable thermonuclear explosives solid compounds of hydrogen - lithium deuteride and lithium tritide. In these substances a whole cycle of reactions take place which give a high effect without the introduction of tritium from without.

Charges in which a thermonuclear explosion is the basis of the destructive action are called thermonuclear charges. At present nuclear weapons are known in the form of charges of rockets, aerial bombs, and torpedoes. It is considered that rockets are the most effective for delivery of nuclear charges to the target.

For the creation of nuclear charges it was necessary for our specialists to set up industrial extraction and production of uranium.

In Table 1, we present the comparative expenditure, according to the foreign press, for obtaining 1 kg of natural uranium, enriched uranium, (containing an increased quantity of uranium-235 in comparison to natural), and nuclear fissionable material, by means of chemical extraction from irradiated rods.

Table 1

Product and operation	Cost per kg in dollars
Natural uranium	44
Enriched uranium, 1% uranium-235 ...	75-95
Enriched uranium, 5% uranium-235 ...	700-1200
Enriched uranium, 90% uranium-235 ..	15,000-30,000
Chemical processing and extraction of nuclear fissionable material	4000

The production of nuclear fissionable material for rocket charges is complicated and labor-consuming and requires huge forces and assets.

With greater pride we the Soviet people, including Soviet soldiers, will realize that our country had the capability to resolve the manifold problems of obtaining fissionable materials in sufficiently large quantities for nuclear charges. Without this there would be no talk about any serious use of nuclear energy for strengthening of defensive capability. After all even the United States required considerably more time than the Soviet Union for stockpiling a more or less considerably number of nuclear charges.

A special remark was made lately by I. V. Kurchatov because of a statement by the President of the United States that "the United States could have struck a blow on the USSR when they possessed the atomic weapon." I. V. Kurchatov answered that the President of the United States was not correct. At the time the Soviet Union began to store its own reserves of nuclear charges, in the United States the reserves were so small that they could not have serious value in war.

Now we will explain the working principles of nuclear charges for a rocket. In the process of storage the mass of a charge is divided into parts, each of which is by all means less than critical. These parts are joined only at the time of the explosion. This is achieved by setting off an ordinary explosive. The parts of the charge made from uranium-235 or plutonium, being joined together, will form a mass which is sufficient for development of a chain reaction of the explosive type.

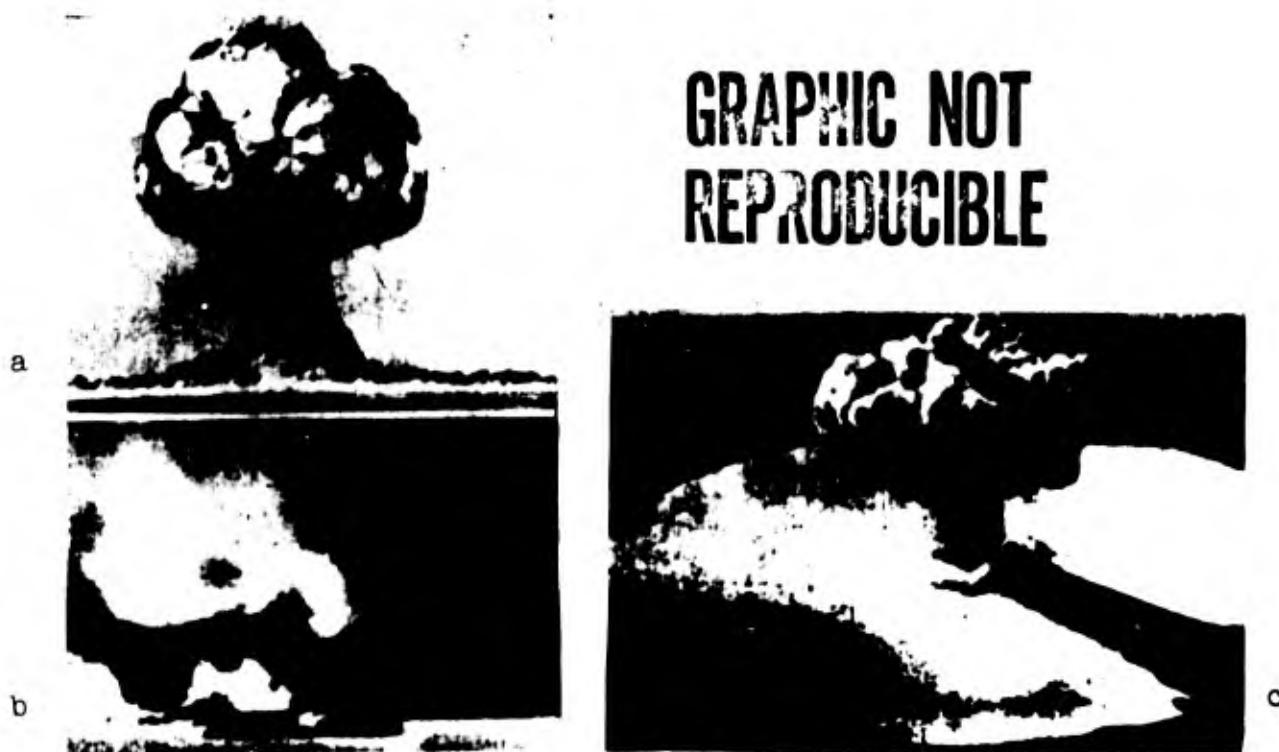
A nuclear charge consists of a mass of fissionable material, surrounded by a reflector of neutrons, a powder charge and its electric detonator, and the source of the neutrons necessary for starting the chain reaction. Based on the principle of action atomic ammunition can be "gun" or "implosive." In the "gun" arrangement powder explodes and the separate parts of fissionable material are, as it were, fired toward each other. A mass greater than critical will be formed and a nuclear chain reaction begins. In the "implosive" arrangement the same explosion of conventional explosive compresses the fissionable material and also creates conditions for a nuclear process.

The power of an explosion of nuclear charges can be evaluated by TNT equivalent, that is, it can be compared with an imaginary explosion of conventional explosive of the same power. In a short interval of time, on the order of millionths of a second, a huge amount of energy is released. During a nuclear explosion the great amount of energy released in so short a time causes an increase of pressure up to millions of atmospheres and a rise in temperature to tens of millions of degrees.

What are the peculiarities of explosions of nuclear charges? Based on their combat characteristics, nuclear charges differ considerably from explosions of charges of conventional explosive. The power of a nuclear explosion can be many thousands of times more powerful than an explosion of the largest high-explosive charge. During an explosion of a nuclear charge, just as during an explosion of a conventional, a shock wave is formed. But its destructive action is many times greater. Explosion of a nuclear charge, in contrast to a conventional one, is accompanied by powerful fluxes of light radiation and invisible radiation which is called penetrating radiation. The light radiation is capable of causing burns and igniting combustible materials, and the penetrating radiation renders a harmful biological influence on the human organism. An explosion of a nuclear charge differs from a conventional one also by the fact that in the region of the explosion and along the path of the radioactive cloud of the explosion there is the possibility of radioactive contamination of the terrain, water, local objects, combat materiel, and people who are outside of shelters. Contamination occurs as a result of fall-out of radioactive substances which are formed during the nuclear explosion. Radioactive radiation of these substances, just as the penetrating radiation, has a harmful effect on the human organism.

What are the types of bursts of nuclear charges? Explosions of nuclear charges can be carried out at different altitudes in the air, at the very surface of the earth (water), and under the earth (water). In accordance with this, bursts of nuclear charges are named air, surface (above water), and subsurface (underwater) bursts.

The external picture of each type of burst of a nuclear charge has its own characteristic peculiarities. At the moment of explosion of a nuclear charge in the air a dazzling flash appears. Even on a bright sulit day it illuminates the terrain and sky for tens of kilometers from the site of the explosion. During an air burst of a nuclear charge, immediately after the burst a luminescent region is formed in the shape of a fireball (during a surface burst it is a hemisphere). The brightness of glow of the fireball in the initial stage considerably surpasses the brightness of the sun. The fireball, which is expanding rapidly, rises upwards. Here the temperature and its related brightness of glow of the fireball decrease gradually. Several seconds after its appearance the fireball turns into a swirling cloud of explosion. Simultaneously a column of dust and



Appearance of nuclear explosion (a), action of shock wave of nuclear explosion (b), explosion of nuclear charge in ocean (c).

smoke rises from the earth behind the cloud. As a result of this the cloud takes on the characteristic shape of a mushroom. In some cases during an air burst of a nuclear charge the columns of dust

and smoke is not connected with the cloud from the explosion. The cloud from the nuclear explosion attains an altitude of several kilometers. As it rises it gradually expands and disperses.

Underwater and subsurface explosions of nuclear charges are characterized by the fact that the burst and fireball are usually not seen during these explosions. During an underwater explosion of a nuclear charge a huge column of water rises into the air and a large cloud is formed over it. As a result of the collapse of the column of water the so-called basic wave is formed — a mass of small drops of water, containing radioactive products from the explosion. In spreading to all sides from the center of the explosion, the basic wave is turned into a stratocumulus cloud. Radioactive rain falls out from this cloud.

During an underwater explosion of a nuclear charge, on the surface of the water a wave will be formed which attains a height of 20-30 m.

During an underground explosion of a nuclear charge a huge quantity of crushed ground, mixed with radioactive products of the explosion is ejected to a high altitude. The gigantic column which is formed here collapses and turns into a dark cloud. At the site of an underground explosion a huge funnel is formed. In the region of the explosion and along the path of the cloud a large quantity of radioactive dust falls out. An explosion of any type of nuclear charge is accompanied by strong sound, reminiscent of a blow or rollings of thunder.

The main striking factor of a nuclear explosion of a rocket charge is the shock wave. It accounts for nearly 50 percent of all the energy of the explosion.

As it gets further away from the center of the explosion the pressure in the shock wave drops. At a distance of 10-15 km from the center of the explosion the shock wave converts into a sound wave. The effect of the shock wave depends on the type of explosion of the nuclear charge: air, surface (above water), subsurface (underwater). The effective casualty radius and radius of destruction of material by the shock wave on terrain not equipped with protective structures is greater during an airburst, but on terrain which is equipped with shelters (reinforced shelters, dugout shelters, etc.) it is greater during a surface burst. The magnitudes of radii of zones of casualty effect and destructive action by the shock wave of a nuclear explosion are proportional to the cube root of the TNT equivalent.

Light radiation of a nuclear explosion accounts for 30-40 percent of the energy. It can cause burns, charring of the skin, combustion and charring of different materials, and numerous fires. On open terrain light radiation usually possesses a greater effective casualty radius in comparison with the shock wave and penetrating radiation. The influence of light radiation also depends on the nature of the explosion. During a surface blast part of the light energy is absorbed by dust, lifted up by the shock wave.

The penetrating radiation of a nuclear explosion is a flux of gamma rays and neutrons, able to spread in air space for many hundreds of meters. Although the formation of penetrating radiation accounts for an insignificant part of energy of the explosion, it is capable of exerting a serious casualty effect on personnel.

Radioactive contamination of the terrain occurs as a result of fallout of radioactive products from fission of the nuclear charge onto the land, and also the formation of artificial radioactive isotopes under the influence of the neutron flux flying out of the reaction zone during the explosion. A high level of radioactive contamination is caused by surface bursts of nuclear charges. Also a considerable area is contaminated as a result of fallout of radioactive dust from the radioactive cloud. The larger the nuclear charge, the stronger the action of destructive factors of a nuclear explosion, and the greater the area which is rendered dangerous to humans.

What sort of nuclear charges are used? According to the foreign press, nuclear charges have the explosive force of from several thousand to several hundreds of thousands of tons of TNT. Regarding nuclear charges with an explosive force of millions of tons, they are made on the basis of thermonuclear reactions using heavy isotopes of hydrogen and lithium. Explosive force of thermonuclear charges fluctuates within limits from several thousand to tens and even hundreds of millions of tons of TNT.

I. V. Kurchatov calculated that during the explosion of only one large thermonuclear charge energy will be released which will exceed the energy of all explosives used in the entire world during the years of the Second World War. The scientist-patriot stated with pride that the Soviet nation armed its own army with all the necessary types of nuclear and thermonuclear charges. The thermonuclear weapon — the strongest and the mightiest — was carried in the USSR earlier than in the United States.

On 12 August 1953 in the Soviet Union the first thermonuclear charge was successfully tested. During this time the American specialists still fussed over their own awkward thermonuclear offspring, which they nicknamed "Mike." An eloquent character was given to this "Mike" by the American journalist Stewart Alsop: "Mike" is a monstrously bulky device with dimensions greater than those of a large home. Certainly, it would be impossible to place such a construction in a ballistic missile and lift it into space, through which its trajectory passes..." The problem of creation of a thermonuclear charge useful for tactical objectives was solved by the United States of America a half a year after us — in March 1954.

And even now the United States lags seriously behind the USSR in the production of thermonuclear charges. Only our country possesses giant charges with a power of 50 and 100 million tons, and Soviet rockets are able to confidently deliver such thermonuclear charges to any point on the earth. The most powerful nuclear warhead for rockets in the United States, according to the acknowledgement of the American press, is considerably less than the Soviet.

It is necessary to state that 100-megaton thermonuclear charge still has never been tested. A charge with a power of 50 million tons was tested. At the time the Soviet press reported on this matter: it was necessary to abandon the testing of a 100-megaton thermonuclear charge since if it were detonated even in the most distant places, then it might still knock out the windows where you were standing.

In another later report it was stated that in the USSR there already exist thermonuclear charges which were larger than 100 megatons.

In order to give an idea of the destructive factors of a thermonuclear explosion of a rocket charge, we will refer to figures which were presented in the foreign press. If a rocket warhead with a power of 10 megatons causes complete destruction over an area of several hundred square kilometers, then an 100-megaton charge, based on theoretical assumptions, will subject an area of several thousand square kilometers to complete destruction.

Thanks to the efforts of Soviet specialists, in the USSR at present the production of all types of thermonuclear fuel has been mastered. For example, expenses for the extraction of deuterium from water have become small. The cost of deuterium as a fuel comprises less than a percent of the cost of coal. And 400 tons of deuterium are equivalent in energy release to a billion tons of coal and oil.

In the Soviet Union not only have methods been developed for the production of fuel for the giant charges of rockets, but also reserves of them have been accumulated which are fully sufficient to restrain any aggressor. This is a great victory for Soviet science, technology, and socialist economics.

Soviet scientists and atomic engineers and all employees of the atomic industry have fulfilled their duty to their country. For many years they worked persistently and selflessly, first at the creation and then at the improvement of nuclear and thermonuclear charges for rockets. They understood well that a threat hovered above the state and that if we did not have powerful nuclear missile weaponry, forces would exist which would strive to force our beautiful Fatherland to its knees. Our scientists and designers achieved a high degree of effectiveness in the creation of charges for rockets. They created perfected, economical, and very powerful charges for the Soviet Arm Forces.

It is namely our country which is forging ahead in the development of nuclear missile weaponry, and the most powerful country of capitalism - the United States - is forced to overtake us. Here is what American General Shoup said on this matter: "If the Soviet Union has an arsenal of large nuclear charges and some potentiality for delivering them here, and we do not have them, then this is very poor both in a material and a moral respect."

Thus, even our foes will recognize that it is the Soviet Union which now possesses the most powerful nuclear and thermonuclear charges in the world and the most perfected means for their delivery to any targets. This powerful nuclear missile shield ensures the safety not only of our Fatherland but also of all other socialist countries.

Creation of the Rocket Forces and the Role of Economics and Science

In strengthening the defensive capability of the Soviet country, in the creation of new weaponry and new forms and kinds of forces a decisive role is played by our well-developed economy.

Every Soviet person, our soldier knows that for all our successes we are obliged to the socialist system, wise leadership of the party, high creative activity of workers, directed towards strengthening the might and further blossoming of our dear Fatherland. Creation of satellites, the most powerful rockets first of all bears witness to the growing force of our economy. It is possible to say that the blossoming of our economy is one satellite of Socialism. And this satellite, figuratively speaking, was put into orbit by our labor during the years of industrialization of the country, successful fulfillment of five-year plans and seven-year plans.

Only a country attaining "cosmic altitudes" in development of the most contemporary branches of industry, has within its powers the mastery of production of powerful rockets, for which much valuable material, metal, energy is required.

Our powerful rockets embody the production of almost all branches of Soviet industry, achievements of science. And not only what was earlier well-known, but also such new ones as metallurgy of heat-resistant alloys. Synthetic chemistry prepares for rockets special forms of combustible with extraordinarily high calorificity and extraordinarily high specific gravity. This fuel blazes as the sun on takeoff of a rocket. For rockets we prepare superprecise components in plants, protected from the least concussion.

It is possible to imagine how grandiose a rocket is if one jet engine has 10 thousand components. How much of them are there in a rocket, exactly fitted, ideally made, reliable and "endurant" in any conditions of flight?

All material possibilities for development of rocket technology was created by socialist economics in a short period. It succeeded in development in accordance with a grandiose Party program for creation of the material and technical base of Communism.

In the figures of fulfillment of the seven-year plan sounds the sure step of our swift movement forward. Actually, in the postwar years the USSR advanced far from 1945 levels of production of steel, cast iron, rolled steel, oil, carbon, cement, electric power, which are all that a person determines by contemporary military economics of any country.

If one were to compare production of the most important forms of production of heavy industry in 1940 and 1965, in 1965 there was attained its multiple increase. Of electric power in 1940 there was produced 48.3 billion kilowatt-hours, and in 1965 - 507; of steel we smelted 18.3 and 91.0 million tons, of oil we obtained 31.1 and 243 million tons, carbon accordingly 166 and 578 million tons. The output of cement increased from 5.7 to 72.4 million tons, machines from

58.4 to 185 thousand pieces, motor vehicles from 145 to 616 thousand pieces, tractors from 31.6 to 355 thousand pieces.

In the new five-year plan there is foreseen an increase in output of electric power to 840-850 billion kilowatt-hours. We aim to bring the output of oil to 345-355 million tons, coal to 665-675 million tons, smelted steel to 124-129 million tons. There will be a sharp increase in production of all forms of industrial production, new levels in development will be reached by our agriculture.

The Communist Party produced a wide program of improvement of control of industry, improvement of planning and strengthening of economic stimulation of production. The Party seeks more effective use of achievements of science and technology. All of this opens new possibilities of faster development of our country.

In resolutions of the 23rd Congress of the CPSU there was drafted a remarkable program of struggle of Soviet people for the fastest creation of the material and technical base of Communism.

On the basis of the fast rise of the economy of the country from year to year there is an increase in the standard of living of Soviet people, all the more fully meeting their spiritual and material needs. The population of our country grows. Yearly it is increased by several million persons.

Development of our economy is a decisive factor in strengthening the might of the Fatherland. The well-known Marxist position about the fact that armament, staff and organization of armies and fleets, military art, depend first of all on the stage of production and means of communication attained at a given moment finds bright confirmation in contemporary conditions.

The Marxist position about the decisive role of economics in strengthening the defense of the country constantly is confirmed in life. The force of the army is now estimated not only in terms of the quantity of weapons and divisions, but by the level of development of the economy: this is fundamental. He who has a strong economy has the possibility, if he wants, to create a strong army.

Even during the years of the passing war our economy showed its great force. Only material damage, caused by invasion of Hitlerite Germany, including expenditures for war, was calculated at a sum of over two trillion rubles (in the old scale of prices). This is larger than the sum of capital investments anticipated by the seven-year plan, and is equal to the sum of capital investments for 40 years of Soviet power.

After such losses any, even the biggest, bourgeois state inevitably would come to a state of deep economic decline. And if this did not happen with the USSR, then it is only thanks to the advantages of our socialist system of economy, titanic efforts of our people and wise leadership of the Communist Party, inspirer and organizer of all our victories.

The possibilities of an economy are vividly characterized by its ability to give an army new weapons in a massive scale for new conditions. This test was successfully passed by the industry of the USSR during the years of the Great Patriotic War. It was left far behind the industry of fascist Germany in the production of the most modern aircraft, tanks, artillery systems, small arms. It is sufficient to say that in four years our industry produced almost 490 thousand arms, more than 102 thousand tanks and self-propelled arms, nearly 137 thousand combat aircraft.

The inexhaustible possibilities of our economics appeared dazzling in production of a new form of weaponry — unguided rockets called "Katyushas," which in that period only in our Soviet Army obtained real development and mass combat employment.

History knows many examples, when the economies of fighting countries could not solve the problem of production of new war assets in needed scales. Thus in particular it was in fascist Germany during the years of the Second World War.

Hitlerite Germany decided to use in war a new weapon — guided missiles V-1. As released by German industry, guided missiles were far from perfect, possessed low speed, which permitted interception of them by usual antiaircraft defense weapons. But even of these missiles only a few were released, and they did not play an independent role but served only as a supplement to aviation.

It is possible to give an example from the postwar period. Englishmen at one time started an attempt to create their own intercontinental rocket with a nuclear charge. The beginning work on this rocket, called "Blue Streak," was accompanied in England by noisy advertisement. Much was said about the "important role" of English "strategic nuclear forces" in maintaining the so-called "restraining power" of the notorious "free world." However in April 1960, during the actual climax of work, after 60 million pounds sterling were spent, the unexpectedly declared its cessation. A significant role in this was played by the limited possibilities of the English economy.

The successes of the Soviet country, occupying a leading place in the world in rocket construction, are a convincing index of the power of our economy, the high level of development of our productive forces.

If one were to talk about our economic possibilities, about the defense power of the Soviet state, then it is necessary to say that the Soviet Army has accumulated the most insuperable force. In our country for the first time in the world intercontinental ballistic missiles were created. Immediately they were put into production, put on line.

During a visit to one such plant and an acquaintance with how workers, engineers, scientists produce rocket, people experience contradictory feelings: they see that here is produced the most deadly, the most aggressive weapon, and on the other hand they are proud that this weapon is ours. They are proud because this weapon

is at the disposal of the most peaceloving state, in the hands of the Communist Party, our people, who assert peace. It is a threatening weapon against those who would want to unleash war. In the press it was reported that in a year only one plant made on line 250 rockets with hydrogen warheads. This is many millions of tons, if one were to convert to usual explosives. If such a deadly weapon was detonated over any country, then in general, nothing would remain there.

The Soviet economy gives the army and fleet a whole needed "assortment" of rockets. Certain forms of rockets have already been made in such numbers that their production has ceased, and manufacture of certain other forms has been cut back. The economy of the country of conquering Socialism has permitted creation of a mighty arsenal of nuclear-rocket equipment.

An important condition in the development of rocket troops in our country is the remarkable achievements in education of the people. In the whole world the striking achievements of USSR in development of People's education have obtained acknowledgement. Only in 1965 the national economy of the USSR obtained one million specialists, of them 400 thousand with higher education and 600 thousand with special secondary education. The higher educational institution of our country yearly graduate over 120 thousand engineers, almost 3 times more than in the United States. In the national economy of the country there are more than 11 million specialists with higher and special secondary education, over 600 thousand scientists.

Foreign observers staying in USSR, independently of what views they hold, are unanimously delighted by our achievements in the People's education. The Italian count Luke Pretromarchi, an enemy of Communism and defender, as he says, of "private capitalism," writes about Soviet schools: "The chief merit of their schools consists of the fact that they have spread to the people a love of knowledge, turned the Russians into a people with the highest level of general education. Their passion for learning saturates the very air of the country, so infectious is their enthusiasm in relation to all forms of knowledge. They study everything."

One can say: what value does this have for our army and fleet, for the Rocket Forces, finally? Especially great value. Into the ranks of the armed forces there yearly arrives a well educated prepared augmentation. Very many young missilemen with higher and secondary technical education. And how they easily and rapidly master the latest technology!

In a letter to the editorial office of "Red Star" Engineer-Captain A. Dovbnya related how a soldier with higher physical and mathematical education arrived at his detachment. He became an outstanding person, helped others, became the spirit of scientific and technical propaganda in the subdivision. And there are many such examples.

Another picture is the army of the United States. In 1965, as reported by the press of 183,535 American youths of age 18 undergoing their initial check, 75,249 (41 percent) were recognized unfit for military service in terms metal data. It was established that they

"do not possess the mental development necessary for passage of military training during the proper period." "The most common defect is inability to read or to do simple arithmetical calculations." Even the President of the United States was forced to characterize such numbers "as an accusation and a sinister warning."

The solution of gigantic problems therefore on the shoulders of the Soviet people, including Soviet soldiers and missilemen is such that their heart truly burn with the inextinguishable fire of love for their native land, unshakable filial fidelity for their native Party. This even our enemies cannot negate. Recently one conspicuous bourgeois worker, visiting the USSR, made this eloquent acknowledgement: "The Russian person is in love with his land... The patriotism of Russians is this day a great feeling..."

With pride our soldier performs his difficult service in any conditions, since with his own heart he feels the importance of that post which his Fatherland entrusted to him. Neither complaints nor aches do we hear from our missilemen, although their service is especially tense and responsible. Soviet soldiers have high morale.

And here one would want to tell about the low morale of servicemen in rocket units of armies of imperilistic countries. About this the foreign press writes extensively. Special alarm has been caused, for example, by the ever increasing number of officers who rush to leave military service. Thus, the West German press is crushed that officers and non-commissioned officers inherited from fascist Wehrmacht are aging and leaving for retirement, and the Bundeswehr is now experiencing a severe deficiency in younger officers and non-commissioned officers. According to official data, in Bundeswehr it is not possible to man a quarter of all posts mainly in the categories "Lieutenant-Captain." A fourth of the non-commissioned officer posts remain vacant. Young people do not go to officer schools, considering the military profession actually nonrespected. There is sufficient cause for the revanchists to be upset!

The command of the Bundeswehr tries to maintain morale of soldiers by strictness and drill. The press conducted an interrogation of servicemen and persons discharged to the reserves. Seventy nine percent of the questioned persons talked about the roughness and mockeries reigning in units of the Bundeswehr; more than half of them reported about forced marches with huge physical overloads, widely practiced in the Bundeswehr, not infrequently leading to cases of death.

Coarseness flourishes. Officers and non-commissioned officers address soldiers no less than "idiot," "floor rag," "dirty pig," "limping dog," etc. "Martial words," ascertains the press, "are widespread in the Bundeswehr just as this took place in the Wehrmacht." The journal gives many examples of the present mockeries of soldiers, the depreciation of their human merit.

A similar position in the army of the United States is noted by the American press: "Chiefs manifest to soldiers an absolutely impossible relation, approach officers as "things" and not as living people."

Dismissed from the Army of the United States, Major Marion T. Wood, explaining the cause of his departure from the military service, refers to the fact that in the Army of the United States chiefs "relate to scientific progress, weapons and materiel with greater respect than to the lives of the military." "I am tired," states Wood, "of broken promises and half-truths."

Many facts published in the foreign press speak about the low moral qualities of servicemen who continue service in the Army of the United States. And this is not accidental. Some of the young people arriving are "treated" by pro-facist organizations, all young American fellows from childhood are "inoculated" with the microbe of profit, movie fighters preach the cult of robbery, violence, murder. And all of this occurs in a setup of full impunity of shameless reactionary elements in the Army of the United States.

The high morale of Soviet soldiers is an important condition of our power. All see that in our socialist country considerable successes are attained in development of economics and culture, in moral growth of the Soviet people. In construction of Communism the Soviet people show samples of their self-assertion, examples of valor, mass heroism in all regions of activity, including military service to the Fatherland.

The achievements of rocket technology in the USSR are explained by the unprecedented progress of Soviet science and technology. Advanced Soviet science and technology, supported by the gigantic advantages of a socialist structure, were developed and are being developed at a rapid tempo. They take on higher and higher altitude, especially in the main directions - in rocket building, use of atomic and thermonuclear energy, radio electronics, chemistry and the other most important branches.

Our scientists penetrate more deeply the secrets of the atom, with more sureness place its inexhaustible energy at the service of the Soviet people. Reassuring news about the "taming" of energy of a hydrogen explosion comes from the front. Already attained is control of a thermonuclear reaction at a temperature of 40-100 million degrees for hundredth fractions of a second, which is a very considerable time for such processes.

New stations appear on the map of atomic electric power engineering. The Beloyarsk Atomic Electric Power Station named after I. V. Kurchatov has been put into operation. Atomic submarines plough the deep of the oceans. Several sailings in Arctic Ocean have been conducted by the first born of the atomic naval fleet of the USSR - the giant icebreaker "Lenin." In only three sailings the atomic icebreaker covered a distance of 100 thousand kilometers without recharging its nuclear reactors.

The family of Soviet jet liners is growing, carrying on its fast wings to all corners of the earth the glory about the technical progress of our mighty socialist oligarchy.

One of the most important directions where Soviet scientists have secured important successes is quantum radio engineering. This

is the use of one of the most surprising possibilities of an atom. If one were to force atoms to radiate strictly in one direction, then there would be obtained a very dense ray of light. To force certain substances to emit such a ray is possible by using laws of quantum mechanics. These are called quantum generators.

Academician M. V. Keldysh reported in one of his articles that a "quantum generator will have paramount value for development of communication engineering, especially in space, for computing machinery, energy transmission without wires, thermonuclear research, a new technology." It turns out that a light ray from a quantum generator can be used to make even... diamonds. Not to mention other materials whose transition upon treatment by their light ray gives a great effect. Industrial application of light rays will promote growth of our economy, and that means defense possibilities.

All the more real becomes transmission of electrical energy not by wires, but with the aid of light rays. In USSR there has already been created a quantum generator made from a semiconductor, whose basic peculiarity is a high coefficient of conversion of energy of electrical current into light energy. Our scientists have also proved the possibility of a reverse transformation with high efficiency. This will lay the foundation of light transmission of electrical energy.

Quantum generators have already been released in our country and are designed for treatment of hard materials, for surgical operations on the retina of the eye, for investigations in biology, geodesy, communications.

Absolutely unexpected for uninitiated people can be the application of quantum generators in thermonuclear research. However, under the impact of radiation of lasers it was possible to obtain a dense plasma with a high temperature. Heating of the plasma was brought up to tens of millions of degrees.

With the help of an optical quantum generator there was carried out light location of the moon, where a very high accuracy of definition of relief of this natural earth satellite was obtained.

Even more various "professions" have been assigned to Soviet rockets. They "split" clouds which threatening with hail delicate plantings in Transcaucasus valleys, they "sound" the atmosphere, helping predict weather. Even during the International Geophysical Year Soviet scientists launched 125 research rockets. In print articles have been published on our meteorological rockets and their check in industrial conditons. One of the journalists visiting the enterprise which releases meteorological rockets, with admiration responded about equipment he saw: "When you go about the workshops of enterprise where from hundreds of components stratospheric laboratories are made, their great accuracy literally can be sensed at each step. The weight of certain parts is measured in tenths of a gram, and their dimensions in microns. The equipment has to be not only faultlessly exact, but also able to sustain huge overloads, vibrations, which are inevitable during launching and landing. With precision of truly striking cunning the instruments transmit from

high altitudes information about temperature, pressure of the air, about the value of solar radiation... Can one really enumerate all that miniature instruments mounted in a meteorological rocket which sounds the sky will tell!"

Our science is storming not only the heights, but also the depths of mineral resources of the land. New deposits of useful minerals are being opened. To the brightest achievements of such a kind it is possible to relate the discovery of the most valuable deposits of Yakutsk diamonds.

As the shock front of science these have stood the widest investigations of Soviet scientists in all regions of chemistry, playing an outstanding role in creation of the material and technical base of Communism.

Our chemists have created a series of new polymers, among which there are those which possess high mechanical strength and elasticity in a gigantic interval of temperatures, from -200 to $+400^{\circ}$. They have high electrical insulating and other valuable properties.

Soviet chemists are learning to artificially reproduce all which is most useful that mineral resources of the earth give. They recently could even develop methods of production of artificial diamonds, a creation of nature previously inaccessible to man. Contemporary techniques permit obtaining in one chamber in several minutes more than 20 diamonds. On the whole production of artificial diamonds in our country exceeds the output of natural ones, lowering their cost as compared to those from Yakutsk. All of this leads to technical rearmament of many branches of production, essentially increases the potential of the metalworking industry. In our press the huge value of contemporary chemistry for development of radio electronics, atomic and jet engineering has been repeatedly underlined.

On the whole our science and technology are doing everything so that the Soviet nuclear-rocket arsenal will completely meet the requirements of armed struggle at a contemporary level.

Contemporary Rocket Arsenal

(According to the Foreign Press)

So that one can have a clearer idea of the arrangement and classification of rockets and estimate their possibilities, it is necessary to preliminarily clarify several theoretical questions. First of all it is useful to remember that a rocket's principle of motion is based on formation of a reaction force on account of an outflow of fuel combustion products from the nozzle of the engine. This force is transmitted to the body of rocket, accomplishing flight. Flight speed, according to the formula of K. E. Tsiolkovskiy, is greater as specific thrust increases. Speed depends also on the charge-weight ratio of the rocket, the ratio of fuel weight to the initial (starting) weight of the rocket.

Specific thrust is one of the most important characteristics of a rocket. It is understood to mean the ratio of engine thrust to flow rate per second of fuel. This means that by its value it is possible to judge the economy of a propulsion system and the quality of a fuel. The specific thrust of contemporary rocket engines is designed to be 220-300 kg s/kg.

Charge-weight ratio of a rocket reflects a peculiarity of its construction and assignment. Thus, for long-range rockets the charge-weight ratio is higher than for short-range rockets. And the speed of "long-range" rockets is higher than for "short-range."

The formula of K. E. Tsiolkovskiy says: for production of high speeds a rocket should have a perfected engine construction, high-calorie fuel and small body weight.

Still two indices can distinguish one rocket from another: specific fuel consumption and weight per horsepower. The first idea includes the quantity of fuel needed per unit thrust of the engine per second. It is related to flying range: the lower specific fuel consumption, other things being equal the greater the flying range. The degree of constructional perfection of the engine is characterized by its specific gravity — the ratio of construction weight of the engine to its thrust. Usually it is characterized by hundredths of a unit (0.02-0.05 kg/kg).

Thus, the distinction of a rocket from usual artillery shells is the presence of an engine. At the expense of energy of this engine flight of a guided missile is accomplished in the atmosphere as well as its acceleration for going into a vacuum. On it depend all basic characteristics of a rocket — speed, flying range, altitude, load capacity. With the help of the engine the rocket climbs, attains a necessary speed and, this means, it ensures the assigned distance. Work of an engine of a rocket can be compared with the work of the heart, on the activity of which depends functioning of all systems of a living organism.

In rocket construction two basic forms of "hearts" are used — solid fuel rocket engines (RDTT) and liquid fuel rocket engines (ZhRD).

Characteristic for rocket engines is the fact that their work does not depend on external conditions, for example, on concentration of oxygen in the atmosphere, as an aircraft engine does. For an aircraft engine the oxidizer — the substance necessary for combustion of the fuel — is the oxygen of the air. This means, with climb of an aircraft to an altitude where rarefaction of air is greater, effectiveness of work of the engine drops. With a rocket engine this does not occur. All substances necessary for work of this engine are located on board the vehicle. Economy and rocket power thrust do not change depending on flight speed, but with an increase in altitude are even somewhat improved. These properties of a rocket engine have opened prospects of very long-range and high-speed flights of rockets, including in airless outer space.

The engine which indeed, as it were, took man by the hand and

led him into space, is the ZhRD engine. It is the reliable "heart" of many types of operational rockets. In these engines on the oxidizer and fuel are special liquid substances. According to the foreign press, as an oxidizer there can be used, for example, liquid oxygen, nitric acid, and as fuel - kerosene, alcohol, aniline, etc.

Everyone who at least in broad terms knows the work of an aircraft turbojet engine, knows that in it there are special combustion chambers, where air from the atmosphere and kerosene from the tanks enter and where combustion of the fuel occurs. In a liquid engine both oxidizer and fuel move from special tanks with the aid of pumps or under pressure. In the engine chamber they are mixed and burn. The gases formed have temperatures near 3000° , they are expanded in the jet nozzle and pass out, creating the thrust.

Thrust of a liquid engine is very high whereas its weight is relatively small. But very much fuel is expended. Foreign specialists calculated that in an engine with a thrust of 100 tons every second (!) the chamber is fed almost half a ton of fuel. It is clear that the reserve of fuel on board the rocket cannot be infinite, therefore usually ZhRD are designed for comparatively short-term work. But also for a short time work they give a rocket such a pulse of energy that it turns out to be able to surmount continental and even inter-continental distances.

For a liquid engine new experiments and investigations have permitted increasing their specific thrust, that is, the thrust given by fuel burning in one second. For this the most effective sorts of fuel are used.

As an oxidizer there can be used liquid oxygen or such compounds as nitric acid, nitrogen tetroxide and others. Oxidizers are usually divided into high-boiling and low-boiling. To the first pertains nitric acid (boils at a temperature of $+86^{\circ}\text{C}$), to the second - liquid oxygen (boils at a temperature of -183°C).

What are properties of oxidizers and what should one consider when he has to deal with them? Nitric acid is unstable and is decomposed at room temperature. Because the acid constantly contains oxides of nitrogen, it has a ruset color.

For rocket engines the most suitable is nitric acid in which the water contents does not exceed 2-4 percent. Exceeding this quantity of water negatively affects the thrust obtained.

There are three remarkable factors connected with the use of nitric acid as an oxidizer. The first: this acid contains 76 percent oxygen, which characterizes it as a powerful oxidizer. Second: it has the greatest specific gravity of all oxidizers, and this means that fuel based on it have high calorificity. The third factor: nitric acid can in a number of cases over and above the role of oxidizer act as a cooling component.

But nitric acid has properties which complicate its use. Its vapors are poisonous, and when it gets on the skin it causes burns. Even metals are not resistant to it.

For example, in metallic containers in which nitric acid is transported a gelatinous precipitate will be formed. It is necessary to take measures that it will not get into the engine and interfere with its work. Scientists have found a substance whose addition lowers the aggressiveness of nitric acid with respect to metals. Among these substances it is possible to indicate sulfuric acid. Mixtures of it with nitric acid are called blends. Lowering of the activity of nitric acid is also attained by mixing it with nitrogen tetroxide. Then specific gravity increases, freezing point drops, liberation of oxygen for oxidation of the fuel is increased.

The second basic oxidizer in rocket fuels is liquid oxygen. This is a stronger oxidizer than nitric acid. During liquefaction the volume of gaseous oxygen drops almost 800 times. Inasmuch as liquid oxygen boils at extreme cold, in usual conditions it strongly evaporates. Thus, before coming in contact with the combustible in the engine it volatilizes by one half. For the same reason liquid oxygen cannot be used for cooling combustion chambers. During use of this oxidizer it is necessary to consider also the fact that it is dangerous to mix it with an impurity, as it becomes explosive. This is why before "packing" in special containers liquid oxygen is by all means cleaned and degreased.

As nitric acid and liquid oxygen have become traditional oxidizers, so kerosene and alcohols have become traditional combustibles for ZhRD.

Kerosene is used not only in a pure form, but also in mixture with gasoline. Sometimes this fuel is called a hydrocarbon, or petroleum. The boiling point of kerosene used in liquid-fuel rocket engines is from 150 to 280°C. During combustion of 1 kg, 10,250 kilocalories of heat are liberated. The specific gravity of kerosene is small (0.8 g/cm³): this, of course, is its deficiency. But it is compensated by such positive qualities as the possibility of production on a broad scale, low cost, nontoxicity and nonaggressiveness with respect to metals. It is necessary to note that kerosene will not form with oxidizers a spontaneously inflammable mixture. This mixture has to be "ignited".

Alcohols are less effective than kerosene. But they do have tempting qualities. They improve the condition of cooling of combustion chambers, require less oxidizer. Best results are obtained with ethyl alcohol in mixture with liquid oxygen; the worst - methyl.

The specific gravity of alcohols is only somewhat less than the specific gravity of kerosene. But here the boiling point is 2-3 times lower. During combustion of 1 kg ethyl alcohol 7.180 kilocalories are liberated, but methyl - 5330. Alcohols also are comparatively cheap and are nondangerous in handling.

Those who are acquainted with contemporary rocket technology may meet in literature such names of combustibles as hydrazine and dimazine. Hydrazine is very effective. It is obtained from ammonia. It is necessary to handle it carefully: it is poisonous. And still it has deficiency: it freezes at a temperature of -2°C. A much

lower freezing point has a derivative product of hydrazine, dimazine (-58°C), also a very widely used rocket combustible.

There are also combustibles which ignite upon contact with oxidizers. Such spontaneously inflammable fuels are usually used as starters. Among them: fine-250, hydraxine-hydrate and others.

Thus, we will assume that the fuel is selected. What engine scheme it is necessary to use in order to convert the combustion of this combustible into thrust? First of all we require tanks, a system to supply components to the combustion chamber and, naturally, an actual combustion chamber and nozzle through which gases pass. Combustible and oxidizer move through injectors. Before getting to the combustion chamber the fuel can proceed to the nozzle by passing through the space in internal jacketing in the chamber to cool the external and inner shells of the chamber.

Several words about the systems with whose help the combustible and oxidizer move continuously from tanks to the combustion chamber. The arrangement of such systems are usually pumps and expellers. In the first of them for a fuel feed special pumps are used. For this system there is characteristically comparatively low pressure in the tanks, which does not raise the necessity of specially making provisions for their strength, and this is always connected, as it is known, with an increase of weight. For putting a pump in action a turbine is used. The turbine and pump form a single turbopump assembly. The turbine is usually put in motion steam gas obtained by decomposition of hydrogen peroxide.

In a pressurized system, combustible and oxidizer move from tanks into the combustion chamber by pressure of the compressed gas. The simplest example is a tank system. A spherical reservoir of compressed gas through a reductor is connected with tanks where a constant pressure is maintained. The necessity of a thick-walled tank renders the system heavier. In order to avoid this, for displacing the combustible and oxidizer the hot gases obtained during burning of a powder charge or work of an additional low capacity liquid-fuel rocket engine are sometimes used.

To get the result, it is possible to say that a pressure fuel feed system is justified only on small and average rockets. For bigger rockets it is considered more preferable to use a pump system, although it is usually technically more complex.

It is essential for work of a liquid-fuel rocket engine to ensure reliable ignition. It is possible, for example, to ignite with the aid of electricity a powder charge, and that in turn will light the basic fuel. Reliable results are also obtained by using a hypergolic fuel.

In order not to subject the engine to danger of destruction, it is started in steps. For this at first the combustion chamber is fed small portions of fuel. Gradually the supply is brought to the value of full consumption. Cutoff of the engine or a stop are attained by supply, for several seconds, of one component instead of two.

Special value in a number of countries is given to creation of propulsion systems for rockets filled with fuel components at the plant and capable of being stored in combat readiness for 5-6 years in any meteorological conditions. For this purpose such fuels are used, as amines and their mixtures: hydrazine, asymmetric dimethylhydrazine, 1-methylhydrazine, ethylenediamine, a mixture of xylydine and triethylamine, hydyne, aeroxine. Oxidizers, as a rule, are red-fuming nitric acid containing nitrogen tetroxide and anticorrosion additions, nitrogen tetroxide, chlorine trifluoride, boron pentafluoride. By using, for example, amines and red-fuming nitric acid as components of a mixture high specific thrust can be obtained, and prolonged time of storage without noticeable corrosion in aluminum tanks can be ensured.

Besides tanks in the construction of a propulsion system, for prolonged storage there is anticipated a powder pressure accumulator. It serves for supply of fuel components to the combustion chamber. This battery is protected by a membranes from hitting components of the liquid fuel.

After filling tanks with fuel at the plant, in the powder pressure accumulator is placed a grain of solid fuel, so that before starting the engine one should only insert the igniter. In the process of storage of the propulsion system it is possible to inspect the grain by removing it from the engine. It is absolutely clear that liquid engines working with a storable propellant and filled at the plant have great advantages over engines filled directly before launch. They sharply increase combat-readiness of rockets, simplify the process of technical operation at combat positions.

Let us now turn to another type of propulsion systems for rockets, based on application of a solid fuel rocket engine. For them, characteristic is the fact that substances participating in the working process are beforehand placed in the combustion chamber, they do not have to be pumped as this occurs for liquid engines. Hence, the first advantage of a solid fuel rocket engine is its high readiness for launch. Construction of a solid fuel engine is simple, the lack of a need of pumps reduces the number of moving parts. All of this ensures high reliability in work. But they do have a "bottleneck": solid fuel burns rapidly, it is difficult to regulate the process of burning.

What constitutes a solid fuel? This is a mechanical mixture or chemical compound of oxidizer and fuel. According to the foreign press, until recently in a number of countries a fuel was widely used in which the basic substance was nitrocellulose. Cellulose in great quantities is contained in plants such as flax, hemp, and cotton. In wood it is nearly 50 percent. By treating cellulose with nitric acid, one obtains nitrocellulose.

In order to obtain a solid fuels called a ballistite, nitrocellulose is dissolved in nitroglycerine and dinitroethylene glycol. Then to the fuel are introduced additions in order to give it the needed properties. Such additions are wax, vaseline oil, camphor, resin, and sometimes magnesium oxide, chalk, lead oxide and other substances. Charges made from ballistite fuel are prepared by

stamping or casting.

Besides, abroad their density is equal to 1.6 g/cm^3 , and the temperature of burst 200°C . In the opinion of foreign specialists, ballistite fuels do not have much prospect of application except for tactical rockets and "air-to-air" missiles. This is explained by the fact that power possibilities of ballistite fuels are small. Moreover, it is difficult to ensure their normal burning at low pressures in the combustion chamber.

Scientists in a number of countries have proposed the use of so-called composite fuels. They constitute a thin mechanical mixture of combustible (bitumen, tar, synthetic rubbers, etc.). Also added are combustion catalysts (soot, paraffin, copper oxide. The specific gravity of the fuel is obtained on the order of $1.5-1.7 \text{ g/cm}^3$.

The production process of composite fuel is considerably simpler than for ballistite. Their burst temperature is also higher ($250-300^\circ\text{C}$). Burning occurs stably. A composite fuel can be stored without a change of properties for many years. In print a report appeared that it is already possible to obtain charges of such a fuel with a diameter up to 2 m and a weight of several tons.

In the process of work of the engine products of burning pass through the exit nozzle where burning rate of the fuel charge depends on its configuration, initial temperature, pressure in the chamber.

At first solid fuel engines were used only on small rockets; now they have obtained rights of citizenship for distant and even intercontinental rockets.

Regarding a comparative appraisal of fuels, the most promising are considered such liquid fuels as boron hydride, and in particular pentaborane and decaborane. Among solid fuels the most promising are polyurethanes. With their use it was possible to increase the time of work of engines. In the United States projects of nuclear engines enjoy considerable attention, they are considered very effective.

How is control of rockets carried out? We already noted that rockets do not need a crew, they are controlled by automatic machines. Automatic control of a rocket weapon is a logical development of control systems used in artillery, aviation and other branches of technology. Even K. E. Tsiolkovskiy indicated that for control of rockets completely applicable are general principles of the theory of automatic control.

On a rocket leaving a launcher, besides the force created by the engine, there act aerodynamic forces. The point of application of the resultant of these forces is called the center of pressure. Location of the center of pressure with respect to the center of mass of the rocket has an effect on its stability in flight. When the center of pressure is ahead of the center of mass, the rocket is in a state of unstable equilibrium. And then a random disturbance, gusts of wind, disturbance of the geometric forms of rocket or thrust

symmetry, lead to deflection of the rocket from its trajectory.

How does one increase stability of a rocket in flight, shift the center of pressure back with respect to the center of mass? One can solve this problem by application of a stabilizer in the form of an empennage. However it acts effectively only on guided and comparatively small guided rockets. Another means of safeguarding stability of a rocket is by giving it a rotation about its longitudinal axis. But here are the same limitations, impossibility of using it for large guided rockets. The most radical method of shifting back the center of pressure turned out to be application of special automatic machines. They fulfill, as it were, the role of empennage and preserve stability of the axis of the rocket in spite of different perturbing influences.

As the basis of the structural scheme of the control system of a rocket lie a external control network for angular stabilization. The first ensures attitude control (stabilization) of the center of mass of the rocket with respect to the calculated trajectory, the second eliminates angular oscillations of the rocket with respect to its center of mass.

The question arises, what sources of information can be used on board a flying rocket for maintaining a needed trajectory? This can be radiation of terrestrial or celestial orienting points, natural fields of the earth - magnetic, gravitational, temperature, pressure, etc. In accordance with the character of sources of navigational information we usually name four control systems: autonomous, command, beam rider guidance, homing guidance.

An autonomous system consists of automatic devices located on board a missile. The principle of action of autonomous systems is gyroscopic, inertial, astronavigational, or radio astronomical.

In autonomous systems, natural fields of earth and radiation of stars are used for measurement. With their aid different values characterizing motion of the rocket are measured. They are compared with an assigned flight program. If a divergence is revealed between them, then airborne automatic machines produce signals which in the end correct the direction of flight of the rocket or its position on the trajectory.

A distinctive quality of autonomous systems, especially those founded on the use of natural fields of the earth, is their high noise immunity. Absolutely noise-immune are systems which do not use any other external information except that delivered by the field of gravity (gravitational field) of the earth. Such systems are called inertial. They are so called because in them is measured acceleration of the rocket with respect to inertial space, including the sun and stars.

What does measurement of acceleration of a rocket give us? Acceleration is an increase of speed per unit time. In order to find out speed in terms of it, one must integrate (sum) this increase of speed. And then according to speed, in this way one can determine the route passed by the rocket. And not only the route, but also drift of the rocket from the assigned trajectory.

Usually on board a rocket there are three accelerometers. They are set on a platform stabilized, with the aid of gyroscopes, in inertial space. Accelerations are measured in three directions — height, lateral deflection from the plane of firing and in the direction to the target (in the plane of firing). According to data about accelerations we obtain velocity and route of the rocket, and also the value of lateral deflections. Besides high noise immunity, a merit of an autonomous control system is its effectiveness of guiding over great distances.

On board a ballistic missile the autonomous system consists of two main parts: automatic stabilization machine which ensures motion on a calculated trajectory, and an automatic machine for firing range control. The automatic stabilization machine is nothing else but a multichannel automatic control system. It controls motion of the rocket immediately in several parameters. For this every channel has a measuring element, correcting device, amplifier, steering machines and control surfaces. The automatic machine for firing range control will turn off the engine at that moment when values of parameters are attained which will ensure the needed target hit accuracy.

Attainment of the assigned velocity at the end of powered flight has the greatest effect on hit accuracy. Therefore, for simplification of the distance control system it is "forced" to control only one parameter: speed.

For winged rockets the basis of the control system is an automatic pilot. But in contrast to aviation, a rocket automatic pilot "self-structures" the beginning of trajectories when the rocket climbs. Then it "conducts" the rocket horizontally and "directs" its exit to the target. Also automatically determined is the moment of destruction of the warhead, proceeding from the value of the route passed which beforehand was assigned. Inasmuch as a winged rocket flies in dense layers of the atmosphere, automatic machines must still correct for lateral drift.

Thus, an autonomous system does not measure the position of the target. A command system, on the contrary, continuously determines the position of the target and missile, on the basis of which signals are produced (commands), directing the missile to the point of collision. From what was said it is clear that an autonomous system is used for guiding missiles to fixed targets, but command systems — to mobile targets. In a number of cases by means of command remote control, guiding of surface-to-air rockets to aircraft is carried out.

In practice there exist instruction systems of command remote control with one and two radars. The first is called a monobeam, the second — a double-beam system. In a monobeam system the same locator watches after motion of the target and the rocket. On board the rocket there is also set a responder for increasing the reliability of its tracking locator. The locator has two receivers for separate reception of signals from target and rocket. Data about them enter a computer, they produce commands transmitted on board the rocket by a transmitter.

Improved is the double-beam command remote control system. Its work scheme is such. An early-warning radar looks for a target. As soon as it is revealed, data about its location immediately enter antenna drives of the target radio tracking unit. And during all the process of guiding, this locator constantly watches after the target and transmits data to a computer. The radio tracking unit of the rocket continuously determines its position and also issues data to the computer. It automatically produces a rocket flight control command.

In this system several indicators are provided by which it is possible to observe the guiding of the rocket. Also provided is transition from automatic to hand target or rocket tracking by the operator. On the screen of the indicator the rocket is depicted in the form of a light spot.

So that rocket will be more rapidly brought into the zone of coverage of its radio tracking unit, is preliminarily the launcher. This helps to make one more computer.

The actual guiding of a surface-to-air rocket to a target can be carried out according to the method of three points, when the ground intercept control station, rocket and target are all the time along one straight line. This method is connected with great trajectory curvature, and this means, with great mechanical influences and overloads for the rocket. With considerable curvature is also connected the method of pursuit, when at every moment of guiding the rocket rushes to the target. Best is guiding to a predicted position - an exactly precalculated rendezvous point of rocket and target.

With a command system, complex and bulky equipment is not needed on board the rocket: all basic equipment is at the ground intercept control station. A deficiency of the system is the fact that at every given instant from the control point it is possible to control only one rocket. Therefore it is impossible to give a rocket salvo, and this, undoubtedly, can be required in a combat situation for increasing the probability of a target strike.

Also used is a radio beam guidance system, that is, when the rockets move along a unique radio path, provided by the antenna of a special radar. Figuratively speaking, a missile in this case reminds one of a hare, which getting into the ray of a searchlight, runs without turning to the right or left. What is the carrying capacity of the system? Judging by one foreign zenith complex, the transmitter of a ray and tracking radar permits releasing up to 12 rockets per minute. But accuracy at great distances is insufficient.

Insufficiently "long-range" is also considered the system of homing guidance, when a missile, by radiation of a target or reflection of signals from it, finds the route to a target "itself." The system can be active (all equipment for irradiation of the target and reception of a reflected signal is on board the missile); semiactive (the target is "illuminated" from earth), and passive (on board the missile is only a receiver which catches the radiation of the target). For homing guidance are used radio waves, infrared rays, sound vibrations. The range of this system can be judged according to one of the foreign types of self-guided missiles: it is able to be guided

on target from a distance of 13 km.

For the most successful guiding of carrier-rockets, abroad not infrequently they use combined control systems. Thus, during launching of a long-range missile at the starting stage the command system acts, at the target approach phase - inertial, or astronavigational, and at the final stage - a homing guidance system.

Classes and Forms of Rocket Weapons

One of the characteristic lines of development of nuclear rocket weapons consists in the huge variety of classes, types and especially varieties of carrier-rockets. At times during comparison of those or other samples it is difficult even to imagine that they pertain to rocket weapons.

In a number of countries of the world operational rockets are divided into classes according to whence they are launched and where the target is. According to these criteria we distinguish four basic classes: "surface-to-surface"; "surface-to-air," "air-to-surface" and "air-to-air." By the word "surface" is understood distribution of launchers on land, on water and under water. The same pertains to location of targets. If their location is designated by the word "surface," that means that they can be on land, on water and under water. The word "air" assumes location of launchers on board aircraft.

Certain specialists subdivide operational rockets into a considerably larger number of groups, trying to embrace all possible cases of location of launchers and targets. Besides, by the word "surface" already is implied only location of installations on land. By the word "water" - location of launchers and targets above water and under water. With such a classification nine groups are obtained: "surface to surface," "surface to water," "water to surface," "water to water," "surface to air," "water to air," "air to surface," "air to water," "air to air."

As a supplement to the above mentioned types of rockets, in the foreign press very frequently mentioned are three other classes: "earth-to-space," "space-to-earth," "space-to-space." This case concerns rockets taking off from land to cosmos, capable of being launched from space to land, and fly in space between objects in outer space. An analogy of rockets of the first class can be the ships "Vostok." The second and third classes of rockets are also realizable. It is known that our interplanetary stations were delivered to moon and headed to mars by rockets starting from aboard a carrier rocket located in space. With the same success a rocket from aboard a mother rocket can deliver a load not to the moon or to mars, but to earth. Then will be obtained the class "space-to-earth."

In the Soviet press there sometimes is used a classification of rockets according to their belonging to ground troops, the Military Naval Fleet, Aviation or Antiaircraft Defense. As a result there is obtained such a separation of rockets: ground, naval, aviation, artillery. In turn aviation is subdivided into guided missiles for blows from air to ground targets, for air battle, and aerial torpedo.

The line of division between rockets can pass to action range. Range is one of those qualities which the most vividly characterizes a weapon. Rockets can be intercontinental, that is, able to surmount distances dividing the most distant continents, for example Europe and America. Intercontinental rockets can strike objects of an enemy at a distance of over 10 thousand km. There are continental rockets, that is, those which can surmount a distance inside one continent. These rockets are designed for defeat of military objects located to the rear of the enemy at a distance of several thousand kilometers.

Unconditionally, there exist rockets of comparatively small range of operations. Some of them have a distance of several tens of kilometers. But all of them are considered the main weapon of destruction on the battle field.

The closest to military affairs turns out to be separation of rockets according to their combat assignment. Rockets are divided into three forms: strategic, operational-tactical and tactical assignment. Strategic rockets are intended for defeat of the most important, in military respects, centers of the enemy, covered by him in the deepest rear. Operational-tactical rockets are mass weapons of the army, in particular land troops.

Operational-tactical rockets have a distance of up to many hundreds of kilometers. This form is subdivided into short-range rockets intended for defeat of targets at a distance of several tens of kilometers, and long-range rockets, for blows at targets, at a distance of several hundreds of kilometers.

Between rockets there is still a distinction in terms of peculiarities of their construction.

Ballistic missiles are a basic combat force. It is known that on the arrangement and type of engine depends the character of flight of a rocket. By these criteria we distinguish ballistic, winged rockets and winged missiles. Ballistic missiles occupy a leading place: they possess high tactical-technical characteristics.

Ballistic missiles have an extended cylindrical body with a pointed nose cone. The nose cone is designed for destruction of targets. Inside it is placed either a nuclear or usual explosive. The body of the rocket can simultaneously serve as walls of tanks for components of fuel. In body there are provided several sections, in one of which is placed control equipment. The body basically determines the passive weight of the rocket, that is, its weight without fuel. The greater this weight, the more difficult to reach great distance. Therefore the case weight in all possible ways is lowered.

In the tail section is the engine. These rockets start vertically upwards, attain a defined height at which instruments work, decreasing the angle of their slope to horizon. When the power plant ceases work the rocket under the impact of the force of inertia flies on a ballistic curve, that is, on the trajectory of a freely thrown body.

For clarity, a ballistic missile can be compared with an artillery shell. The initial, or as we call it, active section of its trajectory when the engine works, can be compared with a gigantic invisible artillery barrel, which gives the missile direction and flying range. In this period the speed of the rocket (on which distance depends) and the angle of inclination (on which the course depends) can be directed by an automatic control system.

After burnout in the rocket the nose cone on the uncontrolled passive section of the trajectory, as also any freely thrown body, experiences the influence of forces of terrestrial gravity. On the final stage of flight the nose cone enters the dense layers of the atmosphere, flight slows down and it attacks on target. During entry in the dense layers of the atmosphere the nose cone is strongly heated; so that it is not destroyed, special measures are taken.

For increasing flying range a rocket can have several engines which function in turn and are automatically dropped. With joint efforts they reach such a speed of the last stage of the rocket that it covers the necessary distance. In print it was reported that a multistage rocket attains a height of more than a thousand kilometers and covers a distance of 8-10 thousand km in approximately 30 minutes.

Inasmuch as ballistic missile rise to a thousand-kilometer height, they move practically in a vacuum. After all it's well-known that on a flight, for example, an aircraft in the atmosphere interacts with the ambient air. In a vacuum any apparatus will move just as exactly as celestial bodies. This means, it is possible to very exactly calculate such a flight. This creates the possibility of errorless hits by a ballistic missile on a site of relatively small dimensions.

Ballistic missiles are of two classes: "surface to surface" and "air to surface."

The flight path of a winged rocket differs from the flight path of ballistic missile. After climbing, the rocket starts to glide to the target. In contrast to ballistic missiles, for these rockets there is a lifting surface (wings), and the engine is a rocket or jet (using as oxidizer the oxygen from the air). Winged rockets obtained wide propagation in anti-aircraft systems and as armament of interceptors.

Winged missiles, in terms of construction and type of engine, are close to aircraft. Their trajectory is low, and the engine works during all the flight. Upon approach to a target a winged missile steeply dives at it. The comparatively low speed of such a carrier facilitates its interception by usual means of anti-aircraft defense.

In the conclusion of this short survey of existing classes and types of rockets one should note that aggressive circles of the United States place prime attention on the fastest development of the most powerful types of nuclear rocket weapons, with the intention, apparently, of obtaining military advantages with respect to the USSR. However such hopes of the imperialists are absolutely unrealizable. Our nuclear rocket weaponry is developed in full correspondence with

the problem of reliable protection of the interests of the Fatherland. In the competition dictated to us by aggressive forces for quality and quantity of produced nuclear rocket weaponry we do not yield to those who threaten us with war, but in many respects we exceed. The powerful nuclear rocket weaponry in the hands of the Soviet Arm Forces is a reliable guarantee of peace and safety of not only our country, but also all the socialist empire, all humanity.

2. ROCKET FORCES TODAY, THEIR SUCCESSES IN COMBAT TRAINING

"We Are Strategic!"

When on days of military parades in a solemn march on Red Square subdivisions of the strategic rocket troops enter, on the rostrums there is not one person who does not experience deep excitement. And this is understandable. Soviet people justly consider that in the might of threatening rockets, in excellent qualities of our missilemen are embodied the best features of the Soviet Armed Forces at this contemporary stage of their development.

Very true are the verses by one of the poets about our army:

Having begun our victorious path
Away from the blows of sharp bayonets,
Today rocket spearheads
Soar into the clouds.

Fully completed is our rearmament of the Soviet Army with rocket technology and our creation of a new form of Armed Forces, the Strategic Rocket Forces. This is our main rocket force, in constant readiness to carry a crushing blow to the aggressor in case he decides to attack the Soviet Union and other socialist countries. Thanks to the concern of the Party and Government, the rocket troops have everything necessary for maximum readiness: reliable, invulnerable for global defense, intercontinental and other strategic rockets, launchers, missiles of extremely high power. At present the handsome organizational structures of the rocket has been created, their role and assignment in the defense system of the country have been determined, new regulations and manuals are being developed.

The creation of the Rocket Forces demanded further development of Soviet military science, solution of a series of new questions of military art. And this problem was successfully solved.

Thanks to the care of the Party and Government our Rocket Forces

in a short period has grown in quantitative, organizational, technical, and especially, qualitative respects. Equipped with latest nuclear-rocket weapons, these troops have obtained the possibility not only to ensure lightning destruction of the most important enemy groupings, but also to completely crush his military economic potential, to disorganize state and military control, and to destroy his means of nuclear attack.

The Soviet Strategic Rocket Forces are able to inflict destructive blows simultaneously on a considerable number of objects, to maneuver their fire in a short time, to transfer basic forces from some directions to others, rendering decisive influence on a change of situation to their own benefit. If earlier strategic war targets



**GRAPHIC NOT
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First period of mastery of a new weapon by missilemen. The Soviet strategic rockets have just been put into position. Specialists proceed to align systems and mechanisms before a combat launch.

were attained by means of solution of tactical and operational problems on a ground theater of military actions over a prolonged time with expenditure of considerable forces and means, then now with the help nuclear-rocket weapons strategic targets can be reached in a short time and on any theater of military actions. Rocket troops,

thus, can render a substantial influence not only on the progress, but also on the outcome of war.

And the nuclear loads lifted are larger, and they hit more precisely...

As one can clearly see, externally a strategic rocket constitutes a long cylindrical body, in the nose part changing into a cone. In the tail section one can easily see the control surfaces intended for steering the rocket in flight. In a word, it has all the criteria of a long range ballistic missile.

In order to ensure sufficient speed, and that means, flying range, there are several stages in a strategic rocket. The engines lift the rocket to a great altitude in space where it does not encounter atmospheric drag on the greater part of the route. After the last stage shuts down the head of the rocket is separated and heads towards the target.

The fact that a strategic rocket rises to an altitude of more than a thousand kilometers and develops a speed of over 20 thousand km/h determines reliability of its delivery of nuclear charges. For comparison it is possible to indicate that the average flight speed of a long range rocket is 20 times higher than the flight speed of aircraft and 10 times higher than the initial speed of a gun shell. A subsonic bomber spends more than 10 hours to deliver a bomb a distance more than 10 thousand km. And a rocket "waves by" in half an hour.

The power of the engine of one strategic rocket is colossal: it is equivalent to the power of ten electric power stations, such as the biggest in the United States, the Grand Coulee hydroelectric station located on the Columbia river. Furthermore, for comparison let us say that the power of a piston aircraft engine is a thousand times less, and the power of a jet aircraft engine is hundreds of times less than the power of one such electric power station.

For flight control of strategic rockets perfected systems are used. As was already noted above, a characteristic property of these systems consists of their independence from any ground radiotechnical devices. This means that from earth it is impossible to influence the trajectory of strategic rockets. This in addition to great altitude and flight speed still more ensures the invulnerability of strategic rockets.

Very high are other technical indices of Soviet strategic rockets. They are simple in operation. Their launch preparation time is literally a few minutes. Without special engineering preparation strategic rockets can be started from field launch sites. All of this concerns the possibility of ensuring viability and invulnerability of launchers from strategic enemy attack weapons.

Special admiration is elicited by our rockets, which are able to reach any point of the earth, not by the shortest route but also by the most distant and alternate route.



**GRAPHIC NOT
REPRODUCIBLE**

First period of mastery of a new weapon. On night duty of strategic missilemen.

The Commander in Chief of the Strategic Rocket Forces recently confirmed once again: "Existing systems of antiaircraft and anti-missile defense cannot resist nuclear rocket blows. And no matter how strong this defense, our strategic rockets would inevitably reach the assigned targets."

To the excellent qualities of the weapons which missilemen of the strategic forces possess there pertains especially high effectiveness. It is ensured by use of powerful nuclear charges. We already noted that the Soviet Union has nuclear weapons in great "assortment," starting from charges of small gauge and finishing with charges 50-100 million tons and more.

One nuclear charge with an equivalent of 100 million tons TNT 5000 times exceeds the power of those atomic bombs which were dropped by Americans on Hiroshima and Nagasaki.

At the 23rd Congress of the CPSU it was indicated that in the period since the 22nd Congress, complex and especially important problems of military construction were solved. This permitted increasing the reserve of nuclear ammunition of different assignment,



**GRAPHIC NOT
REPRODUCIBLE**

Three-stage solid propellant strategic rocket — an outstanding achievement of Soviet science and technology. Its showing at a military parade in Moscow was an event which caused interest in the whole world.

strengthening the degree of equipment of all forms of the Armed Forces with means of their application.

Great attention in this period was allotted to development of our Strategic Rocket Forces and atomic submarines. They serve as the fundamental means of restraining the aggressor and decisive destruction of him in war. In interests of their improvement there were used all latest achievements of Soviet science and technology, the basic efforts of leading branches of military industry were dedicated to it.

And the heroic labor of workers, engineers, designers and scientists bore fruit. In our country there has been created a series of principally new forms of rocket armament. The Minister of Defense of the USSR from the rostrum of the 23rd Congress stated: in the Strategic Rocket Forces there has been built a large number of new, and what is especially important, mobile launchers, for which we express deep gratitude to designers, engineers and workers of our defense industry.

Visible confirmation of the rocket might of our country were military parades on Red Square in 1965 and 1966. Especially impressing is the mighty technology of the Strategic Rocket Forces. Intermediate range rockets also attracted attention. Although they are called "intermediate," certain new types of these rockets are able to reach the most remote continents.

A remarkable novelty are solid propellant rockets of inter-continental and intermediate range on self-propelled launchers. Not one army in the world has such an effective weapon. Such strategic rockets constantly change their positions and cannot be reconnoitered

and destroyed by enemy. They are always ready for immediate action.

Unexcelled in terms of power are intercontinental ballistic missiles. They earlier participated in parades, but all the same it is difficult to tear ones eyes from them.

In front of the Lenin Tomb three-stage intercontinental solid-fuel rockets passed. Such rockets are simple and reliable in operation. Their service is fully automated. They can be launched in a minimum period of time from underground silos as well as from other launches.

The military parades were ended with grandiose rockets wich are akin to the powerful carrier rockets which with sureness injected into space the ships "Vostok" and "Voskhod" with the now famous astronauts on board. For these rockets there does not exist a limit to flight distance, and the possible power of their nuclear war heads is fantastic. Rockets of precisely this class are able to strike an enemy target from literally any direction, which makes them practically invulnerable to antimissile defense weapons.

The military parades once again demonstrated the high level of Soviet rocket construction, successes of missilemen who are remarkable masters of their business, highly educated specialists. This, addressed to them, was the ceaseless applause of guest at the Square.

Military parades produced a huge impression abroad. Thus, the military observer of the newspaper "New York Times" H. Baldwin wrote: "The parade (9 May 1965) can be considered impressive and indicative of the high level of military research... In general opinion, here the most important achievement of the Russians from all that was shown was the intercontinental ballistic missile working on a solid fuel. ...One other new Soviet rocket was short, thick and heavy, which weatern observers called the "Iron Maiden." As a supplement to solid propellant rockets the Russians for the first time publicly demonstrated what obviously is one of the variants of the carrier rockets used in many space launchings. This is a huge three-stage liquid-fuel rocket. Altogether the Russians at their parade in 1964 showed five new rocket systems and in 1965 four more. Additionally they also showed all those rockets which were demonstrated earlier - 16-18 different systems."

When at military parades at Red Square highly mobile strategic rockets on self-propelled launchers appeared, they caused an animated response from the foreign press.

The newspaper "New York Times": "The Soviet Union showed new rocket systems, compact in dimensions and very mobile on land in order to escape from air and space reconnaissance. Western military specialists consider this addition to the Russian nuclear arsenal impressive, since it demonstrates further successes in construction and mobility, increasing the huge power which Soviet rocket technology has long demonstrated." The English "Daily Mirror": "In the opinion of western specialists, due to high mobility this rocket is practically impossible to spot on land." The West German "Rheinische Post": "Moscow is showing the most contemporary rockets."

Our military parades at another time had the most unexpected consequences. Here is one of them. The Secretary of Defense of the United States, MacNamara, was publicly planted in a puddle. Only in 14 April 1965 he, by habit bragging about American rockets, categorically stated that in the USSR "There are no strategic ballistic missiles with solid fuel engines." And here in about three weeks - 9 May 1965 at the parade in Moscow there impressively passed by strategic solid propellant rockets. It serves the presumptuous braggart right.

Every time after military parades in Moscow the Western press discusses the question about comparative power of the USSR and the United States. One of the American journals so formulated an answer of specialists of the West on the question about the power of the USSR. "Successes of the Soviet Union in antimissile defense, so to speak, are equal to successes of the United States if they do not exceed... Furthermore, there are criteria that the Russians have already created hydrogen bombs equal in power to millions of tons of TNT. They declare with apprehension that these gigantic war heads are able to paralyze American rockets in their underground silos with the aid of bursts of electromagnetic energy before these rockets will be able to be launched."



**GRAPHIC NOT
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New Soviet rockets participating in military parade at Red Square in Moscow.

General T. Powers before departure from the post of Commander of the Strategic Air Command of the United States stated: "To count

on rockets" would signify that the United States invested billions of dollars in a "Maginot Line" of "Atlas," "Titan" and "Minuteman" rockets which can be rendered harmless as a result of a blow from the Russians." And its appearance sounds the acknowledgement that the "Russians are not marking time."

The same journal speaks about American rockets: "American weapons accepted for armament in recent months as "New" - starting with tanks and finishing with rockets - did not produce any great impression on Congress." Member of the House of Representatives, Melvin Laird (Republican from Wisconsin), a member of the Defense Appropriations Subcommittee, stated because of affirmations of government: "What difference does it make when you say, each time you change the number on a model, you create a new type of weapon."

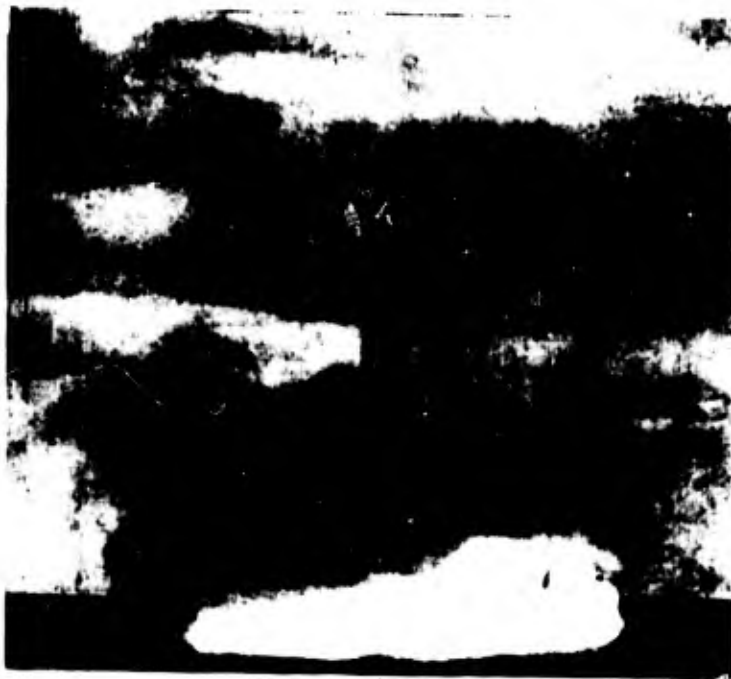
Regarding, however, the imaginary quantitative superiority of the United States in rockets, then one would want to be reminded of the well-known statement of the Minister of Defense of the Union of Soviet Socialist Republic on this count. To that quantity of rockets which threaten us we will answer by a simultaneous blow of a few times larger number of rockets and such power of nuclear charges which indeed would erase from the face of the earth all objects, industrial and administrative and political centers of the United States, completely destroying those countries which leased their territories for American military bases.

American specialists themselves have concretized the possible consequences of a nuclear attack on the United States by that power of charges possessed by the Soviet Union. "Only one 100 megaton warhead," they write, "dropped on New York, would destroy practically everything in a radius of approximately 36 kilometers and would elicit firestorms and radioactive fallout which would cover the territory of whole states."

The Secretary of Defense of the United States, R. MacNamara in 1965 was forced to officially recognize that an attack by Soviet strategic rockets of only 200 cities of the United States could in a few hours lead to the destruction of 149 million persons and two thirds of the industrial potential of this country.

It is true, MacNamara as before now tries to substantiate the supposedly unlimited military power of American imperialism. As before his warlike boastful statements are not ceased in which he in sensational form advertises the means of destruction of millions of people created by Americans, conducts cannibalistic calculations of victims and destruction.

Soviet people have no need to advertise their rocket forces and the fact that in their hands is a reliable force for controlling aggressors. They know that the hope of those who count on lowering the accuracy of our rockets will not be justified in combat conditions as compared to test launches. For Soviet missilemen have excellent training. During the last few years, as was noted at the 23rd Congress of the CPSU, we conducted a large number of rocket launches, combat firing, large operational and military assignments. The overwhelming



**GRAPHIC NOT
REPRODUCIBLE**

Launch of a Soviet ballistic missile.

majority of them were completed successfully, in spite of a sharp complication of conditions of fulfillment of combat missions. It is sufficient to note, for example that almost all launchings of rockets taking place in 1965-1966 were carried out "fine" and "excellent."

There will be catastrophic consequences for the United States if the Americans unleash a "mad" nuclear conflict. This is recognized even by a group of authoritative American specialists headed by Professor Seymour Melman. They stated: "The USSR has an ability of multiple "over-kill" with respect to the United States."

The same thought, but in other words, is expressed in a directive from the Pentagon about civil defense. It says: "A mass nuclear attack on the United States could inflict so much damage that the American Armed Forces would have to hold on here, in order to help in rescue work instead of moving them overseas for direct participation in military actions."

Symptomatic from the point of view of fear of retribution for aggression is the decision about immediate migration of the command of antiaircraft and antimissile defense of the United States. It is in a two-story reinforced concrete bunker in the city of Colorado Springs. Now such distribution is considered unreliable, and has been decided to lock it under a granite cliff.

Actually, at the base of the American Rocky Mountains hot work boils. From a mountain 3 km high they have removed the core and erected there the location for the command. Overhead, just in case, a layer of granite 720 m thick was left.

But all objects, after all are not concealed under cliffs. And the specter of inevitable rocket retribution, as before, coolingly pressures lovers of military adventures.

Creation of strategic rocket forces in the United States. In accordance with the recently accepted "strategy of flexible reaction in the United States, military leaders of the Pentagon have allotted great attention to questions of vulnerability and readiness of their own strategic forces. Not accidentally, Americans rush to place long-range rockets in underground launchers, in special silos. They depend on the safety of such installations from atomic explosion, if it occurs not closer than 1.3 km and if the power of the charge does not exceed 5 megatons.

They advanced the requirement about the fastest possible preparation of rockets for launching. For this, near them crews are on 24 hour duty and the actual rockets are completed with the nuclear combat units. But unconditionally, sometime will be required for preparation before launching. Rockets with liquid-jet engines still have to be filled with fuel components, checked before start. On this in the United States not less than a quarter hour is spent. The time of preparation of rockets with liquid-fuel rocket engines stored completely filled with components can be reduced.

Experiencing uncertainty in unfaillingness of their rockets, leaders of the American strategic forces have provided mobile teams for removal of malfunctionings. But sometimes removal of a defect requires a prolonged period, so an out-of-order rocket is replaced by a spare. For this, every 9-12 ready rockets have one spare in an assembled state.

For rockets with a solid fuel engine there are set ever more rigid time norms of preparation for launching. But also here these are provided spare rockets in exchange for those out-of-order. It composes 10 percent of the number of rockets located on launchers.

Military circles of the United States have rushed to combine combat employment of strategic rockets with strategic aircraft. In the first attack it is not assumed that all rockets will be used, part of them are kept in reserve. One launcher is designed to launch only one rocket. Repeated launchings are considered hardly probable since their bases will be crushed from the side of the opponent.

Even now, and this generals from the Pentagon do not conceal, each rocket has a defined target. This is the job of the strategic targets planning control in which in the sweat of their brows 180 generals, admirals and officers, representatives of different types of armed forces, are working. In turn sighting data is prepared by a special computer center. It supplies the command with target plans, reconnaissance data about their radar protection and so forth.

In order to weaken the impression of the population of the United States and their allies from publication of data on immediate preparation by the Pentagon of strategic nuclear blows, in the American press there appeared a report on consideration of objects subject to

such attacks. Secretary of Defense MacNamara even offered to introduce some "rules" to regulate a nuclear war, to inflict blows only on armed forces, but not on inhabited localities. As if the Minister of the United States does not know about the gigantic force of striking factors of nuclear explosions, able to put out of commission not only a whole region, but also a country. A worthy answer to this jesuitical maneuver was given by the Soviet public. In our press it was underlined that this monstrous proposal is impregnated from beginning to end with hate of people, humanity, since it tries to legalize nuclear war and thereby the destruction of millions and millions of people.

Yes, concern for a peaceful population appears with military circles of the United States only to be words. In reality, as the press reports, the most protected strategic rockets of the United States are aimed precisely at cities. Besides, the military command figures that a city can be struck by one rocket, whereas a military object, as a rule, will demand several blows.

The actual process of the first blow, which the American military clique for camouflage of its aggressive projects calls a return, is sketched in print in the United States in the following way. If the President will permit the use of strategic forces, then coded orders for launching intercontinental rockets from a ground control station should enter the rocket base control centers. Control of these bases is carried out from an underground ground control station. Fearing its breakdown from a nuclear blow of the enemy, specialists of the United States duplicate control from aircraft, for which one of them is always in the air.

At a rocket base the order about launching should proceed to operators in coded form. They already have a pack, which in such a case is opened, and the contents of the proceeding order is compared with that already available. In case of coincidence of data operators open by wrench blocks of push buttons for launching the rockets. Furthermore, by the word of MacNamara, with the aid of a duplicating arrangement launching of every separate rocket can be carried out by a coded signal from an air control station.

In one of the American journals, there was a report by two journalists visiting a silo during duties of strategic missilemen. Characteristic was the title of the article: "Peace is full of nervous stress." Actually, for American rockets it is as if someone on purpose created a situation of special disturbance and agitation. Those arriving at a launcher post are given a key and code on chains which are hung around the neck, and also a high-caliber loaded pistol with a short barrel. "It", - writes the journal, "is intended for protection from any uninvited guest." And this is written about crews well protected in shelters; it comes out as if, American missilemen fear each other.

Characteristic are the words which start the description of duty: "Our voluntary incarceration has begun." Even externally everything there reminded the correspondents of a prison. "All walls and all equipment are colored pale green. "We get sick of this color," - said Lamb (one of the officers of the day).

The observant authorities removed from underground literally all temptations. "Voice recorded on tape are masculine. Specialists decided that a female voice can lead into temptation the inhabitants of a secluded capsule, so that they would want to press pushbuttons in order to listen."

In a word, nothing human is left by the Pentagon for rocket duty personnel. Moreover, all their service is accompanied by force of fear. Every trifle... is turned into intrigues of an invisible enemy.

"Suddenly from the panel resounded a shrill whistle," write the journalists, "and a red lamp flashed, signaling about a disturbance of the security system for rocket number five... Above, on order from below, an assault echelon of two persons, armed with pistols and carbines, rushed to the machine in order to investigate what happened with rocket number 5."

The reader waits: surely, some terrible saboteurs disturbed security... But, report the journalists, "this time the disturbers turned out to be two squirrels." And further without any humor they add concerning the sinful aggressive squirrels: "Security measures with respect to "Minuteman" rockets are very strict, and every disturbance is investigated with all seriousness."

The nervous setup weighted on the journalists. The report continues, "We were hungry, although we did not take 50 steps... We ate as if we had dug a ditch."

"That's nerves," explained the officer."

But the agitated military authorities did not get an appetite as did the journalists, and duty shifts. "The dinner hour was suddenly interrupted by a signal on the "Red telephone." It rang from headquarters. The sound resounded high, shaking like the voice of a goatsucker recorded at 33-1/3 and played back at 78. It drowned out all other sounds in the capsule."

The correspondent explains: "If the order to start military actions ever comes, then... this shivering signal will resound and then we'll hear the persistent hard voice."

Shivering, hard... Only by such epithets is it possible, apparently, to characterize the announcement system designed to hold people at the rockets under constant stress. They feverishly have frequent checks conducted suddenly.

"At 12 hours 40 minutes sounded the shrill signal. It originated from abroad an aircraft flying at a high altitude. There constantly is one of the generals in case headquarters on land is destroyed. The general was checking if all stations were vigilantly carrying out their duties."

After a certain time, again a "sudden sharp signal."

"It's difficult service," confessed an officer to the correspondent. "With all bans and limitations we are like robots."

And already the correspondent makes his conclusion:

"A stay in the capsule without sleep can be simply tormenting... Sometimes the officer from another capsule in a tired voice pitifully says over the radio: "Hello, Lima, talk with me."

And thus the correspondent describes his own health after a stay in this atmosphere for twenty-four hours. "The hand approached six o'clock. Time to rise. Appearance was unimportant. Clothes were crumpled, eyes red, mouth dry, cheeks with bristle. We moved about weakly. We ordered breakfast..."

After breakfast the clock, it would seem, quite stopped... Suddenly it seemed to me that I could not live to see the change of duty, exchange of keys, revolvers and codes. I terribly wanted to escape from this nuclear trigger mechanism and return to where the sun glitters..."

And this is written by a person staying underground 24 hours. And what to say about American officers, located there regularly? The best of all about their state is shown by the strictest control over them. The American journalists write: "They are checked at least every 6 months by special groups, called standards committees, frequently inspectors look them over. Commanders and friends watch after their spiritual agitation, excessive enthusiasm for drinking, lack of restraint in anger and abnormal behavioral phenomena."

Indeed, under conditions of stifling nuclear psychosis the psyches of people not infrequently break down.

It is indicative that in the United States problems of inter-relations of a person and rocket are the sharpest. There it is necessary to take special "precautionary measures" against, as the Americans say, accidental occurrence of a nuclear war. These measures of precaution are dictated by full distrust of the American power for their missilemen. They, not without reason fear that a rocket will rise into the air "from mechanical malfunctions or human error in command instances, stretched from the White House to those persons, who are in long-term fire positions and who will actually have to conduct a nuclear war."

Not trusting even their own officer-missilemen, the powers of the United States require that a decision on launching a rocket be carried out by two persons. In one of the newspapers the interaction of these persons in 564th Subdivision of strategic rockets was so described. "Captain Bruce Henderson and Lieutenant William Pitts separated by a meter of space, sit in white robes over a panel with rows of gray pushbuttons. They watch one another at the panel. Thus passes hour after hour... But if Pitts moves suddenly, waves a hand, Henderson immediately grabs a pistol and points it at him. If Pitts remains still Henderson in a minute puts the pistol away..."

And one American journal gives another detail illustrating what degree of distrust the American military clique has attained. Missilemen "will be separated from each other by impenetrable bullet-proof glass, so that not one of them could convince the other - maybe

with the help of a revolver - to join with him in order to launch rocket without a corresponding order."

And all these precaution are widely described in the press. "According to how," writes the American press, "a nuclear weapon becomes all the more complex, disturbance is strengthened as regards the possibility either of accidents in this mechanism... or a psychic disorder for person occupying a responsible post."

Feverishly is the race of strategic rocket armaments conducted in the United States, preparation of rockets for combat employment, aggressive plans against peaceloving peoples.

Our strategic rockets are in reliable hands. Soviet people well know that our country possesses superiority over the United States not only in strategic technical weapons, but also in "strengtn" of the most decisive military matter "of human material." Devotion of our missilemen, as of all Soviet soldiers, to ideas of Marxism-Leninism, and the Party and people bears unprecedented enthusiasm, a tendency by one's own labor to brace the might of a country, to increase combat-readiness, to improve one's own spiritual-combat qualities.

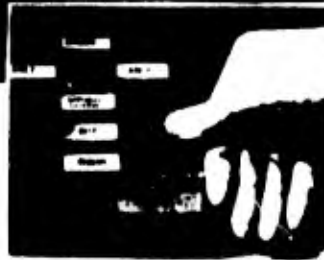
Soviet people do not even think of worrying about the strength of spirit of their soldiers. For our missilemen have a clear conscience, hard moral foundations, unshakable self-control. Everyone visiting the garrisons of the strategic rockets can say: "We did not see pistols, directed by one duty officer at another, and bullet-proof glass we did not see. We saw calmness and confidence, fraternal confidence, bright looks and bright faces."

New is the appearance of our rocket units and their garrisons as compared to these that we saw in the past. Now they remind us of industrial enterprises, where they have their own energy station, production lines, the most complex mechanisms. Here science is just as tightly joined with combat material as stages of rockets to each other.

And almost every specialist encountered by you in the unit, it is not possible to doubt, is an engineer or technician. Their part in the staff of officers of subdivisions reaches 70-80 percent. And all of them, as a rule, advocates of new technology, are fighters for the best preparation for combat employment.

"We are strategic!" with pride soldiers of the Rocket Forces talk among themselves and try by their work to confirm.

The daily life of a missilemen is heroic. Especially many surprises were encountered in the first period of development of rocket technology. Once, before the actual launching of a rocket, when the crew was already in the shelter, Guards Senior Lieutenant Goloboyev heard a strange sound, similar to a whistle. Looking from the shelter, the officer noted that tubes from the starting pneumatic shield on board the rocket had burst. Apparently, they did not withstand the high pressure. Air burst out with a whistle.



**GRAPHIC NOT
REPRODUCIBLE**



Now the push button "launch" is pressed.
The cover of the silo is shifted aside.
The strategic rocket is launched from
underground.

Goloboyev comprehended that if in three minute air was not fed on board the rocket hydrostatic instruments would break down. Without delaying, he darted from shelter. After him ran Sergeant Bus'kov. In all two minutes were required for their heroic efforts to remove the malfunction and ensure normal supply of air on board the rocket. The combat mission was carried out successfully.

The first experimental missilemen worked in difficult conditions. They actually prepared the rocket for the first launch.

In no less difficult conditions soldier-missilemen in new units are fulfilling their assignments. Here is one example of this. In severe winter, personnel headed by Commander Lieutenant Colonel Vlaksiy in a 45 degree frost were landed from helicopters on a meadow in the middle of a dense wood. Here it was ordered to arm the position for launching rockets. In spite of the toughest conditions, the soldiers twice earlier than the period fulfilled the problem on hand. The Commander in Chief expressed his gratitude to all personnel.

The press narrated about a young officer Valentin Vesov, who together with his comrades secured a saving of two seconds during preparation of a rocket. This success was noted in the order of Commander in Chief, and the experience spread to all units.

In that same unit there is a soldier who in his first year of service so deeply grasped the new technology that he addressed to a designer of rockets a proposal for improving distribution of instruments for which the soldier was responsible. The designer answered: "The proposal is valuable and we will endeavor to incorporate it," and asked: "If you think of anything else, write to us..." So began a correspondence between a well-known scientist and an inventor still unknown to the world, an ordinary soldier of the Rocket Forces. And a correspondence about one of the important questions of development of the new technology! Here is the kind of people standing by the weapons! Here is whom the Fatherland has entrusted the most threatening defense of peace and safety of peoples!

It is impossible not to mention one officer-innovator in this unit who only in the last two years obtained four author's certificates, and his subordinates — ten certificates. Without such innovation combat work of missilemen is inconceivable.

A real innovator in the N-th unit is Officer Kavarukhin. Somehow during a check of a rocket, in a welding of one of the units the soldiers revealed a hardly noticeable slot. If during correction of this defect one acted by usual methods, then for some time the rocket would be unready. What to do? Some dare-devil offered to weld the seam on place, not taking off the unit. Kavarukhin, consulting with his senior chief, decided on the experiment. This was a risk, founded on the firm calculation on already accumulated operational experience with rockets. Moreover, a similar situation can be repeated in combat conditions, and soldiers have to learn what will be demanded from them in a combat situation.

And here is the welder at the rocket. Prepared are fire extinguishers, asbestos covers. The welder moved the mask on his face and proceeded to the matter. Kavarukhin watched his every motion. The welder was just completing the work when they called Kavarukhin to the telephone. The senior chief was interested in how the repair was going.

"Already finished"! reported Kavarukhin.

In several minutes the chief was at the subdivision. He checked the quality of the work, inquired about who organized the repair, and, warily, paternally smiling, appraised the success of the missilemen

in one word: "Magnificent!"

Great exactingness to their labor is characteristic for all missilemen and their commanders. Having on hand the huge means of responding for constant readiness of the most powerful weapon, officers do not waive even their own demandingness.

In one of the rocket garrisons we happened to meet with Major Ivan Bogarnikov, whose successes are widely known not only in the N-th unit.

Relearning the rocket specialty, he worked at first as chief of staff, but then at the control room. Now Bogarnikov is commander of a rocket subdivision. Only he who is acquainted with the number of obligations of a commander of such a rank in the Rocket Forces understands well how much effort and energy is required from him. He is master of not only a technical position, although concern for it would suffice another person, but also of much else that should be in constant readiness, to promote the best service of missilemen.

We remembered a characteristic stroke. During a complex assignment, when the rocket occupied its vertical position, Bogarnikov was distracted a minute from observation of it and called the driver of his "GAZ" automobile:

"Go into the city, to the club, for a contrabass."

"GAZ" automobile was concealed between pines. And we thought rocket - and a contrabass for after hours. How great is his range of cares! And all these cares Bogarnikov carries surprisingly easily and even gayly. And this is now necessary it is for all people working under his command that not for a minute they lose spirit under the burden of unparalleled responsibility for full readiness of the main weaponry of the country.

In the solution of all the very various and very difficult problems great help to the commander is rendered by Communists and Komsomol members. This by their initiative, supported by Bogarnikov, in the subdivision was turned into a fight for first place in equipping the training base, in allotment of rocket weapons. We happened to visit classes of the rocket subdivision. Really, visiting them, it was difficult to believe that this was not a higher educational institution and not headquarters and the most usual combat news study here.

And the place for storage of rockets! This is the sanctum sanctorum of the subdivision. The cleanliness, efficiency in them is such that any laboratory with finest instruments could envy. Soldiers here maintain the most favorable conditions for storage of a weapon so that it is constantly readily to say the weighty word to those who, losing reason, dare to attack us.

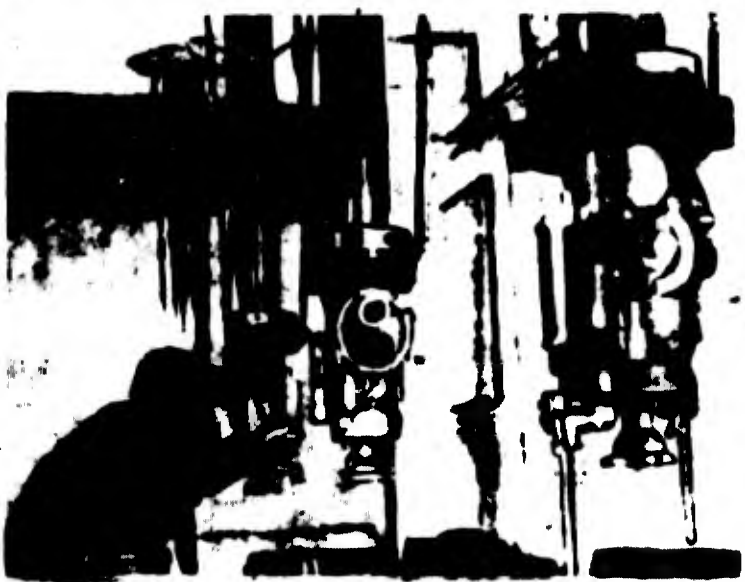
The true tone in life and studies of soldiers is given by the officers headed by the commander. All of them are class specialists. Now many of them persistently storm the highest stage of skill - first class.

When we talk with missilemen about their commander, they in one voice note his remarkable qualities: and himself, and others he measures according to one, high standard. And in a difficult minute of combat work, as in his personal life he does not make excuses. He equally divides with subordinates the difficulties of service, he does not try to depart into the shadow during failure, does not rush "emerge into the light of Jupiters," when the subdivision gains a victory.

Not all immediately notice this quality of a commander. Thus it happened, for example, with Lieutenant S. Pridya entering the subdivision directly from school, he sickly reacted to any remark of the commander, considered that he was unnecessarily being picked on. It is possible, allegedly, to require from another, when one's self does not concretely respond...



Launching of a strategic rocket requires attentive work.



**GRAPHIC NOT
REPRODUCIBLE**

He decided to complain to the deputy commander for political affairs. The major listened, but was not persuaded. He, the deputy for political affairs, knew well his commander, understood this "nagging." Only said:

"Fine. I'll look into it. But you watch yourself. Maybe you too are in error."

Days went by. Weeks went by. The deputy did not give an answer to the lieutenant, he waited for the young officer himself to come to him. On field assignments, where the commander and lieutenant were together, the deputy more than once saw the fire of admiration in the eyes of the young officer, when Bogarnikov first conducted a multistage rocket over the snowy virgin land or in moments of rest, freezing, frosting, when he encouraged those around him with jokes.

And the lieutenant came to the deputy. He did not say a word, but the major already comprehended by his guilty expression that the conversation would have a different continuation.

"Comrade major," the lieutenant slightly reddened, "if it is possible, then let us assume that what I said to you earlier will remain between us. I was in a hurry. I wanted by lies to protect myself. I became ashamed, believe me ashamed..."

"So it will be."

Surely, Bogarnikov did not suspect congratulating the success of Lieutenant S., how much commander exactingness meant for him in the period of rocket youth...

The same high exactingness to self and subordinates distinguishes advanced engineer-missileman Victor Vladov. He, so to speak, leaves no time for himself, presents literally triple requirements for his own knowledge, own work, participation in public matters. Engineer Vladov finished the academy, but took up practical mastery of technology in the unit with the greed of a first-year student. Being a mechanical engineer, with enthusiasm he learned electrical circuits, climbed in all the hiding places of the equipment complex.

In the course of independent studies in the unit Vladov studied such questions, mentioning which would recently cause surprise. He, for example, was interested in potential possibilities of combat materiel, and in particular its operational reliability. In order to more deeply penetrate the essence of these questions, the young officer studies probability theory, fundamentals of information theory and mathematical statistics. On the basis of theoretical data and conducted experiments Vladov decided to prepare a work about reliability of permanent armament. This is already scientific work, and intending to fulfill it is a usual engineer in a usual rocket unit. This is not a mark of newness in the life of the Rocket Forces! Not accidentally, in "Pravda" it was noted that obtaining the rank of master officer missileman takes no less effort than delivery of a candidate minimum.

Reading about the fact that Vladov studies complex questions of theory, the reader can think that this is some kind of specialist-

.of-a-kind working far off from people. But this is not so. The duty which he occupied after termination of the academy required from him much work with people. And here the young engineer turned out to be as it is said, at altitude. In this one can see the trends of the time - a military engineer is also an excellent commander-educator. The principles of a member of the Lenin Komsomol, he has combined with the organization and exactitude of a military person the technical horizon of an engineer. This many-sidedness promotes achievement of a single target - preparation of a conscious and skillful missilemen, stable protectors of the Fatherland.

And finally, one more quality, without which it is difficult to imagine our officer-missileman, is innovation. Precisely this does not permit him to stroll past problems of improvement of method, exploitation of technology, preparation of rockets for launch.

Engineer Vladov, for example, from the moment of actual arrival in the unit presented himself as a person of creative search. He offered to improve his educational base. After this the "agitated" officer, becoming already an assistant of the service chief, found several possibilities to improve methods of storage of weapons.

About the commander-missileman a reader can form the opinion that he is a dry pedant, something like a walking virtue. No, this is a witty, gay converser, true comrade and, in spite of physical and technical education, a poet and dreamer. He dreams not only of such serious things as post-graduate studies, but also new accomplishments in the world of art, literature, sports... In a word, this is a living, active, combat person, on the call of his heart taking on himself the mission of armed protector of his native land and fulfilling it with honor.

The missilemen received the torch of courage from soldiers of the senior generation. In our press there was a narration about the N-th rocket unit. During the years of the Great Patriotic War under its combat banner fought artillery men. From the ranks of this unit emerged seven Heroes of the Soviet Union, two thousand of its soldiers for courage and valor were awarded with combat orders and medals. Young soldiers sacredly increase the glorious combat traditions of heroes, artillery men. The unit rightfully is considered one of the best. For the second year soldier-missilemen of this unit won the prize Red banner of the TsK Komsomol. And 70 percent of the soldiers, sergeants and officers here are outstanding persons of combat and political studies, 80 percent are class specialists, almost every second possesses allied specialties, all soldiers are real masters of their difficult rocketry. An experienced educator, leader and organizer was the commander of the unit, on account of which there were several successful rocket launching.

In the Rocket Forces is widely known the heroic act of Communist ordinary Aleksey Andryushchenko. At the price of his life he saved the life of his commander. Missilemen strive to be worthy of the military valor and fame of their fathers.

Rocket University... The scene is where participants of a future parade are being trained. Rockets with covered bodies and

streams of water flowing from carts. Around them trooped the missile-men. One officer I learned about who the commander presented to me while still on march: Major Basyukov. Excellent growth and width of arms, calm with big facial features, attentive open glance — all in him spoke of outstanding physical and moral power. I knew that he commands a rocket battery, which for five years was constantly rated excellent. And, asking him about matters of the battery and his personal life, I expected to hear something like a report about achievements. But it was quite otherwise:

"Mainly I suggest to myself and subordinates: don't boast about what is attained. And then Gutnikov took me to a movie, in a documentary was his portrait. And here you came to us. For our pride is pleasant. It is easy to boast."

Such alertness against conceit appeared to me very remarkable. Missilemen of the strategic Forces, as no other, cannot and may not be satisfied with attained results. The weapon they have is new, its possibility is inexhaustable, to the end not revealed. Therefore the practice of ordinary people of the Rocket Forces now rises to the level of scientific investigations, which permit making far-reaching conclusions for the future.

The rocket service loves what is inquisitive, agitated. Exactly such was Anatoliy Mikhaylovich Basyukov from Volgograd, a pupil of the mortar artillery school. His father served in units of ground aviation defense during the years of the Great Patriotic War. His love of aviation was transmitted to his son. Basyukov the younger went into winged artillery the artillery subdivision of the assault division. Since then he has had no more memorable event than his first jump with a parachute. The almost zero gravity state, he remembers is as for astronauts... In eight years of service in assault units Basyukov has accomplished 180 jumps.

Basyukovu offered to transfer to the Rocket Forces. Anatoliy Mikhaylovich untiringly studied the new rocketry, comprehended the interconnection complexes, was prepared for combat employment.

His subordinates are trying to match him. All of them are creative people. Three have diplomas of higher education; five — average technical, and most finished ten-year school. With them it was easy to talk about complex technology. Yes, even they rushed to make intelligible every occupation, helped to equip the training corps. In a subdivision — a training corps! Was it so earlier in our army? Here is evidence of one of the writers visiting the Rocket Forces: "I was in several locations with missilemen. I inspected training classes. They were similar to college student laboratories..."

Demandingness toward themselves is seen as the main index of combat readiness of the rocket subdivision — as a combat launch. In all the battery conducted eight launches. The first four were carried out "fire," the last ones deserved the appraisal "excellent." This means that after the first launches all was weighed on scales of highest exactness. And every number of the squad at his place obtained scientifically proved "parameters" of actions.

The tone is set for the subdivision where as chiefs are Senior Lieutenants Krasnov and Gutnikov. Both are 1st class, all their subordinates — class specialists. They do not have one breach of discipline.

All of this came, of course, not at once. But the course on service of missileman is incompatible with a breach of discipline, in the battery it is strictly maintained.

Not all soldiers arriving to serve here immediately find that the rocket post of a country is the most important, the most responsible and what is here all important — the contents of the weapon in spite of its appearance. Not understanding this at first, for example, was private Chernyayev. This unassembled, loose soldier interfered with all his surrounding but did not notice this and even flaunted his deficiencies. They warned him that in such strict matters, as rockets, such behavior was fraught with serious consequences. But he only brushed it off.

And here life severely punished him. In one trip he almost put a machine out of commission. From him they asked in all strictness, from commander to barracks comrade in the barrack. He got into an "encirclement of demanding Communists and Komsomol members. "Recovery" began... Now Chernyayev is an excellent specialist, a participant in parades. The same occurred with Private Bugayev, a driver. And he also "recovered" fast under the influence of the commander and the collective of the subdivision.

The process of turning a recruit into a genuine missileman starts from acquaintance with the garrison. In the garrison, picturesque and spacious, only troops, one would think, a subdivision. And what was it like? An electric power station, a fleet of the most powerful vehicles, central heating plant, dining room, bath. Even a spacious club and movie theater, a hotel for duty shift replacement officers... All around cleanliness, as in a surgical room in a hospital, although no white robes. In the summer the small town is drowned in flowers.

People in the rocket subdivision go through a unique university. And many officers study by correspondence in the highest educational institutions. Day after day personnel develop qualities which are necessary in a nuclear rocket subdivision.

As also for all soldiers, the authentic law of life for missilemen becomes the moral code of a builder of Communism. This code is assumed as the basis of all educational work in the rocket

forces. All force of influence of commanders, Party and Komsomol organizations now heads towards formation of the best qualities characterizing a Soviet soldier. This, first of all, high principle, is infinite devotion to the Native Land, matters of Communist construction, a burning hate of imperialistic aggressors, moral stability, vigilance, high combat readiness. For soldiers are educated in discipline and organization, honesty and truthfulness, always critically appraise their achievements, the tendency is to go only forward.

Combat training of personnel of the rocket forces is constructed in accordance with the main problem of our arm forces, formulated by the Minister of Defense of the Union of Soviet Socialist Republics. It consists of an order to study and to work out methods of reliable retaliation of a sudden nuclear attack of an aggressor, and also methods of breakdown of his aggressive projects by means of timely placement of crushing blows. It is very important, besides, that occupation and teaching be conducted under conditions which approximate the peculiarities of contemporary war, real situations, which can form in the initial period of war in case of an attack from an aggressor.

In the units they persistently master technology, learn skillfully to use it in different combat conditions. Among soldier-missilemen spreads the socialist competition for an increase of class status, increase of the number of excellent squads.

Missilemen have secured new successes. The number of excellent subdivisions in the Strategic Rocket Forces was increased almost 3 times, the quantity of class specialists considerably increased. Almost all practical combat launchings of intermediate range rockets are carried out with appraisals "fire" and "excellent," and combat squads of intercontinental rockets already several years in succession have hit their targets only "excellently" and "fire."

Our Native Land worthily notes the successes of soldier-missilemen. Ten of them after mastery of the new rocket technology were awarded orders and medals. Here it is possible to call out the names of such excellent officers, as Moskal'tsev, Oleksentsev. For high personal preparation, achievement of excellent results by subdivisions a number of commanders ahead-of-schedule were appropriated military ranks. Among them are officers Gurov, Popov, Zenin and others. A beacon for all rocket teams is the subdivision headed by officer Shironov. This subdivision more than three years has carried the rank of excellent. Almost all personnel are class specialists. The combat collective is friendly, united, in terms of force it has the most complex assignments.

An index of high consciousness of soldier-missilemen is the fact that exactly they came forward as initiators of motion for an encounter with the 40-year acquisition to the Komsomol of the name of the great Lenin. The Lenin torch obtained in troops of different assignment the widest span. In the course of this, soldiers better master the Lenin military-theoretical heritage, seek successes in combat and political preparation, struggle for deep military technical knowledge.

With huge persistence missilemen master the theory of jet propulsion, radio electronics, nuclear physics, electrical engineering, in order to confidently look after processes occurring in combat materiel during preparation for launch, during launch, in the flight of the rocket. But only theoretical knowledge is insufficient. Each member of the rocket team should be a real master of his specialty. And the team on the whole should understand at any time of day and night, under conditions of use of nuclear weapons by the enemy, how to clearly and rapidly prepare all systems of the rocket for combat employment. Here are needed promptness, skill, and possession of work procedures, and physical toughness. At launching sites are needed the greatest discipline and organization, coalescence and coordination, responsibility and selflessness. But then what satisfaction soldiers experience when a mighty rocket, leaving a bright fire tail, uncontrollably rushes to a target and resolutely crushes it.



**GRAPHIC NOT
REPRODUCIBLE**

Soviet three-stage rockets, blood sisters of those which inserted "Vostok" space-ships in orbit.

Participating in the Lenin competition, missilemen secured great successes. Initiators of this motion, as they promised, made their subdivision excellent. Other teams are moving forward. The Central Committee of the Komsomol established the challenge Red Banners for rewarding the best Komsomol organizations of the Strategic Rocket Forces.

Great educational work is conducted by commanders, political workers, engineers, all commissioned personnel of rocket units. Thanks to timely care of the Party, training of cadres of missilemen troops of strategic assignment are completed by highly educated, interested officers, ready to start after any most difficult matter... Cadres are forged of missilemen in our best academies and schools, having the very rich experience of instruction and training of future rulers of the threatening weapon.

To be a stormtrooper on rocket routes... The glorious tradition in life of our Army and fleet is the receptions by leaders of the Party and government of graduates of military academies in the Kremlin. For those, who with academic baggage waited to walk

in military formation, warm parting words bore a burning tendency as soon as possible to embody these councils in life. Those who still remained behind the walls of academies only with admiration listened to stories of senior comrades of graduates, with still greater energy were prepared for the solemn moment in their life - leaving the academy.

I happened to converse with such a student. He started his thesis work and did it all so that it worthily crowned a long period of studies.

A handsome figure, light-haired head, attentive eyes. Here sits an ordinary student, a future engineer-missileman, but what an interesting path behind him. He was a fighter pilot. Then he decided to enter the air academy in order to become an engineer. He entered and started his studies, then the news came: a series of higher educational institutions were shifted to rocket education. They offered: who wants to be an engineer-missileman? And Anatoliy Vostrov answered by consent. This was not a surprise. He already in his first acquaintance with jet engineering was seduced by it. And here he was offered to become in the future a navigator of rocket routes. This was something new, and quite like aviation...

In the higher educational institution where he passed, he, as his comrades, was given the possibility to meet with Soviet rocket technology. This was an "inversion" of former aviators into admirers of rocket technology. The future students were not only shown mighty, upwards directed rockets, but were also permitted "to make" in their hiding places, to participate in preparation of launches, to sense the usual - but what responsible! - numbers of rocket designs.

It is difficult to say, was this a calculated methodical procedure - preliminary acquaintance with rocket technology - or did it appear accidentally; but anyone who has sensed the power of a new weapon has for a prolonged time experienced a special rise of the senses, an elevated mood. Here with such a mood proceeded future engineers-missilemen, and among them Anatoliy Vostrov took up his assignment.

In a year, outstanding person of studies Anatoliy Vostrov wrote his mother that he has two joys: he was honored with a Lenin scholarship and a daughter was born. The daughter is now four years old. A scholarship was also awarded to his companion during these years. He not only theoretically mastered principles of control of rockets, peculiarities of their flight, control of trajectories, or, as aviators say, routes... He also "smelled" rocket powder, was in on launches of rockets.

Anatoliy actively participated in military scientific work. His report done at a scientific and technical conference of students, along with reports of his comrades received the encouragement of the chief of the academy.

Under the leadership of his favorite professor, Anatoliy prepared his thesis. He wanted his work completing the course of instruction to be valuable for practice in combat employment of rockets.

The route of Communist Anatoliy Vostrov — this is the route of many of our missilemen.

Now Anatoliy is on intimate terms with rocket technology, especially with methods of calculation of rocket flights. And this is not accidental, he became a navigator of rocket routes. Let us wish to him success in his new and very promising field...

Here the former admirers of aviation, artillery, naval service have become real friends of the rocket for all their life. This love for a new profession, consciousness of responsibility for protection of the Native Land inspires those who already stand in combat formation, and those who are prepared to enter it.

* * *

Rocket technology, embodying the most outstanding achievements of contemporary science and production, is loved by people of wide horizon, generous heart, strong spirit, of great strength. Exactly such people are our soldiers of forces of strategic assignment. They will not tremble before any test and with the unit will fulfill all problems of defense of peace and safety of their dearest Native Land.

Soviet Strategic Rocket Forces, as underlines in our press, in short periods were turned into powerful and threatening shields in the way of realization of insidious projects of imperialistic aggressors.

Our strategic rockets possess especially high combat properties. And they not only do not yield to America but considerably exceed them in terms of all indices. This is not only the opinion of Soviet military leaders. Acknowledgement of superiority of our rocket was expressed more than once by important western and American specialists. But Soviet military leaders, of course, know more than them about our own weapon and can with foundation judge its merits. The Soviet nuclear rocket weapon ensures suddenness of preparation and carrying out of launches in a very short time, delivery of nuclear warheads of any power to the most remote regions of the earth. There are rockets able to strike objects of the enemy from any direction. This brings to nought the antimissile defense of the enemy and, thus, increases the reliability of destroying the target.

Regarding the power of nuclear charges delivered by our strategic rockets, they are able to destroy in several seconds any contemporary large city or industrial region. After explosion of such a nuclear charge a huge area a few times larger than the lethal area from the shock wave is subjected to strong radioactive contamination.

The high quality and reliability of our rocket technology are confirmed by very successfully conducted combat launchings of rockets, its high operational characteristics and unflinchingness of action.

All the world knows that only the Soviet Union possesses nuclear charges attaining the fantastic power equal to an explosion of 50-100 million tons of TNT. Americans do not have nuclear charges of such power. Repeated failures of launchings of American rockets and explosions on launchers witness that American rocket technology is far from perfection. And it appears that leaders of the Pentagon, bragging of the power of their rocket technology, issue what is desirable as real.

To that which is mentioned above about our strategic missilemen, one should add that these forces have such a quantity of combat nuclear charges and rockets which will allow us, if only the imperialists manage to unleash war, to destroy any aggressor, wherever he is, including aggressors who have contemporary nuclear weapon.

Soviet scientists, designers, engineers, technicians, workers created the best in the world nuclear rocket weaponry. Their outstanding scientific, technical and industrial achievements have glorified the Soviet Union, confirming once again the greater advantage of the system of Socialism over Capitalism. Their successes showed all the world that the Soviet Union occupies the most advanced positions in the region of science and technology.

Soviet soldiers very sincerely thank our scientists, designers, engineers, technicians and workers for the great creative labor and wish them excellent health and new successes of subsequent improvement of nuclear rocket weaponry.

The Strategic Rocket Forces as other kinds of rocket forces are continually being developed. Soldiers, with success mastering the technology, find new means of its combat employment, reduction of time of preparation for launches.

Troops of strategic assignment have now in their arsenal intermediate range rockets, intercontinental, global. Weapons of strategic missilemen come forward now in new, highest quality. Thanks to the cares of Party and government our armed forces have obtained rockets which work on new highly effective fuels, including solid. This permitted extraordinary simplicity and reliability of rockets in operation, duration of periods of their storage and a high degree of readiness for launches.

For starting strategic rockets, personnel are prepared to use different starts. Some of the launches are unified: they are useful for rockets of various types.

With legitimate pride we can say: in our country there have been created and mastered in operation mobile launches of strategic rockets - the latest word in development of rocket weaponry. Not one other country in the world has them.

Our stationary launchers possess remarkable qualities. They are thoroughly masked from air and space reconnaissance, and are reliably protected from nuclear blows. The opening of a silo is covered by a large flattened hemisphere cast from metal of high strength, but after depressing a pushbutton this armored shield gains surprising agility.

From silo launchers we can launch the most powerful intercontinental rockets. Control of their start is also produced from underground, from ground control stations equipped with the latest electronic equipment. Especially novel for the power of our rocket forces is the fact that they can start from underground several rockets, give a rocket salvo.

In preparation of our rockets for launch all possibilities are considered which can occur in combat conditions. For launching strategic rockets field positions are used.

Authoritatively and swiftly intruding on launching sites are automatics, electronics cybernetics. Writer Vadim Kozhevnikov, visiting the Strategic Rocket Forces wrote: "Cybernetics, a veteran of the Strategic Rocket Forces, had already obtained a multiple increase in service in the form of a set of improvements." Less and less populous become launches of our strategic rockets. The fact that earlier it was done by a human hand, now all the more frequently it is done by instruments, automatic relays and controllers. The process of mechanization, automation and centralization of control checks, regulations, preparatory works and launches themselves will continue swiftly and widely.

The main care of missilemen is that they hold their weapon in constant and highest readiness for action. And this depends on absolute reliability of not only a weapon on the whole, but also each of its components, every mechanism and aggregate. On safeguard of such reliability and readiness is directed the creative thoughts of missilemen, work of commanders, political organs, Party and Komsomol organizations. They seek that literally every missileman at his post act in exact correspondence with requirements of science, lovingly and scrupulously nurse the system entrusted to him, so that it, as all others, in the needed moment, a moment of state importance will act clearly and unfailingly.

The remarkable moral qualities of our missilemen, unexcelled properties of Soviet rockets are checked during launch in the water the Pacific Ocean. They appeared during the latest launches in 1965-1966. The splendid accuracy of the teams, the greatest reliability of the most complex technology — here is that first and main impression which remains, when we ponder the niggardly lines of reports of TASS about launching the Soviet Union of powerful carrier rockets. The teams ensure launching without special preliminary preparation and special engineering equipment. Rockets are rapidly delivered to field positions and are started on assigned targets.

Caring about the safety of the Native Land, Soviet people have created superpowerful rockets. They ensure target delivery of nuclear charges over different trajectories and are able to maneuver (change of parameters of flight). Such rockets were shown on 7 November 1965 and 1 May 1966 during parades on Red Square.

In order to make unreal the plans of aggressors to surprise our country, Soviet designers have created different new rocket systems, stationary, compact and automatic with a high degree of shielding and mobility. To spot them is practically impossible.

On the whole, qualitative improvement of Soviet strategic rockets goes along with simplification of their construction, lowering of weight and dimensions, full automation of processes of preparation and starting, increase of combat possibilities of the weapon.

All of this, taken together, excellently ensures maneuverability and invulnerability of the rocket forces. And if to this one adds the fact that our rockets are the most exact and powerful in the world, then it is possible to imagine what this punishing sword in the hands of Soviet people has for any aggressor. After all, fifty and hundred megaton nuclear charges are not an empty threat, but a real warning to lovers of military adventures. During mock firing our strategic rockets more than once delivered the nuclear warheads to the targets. The same way, unfailingly and confidently, they will do this in case of military attack on us by the imperialists, carrying uncontrollable retribution to instigators of war, wherever they are.

As test showed, we have rockets able to get exactly in an assigned square from a distance of 13 thousand km. Such remarkable accuracy distinguishes the control system of the rockets. Especially cleanly goes the launching of rockets, action of measuring systems and equipment. The successful launching of improved variants of carrier rockets for objects in outer space in the region of the Pacific Ocean portend further mighty steps in mastering of outer space, strengthening of the defensive capability of our Native Land.

Victories in Space and Contribution of Missilemen

...A countdown of minutes remained prior to the launch of the space rocket. Then there is a short, like a shot, command "launch" which resounded. The site where the rocket is purified from service structures, rapidly began to be blanketed by thick gray smoke. Below there appeared an unbearably bright, eye piercing column of flame. Resting on it, the rocket, it seemed still stood, as if it has not decided to detach from earth; and only peals of thunder shook everything.

In an instant the rocket trembled and slowly lifted upwards. At this moment one journalist compared it with a tailed sun. It travels faster and faster, breaking the mighty path of terrestrial gravity. It is already high in the sky like a day star. Soon it appears as a little flame. The calculation point approaches where from the rocket the spaceship will be separated, which awaits the carrying out of space navigation.

Thus there is begun the film "Russian Miracle," unforgettable frames of which recorded the putting into orbit by the powerful space rocket of the ship Vostok-1 with Yuriy Gagarin on board. Authors of the film justly consider this moment the greatest expression of achievements of the Soviet people, having surmounted as the spaceship did terrestrial gravity, the oppression capitalistic exploitation and in an unparalleled short period accomplished under leadership of the Communist party the authentic jump from darkness to light, from backwardness to progress.

Soldiers of rocket forces and soldiers of all forms and kinds of armed forces are proud of our remarkable victories in space by the fact that in these victories is found the contribution of missilemen who carried out launching of space rockets. A serious test of the preparation of crews of rocket forces, noted in his time the Commander in Chief of rocket forces of strategic assignment, appeared the launchings of ballistic rockets with satellite vehicles Vostok, providing successful fulfillment of assignments of the party and government by Soviet astronauts in their historical flights into space.

How the inspired missilemen worked at the spaceport on the historical day of 12 April 1961 during preparation for launch of the spaceship of Yuriy Gagarin the author of this book heard from the commander of the missilemen of the spaceport.

"With great pride," said the commander, "we received the news about the fact that we were trusted to carry out launching of the gigantic rocket with a man in the spaceship. The personnel were literally inflamed by this matter. When periods of the forthcoming flight were well-known, communists gathered, in order to determine their tasks. They gave the work to do everything possible so that the celestial space year would be flawless.

In the process of preparation of the rocket for launch those who check it later will be convinced of the good condition of the assembly and fasten a flag to it. The nearer the launch approaches the more the flags are scattered on the gigantic rocket, and the higher the confidence in the unfailing action of the entire complex of mighty technology.

In the morning on the eve of the launch the last check of the rocket was made. Everything was normal. At 1300 hours there was a meeting of Yuriy Gagarin on the launch site with the launch crew. Several dozen people gathered to see and listen to the first astronaut. It was a very good, cordial meeting.

"All my life I will remember," continued the commander of the missilemen of the spaceport, "the sunny morning of 12 April 1961. Yu. Gagarin arrived and was accompanied by the chief engineer to the elevator. This was an important minute. Soon our comrade will depart into space, and the whole world will learn about the great feat of the Soviet people. Here the elevator easily carried him upwards, stopping at the entrance into the cabin of the spaceship. On land everyone quickly went to their work stations. No one remained on the site. A loudspeaker counts off the minutes remaining before launch. At the ground control center everything came to a standstill in expectation of the forthcoming event. Officers at control panels attentively watch readings of the numerous instruments about the readiness of different systems. One after another reports follow. The chief of the launch crew reports to technical leader about the readiness and asks permission to launch.

A hand slowly descends on the "launch" push button. The final seconds tick off. Then the push button is pressed. The rocket faster and faster shoots upwards.

We see on screens of television sets how brightly the cabin was illuminated by sun rays shining through the illuminator. Yu. Gagarin began to report in detail about his health, G-forces, separation of rocket stages and operation of systems of the spaceship. Everyone held his breath and listened to the transmission of the first astronaut."

The motherland rated highly the feat of Yu. A. Gagarin and those who prepared its flight into space. We, the Soviet people, are proud of the feat of Yuriy Gagarin, and we are delighted with the scientists, engineers, technicians and workers who put their mind and heart into the creation of this ship and in its amazing flight.

Before the launch of the space man-carrying rocket, all scientists, designers, engineers, and workers - in a word, all specialists, including missilemen, fulfilled the gigantic preparatory work every stage of which signified historical stakes in the journey of conquering space.

From the first satellite to manned space flight, .. 4 October 1957 began an era in the conquering of space by earth inhabitants. It revealed the flight of the first Soviet artificial earth satellite launched by Soviet missilemen.

The first achievements of Soviet missilemen in conquering space made an enormous impression in the whole world. As the New York Times wrote, "American tourists in the USSR suffered from a unique sickness - satellitemania. They had a deep sensation of their inferiority, founded on the assumption that as soon as Soviet rockets are better than American rockets, then everything Soviet should be now or in the very near future better than all of ours."

Curiously there is another acknowledgement of the American press: "The wide use in the West of the Russian word "sputnik" instead of the heavy American term "artificial earth satellite" is, incidentally let us assume, not the main, but nonetheless an important evidence... of the priority which Soviets have in conquering space."

After the first satellite in outer space there were launched even more perfected satellites of earth, sun and moon and automatic stations. All of them were launched by Soviet missilemen. Soviet scientists obtained extensive information about space, which enabled them to solve even more complex scientific problems. A check of the skill of the missilemen was made by subsequent launchings. A message with the coat of arms of our native land was delivered to the moon, and the invisible side of the moon was photographed.

The moment came nearer when a Soviet person would take the decisive step into space. In May of 1960 there was put into orbit the first spaceship-satellite of enormous weight - 4.5 t. In the pressurized cabin of the spaceship there was provided all that was necessary for simulation of a pilot; even a special load simulated the weight of the astronaut. In this experiment systems for providing safety of the flight, the control of them in space were tested. August of 1960 was marked by the launching (by Soviet missilemen) of the second spaceship into orbit as an earth satellite. Its weight without the last stage of the carrier rocket was 4600 kg. In the cabin of ship there were animals, including two dogs. The most memorable thing connected with the launching of this ship was the successful return of it to earth after fulfillment of twenty-four hours of the program of investigation. The control system and arrester of the ship operated with high accuracy - deviation of the landing point from that calculated amount to a total of several kilometers. It is significant that the aircraft passed through the earth's atmosphere unharmed due to a special heat shield. Good health was preserved for the animals who accomplished takeoff, flight into space at a distance of over 700,000 km and landing. The fact that the return of the ship to our planet, and also vital conditions in the cabin during prolonged flight were so successfully ensured was indicative of the approaching flight of man into space.

And yet Soviet scientists conducted many experiments before a spaceship with a person on board launched by missilemen, was put into orbit as an earth satellite.

Let us give systematized data on launches of rockets, showing boundary marks of the path which led a Soviet person to triumphal flights into space.

4 October 1957 - first artificial satellite. Weight - 83.6 kg. Duration - 94 days, made 1440 orbits around earth.

3 November 1957 - second artificial satellite. Weight - 508.3 kg. On board was an experimental animal - the dog Layka. Duration - 163 days; it made 2370 orbits.

15 May 1958 - third artificial satellite. Weight - 1327 kg. Duration - about two years. It made over 10,000 orbits.

2 January 1959 automatic space stations Lunik-1. Weight of last state of rocket - 1472 kg, weight of station - 361.3 kg. It turned into an artificial satellite of the sun.

On 12 September 1959, with the help of the second rocket the station Lunik-2 was launched. Weight of the last stage of the rocket - 1511 kg, weight of the station - 390.2 kg. It delivered a message with the State Emblem of Soviet Union to the moon.

On 4 October 1959 the third space rocket took into space the station Lunik-3. The weight of the last stage of the rocket was 1553 kg, and the weight of the station was 278.5 kg. It orbited the moon and photographed its reverse side and transmitted the photographs to earth.

15 May 1960 - first spaceship-satellite. Weight - 4540 kg. On board the ship there was a pressurized cabin with a load simulating the weight of a person.

19 August 1960 - second spaceship-satellite. Weight - 4600 kg. On board the ship there were dogs Strelka and Belka. The ship, together with the experimental animals, successfully returned to earth.

1 December 1960 - third spaceship-satellite. Weight - 4563 kg.

4 February 1961 - heavy artificial earth satellite. Weight - 6483 kg.

On 12 February 1961 an automatic space station to Venus was launched from a heavy earth satellite. Weight of the automatic space station - 643.5 kg.

9 March 1961 - fourth spaceship-satellite. Weight - 4700 kg. On board the ship were the dog Chernushka and other biological specimens. The ship together with all its living inhabitants, successfully returned to earth.

25 March 1961 - fifth spaceship-satellite. Weight - 4695 kg. On board the ship-satellite were the dog Zvezdochka and other biological specimens. The ship returned to earth in the assigned region.

These and our other achievements in space are, undoubtedly, the result of heroic labor of all the Soviet people. The launchings of space rockers for those who sent them into stellar expanses, serve

as a unique testimonial of remarkable skill, innovation, deep understanding of duty, and mutual gain.

One day there came to the editorial office of Krasnaya Zvezda [Red Star], after delivery of tests, in the Correspondence Branch Academy, missilemen Vitaliy Kolesov. He told a great deal how he and his friends from the spaceport participated in the launchings of space rockets, satellites and spaceships. Soon readers of newspaper could become acquainted with stories of the space missilemen. Modestly he says almost nothing in the articles about himself but only about the others, although he himself played far from the last role in the preparation and realization of the space launching.

Vitaliy Kolesov, with a special sense, talks about the selflessness of space missilemen, high responsibility of one for all and all for one. It is in this respect such a case is significant.

The missilemen prepared for launching of a station which became the first artificial planet, satellite of the sun in history. Its launch was on 2 January 1959. Here in the new year night everyone of the launch crew in the testing body checked the future envoy of earth. The check was completed, but no one departed from the body. This was not by order, but it reflected their internal need to do everything literally everything, on rocket; otherwise, to them even the new year holiday would not be a holiday. Words of the senior chief, called here the "Supreme Launch Commander," did not help. He proposed:

-Let us finish. We have still time. Moreover, it has long been known that one is fresh in the morning.

However, engineer-tester Vladimir Ivanovich, on behalf of everyone, protested:

"There will still be a holiday. But for us to leave the rocket at least with the slightest doubt is unbecoming."

Everyone remained: they decided to check not just one section, but the entire rocket again. They rested a little and smoked. Only Vladimir Ivanovich was not among them. When the launch team returned to their work station he already waited for it there.

"I was thinking and, you know, I decided that we can accelerate the check."

"How is that?" resounded the surprised cries.

"Remember, we had talked earlier that it is possible to consolidate the operation? So before the new year let us do this. Vladimir Ivanovich showed his calculations.

Everyone became acquainted with interest. The "Supreme Commander of the launch," whose word was decisive, as missilemen say, gave the word, and work was carried on in a new fashion.

It is necessary that the unforeseen had to happen! One of the personnel dropped a screwdriver inside the rocket. To look for it there was like looking for a coin on the bottom of the sea. The crew was upset - "was it necessary to be so careless!" But Vladimir Ivanovich did not lose his head. Having cast a look in the direction of the guilty, he loudly and confidently ordered someone to bring a magnet. Like a swarm of midges on the world, the metallic screwdriver flew to the strong magnet. Here it was, ill-fated, in the hands of Vladimir Ivanovich. Silently but very expressively missilemen referred to the inadvertence of their comrade. This surely, would be the most memorable night in his life when he tried to do more than everyone and better than everyone.

Meanwhile the check continued to the end. When before midnight there were just several minutes, Vladimir Ivanovich declared:

"That is now everything. Our space work is on schedule. Happy New Year, comrades!"

What happened there then! Everyone embraced and kissed each other. Their hearts were filled with joy because the rocket was completely ready for launching. Now they could celebrate the new year. Vladimir Ivanovich suddenly turned to all with the proposal to greet the New Year at his house. Everyone noisily expressed his consent. Only the transgressing technician was silent. Vladimir Ivanovich noted this. He said, "Everyone goes, everyone!"

A thankful smile changed the expression of alarm on the face of the technician.

...Another case is associated with launching of the automatic station into space. The command appraised highly the success of the missilemen and decided to note their work. The chief of the launch crew was assigned to select people for encouragement. He could not select one who differed from the others.

"This is impossible," said the Central Launch Board, "think further."

But no matter how much the chief thought, it was difficult to select someone. It was decided to award a valuable gift to the actual chief of the crew, but all personnel would be given thanks. So the decision was made. But the recipient in no way wanted to receive the gift, and everyone repeated: "Others distinguished themselves more." He nevertheless took the ultramodern radio receiver and then placed it in foyer of the hostel. "Achievements are made jointly, so let joy be shared jointly."

Such selfless members of a large collective is characteristic of space missilemen. Each man does the maximum - the collective accomplishes the feat. But, in launching satellites and stations, missilemen dreamed about the launching of a rocket carrying a person. In the press it was described the enthusiasm with which they prepared and carried out for the first time in the world the putting into orbit of Soviet spaceships with a person on board.

Further and further into the depth of the universe. In all respects to what Soviet missilemen do, in our flights into space there were immediately taken startling rates. The second astronaut, G. S. Titov, stayed in space twenty-four hours. After one orbital pass there followed seventeen! Especially delighted were specialists of the whole world about the solid reserve of power of Soviet rockets, which enabled putting into orbit the mighty Vostok ships, providing authentic comfort to the astronauts in flight, and also comfort safety to them on takeoff, in flight and during landing.

After flights of Yu. Gagarin and G. Titov the author of this book had a conversation with the designer directing the creation of the spaceships-satellites. He related how preparation for flights of pilots-astronauts Yu. Gagarin and G. Titov was conducted and told about possible prospects of future works, tasks which can be now considered technically real.

"In his time," said the designer, "American newspapers glimmered broadcasting statements about the fact that the United States beyond any doubt and, of course, earlier than everyone else, will send into orbit around earth their satellite Vanguard.

The Soviet Union also declared their intention to launch artificial satellites in the program of the International Geophysical Year [IGY], but this statement was not accompanied by self-confidence base on the effect by publicity. By the order of Central Committee of our Party and Soviet government in the USSR there were conducted operations on the preparation of launching the first Soviet satellite.

All works in the USSR were produced thoroughly, on a solid scientific and industrial base, with the use of the latest achievements of our science and industry in the field of metallurgy, electronics, mechanics, mathematics, advanced technology, chemistry, etc. These works were conducted by collectives of Soviet scientists, designers and highly skilled workers of the most diverse specialties and branches.

In their activity there appeared the best traits educated by party of the Soviet people — deep consciousness of their duty, principle, sense of new ideas, creative approach, collectivism of the people, and closely bound by unity of purpose.

Literally on each step of this enormous work, directed towards the development of Soviet rocket technology, there was felt the daily attention of the party and government.

The Central Committee of the Party and the Soviet government believed in the success of the matter and in creative forces of the Soviet people, although the very problem of penetration into space was so new and complex that it was possible to expect any surprises, difficulties and even failures.

Now it is known to the whole world that these efforts were a successful, triumphal victory of the Soviet people above the gravity force of the planet. In the United States after numerous failures a

satellite was launched just in 1958, but according to their technical data it did not compare with the Soviet satellite. Thus ingloriously the American Vanguard was rolled into the rear guard!

The second and third Soviet artificial earth satellites successfully accomplished their flights, generously enriching science by results of greatest value and giving enormous practical experience. It was resolutely necessary to move forward, and this step was made with great perspective.

There appeared mighty Soviet satellite vehicles. At first there were only test flights, but they differed by a solid sequence and were complex. The last circumstances is of great importance, inasmuch as it provides new progress in the development of rocket technology, in the creation of first-class automatic ground service for the most exact observation and measurements, and in the conception of principles of space medicine, etc.

It is obvious that what Soviet science and technology achieves is only the beginning. Subsequently flights of satellite-vehicles will be a common phenomenon and more prolonged. Scientists work very much on further improvement of contemporary spaceships and on the creation of new orbital aircrafts intended for flights in outer space adjacent to our planet. These flights should serve for establishing high reliability and for fixing of all technology of orbital flights.

Man should and can learn about space and earth, and he should and can freely and calmly fly in space, perhaps using this means for transportation purposes, for transfer of cargo and passengers at higher speeds of motion inaccessible in terrestrial conditions. There can technically realistic be considered at present the development in the near future of satellites for the relaying of communication and television, for purposes of navigation, performance of operational service by observation of atmospheric processes and physical characteristics of earth's surface, which is extremely valuable for weather forecasting (and possibly, subsequently for active formation of weather), and for solar survey, which is important from an astro-physical and geophysical point of view and other applied national-economic and scientific purposes.

Of great interest is a comprehensive study by means of artificial satellites of our earth, as planets of the solar system, of other planets the natural processes developed on them, and life forms there existing.

An important stage in the development of flights of artificial satellites would be the creation at various altitudes of permanent orbital stations existing eternally above the surface of earth.

In this case, besides the many new and complex problems there should be reliably worked out a system of rise on the side of such a station and, of course, the problem of safe descent to earth of service personnel servicing or controlling a similar station. It

would be profitable from a technical point of view to create orbital stations directly in orbit around earth, which would permit making them (considering conditions of weightlessness or the small magnitude of artificial gravity) in a different constructive, technical quality, not quite as the construction on earth in a medium of terrestrial gravitation.

In this direction there are great possibilities in the construction of both orbital satellites and spacecraft for further flights to other planets.

Soviet space rockets, launched in the direction of the moon and around the moon, and also a rocket and automatic space station, launched in the direction of the planet Venus, laid the first experimental routes in the boundless spaciousness of the universe.

Not so far away will be the time when a Soviet person will go to the moon and near planets of the solar system. This will be a necessary and regular stage of study of the universe.

The dreams and plans of the famous Russian scientist, founder of celestial navigation, K. E. Tsiolkovskiy, have come true; he bequeathed "all my labor to aviation, rocket navigation and interplanetary communications — the Party of the Bolsheviks and Soviet power — the true leaders of the progress of human culture.

Today with pride for our Fatherland we can say that the Soviet people under the leadership of Communist Party successfully implements in life the brightest hopes of the Soviet people in the name of peace, happiness and progress of all mankind.

In his story, as the reader could not help noting, the outstanding designer stressed that subsequently flights of satellite vehicles will be even longer. And indeed, in August of 1962 there was accomplished the first group space flight by Andriyano Nikolayev and Pavel Popovich on the ships Vostok-3 and Vostok-4, which lasted several days. This flight created universal admiration. Even in well-developed capitalist countries, which for a long time boasted of their technical power, with special emphasis made acknowledgement of the leading role of the USSR in the development of rocket technology and space studies. "These Russians will try anything... They have accomplished such feats which Americans still have not tried to accomplish," wrote the English newspaper Daily Mail. It was reiterated by the newspaper Rheinische Post from West Germany: "Soviet science celebrates a triumph. The double launching of spaceships into one orbit was exceptional. The flight in zero-gravity state was exceptional. Exceptional was the approach and withdrawal of the "space twins" from each other being similar to a game. The completing record was the double landing. Soviet Union took a gigantic step forward."

Thus, the unparalleled prolonged formation flight was brilliantly completed, and an extensive program of scientific investigations was carried out. First of all one should note a fact of exceptional importance. The mighty rockets, ships and their most complex equipment, created by the genius of the Soviet designers, scientists,

engineers and workers, showed complete unflinchingness in all stages of flight and absolute reliability in complex conditions of the stellar trip. The accuracy with which the missilemen accomplished the launching of both ships is staggering. After all the distinction in the inclination of their orbits amounted to only several minutes of an arc but in distance from the surface of earth a total of several kilometers, that is less than one two-thousandth of the radius of the orbit. All of this clearly indicates that in the field of rocket-space technology in the USSR a higher level is reached than in some other country of the world.

Investigations conducted by our brave astronauts in formation flight were the remarkable continuation of systematic conquering of space started on 4 October 1957. With this flight there were dispersed and removed many doubts and confusion with respect to the possibility of people enduring over a prolonged time the zero-gravity state. It is known that certain medical specialist doubted the possibility of prolonged stay of a person in space.

The flights of Yu. A. Gagarin and G. S. Titov gave valuable material for a correct solution of this problem. The efforts of our scientists during the preparation of prolonged formation flight in space were directed towards the investigation of possibilities of increasing the physiological stability of man's organism to the effect of factors of space flight. Special attention was given to the development and use of methods of the investigation, which allowed determining the peculiarities of functioning of the vestibular apparatus in interaction with the motor and visual analyzers. The vestibular apparatus, as is known, plays an important role in the safeguard of equilibrium of the body at rest and in motion, since it senses the change in position of the head and body in space and also direction of motion of the body. Analyzers are complex nervous mechanisms carrying out ultrafine analysis of certain irritations sensed by organism. Soviet specialists proceeded from the assumption that reactions of the organism to conditions of outer space depend on coordinatedness of operation of the vestibular apparatus, and motor, visual and other analyzers.

Taking all this into account the selection of the astronauts is made, and their training is organized. There were also taken measures in order to improve conditions for a more prolonged stay of a person in the cabin of the spaceship. In order to obtain more thorough data on the state of astronauts in flight, the volume of scientific information from aboard the spaceships was considerably increased. This was achieved by means of biotelemetry, that is, transmission from space to earth by radio of data characterizing the state of the organism. The efficiency indicator of the astronauts was determined by the radio traffic on the space-earth communication channels. With the help of television observation was conducted of the behavior of the astronauts, their motions, poses, etc.

In the course of preparation and the actual formation flight important medico-biological investigations are carried out. It was possible, in particular, to study the effectiveness of methods of selection and training of the astronauts, to check the systems of

life safeguard and safety in flight, to obtain data on the efficiency of the astronauts on different segments of the flight of the ships, on the state of the basic physiologic functions of their organisms, etc.

Thus the first prolonged group space flight in the world gave important data for science. A. G. Nikolayev and P. R. Popovich brilliantly coped with difficulties of the prolonged space flight maintained sufficient efficiency, and especially punctually and orderly fulfilled the scientific program. No pathologic changes were revealed in the state of health of the astronauts after the flight.

Thus the flight of A. G. Nikolayev and P. R. Popovich convincingly showed the incompetence of the doubts of certain medical specialists in possibility of prolonged stay of a person in zero gravity state. Characteristic in this respect is the story of A. Nikolayev about his own health in flight: "I considered that I had to experience the inconveniences... caused by the reaction of the vestibular apparatus in zero gravity state. However neither in the first orbit nor at the end of the four day flight was any trouble with the vestibular apparatus encountered by me or Popovich. Moreover, in conducting for the first time in space vestibular tests, I was careful and tried to fulfill all the prescribed turns by head and movement of eyes in a strictly specified volume. But, by not having detected at least the smallest unpleasant sensations, I began in addition to the program to increase the force of influence on the vestibular apparatus, making many rapid turns of the head to one and another side, moved in the cabin in various directions, revolved around my longitudinal axis with free fall, but the result was the same - no troubles. Pavel Romanovch was right when he said that our vestibular apparatuses were "damped." For pilots of spaceships Vostok-3 and Vostok-4 during flight no vestibular disorders were found."

Successful realization in the USSR of a space flight of great duration means that the time is near when our astronauts will guide their mighty ships to planets of the solar system. This inspiring thought was stressed at a meeting dedicated to the greeting in Moscow of Hero-astronauts A. G. Nikolayev and P. R. Popovich: the formation flight is a new appreciable step made on the journey to interplanetary communications.

Of very great importance is the data obtained during the flight of A. Nikolayev and P. Popovich about systems of radio and television communication of astronauts with earth and of communication between spaceships carried out for the first time in the world. In the ultrashortwave range on land there is usually provided communication at a range of direct vision, but in space conversations between astronauts were conducted at a distance of several thousand kilometers. The distance of communication on short waves in a number of cases exceeded 10,000 km. It is interesting to note that radio communication was not interrupted at those moments of flight when astronauts abandoned their seats and freely floated in the cabin. There were special microphones and loudspeakers providing

communication from any place of cabin. Ultimately there is obtained extraordinarily valuable material on the passage of radio waves and organization of radio communication simultaneously with several ships in space, which permits conducting further experiments with even greater scope and confidence.

In the past in the press much was written about meteoric and other dangers, as if they were waiting for man in space. As a result of the space flights of Soviet astronauts it was possible to determine that meteoric danger is small, and the probability of an encounter with big meteorites, which could disturb airtightness of the cabin, but even more would the astronauts, is even less. It is possible to consider determined also that, apparently, both space and corpuscular radiation are not dreadful to astronauts, in any case in periods when their catastrophic intensification is absent.

Thus the numbers of our astronauts are supplemented. Among them are representatives of various nationalities. Gagarin and Titov are Russian, Nikolayev - Chuvash, Popovich - Ukrainian. In their friendship it is as if there is embodied great friendship of equal and free Soviet people.

There is a completely different picture in the United States. Here even in the area of training of astronauts racial discrimination reigns. Striving to create at least the visibility of prosperity, leaders of the American space program included in the number of astronauts a negro, Edward Dwight Jr. But soon he was removed from participation in preparation for the flights. One of the magazines reported: "Here it is more than a year that Dwight has not been at Cape Kennedy and not at some other base connected with space investigations, but at an air force base in the state of Ohio." E. Dwight himself wrote a letter in which he enumerates cases of racial conditions to which he was subjected during studies. Once he was summoned by a high-ranking officer who said: "What in the devil does a colored man need to in space? I would not let this to occur! If I had my way none of your kind would be permitted to wear the flying uniform."

E. Dwight thus characterized his position to a correspondent of a magazine: "I endured many humiliations... I was not allowed to participate in the space program... In the air force even the words "civil rights" are considered something shameful." Thus racial discrimination, racial oppression, and unequal rights for women, even more manifested in the life of the United States, are reflected in the preparation for space flights.

With their unprecedented feats both astronauts V. F. Bykovskiy and V. V. Tereshkov, accomplishing jointly a flight in space in June of 1963 glorified the Fatherland. The flight of V. Bykovskiy continued for a prolonged time - 119 hours. His ship covered distance of more than 3,300,000 km. The distance and duration attained in this flight indicated the enormous progress of Soviet rocket-building, based on achievements of Soviet science and technology.

V. Tereshkova is now well-known to the whole world as the first woman astronaut in the world. The program of her flight was calculated for twenty-four hours with possible continuation to three twenty-four hour periods. Valentina fulfilled the maximum program, having maintained efficiency and manifesting courage worthy of the Soviet woman. Her stellar trip lasted 71 hours, and she accomplished 48 orbits around earth and flew during that time about 2,000,000 km.

Besides the fully evident importance of a prolonged space flight in which for the first time a woman participated, one should note the fact that the program of medicobiological investigations this time was considerably expanded as compared to preceding flights. There were introduced considerable improvements into the systems, which provided normal vital activity of the human organism. Not by chance after a flight astronauts talked about their stay in space as being in a "zone of comfort." Still wider were scientific observations by the astronauts themselves: observation of constellations, photographing of the sun and edge of the disk of earth during rising and descent of the sun, visual and optical observations from space over the surface of earth. These data will bring great benefit to Soviet science. The experiment obtained as a result of the flight of V. Bykovskiy and V. Tereshkova permitted introducing further improvement into layout and equipment of spaceships.

Table 2 gives comparative data on flights of Soviet astronauts on the ship Vostok and American astronauts in single-place capsules.

The spaceship Vostok became a symbol of the 20th century. How was it arranged? It consisted of two main parts: lowered apparatus and an instrument section. In lowered apparatus, made in the form of a sphere 2.3 m in diameter there is the astronaut and everything that it is necessary to sustain his life in flight and landing after the space trip. In the instrument section there is equipment operating in flight along the orbit and braking equipment. Both units of the ship are connected with each other with the help of four coupling bands.

On the surface of the lowered apparatus there was the heat-resisting shield, and in three illuminators there were inserted heat-resistant glass. Inside the sphere the cabin of the astronaut is found. On the left the panel with instruments is located, which allows regulating the temperature and atmospheric humidity in the cabin, controlling the complex of electronic gear, and orienting the ship in flight.

In reading the description of the cabin, one can think that the creation of the ship is a common thing and, apparently, simple. However, in reality this is not so. Konstantini Feoktistov said, "The spaceship is the most complex of all existing machines. To make such a machine is very difficult." All the parts of the layout of the ship are new and unparalleled, which require for its affirmation in life tedious search, foresight and calculation. After all the total amount of the equipment of the ship Vostok numbers 300 instruments, and in these there are 240 electronic tubes and 6300 semiconductor diodes and triodes, 760 electromagnetic relays and switches.

Table 2. Data on Flights of Soviet and American Astronauts in Single-Place Spaceships

Date of launch	Space-ship	Astronaut	Country	Number of orbits around the earth	Duration of flight	Distance traveled in space
12 April 1961	Vostok-1	Yu. A. Gagarin	USSR	1	1.8 h	41,000 km
6 August 1961	Vostok-2	G. S. Titov	USSR	17	25.3 h	703,000 km
20 Feb. 1962	Friend-ship-7	J. Glenn	USA	3	4.9 h	125,000 km
24 May 1962	Aurora-7	S. Carpenter	USA	3	5 h	125,000 km
11 Aug. 1962	Vostok-3	A. G. Nikolayev	USSR	64	95 h	2.6 million km
12 Aug. 1962	Vostok-4	P. R. Popovich	USSR	48	71 h (in a joint flight with Vostok-3)	About 2 million
3 Oct. 1962	Sigma-7	W. Schirra	USA	6	9.2 h	250,000 km
15 May 1963	Faith-7	G. Cooper	USA	22	34 h	950,000 km
14 June 1963	Vostok-5	V. F. Bykovskiy	USSR	81	More than 119 h	More than 3,300,000 km
16 June 1963	Vostok-6	V. V. Tereshkova	USSR	48	About 71 h	About 2 million km

Especially important are such operations in flight on the Vostok as the determination of attitude, speed and orientation of the ship with respect to the sun and accomplishment of landing.

As a rule, astronauts on the Vostok land separately from lowered apparatus. This occurs thus. At an altitude of 7000 m there is automatically opened the cover of the entrance hatch, and in

two seconds there is catapulted the seat with the astronaut and the parachute system actuates. But the astronaut lands without the seat, as it will be separated at an altitude of 4000 m. The astronaut continues descent by parachute, having with him survival kit and a boat which automatically fills with air. It ensures rescue of the astronaut in case of a water landing. He descends at a rate of 6 m/s. Immediately after landing the direction finder is turned on; its radio signal facilitates search of the astronaut.

The lowered apparatus also returns to earth by parachute, which opens at an altitude of 4000 m.

By the way the seat of the astronaut has one more function: it serves as a recovery facility at launch. In the case of an accident it urgently ejects the astronaut. In supplement to the catapult device there are provided special rocket engines capable of removing the astronaut from the dangerous zone and lifting him to an altitude sufficient for reliable operation of the parachute system.

Yu. Gagarin, G. Titov, A. Nikolayev, P. Popovich, V. Bykovskiy, V. Tereshkova introduced altogether in swift space flight on Vostoks of more than 383 hours. All of them talked with delight about the comfortableness of the ship.

The firstling of the space fleet, the Vostok will remain forever in the memory of our people, and with it are connected feats opening to the people, the path into space and the Universe.

In conversation with correspondents directly at the spaceport, in connection with the flight of V. Bykovskiy and V. Tereshkova, Academician S. P. Korolev emphasized the importance of the further increase in duration of the flights. He called that the flight of the Soviet interplanetary automatic station Mars-1 required seven months. The duration of circling around the moon can amount to 8-12 days. It is natural that for realization of a similar trip it is necessary to adjust well the whole technology and to develop systems of the ship which provide a prolonged vital activity of the organism under conditions of space flight.

The thought expressed by S. P. Korolev about the flight V. Tereshkova is interesting. She encountered overloads expected by an astronaut in flight only during preparation for this flight. Tereshkova was not an aviatrix. Hence this suggests the consequence concerning the high perfection of our space technology and successful solution to problems of training of a nonpilot for space flights. This means we can train as many astronauts as we need.

Speaking of the importance of different observations in space, Sergey Pavlovich indicated the necessity to notice how the seas, rivers, mountains, colors of earth look, as well as its shadow as viewed from space. Knowledge of these landmarks, he explained, will be very important in the return from long-range flights.

To the question of correspondents as to what importance the approach of ships in orbit has, the outstanding designer answered:

"The problems of rendezvous and connection, the so-called attachment, of spaceships are set in the agenda of space navigation. In such a way we will manage to create large orbital stations necessary for research purposes and fulfillment of the role of docks for spaceships. From such docks will be supplemented equipment, fuel reserves, provisions, and the necessary help will appear.

Joint flights of our astronauts serve as a step toward the attachment of ships in space. For the time being spaceships fly according to the so-called self-braking orbits. This means that in all cases, even if the braking mechanisms do not operate, motion of the ship will be delayed by atmospheric drag, and in a comparatively short time it will descend to earth. The question is only in the time and place of landing. The presence of space docks and the possibility of connecting the ships with each other will allow us to use higher orbits and to extend the boundaries of space navigation.

In conclusion of the conversation with correspondents at the spaceport, Academician S. P. Korolev reported his opinion about the flight to the moon. Flight to the moon, he said, is an extremely tempting but very difficult problem. Such a flight of returning from moon to earth is even more complicated. It is certain that in not too distant a time manned flight to the moon will become a reality; although for a practical solution to this problem it will require, apparently, several years.

Thus from this conversation the conclusion can be made that flights of great duration and distance indicate a great step toward realization in the future of trips to the moon, mars and other planets of the solar system.

First space crews. On 12 October 1964 at 1030 hours there was put into orbit an earth satellite by a new powerful rocket for the first time in the world. This was the three-seated piloted spaceship Voskhod. On it were the commander of the crew Engineer-Colonel Vladimir Mikhaylovich Komarov, a scientist - Candidate of Technical Sciences Konstantin Petrovich Feoktistov and physician - Boris Borisovich Yegorov.

The period of revolution of the ship Voskhod around earth was 90.1 minutes, the minimum distance from the surface of earth - 178 km and maximum - 409 km. The Voskhod flew around earth 16 times and after completion of the program landed at 1047 hours.

Thus for the first time no longer one person but a whole collective of Soviet people were in outer space. They worked together friendly, selflessly and creatively.

Success of the flight was furthered by the fact that the designers had constructed a new spacecraft. In it was a three-seated cabin, new instruments, and a number of fundamentally new systems.

For descent of the ship from orbit two retrorocket systems were provided: the main and reserve. This made it possible to select confidently a higher orbit than those which were attained earlier.

The television system of the ship permitted spectators on earth to see not only what was being done in the cabin of Voskhod but also a picture observed from the side of the ship.

The crew in flight observed brightness layers, aurora polaris, measured altitudes of stars, investigated the behavior of liquid in weightlessness. Medicobiological investigations during the flight of Voskhod are especially valuable in that they were conducted not only with the help of radiotelemetry but also directly. This was done by B. V. Yegorov, who observed the state of his comrades. On the whole the historical flight of V. M. Komarov, K. P. Feoktistov and B. B. Yegorov signifies the beginning of a new stage in the development of space studies. It proved that multiseat spaceships make it possible to conduct complex physical and technical and medicobiological investigations of the atmosphere of our planet.

On 18 March 1965 the world learned about the brilliant flight of Voskhod-2 piloted by P. I. Belyayev and A. A. Leonov. This flight was qualitatively a new step in space studies. The egress of man into space, accomplished during the flight of Voskhod-2, opened up a new era in the conquering of outer space. This unprecedented experiment proved that man could not only accomplish flight inside spaceships but also actively function in outer space, fulfilling observations and other operations, in a word, work in space. Hence there are created real prerequisites for the solution of the most complex problems, including flights and landing on the moon and on planets of the solar system.

What problems must be solved by Soviet specialists in the process of preparation for this unusual experiment?

First of all, they were concerned about the protection of a person egressing in free space from possible dangers. The fact is that in leaving the ship an astronaut can encounter meteorites which can have a harmful radiation effect on him. Our specialists, on the basis of scientifically proved forecasts, selected the orbit and time of flight in such a manner that the probability of encounter with meteorites would be minimum. In refining the time of egress of Aleksey Leonov from the ship, scientists anticipated the degree of solar activity.

This flight was thus imminent to improve the system of the satellite vehicle so that Aleksey Leonov could freely emerge into outer space and return to the ship, which flies at a speed of 28,000 km/h.

To stay in unknown space was not a threat to our astronaut: he wore convenient and reliable pressure suit created by Soviet specialists, which weakened the radiation and durably protected him from low pressure, overheating and cooling. He used the autonomous system for safeguard life.

Our medics and biologists who prepared the person for soaring in space had to solve difficult problems. After all, in open space there is no support and motor coordination is constructed differently. Pavel Belyayev and Aleksey Leonov passed successfully this program of preparation.

On land they learned to act as though in space. At the spaceport Aleksey Leonov said: "I very frequently saw in my imagination our flight in space, more exactly, my space experiment. How many times I performed them in my mind, played them over in the ship I am not able to say. These things were very tediously prepared. It, of course, was difficult. We were taken in a pressure chamber to an altitude of forty kilometers. On a jet aircraft we made up to twenty "humps." Furthermore, we conducted tens of conventional flights. All details were worked out on land. We knew in space it would be even more difficult..."

The ship Voskhod-2 traveled around earth at an orbital rate of 90.9 minutes. Its maximum distance [apgee] from our planet was 495 km, and minimum [perigee] - 173 km. This was the highest orbit up to that time that was achieved in manned space flight.

On second orbital pass the fantastic and amazing feat occurred: Aleksey Leonov left the ship. When space television transmitted these historical minutes, the world was filled with admiration. It was striking that a person, being in a vacuum, acts resolutely and calmly.

Being in boundless spaciousness, the Soviet astronaut did not simply watch the surroundings but accomplished purposeful motions, fulfilling elements of working processes. He was 5 m from the ship and stayed in space 20 minutes, minutes of these 10 were in free soaring. As the experiment showed, emergence from the ship into space proved to be easier than that of returning back. However, Leonov successfully fulfilled this operation.

Why is this flight directly connected with the future landing of people on the surface celestial bodies?

A designer in charge of making spaceships answers these questions thus: "For future world space navigation it is important that man learn to "walk" in space. Further investigations of outer space will require that astronauts have the skill to work outside the ship with scientific equipment, and when it is indispensable to repair the ship, conduct, for example, welding operations. There can be cases when the crew of one ship will have to help astronauts of another ship in outer space. This will be possible, if the method of egress of a person from ship is mastered."

An important stage of astronautics is considered the building of manned orbital stations. It will be necessary to change crews on them several times. For this it is necessary to solve the problem of rendezvous, or attachment, of ships and furthermore to create conditions for transition from one ship to another.

In flight there were made TV transmission showing the egress of a person in space. The commander of the ship, P. Belyayev, tested the manual landing system of the ship.

In the glorious ranks of the Heroes of the Soviet Union came two more astronauts - P. I. Belyayev, A. A. Leonov. After them will follow our other envoys into outer space, the conquerors of interstellar space.

Table 3. Orbital Flights of Soviet Astronauts on Two and Three-Seated Spacecraft

Date of launch	Ship	Astronaut	Country	Number of orbits around earth	Duration of flight	Distance traveled in space
12 Oct 1964	Voskhod	V. M. Komarov K. P. Feoktistov B. B. Yegorov	USSR	16	24.3 h	About 670,000 km
18 Mar 1965	Voskhod-2	P. I. Belyayev A. A. Leonov	USSR	17	26 h	More than 720,000 km

The International Aviation Federation (FAI) in autumn of 1965 affirmed as absolute world records the outstanding achievements of Soviet astronauts P. I. Belyayev and A. A. Leonov. As a record the altitude of orbital flight, 497.7 km was affirmed. The time A. A. Leonov stayed in free space was also recorded as a first world achievement.

In the "File of Records" of P. I. Belyayev and A. A. Leonov, represented by the Soviet Union in the FAI, there is contained act on the determination of distance of the departure of pilot-astronaut Leonov from the ship. It was determined by the full length of the umbilical cord at 5.35 m.

In the same file there is a description of the two-seat ship Voskhod-2 a piloted two-seat rocket apparatus. It was developed on the basis of a spaceship-satellite in conformity with the egress of an astronaut into open space. His egress and return to the ship were carried out by the sluice method.

Voskhod-2, as compared to the Vostoks, qualitatively was a new step in the construction of spaceships. But the features characteristic for our first ships are incorporated in it. It consists of a lowered apparatus with a pressurized cabin for the crew and an instrument section. In the pressurized cabin all conditions for vital activity of people are provided; there are reserves of food and water, means of control and direction of operation of built-in systems of the ship, a unit of instruments of radio equipment, television cameras, video channel device, movie and other photographic equipment, equipment for medical and scientific investigations, direction finding equipment on the compartment of descent and landing. In the instrument section there are power sources system of thermal control and a liquid retrorocket system. For duplicating it there is provided a reserve braking solid propellant engine which permitted crossing to a higher orbit. Voskhod, in contrast to Vostok, was equipped with system for soft landing, and crews landed not on parachutes but in the cabin.

As usual, on the surface of the lowered apparatus there is a heat shield. There are special hatches for abandoning of the cabin by the crew. But the main characteristic for the cabin of Voskhod is the sluice device. It permits emerging into space and returning back without decompression of the cabin. For getting out of the hermetic chamber there is a special hermetic cover of a hatch, which can be opened and closed automatically on command from the panel or manually. Through this hatch the astronaut goes into the sluice chamber. Through the other hatch with its hermetic cover he emerges into open space. Two movie cameras photograph the astronaut in the sluice chamber. One more apparatus fixes motion of astronaut "floating" in space. After completion of the egress program by the astronaut in outer space, the sluice chamber will be separated from the ship.

Control of the ship is possible automatically or by means of manual control. In this case there is used an optical orientator to determine the direction of flight and local vertical or ionic plotters of velocity vector of the ship. Signals of ionic constructors of the velocity vector of the ship are indexed on video control equipment of the television system of the ship. The system of manual control of flight and descent was used by P. I. Belyayev magnificently in practice, and this confirmed its high qualities.

A new task of television on Voskhod-2 was the observation of an emergent astronaut. This required the use of two cameras of external observation.

An instrument for determination by the crew of the position of ship in orbit and coordinates of the landing point is original. It is made in the form of a globe rotating about two axes. Under the cross lines plotted on the front glass of the instrument at every moment there appears the terrain above which the ship-satellite flies. Construction of the globe permits introducing the necessary correction into operation of the instrument according to the results of actual changes of parameters of the orbit.

Students continue work of the teacher. The creation of rocket-space systems, with the help of which was carried out the first egress in the world of a person in space, as well as flights of the first satellite and first piloted spaceship, was directed by the outstanding scientist and designer, twice Hero of Socialist Labor, Communist, Academician Sergey Pavlovich Korolev.

On 14 January 1966 in Moscow he suddenly died at the age of 60. Our country and the whole world of science lost a scientist whose name will forever be associated with one of the greatest conquests of science and technology of all times – the discovery of the era of conquering outer space by humanity.

S. P. Korolev was born on 30 December 1906 at Zhitomir in the family of a teacher. From 1927 he worked in the aviation industry. In 1930 without leaving production he finished a course in aeromechanics at the Bauman Moscow Higher Technical School, and in the same year, the Moscow School for Pilots.

Having become acquainted with K. E. Tsiolkovskiy and his ideas, he took a great interest in rocket and space technology and became one of the founders.



Sergey Pavlovich Korolev
(1906-1966).

**GRAPHIC NOT
REPRODUCIBLE**

In 1932 with his participation there was organized group on for the study of jet propulsion (GIRD), a collective of which were created the first experimental rockets.

From this time until the end of his life, he gave all his forces to the development of Soviet rocket-space technology.

Being a young scientist, in 1932 S. P. Korolev, penetrated by an ardent faith in the ideas of Tsiolkovskiy on interplanetary flights and the conquering of outer space by man, began to work in field of development rocket-space technology and became one of the leaders of the largest scientific and technical collectives for development of this technology.

The devotion to work, extraordinary talent of scientist and designer, ardent faith in his ideas, boundless energy and outstanding organizational abilities of Academician Korolev played an enormous role in the solution of the most complex scientific and technical foresight, and this futhered the implementing in life of the most complex scientific and technical projects.

The Soviet people created the mighty rocket technology and opened road to space.

S. P. Korolev was the greatest designer of rocket-space systems which provided conquest of the basic stages of space research. These include the first artificial earth satellite, which was the beginning of the space era, many satellites creating a new epoch in the study of physical properties of outer space, the first flight to the moon, circling of the moon and the photographing of its invisible side, spaceship-satellites and the first manned space flight in the world, and the first egress of man into free outer space.

Friendly parting words before a space flight, advice during fulfillment of a flight, and skill in making the correct decision in any situation were all traits of Sergey Pavlovich.

He escorted Soviet astronauts into space flights and met them after return to our Native Soviet Land.

S. P. Korolev dedicated his life to selfless service of his Native Land and the development of advanced science and technology of our country. His enormous talent, inexhaustible energy and warm heart created deep respect in all who knew him and worked with him. Academician Korolev belongs to a number of those remarkable scientists of our country who made an indelible contribution in the development of world science and culture.

He educated many scientists and engineers now working in different scientific and design organizations. The Soviet specialists he educated and the astronauts will steadily continue and develop the work to which Sergey Pavlovich devoted his glorious life.

The forcing of space programs of the United States. In the United States, in answer to achievements of the USSR, there was started the forcing of programs of space studies. The director of the National Aeronautics and Space Administration, James Webb, stated in spring of 1965 that it will be a long time before in the United States there will be operational rocket-carrier of the same power as the Russians have been using during the last 3-4 years.

"However, you know that the Russians are possibly also working on the development of a more powerful rocket," said Webb. "The fact is that they pulled ahead at the very beginning, and a long time is required to overtake them."

The French journal Express published in the issue for 10 June 1965 an article devoted to the flight of the two-man ship of the United States Gemini-4 with James McDivitt and Edward White on board. It was called: "Bluff in the game where the stakes are space." In it was stated: "The feat of the Soviet astronaut Leonov, whose egress into space from aboard the Voskhod could, owing to television, be observed in the whole world, disturbed the sequence of American plans. In order to accept the challenge of the Russians, engineers of the United States, at the insistence of the President, had to accelerate the program twice..." It was exactly for this purpose that the Gemini flight with McDivitt and White on board was performed. "...With the desire to prove that the United States could compensate its lag and even surpass its rivals," continues the journal newspaper, "they accepted the decision to carry out a space rendezvous. Pilot McDivitt had to fly his spacecraft several meters away from the second stage of the rocket, which had put the ship into orbit. White, emerging from cabin, had to be pulled by hand to rocket..."

The egress of White into space occurred successfully on the third orbit but not on the second orbit as was scheduled. In the Russian spacecraft Leonov had a sluice chamber and thereby had time to prepare for the egress. The small dimensions of the Gemini cabin, conversely, compelled White to emerge into space directly from the cabin...

A lack of space on board the spacecraft also did not make it possible to transmit this experiment by television, since it was impossible to take a television camera. Actually, White and McDivitt were in the cabin in so constrained conditions that they were forced to eject overboard certain scientific equipment... In the end it was necessary to refuse the plans to carry out rendezvous in space... However, from a technical point of view the Americans had no reason to be in such a hurry. The Gemini is limited in its possibilities by the program, since the Titan rocket is not able to send into orbit an additional weight... And whatever the boldness of astronauts was, whatever the courage of engineers was, and even impatience of statesmen, it does not follow to bluff in a game where the stakes are space."

1965 was a year of further development of the investigations of circumterrestrial space. Besides satellites of the USSR and the United States there appeared in space French satellites. Four American astronauts, Lovell, Borman, Schirra and Stafford, accomplished bold flights and almost touched their ships. This was a serious achievement. In subsequent flights American astronauts carried out docking of the ship with the rocket, maneuver of orbits and prolonged egress of a person in open space.

However, the position remains firm that the Soviet Union established the most important stake in conquering space. The press of the whole world notes the high scientific level of Soviet space studies. At the same time the press of many countries criticizes the space program of the United States for its military

directivity and adventurism. "Americans carefreely obstruct outer space," writes the English magazine Economist. "They detonated there at high altitude atomic bombs, amplifying the intensity of the radiation belt... They shot into space copper needles, which would be able, if the American military had their way, to interfere with radio signals sent to earth from space. In an uncontrollable satellite, which flew not, as was assumed, around earth, there revolved deadly American plutonium... Space rubbish collectors -- the ignoramuses continue to obstruct the vacuum above us... old rockets, used accelerators, satellites no longer in commission, some from which still transmit gibberish, and fragments of bombs and needles."

At one press conference of the American astronaut Borman it was asked can it happen that at sometime one of the astronauts will perish. He answered: "We quite inevitably will lose some crew. This has to be recognized. We all lost friends during flights... We will have to pay with money and, of course, lives."

Indeed, the pursuit of space firms of the United States for profit and the advertising racket lead to unnecessary haste, noncompletions, failures directly before launch and in flight. Let us remember at least the despair of the ship Gemini-6 whose flight had to be postponed already after the engines were operating. It is understandable to what danger the astronauts located in the ship were subjected. The flight of Gemini-8 was necessary urgently to abort, since the system of stabilization failed. The crew turned out to be on verge of a catastrophe. In both cases American astronauts had to manifest all their courage and composure.

Is there danger in the flights of Soviet astronauts? This question is answered well by Yu. Gagarin:

"The collective of Soviet astronauts, being in readiness from the first flight to new trips, awaits still many complex experiments in outer space. Are these dangerous? Yes, they are dangerous. But we believe in the reliability of Soviet space technology, in the genius of remarkable Soviet scientists and designers and in the skill of our workers."

New victories of Soviet astronautics. The launching by Soviet missilemen of the Zond into outer space, the maneuvering satellite Polet-2, the Electron systems, and also a number of satellites of the Cosmos series gave new valuable information on outer space. Under conditions of space flight of the automatic station Zond-2, for the first time electro-plasmajet engines were tested.

Space events in 1965 and 1966 are plentiful. Our missilemen worked hard. 16 July 1965 newspapers reported that one rocket carrier put into orbit five earth satellites at one time: Cosmos-71, -72, -73, -74, and -75. On the following day the Soviet press announced the fact that the space station Proton-1 was in orbit. In reports about this launching it was emphasized that for the purpose of safeguarding the fulfillment of the outlined program of space

research in the USSR there was created a rocket carrier with a total power of the engines at 60 million horsepower. It had put into orbit the station Proton-1 and complex instrumentation. The total weight of the payload put into orbit (without the last stage of the carrier) amounted to 12.2 t. This station was equipped with a single complex of equipment, able to record more than 180 parameters. The electronic units of this equipment contained 9000 semiconductors, more 4100 transistors and more 4500 crystal diodes. The launching of the space station Proton-2 was a new scientific and technical achievement. The creation of a unique scientific and rocket and space complex laid the foundation for carrying out earlier impossible investigations of an enormous range of physical phenomena — from processes in the microcosm to gigantic processes of galactic and even metagalactic scales.

On 18 July the automatic station Zond-3 was launched; it was intended for physics studies of the distant outer space and the working out and testing of different built-in systems. In particular, on board the station there was installed equipment for photographing the planets and transmission of an image from distances of up to hundreds of millions of kilometers.

With passage of station Zond-3 past the permanent earth satellite, moon, it photographed that part of it which had remained unknown up to now. Photographs were received on earth and gave in to Soviet scientists new important data on the structure of the lunar surface. There are revealed, for example, borders of the Sea of Spring in the north and even new seas. It was possible to precisely determine their number. Again there are revealed formations not encountered on the hemisphere of moon visible from earth, a chain of small craters hundreds of kilometers long.

World public opinion very highly appraised the new contribution of Soviet astronautics in the study of the moon.

In the same July the Soviet press reported on first results of the exploitation of satellite Molniya-1. It became reliable communication between distant cities of the USSR. The line of long-distance communication through space provided stable transmissions of not only black and white, but also colored television. Through satellite Molniya-1 there was established a regular exchange of television programs between the capital and the Pacific Ocean seacoast.

During May and June of 1965 tests of a multichannel system of telephone communication were conducted. Systems simultaneously transmitted telephone conversations, operated voice-frequency telegraph, phototelegraph, and radio broadcasting. In June of the same year Moscow-Vladivostok initiated a commercial interurban space telephone communication. An achievement was realized about what before was only a dream: a telephone operator of Moscow or Vladivostok collects number of telephones of subscribers of another very distant city and calls them through space. Improvement of all forms of long-distance communication continues in the interests of the Soviet people and all humanity. Experiments in space

communication obtained further development after the putting into orbits of the second and third staellites of the Molniya-1 type.

On 6 November 1965 at 24 hours according to the local time, tens of thousands of inhabitants of Primorskiy Kray, tuned their television sets and were taken to the Kremlin, in the Palace of Congresses, where there began a solemn session dedicated to the 48th anniversary of the Great October Socialist Revolution. They saw the solemn celebration of 1 May 1966 in the capital of our Native Land simultaneously with Muscovites also owing to the Soviet communication satellite Molniya. The quality of the transmissions through space was high.

Here again we want to contrast this noble program to the American program of development of space communication, which is based mainly on the obtaining of profit. As the English newspaper, Daily Mail reported on 16 June 1965, the United States requires such high pay for the use of their artificial satellite that American and English television stations refuse to use it... Officials of English television were convinced that it is cheaper to deliver film by aircraft than to use transmissions by the satellite. And in the United States itself there was boycott of this communication satellite. Commentaries, so to speak, are unnecessary.

Every year even more complex launchings are possible by our missilemen. The brightest achievements in the conquering of space were celebrated by the XXIII Congress of the CPSU.

The station Lunik-9 accomplished for the first time in history a soft landing on the permanent satellite [moon] in the region of Ocean of Storms.

This problem was especially complex. The fact is that on moon there is no atmosphere, and those devices which have already been tested for the landing of apparatuses on earth do not fit there. Deceleration here can be carried out with the help of rocket engines triggered on command from earth. These engines have to reduce the speed of the station to zero at the time of contact with lunar surface. This program of flight control was punctually and clearly realized - the station landed softly on the moon.

Antennas of the station opened 4 minutes and 10 seconds after lunar impact. The moon entered into direct communication with earth.

From the point of view of development of space communication the operation of our laboratory Lunik-9 and the obtaining of information from it on earth can boldly be called the birth of interplanetary communication. For the first time in the history of science we on earth listened to a transmission on radio from the surface of one of the celestial bodies of our solar system. We not only listened but also saw the panorama around the station.

The television camera of the station Lunik-9 was raised above the surface of moon. The radius of its survey amounted to 1.5 km.

The transmitter of the station operated on the frequency of 183.5 MHz. The last performance of communication with the station took place 75 hours after lunar impact.

What did the circular panorama of moon show? Terrain around the station is hilly with separate craters from one to several meters in diameter. Lunar dust on photographs transmitted by the station cannot be seen. Conversely, there is seen rock of the pumice type or slag. It turned out to be durable enough that the station did not plunge through it.

It is necessary to note the high quality of the photographs obtained by means of the station Lunik-9. The complete panorama of photographs was 6000 lines and was transmitted in 100 minutes.

As a result of the work of the first lunar laboratory the intrinsic radiation of our natural satellite is revealed. This radiation, apparently, is caused by nuclear reactions occurring under the impact of cosmic rays in the surface layers of moon. Further investigation of this radiation will help to reveal the chemical composition of lunar rocks.

High accuracy in operation of all systems was required in putting the space stations Lunik-10, Lunik-11, Lunik-12 and Lunik-13 into selenocentric orbit. It was necessary to place the space station exactly in the flight path to the moon and provide control and direction of its motion and clear orientation with respect to the celestial bodies. And finally, there had to be carried out strictly proportioned deceleration near the moon. The station flies as if past the moon, and at a precalculated moment the retrorocket reduces the speed of spacecraft and shifts it into an elliptic circumlunar orbit. All of this was possible to fulfill successfully by Soviet scientists, engineers and missilemen.

What kind of observations were the first lunar satellites to carry out? They refined the question about the magnitude of the magnetic field of our natural satellite, studied the chemical composition of its surface, the temperature regime, radiation, etc... Much was obtained by the measurement of the parameters of motion of the artificial satellite of the moon for a more precise definition of its mass and configuration.

For the outstanding achievements in realization of a soft landing of Lunik-9 and the creation of the first artificial satellite of the moon, collectives of specialists were awarded the Lenin prize.

On 22 February 1966 there was put into orbit the satellite Cosmos-110 intended for biological investigations. On board were two dogs - scouts of space - Veterok and Ugolek. The orbit was so selected that the satellite for a long time appeared in zones of increased radiation of the internal radiation belt of earth; apogee of the orbit was 904 km. The dogs stayed in flight 22 days.

The experiment on the satellite Cosmos-110, with a flight lasting 22 days with two animals Veterok and Ugolek gave scientists new data on conditions of prolonged orbiting, passing through regions of intense radiation, and on the influence of these conditions on a living organism. Without doubt these data will be used in the preparation of new flights of piloted spaceships.

On 1 March 1966 in space studies there occurred an event which literally aroused the whole world. Soviet missilemen hit Venus! Indeed, after three and a half months in outer space the automatic station Venus-3 reached the surface of the distant planet and delivered a message there with the emblem of the Soviet Union. The station Venus-2 several days earlier passed by Venus (at a distance of 24,000 km from it). Flights of our stations to Venus permitted solving a number of fundamentally new problems of interplanetary flights and obtaining valuable scientific data.

At "Stellar Town" in an encirclement of pines there was built a granite wall. Each of the slabs making up this wall symbolizes a flight into space. On a slab there are the names of the Heroes-astronauts. I think that on these tablets one should record the names of those who send the spaceships into the Universe — the missilemen.

Achievements of USSR in space, as in a mirror, reflect the achievements in the development of science and technology and in the strengthening of the might of the Fatherland. Mighty rockets, with whose help our astronauts accomplished their unprecedented space flights around earth, are able to lift and deliver nuclear bombs to any point of the earth.

Our missilemen are always ready for combat. This they have proved by many accomplishments, including the launchings of space rockets.

Soviet missilemen, brilliantly fulfilling missions of the launching of spacecraft Vostok and Voskhod, satellites Cosmos and Electron, stations Lunik-9, Lunik-10, Lunik-11, Lunik-12, Lunik-13 and others, continue works on the testing of powerful ballistic multistage rockets, which are intended for the launching of heavy earth satellites and realization of space flights to planets of the solar system. Splendid accuracy of calculations and the greatest reliability of the most complex technology are the first and main impression which remains, when we think about the niggardly lines of reports about the launching of powerful rockets in the Soviet Union.

Work of Missilemen of Ground Forces

There was not one form of our armed forces which would not be converted radically after the rearmament by rocket technology. This pertains to the glorious victories in battles of World War II

of our ground forces. The basic force of these troops now became major rocket units and units of operational-tactical and tactical assignment, armed with rockets with conventional and nuclear charges.

The period after the XX Congress of the CPSU was an important stage in the development of ground forces. They considerably were reduced in quantity, but their battle capabilities grew considerably. Now these troops are able to conduct highly maneuverable combat operations at an unprecedented rapid rate at great operational depth and under conditions of bombardment of nuclear weapons by the enemy. Their main fire force is nuclear missile weaponry.

Rockets of ground forces could be seen in parades on Red Square in days of national holidays. The first to pass on the square were operational-tactical rockets and tactical, in outer appearance similar to their predecessors, the Katyusha rocket launchers, which obtained glory during the years of World War II.

Combat employment of rockets. Actually, the mass application of solid-propellant rockets — the Katyusha rocket launchers — wrote a glorious page in the combat chronicle of the Soviet Armed Forces. The first baptism of fire of the sixteen-charge rocket launchers was received on 15 July 1941 in the region of Orsha. Having conquered the city, the German-Fascist forces were prepared for further advance forward.

Near the central station there was gathered a great number of hostile infantry, motor vehicles and combat materiel. Hitlerites efficiently bustled about on the terminal area and railroad tracks. And suddenly, as threatening retribution, a "hurricane of fire arrows" attacked them. The area and station were filled with smoke. Ammunition was blown up. Vehicles burned. The Hitlerites, enveloped by panic, scattered. To the outskirts of Orsha stretched a fire glow which did not cease for several days.

This blow was delivered by the first battery of Katyusha rocket launchers under the command of the first Soviet combat rocket commander, I. A. Flerov. Similar weaponry was still not known to the military art of not one country in the world.

Thus the action of Katyusha rocket launchers in August of 1941 was described by the Lieutenant General of artillery, G. Plaskov: "I was at the observation post, when there approached a passenger vehicle. An unfamiliar commander emerged from it, he asked something and then was directed to us.

'Captain Flerov, commander of the battery of rocket launchers,' he reported.

We exchanged glances puzzlingly: No one had any idea about what weaponry was being discussed. From documents which he handed to me the captain was clearly the only one; under no circumstances should the enemy have the secret of devices of a new form of weaponry.

In several days thousands of soldiers and commanders for the first time in their life heard and saw a salvo of the Katyusha rocket launchers.

We at observation post were numb when we heard the first salvo. With a deafening roar, whistle, rolling gnashing, leaving behind huge clumps of reddish black smoke, the "burning comets" traced sky above our heads. And all of this was in just an instant. I grabbed the stereoscopic telescope. My mind could not comprehend what would happen four kilometers from us! There were neither tanks or vehicles left, and even the land burned!

Our hearts were seized with joy and pride for our Native Land and for the creators of the unparalleled threatening weapon."

Germans very much wanted to learn of construction of the Katyusha rocket launchers. In 1941 there was intercepted an order of Hitler in which read: "The Russians have an automatic multibarrelled flame-throwing gun. Shot is produced electrically. During shot smoke will form. Immediately report the capture of such cannons."

Hitlerites began to hunt for the battery of Flerov, tried to cover by artillery fire, attacks from the air. But it, being mobile and easily controlled, was elusive, and the enemy struck outright.

A little time passed when suddenly Flerov attacked in mass the enemy tanks and motor vehicles. Losses were great, and hundred of Hitlerites died. Enveloped by fear of the threatening weapon, the fascists gave it the name "infernal meat-grinder." And with even greater frenzy they looked for ways to destroy the battery of rocket artillery; they dropped landing forces declared that awards would be given to those who will seize and will deliver to them the new weapon of the Russians. But the battery continued to live and smash the enemy.

In October of 1941 the combat path of Flerov's battery tragically broke. The battery of Katyusha rocket launchers in the region of Vyaz'ma was encircled. For along time there were not known the details of the last days of struggle of the heroic artillerymen. Retired Colonel N. Afanas'yev expended much effort in order to find participants of events of those days who remained alive. He found 23 officers, sergeant and soldier from composition of battery of Flerov. Here is what they revealed.

On 7 October 1941 in the region of the village Bogatyr', Vyazemskiy Rayon, Smolensk Oblast, the Katyusha rocket launchers were surrounded by fascists, who tried to take in entirety and safety the rocket launchers and those who with their help struck down the enemy. However, this calculation collapsed owing to the unprecedented courage and selflessness of Captain Flerov and his subordinates.

Not seeing another exit from the most difficult position, Ivan Andreyevich ordered to destroy all combat materiel. And here near the fascist ambush, as if in an answer to squall fire, deafening

explosions resounded. Flerov personally detonated the head launcher. Together with the technical death of the Heroes the commander of the battery and the majority of the personnel perished. For courage and bravery manifested in the fulfillment of missions of command in battles on the front in 1942, the Presidium of the Supreme Soviet of the USSR, by Decree of 14 November 1963, awarded posthumously to Captain Ivan Andreyevich Flerov the order of Patriotic War of First Degree.

Remaining alive, combat companions in arms of Captain Flerov - Lieutenant A. V. Kuz'min, Sergeants I. Ya. Nesterov, A. A. Zakharov and others (total of 46 men) - managed to depart from pursuit of the enemy. They continued to fight the enemy in the name of victory, for the sake of which devoted their lives as the first Heroes-missilemen.

Thus there began the combat biography of Soviet rocket launchers having the official designation BM-13. Since those memorable days even more of these launchers appeared at the front. They participated both in defensive and offensive combat.

Soviet military science developed the most effective principles of combat employment of new weaponry. The chief one among them was the concentration of rocket launchers in the direction of the main blow, a massing fire on the most important objects.

In accordance with principles of combat employment and development of technology of rocket artillery, its organization was changed. In the summer and autumn of 1942 the basic units of rocket artillery were batteries and battalions. Subsequently our command changed over to bigger formations - regiments, and from the end of 1942 there appeared on the front brigades and divisions. The major units were created only for combat employment of heavy rocket missiles. The organizational form of the employment of light missiles remained separate battalions and regiments.

On what fronts was there used rocket artillery during the years of World War II? This question can be answered thus: on all fronts of World War II. Its mobility made it possible to concentrate the main efforts on the main decisive fields of battles. Thus during 1941-1942 in defensive battles in the outskirts of Moscow from 35 to 50 percent of all rocket artillery of the army in the field participated.

Subsequently, in connection with the offensive of the fascists in the south there was concentrated a great number of rocket launchers. Here they were united in maneuvering groups intended for delay of the offensive of the Hitlerites. One such group, created by Colonel Nesterenko, not only successfully operated in coordination but also independently repelled tank attacks of the enemy. Former Commissar of the Battalion, Lieutenant Colonel of the reserve Ye. Yurcvskiy, recalls that with the help of fire of the rocket launchers the tanks were stopped on the road Mecheretenskaya-Novokuznetsovka and on approaches to the Cossack village Peschanokopskaya.

"In the Kuban' and Don steppes," recalls Ye. Yurovskiy, there was developed tactics of the application of new weaponry. Battles with the German-Fascist aggressors in the summer of 1942 showed that the "guards mortar" units are weapons of powerful and sudden fire and crushing blow. We learned to strike with them, rapidly change positions and accomplish swift marches."

In the course of battle on this front the scouts of rocket artillery accomplished a remarkable feat and for the first time caused fire of rocket weaponry. This is what happened. Tanks of the enemy approached toward the observation post. Abyzov, Zhuravskiy and Kravchenko reported to the commander of the small units of rocket artillery: "The enemy tanks are firing on us."

With great spiritual emotion the missilemen fired the missiles at such an unusual target. Soon fire and smoke enveloped the whole region where the scouts were. Only after several days did the missilemen encounter their friends. It appears, they were protected from the effect of fire of the Katyusha rocket launchers ...hostile tanks.

In preparation of a counterattack in battle on the Volga there was concentrated 37 regiments of light missiles and 5 brigades, which numbered 142 battalions of heavy missiles.

Just for the period of defensive fights in the battle on Volga about 3000 salvos of rocket artillery were used.

In the course of offensive operations of the Soviet Army the exceptional qualities of the rockets were completely used for breakthrough of the defense of the enemy on the decisive directions. In certain operations rocket artillery played even a decisive role in the safeguard of combat actions of the troops.

In the middle of August of 1943 the troops of the Bryanskiy front had the task of destroying the big grouping of enemy and liberating Bryansk. Twice the places of breakthrough were designated, and both times it was necessary to cancel them: preparation of our troops was noticed by the enemy. The third time it was decided to carry out breakthrough in the zone of the neighboring army of the Western front and then with development of the offensive to emerge on their direction directly on the flank and rear of the main grouping of the enemy.

Success of fulfillment of the concept depended on the speed of regrouping of forces and means and the safeguard of surprise. For preparation of the operation there were given 40 hours, and then the main burden of the safeguard of breakthrough was put on the rocket artillery. For two nights it was rebased at the needed sector, and toward the outlined period five regiments of Katyushas were ready to open fire. Moreover, with every rifle division there had to advance a regiment of Katyushas.

With sudden mass fire of rocket artillery the defense of the enemy was suppressed, and the hostile troops taken by surprise, proved to be demoralized and lost control. This permitted troops of the Bryanskiy front to quickly rupture the main zone of defense and then successfully develop and complete the operation with a victory.

In the removal of the siege from Leningrad the Leningrad and Volkhovskiy fronts used one and a half thousand rocket launchers. Already in the course of battles, recalls Chief Marshal of artillery N. N. Voronov, an especially difficult situation formed at Coyrov. General M. S. Mikhalkin, who commanded the artillery of the army, pushed forward rocket artillery on this sector. A tornado of fire cleared a path to the infantry, and the base point of the fascists was taken.

Scales of the application of rockets in offensive combats are discussed with such figures. Four Ukrainian fronts before the beginning of the 1944 offensive had 2500 rocket launchers.

The heroism manifested in the first missilemen is indicatively simple facts given in the diary of Gurads Sergeant of the Reserve, I. Bratchenko, sent to the editorial office of the newspaper Red Star. Here are several excerpts referring to the period of releasing by our troops of Byelorussia.

"27 June 1944. Everything merged into the same days and nights. Fight and fight — without end. We went on the offensive 24 June. Early in the morning an artillery symphony resounded. For more than an hour there was such a rumble that, it would seem, any minute the earth would split. The defense of the enemy was ruptured, and we advanced forward and liberated several villages of the Gomelskaya oblast.

We advance actively. Today we rushed so that we arrived up to Rogachev to the river Drut'. But here at the river we ran into a small hitch. Bridges were detonated, the crossing was gone. We saw pines and on shoulders along a swamp drag them for construction of a crossing. None of us had even a dry stitch; everyone is wet, dirty. We are tired, have not slept for several days; guardsmen nevertheless are cheerful, alert, and joke.

We made the crossing, quickly moved to the opposite shore. We found a place for a firing position and then fired a salvo. When we departed the enemy opened fire from their armament. The motor of our combat vehicle was stopped. One after another the shells burst; fragments in several places pierced the cabin. We look, and in several minutes at a terminal velocity another Katyusha rocket launcher rushes toward us. Commander of the detachment Vasily Sokolov first noticed our trouble and hurried for help.

Terrain is well ranged by the enemy, and it conducts fire very accurately. At first they undershoot. Then overshoot. And suddenly a shell burst almost in line with the vehicle. But it did —

not stop until it reached us. From the cabin leaped Sokolov. On his face blood flows: he was wounded by a fragment in the cheek. Squeezing the wound by the hand, he helped quickly to unwind and to hook the cable over the hooks. The reserve firing position was reached safely. Here the chief of communications of the battalion Senior Lieutenant Starikov reported to us: "Good men, guardsmen, destroyed the motor column enemy!"

30 June... Not far from Bobruysk, where our firing position was, during an artillery raid communication with the observation post was disturbed. The communications man Sirotin was given the mission to find the break and eliminate it. Sirotin, crawling and rushing under fire of the enemy, moved in the direction of the observation post. One hour passed then two, and communications was still out. There was dispatched a second communications man - Kozin. He found Sirotin injured in the back and in both hands; he held the cable in his hands but was not able to join it. Kozin repaired the connection and then loaded on his back the gravely injured Sirotin and crawled to the battery. Under intense fire Sirotin was again injured, this time mortally. Thus Kozin crawled to the battery with a dead combat friend.

4 July. Yesterday our troops took Minsk. In battle on approaches to the capital of Byelorussia the commander of the battle launcher, Gorshkov, distinguished himself. By the order of the battalion commander Bel'shin, he and his detachment still before evening not far from the main line of resistance dug out a large shelter for the Katyusha rocket launcher. All night the missilemen remained in ambush. In the morning the hostile motorized infantry and tanks attacked. Here is when Lesha went into action. He struck in volleys with all the power of the Katyusha rocket launcher. In an instant the hostile attack was choked. Tanks were burned. True, some of them tried to escape. But they were unsuccessful: our gunners struck by direct laying and brought to an end the work started by Gorshkov.

11 July. Offensive is continued. Katyusha rocket launchers outdistanced everything and approached almost close to the German screens. Further the line turned out to be severed. Only three combat slipped through. They were destroyed. Our launcher was under fire. There are no trenches. Where will we hide? We rushed with the charged Katyusha rocket launcher. We took a fragment, and a missile of the Katyusha rocket launcher will destroy it and us. One short round! One over! One to the right.

"We will not get hit, no, we will not get it," Khaltushin, commander of the launcher kept repeating. And this is the way it turned out.

"Now let us show him how one must shoot," says the Senior Lieutenant Minyaylo. They "played" with one launcher. From the forest from the rye with arms raised the Hitlerites began to emerge. In their eyes was terror; their lips shook; they gave up.

15 July. War. How much it requires from soldiers! From everyone. This includes that from rocket men, who now we call missilemen.

We just arrived at the firing position and immediately dug a shelter into which the Katyusha rocket launcher freely fits. While digging one becomes so tired using the shovel that the hands shiver. But then the firing and bombing of the machines standing in the shelter are not terrible.

But then the command was given. All fatigue disappeared! The drivers quickly drive their combat vehicles from the shelters, and we then, in an instant, load them. Petya Antonenko, a strong person from Krasnoyarsk, managed to drag the missiles by twos immediately. Nikolay Plekhanov, usually the phlegmatic and sluggish soldier by nature, here at great speed runs to the combat launcher and skillfully loads it. He did it skillfully and in an instant. Great experience and skill come to the fore front.

The launcher is loaded. Again the command sounds: "Remove the caps." Vanya Malkin is on the twin mounts. With quick hands he removes the caps, and like a squirrel, easily jumps to the ground. Then the gunner, Sergey Makotrin, commands how to operate the turning the lifting mechanisms. Here already he reports: "Ready!" We are already in the deep shelters. In the cabin of the combat vehicle there remained only the driver and commander... Crack, rumble, squall fire and smoke. The Katyusha rocket launcher had "played." Again it was loaded. And again: "Fire!"

The work of the Guardsmen is coordinated! To keep learning they spend every free minute at the combat launchers. Mutual interchangeability in the battery became law. Anyone in battle crew can if needed replace a gunner and a gunner and his assistant, the commander. The great training and precious experience is explained the fact that the entire battery one and a half to two times faster than is assumed by norm leads technology into combat readiness.

It is just daylight, and to the battery already arrived the commander of the battalion, Captain Kulik, who thanks us for the good service. Good service! In this war there are coordinated action, skill to smash the enemy, adroitness and keenness. The commander of battalion was stingy with praise, but he was full of gratitude. Praise was deserved. We learned this from one injured infantryman going to the medical battalion. Here is what he related.

"It was still a long time to dawn when suddenly the enemy began firing their mortars and cannons. We knew after the fire stopped there will come the infantry. This was the case after a volley of fire. And here is your captain with our commander of the battalion preparing data. Already Hitlerites were quite near when your captain gave the command to the battery. And suddenly the Katyusha rocket launchers fired. There were hundreds of "fire arrows" through the whole sky! The scene was as in a fairy tale. In one instant the whole front line of the Germans was broken. There was solid fire and smoke."

The infantryman completed his story and then asked who in our crew is the gunner. We pointed to Makotrin. He kissed him and then went on to the medical battalion. We again lifted high into the sky the directing twin mounts of the Katyusha rocket launchers expecting the next command of "Fire."

Thus day after day our first missilemen went to battle. From battle to battle their strength grew. In the Berlin operation in the composition of the 1st and 2nd Belorussian and 1st Ukrainian fronts there participated 44 regiments of 82 mm and 132 mm rocket missiles and also 24 brigades of heavy 300 mm missiles of improved accuracy. The contribution of rocket artillery in our glorious victory was great and influential.

Rocket launchers even now have not lost their importance. This deserved combat weapon rightfully leads the march of rocket forces in days of military parades on Red Square. However, missiles have become now more powerful, the launchers more perfected and the vehicles more maneuverable.

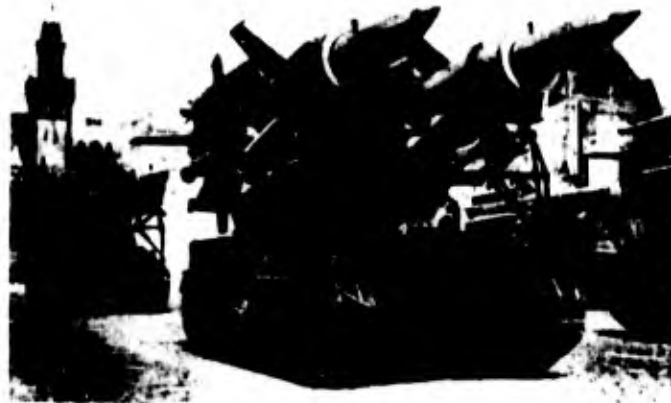
Guided operational-tactical missiles... But of course, the rocket weaponry of ground forces is now not limited to rocket missiles; it is very diverse in power, the character of application and effectiveness. This is well evident at our military parades. Operational-tactical weaponry is represented at parades by silvery rockets with sharp-nosed warheads. Behind them pass rockets mounted on a tank chassis. They have long, slender bodies and sharp noses, and in the tail part there are small stabilizers. The high combat characteristics of operational-tactical rockets have great maneuverability, reliability and accuracy of hitting a target, and these ensure inflicting crushing blows on the enemy. Even the smallest such rocket has the power of a thousand times that of the power of the salvo of the legendary Katyusha rocket launcher.

The main weapon in the ground forces now is the ballistic missile. In guided ballistic missile, besides the engine and warhead there are devices guiding its flight. They are based on the latest achievements in electronics, automatic equipment and electronic computing technology. The flight guidance system of the rocket includes control actuators gas-jet aerodynamic vanes.

In rocket forces of operational-tactical assignment the basic operational system is considered to be the rocket complex. Making up its composition are the rocket, the launcher and all equipment necessary for preparation of the rocket for combat employment. The composition of the complex and arrangement of its units depend on the kind of rocket, guided or unguided, and the kind of engine, liquid or solid fuel.

It is natural that for unguided rockets the simpler they are in construction, the simpler their complexes. The launching of unguided rockets is carried out from launching rails of launchers. In every case the launching rails are given a definite angle of elevation and azimuth. Thus the rocket is guided to the target. Stabilization of it in flight is carried out either by rotation or by aerodynamic stabilizing fins.

Abroad guided missiles with liquid-fuel jet engines have in composition of the complex checking-launch, lifting and transport, guidance-testing, servicing and auxiliary equipment. The control-launch equipment provides prelaunch check and the launch. The launcher itself, as a rule, is disposed on trailers and semitrailers and on wheel and caterpillar chassis. On such a mobile launcher the rocket is completely ready for launching. Before the launch it is given only the needed angle of elevation. Rockets taking off vertically have a launching pad with mechanisms for raising the rockets and turning of the table itself.



**GRAPHIC NOT
REPRODUCIBLE**

New rockets on parade in Red Square

Prelaunch checks are carried out usually from the cabin of the caterpillar personnel carrier. On this personnel carrier there are assembled also a gas turbine engine, electric generators, a compressor and an air conditioning unit. There is a panel for remote launching the rocket.

In examining an enumeration of equipment of the personnel carrier, the reader can say that the engine and generators made up their electric power station of the complex; and this is understandable because in traveling the compressor is difficult to dismantle. The compressor with the conditioning unit produces the air, purified from mechanical impurities and oils. It is needed to test the rockets for airtightness, for servicing the systems of the fuel supply and so on.

In the foreign press there is widely discussed the means of development of complexes of operational-tactical rocket weaponry. Frequently it is debated what benefits are given in the application of liquid and solid fuels. There are stressed the benefits of solid fuel: the engine on it have less weight, the number of moving parts is reduced, and servicing of the rockets is simplified. They have a high reliability and are in constant readiness for launching. At

the same time there are indicated the deficiencies of the solid propellant engine: sensitivity to temperature variations and pressure, difficulty of thrust control and low calorific value of fuel, almost ten times smaller than that for oil. There are merits and deficiencies also for the liquid engine.

For example, there is the possibility of thrust control of great power, and at the same time control of hundreds of moving parts; there is a comparatively long time in servicing the tanks with fuel, etc.

But neither solid propellant engines nor liquid engines are excluded. There are developed both forms of engines. Now for operational-tactical rockets in armies of a number of countries they are beginning to use solid propellant engines with two stages of thrust. Such engines have two charges of fuel, two combustion chambers and only one nozzle. During launch one charge burns and on the journey, the other.

Regarding the development of the liquid engine, the whole world uses preliminary (plant) refueling, which preserves its effectiveness for a long time. The transition to liquid fuel rockets with constant and prolonged readiness for launching is a new stage in the development of the operational-tactical weaponry.

Recently the foreign press has written much about rocket engines using hybrid fuel. It occupies an intermediate position between solid and liquid fuel. The oxidizer in it is liquid, and the fuel is solid with additives of light metals. Hybrid fuel has received limited application in a number of operational-tactical rockets, so it is difficult to judge its future.



**GRAPHIC NOT
REPRODUCIBLE**

Missilemen at their initial position for launch.

There is a continuous development of rocket launchers. Military specialists seek the increase the operational and tactical mobility of rocket complexes, mechanization and automation of technological operations and standardization of ground equipment. It is attempted to make the launchers all-purpose, useful for installation on wheel and caterpillar chassis, as well as for transportation by air. Universal checking equipment, which would allow checking literally all elements of the rocket complex, is being developed.

With the development of new rocket complexes abroad, along with mobility there is given attention to the high fire power and stability. Fire power is increased owing to fire productivity and the use of even more powerful warheads. Reliability of the rocket system is sought by means of improvement of the maneuverability.

Along with the reduction of the time of stay of the complex in the launch position, to increase the stability is is considered useful to reduce the ground equipment and to use camouflage and shelters.

If one were to list the operational requirements of operational-tactical rockets which are declared in the American press, there would be eight basic points:

1. Combat nuclear unit should be mutually interchangeable, of small dimension, and have a power up to several hundred thousand tons.
2. The accuracy and reliability of destroying group and single targets.
3. Possibility of easily and quickly transporting a complex on land and in air and launching a rocket not only from land but also from aboard different vehicles and aircraft.
4. Possibility of regulating the range of operation.
5. The spending for preparation of the complex for launching of not more than two minutes.
6. Does not depend on weather conditions.
7. Complex should not include more than 50 units. Part of the units should be mutually interchangeable.
8. Use of rocket systems should be economically justified for at least 10-15 years.

Of course, in the United States there is no complex now which at least approximately satisfies these requirements. Even solid propellant tactical rockets of the shortest range of operation require more than a half hour for preparation to fire. Search for the best variants of a complex for the field of battle continues.

Many combat characteristics of a rocket depend on the perfection of the guidance system. As the press reports, American specialists do not use now radio command and radio inertial systems mainly because of their sensitivity to interference; and the ground equipment of these systems is rather bulky. Transition to the inertial guidance systems is also not smooth: the accuracy of guiding the rockets to the target decreases, airborne equipment is complicated, requirements are increased for operations for preparation of the guidance systems before launch. To eliminate all these deficiencies of inertial systems gyroscopes and other instruments which enter into their composition will be improved abroad. The duration of operation of the inertial systems is increased so that they can guide rockets not only on the powered flight but also free flight. Even nose cones are controllable. Being separated from the rocket, they themselves will be able to be guided to the target.



Antitank guided missiles in a parade.

Every Soviet rocket complex constitutes a whole system of the most precise instruments, units and vehicles. In it are embodied the genius and labor of Soviet scientists and workers, the achievement of such latest branches of contemporary production as precision instrument binding, special metallurgy, and atomic and electronic industry and others. In the creation of conditions for rapid development of rocket technology there brightly appeared the wisdom and perspicacity of the Communist Party and its Lenin Central Committee and concern for strengthening the defensive capability of our Fatherland.

Operational-tactical rocket weaponry is able to destroy targets at distances from several to many hundreds of kilometers. This means that with this weaponry there can be inflicted blows both on objects in direct proximity or, as was earlier stated, on the forward edge, and those in the rear area. Targets at which there can be used operational-tactical rocket weaponry are usually the most important groupings of troops of the enemy, its means of nuclear attack, control centers, communications centers, and airfields of nuclear aviation.



**GRAPHIC NOT
REPRODUCIBLE**

Combat launching of antitank guided missile.

Soviet Ground Forces have antitank guided missiles in their armament. Such missiles provide reliable striking of tanks at a considerable distance. There are also highly mobile antiaircraft weapons of the ground forces intended for covering them from attacks of the enemy from air both in place and in motion.

High accuracy of firing is characteristic for all Soviet operational-tactical rockets. There is required the shortest time for preparation of them for launching. They possess great reliability, are simple and convenient in operation, and provide to the units high maneuverability and passability on any terrain. It is characteristic that in units of our ground forces armed with rockets there were no emergency launches or abnormal flights of rockets. There did not appear any disturbances or rejections of control system of the propulsion system making it necessary to blow up the rocket in the trajectory. At the same time the foreign press continuously reports that in the United States similar events with rockets, induced by their unreliability, are very frequent.

With pride Soviet soldiers realize that in combat characteristics our rockets considerably surpass the rockets used in the armament of the Army and Navy of the United States and other capitalist countries.

Numerous exercises with combat firing have convincingly confirmed the high combat capabilities of rocket units of the ground forces, the accuracy with which the rockets hit the target, the speed of scanning from the march for launchings of rockets and the ability to move great distances without loss of combat ability. Exercises successfully occurred in a different season, by day and at night and in different weather.

The presence of threatening and perfected operational-tactical rocket weaponry now permits ground forces to carry out combat missions in a new fashion. They can conduct operations on a wide front, in the absence of a continuous line of the front, at a swift rate, inflicting powerful destruction on the enemy. Nuclear missile weaponry permits in a short time finishing off a sharp break in

combat actions. After rocket and nuclear blows completing the destruction of main groupings of the enemy will be tanks, motorized infantry and airborne and other special units in close coordinated action with each other.

In a new fashion problems of the maneuver and concentration of fire on decisive directions will now be solved. Earlier, during the years of the Second World War, to break through the defense of the enemy it was necessary to concentrate up to 250-300 artillery cannons one kilometer from the front. This required the delivery of an enormous quantity of ammunition, control was complicated; and it required considerable time. Now salvos of hundreds and even thousands of cannons are replaced by one-two nuclear missile blows. This maneuver, or, as they now say, the maneuver by trajectories, takes a total of several seconds.

But the question arises: does not the rapid development of rocket troops lead to rejection or depreciation of the role of other forms and kinds of forces? By no means. Soviet military science proceeds from the fact that, although the basic means of conducting war has now become nuclear missile weaponry, victory in war will be attained by joint coordinated actions of all forms of armed forces and kinds of troops.

Unconditionally, as was repeatedly noted in our press, the decisive role in the achievement of basic aims of war will be played by strategic rocket forces. But in contemporary conditions ground forces continue to be considered not only obligatory but also a very important component part of the armed forces. This means that they should be sufficiently strong, mobile, well armed and organized.

As compared to the last war our ground forces have become completely different. The Party and government, in caring about the strengthening of the defense power of the Soviet state, pay great attention to their further development. Our ground forces are disposed with nuclear means, having in their composition such arms of service as rocket forces of operational-tactical assignment, which are the main fire force of destruction of the enemy. These forces are able to strike any object at great distances, rapidly creating a decisive turning point in the combat situation. Nuclear weaponry and rockets of operational-tactical and tactical assignment of our ground forces, as is known, not only do not yield in quality and quantity to foreign models but surpass them.

Missiles in ground combat. It is also worth remembering that military actions in the past were conducted mainly for the purpose of destruction of armed forces on fronts and for simultaneous capture of territory. Offense and defense of ground forces were carried out with artillery and aviation support. Engagements of forces, in direct contact, had decisive value.

Now the principal means of destruction, naturally, is considered nuclear missile weapons, the basic method of conducting warfare — mass nuclear missile strikes. Wide application of nuclear missile weaponry will lead to the formation of numerous areas of complete destruction and radioactive contamination. Military actions will be highly maneuverable and will require great mobility of forces.

Expecting the possibility of nuclear strikes, forces will occupy initial position in broader regions, and the offensive itself will be conducted in wider zones and more widely dispersed combat formations.

In light of new views on conducting combat operations in conditions of application of nuclear missile weaponry there is being reconstructed the organization and combat training of the armies of a number of foreign countries. In the United States, for example, besides usual missile units for direct support of troops there is created a so-called field missile command, designed for rapid transfer to any area of the world. This corps is able to fight at a rapid rate. In the missile command there are squadrons of unguided and guided missiles. To ensure the needed mobility personnel and equipment are distributed on 850 different vehicles. By supporting the field army, the command can operate in a zone up to 200 km in width.

Field missile command is considered in the United States to the latest and most contemporary army. However, in the foreign press it was repeatedly indicated that it is far from perfection. In the United States it is considered necessary to increase the speed of transfer of security, increase the range of missiles, and to simplify their maintenance.

At one time on the basis of the "Pershing" missile in the United States there was created a battalion having in its composition not one fire battery, as usual, but three. Such structure is introduced similar to the organization of field artillery of the past. Besides fire subdivisions, in the battalion there are HQ battery and maintenance battery. Number of battalion personnel exceeds 600.

The composition of every fire battery includes a fire section, containing one launcher, and an ammunition supply section.

The maintenance battery obtains missiles and heads at supply points and delivers them to fire batteries. American specialists are especially proud of the construction of containers in which missiles are delivered: they apparently permit checking the good condition of missile sections and removing defects. Perhaps in

view of frequent failures of American rockets, this measure indeed deserves attention.

"Pershing" missiles are two-stage, and have solid-fuel engines. They are armed with conventional and nuclear warheads. Length of missile in assembled form is about 10.6 m, weight 4536 kg. It is transported by full-track and wheeled vehicles. Range is from 185 to 740 km.

The first fire battalion armed with the "Pershing" was tested under field conditions at the end of 1963. Results were written about cautiously, with a hint on usual difficulties for missile systems of the United States: "Undoubtedly, there is no new system of armament, which would not have deficiencies in the initial stages of its use." But from the fact of appearance of such a system itself it appears that the military leaders of the United States decided to modernize missile subdivisions, which the field army commander may need, as they themselves state, "on the nuclear battlefield."

Considering the presence of nuclear missile weaponry for armies of imperialistic states, our soldiers have to be prepared for operations under conditions of application of means of mass destruction by the aggressor. Therefore, in operations of ground forces in contemporary conditions antiaircraft defense, nuclear protection, and measures undertaken for elimination of consequences of the effect of means of mass destruction are of great value.

Foreign specialists consider that along with nuclear missiles the application of missiles with conventional charges is possible in combat. Their striking power does not considerably exceed that of artillery systems.

It is considered that foreign tactical missiles with conventional charge are still inferior to cannon artillery with respect to certain indices. This pertains, for example, to quickness of opening fire and precision of firing. Thus, the NATO journal "Review Militaire Generale" contained characteristic acknowledgement: "Great successes in the increase of flight range of missiles with tactical operating range (16-120 km for missiles of the United States Army) are reduced at present by insufficient precision of impact." Nonetheless, even missiles with conventional charges, having greater range than any other tactical weapons, permit expanding the combat boundary and increasing the space enveloped by them along the front and in depth. Ships and aircraft, armed with missiles, extend the borders of naval and air battles respectively.

Along with this, taking into account the application of nuclear weaponry, combat operations require particular dispersion of forces. Missiles are just the weapons which are beneficial for the needed dispersion, since even at a considerable distance of units from each other the missiles can provide their mutual fire support.

In the NATO journal of forces on this matter there is stated: "Development of rockets and guided missiles and their transformation

into tactical fire weapons with great operating range and high fire effectiveness (including when firing with chemical ammunition) can considerably provide conducting of combat operations by small units and subdivisions under conditions of large dispersal."

How are the Soviet multiple rocket launchers, which proved themselves well during the Great Patriotic War, assessed at present? You know now with their help it is possible in very brief periods to strike large areas, and to deliver especially effective fire on exposed personnel. Now multiple rocket launchers are recognized as important highly maneuverable fire weapons, with the aid of which it is possible to rapidly concentrate fire in the needed zone. On the offensive they can help in repelling the counterattacks of the enemy, when nuclear weaponry is inapplicable, and in defense - when repelling attacks. For all of these reasons multiple rocket launchers continue to improve.

One more type of missile - guided antitank missiles - have now received wide development. Appearance of effective guided antitank missiles affects the construction of tanks and methods of their combat employment. Foreign specialists consider it important to increase maneuverability of tanks even by means of lightening the construction of heavy tanks, thick armor, etc. Maneuverability can help the crew evade a missile, and mobility will help to rapidly approach the position for launching these missiles and thereby exclude their effective application. At the same time there are developed methods of application of guided antitank missiles themselves as a new means of combat.

It would have been possible to still further continue enumeration of changes in military affairs, caused by the introduction of missile weaponry. Let us note here only that new requirements of control of forces caused the necessity of wide automation, and in a number of cases the application of electronic computers. Radical changes were introduced by new weapons in organization of the rear, and in all forms of operational and combat security. Reconnaissance, for example, should now operate at great depth, with increased rapidity, and with particular precision of determination of target coordinates. In the age of nuclear missile weaponry engineer support, communication, and many others should be constructed in a new way.

Masters of march, maneuver, fire. Technical and fire capabilities of ground forces were increased. However, even today there remains an absolutely firm position about the decisive role of man in warfare. Combat success, as before, will be decided by the personnel. Soviet soldiers, devoted to the homeland, politically conscious, hardened spiritually and physically, while continuously mastering contemporary military affairs, will be able to perform their duty in the most difficult conditions.

Rocket units of ground forces, as other arms and types of forces, thanks to encouragement of the party and government have

highly skilled cadres of commanders, engineers, technicians, and other specialists. Command, political, engineering, and technical personnel skillfully organize combat and political training of missilemen, mobilize them into new successes in mastering missile weapons and keeping them in constant combat readiness. Officers, sergeants, and soldiers of rocket units of ground forces master their first-class weapons with great persistence, learn to perform marches skillfully, carry out maneuver by forces, and deliver crushing rocket fire.

It is possible to name many leading missilemen. Let us refer to such an example.



**GRAPHIC NOT
REPRODUCIBLE**

Column of powerful ballistic missiles on self-propelled launchers.

In the command car, heading the column of "multiple rocket launchers" at a parade in the honor of the twentieth anniversary of the victory, there sat four officers: Lieutenant Colonel L. N. Shiryakin, battalion commander, Majors V. V. Mel'nikov, V. S. Peskov, and V. N. Kiryukhin. All four are veterans of the Great Patriotic War, bearing the combat experience of front line soldiers, by word and deed passing the baton of courage and fame of hot combat years to young soldiers.

V. V. Mel'nikov has great authority in the unit. He is highly respected, especially for fearlessness and combat skill manifested in battles in the environs of Moscow, at Kursk Bulge, at Wisla and Oder, and finally in the den of the enemy - Berlin. He fought in rocket artillery, and by personal experience was convinced in the crushing force of this mighty Soviet weapon. His stories are especially valuable for missilemen. The beginning of Mel'nikov's combat record was as a lieutenant - college graduate. First

acquaintance with the new weaponry did not inspire a special likeness to it - comparatively small missiles in open lattice launchers. Really and truly, so to speak, these missiles are able to generate a tornado of fire... Here is combat on the Western front. Mel'nikov is in reconnaissance of targets for "multiple rocket launchers." This was in 1942 in the region of Kozel'sko. This was his baptism of fire.

While moving along the front, he unexpectedly noticed a difference in the tracing of the advance on the map and in reality. This was at the meeting point of our forces. A rye field seemed uninhabited - neither our forces nor fascists. It had to be certain where the enemy was, otherwise the salvos of "Katyusha rocket launchers" would turn out to be futile. The scouts crawled along, being concealed in a yellowish sea of ripening grain.

They crawled almost across the whole field. Ahead they heard German speech. It became clear where the advanced fascist units were located. It was possible to fall back. But the fascists noticed the scouts and opened fire.

- All goes correctly, - concluded Lieutenant Mel'nikov, noting the hostile fire weapons. But mortar shells and projectiles fell increasingly closer and closer. The scouts had to start something. The battalion medical assistant proposed:

- I will reveal myself. You fall back...

The lieutenant, touched, embraced him. The medical assistant opened fire. And for a long time afterward the scouts heard how in thunder of fascist guns there were interlaced sounds of short burst from the medical assistant.

Quickly Mel'nikov was at the command post of the rifle unit and by radio to division headquarters he passed precise data on German fire weapons of the fascists, concentrated in the region of Kozel'sk.

Then over the head of Mel'nikov and his comrades fiery arrows of rockets swept pass. Above the ripe rye and further above the positions of fascists there arose a column of smoke, mixed with dust... Our troops almost without losses seized the point of resistance of the fascists. This first combat of Mel'nikov was noted by the command. He received the medal "For courage" from the hands of Mikhail Ivanovich Kalinin himself. This turned out so. The battalion of "Katyusha rocket launchers," in which Mel'nikov served, Millers, was directed to Moscow for reforming. Here the soldiers distinguished in combat were handed awards. To be in the Kremlin, in the center of the capital and the entire country, - what enthusiasm enveloped the then decorated, with what zeal they began to prepare for new grim battles!

...Then there were battles at Orlovsk-Kursk Bulge. Fascists were ready for the offensive. On 5 July the battalion changed

position at night. All night they dug in, organizing at the new point. Mel'nikov, just now handling the battery, directed preparation of the position, his subordinates. Our artillery conducted counterpreparation for morning. Above the location of fascist troops, prepared for the offensive, for a long time there ranged a firey tornado.

Burdensome silence advanced on the dawn. The tired soldiers of Mel'nikov's battery arranged a rest. Some expressed doubt: was it worthless to change position, after all the other battalions remained at their places. Suddenly one interrupted the conversation by a shout:

- "Junkers" are coming!

Indeed, from the west there was heard the characteristic howling of the engines of fascist bombers. They looked intently - in the sky as if a cloud - there were groups of aircraft. When they arrived and started to bomb the disposition of Soviet troops, artillery shelling resounded - the enemy started preparation for the attack. Our fighters moved toward the Hitlerites, in the air a deadly merry-go-round twirled...

As soon as it was cleared up, the battalion, having changed positions at night, suffered much less than the others from bombs and shells. When the fascists were able to be wedged by tanks in one direction, this battalion, as the most combat-ready, was moved into the dangerous point. And the guards showed themselves worthy. For one day the battalion gave 30 two-machine salvos on tanks and motorized infantry of the enemy, inflicting huge losses on them.

Then with the same fire intensity the battalion operated on approaches to the Ponyri station. The enemy could not overcome the fire screen, set up by soldiers, including missilemen, in its path.

And here our troops changed to counterattack. The battalion of "Katyusha rocket launchers" was transferred to the Ol'khovatka region. There it, being dug in at a ridge, spent the entire day under bombardment, but it accomplished the mission: help our forces cut off the Hitlerite tanks from the infantry and destroy them separately.

On the breast of V. V. Mel'nikov's rocket battery commander there sparkled the combat Order of the Red Banner. In days of the most intense battles Vasilii Vasil'yevich was accepted in the ranks of glorious Communist Party.

And still more battles and more engagements. Wisla, Oder, Zeyelovsk hills, and finally the finale of the war - Berlin. The battalion in which V. V. Mel'nikov served delivered its last salvo on Reichstag and Tiergarten. This was one of the last salvos of the war. After this artillery attack the command was heard:

- Clean and paint the vehicles. For you the battles are finished.

Joy and triumph enveloped the guards. Light feelings were increased and new decorations adorned the breast of missilemen. Vasilii Vasil'yevich for courageous and skillful leadership of the battery of "Katyusha rocket launchers" in the Berlin battle was awarded with the Order of Aleksandr Nevskiy.

...Another veteran of present subdivision of missilemen, its commander Lieutenant Colonel Shiriyakin fought in motorized infantry units; Major Kiryukhin, deputy for political affairs, was gun commander, and was awarded the Order of Glory for courage manifested in the Kishinevsko-Yassk operation. Peskov, the party bureau secretary of the battalion, took part in battles with the enemy 900 days in blockaded Leningrad. He participated in the breakthrough of the blockade in the Ladoga region.

Under the leadership of officers-veterans the missile subdivision strives for new successes in combat training. Here there is attained 100-percent proficiency rating. Since 1954 the advanced battalion constantly participates in parades. It conducts exercises and firings excellently.

Among the officers-missilemen we encounter a participant of the war, having obtained the rank of Hero of the Soviet Union in its very last days. This is Yu. V. Sadovskiy. During the war he served in a tank-destroyer artillery regiment, named in frontline use by the regiment of Moscow workers. The fact is that it was formed in the capital basically from young people of Moscow plants. This regiment traversed a great combat record, but its most severe test was held at Berlin. It turned to be that in its entire route it as if gathered forces, in order to accomplish a glorious massive, I would say, regimental, feat.

This was southeast of Berlin. The frenzied Fuehrer in the imperial office basements dashed around in hysterics, expecting, conjuring, hoping for the approach of the army of General Wenka from the southeast for help of the Berlin garrison. From the Kottbus region a grouping of fascists rushing to meet Wenka, to link up with him, was broken. Between the forces of Wenka and the Kottbus grouping, having occupied a perimeter defense and keeping them from moving toward each other, our forces stood to the death, and included in their number were tank destroyers. Three days without letup they struck tanks and motorized infantry of the enemy, being possessed in thrusting forward, not paying attention to losses. Precious time was gained. Hitler never lived to see Wenka, whom our forces at first stopped, and then destroyed. Disposition of the regiment of Moscow workers toward the end of the glorious battles were surrounded by heaps of eradicated and smashed equipment, and hundreds of corpses of killed fascists. But our regiment also paid a dear price for victory. Of 500 soldiers and officers there remained only 54. Of 24 guns there were only two in service. One-hundred thirty-eight soldiers and officers were awarded Orders. Eighteen men received the rank of Hero of the Soviet Union. To many these awards came posthumously. The remaining living soldiers buried eight Heroes of the Soviet Union literally on the eve of victory.

In that memorable battle Sadovskiy became a hero. Now, while training young missilemen subordinate to him, Yuriy Vladimirovich tries to inoculate them with the courage and staying power necessary for conducting contemporary warfare, in which collectivism, coordinated friendly efforts of all personnel have become still more important, still more necessary than earlier.

Officers of this unit under the leadership of their commanders in several years mastered different types of missiles. Many subdivisions during these years were constantly excellent. Namely such a subdivision headed by Captain V. Poroshin proved itself.

Initiative was born in the unit: soldiers do the work of technicians. Its initiator - Pvt. Yuriy Alabin, delegate of XIV congress of Lenin Komsomol. In the struggle for mastery by knowledge in the volume of technology there immediately joined in Pfc's Gorbuntsov, Vatov, Tarakanov. All of them already do the work of technicians. And not only they, but another 32 soldiers are prepared for this.



Ballistic missile
before launching.

**GRAPHIC NOT
REPRODUCIBLE**

Yu. Sadovskiy and other officers strive so that in each subdivision there would be a strong monolithic collective, able to jointly solve any combat problems. Officers-veterans pay much attention to graduates of academies and schools arriving at the unit. And it is no coincidence that here they rapidly enter combat formation. It is possible to refer, for example, to the experience of Lieutenant G. Rozhin, Communist. In a half a year stay in the unit



**GRAPHIC NOT
REPRODUCIBLE**

Missile crew operates precisely.

after school, with help of senior comrades he mastered a new system for it. And he manages a complex matter. He is commander of the headquarters platoon. But this did not confuse the lieutenant. He obtained first-class skill, mastered the method of instruction, became a good lecturer, and leader of political education. He skillfully approaches training of soldiers and sergeants, although many consider him their own age. He is with them in the combat toil of exercises, on the ski-track and on the athletic field. Rozhin has a second-class athletic rating on skis and all-around combined tournament.

Thus, in peaceful studies there are fostered and consolidated for missilemen those qualities which will allow him to stand out and to crush the enemy in the most violent contemporary combat.

Enthusiasm. Before officer Grigorov there stood agitated battery commander Valuyev. Without looking into the eyes of the

commander he stubbornly repeated:

- I ask you to transfer me from this unit into ordinary artillery. Here I am, as on thin ice...

Gigorov studied his subordinate, lightly tapped his boot with a branch. This was not the first conversation with Valuyev. It is a familiar song. He did not want an experienced officer to go hat in hand to missiles, he considered it better to remount his familiar artillery "hobby-horse." This began from the moment he arrived. As he saw how complex the technology was here, he immediately "soured." "But after all he has self-respect, and proudly should have said: I am a missileman, I'll master the new weaponry. But no, it is not apparent now. How can they be forced to speak?" - thought Grigorov. And aloud he said:

- How do you not notice that side by side with you there is a miracle. It yields to you, but you want to pass by indifferently. Let us sit... - offered the commander and first made himself comfortable on the grass under a birch. Next the battery commander dropped down reluctantly and sat in a rather inconvenient and constrained pose.

- I have grown fond of our missile, - continued the commander. - I like it more than any ballistic. It is true, she has a very complex system, but then what an intelligent machine! It's both reliable and precise - you'll fall in love with it.

- In outward appearance it is beautiful, but you do not know how it will show in firings, - countered Valuyev with restraint. He sat with the appearance of a person who knows in advance that no one will change his mind.

Soon it came time to drive the missilemen to combat firings. Valuyev together with everyone was prepared for them, although without enthusiasm. Grigorov, watching him, strongly relied on the firings - it is impossible that they would not work. The captain needed a good scolding.

And the scolding was not long in coming. On the firing range, where the missilemen arrived, they had to pass firing tests... And... Valuyev did not pass. You should have seen the disappointment of the entire crew. Only the commander at first tried to swagger: "We did not pass immediately, so we will pass later on." But his appearance said otherwise. With envy he and his subordinates looked at Senior Lieutenant Zhizheyko, at the rush of passed test. The battery in which the senior lieutenant served was already prepared for firing, but Valuyev and his crew again sat behind books, at instructions, and took training. "It seems our doubting Thomas is seriously worried," - thought Grigorov watching him.

Meanwhile the crew, where Zhizheyko was the operator, came to the launching sites. Topographers entered in matter - they were faced with attaching the launch point, determining its coordinates, and laying the direction to target. The crew managed this problem.

The launcher arrived at the launching site. The driver accurately turned it in the needed direction.

- To action! - resounded the command.

Soldiers stuck to the instruments. Computers prepared data on the target. Complex check began. Simultaneously there was determined error of turn of launcher with respect to the direction on target.

Readings of instruments are introduced into missile equipment together with data prepared by computers. And the missile received the order. With this there were considered wind, effect of rotation of the earth, and error of turn of launcher...

Soldiers of the other crews vigilantly watched their comrades. The attentive gaze of Valuyev also was not taken away from the launch. Everyone was very pleased with the fact that members of the crew with the help of push buttons controlled formidable equipment. In fact, the people could scarcely be seen: so small was the crew, considerably smaller than the weapons.

The moment of launch approached. The driver and operator were stationed at the panel, far away from the launcher.

The operator pressed the "Launch" button. In an instant the silvery missile escaped from the container as if it acquired wings, and gently climbed, leaving behind a dark stream of hot gases. In a second the missile shuddered, being freed from boosters, and, harmonious, obedient to the will of man, rushed toward the invisible target.

- What a weapon we have in our hands! - exclaimed the operator, turning to Valuyev. He only waved his hand and began to walk toward the trainer.

Lately in the evening the flag of the tent was raised, and Valuyev entered awkwardly, somehow sideways, toward Grigorov:

- It's a pity that I did not fire first. But I surely will be second. I will not allow misfires.

And it was true, Valuyev's crew conducted the following firings. You should have seen how thoroughly and even enthusiastically they were prepared. Grigorov was agitated: was Valuyev's just born attachment to the new weaponry tested? Failure could crack his still fragile enthusiasm.

After the missile was concealed in the misty haze of the horizon, we began to wait for the result. The news came quickly: The target is destroyed. The entire evening the crew did not cease recollections about the firing, and gay jokes. Thus dedication took place among the missilemen.



**GRAPHIC NOT
REPRODUCIBLE**

Night does not hinder the missilemen.

Having returned to winter quarters, the soldiers learned that they were going to participate in the military parade on Red Square. Valuyev was included in the gala crew, noticeably cheered after the firing. Passage along the block of Red Square under the delighted looks of thousands of people strengthens the high sense of participation in great accomplishments of our time, in the state interests of beloved Fatherland. Participation of Valuyev and his comrades had exactly such action...

After the parade an assignment was received — to single out the combat crew for carrying out demonstration firings. Grigorov — an experienced educator and psychologist — dwelled on Valuyev's crew. He summoned the officers, and told of his decision. The face of Valuyev was flushed, he looked at the commander unblinkingly: does he joke? But, seeing that he is serious, with an unexpectedly hoarse voice Valuyev said:

- Thank you for the confidence. I will not let you down.

And he did not. The Marshal present at the firings was delighted by the combat might of the weaponry, and skill of the crew. Missilemen received gratitude.

Now Captain Valuyev is the best battery commander in N unit. He is ready to enter the academy. He became an honored missileman, and skillfully trains young people. Recently Lieutenant Belous came to him to serve on the battery. His affairs went badly. Battery commander personally worked with him in the field, often discussing the missile service. Now Belous is an experienced missileman. He is also a candidate for studies in the academy.

When I learned of this, I asked Grigorov:

- Does it turn out that people stand on their own feet and depart from you?

- Yes, that happens. It is impossible otherwise. You hold on to one - others don't last.

Rocket subdivisions from laboratories of valuable experience of application of new weaponry still become the center of the growing new cadres - officers-missilemen in spirit and vocation.

Subdivision of missilemen, headed by officer V. I. Yapryntsev, achieved great successes. He became acquainted with new weaponry in the very earliest period of the existence of rocket forces by special courses. The officer finished these courses with distinction and in the number of the first retrained artillery men was designated commander of the missile battalion. A representative of the high command gave a speech before graduates of courses:

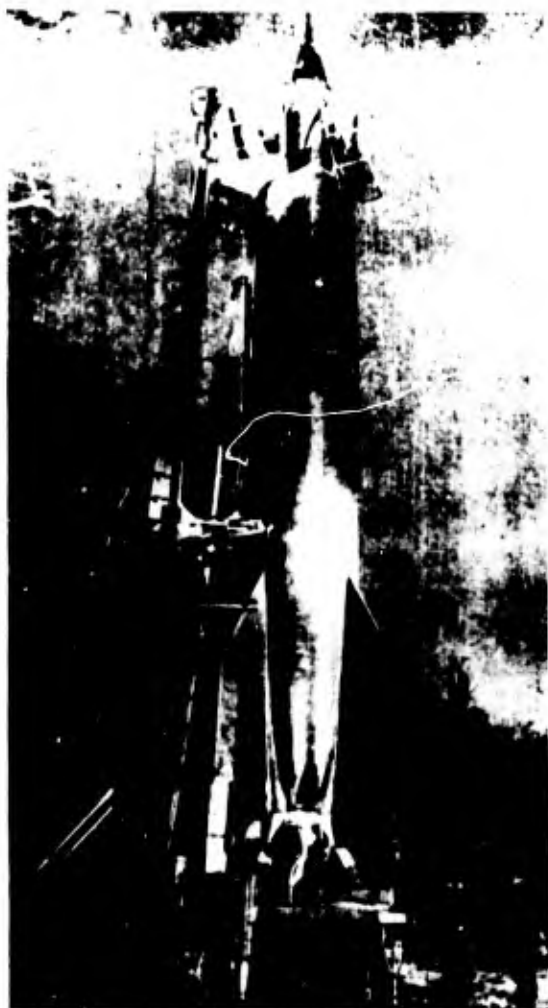
- Battalions where you were assigned are soon going into the field, for operations with combat firing. You understand what examination these subdivisions and their weaponry should take. This business is new for everyone...

This is stated, thought Yapryntsev, by the well-known military leader, Marshal of Artillery, Hero of the Soviet Union. He speaks with such preoccupation, as if it were not Yapryntsev, but he himself whom the as yet unfamiliar battalion awaits to command it. Yes what a break, what a completion of studies! After all this is only the beginning, one more step of the continuous ascent to rocket skill.

And the studies continued. Only training classes were extended, they became immense field spaces. Lectures were replaced by multi-kilometer marches, sleepless nights on the firing range. Both takeoffs and failures, as in any new matter, we walked step by step.

...First launches. It is probably more correct to call them the first command launches. It is one thing to watch the preparation

and launch of a missile as a listener, and quite another to personally respond to them. Here there is no calm minute: is everything provided for, will there be confusion somewhere? After all in case of a failure neither chiefs nor subordinates will show efficiency ratings with excellent evaluations for the studies, successes on courses will not be justified.



**GRAPHIC NOT
REPRODUCIBLE**

Preparation of missile for launch has begun.

An umpire reported: in grid N there is revealed a concentration of "enemy" troops. They are clearly aimed at the flank of our attacking forces. It is necessary to wreck the "hostile" intention, to guard the advancing units.

Yapryntsev was involuntarily thinking: is it really possible for one rocket subdivision to fulfill such a mission? But the doubt was brief. In its place there were confidence and resolution. Together with everyone he joined the combat work, remembering only one thing: to carry out the order in any case. Passing from crew to crew, seeing the men in action, he was filled even more with the

joyful thought: with such it is possible to be devoted and to do great deeds. And he thought involuntarily: what opinion will they have about me? Will they be convinced in the fact that it was to some purpose that I was instructed in order to take my place in their number?

The firing answered all questions: can a rocket subdivision solve a problem? Yes, it can. Can they cope with the complex obligations of a crew not similar to those it knew in the Patriotic War? Yes, they can. Is it able to control such power?

Reflecting over this last question, he remembered how at the end of exercises he was called to the radio station. The general, gladdened by the precise impact of the missile, warmly thanked Yaprntsev. And not only himself, but also the soldiers standing side by side heard the exciting words:

— We have started well, comrade major. I wish you new good fortune.

It seems that all of this was long ago. The battalion has already taken precedence many years. The commander himself was given the rank of lieutenant colonel ahead-of-schedule by the Minister of Defense. Government awarded him the Order of the Red Star.

Ascent to rocket skill, to the art of precise impact does not endure stagnation and idleness of thought. Always on the go, in the unceasing search for new, creative — thus leading commander-missileman, Communist Lieutenant Colonel V. I. Yaprntsev lives and serves.

Missile testers. With the appearance of rocket forces there were created new professions. One of the most heroic, undoubtedly, is the profession of missile tester. It requires special qualities, special devotion to duty.

When technical personnel prepare a new aircraft for flight, the mission they have is undoubtedly not simple. But a test pilot flies the vehicle, and, if something is missed he, having the highest skill, colossal experience, and finely developed intuition, will still be able to correct the position. Missile goes from the hands of the testers as if in independent flight, and actually no one will correct on it that which is unfinished on earth. Here is why missile testers have uncompromising exactingness, a responsible attitude to any, one would think, small matter.

There is one more characteristic distinction in the work of missile testers. At all times they have to deal with new missiles, to master them in a brief period. The missileman in the service works easier, once the missile is accepted in the arsenal; missileman has the possibility to smoothly "straddle" combat materiel.

There is still difficulty for the tester — he must reveal everything positive and unsuccessful in the new design so that if



**GRAPHIC NOT
REPRODUCIBLE**

Steeplejack training does not shun missilemen.

it is predestined to live, the forces would not resent its creators. It is not without reason that testers often remind each other: "What we examine will turn up in the service."

Testers consider that missiles, as people, have their own "characters" and they reveal them sometimes at the beginning of checks, and sometimes directly on the launching site. Here it is necessary to exactly establish causes of any deviations in the behavior of the missile from norm. The testers have to unerringly make these "diagnoses." Oh how difficult it is to make them at times! Besides knowledge, skill, and patience there is needed intuition, and, if you want, talent.

In "Krasnaya zvezda" there was a story about one tester with the surname Kostenko, literally a master of missile diagnostics. Somehow the missile, which the testers had already taken a liking to, became capricious. All checks gave positive results except one - in the control system, the main stuffing of the body so to

speaking, abnormality was sensed. It caused unforeseen oscillations of effectors. What was the oddity?

Whatever assumptions the testers made, not one of them was justified. Then they turned to Kostenko for help. And he helped. First of all Kostenko offered his own logic of search. Gradually, step by step, not omitting one component, — and the result was not long in coming. On the screen of the checking instrument appeared a sinusoid. Oscillation of effectors occurred in phase with it. Everyone watched Kostenko, having drawn this conclusion, as a magician.

— Look in the feed circuits...

This work lasted three days. Three days, taking turns with brief rest, the testers did not depart from the hangar. Finally the defect, appearing as far back as in the process of production, was removed. The shadow of distrust, lying on the new missile, was dispersed, and the testers with a light heart gave it a start in greater life.

Missile tests — this is direct continuation of scientific investigations which the scientists started, long before the creation of concrete samples. Tests — this is direct continuation of the creative labor of designers — creators of new weaponry. Many times on the testers' proposal there were introduced improvements to, it would seem, the finished sample.

Somehow before launching one of the missiles the testers revealed that a control circuit of instruments is not provided in it. Missilemen waited suitable weather for a long time, and now there is unexpected delay. To postpone the launch for a long time, in order to mount the circuit, was simply impossible.

Officer Zheludev gained the initiative. He offered to assemble an equivalent circuit for checking the instruments on board. And the work was in full swing. In a short period the instruments were checked, and the missile departed into space...

— Thank you for the initiative, — the missile designer pressed the hand of Zheludev.

Working out methods of preparation of missiles for launching requires much more creative work than usual from testers. Officer Agin studied the operations of aiming and erecting the missile for a long time step by step. He made measurements, compared data of launches. And finally he declared:

— Aiming the missile before launching is a superfluous, unnecessary operation.

And he proved with such mathematical calculations and practical bases that they would do credit to a venerable scientist. Although Agin did not think of the advancement of his own work as a dissertation, this was the most genuine scientific labor.

A great deal new and interesting springs up for missile testers, and it is embodied in points of instructions, in paragraphs of regulations, and becomes standard for soldiers or rocket forces.

Missile tests require not only skill, but also outstanding boldness and courage. One typical case in this respect was related in "Krasnaya zvezda" about missileman senior engineer-Lieutenant A. F. Ivanov.

Missile tests are past. The missile was already prepared to rise into the air. People have withdrawn or are in the shelter. Through binoculars and periscopes they watch the missile, and finally in the control room Serebryannikov appeared, the technical leader of operations, and ordered:

- Start the engine!



**GRAPHIC NOT
REPRODUCIBLE**

Missilemen on winter exercises.

The voltage grew, but the sound of the started engine was not audible. It became clear that the command does not come off, since the breakaway plug does not drop and the starting circuit of the engine is not closed. One may see that the ejecting spring turned out to be weak and does not detach the plug.

The solution came immediately: it is necessary to help the plug to drop! Serebryannikov warned:

- I will check the plug myself. Remain at your stations, do not open the door, do not look.

The question worried everyone: will he succeed or not?

The officer, not taking his eye from the breakaway plug, approached the missile. He lagged another second and suddenly unexpectedly for everyone he pulled the thick cable of the breakaway plug himself. The plug dropped. The engine received the command, the missilemen knew: in several seconds it begins to work, belching flames.

Everyone exclaimed simultaneously:

- What is he doing?

Serebryannikov was already running headlong from the missile in the field. After all there were only seconds at his disposal.

Still not everyone realized what happened until a puff of smoke appeared from the combustion chamber of the engine, then a tongue of flame. The powerful roar of the engine shook the concrete walls of shelters. Puffs of smoke, mixed with dust, began to rage. The missile soared.

In the shelter resounded the order:

- Ambulance take your position!

To the powerful rumble of the missile there was added the drawn-out waiting of the siren. Vehicles rushed from everywhere to the point of launch!...

When the missile engine began to work, Lieutenant Colonel Serebryannikov was already lying on the bottom of a small trench, dug out three tens of meters from the missile. Above his head he heard a terrible thundering noise as if the sky burst. The hot hurricane of gases and sand pressed him to the ground.

"It went!..." - swept to his head.

Having sensed that the missile had departed he arose and started to get out of the trench. His ears rang. From all sides people ran to him. Not hearing voices, seeing only their desperate gestures, in dust from legs to head, he went toward them.

- Igor! Aleksandrovich, you are in one piece? How do you feel? - they worried him.

Deafened, not understanding what they were asking him, he briefly explained:

- The ejecting spring of breakaway plug is weak. It was somewhat worn... And the missile was to be pitifully ruined...

This history pertains to a time when we already have created and tested improved, reliable missiles.

What missilemen they are! We cite the story of engineer-Captain A. F. Ivanov about the courage of missile testers. The author of this story himself deserves the attention of the readers.

Once the editorial mail of "Krasnaya zvezda" yielded a letter from a missileman, signed: "Senior engineer-Lieutenant A. Ivanov." His letter pertained to a rather common question - technical studies of soldiers. But the observation of the author attracted our attention, his skill to evaluate facts and to separate the main thing in the subject. The officer sharply opposed formalism and showiness on studies, when some chiefs see their problem in the arrival of

examiners "to plant trees where they never grew, and to pour sand on a path along which usually no one goes..."

On the basis of this letter we printed an article in "Krasnaya zvezda" and we advised Ivanov to prepare material about the teachings of missilemen, on which there should be combined tactical and technical groundwork. And in due time the editorial office received the correspondence. Soon it saw light under the title: "Two sides of one medal." In it the real knowledge of life was touched, the skill of the author, it would seem, by small facts to see what hinders other crews from moving forward...

And at the same time from Ivanov's letters there rose the image of the cultural officer having a fine feeling for literature. Judging by everything he has learned much, inherited considerable cultural knowledge from educators - teachers and commanders.

When we became closer acquainted with officer Ivanov, before us appeared a soldier-missileman in all his charm. The broad mind, tendency toward new knowledge, toward the fastest application of it in practice are combined in him with excellent organizational Party qualities. In spite of his youth, he is a veteran of one of the first missile units.

At the site of the future location of the unit nothing, it would seem, indicated the fact that barracks will be here. An even, smoothly whittled peg protruded lonely, hammered into the ground cracked from the intense summer heat. It was a criterion of the fact that soon people will come here. And people came...

Years passed... Rows of barracks were lined up. There were stretched numerous lanes of young trees near asphalted roads and paths.

New life began. The life of a large collective. Diligence, punctuality in performance of their official obligations, with respect to the cause, were instilled in the people. All operations were fulfilled thoroughly, with self-control, with mutual control, otherwise there could not be conversion to new missile technology.

The first combat launch is remembered. While preparing to launch the missile, everyone worked without the usual haste, without the usual tendency to go into normal. Operations began in the evening, and the start was planned at midnight. It was a dark steppe night, froststruck. It was unpleasant because the missile was covered with hoarfrost, hands stuck to metal.

At 2300 everything was ready with the exception of trifles. In one of the missile hatches a screw was not screwed in. Working on the upper bridge, Lieutenant Pronichev still fussed with it. He tried all sorts of screwdrivers, dropped his gloves, but the screw did not move. His face, red from the strain, was illuminated by searchlights.

- Pronichev! Finish the work. Descend from the bridge. It is necessary to declare readiness! - the technical leader shouted from below.

- Another minute! - the answer is heard.

Everyone had already departed for the shelters. Only several people remained at the missile. Pronichev was still on top.

And at this instant the metal budged, budged before the will and effort of the person. Pronichev departed from his station only when everything to the last trifle was done.

Illuminating the darkness of the November night, the missile departed. It was reported to us that it struck the target in the assigned region. All were glad. Pronichev said calmly: "How otherwise? Everything should be so!" True, Yura. Just so," - all his friends agreed with him.

And so it is on each combat operation, on each complex exercise. Attention, check, once again check.

It is not necessary to think that there were not errors in the work. There were errors, but thanks to the exceptional attention of all the workers they were corrected before launch.

"Soon, - remembers A. Ivanov, - we were placed with Pronichev. He looked sad, they transferred him to another unit.

- You know, my service is with difficulties, everything is not progressing well somehow, - he confessed with bitterness and waved his hand: - and he wanted very much that a missileman would be obtained from me.

I calmed him down:

- It is nothing. Everything will be alright. We will meet again when you are a real master of missiles.

I do not know why, but I indeed believed in this. And here after several years we met again. From the festive photograph in "Krasnaya zvezda" there peer six smiling faces. Under the photograph the significant inscription: "Here they are, masters of formidable missile technology..." and the first from the left - Captain Yuriy Pronichev."

Ivanov with agitation remembers one of the episodes of winter training of missilemen, which turned out to be connected with interesting surprise. On this exercise Lieutenant Putyatin and his crew awaited to carry out a combat firing.

The subdivision commander, who went to obtain the missile, reported joyful news: a new operational missile received, it rested under a tarpaulin cover.

The face of Putyatin was illuminated with a smile.

The cover is dropped. The uncovered missile smells of fresh paint. A real operational missile!

When the missile occupied its place at the site, the subdivision was formed. The commander declared that from here they will go directly to the launch site. And here he stated why the formation was immediately roused:

- We went on parade with it.

This was a surprise.

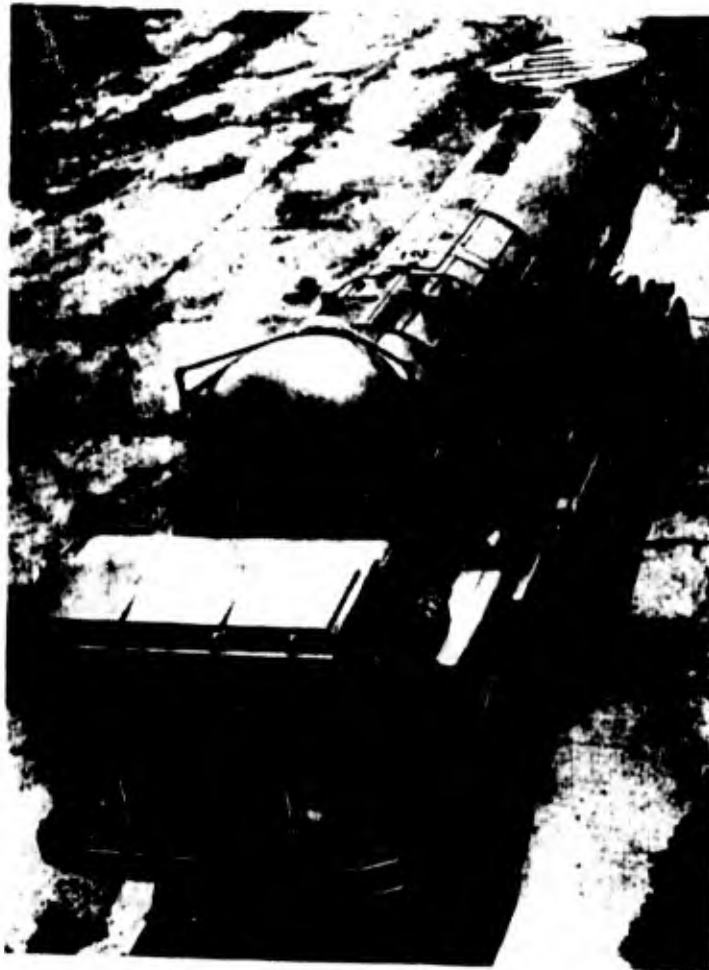
And here the missile and people, having met a second time, set out. The command for launching resounded. A firey tornado shot up from the ground. In the hand of Putyatin, having just now carried out the launch, quivered the petals of a red flower, obtained at the parade from a Muscovite lass. The missile departed to a distant invisible target. Ivanov stood side by side with Lieutenant Putyatin. And understood what he thought about in that minute.

Men! Look! This is he, Lieutenant Putyatin, shortly after a parade in the glory of all the Soviet people produced his first combat launch, having displayed the crushing power of Soviet missile weaponry, standing on guard of peace. He showed everyone - both friends and foes. Know there, abroad, what we have, and do not plan black deeds.

Then officer Putyatin departed for studies at the academy. Now he, a captain, successfully masters "rocket science." Ivanov also entered post-graduate school. He also became a captain, he is prepared with new knowledge and with new training to undertake still more complex problems in the increase of combat-readiness of missile units.

Evidence of the high combat maturity of soldiers-missilemen of ground forces are combat firings. They occur invariably with high results. In spite of stringent requirements on readiness time and accuracy of launch, all units armed with operational-tactical missiles carry out the mission "well" and "excellently."

Missilemen, as all the soldiers of our Armed Forces, inspired by concern of the Party for strengthening the might of our native land, develop socialist competition for mastery of new heights of combat skill. Personnel of missile units and corps of ground forces infinitely devoted to the native land, increase vigilance and combat-readiness in every possible way, in order together with other arms of the service to reliably stand on guard of the peaceful labor of the Soviet people - builders of Communism.



**GRAPHIC NOT
REPRODUCIBLE**

The appearance of the container is unique, reminding one of a cistern. But enclosed in it there is a formidable operational missile.

Watching the Skies

(PVO Missilemen)

Thanks to rapid development of nuclear missile technology the combat might of air attack means sharply increased, the role and value of national antiaircraft and antimissile defense were increased. The Central Committee of our Party and the Soviet Government have manifested and are manifesting national antiaircraft and antimissile defense. In PVO there are created surface-to-air missile forces, which in interaction with new fighter planes reliably protect the Soviet sky. Not accidentally foreign military circles are forced to recognize that the USSR has a powerful antiaircraft defense, a network of fighter aviation airfields.

What is the technology of our missilemen? At military parades

in Moscow it is possible to see anti-aircraft missiles. They have thin needle-shaped bodies and dual tail surface. In the body are placed propulsion system, control equipment, and the warhead. Soviet missiles possess good combat range, which can be indicated by the fact that the first missile downed an American spy aircraft at an altitude of 20 thousand meters 1 May 1960. American newspapers wrote that Soviet PVO Forces are fully capable of knocking down "bombers flying at altitudes up to 23 thousand meters."

Soviet surface-to-air missile technology grew qualitatively. Since before missiles had a range of tens of kilometers, now their range is sharply increased. Any violator of our air space waits unavoidable destruction.

PVO Forces along with perfected missiles have various systems of automation. Automatic devices help personnel to use more fully the possibilities of missiles, facilitates members of crews to carry out their duties. This contributes to gaining time, ensures high combat-readiness, permits not allowing approach of the enemy to "critical" distance from the defended object, and permits inflicting a timely smashing attack on him.

It is necessary to consider, of course, that the missile does not actually act by itself, but is launched and controlled with the aid of complex equipment. As a technical unit in surface-to-air missile forces there now appears a surface-to-air missile complex. Besides missiles it includes launchers, control system, auxiliary equipment, and control-checking equipment.

For the surface-to-air missile itself we distinguish such parts, as airframe, control device, warhead, and engine. Airframe serves for distribution of equipment, safeguard of stability flight control of missile. The central part of the body is cylindrical, and the nose and tail part - conical or ogival. Of these three shapes, apparently only ogival requires explanation - it occurs from ogive - solid of revolution, generatrix of which is the arc of a circle.

To the body of missile are fastened wings and rudders. They can be made in the form of triangles, trapezoids, rectangles. Regarding the location of wings and rudders on the body we distinguish such aerodynamic schemes: normal, "canard," with pivoting wing, and tailless. In a normal scheme the wings are located forward, controls - aft. In the "canard" scheme - it is the opposite. In the third type with usual location of control devices the wing is made pivoting. Name of the fourth scheme speaks for itself - it has no tail controls.

For surface-to-air missiles there are, as a rule, two engines - booster and sustainer. The booster is called accelerator. It serves for acceleration of the missile, and then the sustainer is brought into action.

For normal operation of complex auxiliary equipment and controlling and measuring equipment are necessary. The ready-for-action

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In Red Square in Moscow surface-to-air missiles pass on military parade.

missile is delivered to the launching site and with a truck-crane is placed on the launcher.

New problems. In order to present better problem which surface-to-air missile forces are called on to solve together with other arms of PVO Forces, it is necessary to at least briefly examine contemporary means of aerospace attack of the imperialistic states. Despite the fact that they count of nuclear missile weaponry, a known place is still assigned to bomber aviation. Thus, in the United States there are still preserved in a considerable quantity B-52 and B-58 aircraft, and even B-47 aircraft. The latter, it is true, as obsolete, are completely removed from armament from the middle of 1966. Measures are taken for modernization of aviation, new types of low-altitude carrier aircraft with supersonic speeds are developed.

Among the weapons of operational-tactical assignment in the United States there are tactical and flight-deck aviation along with missiles.

What character of actions of the aggressor is it necessary to consider by our antiaircraft-missile forces? The Pentagon, for example, anticipates sudden mass application of all means of aerospace attack available at the disposal of the United States. Their aviation conducts combat actions with breakthrough to probable objects of attack at low altitudes, with the application of intense radio interferences.

New problems are placed before contemporary PVO by the appearance of nuclear missile weaponry, and in particular such carriers as ballistic and winged missiles. Contemporary PVO should be not only antiaircraft, but primarily antimissile.

How much effort and resources were expended in the United States until it was possible for them to create contemporary antiaircraft defense. The fact is that American means of antiaircraft defense are able to combat only aircraft and winged missiles and are absolutely ineffective against ballistic missiles — the main means of nuclear air attack.

Soviet scientists have created reliable means of combating missiles of the enemy. Now our PVO Forces in interaction with forces and resources of PVO of ground forces, naval forces, and armies of countries of the Warsaw Agreement are able to successfully carry out their main mission — to reliably protect the territory of countries of the socialist camp from nuclear strikes, from any means of aerospace attack of the aggressor.



**GRAPHIC NOT
REPRODUCIBLE**

Soviet long-range unmanned interceptors, shown for the first time at military parade on Red Square 7 November 1963.

Antiaircraft defense forces of our country consist of surface-to-air missile forces, missile-carrying aviation, radio and special forces. The basis of their combat might is composed of qualitatively new arms — surface-to-air missile forces and missile-carrying fighters and interceptors.

In the composition of Soviet surface-to-air missile forces there are corps and units, having in their arsenal weapon systems of various assignment, including long-range unmanned interceptors. The combat possibilities of weaponry of these forces permit striking practically all contemporary means of aerospace attack at maximum ranges, high and low altitudes, and supersonic flight speeds. Besides the result of their actions does not depend on the season and time of day, meteorological conditions, or radio interference.

Surface-to-air missiles in many cases replaced antiaircraft cannon artillery, which determined a new qualitative jump in the development of Soviet PVO Forces.

Our remarkable combat materiel is continuously improved. There are expanded the range limits of surface-to-air missiles at low and high altitudes. Range of firing and rate of fire grow. We have developed and accepted in our arsenal new highly effective surface-to-air missile systems. Missiles with nuclear charges of various power considerably increased the combat possibilities of surface-to-air missile forces.

At present the Soviet surface-to-air missile complexes with respect to their combat capabilities and especially range at high and low altitudes, accuracy of striking targets exceed corresponding antiaircraft defense systems of the United States. Our missiles are able with great accuracy to strike all types of contemporary aircraft at all altitudes and speeds. "Intelligent" radio electronic devices precisely guide surface-to-air missiles to the target, even if they maneuver or are covered with radio interferences.

Imperialists in their aggressive plans increasingly count on sudden strikes with the aid of missiles. Furthermore, in the foreign press the opinion is stated that not only the atmosphere, but also outer space can become an arena of military actions in the future. Such views are preached especially persistently in the United States. American military clique develops a special plan, designed for 10-15 years and anticipating the creation of space combat means. Regarding the use of space for military intelligence, the United States regularly launches satellite-spies into space.

In the American press it is said that the zone of future military actions will spread to an altitude of thousands of kilometers. Already the United States has developed manned systems of orbital station type MOL, able to strike different targets. There is studied the project of a military space system, which it is assumed to launch at an altitude of 36 thousand kilometers.

Former commander of SAC of the United States, Power, stated that control of American global strike forces, will perhaps sometime be carried out from a colossal maneuvering command post in space. "Space possesses, - said he, - potential military advantages that are unique in their type.

Perhaps, - continued Power, - we will come to the conclusion that a maneuvering command post in space will be a unique sufficiently reliable structure of command and control... If the necessity in such a space command post appears, then it should be large enough to have all the electronic equipment necessary for collection, treatment, and propagation of operational information on a global basis."

The Pentagon leans on project "Gemini" ("Twins") in preparation for the creation of a space post of the United States. It consists of a ship, designed for two people. It has already accomplished a series of flights, in which military problems were solved.

The "mad" Americans persistently nurture plans of war in space. According to their plans, which the journal "Western Aviation" divulged, in five years "manned tactical and strategic weapon systems should be basically replaced by ballistic missiles and space weapon systems."

This is why the "mad" Americans met the conclusion of the Moscow agreement on prohibition of tests of nuclear weapons in three spheres and the international agreement not to put nuclear weapons into space orbits with such spite and dissatisfaction. They give heart-rending wails about the fact that these steps "kill" the American program of military use of space. Trying to hide under the myth about the defensive character of the military plans of the United States in space, the "madmen" declare these acts "betrayal of America."

Rockets against rockets... Thus, to anti-aircraft defense is now added an antimissile missile. In a number of countries of the world corresponding work is being conducted. For example, in the United States already for several years there has been an antimissile missile for striking satellites on orbits up to 300 km and nose cones of ballistic missiles on the final section of their trajectory. On this 8 billion dollars has been spent. But after prolonged work on a country-wide scale and after 1 billion dollars was spent, specialists of the United States in 1963 came to the conclusion that the antimissile "Nike-Zeus" created by them turns out to be insufficient. It is considered that it cannot act under conditions of a "high density" raid and a raid from various directions. Furthermore, it would enter action late (the carrier rocket would succeed in creating false targets and different interference). It is known that it is very difficult to get such a small target as the nose cone of a ballistic missile. By trying to destroy a powerful nuclear combat heads of ballistic missiles near a defended object, we (so say the American specialists) risk incorrigible damage to ourselves.

The problem of identification of a real warhead among a multitude of false targets (mock-ups) especially disturbs American military circles. One of the American journals so declared on this count: "For the United States this problem is complicated even by the power of Soviet rocket engines. Their rocket can lift a considerably greater weight to a ballistic trajectory than our rockets can. This means that every Soviet rocket, besides its deadly warhead, can also carry several mock-ups and several metallic objects of the same density and section as the warhead. Besides the use of mock-ups, in the future, specialists expect the creation of warheads which will be able to change course during flight. This will make the antimissile missile of the United States still less effective."

As a result, the American press reports, "the long delayed program of creation of the Nike-Zeus" has been modified... On development of this most important weapon, which now will be called Nike-X, will be spent an additional 1 billion dollars. This system can be ready not earlier than the end of the sixties."

In 1966 the Defense Department of the United States planned only to finish and test the Nike-X system. It includes the "Sprint" missile. The first launch of it was carried out on 26 March 1965.

In the opinion of the Secretary of Defense of the United States, the Nike system of antimissile defense is insufficiently perfect and in case of a mass rocket attack cannot ensure protection of the territory of the United States. For this reason and from the necessity of huge expenditures (15-20 billion dollars), starting of this system in series production has been deferred.

Recently in the United States they started work on creation of an antimissile which would have been possible to set on protection of launching sites of strategic rockets. In connection with this, the fact that the covered area in this case is small and the strength of the protection is high, interception of the target is considered permissible at low altitude. This sharply distinguishes the new system from Nike-X. But in the opinion of American specialists, the end of development of even the new system is not in sight.

In connection with this a proposal was advanced to create an antimissile attack satellite. Work is being conducted by several firms in the United States. The satellite is assumed to be equipped with comparatively small rocket missiles and with their aid they can destroy a rocket on the initial section of its trajectory.

Straining all their efforts, American specialists look for ways of creation of new means of struggle with rockets.

Thus, the Armed Forces of the United States wasted much time in construction of a space satellite called "Midas," which could note launchings of Russian rockets...". This is reported in published materials of the congress. Congressmen were told that 200 million dollars was spent, and all without success. It was necessary to approach the project from another end" the representatives of the Pentagon said in excuse.

"If program will be, as before, carried out in this direction, then it will never give us a reliable system," said Braun, director of the research and technical administration attached to the Department of Defense of the United States.

This collapse turned out to be all the more sickly when England decided to count on the "Midas" system. But in February 1963 the newspapers of this country reported that the hope of using the "Midas" system for information about rocket launchings were not justified. The press further explained that the "Midas" was an artificial satellite with a built-in infrared device. It is in orbit 2 thousand miles from the surface of the earth. It was assumed that such a satellite would be able to reveal a rocket at a distance of 6 thousand miles. The station for reception of signals from the satellite would be constructed in England, in Cumberland county. However during tests of "Midas" satellites it was revealed that the device could not distinguish a rocket at the time of launch from

other sources of infrared radiation. The system too frequently passed a false alarm, moreover malfunctions frequently appeared in it.

The following collapse in development of antimissile technology was declared by the director of the administration for latest research work Doctor Jack Ruin. He declared the annulment of one more space program. This pertains to the so-called "Bambi" system, designed for detection of intercontinental ballistic missiles and for interception of them during launch by armed artificial reconnaissance satellites. Even this project turned out to be unrealized.

The USSR far outstripped the United States not only in creation of intercontinental and other rockets, but also in the area of antimissile defense. All of us with a sense of patriotic pride grasped the report of the Minister of Defense of the USSR about the fact that in our country we have successfully solved the problem of destruction of rockets in flight. And in a later statement the Minister of Defense of the USSR reported that our scientists developed, and engineers, technicians and workers designed and prepared complexes of numerous means for protection of our country from a nuclear rocket attack from the enemy.

At military parades in Moscow since 1963 there have appeared subdivisions of pilotless interceptors. These long-range surface-to-air rockets brilliantly displayed their abilities in training. They possess great combat possibilities and are able to ensure a strike of all contemporary means of aerospace attack.

Great are the successes of the Soviet Union in development of antimissile weaponry. In the United States they recognize the outstanding successes of the Soviet Union in solution of the problem of destruction of rockets in flight and creation of a complex of antimissile weapons. Foreign specialists consider that such a circumstance seriously reflects on development of contemporary antiaircraft defense.

Many statements of foreign specialists turned out to be a cold shower for maniacs in the United States who had set their hopes on the power of American rockets. Senator Strom Thurmond, for example, stated that "defensive systems of Russia have attained the level where Russians can destroy in the air our "Polaris" rockets, and even, possibly, our "Minutemen" rockets. And after all, exactly these rockets are exalted in the Western press as the most invulnerable.

The well-known observer H. Baldwin in the "Sunday New York Times Magazine" wrote that "the political and psychological consequences of Soviet superiority in the area of creation of system of antimissile defense can be terrible."

The Soviet people, on the contrary, in all possible ways welcome successes in creation of antimissile defense. They are gladdened by the fact that our antiaircraft defense forces are able to cope with any means of aerospace attack by an aggressor. The



Start! A Soviet antimissile missile soars upwards as a meteor. The target will be struck exactly.

**GRAPHIC NOT
REPRODUCIBLE**

antiaircraft defense forces have for this the most varied forms of weapons. They can strike single and grouped targets at maximum and low altitudes, at any time of the year or day, in any weather, under conditions of radio interference from the side of the enemy. For simultaneous destruction of air targets we use group starts of surface-to-air rockets. Besides, each of the rockets confidently finds and knocks out its designated vehicle.

For reliable destruction of large groups of vehicles, and especially, dangerous means of air attack by an aggressor, our surface-to-air rocket forces have rocket not only with usual, but also with atomic warheads. At one time during training a test was conducted of such warheads; they were used on airplane targets. Only charred remains of them remained on land.

Our antiaircraft defense has reliable weapons for struggle with ballistic intercontinental rockets and rockets of submarines. These weapons serve for protection of vital centers of the country from possible nuclear rocket attack. Such weapons are antimissile defense complexes. They include special radars for detection, identification of warheads of the enemy and other stations, and also different types of antimissile weapons.

One of our antimissile complexes includes long-range pilotless interceptors. During training firing, with the aid of such antimissile missile we clearly intercepted the warhead of a ballistic missile flying at a cosmic velocity.

Still more effective is another Soviet antimissile missile. It is able to destroy the warhead of ballistic missiles at a great distance from the protected objects.

At military parades in 1965-1966 mighty antimissile missiles were shown in special containers. They are able to effectively

destroy the nuclear warheads of rockets at a great distance from the guarded objects. Recently it was possible to take further important steps which sharply increased the effectiveness of anti-missile defense.

Baptized in combat. Soviet rocket technology has won praise as being the best in the world, and missilemen have manifested themselves as distinguished masters. Forever immortalized are air defense missilemen of our country who fulfilled a combat mission set by the Soviet Government on destruction of an American reconnaissance plane which intruded the air space of the USSR on 1 May 1960.

It is necessary to underline that our air defense missilemen and their combat friends, the radar operators, even in peaceful time carry on combat duty, are in constant readiness to deflect an air attack on our country. Air defense controlled complexes, which, as noted in the newspaper "Izvestia" for 13 July 1960, compose the basis of our antiaircraft defense, include radar, automatics, calculating equipment. Radars are called to reveal an air target, wherever it may be, in the stratosphere or at low altitudes. Every subdivision having radar examines its own zone. All radar subdivisions create in the air, as it were an invisible net which not one disturber can surmount unnoticed. In the newspaper "Izvestia" a quite appropriate saying of soldiers of antiaircraft defense was quoted: "Our indicators will show even a metallic flea, if it appeared in the stratosphere."

And the first to show high combat skill on that memorable day 1 May 1960 were soldier-radar operators who in good time revealed and clearly followed the aircraft of the spy Powers. Watching it in the zone guarded by the N-th rocket unit, soldiers of the radar company commanded by captain of technical service M. S. Alipatov. He sat that memorable morning, as usually, at the panel, issuing orders to chiefs of stations, plotters.

Located at the screen of plan-position indicator, operator 1st class Pfc. V. Tokalov noted a characteristic burst — a mark about an aircraft in the air. The target was at an altitude of 20 thousand m with a speed of 900 km/h.

Thanks to the skill of the operator the spy was revealed at distance greater than appeared in the technical log book of the station. How observation of the flight of the aircraft passed was narrated then by officer Alipatov:

"At first we were all somewhat agitated. But as soon as locators "took" the target, everything fell into place. Not for a second did the pulse from the target on the screens vanish, while missilemen by their fire did not interrupt the flight of the unwelcome guest.

But this was somewhat later, and now data obtained from radars entered the ground control intercept station equipped with most precise control equipment.



**GRAPHIC NOT
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The missilemen are contented. The weapon is in standard state. Training firing passed excellently.

Lieutenant G. Bukin, as usual, was at the screen of the radar indicator which had to take data from subordinates of Alipatov and give missilemen the target designation. Next to the lieutenant was Junior Sergeant V. Duda. The radar operators followed the target clearly and unerringly.

Soldiers reported the situation to commander of the subdivision Captain N. I. Shelud'ko. And he determining parameters of motion of the target, in turn notifies his senior officer.

... At the same time, in the rocket subdivision headed by Major M. R. Voronov, soldiers with alarm took their combat places. Specialist radar operators under the leadership of Captain V. V. Chernushevich prepared the target designation. At the blue screens was Senior Lieutenant E. Fel'dblyum, operators Junior Sergeant V. Shuster and Private N. Smolin.

At the launching site is the same composure, exactitude, organization. Captain N. Kolosov, Sergeant A. Fedorov do not look away from instruments, ready for immediate action.

This subdivision had to directly fell the aircraft-spy by rocket. Were heard the calm commands of Major Voronov, frontline officer, who had great command experience.

Frontline hardening helped Mikhail Voronov clearly and confidently act as commander-missileman in this decisive moment. From the control compartment he directed actions of subordinates who with alarm prepared the weapon for war. At the launching site of the subdivision of Major M. Voronov all was ready for launching the rockets. As soon as the command resounded, a rocket with a mighty roar shot upwards, leaving after it a train of fire and

smoke. As in a storm, the pines surrounding the position bent and swooshed.

"The target is hit," the operator reported to Voronov.

Actually, the rocket struck Powers' aircraft, he lost control and it started to break up. Pilot Powers jumped with his parachute from the destroyed vehicle.

All embraced with joy from consciousness that they successfully carried out a combat assignment of the native land. The intruder aircraft, secretly penetrating into our country for espionage, was brought down by Soviet missilemen. And our missilemen so knocked out the aircraft that the pilot, living, with equipment whole, in a word was real proof on hand of air robbery and espionage of the Americans in Soviet air space. Skillful actions of our missilemen permitted the Soviet Government with finality to expose the provocateurs from the Pentagon.

The native land appraised highly this standard action of soldier-missilemen. Different officers, sergeants, soldiers were awarded orders and medals of the USSR. Among them are Senior Lieutenant S. I. Safronov, Captain N. I. Shelud'ko, Major M. R. Voronov, Lieutenant G. D. Bukin, Senior Lieutenant E. E. Fel'dblyum, Captains V. V. Chernushevich, V. I. Kulagin, Captain of Technical Service M. S. Alipatov, Sergeants I. A. Sambuyev, A. V. Fedorov, A. I. Yarovoy, Junior Sergeant V. P. Duda and others. All of them in 1960 from the high rostrum of the fifth session of the Supreme Soviet of the USSR on behalf of the Soviet Government were expressed gratitude.

What did the first combat employment of Soviet surface-to-air rockets show? First of all, high qualities of Soviet radiotechnical means, well combined with rockets and possessing the ability to exactly determine the location of aircraft and to follow them. Also important is the fact that an invulnerable, in the opinion of American specialists, high-altitude aircraft, specially built for sabotage-espionage goals, was brought down by a Soviet rocket at its flight ceiling. Apparently, therefore the Pentagon found it very difficult to be reconciled with this strike. Military circles of the United States inspired different fabrications in press concerning how the spy Powers turned out to be in the hands of the Soviet power. One said that he was a traitor, he himself sat and voluntarily surrendered to the Soviet Union, another reported that he got in our hands as a result of forced landing or was brought down from malfunctioning of aircraft and forced to lower to an altitude of 10-12 thousand m.

In the Soviet press at the same time there was given a worthy answer to similar fabrications, directed towards compromising our anti-aircraft defense and simultaneously by any means to restore faith in the invulnerability of reconnaissance planes for the purpose of recruiting new spies. But maybe, the gentlemen of the reconnaissance department of the United States, it was discussed



Rocket technology opens its secrets only to very persistent soldiers. In the photograph is shown one of the assignments of the rocket.

**GRAPHIC NOT
REPRODUCIBLE**

in our press, indeed do not know about the existence in the Soviet Armed Forces of surface-to-air rockets? Then it is possible to help them. Indeed, gentlemen, we have such rockets, and we have excellent missilemen. Our rockets are able to strike a target not only at an altitude 20 thousand m, but considerably above that. In a word, the United States has no aircraft with a ceiling which our rockets would not attain.

At the same time in the West they started such an argument: inasmuch as Soviet Union earlier had not hit American aircraft, then it thereby showed its weakness. Yes, we do not negate it, the Soviet press wrote then in answer to this argument, there was a time when we could not knock down these aircraft because they flew very high. Our fighters attained this altitude, but could not strike an aircraft of an aggressor.

Then the Soviet Government said to the scientists, engineers, workers: it is necessary to eliminate this gap, it is necessary that our sky be clean of hostile aircraft. Scientists, engineers,

workers worked well above fulfillment of this assignment. They, as is said, caught up and created remarkable rocket weapons. And here now the American military clique gave the USSR the possibility of examining in full measure the effectiveness of these rocket weapons. The Central Committee of the Communist Party and the Soviet Government expressed their gratitude to the scientists, engineers, workers - all comrades participating in creation of such remarkable rockets.

During fulfillment of the responsible assignment of the native land, the soldier-missilemen showed that they have the skill to operate these huge arms. This skillful use of weapons is carried on as a race by all crews of the anti-aircraft defense forces. This was mentioned at a meeting taking place in 1960 in Sverdlovsk in connection with rewarding the soldiers and officers of the rocket subdivision who were distinguished during destruction of the American spy plane. This is what was said in a salutatory letter of participants of the meeting to the Central Committee of the CPSU: "the skillful actions of our comrades, exactly fulfilling a combat order of the native land, knocking out the spy aircraft by a first rocket, made it possible to strip from the aggressors the mask of peace lovers..."

The glorious matters of our combat comrade-protectors of the Ural sky were highly estimated by the native land. We assure the Central Committee of the Communist Party of the Soviet Union and Soviet Government that we henceforth will give all our strength to service and work at that post where we are placed. Let us treble our vigilance and combat-readiness"!

In 1963 I happened to visit the launching sites whence the rocket took off which hit the spy aircraft. There now is a monument there in honor of this event, a model of a silver rocket. On launcher there burns a red star, noting the combat team, and there is an inscription noting the events of 1 May 1960.

In the subdivision the spirit of high military solidarity, constant readiness in the name of our dear native land has remained constant. Traditions of this subdivision are multiplied in other teams of the surface-to-air rocket forces.

Surface-to-air rocket units of anti-aircraft defense begins from the famous steel battalion of the Putilovskiy plant, created at the beginning of 1918 in Petrograd. And there is in the surface-to-air rocket forces a unit which is a direct descendant of that battalion. It has covered its banner with combat glory.

Between guardsmen-missilemen and workers of the Kirov (formerly Putilovskiy) plant a strong friendship has been established. The plant and unit exchange delegations, organize meetings of workers and soldiers. The Kirov's workers have established a challenge Red Banner which will be yearly handed to the best subdivision of the unit. Many young Kirovskiy workers have been directed to serve in this unit. In the unit combat specialities have been mastered by 39 members of brigades of communist labor.

Great successes have been attained by soldiers of other rocket units. They persistently master methods of firing on targets at low and maximum altitudes independently of whether these targets possess subsonic or supersonic flight speed, learn to reveal and to destroy targets with a small reflecting surface under conditions of strong radio interference. Missilemen are prepared to inflict strikes on air targets of the "enemy" at distant approaches to defended objects.

Destruction of targets by a first rocket has become the law of missilemen, a remarkable tradition. For example, in 1965 and 1966, 90 percent of all firing was carried out with the appraisal "fine" and "distinguished."

Maneuverability of subdivisions has been increased by application of air, automotive, railroad and naval transport. This permits the surface-to-air rocket troops to create groupings in any direction, and to do this in the shortest possible time.

Missilemen must serve in regions of the Transarctic, in deserts of Central Asia, in mountains and taiga. But difficulties do not hinder them, in the most complex conditions, to excellently fulfill their training-combat mission.

Thus, the subdivision commanded by officer P. Konstantinov accomplished a multikilometer march under conditions of rugged desert terrain. It was very hot. The temperature in the shade reached 43 degrees. In these conditions missilemen for twelve hours deflected air raids of an "enemy." Then they had to fold up their combat weapons, march, and again get the equipment in readiness to control fight. The soldiers surmounted all difficulties in their path.

In another region of the country, in difficult winter polar nights, under conditions of snow drifts and low temperatures, missilemen headed by Major V. Savink confidently and vigilantly carry out combat duty. Many subdivisions of the surface-to-air rocket forces secured great successes in combat and political preparation.

Everyone must do his best. Good news, as they say, carries far. Soldiers of the district know well what is done in the advanced rocket unit where officer Z. P. Kuz'menko serves. Actually, here there is a great deal which can be learned and adopted with great benefit.

Successes of a subdivision are determined first of all by how a commander, Party and Komsomol organization manages to unite a combat collective, to ignite the hearts of soldiers to worthily serve their native land, to make everyone at his post do the maximum possible for strengthening discipline and organization for increasing combat-readiness. This stake working at a maximum is a characteristic quality of missilemen carrying watch in difficult conditions, in hot deserts, where the service is in full combat stress.



**GRAPHIC NOT
REPRODUCIBLE**

The commander gives missilemen a training-combat mission.

Management of contemporary combat operations, use of the most complex technology and weapons require from soldiers of all specialities great knowledge, skills. This pertains especially to rulers of threatening rocket weapon.

During the study by soldiers of complex technology in a combat duty subdivision, many difficulties are encountered. Right here is checked the real skill of a commander. He must know how to structure the studies of soldiers in accordance with high requirements of the present day; this means there will grow in the subdivision class specialists; this means the possibility the technology will be used to the end. The commander of a subdivision seeks that every member of a crew will become an authentic master of rocketry, and he himself gives his subordinates a good example in mastery of the new technology. In the past a commander of a platoon of projectionists, now he has deeply learned the contemporary methods of acquisition and tracking of targets, construction and application of surface-to-air rockets. As a person liking the new technology, he has become its patriot, active propagandist.

And in this appears a remarkable quality of all our advanced commander-missilemen. They have high party qualities, the skill and exactingness of an educator, good tactical horizons are constantly combined with thorough technological preparation. And the preparation is not only theoretical, but also especially practical, such that permits the commander of a crew to look into a complex electronic circuit, from the position of an expert to appraise the quality of routine maintenance work, and when indispensable to skillfully fulfill one or another operation on the equipment. This to a huge degree lifts the authority of a commander in the eyes of soldier-specialists, endears him to his subordinates, helps appraising what is new and advanced that is born in the course of combat studies.

Exactly such an officer-missileman was Communist Kuz'menko. He confidently looks at circuits of instruments, he can show how to find and remove malfunctions, fix a block. Such a fact is characteristic. Somehow a crew at a reconnaissance and target indication station during examination of their work mentioned that their field of vision was getting worse. Kuz'menko did not believe it. He checked everything himself and established that certain members of the crew did not look at the schematic diagrams right, retreated from rules of operation of the station. He conducted several assignments, additional training. And now the station "sees" even further than is shown in its log book.

Z. P. Kuz'menko gives attention to innovations, in all possible ways supports and directs the work of soldier-innovators. He supports all that promotes acceleration of preparation of a weapon for fight, an increase of accuracy and reliability of launching the rocket and striking targets. He supported an initiative directed towards improvement of the method of control of instructions of operators. With his active participation there was developed a construction of a light tableau on which firing personnel can see all initial data in digital designation.

Sometimes in subdivisions which are far off from headquarters there exists the opinion that in their conditions wide technical propaganda is unrealizable. Such an opinion is absolutely groundless. There are many forms of technical propaganda which turned out to be very successful for the rocket subdivisions. For example, in the unit where officer Kuz'menko serves there are technical conferences. At one of them, taking place before routine work, with great benefit they examined the contemporary technology of this work, rules for use of the new instruments.

In all his matters commander leans on the strength of publicness. Communists and Komsomol members, his first-rate assistants in the fight for new heights of skill, are initiators of glorious undertakings. Especially rich as such undertakings was the most tense period of studies - preparation for combat firing. After an open party meeting, called for soldiers worthily preparing for a forthcoming test, many valuable proposals were introduced.

The purposeful work of commander, Communists and Komsomol members, all the collective bore fruit. The combat firing was carried out excellently. Experienced workers at the proving ground, soldiers of this unit showed some special composure, discipline, ability to sustain the highest loads. Effective was the regular, with indulgences, training, moral and physical hardening. At the proving ground the soldiers of the launch team considerably exceeded work norms in means of protection. But mainly the missilemen with the first blow felled the air target.

However the commander and soldiers of the subdivision do not rest in their laurels. All their thoughts and efforts are directed towards making a new step on the way of increasing combat coordination and combat-readiness.



**GRAPHIC NOT
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Surface-to-air rockets guard the native soil.

In advanced launch position... When I for the first time met with the commander of the launch battery Captain Vinogradov, then what first came to mind for definition of his style work was the old word: "Thriftiness." I right here threw off this definition: really it seemed very inapplicable to the service of a captain and his agitated work. Really, in another battery there were warm cabins. Tubes, condensers and resistors were locked in metal cabinets. But here the winter ice, wind or in the summer the scorching sun freely play above the bunkers with launchers. Such work the eye does not grasp in one glance. Really, there one's roof is the sky, and floor — the spaciousness of the native soil.

And nevertheless the sensation that all at the launch sites of the battery was somehow very acclimatized, thriftily arranged, did not abandon me. Every step of the entrenchment, step of a small ladder is thoroughly sealed, cases on launchers are evenly strained; where necessary, a path is layed, as necessary it is colored, lined. Let us shift our view to the soldiers — the look pleasant, one like another, and in their uniform all is adjusted, sturdy, folded. And the commander himself — broad-shouldered with volitional face, similar to Valeriy Chkalov, somehow was well inscribed in this well-organized "life" of the launch battery...

His love of order, exactitude and orderliness grabbed literally all. On assignments — severe sequence in method, equal exactingness. He carefully considered setting of problems before every man. On training, while one crew prepares a rocket for launch the other watches it. Then the commander listens to every working man about what he did, what in his opinion, is in error. Then the observers are asked about it. Then the crews change roles. And again a tedious clarification of errors, step by step persistent removal of them. But all of this is done cheerfully, with clear consciousness of the goal, with the gay bantering of the commander...

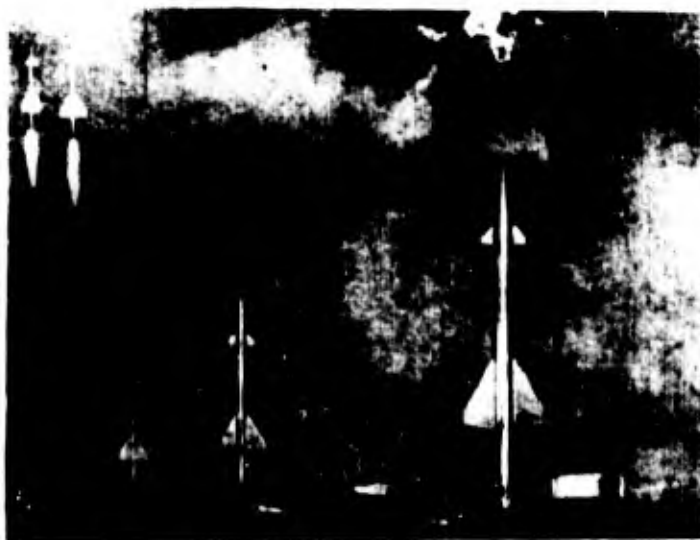
In assignments here they try to introduce the spirit of contest. Every man has his limit, and the commander — the same. He decided to master the speciality of an officer for guiding, and persistently studies flight rocket control equipment...

After the first months of studies, crews first colliding with rocket technology excellently fulfilled a combat firing. This was the test, as was charging with unparalleled faith in the new weapon.

The crews arose to combat duty.

During combat duties every free minute was used for "conquest" of all imperfections in the skill. Vinogradov set each a goal — a senior should understand how to do everything for the commander of the launchers, and he in turn for the commander of the platoon. In the battery there are no deputies in combat work if a person is not at his post. Mutual interchangeability ensures uninterrupted combat work in any conditions.

By joint efforts it was possible to save a great deal of time in preparation of rockets for combat employment. Very useful turned out to be analysis of best indices of crews in stages. With the aid of a chart it was possible to reveal the operation, on which one or another crew loses time. And now the subdivision confidently increases the tempo of combat work.



**GRAPHIC NOT
REPRODUCIBLE**

Combat firing: rocket salvo.

...On positions in any weather, at different times of day it is possible to see the energetic figures of soldiers. These are physically strong, hardened people. And even during firing, conducted in a situation close to combat, when load ever increases, rhythm of work is not disturbed.



In the most difficult conditions Soviet missilemen worthily carry their watch. On these photographs are recorded two moments of training conducted in the desert.



**GRAPHIC NOT
REPRODUCIBLE**

Physical culture and sports produce sufficient strength, speed of reaction, strength of muscles. In winter here there is skiing every Sunday. Not for a day are ceased assignments on horizontal bars, barbells. Regularly we have basketball and volleyball meets, light athletic matches between subdivision. In morning exercise they are considered requirements for soldiers of various specialities...

The commander, Party and Komsomol organization try to develop for soldiers a desire to serve as well as possible, ever worthier. Young people entering this friendly collective are contaminated by thirst of knowledge, love of order, they become jealous advocates of traditions of the advanced subdivision. All soldiers became accustomed to daily see the grandeur and proud meaning of the labor of the masters of these threatening rockets. And not accidentally any of the heaviest work is fulfilled by soldiers readily, with enthusiasm — be it development of a small town, clearing of snow on positions or preparation of rockets for launch.

The soldier feel at home in the battery. And not accidentally many of them have forever connected their life with the surface-to-air rocket forces.

...A junior sergeant arrived here, Kalyuzhnyy. Officer Vinogradov paternally received him, helped him become a good commander of a launcher. The young commander was demanding, but



**GRAPHIC NOT
REPRODUCIBLE**

Among snow-covered trees, a better position will not be devised!

for a time still unskillfully used his rights. Vinogradov gradually instructed his commander in the art. Kalyuzhnyy, serving his period, went to study and returned to the unit a lieutenant. Remaining to serve in the battery was Sergeant Prilipko. He excellently fulfills his obligations. Others will follow in his footsteps.

* * *

Boiling, tense is the life of missilemen of antiaircraft defense. Their main case is to vigilantly watch the sky on their screens and hold in readiness the threatening rocket in order to block the path to any disturber of air boundaries of the USSR. Watching the sky, they are always at their post.

Masters of Aerial Rocket Carriers

In the skies of Mongolia. The year was 1939. The time was the hot August days in Mongolia during the violent fights against the Japanese aggressors. Exactly at this time an event took place which plunged the Japanese pilots into a commotion. Imperial fighters with their red circles of the rising sun on the wings were fired upon from an unknown direction. At first they assumed that new anti-aircraft guns had appeared, but the region where the Japanese aircraft had flown was absolutely deserted. The Japanese inspected their damaged fighters. They found fragments, but they could not decide what they were from. Apparently, they were from a shell of an unparalleled huge caliber from some unknown and threatening weapon.

Now it is possible to say that this was indeed a new weapon: they were aircraft missiles, or, as they are now called, unguided missiles.

By the efforts of designers Yu. A. Pobedonostsev, F. N. Poyda and I. I. Gvay, with the help of production workers it was possible to prepare five fighter planes, equipped with rockets, for participation in combat.

The first combat aircraft with rockets composed a group, headed by Captain Zvonarev. This group participated in combat in the summer of 1939, near the Khalkhin-Gol River. Besides Zvonarev, the group included pilots Pimenov, Fedosov, Mikhaylenko and Tkachenko.

It was noted that the Japanese fighters expended much effort in hunting the aircraft which were armed with rockets. True, all of them returned to the airfield from their first fight, but in Zvonarev's aircraft 14 holes were counted, and in Fedosov's aircraft there were 40 holes. It was decided that the external appearance of all the aircraft in the unit should be made to resemble the missile carriers in order to disguise the use of the new weapon.

On 20 August, 1939 at 1600 hours, Zvonarev's group took off. Below, the right bank of the Khalkhin-Gol, which was pocked by the explosions of bombs and shells, was visible, while far off in the summer haze black dots appeared — Japanese fighters. Noting the formation of the Soviet combat aircraft, the Japanese at first began an approach. At a distance of about a kilometer from them, Zvonarev ordered a volley of missiles fired. The Japanese fighters, not accepting the challenge, began to run.

When the missile carriers returned to their own airfield, Zvonarev was congratulated by the unit commander.

"Two I-97 Japanese fighters were brought down by your volley. This undoubtedly is your trophy, since no one else fired," he said.

The personnel of the missile carrier group were proud and happy with their success in using the new weapon. But ahead there were new fights, and they were thoroughly prepared for them. The ground

crews worked very hard. They were led by military engineer 2nd class Popovich and military technician 2nd class Gubin.

On 21 August, 1939 the first missile carriers participated in repelling a raid by Japanese bombers on a crossing over the Khalkhin-Gol which our advancing units were making. Japanese bombers, noting the Soviet fighters, began to depart. The missile carriers pursued them and, when they had closed to a distance of 800 m they fired a missile volley. The stricken Japanese aircraft, leaving trails of smoke, spun downwards.

On the same day, the missile carriers participated in combat with fighters, and on subsequent days they took part in other aerial skirmishes. In all these fights our rockets neatly struck down the Japanese aircraft.

Captain Zvonarev, military engineer 2nd class Popovich, military technician 2nd class Gubin departed, upon termination of hostilities, with a report regarding the results of missile use. They had a short but significant report. It declared that five missile-carrying aircraft had participated in 14 air battles. In combat Zvonarev's group knocked down 13 enemy aircraft, including ten I-97s, two bombers and one light bomber.

Thus began the combat history of our missile-launching aircraft. During the years of the Great Patriotic War, and guided missiles were the formidable weapon of fighters, bombers and ground-attack aircraft.

In the postwar period, both the aircraft themselves as well as their rocket armament were rapidly improved.

New capabilities. "...More than half a million Russians, assembled at the airfield, saw over 300 aircraft streaking through the clear sky, although some of them were more easily heard than seen. New long- and medium-range bombers and jet fighters flew across the sky like lightning and vanished before the attending foreign attaches could adjust their binoculars, so that in order to see them a little better..." Thus wrote one U.S. newspaper about one of the air parades at Tushino, in which missile-launching aircraft took part.

Air parades have confirmed that in the USSR the swift progress of scientific and technical aviation thought continues, and that new outstanding successes in aircraft and engine building and in the equipment of aircraft have been attained. The Soviet people, directed by the Communist Party, by their daily and untiring labor develops newer and newer branches of science and technology, including those on which the high defensive capability of our country depends - its winged shield. By equipping the armed forces with missiles and an atomic submarine fleet, we do not exclude aviation, but we continue to develop and to improve it. Piston-driven combat aircraft have been completely replaced by contemporary jet machines, including the supersonic long-range bombers. Cannon and machinegun aircraft weapons

have been replaced by missile-types. During the last few years, speeds of combat aircraft have attained 3000 km/h, and flight altitude has reached over 30,000 meters. Missile-launching aviation is being more widely introduced.

What are the combat capabilities of missile-launching aviation? They are determined by the high characteristics of aircraft and by the remarkable aircraft missiles. The Soviet Air Force (VVS) is armed with missiles of two classes: "air-to-surface" and "air-to-air." This means that the missiles are launched from aircraft to ground and air targets.

Let us first become acquainted with the "air-to-surface" missiles. Externally they resemble fighter aircraft. They have an



**GRAPHIC NOT
REPRODUCIBLE**

Soviet turboprop missile carriers in flight.

engine, wings and controls, True, such a missile is smaller than a fighter. It is suspended under the fuselage of the carrier aircraft.

This is how the aerial missile carriers are used. The aircraft take off from their airfields and proceed to the assigned missile launch point. The missile's engine and guidance system are activated, and the missile flies to its target. In flight it can develop great speed.

What is changed, in this case, as compared to bombing? In order to strike an enemy object with bombs, it is necessary to penetrate his antiaircraft defense (PVO) zone. In the last war, bombers, having executed their mission, often encountered such strong fire from fighters and antiaircraft artillery that they suffered heavy losses. It is different now. Inasmuch as the missile-carrying aircraft can inflict blows without even approaching to the zone guarded by the enemy, then its vulnerability undoubtedly drops. Missile-launching aviation can inflict nuclear missile blows on an aggressor from great distances, without approaching the zone of his antiaircraft defense. Consequently, the combat capabilities of aviation have increased considerably.

"Air-to-air." The introduction of missile weaponry into aviation has involved not only bombers, but also fighters. Their basic weapon has become the "air-to-air" class missile, designed to strike aerial targets.

At first the aerial warfare missiles were guided. They were used during the years of the Second World War, and they are still in use. At the same time, even greater value is being assumed by guided missiles of the "air-to-air" class. For these missiles it is characteristic that in flight special airborne equipment automatically corrects sighting errors, considers a position change of the aerial target and ensures high strike accuracy.

It is understandable that a guided missile most fully satisfies the requirements placed on air combat weaponry. After all, due to the growth of flight speeds of bombers and fighters, contemporary combat in the air has become very transient. This means that the target must be hit on the first pass, since another is improbable. Furthermore, it is necessary to attack now from greater distances than before. Previous armament did not permit solving these problems, while a further increase of caliber is connected with an undesirable growth in weight of the weapon, and recoil force, acting negatively on the aircraft. Missile weaponry eliminated these problems. The weight of the devices from which the missiles are launched is low. The powerful missile warhead permits destroying military aircraft of any construction. Guided missiles, launched from great distances, possess high target strike accuracy.

Soviet supersonic fighters have aerial combat guided missiles in their arsenal. Their flight trajectory can be modified to compensate for any deviation caused by an error in sighting or by a maneuver of the target. Thus, these missiles, even in the worst weather conditions, both day and at night inevitably will strike aerial targets.



**GRAPHIC NOT
REPRODUCIBLE**

A threatening contemporary Soviet interceptor aircraft, armed with missiles.

Our military aviators have powerful and efficient equipment which obeys the skillful airmen who are experts in the theory and practice of contemporary aviation. And not just the general theory and practice, but regarding those aircraft, engines, sights and missiles, with which the specialists work.

Especially great is the role of flying personnel in ensuring the best use of the capabilities of aviation missile weaponry. This is why it is important to organize correctly the study of the tactics of using missiles of the "air-to air" and "air-to-surface" classes under different weather conditions, in both day and night and different objects, including moving naval targets.

A good method of preparing the crews of missile-launching aircraft (along with other types of exercises) are tactical air exercises. Where, if not here, do flying personnel have all the opportunities for developing tactical thinking and for obtaining the knowledge and skills which are so necessary in contemporary combat. It is important only to forbid the oversimplifications and indulgences which orient a pilot toward an easy victory in the air. Everything must be done so that our aviators themselves learned to find the route and methods of achieving a victory in a difficult struggle with a strong, technically equipped enemy, who has missiles along the other forms of weapons.

Of important value in training and educational work is immaculate order on the airfield, in training classes and in a small town. The need for the strictest discipline on the ground and in the air is caused even more by the complication of technology and the growth of its combat capabilities. Therefore, the precise execution of requirements of regulations and manuals and the greatest composure and organization of each airman will ensure qualitative flying training and will prevent any accidents in flight and on the airfield.

The combat training of aviators continuously increases. Socialist competition is widening in which airmen vie for an increase in proficiency rating, mastery of allied specialties, etc.

The level of combat-readiness and combat capability of our Air Force completely ensures the solution of problems placed on them. The basis of our aviation combat power is first-class equipment. Now Air Force units have supersonic, all-weather missile-launching aircraft. Their high tactical flying qualities, in combination with the threatening missile weapons of the "air-to-air" and "air-to-surface" classes, as well as the most precise instruments and radiotechnical equipment, permit surely destroying any enemy objects on land, in the air and on water.

Glorious, skillful airmen compose the combat formation of our aviation. Cultivated and educated in the all-conquering concepts of Marxism-Leninism, they are fully devoted to their people and to the native Communist Party, and they are filled with a great consciousness of personal responsibility for an assigned mission. In this deep conviction the greatest force of spirit and skill of the airman are born. Strong in that confirmation is the successful mastering of new equipment and the growth of proficiency rating of aviators, the majority of which are pilots of the 1st and 2nd class. The combat skill of our airmen is great. This is indicated by the almost 100% accuracy of combat missile launches from the air to different objects.

There are more advanced units, subdivisions and excellent military collectives; these are the authentic beacons of combat and political preparation. Now in every unit and air formation a great number of first-class specialists serve, exemplifying military valor.

In 1965-66, a large number of pilots and navigators of our aviation were awarded honorary ranks — Deserved Military Pilot of the USSR and Deserved Military Navigator of the USSR. Among them are our famous air aces, such as Colonels A. S. Stepochkin, P. P. Panchenko, A. V. Karikh, and others. Colonel Stepochkin, for example, in the postwar years was awarded the Orders of the Red Banner and the Red Star. Under his leadership, our pilots were some of the first to accomplish an extreme long-range flight with mid-air refueling of the missile carriers. Colonel Stepochkin himself mastered several aircraft, and he flew both day and night, in good and adverse weather conditions, over mountains, sands, sea and ocean. This is the kind of tutor which our pilots in missile-launching aviation have.

Many types of machines were mastered by Colonel A. V. Karikh. He was one of the first to fly jet fighters. Then he became a master of flying interceptors, mastering to perfection the methods of their combat employment.

One of the first in the group to master missile volleys was Colonel Karikh. He fired rockets day and night. He had an experience when the radio-controlled target ceased to obey commands from the ground. He was required to shoot it down immediately. And Karikh delivered a crushing rocket blow to the target. The target was delivered "in splinters."

In all, Colonel Karikh mastered 25 aircraft in his own flying life. And now he successfully flies all types of contemporary fighters.

Excellently qualified in contemporary aerial missile-launching technology is still another Deserved Military Pilot of the USSR - Lieutenant Colonel V. V. Molin. Molin is a political worker and simultaneously a first-class pilot, having mastered 12 types of aircraft. He has been awarded two orders for his excellent mastery of contemporary fighter-bombers, which have now become missile carriers.



**GRAPHIC NOT
REPRODUCIBLE**

Soon the missile carrier will begin its flight.

The flight biography of P. P. Panchenko is instructive. He teaches subordinates, first of all, by his personal example. Panchenko mastered 14 types of aircraft to perfection. And now he flies contemporary missile-carrying aircraft. In the unit which he leads, for eight years there have been no flight accidents. The regiment, under the leadership of P. P. Panchenko, for three years has held the transitory Red Banner of the Military Council.

It is characteristic for P. Panchenko that he has a tendency to master the specialties which would help him to direct flights better. Somehow, watching a ground control officer, he saw that the latter was confused, lost precious seconds, and did not help the crews in the air at all. Then Panchenko decided to become a ground control officer. He studied the equipment, passed the training and passed tests for navigator 3rd class. And now Panchenko can himself work at the plan-position indicator, helping the pilots tactically, sharply and effectively to perform in the air.

In this episode the usual (for Colonel Panchenko) concern for flight control was reflected. His ground control intercept station is one of the best. At the work station of the commander and the ground control officer there is a demonstrational device. On it

all of the information is concentrated by which it is possible easily to monitor flight control at all stages. In this ground control intercept station other equipment is also very efficiently placed: the direction finder indicator, the speed indicator and others.

Many innovations were born here and in the combat employment of contemporary missile-carrying interceptors. Officer V. Krasnov, a Communist, proposed a method for increasing the detection range of an aerial target with the help of a radar sight. In training for flights in combat employment at night and in adverse weather conditions, in the unit a special stimulator stand was constructed. These studies helped the pilots, led by Colonel P. Pachenko, unerringly to intercept and to "destroy" the targets by missile fire on the first attack pass. In this exact manner performed pilots (Communists) A. Volkov, P. Baranov, V. Krivokhizhin, G. Mal'tsev, and L. Tulupov at one of the training sessions.

All of these aviators are skillful, highly prepared specialists. The pilots irreproachable master their entrusted weapon. In their combat training they exceeded the usual norms for a well-prepared aviator. They skillfully take off during weather which is below the established weather minimum. They confidently master the technology of take off and landing from the ground, and they have been taught to land on unfamiliar airfields in adverse weather conditions. Conquering new barriers in combat training, the personnel of this regiment have performed for an extended period without flight mishaps.

What is the basis of the achievements of these advanced military collectives? Whence is the great energy taken which helps men to seek newer and newer barriers in combat improvement? The high indices in combat training are explained, first of all, by the skillful organizational and educational work of the supervisory personnel. Advanced commanders and political workers, acting in close contact with the Party and Komsomol organizations, explain in detail to the personnel the problems of combat studies; then constantly seek to increase political awareness and the personal responsibility of each airman for the duty assigned to him.



**GRAPHIC NOT
REPRODUCIBLE**

Firing rockets from a fighter aircraft.

In such units and subdivisions the entire training process is planned clearly. Ground training is conducted in together with the problems of flight operations. Proper attention is allotted to the special training of all personnel. By combining the unremitting exacting quality with concern for the life and needs of their subordinates, the commanders firmly implant strict military discipline and order and seek strict performance of flying laws and the requirements of regulations.

Great successes have been achieved by the interceptor pilots of our antiaircraft defense (PVO). The press gave the following characteristic of Soviet PVO missile-launching interceptors: they can destroy winged missiles and their carrier aircraft under any meteorological conditions, at any altitude and at any flight speeds.

PVO missile-launching aviation possesses high maneuverability, which permits rapidly concentrating its efforts in decisive directions, against the main groupings of the means of an air attack. Its great flight range renders it an effective means of destroying the carrier aircraft of winged "air-to-surface" missiles before they reach their launch points.

Let us tell of one shining example of missile-launching aviation - a squadron of first-class pilots, headed by Major Karlov.

Special volatility. When I asked one of our best interceptor pilots, Major V. F. Karlov, who has excellently mastered all forms of flight in missile-carrying aircraft, what appeals most to him in his aircraft, he answered immediately:

"Some special volatility. In my previous aircraft, when lowering the rpm during landing you could feel the aircraft start to drop, but this one flies..."

After conversations with Karlov, with his commanders and his friends, it seemed to me that the best characteristic of Karlov himself would be the same words which he said about his machine: special volatility.

Wherever Karlov studied, he always mastered his aircraft fastest of all, and in the shortest program, as the aviators say, took off in it. While still in aviation school, the squadron commander assembled the young men after the first flights and, pointing to one standing at a distance, on left flank, a short, obviously quite young student, he said:

"Let him be your example..."

Arriving at the unit, Victor Karlov met the jet fighter for the first time. The unusual appearing aircraft stood there with its sweptback wings tilted back. In contrast to piston aircraft, with its forward engine and propeller, the jet seemed to be missing a main part, without which flight seemed impossible... But the new aircraft flew, and how!

And here Victor experienced no difficulties. His special volatility enabled him quickly to tame the jet "jumper." When you ask him about his impression regarding this, he says with a smile:

"The machine is powerful. In my left hand I sensed a gigantic power."

Indeed, the jet engine, the rpm of which the pilot controls with his left hand, was much more powerful than the piston engine. This promoted its rapid introduction into high-speed aviation. Thus for Victor, transferring to the jet fighter, flight speed increased by 3 times...

The following stage in aviation progress is briefly described by the pilots: supersonic. For mastering aircraft which fly faster than sound, several young pilots were picked from the squadron. Victor was among them.

...Somehow three of them went to an aviation personnel settlement, and suddenly a young neighbor boy ran up to them and hurriedly reported:

"A bomb exploded over there..."

But before he could finish his story and before the pilots could express their attitude, a new thunderclap resounded from the clear sky. This is how flights began in the supersonic machines. It was necessary to calm the boy down: it was nothing terrible, just an aircraft breaking the sound barrier.

Soon the retraining program was completed. Karlov's proficiency rating increased, his combat skill increased and he became a real interceptor pilot.

This time includes one more landmark in the life of airman Victor Karlov. On his aircraft sharp-nosed, spindle-like rockets appeared.

And for him a new school "was opened" - the school of mastering the combat employment of missile weapons from fighter aircraft. Together with the growth of his flight qualifications, the official position of Communist Karlov also changed - he first became a flight commander, and then a squadron commander. He had to learn not only the actual new procedures of aerial combat, but he also had to instruct others.

And here began the first missile firing on aerial targets. Flying on the missile carrier was Karlov's pupil Captain Ponomarenko. The target was felled by the first missile. Another flight - Captain Tsyplakov was in the air. And again a hit by the first missile. High results were achieved by the other pilots of the squadron headed by Major Karlov. They also successfully completed missile firing on ground targets.

The basis for success of the commander and all of the squadron pilots was their deep understanding of their duty to the Fatherland, their real collectivism and persistence in solving the problems at hand. The party organization, headed by Captain Kulikov, became the real spirit of competition. It was not accidentally that here all of the pilots were 1st class. The unit (on the whole) has flown over 11 years without accidents.



**GRAPHIC NOT
REPRODUCIBLE**

Crews of missile carriers are masters of combat launches. One of these launches is shown in the photograph. The first crew has accomplished a launch, and the second is ready for it.

The present generation of pilots continues the glorious traditions of our front line soldier-aviators. In this unit the airmen are constantly tutored in pride for past combat events. After all, the unit in which they serve fought at Khalkhin-Gol, served on the Soviet-Finnish front, and from the first to the last day participated in the Great Patriotic War. Here four Heroes of the Soviet Union emerged.

Now their place in the combat formation is occupied by Karlov, Tsyplakov, Ponomarenko and their military comrades — people of such warm hearts, the bearers of glorious traditions. They are distinguished by high aviation culture, political and combat maturity, constant thirst for knowledge and many-sided interests.

Tayplakov, for example, in his free time from flying studies studies Marxist-Leninist philosophy. The other pilots independently study transactions of the classics of Marxism-Leninism. This helps them to have a true orientation in life.

Pilots of missile-launching aviation — the reliable protector of the air boundaries of our native land — persistently improve their combat skill.

Our Air Forces, in cooperation with the forces of the nation's antiaircraft defense (PVO strany), are in constant combat readiness to repel any air attack by an aggressor and to inflict on him (jointly with the Strategic Rocket Forces) powerful nuclear blows.

On Board Seagoing Missile Carriers

Fire arrows over the water. Missiles were introduced into the Navy (VMF) after they had proven themselves with aviation and land forces. According to Hero of the Soviet Union G. Ternovskiy, a participant in combat employment of missiles on ships of the Black Sea Fleet, this occurred in March of 1942. Then on the decks of cutters — submarine hunters — gun-carriages with guide rails appeared. On each cutter there were two rocket installations, ensuring the simultaneous launch of eight missiles.

The first blow was inflicted on aerial targets. Over the water streaked the first fire arrows. Subsequently, the sailors were convinced that the use of missiles for strikes from ships on ground targets was more effective. For this the launchers were improved.

On 11 December, 1942, our scouts revealed a grouping of fascist troops southwest of Novorossiysk, near the Aleksna farm. At night, by sea, four missile-carrying cutters headed toward this region. Fire was conducted in volleys then and there from two cutters, launching 64 missiles. The crews of the other two cutters at this time loaded the launchers and also fired in a volley. The blows were on target, and caused the enemy to suffer great losses.



**GRAPHIC NOT
REPRODUCIBLE**

In naval rocket firing, Soviet missile-men have achieved outstanding successes.

Almost two months later a schooner, armed with missiles, participated in safeguarding the first echelon of a naval landing at the dock of the Novorossiysk fishery. It delivered three crushing volleys of 96 missiles, exactly striking the target.

On the basis of the combat experience gained, it was decided to arm the entire group of Black Sea cutters with missiles. They were called artillery cutters, or, abbreviated, AK. Besides strikes on enemy airfields and assemblies of hostile troops, the AK successfully participated in sea battles.

March, 1943. Two missile carriers were in combat with a group of enemy torpedo cutters. The AK commander, Senior Lieutenant V. Shkola, ordered two missile volleys fired. One enemy cutter sunk instantly, and the others turned and moved out to sea.

In another instance the missile carriers, in spite of a strong convoy, inflicted a rocket blow on an enemy ship, causing a fire on it.

April, 1944. In the region of Sevastopol', missile carriers attacked an enemy naval transport and its convoy of protector ships. One of the protector ships was set afire.

Somewhat earlier than on naval vessels, missiles passed their combat check on river flotillas. Here we must first mention a battle on the Volga, where, to support the actions of army units, armored river cutters, armed with 132 mm missiles were used. They made over twenty combat firings from October of 1942. After destroying the enemy on the Volga, these cutters were transferred to the Azov Sea and participated in support of a landing in the Kerch region.

Missile-carrying ships of the Onezhskaya flotilla directly interacted with ground units. Here not only torpedo boats and armored cutters were armed with missiles, but also the protector ships.

Characteristic for the use of rockets by the Onezhskaya flotilla was the fact that the comparatively stable location of troops permitted previously (exactly and comprehensively) determining data for firing. Thus was the fire strike of the missile carriers prepared, inflicted by them on 22 August, 1943 on enemy troops, concentrated in the area of the Onezhskiy by-pass canal. The area was precalculated to which, at a strictly set time, the missile carriers approached. From that point a volley of 128 missiles was fired from all of the cutters. The targets were hit.

In the last battles of the Great Patriotic War, active participation was taken by missile-carrying ships of the Dunayskaya flotilla. In the battles for Komarno and Bratislawa, for example, crews of the missile carriers under the command of Senior Lieutenant G. Bobkov were distinguished. The division to which these cutters belonged was given the honorary designation "Bratislavskiy."

Missile-carrying vessels played their own role in the combat operations of the Pacific Ocean Fleet and the Amur flotilla in destroying the Japanese aggressors. It is necessary to note that in the Pacific Ocean Fleet, 132 mm missiles were mounted on certain assault ships in the nose sections. The first firing from these ships took place in the spring of 1945. Here the combat experience of missile carriers of the Black Sea Fleet was widely used. During combat operations of the Pacific Ocean seamen, rocket missiles were used to safeguard a naval landing on the Kuril Islands.

The Amur flotilla used the missile-carrying cutters for striking concentrations of hostile troops near the city of Fuyuan', and for striking a powerful Japanese resistance pocket near Naydzya. The Amur missilemen were especially distinguished during a strike on Japanese troops in the city of San'sinu.

The crews of seagoing and river missile-carrying ships in the battles of the Patriotic War covered themselves in unfading glory. Several of the commanders of these ships were honored by the highest distinction of the Soviet Fatherland. The high rank of Hero of the Soviet Union was awarded to the commanders of cutters, Senior Lieutenants V. Pilipenko and I. Shengur. They distinguished themselves in executing combat assignments which were connected with missile strikes on ground and naval targets. Using the combat experiment of the Great Patriotic War and the achievement of contemporary combat materiel, the Communist Party and the Soviet Government increased even higher the power of our fleet.

Both atomic and missile... Our Navy has the most modern weapons. It has radically changed, and its combat strength has risen to a new, higher level. The combination of mobility and maneuverability of a vessel with powerful nuclear missiles had led to the creation of strong and flexible means of armed combat. In the USSR there are surface vessels of a new type - missile cruisers and missile cutters. Their combat capability is incomparably higher than similar classes of ships of the Great Patriotic War period.

However, one should note that Soviet military science considers the underwater fleet a main shock force in combat actions at sea, the basis of which is now the atomic submarine. As compared to other ships they possess much greater secrecy, mobility, a greater range of operation, and, at the same time, low vulnerability. The atomic submarine can move under water for weeks and months, and can fulfill missions which last for many thousands of miles: it need not, like an ordinary submarine, surface or go to a base for fuel.

These capabilities of the underwater atomic fleet are considered in our military structure. As was noted at the XXIII Congress of the CPSU, along with the Strategic Rocket Forces, we have created in the past years an underwater missile-launching fleet capable of executing strategic missions regarding striking enemy objects both at sea as well as on land. Its composition includes new atomic missile-launching submarines equipped with ballistic missiles having underwater launch capability and great range.

These atomic submarines can accomplish long-range missions in the vast expanses of ocean from the Arctic to the Antarctic and there can execute any combat missions successfully. In 1956, for example, an around-the-world cruise of a group of atomic submarines was successfully made underwater.

The Commander in Chief of the Navy, Fleet Admiral S. G. Gorshkov, told what constitute atomic submarines, and gave the details of their around-the-world cruise.

The atomic submarine is the most threatening contemporary vessel. Its cruising range is practically unlimited. Moreover, for an arbitrarily prolonged time it maintains high speed due to its atomic power plants. One such power plant can produce the electric power needed by the industrial enterprises and the population of a large city.

The missile weapons of atomic submarines can strike (with high accuracy) both naval and ground targets at a distance of hundreds and thousands of kilometers. For accomplishing long-range cruises, atomic vessels have the latest navigation equipment, which permits knowing the location of the vessel at any moment. Various radioelectronic equipment enables the vessels to "see" the entire underwater and surface situation surrounding them, and to use their weapons effectively.

The submarine's radio communication equipment allows maintaining contact with its command, while it is at any point in the world's ocean, without surfacing. It, like the other forms of equipment, performed excellently during the around-the-world cruise of our atomic submarines around Southern America, among icebergs and the ice fields in the Drake Passage and in the waters of the Antarctic.

The around-the-world cruise, accomplished under the leadership of Rear Admiral A. I. Sorokin, lasted slightly more than a month and a half. Almost 40,000 km was covered without surfacing. This detachment visited several climatic zones and several times crossed the equator. Personnel coped excellently with training problems, skillfully controlled the equipment, and exhibited stamina, strength and will power.

This cruise was dedicated to the XXIII Congress of the CPSU. It once again convincingly showed the great capabilities of our Navy and the excellent training of Soviet military sailors — true patriots of the Fatherland.

Atomic submarines are highly maneuverable and hidden carriers of nuclear missile weapons. Their new weapon has great destructive force, high strike accuracy and considerable range. Submarines need not sneak close to their targets. The increasing autonomy, underwater speed and submersion depth have increased their secrecy and increased their capability to inflict sudden blows. For underwater naval operations it will now be characteristic that targets will not be waited for in position, but enemy striking forces and convoys will be actively sought, pursued and destroyed.

The appearance of nuclear missile weapons has found reflection also in the views of foreign naval specialists regarding the conduct of combat actions at sea. Above we already referred to a reevaluation in the United States of the role and value of aircraft carriers. In England, with an acknowledgement of their decreasing role in contemporary affairs, Vice Admiral B. Schofield said the following in print. "What can be said," he writes, "about the protection of aircraft carriers from nuclear weapons? If a ship at sea is difficult to strike with a ballistic missile, then it is considerably easier to do this by using an "air-to-surface" class missile from an aircraft." Further, Schofield gives calculations of the vulnerability of a surface vessel to the nuclear warhead of a missile. Even if the explosion of a megaton charge occurs at a distance of over 2 km from the ship, then it will sink the vessel or damage it so greatly that it will require complete restoration. With an explosion of a ten-megaton charge even at a distance of 5.5 km, the ship will cease to move, since the main engine, boilers and internal equipment will break down. Not by accident, in the regular training exercises of the NATO military-naval forces, aircraft carriers operated at a distance of 9 km from each other, and the forces of the fleet, which included 5 aircraft carriers, occupied a huge area. Schofield comes to this conclusion: a group of ships, occupying such a huge area, undoubtedly can easily be revealed by the enemy. And with regard to a strike, "the surface vessel can be hit by one missile."



**GRAPHIC NOT
REPRODUCIBLE**

Like threatening arrows, missiles from aboard ship streak to their target.

Regarding underwater missile-carrying vessels, the same Schofield speaks only in the superlative: "The atomic submarine, equipped with various nuclear weapons, is the most threatening combat vessel today." And the French Admiral Cabanet expressed it even stronger: "The submarine is the weapon of the future... Only it can guarantee supremacy at sea."

The foreign press stresses the difficulties of combat with contemporary atomic submarines. A former commander of an American atomic submarine, Steel, wrote: "The previously used depth charges and depth charge thrower installations are absolutely ineffective in

combat with an atomic submarine which possesses great speed and submersion depth. Only nuclear depth charges with their great destructive force can compensate for those insufficiencies. However, the possibility of using nuclear depth charges is always limited, since an enemy submarine often can be in the operating area of our own forces or... it is impossible to determine with sufficient accuracy the position which it occupies."

In accordance with these views, in the United States, along with the development and modernization of the surface fleet, much attention is being allotted to the creation of atomic missile-carrying vessels. Americans take special care in the construction of atomic submarines armed with "Polaris" missiles (the range of these missiles is about 2200 km). There are 16 missiles aboard the ship; they are in tubes between the deckhouse and the nuclear reactor. They can be launched from the surface and from an underwater position. Before launch the submarine assumes an assigned depth and the missile is shot from the water by compressed air. At this instant the solid fuel engine is switched on, and the missile assumes its ballistic trajectory. Specialists from the United States launched a missile from under water for the first time in 1960.

It is impossible, however, to consider that all of the technical problems of launching and guiding the "Polaris" missiles have already been completely solved by the Americans. And the "Polaris" system has the inherent general flaw of American missile weapons: insufficient reliability. The press reported, for example, a number of unsuccessful attempts to launch the "Polaris" missile from Cape Kennedy. The missiles did not go into orbit: their power plants failed.

In forcing the arms race, the United States military clique allots special attention to increasing the number of atomic vessels. Missile-carrying vessels are grouped in squadrons (with two divisions per squadron). A division usually consists of 4 or 5 submarines.

We must note that the development of underwater missile forces clashes with an unexpected (for the military circles of the United States) obstacle. Thus, according to the permanent schedule on every atomic vessel two shift crews are foreseen. But the Department of the Navy in the United States sometimes cannot ensure this. The shortage of personnel is especially sharply felt on atomic missile-carrying vessels. The lure in the form of privileges and raised monetary allowances does not help. United States officials openly recognize the fact that many sailors do not wish to serve on the new ships. It was necessary to begin urgent recruiting of young men with the strictest subscription to serve in the underwater fleet for no less than 6 years. Obviously, not many young Americans wish to connect their fate with the "shock" weapons, which is the basic rate of the frantic military clique.

Military specialists in the United States devote much attention to the actions of atomic missile-carrying vessels in polar regions, assuming the advantage that a boat under the ice is practically

impossible to reveal from either aircraft or from a surface vessel. At the same time, the crew of a submarine can use an icefree spot or a separation point to surface and to launch missiles at targets on a continent, the coordinates of which have previously been established.

Abroad they also attach importance to close interaction of ships and aircraft, armed with "air-to surface" missiles and based on aircraft carriers. We must say that in the United States the evident reevaluation of the capabilities of aircraft carriers is noticeable. Obviously they possess considerable power, but realizing it in a war is becoming more and more difficult. The aircraft carrier is already very vulnerable. It requires considerable forces for protection, which lowers its secrecy and maneuverability and facilitates inflicting missile strikes on it.

The plans of the Pentagon are becoming all the more evident to create a network of mobile underwater launch sites for their missile submarines around the countries of the socialist camp, in order to hold many important objects in their sights. These plans embody a serious threat to peace.

Our armed forces vigilantly watch the preparations of aggressors. The USSR is not especially impressed by the demonstration of power of the new "Polaris" weapons system, or by any other sabre rattling. Now it is fully clear just what the American ballistic missile submarines and what their strong and weak points are.

At one time, in our press it was stressed that life already now refutes the boasting by representatives of the United States regarding the invulnerability of their weapons system and the technical perfection of their missile-carrying atomic submarines. Neither the depth of the ocean's water nor the ice cover of the Arctic will protect the "Polaris" from detection and a strike. It is also difficult to hide such ballistic missile submarines in the bases where they are often forced to proceed not only to replenish ammunition, provisions and water and to replace crews, but also to eliminate technical malfunctions. Located in their ports and bases, the underwater "Polaris" missiles, as well as their floating bases, constitute a good target for ballistic missiles even in the case when a strike is not inflicted on them, but on objects of base, which will be taken out of commission.

The acclaim given to American missile-carrying atomic vessels is not justified. The destruction of the vessel "Thresher" clearly showed that in the feverish arms race, military circles introduce into service technologically incomplete atomic submarines with great design deficiencies.

The armed forces of the Soviet Union, including the Navy, have all of the necessary equipment. The quality of our atomic submarines in many respects is higher than the American; they can perform different combat missions more successfully, including the search for and detection of underwater "Polaris" vessels. Submarines, missiles and other contemporary weapons are in the reliable hands of Soviet military sailors.

The missiles of our fleet. What sort of missiles arm the Soviet underwater fleet? It is armed with powerful winged and ballistic missiles, designed to strike naval targets, naval bases and military-industrial centers on the territory of aggressor countries.

Under the banner of the Navy, in Red Square in 1965-66 the remarkable submarine missiles passed. These were representatives of the family of threatening solid propellant ballistic missiles of the Soviet ocean-going submarine fleet. Launched from under the water, such missiles can strike an enemy target which is a thousand kilometers from the launch. Our sailors have mastered well the launching these rockets and they have attained high target strike accuracy.

We also have homing missiles. At a range of hundreds of kilometers they can destroy ships of an aggressor approaching the borders of the socialist countries.

After all, it's no secret that if the imperialistic countries belonging to NATO, and especially the United States and Great Britain, were to begin a war against us, they would have to use naval transports widely. And a powerful submarine fleet poses a question as to the possibility of such shipments. Not by accident, the former Chief of Staff of the United States Navy, Admiral Burke, stated that "the threat of the Soviet Union's underwater forces is a mortal one for the United States, and combat with them is a most difficult problem."

And the matter, of course, is not only in the apprehension of the imperialists regarding their own naval communications. The aggressors fear a crushing counterblow. The military observer of the "New York Times" newspaper noted that "a flotilla of atomic submarines, capable of crossing oceans in their submerged state and capable of launching long-range missiles with nuclear warheads onto the territory of the American Continent creates an absolutely new and colossal strategic threat."

The rearmament of our Navy with nuclear missile equipment has posed in a new fashion the questions of using the means of armed combat at sea. Serious changes have occurred in the operational art and tactics of the fleet.

When inflicting nuclear missile blows on an aggressor, according to the views of Soviet Naval Art, the interaction of ballistic missile submarines with naval missile-launching aviation will have great value.

Contemporary military equipment permits firing ballistic and homing missiles from submarines at vital centers and destroying the ships of naval forces of any aggressor. Our missile submarines have learned well how to move under Arctic ice and how to precisely assume a position for launching rockets, which is very important for reliable blows on objects on both land and water.

**GRAPHIC NOT
REPRODUCIBLE**



Two starts and two targets will be hit.

On the pages of American newspapers it is often possible to encounter a very characteristic acknowledgement: "The creation of an atomic submarine fleet, equipped with missiles, will open a new ocean for the USSR - the Northern Arctic - and will render the North American Continent vulnerable to blows from short distances." Yes, the hopes in the United States of those who calculated to start a new war and sit back overseas are collapsing.

Also unfounded is the position of the imperialists in the United States, England and their military allies to develop military bases directly near the coast lines of the USSR. In the newspaper "Pravda," in connection with the warlike statements made by English Admiral Derrick Holland-Martin, it was stressed that even the nuclear missile power which only our Black Sea fleet has at its disposal would be more than enough to reduce to ruins any countries, adjacent to this region, which became the military bridgeheads of NATO.

Soviet military sailors well understand their great responsibility for the successful mastery and use of complex equipment and armament. The crews of missile-carrying vessels persistently improve the military-technical, tactical and other forms of combat training. Submariners have achieved great successes in mock firing of missiles and torpedos. Further widening the development of socialist competition, crews of ballistic missile submarines, as well as all military sailors, increase their skill and learn to use completely all the capabilities of the latest weapons.

The Soviet submarine fleet, with nuclear power plants and armed with ballistic and homing missiles, stands vigilantly on guard over our socialist conquests. It can successfully execute strategic missions in striking enemy objects at sea and on land, acting in the vast expanses of ocean from the Arctic to the Antarctic.

Our submariner-warriors try to be worthy of the high rating of the role and value of the Soviet submarine fleet.

Advanced military men of naval missile carriers and atomic vessels. Let us tell of certain of the officers of fleet who have achieved the greatest successes in mastering new weapons. Here is one of them - Senior Lieutenant B. Shevlyakov. He is the commander of an excellent group on a missile-carrying vessel. In this group the flame of socialist competition brightly burns. The commander himself is the author of many innovations. One of them aids in better controlling missile fire. As his subordinates happily reported, during one training session two blue lights burned on the central panel. This signified that all the equipment was functioning normally. This meant that it was possible to proceed to the following operations. This saved the same seconds which could decide the success of a contemporary naval battle.

A feel for that which is new and constant concern for the success of the entire combat crew of the ship are a characteristic trait of Shevlyakov. He was chosen secretary of the Komsomol organization and attended the Komsomol Congress. He joined the ranks of the Communist Party.

A man of hard fortune, he does not seek easy happiness for himself. Severe naval cruises and responsible rocket firing are the tests of command maturity and of one's readiness to execute worthily any assignment of the Fatherland.

Each ship which obtains missiles as armament takes on a new quality. This also pertains to the smallest ships, the missile cutters. The crews of these ships with pride see in the missiles a means of sharply increasing the combat power of cutters and their role in combat when using nuclear missile weapons. Having obtained missiles, they have become a threat to bigger ships. Compared to a large ship, a cutter is almost invisible, but its missile fire is annihilating.



**GRAPHIC NOT
REPRODUCIBLE**

Soviet missilemen guarding our Fatherland. Any of our rockets from its shipboard launcher will strike the target exactly.

Missile cutters, created by Soviet designers and missile builders, continue the combat glory of the torpedo cutters. Their ability to inflict sudden blows, to act quickly and to maneuver rapidly is especially valuable for nuclear missile combat at sea.

Sailors refer to the missile cutters with respect. They serve on them with great enthusiasm. Let us refer to an officer with a purely naval surname - Moryakov. He was the first in his fleet to launch a shipborne missile from a new cutter.

...Like a bird the cutter floated across the blue sea, approaching the launch position. Once the position was reached, the button was pressed. Launch.

A bright flame struck at the deckhouse glass. The target was hit. The sailors happily embraced one another.

The awareness of their responsibility for the mighty weapon which the Fatherland has given them inspires the sailors. The excellent division of missile ships in which Lieutenant-Commander Moryakov serves, is one of the guiding lights of our Navy. It was awarded a Navy prize. In the division, all crew members feel strongly about the cutter's honor. It is really difficult to call this ship a cutter. A visiting admiral who had spent many years of service on cutters, said to Moryakov:

"You serve on remarkable ships. And enviably so!"

Even correspondents who visited the missile cutters were surprised by their dimensions. The appearance of the cutter missiles is threatening and impressive. And these are only cutter missiles... On the other ships, the big brothers of cutters in weapons, the missiles are even more powerful...

On such a threatening ship, armed with more powerful rockets, serves, for example, Captain 2nd class Ogorodnikov.

Upon completion of school he became the commander of a conventional, nonmissile-carrying ship. Once the commanding admiral, without design, invited his ship commanders to training sessions where missile ships participated. These bursts of launches, from which the sea becomes crimson, these lightning-like missiles darting upward struck the imagination of Ogorodnikov. What joy he experienced when the commanding admiral unexpectedly, as it seemed to him, offered the command of a missile ship. He wanted this with all his heart, but in his soul he feared that he would not conquer the difficulties involved.

But he did. First of all, he studied books and student notebooks, where he tediously made rocket calculations. And when the day arrived to check his missile firing, Ogorodnikov confidently ordered:

"Prepare to launch!"

All was ready for the launch. Fire control officer Pryymachuk pressed the button. The rocket took off, and there could be no miss!

This chapter includes photographs which record episodes from the life of shipborne missilemen. These documents speak of the perfection of the weapon with which the Soviet missile carriers are equipped, and of the intense program of studies which our military sailors undergo.

The radars revealed a high-speed aerial target. Rapidly and precisely the surface-to-air missile installation is readied.

Without fail yet other missiles will strike the target. It just left the guide rails. And the missilemen are confident of the

force and accuracy of the blow. This confidence is well-founded. One can imagine how the target ship looks after its encounter with the missile. Here all commentary, indeed, is unnecessary.

The power of a missile weapon in naval combat is illustrated by this curious fact. The tsarist yacht "Polyarnaya Zvezda," on which in its time the 2nd congress of revolutionary seamen of the Baltic region took place, became a floating base for one of the brigades of the Soviet Navy. The yacht became obsolete and worn out. So, it was decided to use it as a missile target. But after the first blow, by the naval missiles, the yacht sunk.

Representatives of the rescue service joking said to the missilemen after that:

"Jokes are bad with you if you melt the ships with the first missile. After all we have to raise them."

Great successes are sought by the sailors who serve on the atomic vessels which are the pride of the Soviet Navy. Here is one of them, Captain 2nd class L. Zhil'tsov. He speaks of his own ship: "Atomic ship? It's an entire factory! Reactor, engines, automated equipment. Here only an engineer is fit to inquire!"

But Zhil'tsov inquires. He excellently completed a special government assignment. A Decree of the Presidium of the Supreme Soviet of the USSR states this. "For successful execution of a special government assignment, L. M. Zhil'tsov is awarded the rank of Hero of the Soviet Union with a presentation of the order of Lenin."

Ranks of Hero of the Soviet Union have been conferred on other atomic scientists-sailors: flotilla commander A. I. Petelin and electromechanical combat unit commander R. A. Timofeyev.

A submarine under the command of Captain 2nd class Zhil'tsov was at the North Pole and beyond. On its return trip, it passed the pole in exactly the same way. Here is what Zhil'tsov said about this trip: "Having reached the latitude, beyond which pack ice begins, we passed by a somewhat more northerly course, we detected a suitable opening in the ice and began to surface. Here I should like to note the perfection of Soviet navigational equipment, allowing us confidently to surface in an ice-free spot, barely exceeding the dimensions of our ship.

We did not remain long in the ice-free spot. We made the necessary observations, communicated by radio with fleet headquarters, and headed toward the pole. When we reached this cherished place, I said to the crew:

"Comrades, our vessel is at the North Pole!"

In answer a powerful naval "hurrah" resounded.

Thus together with the qualitative growth of the Navy a remarkable people also grows; they are capable of operating all of the most

complex equipment of contemporary ships, including the wonderful contemporary underwater atomic vessels.

3. CONDITIONS OF NUCLEAR MISSILE WARFARE AND REQUIREMENTS OF THE TRAINING OF MISSILEMEN

Nuclear Missile Weaponry and Contemporary Warfare

A characteristic trait of the contemporary stage of development of our armed forces is the fact that their fire power is now determined not so much by the number of troops, but by the presence of the latest forms of weapons and equipment. After all, fire power was always one of the most important indices which, together with esprit de corps, characterized the combat capability of troops.

What determines the fire power of troops. Fire power depends on the level of development of the means of armed combat. Namely, the perfection of armament and the creation of new versions of weapons render a revolutionizing influence on the character of the armed forces and the methods of their operations on the battlefield.

The creation of new forms of weapons, as the history of warfare states, often led to a radical change of the methods of waging war. We can refer, for example, to the revolutionizing influence of the invention of powder and the creation of firearms. Serious changes were caused in the methods of waging war by the appearance (at various periods of history) of rifled weapons and automatic weapons, in particular, machine guns. The fire power of troops in the 20th Century has grown especially intensively. Outstanding achievements of science, technology and production have permitted producing powerful means of armed combat on a mass scale: tanks, mortars, aircraft and, finally, as the greatest embodiment of scientific and technical capabilities - the missile with a nuclear warhead.

The use of tanks and aircraft had an effect on the fire power of troops even during the First World War. In the course of the war, in connection with this, the relationship of types of troops was changed. Thus, if in the pre-war period $3/4$ of the armed forces were infantry, then toward the end of the First World War its numbers dropped to approximately $2/3$. At the same time, the fire power of the infantry almost doubled, light artillery was more than doubled, and heavy artillery increased by 6 times. Characteristically, with

the reduction of the numerical composition of an infantry battalion by 1/3, its fire power doubled as compared to the beginning of the war.

The fire power of troops in the period preceding the Second World War, grew even more rapidly, as well as during the war itself.

Our party, on the basis of the Marxist-Leninist analysis of questions of warfare and army structure, constantly was concerned with the development of the most promising forms of weapons and equipping Soviet troops with them.

Arrival at the front of a huge quantity of the latest weapons, combat materiel and ammunition permitted continuously increasing the fire power of our troops, which, together with high moral spirit, promoted more successfully conducting combat operations. Obviously, due to the introduction of automatic weapons in a rifle company its fire power, in spite of a reduction of numbers, for three years (from 1941 to 1944) increased by 10 times. Regarding artillery and aviation, their fire power increased continuously. This, in many respects, promoted the wider introduction into artillery and aviation of mobile and multicharge rocket installations, producing high-density fire.

The appearance of rocket artillery served as a precursor of the mass "incursion" into military affairs of a principally new weapon, the rocket, rendering the fire power of our armed forces incommensurate with anything of the past.

What traits are peculiar to the nuclear missile weapon as a fire power means? It embodies the qualities of an annihilating nuclear charge, high invulnerability, practically unlimited operating range and high accuracy under any carrier rocket conditions, the possibility of wide maneuvering in flight paths and fire adjustment due to a radioelectronic control system. These obvious properties of the nuclear missile weapons have predetermined its almost simultaneous propagation in all spheres of armed combat — on land, at sea and in the air. At present there are missiles in the infantry, in Anti-aircraft Defense Forces, in bomber and fighter aviation and on surface and underwater vessels. Thus, in military affairs a revolution has occurred.

Above we spoke of the revolutionizing influence of the introduction of firearms. It is difficult, of course, to compare with the revolution which is now occurring military affairs. The introduction of firearms, as we know, took several centuries. Its influence had an effect mainly in the field of tactics, while later it influenced operational skill, and only through them influenced strategy itself. The introduction of nuclear missile weapons proceeded especially quickly and immediately influenced not only tactics, operational skill, but also strategy.

In order to judge the fire capabilities of the nuclear warheads of missiles, let us refer to the data given in the foreign press regarding thermonuclear charges (atomic charges were referred to above). It is reported that a thermonuclear warhead of 10 megatons creates

a zone of solid destruction with a radius of 12-15 km, that is, an area of 400-700 sq. km; a 20 megaton warhead - 15-20 km and 700-1200 sq. km, respectively.

However, the influence of nuclear explosions does not end here. Luminous radiation, carries fires and burns to people at great distances. Thus, damage to the retina of the eye of a man, looking in the direction of a high-altitude thermonuclear explosion, is possible at distances of up to 1200 km. Radioactive fallout in lethal doses can spread, depending upon the type of explosion and the direction and force of wind, for many hundreds and thousands of kilometers.

In order to imagine more clearly the fire power of a nuclear missile as compared to former combat weapons, let us give an example. We know that in all of the combat missions of Anglo-American aircraft in the period from 1940 to 1945, 2 million tons of bombs were dropped on targets in fascist Germany and countries occupied by it. Now one strategic missile easily delivers a warhead which by far exceeds 2 million tons of TNT in explosive force. It has become possible, so to speak, in one stroke to exceed the result of the daily tedious work of aviation for five long years of war. Not only the outcome of separate skirmishes, but also entire battles can be predetermined by nuclear missile blows on enemy combat formations, reserves and rear targets.

The bosses of the imperialistic blocks, rattling their sabres intensively, love to boast of the good communication between cities of the countries in these aggressive blocks. But with contemporary weapons of destruction in the form of nuclear intercontinental missiles and submarines armed with missiles, of what value is the fact that the armed forces of NATO can, for example, ensure communication among these cities for several seconds? Now one just pushes a button, and into the air will fly not only airfields and the means of communication of different headquarters, but also entire cities, and countries can be erased from the face of the earth. Such is the vast destructive force of contemporary weapons, created by man.

The structure of the armed forces has changed. Under contemporary conditions the role and value of different branches of the armed forces have changed. The success of operations and achievement of main goals of a war are decisively influenced by the use of the most powerful nuclear missile weapons, and the forces equipped with these weapons have become the main branch of the armed forces. Their development includes the most important further increase of fire power of the Soviet Army and Navy.

Striking and destroying with missiles huge numbers of objects in a colossal area and at any depth can create favorable possibilities for the operations of all branches of the armed forces and, in the end, would predetermine the achievement of the goals of a war. This is why the Strategic Rocket Forces have been assigned the leading role.

However, no matter how powerful this branch of the armed forces might be, it could not alone solve all of the problems of war. Therefore, Soviet military art assumes that the successful conduct of

military operations in a contemporary war is only possible on the basis of coordinated use of all the means of armed combat and a unification of the efforts of all branches of the armed forces. This is why we are developing such branches of the armed forces as ground forces, National Antiaircraft Defense Forces (PVO strany), the Air Force and the Navy. They also have been rearmed with missile equipment and both by organization and methods of operations, as mentioned above, will little resemble the branches and organizations of the last war.

The ever-increasing concentration of fire power in separate forms of equipment and the wide introduction of automation in military affairs have sharply increased the role of man. The Communist Party and the Soviet Government have always devoted and devote great attention to the preparation and training of military cadres.

In connection with equipping the Army and Navy with nuclear missiles, the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR practically determined the needs of the armed forces in command and engineering cadres. Thanks to this a number of higher military educational institutions were prudently shifted to a missile curriculum, and the number of prepared specialists in the new weapon forms increased at the expense of a corresponding reduction in other curricula. Following the dialectic law of development, in accordance with which the new grows and the old withers, the party correctly plans the preparation of military cadres, devoting special attention to the training of cadres for rocket forces.

How a contemporary war will be waged. In the press it has often been stressed that under contemporary conditions, war would hardly resemble former wars. Now war will begin differently, if it is to be started, and it will be developed differently. Under the conditions, when states have the means to deliver nuclear weapons for thousands of kilometers, war will begin first of all in the depths of the belligerent nations. Here there will not be one capital nor one large industrial or administrative center, nor one strategic region, which would not be subjected to a strike not only in the first days, but in the first minutes of a war as well.

Thus, a future war, if the imperialists manage to start it, inevitably will become thermonuclear, or such a war, where the main weapon of destruction will be the nuclear weapon, and the basic means of its delivery to the targets will be the missile.

To more clearly stress the peculiarities of nuclear missile warfare, let us first recall the characteristic traits of warfare when using conventional weapons, for example, the Second World War. Then artillery and aviation were the basic means of fire power. The power and depth of their strikes were comparatively limited. Military operations were conducted mainly for the purpose of destroying armed forces on fronts, with simultaneous capture or retention of territory. Offense and defense of land armies were carried out with the support of artillery and aviation. The battles of troops, being in direct contact with the enemy, were of decisive value. The shallow territories of theaters of military operations were, in essence, the

limited spatial span of armed conflict.

In the presence of nuclear missile weapons the contents and order of immediate preparation of armed forces for war were changed. The huge range of strategic missiles excludes the necessity of advancing them up to borders, and permits inflicting blows from their permanent bases. This increases, in contemporary conditions, the danger of sudden unleashing of war by an aggressor and dictates the need to maintain constant readiness to destroy and repel an enemy surprise attack.

The beginning of a war, literally the first days on the first hours, will be characterized by the fact that both sides can place the most valuable targets before themselves. The possibility of simultaneous action on the armed forces and the entire territory of an enemy can lead to a reconsideration of the question regarding duration of a war.

The presence of missiles affects the interaction of different branches of the armed forces. It is known that the fire power of land forces had in the past a range on the order of 20 km into the depth of an enemy position. Hence it is clear, what fire support, for example, they could give to naval operations. Now it is different — land forces and the Navy can mutually support one another by "missile fire" at very considerable distances, incommensurate with those of the past.

How the presence of missiles strengthens the combat activity of forces can be seen by the example of airborne troops. During the years of the Second World War they, as a rule, had limited fire power to repel an enemy. Now the means of supporting an airborne landing are such that it can move on to active, highly maneuverable offensive operations.

Combat operations in a future war will be conducted most often in separate directions. During the actions of forces in different directions and in more wide than solid fronts and zones, rockets permit inflicting blows on an enemy in the most remote (to the flanks) directions; that is, actively influencing the development of events in all zones of operations of an army or a corps.

The mass use of nuclear missile weapons will lead to the formation of numerous areas of complete destruction and radioactive contamination, which, in combination with the absence of a solid front and the high mobility of forces, will give military operations a highly maneuverable character. To replace the localized combat of the past we will see transient battles and skirmishes.

Of great value in a future war will be, along with anti-aircraft defense, antimissile defense, anti-atomic protection and measures undertaken for to eliminate the consequences an enemy's using means of mass destruction.

The aggressor will not avoid retribution, no matter where he is... Those in the West who wish to use war as a means of easy profit, should well remember that it now entails a great spatial span and that they will not be able to remain in the rear, unharmed. In this

war, the lines between the front and rear will be erased. No matter where the territory of a country, pulled into this war, it can be subjected to nuclear missile strikes. The vulnerability of states with small territory and high population density increases incredibly. And, on the contrary, states with an extensive territory will appear much less vulnerable. Take, for instance, the Soviet Union. Our territory is vast, and our population is less concentrated in large industrial centers than in many other countries. Therefore, the West will suffer incomparably more.

At one time, in "Pravda," there was a bitter joke which was circulated in England. They say that in this country the people are divided into pessimists and optimists. The pessimists think that the explosion of three hydrogen will be bombs enough to take the British Isles out of commission. The optimists say that it will take not three, but six bombs. These moods express the alarm of the people. After all, if even such an imperfect missile as Hitler's V-type and the raids of German aircraft during the Second World War led to the destruction of 4 million houses, then what will occur if over England there begin to explode bombs and missiles with nuclear and thermonuclear charges?

No less vulnerable to nuclear missile weapons are West Germany (FRG) and other countries which are aligned with NATO and which participate in aggressive military preparations. Scientists of the FRG, for example, calculated that one hydrogen bomb could render temporarily unfit for life an area the size of the Ruhr district.

American military circles place very great value on their bases, especially in those countries connected with the United States by aggressive alliances. "That fact," reported the American press, that America intends to rely on missiles to a great degree which need no overseas bases, does not mean that the United States will recall its armed forces from all overseas posts. The gradual elimination of bases which are equipped with obsolete rockets in proportion to the accumulation of a sufficiently great unnumber of 'Polaris' and 'Minuteman' missiles is anticipated.

"According to the reduction of the number of strategic bombers, certain overseas bases of the Strategic Air Command may be eliminated. However, the removal of long-range bombers will not signify the demise of almost two thousand bombers having a shorter range... They can be used for raids on targets in Russia from a ring of bases located close to the Soviet borders. These air bases will be needed for a long time. They will force Russia to maintain an expensive air defense system. They will also make it necessary for Russia to inflict blows on many targets, whereas the United States can concentrate its attention... on the territory of Russia itself."

No matter what is said, the imperialists' project is insidious. Only the Soviet Union guessed it long ago. Leading workers of the USSR have often warned that with the appearance of nuclear missile the calculation of the United States military circles regarding the specific value of their bases in NATO countries is unfounded.

Regarding those countries who give bases for the aggressive forces of the United States, the Soviet Union will hold in readiness its own unfailing missiles to always be ready to strike both the main aggressive forces as well as the countries, on whose territory these bases are located. Let us assume that all aggressors know that no one will escape retaliation — both master and lackey will be hit. And this will be only for the good of all people who hate war.

The Soviet Government has warned the governments of all countries, on the territory of which United States military bases have been built, that if raids, intrusions or attacks on the USSR originate from these bases, then it will answer by all means available and will render crushing blows on these bases. The peoples of these countries understand that they must take all measures to avoid unleashing the war, in which certain hotheads in the United States attempt to involve them. These hotheads, apparently, trust that they, in case of war, can ransom the blood of the peoples of the nations of Europe, Asia and Africa, where their bases are located, and that they themselves will suffer less.

However, there is nothing more deceptive than such an idea. In case of aggression, Soviet missilemen will indeed strike the American bases in those countries where they are located. Missiles with an operating range of several thousand kilometers can be used for this. But we have both and intercontinental and even global missiles which are designed to strike an aggressor overseas.

Quite recently, great distances, let us say oceans, were a natural barrier for the propagation of wars from one continent to another. The First and Second World Wars primarily devastated Europe. Certain states were still able to sit beyond the vast expanses of ocean or in distant regions. They could not only avoid destruction, but even capitalize greatly on the war.

Such a country was, in the first place, the United States. In the First and Second World Wars, all of the destructive fire, all the terrors, disaster and misfortune were experienced by only her allies. The United States suffered small losses, there was no combat on her territory, and the monopolies raked in huge profits, earned by the blood of those perishing in the war and by the sweat of the American workers. The net income of U.S. monopolies during the years of the First World War was 46 billion dollars, and during the years of the Second World War — 123 billion dollars.

But the greedy monopolies will attempt in vain to repeat this experiment under contemporary conditions. Now the position of U.S. imperialists has sharply changed. Literally in tens of minutes the most destructive weapon — the nuclear weapon — can be delivered to any point on the earth, including the territory of the United States. Here the missiles are delivered accurately and reliably, practically without counteraction, since U.S. specialists have not yet devised antimissile equipment. Missile strikes on the United States can be carried out not only from the earth, but also from such mobile launching sites as submarines.

It was noted above that the greatest losses from nuclear missile weapons will be borne by the country with the greatest density of population and concentration of industry. One must recognize that the United States is exactly such a country.

In the foreign press rather convincing accounts by American military specialists are given which affirm that if nuclear attacks were made on 50 large U.S. cities, then the threat of destruction of almost half of all the population and more than half of the industrial enterprises would be present.

Imperialists in United States are taking intensive measures to create antimissile and antiatomic defense, and they conduct "nuclear alerts" during which government officials are concealed in deserted regions and in caves. During one of the exercises a figure of losses exceeding 50 million persons was reported. It reflects not only the real probability of retaliatory nuclear strikes, but also the attempt to blackmail the population and to obtain more money from the people for the arms race.

However, no arms race will any longer be able to change the fact that under contemporary conditions, the aggressor will not be able to hide anywhere from retribution...

The clash of the strategy of fear. For a long time the United States military circles followed the political doctrine of "from a position of strength," the strategy of fear and "mass retaliation," which were based on an imaginary superiority of the American armed forces. The outstanding success of the Soviet Union in the field of rocket-building have razed to the ground these aggressive designs of the American imperialists and their military specialists.

The very climax of works in the United States regarding creation of the forces of fear (according to Pentagon plans) was inflicted a cruel blow when the Soviet Union reported its successful test of the world's first intercontinental ballistic missile. "This event, which was followed by the launch of surprisingly heavy Soviet artificial earth satellites," reported the United States press, "marked the beginning of the nuclear missile era, and the fact that the Soviets were the first to create a weapon having such value has caused a deep disturbance. Inasmuch as no state had a similar type of weapon, it was impossible not to recognize the fact that... the Soviets... had exceeded our technical skill."

Overseas a feverish reconsideration of views and concepts began. The appearance of intercontinental missiles, the launch of which "it is impossible to anticipate and against which there was no definite protection," made the value of strategic aviation unfounded. Missiles could destroy both the large military objects of a country, as well as strategic aviation bases equally effectively.

United States military specialists distinctly understood that intercontinental missiles, even in the first stage of their development, facilitated a sharp reduction of nuclear weapon delivery time to practically unlimited distances. The United States of America and her allies began to take measures to disperse their objects,

including strategic aviation bases, NATO tactical air bases, rocket positions and aircraft carriers.

Until recently, abroad it was often said and written that the U.S. Navy could deliver a blow and make a landing at any point of the Soviet sea coast. But as they say, "easier said than done." Now, with the appearance of nuclear missile weapons, someone overseas had to ponder the fate of his own shores and greatly extended communications, and the fact that the traditional invulnerability of the United States had been forever eliminated.

Feeling the ever-weakening value of strategic aviation, the military circles of the United States with a zeal worthy of the best application, persistently swung this rotting bludgeon. Efforts were started to increase the "passability" of strategic bombers through a contemporary antiaircraft defense system. Here they tried more to saturate them with radio warfare equipment. Finally it was decided to keep as many aircraft with nuclear weapons in the air as possible. But here it turned out that continuously keeping a third of the strategic aircraft of the United States Air Force in the air was impossible due to a "lack of prepared pilots." Nevertheless, as the Army monthly "Army Information Digest" reported, the United States, along with other measures, introduced an airborne bomber watch with nuclear weapons. "This," wrote the journal, "is to demonstrate American military power to the Russians."

However, the means of frightening the USSR, on which the military circles of the United States placed so much value, turned out to be unfounded. In order to correct their affairs, the American imperialists decided to force a missile arms race in all possible ways. Developing a broad program of missile construction, the American military circles, by acknowledgement of the United States press, met with great difficulties when perfecting the new weapons, which caused a delay in introducing the missiles into action. Time, measured in years, was necessary to prepare designs, launch bases, etc.. Furthermore United States specialists to this day doubt the sufficient effectiveness of their rockets in view of their low technical reliability. For liquid-fuel rockets it is calculated by American specialists at 80, or else at 50 percent.

Here is one of the opinions about the "Minuteman" missile, which works on solid fuel. The newspaper "Chicago Sun Times," referring to a secret commission of prominent scientists, investigating the state of the "Minuteman" missile, affirmed that this weapon "is much less efficient than can be judged by official reports... These reports exaggerated the true accuracy, operating range, combat readiness and invulnerability of this missile."

However, it is impossible to disregard the fact that American imperialists expended great efforts in creating and improving their missiles.

But the Soviet people can feel calm and confident: the contemporary arsenal of the Soviet Army fully ensures inaccessibility to our country. Certainly, inaccessibility is a rather conditional concept. After all, it is impossible to forget the fact that the imperialistic states will not remain stagnant. They, of course, will

apply all their efforts to elevate their rocket technology from that state in which it now stands and to occupy the best position. But it would be naive to think that we will sit with folded hand during this time.

Yes, of course the Soviet Union does everything to use the time it gained in the development of nuclear missile weapons and to occupy the leading position in this field, until an international agreement is reached concerning disarmament.

In connection with the appearance in the capitalistic states, in particular, in the United States, of nuclear missile weapons, the question arises as to the danger of its surprise use. We cannot doubt that there are hotheads, ready to push the world into a nuclear missile catastrophe, not only in the United States, but also in other countries — their allies in the aggressive blocks. Thus, one foreign general in the book Strategy in the Nuclear Century advises the United States to manifest a "justifiable reaction," that is, to deliver a forestalling, or preventive, nuclear missile blow. Such, allegedly, is the "law of preservation of life in the nuclear century."

An exhaustive answer to the supporters of surprise nuclear strikes in the West was once given by our press. If the capitalistic states, despite reason, display their perfidy and attack us first in order to use the factor of surprise of an attack with such a threatening weapon as the nuclear missile, then will they thereby ensure the advantage of victory for themselves? No. Contemporary means of waging war do not give such advantages to just one.

One can be first to attack. This requires no great intelligence, but rashness, and we, of course, recognize the fact that certain of our probable enemies have the inclination to do this. It is often possible to observe how in one as well as in another country the supporters of the policy of "from a position of strength" display ardor and zeal, although the "laurels" of Hitler, one would think, should act coolingly on them.

Let us assume, however, that some state or group of states succeeded in preparing and carrying out a surprise attack on a state which possessed nuclear and missile weapons. But really, could the attacking side, even if we, assume for a minute that it could succeed in striking by surprise, immediately take out of commission all nuclear stockpiles and all rocket equipment installations on the territory the state subjected to attack? Certainly not. The state subjected to attack, if it is a sufficiently large state, always will have the capability of giving a proper rebuff to an aggressor.

The Communist Party and the Soviet Government consider the possibility of a surprise attack, in particular from U.S. military bases located around the territory of our country. In our press it has been noted that we place our rocket equipment so that double and triple duplication was ensured. The territory of our country is huge, and we are capable of dispersing rocket equipment and concealing it well. We create such a system that if some means, intended for striking a counterblow are taken out of commission it is always

possible to place into operation duplicating equipment and to strike the target from reserve positions.

The especially destructive, really global character of thermonuclear warfare makes it mortally dangerous for an aggressor. This is also an essential factor in the struggle to prevent the unleashing of a world thermonuclear war. The preponderance of forces of the socialist camp and of the entire zone of peace enables people by active struggle not to allow war, but to compel the imperialists to disarm.

A policy which is oriented toward world-wide thermonuclear war, no matter who started it, can only be evaluated as an anti-national policy and a policy of wild barbarity. It will never be supported by people to whom the fate of humanity is dear.

Characteristically, the soberest heads in the United States are beginning to understand more distinctly the hopelessness of placing a valve on world thermonuclear war. The American press writes: "The United States is entering into a period of the inevitable 'nuclear stalemate,' which requires new strategy."

Until recently, in the United States, as these officials affirm, the concept of a "counterforce" as a means of ensuring national safety apparently employed the full approval of the Secretary of Defense, who from time to time made very warlike speeches. This policy includes the development of military nuclear forces which are powerful enough to achieve success, if it is necessary, in one blow, without risk of excessive losses from a counterattack.

However, the U.S. press recognizes that a "'counterforce' has become technically obsolete in connection with the construction in the USSR of invulnerable rocket positions... Under such conditions, the concept of a 'counterforce,' reflected in the government's budget, is unrealistic from a military viewpoint..."

The means of an offensive, the U.S. press stresses, has become so varied and deadly that there is no basis to assume the possibility of creating reliable defense systems in the United States from all methods of warhead delivery. Any defense can be silenced and overcome with the help of varied and high-quality offensive weapons. Therefore, in the United States a new concept is being advanced - "the ultimate means of containment." This concept anticipates the creation of a powerful system of means to deliver nuclear warheads, which the United States will use to threaten the rest of the world.

Recently the Secretary of Defense of the United States clarified in greater detail the goals of this military concept. The United States must "maintain powerful strategic nuclear forces." Here the American military circles would like to "decide the question about using these forces at their own discretion." Another goal of the concept: to "support various and effective tactical nuclear forces for use in local conflicts, when this is reasonable and necessary." The U.S. military clique also wishes to "have strong diversified and highly mobile nonnuclear forces, capable of undertaking 'proportioned actions' at any point on the globe."

The transition from the concept of a "counterforce" to the concept of an "ultimate means of containment" is explained by the United States press as being due to the increasing power of the USSR, as well as due to economic factors. Military expenditures, the press says, cause economic stagnation. Two thirds of the main productive resources of America — engineers and scientists — are now occupied with military, and not consumer production. The output of military production, although it is complicated, does not lead to a further expansion of production. Correcting this position requires switching from the use of money and technical personnel in the military field to civil economics. A group of American specialists rather transparently hints at the fact that the United States' NATO allies allegedly expend a smaller share on military preparations and, due to this, offer stronger competition to the United States in world markets regarding consumer goods. "West German enterprises," writes a group of authoritative U.S. specialists, "are automated, modernized and equipped with the latest and best equipment. Their new products are being developed, whereas we emphasize new packing."

From the new United States military concept it appears that in any case the military circles manifest ever-increasing interest in local nuclear missile conflicts, seeing in them a recovery of the facilities of their supremacy in colonial and dependent countries.

The years 1965-1966 were marked in the United States by a new reconsideration of strategy. In the journal U.S. News and World Report there was an article with the remarkable title: "Why has United States strategy become obsolete?" Responding to this question, its author, a former member of the planning section of the Joint Chiefs of Staff, lists three points:

- "1. American alliances on both sides of the globe are rapidly declining...
2. United States bases abroad, the construction of which cost such huge sums, are becoming or soon will become the hostages of nuclear missiles...
3. The military problems which the United States will encounter in case of any war... take on new and much more complex parameters as a result of the loss of the United States' nuclear monopoly..."

What sort of outlet do U.S. military ideologists see from the position created? The answer to this can be the widely published (in the United States) works of Herman Kahn, the director of the Hudson Institute; this is a research organization which analyzes the international situation for the Pentagon. This learned fellow introduced into wide use a new word — "escalation" — for determining the changes in U.S. strategy. What does he mean by escalation? Something like, explains the author, a calculated risk or otherwise "balancing on the brink." But please, the reader, can say, Dulles preached balancing on the brink edge of war. What is new here? Apparently, indeed in all reconsiderations of American strategy, the main point is a return to a more rigid policy, to power politics, to the policy of banditry on an international scale.

In order to place a theoretical basis under this policy, Herman Kahn invented the stairway of a growing conflict, in order, as he writes, "to be able to learn its component parts and to estimate the distance to total war." This stairway has 44 steps.

By his theoretical development, Kahn tries to place in the order of the U.S. military clique recipes for unpunished aggressive actions under different conditions. The meaning of his council can be understood from the names of the steps: imaginary crisis; political, economic and diplomatic gestures; positions become more rigid; a show of force; significant mobilization; "legally" causing a disturbance. At this step of the staircase the author recommends "acting in a very hostile and provocative manner, without exceeding the law." With the 8th step the author drops the fig leaf of law and recommends acts of violence such as bomb explosions, murders and firing on the frontier guards of a country, against which aggression is planned.

The clearly provocative character of the staircase, devised by Kahn, is evident in the description of the 13th step, where the author recommends causing a second crisis in another location - not at the point where the first crisis appeared. "To provoke a new crisis, when the other is in full swing, is obvious impudence, which is extremely provocative," Kahn admits, "but in the paradoxical world of escalation this may embody that which will be considered an effective measure under certain circumstances." The quasi-scientific justification of provocation in simple language means: for the U.S. military clique all means are good if they give the effect of helping to develop preparations for nuclear war.

But the higher Kahn ascends up the steps of his staircase - a guide of the Pentagon - the more provocative and sinister advice he gives. Under point 18 he exalts a "decisive, threatening and merciless step." Here he explains: "An example can be an explosion of any weapon at high altitude over enemy territory. This... would promise hope of intimidating the enemy so greatly that he would make concessions." That is where the zealous theoretician leads. This is a direct unleashing of war.

The author calls the following steps limited war: local nuclear war, a demonstrative attack on a rear area or on military objects, demonstrative raids on different installations and, finally, strikes on population. Feeling the cannibalistic after-taste from such strikes, the author rushes to calm the readers down: "These strikes will be possible without spasms and overgrowth in great wars."

At the 31st step of the American staircase of escalation mutual retaliation appears. This is already thermonuclear war. "Thermonuclear wars," announces the blood thirsty theoretician, "in all probability will be short - from several hours to several months, at a maximum. In such a war, cities themselves will hardly have a serious value as military objects." Nonetheless, the author warns that in case of retaliation (a very broad concept - P.A.) the United States will strike cities.

The subsequent steps of the staircase are the different types of U.S. wars in the nuclear missile epoch. It will be useful for

the readers to know their classification: a gradual war to destroy enemy materiel. We speak about hunting submarines, for example; a limited strike for the purpose of putting units of enemy forces out of commission; a limited attack for the purpose of disarmament; a gradual war against cities; a strike on material values; a strike for the purpose of destroying civilian population.

Among the forms of general war, the author names total controllable and uncontrollable wars. To the uncontrollable he refers a "spasm," which constitutes a "great war with all buttons pressed," i.e., a world nuclear missile war.

What in reality constitutes the theory of escalation, which is preached now as a basis of U.S. strategy, can be seen in the example of the bloody aggression in Vietnam. The escalation of folly and barbarism — so the peoples of the world regard the impudent outrages of the United States military clique in Southeast Asia.

The retired American General, T. Power, tries to introduce the new "contribution" into military theory. He is concerned with the problem of local war. He is resolutely for using nuclear missile weaponry in it. It is better to use nuclear missile weapons, he says, than to make expenditures in preparing special forces to suppress partisan activity.

Journalists reported from New York about such a conversation between Power and television correspondents. When the retired general affirmed that he is in favor of using nuclear missiles in local conflicts, the correspondent specified: "You mean to say — to risk nuclear war." The general confirmed: "Yes, it is necessary to be ready to risk everything."

Then the correspondent shot back: "At the price of how many millions of lives do you assume to secure military victory in nuclear missile war?"

And with this question the dashing atomic warmonger was cutoff. The broadcast director had to interrupt: "Excuse me, but your time is up."

He said, without realizing it himself, the prophetic phrase: the time of the imperialistic atomic warmongers of the United States, accustomed to swinging their nuclear bombs, has indeed passed. It is possible to say with confidence: that which was beyond the capabilities of the imperialists in the past, all the more so is doomed to failure now, when the world arena witnesses radical changes in the balance of power.

In 1965, the publishing house Coward-McCann Incorporated published a book written by the same General T. Power in collaboration with a certain A. Arpim, called Design for Survival. General Power, as was noted above, commanded the American Strategic Air Command, and controlled, by his own admission, 90% of the nuclear arsenal of the so-called "free world."

Now Power looks on the world through a prism of "nine tons of plans" developed, as he says in the book, in the spring of 1961 and examined yearly by the Strategic Target Planning Board. The retired commander advocates speaking with the Soviet Union only in the language of military force, and conducting "diplomacy on the brink of war and playing with fire." He considers it indispensable that the United States "be equal to the USSR in the area of high-power nuclear missile weaponry" and damns the Moscow agreement on partial prohibition of nuclear tests, which, according to him hinders the United States. He objects also to the resolution of the XVIIIrd session of the General Assembly against putting nuclear weapons into space orbits, since it interferes with the United States' aggressive program of use of space for military purposes. In the future he foresees the appearance of "weapons and equipment of war from the ocean depths and from the distant reaches of space."

Power favors dissemination of nuclear weapons among the NATO allies of the United States in Europe, if only because additional "European targets" would divert part of a soviet counter strike from the United States.

As regards purely military conclusions, Power does not recommend that the military circles of the United States "put all its eggs in one basket" and rely on missiles alone. As before, he favors mixed nuclear forces - missiles, bombers, and submarines. But through all his military reasonings one sees distinctly the terrible bared teeth of an instigator of preventive nuclear war: "The most radical measure which this country (the United States) could take... would be to attack the Soviet Union before it is able to attack us - in other words, to start what usually is called preventive war."

In their plans to create new means of struggle American strategists have devised monstrous projects. In particular, they foresee development of missile systems with thermonuclear charges which would be placed on the bottom of seas and oceans, with assigned program of flight to vitally important centers of other states, to be activated by the proper signal from control points.

The Soviet people, including our soldier-missilemen, vigilantly follow the intrigues of the instigators of new war, whatever the smoke screen with which they try to mask their criminal activity.

According to authoritative atomic scientists of the West, "the potential for nuclear death" in the contemporary world is calculated at 250 thousand megatons, that is, 250 billion tons of TNT. For every inhabitant of the planet there are stored, already, on the average, over 80 tons of explosive.

This is why under contemporary conditions it is impossible to fit old yardsticks to world war, or to think of it in old categories. The question is one of a radical, qualitative change in military equipment, of unprecedented growth of the destructive force of the weapons of war. And how is this expressed?

First, the new weapon is in no way comparable with the old. The explosive force of but one powerful thermonuclear charge exceeds by many times that of all weapons used in all wars in the history of

humanity, including the First and Second World Wars.

Secondly, nuclear missile war completely erases the boundaries between front and rear. Moreover, it is the civil population which will be the principal victim of weapons of mass destruction. In such war but a few thermonuclear charges could completely destroy not only the largest industrial centers with their multimillion population, but also entire states.

American experts have calculated that one hydrogen charge of 20 megatons, exploding in air, would level to the ground all brick and frame homes with a radius of up to 24 km from the epicenter of the explosion. A raging sea of fire would burn all that could burn, all living beings in an area extending from New York to Philadelphia. And now there have already been created charges of 50, 100, and even more megatons. According to tentative calculations of scientists, world nuclear stockpiles already are equal in force to 12.5 million such bombs as were dropped on Hiroshima.

And finally, with the present arrangement of forces and presence of new forms of weapons, thermonuclear war, which the American militarists invoke, will not be limited by territories of only two states, but will assume a general character, bringing about destruction and death of millions of people in all parts of world. What does this mean for humanity? One of outstanding fighters against atomic death, the eminent American scientist, Linus Pauling, in his book "No More War," determines the number of possible victims of nuclear war at 800 million. Such is the grim truth about the real character of thermonuclear war. And if this truth is now being concealed from the peoples by statesmen of the West, they are committing a crime against humanity, including the peoples of their own countries.

Certain American politicians are ever more persistently repeating to their people that in thermonuclear war the United States would suffer fewer losses than the Soviet Union and would supposedly gain the victory. This is groundless illusion. The foisting of such understanding of the question is done in pursuit of the aim of preparing public opinion in the United States and among its allies for the unleashing of war: they say it is necessary to hasten to start war now, and that the situation can change. This is nothing but preparation of the consciousness of people for the inevitability of war and justification of the aggressive forces which strive to accelerate the unleashing of nuclear missile war.

But Soviet missilemen with all definitiveness state: if the aggressors unleash nuclear war, they themselves will inevitably burn in its flames.

Rocket Troops - Main Shock Force

The Soviet people have learned through severe historical experience that they can boldly rely on their Army, Aviation, and Navy, created and educated by the Communist Party. The great Lenin taught that any revolution is worthwhile only if it understands how to protect itself. The Soviet Armed Forces, born in the fire of the October Socialist Revolution, showed their ability not only to uphold the conquest of revolution and to protect the Native Land, but with destructive sword to crush the enemy on his own territory.

Soviet soldiers through selfless service to the Socialist Home Land and selfless fulfillment of international duty have earned the fervent love and gratefulness of the workers of our country and other socialist countries. The Soviet people value highly the services of our armed forces. They have seen the might of the Soviet Union and its Army and the might of all socialist collaboration paralyze the aggressive forces of imperialism.

Our Communist Party and the Soviet people are constantly concerned for the improvement of the troops and that they are equipped with the most contemporary means of protecting the Native Land. Strengthening the defense of the USSR, the power of the Soviet Armed Forces and their rocket forces, is the sacred duty of the Party and all Soviet people.

In the current report of the Central Committee of the Communist Party of the Soviet Union to the 23rd Congress of the CPSU it is noted that the most important task of the Soviet state is constant concern for strengthening the defense of the country and the power of our glorious armed forces. Successes in development of economics, science, and technology have permitted us to equip the Army and Navy with the most advanced nuclear missiles and other latest items of combat materiel. The armament of Soviet troops is on a level with contemporary requirements, and their increasing shock force and firepower are fully sufficient to crush any aggressor.

We must never forget the possibility of those tests to which the Soviet people might again be subjected. In the present complex international situation our obligation is to manifest unremitting vigilance. The Party considers it necessary to ensure further development of the defense industry, improvement of nuclear missiles, and all other forms of combat materiel. The safety of our Native Land requires this.

The Communist Party, the Soviet government, and our entire people value highly the honorable and difficult labor of soldiers, seamen, sergeants, master sergeants, officers, generals, and admirals, warmly love their armed forces, and are proud of their combat glory. The Party henceforth will in all possible ways strengthen the defensive capability of the Soviet Union, multiply the power of the Armed Forces of the USSR, and maintain such level of combat readiness of troops which reliably ensures the peaceful labor of the Soviet people.

Party and government are concerned that our armed forces, and first of all rocket forces, be powerful, equipped with the most contemporary means of protecting the Native Land — nuclear and thermonuclear weapons, rockets of all ranges — and that all forms of equipment and weapons be maintained at the proper high level.

Rocket forces are the main shock force of our armed forces. The CPSU instills in all Soviet people the spirit of constant readiness to protect the Socialist Fatherland and to love the Soviet soldier-missilemen. Protection of the Fatherland through service in the rocket forces is the high and honored obligation of the Soviet citizen.

All key Soviet soldier-missilemen in the Army and Navy are instilled with the spirit of infinite fidelity to their people and the Communist cause, and are ready to give all their energy, and if required, their lives, to the protection of the socialist homeland.

The foundation of the military structure is the CPSU's leadership of the armed forces. The Party allots unremitting attention to increasing its organizing and directing influence on all life and activity of troops. It unites personnel, further strengthens the unity of Army and people, instills soldiers with the spirit of fortitude, courage, heroism, and combat collaboration with armies of socialist countries, and with readiness to protect at any moment the Communism-building nation of the Soviets.

The Soviet people never will forget the bitter experience of 1941, when Hitlerite Germany perfidiously attacked our Native Land. They have concluded that the Armed Forces of the Soviet Union and its rocket forces must be in possession of the latest military equipment and capable of dealing a crushing counterblow against any aggressor. Until disarmament agreement is reached the developing international situation leaves us no alternative. The greater the defensive might of our country and the power of the Soviet Rocket Forces, the less the danger of attack and the possibility of the imperialists' leashing destructive thermonuclear war.

The Soviet Rocket Forces are the combat shield of our Native Land and the entire socialist camp.

The basis for creation of domestic nuclear missile weaponry was the outstanding discoveries by Soviet scientists in the field of nuclear physics, mathematics, chemistry, and electronics. The tremendous achievements of our heavy industry permitted us to create in a short period of time a powerful base for production of nuclear missile weaponry on a scale fully sufficient for controlling any aggressor. We have seen the materialization of V. I. Lenin's dream that new inventions in the field of science and technology would make the defense of our country so powerful that any attack on it would be impossible.

Our country has created new intercontinental means of delivery of nuclear charges to target — strategic missiles. They possess combat capabilities which no other weapon can equal. These are missiles of unlimited range. They are able to carry thermonuclear

charges of colossal power, possess high strike accuracy and trajectory parameters which make nuclear strikes sudden and inevitable. These missiles can be used in any season and time of day, under any meteorological conditions. With the appearance of global rockets in military terminology the idea of geographic inaccessibility was obliterated forever.

Our rocket forces were turned in a short period of time into a powerful and threatening screen in the path of realization of the insidious plans of the imperialistic aggressors. In quality and quantity of production of nuclear missiles our country is not only equal to those who threaten us with war, but also in many respects excels them. The mighty nuclear missile is in the hands of the Soviet Arm Forces. The equipping of rocket forces with this most contemporary weapon imposes high requirements on personnel. And this is understandable. However powerful the weapons, the outcome of armed struggle is nevertheless decided by people. Soldiers, sergeants, officers, and generals of the rocket forces persistently improve their knowledge of missile equipment and methods of its combat employment. If the imperialists unleash war, our soldiers will perform their sacred duty to the homeland — the timely launching and precise aiming of missiles.

Personnel of the rocket forces are educated in the all-conquering concepts of Marxism-Leninism and are tireless students of military science, constantly improving their combat and political training. In recent years the combat capability and combat readiness of our rocket forces have increased still more. This was possible because Communists and Komsomol members comprise the overwhelming majority of personnel. Communists and Komsomol members are the standouts in combat and political preparation. They are the initiators of many patriotic undertakings, the leaders of socialist competition, and the model of fulfillment of military duty.

The success of Soviet soldiers and their ardent service reflect the results of the multilateral activity of the Communist Party in the training of all Soviet people in the spirit of constant readiness to protect the socialist Fatherland and love for their Army. That the Soviet people feel deep love toward their missilemen is shown by numerous examples. And this is perfectly understandable because our soldier-missilemen are of one blood and one flesh with the people.

Into the Soviet Rocket Forces flows yearly a new replenishment, consisting of politically well-developed, literature, and physically hardened young people, who accept military service as a high and honorable obligation of the Soviet citizen.

Soviet Rocket Forces are the mighty and reliable weapon of people, its combat force, its glory and pride. The whole world sees them as a cluster of the industrial, scientific, and technical power of the socialist state. They embody the Herculean heroic spirit, courage, and stability inherent to our people. Soviet soldier-missilemen have imbibed all the best that is within the people's masses, are inseparably connected, merged with the masses.

Our people and Army are a single integer, one family, which cannot be in capitalistic countries, where the Army is a force alien and hostile to the workers, in hands of the exploiter classes. The common interests of the communist structure, common cares and desires unite toilers and soldiers in our country. This inviolable unity of Army and people, the remarkable peculiarity of our rocket forces, is the durable basis of their fighting strength.

The strength of our Army consists in the fact that it is really the People's Army, the embodiment of unity of Soviet society and friendship of the peoples of our country. Herein lie its greatest advantages, which do not and cannot exist in armies of the capitalistic states. The Communist Party does everything to strengthen the unity of the people and its armed forces. Regulations of the CPSU require that party organizations and political organs of the Soviet army actively participate in the strengthening of units of Army and the people and maintain close contact with local party organs. In turn, the local party organs must take more interest in the life of military units and penetrate deeper into the practice of political work among the troops.

Inseparable blood ties connect workers, collective farmers, and intelligentsia with soldier-missilemen. Outstanding people from industry, science, and art are frequent and desired guests of missile units.

Our people and the soldier-missilemen are one family. Soviet soldiers live on life with all the people. Our rocket forces have become a remarkable school of active builders of Communism — not only of combat skill, but hardening them to work and life. It is not without reason that soldier-missilemen transferred to the reserve quickly assume an honored place among the front rankers of industry, construction, and agriculture. On construction projects of the North, Siberia, The Far East, and on virgin lands among the best toilers are many demobilized soldier-missilemen.

The Soviet people love their glorious Soviet Rocket Forces and are justly proud of them.

Brace Combat-Readiness, Increase Vigilance!

Conditions of contemporary battle impose new requirements on combat training of soldiers, including missilemen. Future war, if it be unleashed by the imperialists, in its political essence will be a decisive armed conflict between countries of opposite world social systems — capitalism and socialism. Such social essence of future war will make it the most cruel, destructive, and annihilating ever known to humanity. The new world war will embrace all continents and water expanses of the earth. The imperialists will find safety from nuclear blows nowhere. Any military base, any city, any industrial region can be not only destroyed but also covered by radioactive fallout, which will not allow people to live in this area for sometime. The time required for execution of the basic missions of war by contemporary means may be very brief.

The character of contemporary combat will also be changed radically. It will become especially tense, violent, transient, and mobile. The continuous offensive, by day, at night, in any season, will take on special importance.

All of this demands emphasis on the combat training of all forms of armed forces and makes it imperative, now, in peacetime, to create all that is necessary to breakdown a surprise attack by an aggressor and for immediate delivery of a crushing counterblow. This is why under our conditions questions of maintaining high vigilance and of constant combat readiness are of prime importance. The primary mission for all our arm forces in the course of combat and operational preparation is to study and develop methods of reliable repulsion of sudden nuclear attack by an aggressor and to thwart his aggressive plans through timely delivery of a crushing blow against him. The emphasis being made here is that training be conducted under conditions approximating the peculiarities of contemporary war, the situation which may develop in the initial period of war in case of an attack on us.

The main task has been and remains preparation of troops. The revolution in military tactics, the appearance of manifold and complex combat equipment, and further industrialization of war not only do not minimize but increase still more the role and importance of man in it. And this is understandable. After all, equipment alone cannot fight. Men fight, controlling equipment. This means that the revolution in military tactics could not fail to affect personnel — the most important material force in achievement of victory. It has penetrated not only the joints of rockets but also the hearts and minds of men.

The soldier manning a missile thinks and acts differently than, for example, a cavalryman of the twenties. Of course, this is not due solely to technological changes. The new appearance of the soldier was born of our socialist structure, the entire system of social changes made in our country, entry into the period of building of the communist society under the wholesome influence of party concepts, by our whole life. Actually, such transformations as the tremendous progress in development of the productive forces of the country, the great cultural revolution, and the formation of the people's intelligentsia all introduced qualitatively new features into the life of the contemporary Army raised the public and creative activity of personnel immeasurably.

High and comprehensive development, public and creative activity help the soldier-missilemen to more rapidly achieve successes in moral, volitional, and psychological preparation for the tests of nuclear missile war. Our socialist structure and the communist ideology create the most favorable conditions for instilling in the soldier-missileman strong spirit, moral stability, readiness for severe tests. In order to turn these possibilities into reality under peacetime conditions manifold means are used for instruction and training of active, conscious, disciplined soldier-missilemen, ready for decisive actions under conditions of nuclear missile war, and firmly convinced of the might of the Soviet weapon.

Rocket culture. Our country has placed in the hands of the soldiers of the rocket forces nuclear charges of up to 100 megatons, superpowerful motors, and control systems capable of operation over global distances. Such especially complex equipment is under the care of missile crews. To maintain in top condition every charge, every rocket, and all forms of ground equipment is possible only through perfection, using the latest equipment and organizing combat work literally in accordance with the last word of science. Missilemen must not only maintain complex equipment in good condition but must also be in readiness at any moment to reliably, resolutely, and skillfully use their annihilating weapon.

In the practice of combat training of troops was born the concept of rocket culture. It embraces all requirements imposed on the soldier dealing with the new weapon. Rocket culture is the ultimate degree of vigilance and attentiveness, exactitude and organization, and the most thorough knowledge of the innermost recesses of the equipment and one's duties in combat.

It has become customary to say that in the actions of the soldier under contemporary conditions there are no trifles. For missilemen this is doubly true. If he is following orders or preparing a missile for launch, least slackness or lack of attention are impermissible. Any omission can have the most serious consequences. Therefore the inculcation of rocket culture starts with training of soldiers for consciousness, discipline, stability, courage, and the ability in the most complex situation to carry out his duties to completion.

Success in operations of missile crews depends not only on the moral and physical hardiness of the men but also on their technical training. Rephrasing a well-known expression, it is possible to say that one launches a missile by relying not on the force of his muscles of his mind. The minds of commander, engineer, operator, and marshaller should be enriched by the latest data from theory of jet engineering, nuclear physics, radio electronics, automatics, and cybernetics. Knowledge of concrete rocket systems, rules of preparation for launching, and safety requirements must be combined with practical operations which have been learned and become automatic through the performance of preventative maintenance and prelaunch operations.

In advanced units of each category of missile-specialists studies are organized, which help to acquaint personnel with the tremendous achievements of the Soviet military.

How deeply should personnel study missile weaponry, fundamentals of nuclear physics, and all new forms of equipment? For this lessons should be planned clearly to ensure high clarity of instruction. Life demands special capableness of commanders and staffs, a high degree of self-discipline, and considered, literally to the second, utilization of educational time.

Technical training is the number-one task for every missile officer. Senior commanders give their most fixed attention to the

training of those who are called upon to instruct soldiers and sergeants. Organization of commander technical studies has as its aim not only particular, purely practical problems but also should create the basis of technical culture in officers. Therefore special attention is allotted to the study of mathematics, as well as computer automatics, physics, and chemistry, without knowledge of which it is difficult to talk about the scientific and technical horizon of the contemporary officer.

Missile-officers also expand their horizons through participation in military-scientific work. As a rule, officers, accustomed to creative solution of technical problems become experts in the operation and combat employment of a new weapon.

Confirmation of this can be seen through the situation in the subunit commanded by officer Davydov. Officers here are not only experts in theory but also good practitioners. Under difficult conditions, in the desert, they organized two training classes, prepared schematic diagrams of stations, launchers and missile equipment, prepared texts for the designing of vacuum-tube devices, different relays, and safety devices. With enthusiasm officers Sukharev, Galushkin, Gayduchenko, and Lotarev drafted, soldered, and assembled. What difficult skills they obtained in the reading of circuits, and how much easier it is for them now to instruct subordinates!

Life shows us that best results in technical preparations are achieved by those subunits in which Communists and Komsomol members occupy a leading place in the quest for excellent mastery of new equipment, where competition for increased technical knowledge is expanded, and the number of first-class specialists and masters of combat professions is increased.

The indispensable index of rocket culture is skillful application of control and measuring equipment, without which now it is impossible to "transilluminate" and "sound" all joints and organs of a missile. Electrical and electronic devices give an objective picture of the viability of all units and systems of a weapon. Upon how they are used, their condition, and accuracy depends the depth of penetration into all parts of weapon during its check.

To work by touch or by eye is impossible. "It is said of a certain officer: he has operational experience on combat equipment and understands it in all its finer details. But let him start a check and you are convinced that he cannot properly be called a cultured military specialist. He sometimes is hindered by a certain levity and carelessness in the monitoring of equipment, by unskillful use of measuring equipment. And without this it now is simply impossible to maintain observation over complex systems of contemporary weapons - rockets, aircraft, and ships.

Let me refer to the case of Captain Sh. Under his direction parameters of one of the units of a missile were to be measured and their deviations from norms noted. However, the officer, considering the parameters secondary, attached no importance to results of measurements and took no measures to correct the abnormality,

although this was within his power. He called headquarters once, again, and then calmed down.

Should we tolerate such an attitude toward the checking of weapons? Does this reflect initiative on the technical culture of a military specialist?"

The question was thus sharply posed in a letter to the editor of "Krasnaya Zvezda" by Lieutenant Colonel V. Samsonov. Thus it is necessary to say that under contemporary conditions the technical culture of the military specialist is directly connected with the reliability of weapons, and combat readiness of teams and crews. After all, it is upon the manner in which monitoring of the state of equipment in a missile unit is set up and on how responsibly each specialist approaches the carrying out of measurements and the application of corrective measures that the condition and reliability of all weapon systems depend in battle.

Development of military equipment and armament has now attained such a level which makes it absolutely impermissible to attend to them in the old manner — to check their condition and combat readiness by touch and by sight. This is all the more so since for different types of equipment different methods of check are specified, and precision measuring equipment is created, allowing us literally to "illuminate" every unit, every subassembly. To have mastered contemporary methods of monitoring and the use of measuring instruments is just as necessary as it is to know the weapon itself and methods of its combat employment.

This is why in advanced units in the hours of combat studies, in addition to the weapon, monitoring and measuring equipment, operating principles of instruments, order of carrying out of measurements, use of standards, and so forth, are taught. But, of course, theoretical knowledge alone is not enough to provide for monitoring of equipment. Under the leadership of specialists in the field of electrical and radio meterings soldiers are trained to use instruments, and the skills of every specialist are brought to perfection.

Soviet soldier-missilemen are not content with even the least deviations from contemporary requirements for the monitoring of equipment. They have discredited the absolutely incorrect concept that discipline of the soldier is one thing while his following of the rules for handling combat materiel is another. Discipline of soldier-missilemen now is also expressed in the manner in which they knowledgeably handle weapons, and how accurately, efficiently, and orderly the work on aircraft, rocket, or locator.

Soviet soldier-missilemen seek that there remain not one unit in which measurements are still looked upon as something abstract. Such an attitude among inexperienced soldiers sometimes results from the fact that an instrument shows deviation from norm, while the weapon system nevertheless is functional. But advanced soldiers know that this is an apparent condition and that if measures are not taken immediately, at a decisive moment of battle the equipment

may fail.' The cause of every deviation in readings of instruments is detected and eliminated, and all parameters of weapon systems are held, as the specialists say, to nominal.

This is how advanced missileman, Engineer-Major Sherstobitov handles the situation. Once, while taking measurements, he, like Captain Sh, about whom we spoke earlier, discovered a variation of secondary parameters from tolerance. In contrast to Sh, he did not summon help but immediately set about finding the cause of the abnormality in "behavior" of the units. Engineer-Major Sherstobitov not only quickly brought the system into absolutely good working order but also under his leadership Pfc Shabyshev and Junior Sergeant Sitnikov created a new monitoring-measuring device to speed the future checking and adjustment to nominal of parameters of combat equipment.

Soviet missile officers seek that young soldiers do not sometimes develop a disbelief in instrument readings. As a rule, such lack of confidence stems from the fact the instrument has been poorly maintained, or that the one used is out of order. Such a situation can indeed undermine confidence in the accuracy of measurements. This is why missilemen from their first days of service learn to service and store monitoring and measuring equipment correctly, and to perform timely checks on it. This prevents the use for measurements of defective or unverified instruments.

In preparing for actions under conditions of possible application by an enemy of nuclear missiles, our commanders learn to perfection methods and techniques of measurement of indices characterizing the situation in the area of an atomic explosion. Otherwise it would be difficult to avoid errors in determination of radiation level, degree of contamination by radioactive substances, and so forth. After all, these data affect a commander's decision and the character of measures taken for protection and preservation of the combat ability of subunits.

Communists and Komsomol members in these matters show a personal example to all soldier-missilemen and kindle the flame of competition for best fulfillment of tasks of monitoring equipment under the most diverse conditions - on the march, during preparation of weapon for battle.

Wide support of commanders and the entire community is given undertakings directed towards improvement of methods of measurement, methods of storage, check and upkeep of monitoring and measuring equipment. Especially valuable results are attained in a number of military educational institutions, where new laboratories have been created and training aids are published. Missile commander seek that experience in creation of effective stands and original instruments is used everywhere. It is to be applied in every rocket unit and subunit.

Thorough study in the rocket forces of contemporary measuring devices, and skillful use by specialists of the achievements of

science and the experience of practical innovators help to ensure further improvement in the monitoring of condition and readiness for combat employment of the formidable Soviet weapon. High rocket culture is determined also by the degree of effectiveness of the method of training officers and preparation of crews on the whole. In our advanced units much has been done in this direction. The most successful combination of theoretical study and training for missile troops has been found. Special importance is given to the principle of systematic transition from the simple to the complex. In missile subunits underestimation of methodical principles in instruction and training is impermissible. No references to acceleration of training of crews can justify skipping through stages, since gaps in the mastering of functional duties are possible. This is fraught with serious consequences on the launching sites.

The true organizers in the struggle for high rocket culture are rightfully the commanders. They study thoroughly methods of application of the new weapon, its arrangement, contents of regulations and checks, and under their leadership the whole collective successfully improves its combat skill. It is not by accident that in those units in which commanders display advanced rocket culture training of crews and results of launches are better.

Exemplary he is himself a first-class specialist. He is a demanding, energetic officer, whose cheerfulness and enthusiasm inspire his subordinates to ever deeper study of rocketry. Here, on the launching sites and in the classroom, one sees immaculate order. All crews in the unit are excellent; the missilemen have been awarded the transient Red Banner. Such units in the rocket forces are in the overwhelming majority.

But there still are subunits in which such heights of rocket culture have not been attained. Some crews rise slowly to these heights. This sometimes occurs because certain officers are satisfied with first successes — let us maintain the standards, launch our missiles. This is our only concern! We must not rest. Missiles are being improved continuously, as are methods of their preparation and monitoring equipment. One cannot live yesterday. He must look forward!

The result of being oblivious of this truth may be seen through the experience of officer Skorobogatov. During initial mastering of missile technology the officer allotted a great deal of attention to organization of studies for his subordinates. He incorporated operational information on new facets of methods of operation of weapons. But then came the combat launchings. The crew handled them well, and the commander clearly relaxed. The quality of studies and maintenance of equipment worsened. The missilemen began to display self-satisfaction and carelessness. And then, during a check of readiness of systems by the senior commander, a number of deficiencies, adversely affecting execution of assigned mission, were noted.

Constant aid to the commander in the struggle for high culture is rendered by Party and Komsomol organizations. They mobilize all soldiers in an assault on the heights of rocket science and technology and seek that the right-flankers in this matter are Communists and Komsomol members. The efforts of the community must be applied in every unit to organize widespread and captivating military technical propaganda directed toward increasing rocket culture. It is very important that workers of political organs attached to units allot proper attention to the study of the valuable experience of the best missile specialists and its propagation among all soldiers.

Rocket culture must include the element of creative work - innovation. Rocketry is new and is in need of a really creative approach. It is no accident that in the rocket forces there are so many innovators, who introduce the most valuable suggestions in the area of operation and application of weapons. This impetus of the innovators develops further and helps in solving those problems upon which the combat readiness of units and subunits primarily depends.

For advanced methodology. In missile units one hears the expression: "Method is the wings of combat training." This expression has deep meaning: during the mastering of complex missile technology and methods of application of superpowerful weapons, the methodological skill of instructors is of prime importance. Good methodological preparation of commanders, as if wings, helps their subordinates reach the pinnacles of skill more rapidly.

Concern for really scientific organization of combat studies has become one of the most important in the activities of the missile commander. And this is determined first of all by the personal methodological culture instructors. The study of method must be thoroughly planned, organized, and monitored. Unfortunately, there still exists among some the misconception that methodological skill comes to the instructor through accumulated experience alone. Such notions are especially erroneous in the rocket forces, where without mastery of advanced methods of instruction it is simply beyond the capabilities of commanders to prepare all crew members for combat work in the assigned time.

In those units where proper attention is allotted to the methodological side in organization of studies their effectiveness is much greater. It is for the pedagogic art of officers that such great successes were achieved in this past training year in the advanced unit served by officer Goncharov. Every young officer arriving in this unit goes through compulsory commander's school. He is taught by the best methodologists, and must sit in on model lessons and training. It is here that the remarkable masters of instruction, experts of pedagogy and psychology and, effective training procedures, officers Kulinich and Tsibul'nikov, were nurtured. Crews are well prepared, missile firings are conducted efficiently and smoothly, and targets are hit with accuracy.

Noteworthy successes in methodological work are achieved in many other units also. However, one must not think that all has

been done in development of method in reference to the needs of rocket forces. There is much work to be done in this area. A persistent, daily search is being made for new methods of organization and carrying out of training, so that it corresponds to the development of the military situation and progress of combat materiel.

The true tone is given to methodological work among the troops by our missile staff. Their recommendations and instructions on combat training deal with requirements of not only military matters, but also with pedagogy and psychology. Staff officers in making inspections of any kind must be interested in the state of methodological work in the unit, point out specific deficiencies, notice and make known all new and valuable developments.

The literal wells of methodological wisdom are the military higher educational institutions. Experience accumulated by them spreads widely among the troops. Teachers visiting the units not only propagandize contemporary equipment and new procedures for combat actions, but also share their methodological skill with military officers. It is in the academies and schools that many new methodological procedures are born.

A great many valuable methodological innovations are born through combat studies of troops also. Worthy, for example, of the highest approval is the individualized method of instruction developed in the surface-to-air rocket forces. It corresponds well to the specific character of rocket subunits, in which soldiers of different specialities serve. For each of them an individual program of instruction is composed. During the planning and organization of studies, the preparation and ability of each soldier are considered. The new method justifies itself completely in practice — training periods for specialists of higher qualification are reduced, and their class status grows faster than with usual methods of instruction.

Conditions similar to those in antiaircraft units are encountered in other arms also. Therefore the method of individualized instruction can be used with success not only in antiaircraft defense forces of the country.

In missile units it is necessary to create a training base in every battalion. This must be such as corresponds to requirements of contemporaneity. At present many units have founded training bases equal in quality to classes and laboratories in higher educational institutions. In these units automated devices, trainers, movies, and film strips are used widely.

The military innovators went further. They suggested that part of the training base be located at launching sites. In combat work there is free time. It is this which commanders use for supplementary work with subordinates, since visual and other training aids are always at hand. Undoubtedly this valuable and needed initiative will find most widespread use.

For development of methodological work in units much can be done by methodological councils. Their creative work must be

supported in every possible way, and a wide circle of officers must be involved in their activities.

The role in the struggle for the introduction of advanced methodology of Party and Komsomol organizations is great. Communists and Komsomol members support all that is new in this area and seek that every training instructor is armed with advanced methods of instruction and training of soldiers. Party and Komsomol organizations are constantly eliminating that which is obsolete in the training process, amateurish work in classes and at sites, and promoting in all possible ways a creative approach to methodological problems.

By analyzing all the best that has been attained in development of method and making acquired experience the property of our commanders, it is possible to secure further improvement of methodical preparation of training instructors.

Combat launchings — the main objective! The principal and most important index of combat readiness of the missile unit is the quality of combat launchings. If a crew in a short period, under any conditions, efficiently prepares equipment for launch, confidently carries out launching, and realizes exact hit on target, this means that not only the combat team as a whole but each of its members is ready for contemporary combat.

It is not accidental that the quality of combat launchings characterizes the combat readiness of rocket forces. With pride and joy all Soviet people read in our press a report that already nearly 95 percent of combat launches of medium-range strategic missiles and all those of intercontinental missiles are executed "excellently" and "well" by our crews.

Among the missilemen many soldiers have shown themselves to be masters of excellent combat launching. Their number includes officers Begov, Shagarov, Znobin, and others. The characteristics of the units they command are excellent teamwork and accuracy in preparation of weapon, organization and discipline on launching sites. Following the example of the commanders, all officers, sergeants, and soldiers in these units have become experts in fire control. The majority of them are first-class specialists. Furthermore, almost every man possesses to perfection some other speciality, which permits even incomplete crews to successfully fulfill vital fire missions.

The decisive condition for successful actions of a crew on the launching site is justly considered high technical training of every member. If he has good knowledge of the physical principles of operation of all parts of the missile, no unforeseen occurrence can catch the soldier by surprise. He will not be taken aback, will not lose unnecessary seconds, and will not disturb the sequence of operation, and this means he will ensure high-quality and timely preparation of all missile systems.

But knowledge comes in different forms. One cannot rely only on the fact that some or other crewman has mastered theory of jet propulsion, problems of nuclear physics, radio electronics, or operating principles of parts and assemblies. Commanders of missile units seek that the soldiers' general knowledge is crystallized in concrete skills — skill in conducting prelaunch operations and checking condition of equipment through the use of contemporary test equipment. A tremendous role is played here by systematic studies in the unit and practice on the proving grounds, during which specialists learn the finer points of assembly, adjustment, and testing of launchers.

The new equipment requires the strictest observance in training of missilemen of the principles of sequence and clarity. During the years of creation of the rocket forces it occasionally happened that a sergeant or soldier was allowed to advance to more complex training before he had firmly mastered his functional obligations. Such haste resulted in nothing but harm. Now commanders first seek irreproachable knowledge by every crewman of his obligations, successful passing of all tests, and then transition to more complex elements of training. In order to introduce the spirit of competition into this matter, contests on trainers are conducted for best fulfillment of separate operations and problems. Only after every crewman is able to perform his duties automatically do crews advance to complex training.

It is especially important that soldiers learn in the process of launch training to observe sequence of operations strictly. The effects of educational work of the commander and his skill in instilling a sense of highest responsibility in every crewman towards his assigned duties are seen. This, of course, does not exclude the most strict and unremitting check on every step of training. In advanced units a great number of valuable and progressive forms of check and self-check have been developed. Considerable benefit, for example, is realized through the use of special cards, on which are noted conducted operations. Such cards help the crewman to miss nothing and commander to discover any deviation from the rules of preparation of missile for launch.

In one of the units during a check of the systems of a missile, instruments showed deviation from parameters. A check was begun, and it was found that one of the cables was not connected. The soldier responsible for this was punished. But other crewmen had seen the unconnected cable but had not corrected the condition. And in the unit the correct conclusion was made: to strengthen mutual assistance, to make sure that crews are acquainted with the equipment of their neighbors, and to direct initiative of soldiers toward mastery by allied specialities. All of this in considerable measure promotes best interrelationship and mutual checking by soldiers of various crews, and in the end ensures good quality of preparation of missiles for launch.

The Soviet operational missile is the embodiment of contemporary scientific ideas and industrial achievements. It is of considerable

value. Its launching is a source of great confidence for the unit and the sum total of its training. Every launch is carefully analyzed, and experience obtained is studied thoroughly, all of which enriches the combat skill of every member of the crew. Following launches analysis is made of the positive sides and deficiencies of combat training of the crew, and the valuable grains of the new learned through combat employment of missiles are not lost.

Party and Komsomol organizations penetrate into all sides of the study life of missilemen and separate from the sum of all problems those which determine success of combat readiness. For them there is nothing so important as mobilization of soldiers for the best execution of combat launching of missiles. Communists and Komsomol members set a personal example during check and realization of missile launch. They are propagandists of advanced methods of service and preparation for combat employment of the awesome weapon.

With Bolshevik zeal the Communists and Komsomol members in the rocket forces set the tone in observance of requirements of the military oath, military regulations, and the moral code of the builder of Communism. Like authentic lead singers on the march, they are always in on the most difficult sections — there where the radical questions of combat studies and military training are decided. And there is no side of life of the rocket forces, no unit, no ship, no subunit where Communists through personal participation, the force of their ideological conviction, and inspiring example do not captivate other soldiers. Now more than 60 percent of members and candidates of the Party serving in subunits carry outstanding ratings and are first-class specialists. In many units of the rocket forces, air forces, and antiaircraft defense forces of the country 80-85 percent of the Communists are first-class specialists.

Our missiles are rightfully considered the most reliable, powerful, and effective. To man such a weapon and learn to use it in combat conditions is a high honor and responsibility. Soldier-missilemen constantly remember this, especially during decisive stages of training — combat launchings of the mighty strategic giants.

Remember to preserve military secrecy. One of the main requirements for soldier-missilemen is constant and unremitting vigilance. They must know how to identify the enemy, quickly discern his devices, strengthen the safety of our state in all possible ways, and suppress all activities of hostile agents.

Intelligence agents of imperialistic states extend their odious tentacles into the secrets of our state, the Soviet Army, and the Navy. The enemies of our country seek information about Soviet missiles, the location of launch sites, and the distribution and combat readiness of military subunits, especially those equipped with the latest missiles. For collection of espionage information foreign intelligence agents resort to any methods, considering that

the end justifies the means. In arsenal of means used by foreign intelligence agents includes making acquaintance with soldiers, the monitoring of their conversations, interception of military letters, and many others.

Whether the soldier-missileman is on combat duty, traveling on a mission, or participating in training he must never forget the necessity to be vigilant; never and nowhere must he retreat from the rules of preservation of state and military secrets. Documents and papers entrusted to him must be safeguarded as one's most cherished possession. Under all circumstances his behavior must be characterized by restraint, self-discipline, and composure. Talkativeness, carelessness, bragging, and flaunting one's knowledge are absolutely unbecoming. All his deeds and actions are so directed as to leave no crack for the leakage of secrets.

Vigilance, of course, does not come naturally. It is the result of self-education, the result of the work of commanders, political organs, Party and Komsomol organizations. In rocket subunits training of vigilance is constantly in center of attention. It becomes an inalienable quality of every soldier. This is why in these subunits there is no divulgence of secrets, no prerequisites for such.

Exemplary in this respect is rocket unit N, in which officer I. Tyurin serves. Here the most varied methods of vigilance training are used — lectures and discussions are conducted, and special motion pictures are viewed. All of this is done not from case to case, but systematically. Vigilance training is conducted by taking into account individual peculiarities of people. And results are gratifying. Here, for a long time there has not been one case of compromise. Personnel manifest a high degree of vigilance. And such units in the rocket forces are in the overwhelming majority.

Unfortunately, though very rarely, it happens that commanders take action in training subordinates for vigilance only after there has been a case of breach of security. And, after all, the main thing here is prophylaxis — prevention of such cases — the constant study of personnel, and continuous active influence on them. Then no basis is created for leakage of secrets.

Let us show an example. Officer Ponomarev was given a responsible assignment on a mission. But in the unit the individual qualities of the officer were not considered — his moral instability, his inclination to bibations. It was these negative traits that caused Ponomarev his trouble. During the next bibation a chance drinking companion stole his traveling-bag, containing official documents.

This fact clearly shows that the training of vigilance is closely allied with the work of ideological hardening of our soldiers, with the instilling in them of the traits, characteristic of the moral makeup of a builder of Communism. Constantly concerned for the political preparation of every missileman and developing conscientiousness and responsibility towards fulfillment of military

duty, commanders, Party and Komsomol organizations also solve the problem of increasing vigilance. Party and Komsomol organizations can be proud of the behavior of Communists and Komsomol members in this important matter. Party and Komsomol members not only do not allow themselves to do anything that might lead to divulgence of secrets but exact the same from their comrades.

Vigilance of soldiers is increased not only by Party political work but also in the course of combat studies. In training sessions it is important to teach soldiers not only to fulfill their functional obligations but also to educate them correctly. Such approach is very important. Every step in the mastering of skill is accompanied by an increase of personal responsibility of the soldier - his vigilance - especially as in the course of training sessions themselves there can be divulgences of information needed by the enemy.

It is well-known that aggressive imperialistic circles rely on interception of our radio communications, on fixing emissions of different radiotechnical devices. On the territory of a number of countries, first of all in the United States itself, there has been created a network of powerful radio stations, with the help of which American intelligence tries to monitor radiotelegraph and radiotelephone conversations in the USSR.

Combat training and service of our missilemen are directly connected with use of radio facilities. They operate them in such manner that not a single superfluous word is uttered, and with strict observance of the rules of radio traffic and tuning of stations. Commanders do not overlook the least violations of radio discipline and seek that only soldiers having firmly mastered the fundamentals of radio discipline are allowed to work on operational radio facilities.

Commanders, Party and Komsomol organizations in their struggle for high and constant vigilance are aided considerably by the experience of the units and subunits best and most advanced in this respect. Such experience always is studied attentively and spreads fast. District and naval newspapers print materials on training of soldiers in the spirit of the greatest vigilance. They propagandize the experience of skillful application of radio facilities in combat training, the strictest observance of rules of radio traffic, and requirements of radio discipline.

At the head of the missile subunit. One of the subunits of the N surface-to-air missile unit some time back was considered a laggard. There were considerable gaps in training of crews and in operation of equipment. But then the subunit was given a new commander, Engineer-Captain Lesnikov. The wind changed in classes and on the launching sites. Gradually studies and training were put on a strong scientific base. Servicing of equipment also was conducted with a scientific approach. The commander managed to ensure constancy of parameters of all systems of the missile complex. And the subunit began a step-by-step rise from among the laggards. It excelled in combat firing.

The straightening out of matters in this subunit was facilitated by the fact that the commander was an engineer, had had excellent scientific and technical preparation, and could with knowledge of the matter organize instruction of people of the most diverse specialities. The question of technical knowledge of the commander has now become especially important, since military matters are widely involved with the latest achievements of science and technology, the main weapons being the mighty missiles. It has been noted more than once that the operational missile complex is based on the latest discoveries of science. In order to keep such an advanced complex in absolute readiness and to know how to realize its capabilities to the utmost in a combat situation, every crew conscientiously masters all systems and understands in minutest detail all physical processes occurring in the weapon.

This is why it is quite in order that operational missile subunits are all the more frequently being headed by engineers. The engineer-commander is now becoming a typical figure in the rocket forces. It is possible to indicate numerous examples of officers with higher technical education assuming commander's obligations not only by order but also by preference. That specialists are turning to questions of training and instruction of personnel is the result of the great work done in higher military educational institutions and in units. Our young specialists now find themselves in an atmosphere which does not allow them to shrink into a "technical shell."

An example of advance in service common for the engineer is the path taken by officer Dem'yanovich. He was performing engineering duty, showed outstanding capabilities and the ability to organize instruction of personnel. He was transferred to command work, and sought that all crews become excellent. In any matter - checking of equipment, preparation of missiles for launch, and in the classroom - Dem'yanovich feels himself master of the situation. With any "narrow" specialist he speaks on an equal plane on the most detailed sides of equipment. And if he is conducting lessons, he knows what every officer is to learn. The commander and his crews have achieved excellent mutual understanding and perform unerringly in the most complex situation.

Such examples of successful advancement of engineers to command duties are numerous. Graduates of engineering military educational institutions strive to work with the men in all possible ways. They develop in themselves those qualities which are necessary for instruction and training of subordinates, because they are entrusted with an important place in the missile system.

In our educational institutions the study of science and technology is well combined with training of military qualities for future missile officers. Workers of academies and higher schools consider the demands of the troops. Now the main road of graduates of higher educational institution is to units and combat crews, where weapons are prepared for battle and are used under conditions approximating combat. Therefore they train not simply technical

specialists but engineers, able to head combat subunits and lead them to victory in battle.

In missile units the obsolete views of engineers as narrow specialists have been eradicated. To specialists in the new equipment are open paths of advancement to command and staff duties.

A very important form of training of specialists is their involvement in active Party political work. Also deserving of a great deal of attention of Party organizations is the experience of advanced engineer-commanders. It can be a great help in the molding of young specialists among the troops. This experience among the troops is studied attentively, is generalized, and is widely spread.

The advance of engineers to command positions in combat subunits is a sign of the times. Everything is done to ensure that the engineering knowledge which they possess is augmented by command skills, in the interests of further increase of combat readiness of missile crews.

Masters of combat skills. In the combat studies of soldier-missilemen in the course of socialist competition valuable patriotic initiative has been developed. A special place is occupied here by the trend toward increase in units of antiaircraft defense of the number of masters of combat skills.

To become a master means to attain the highest stage of possession of a military specialty. To this level can rise only he who successfully passes through all stages of class status and then makes one more great advance in his improvement for combat.

To the master are inherent especially deep physical and technical knowledge, clear understanding of principles of combat employment of the new weapon, and possession of several allied specialities. No less essential for him are length of service, participation in combat firing, and fulfillment of high norms in servicing his own and other sections of equipment complexes.

In the beginning there were very few masters of combat skills in units. The first to reach this highest stage were: in the Moscow Antiaircraft Defense District, missile officer Kuvyrchenkov; in the Baku District, missile officer Savinskiy. Others followed.

In one of the surface-to-air missile units of the Baku Antiaircraft Defense District real initiative was manifested by master sergeants of the reenlisted service. They took on the obligation of preparing for and becoming masters of combat skills. A great many difficulties awaited them along this path. It was especially difficult to adjust to classes on theory and to master schematic diagrams and functional relationships of the entire complex. After all, all of this had to be combined with regular duties, with fulfillment of direct obligations in their crews. But these difficulties did not stop the initiators of this patriotic move among the reenlisted personnel. They spared neither effort nor energy in the achievement

of their goal. The first of them to become master of combat skill was the Communist Kravchenko. Now in the Baku Antiaircraft Defense District a great many master sergeants have attained the highest stage of skill.

Growth of the number of masters of combat skill is the true index of increase of combat readiness of missilemen. It testifies to correct organization of the training process to skillful combination of theory and practice in training. Many commanders, political workers, Party and Komsomol organizations manifest constant concern for improvement of studies of specialists, for development among them of competition for new successes. The cultivation of masters is aided also by the fact that the experience of the best missilemen, aviators, and radar operators in advanced units serves as a truly powerful lever, an active aid to the increase in qualifications of all soldiers.

The situation is such at the N surface-to-air rocket unit. Here the commander, Party organization, and the entire community manifest fervid interest in increasing the qualifications of missile officers. And this bears fine fruit. In just one subunit two officers - Stovbenko and Neklyudov - passed tests for master of combat skills. They showed excellent knowledge of equipment and schematic diagrams of complex elements of the overall complex. Their trips to the proving ground constantly earn them high praise for firing. As is customary here, the experience of masters of combat skills is widely used in the training of soldiers. This helps their comrades to master allied specialties and to learn how most effectively to use their missiles.

Great benefit is derived from well considered plans for training specialists of highest skill. Thus, in the subunit, served by Stovbenko and Neklyudov by the end of year, according to the plan, there should be six masters. In order to realize this plan, a complete system of training was developed in the unit. For this officers are transferred for several months to an adjacent system. They work there with full responsibility and with great relish. These are people of creative daring. They understand that such practice opens to them the prospect of not only increasing their skill but also for promotion and advancement to duties requiring knowledge of several systems.

Thus, in many units the work of training masters of combat skills is conducted systematically and purposefully. Accepted obligations are reinforced organizationally and methodologically. In these units there already are many masters of combat skills, and especially among the soldiers of reenlisted service. These masters determine paths of training of specialists, inspire them by example, and expose them to new capabilities of equipment.

Thanks to the great efforts of commanders, Party organizations, and advanced specialists, many soldiers rise to the ranks of the best masters of their business. And they are known in the unit and beyond.

Personnel are informed of how their right-flankers attained the pinnacles of skill and of that which is instructive in their activities. Thus, an authentic source of combat experience is used in training crews.

Propagandizing the achievements of masters of combat skills is an important matter. Every soldier in the rocket forces knows well the requirements imposed on one who would pass tests for the honored rank of master and uses widely the experience of those who already have crossed this boundary.

An honored vocation. Missile engineering service has now taken on great importance. Its main mission is to maintain the ominous weapon in immaculate order and to be in constant readiness for its combat employment. The engineers - and their number among the troops has increased sharply - are the true champions of high technical culture. They are irreconcilable toward any deviations from scientifically proved methods of operation and preparation for launching of all missile systems.

Soviet military science assumes that however mighty the equipment, the success of its combat use, as before is determined by people. Therefore the leading concern of the missile engineering service is justly considered comprehensive training of personnel for truly masterful application of the new weapon. Engineers are skillful educators of the soldiers, advocates of all that is new in technical studies. And the biggest successes are achieved by those units where the missile engineering service manifests activity and initiative in educational work, every lesson being conducted on a high ideological and methodological level.

The situation is such, for example, in the subunit served by Engineer-Captain Ivanov. Here a good educational-material base has been created. The engineers constantly increase their own knowledge and skillfully educate and instruct personnel. Studies began in an organized manner in the new year also. It was in this subunit that the movement for high rocket culture was born. It has now spread to many units and subunits. Similar examples of engineers making a worthy contribution to the increase of technical knowledge of missilemen are numerous.

Organization of technical studies is far from all that is required of the missile engineering service. Engineers seek that soldiers gain not only knowledge of the rules of operation of equipment and of safety measures but insist on their strict observance. The carrying out of orders and performance of preventative maintenance and repair works in full measure, precisely on time and with excellent quality, is the law of life in the missile-subunit.

Certainly, the fight for best mastery of the new weapon, mastery of the heights of technical culture concerns not only engineering-rocket service. Concern for this passes as a red filament through the whole activity of commanders, political workers, Party and Komsomol organizations. They worry about the most reasonable use of engineering cadres, direct their efforts toward a solution of the main problems on which depends the combat-readiness of rocket crews. Communist-engineers show example in knowledge and application in practice of all that puts contemporary science at the service of a missileman specialist.

In the march for high culture of fulfillment of all operations in service of rockets, of considerable value is bright and purposeful technical propaganda. Its main voices are engineers, and as a rule every officer of the engineering-rocket service has a personal plan of propaganda of rocket technology and not less than 2-3 times a month comes before soldiers on these subjects. And on the whole the engineering-rocket service so plans and organizes military technical propaganda to ensure its greatest effectiveness.

Mastery of rockets is a new matter, it requires from soldiers a creative attitude. Our engineers head up the actions of innovators in rocket units, come forward actually in the role of scouts of what is new. Engineer-missilemen have introduced many valuable proposed innovations. Senior Engineer-Lieutenant Cherenukin, for example, has developed an improvement noted by an incentive premium, and now the young officer works on a new model of an instruction machine. Now quite rarely in units does one encounter engineering-technical workers who chill to invention and innovation, to the search of improved procedures of combat work and methods of instruction. After all, such indifference, carefreeness is unbecoming to an engineer-missileman.

Consciousness of their personal responsibility for the safety of their Native Land gives birth to a hot tendency in missilemen to as well as possible fulfill their duty. It finds bright expression in the socialist competition in which engineer-missilemen participate. At the beginning of the educational year they help by competing to determine new boundaries of improvement of combat skill. Assisting in the course of studies before fulfillment of their obligations, engineer-missilemen promote the best mastery and combat employment of rocket weapons.

In the Rocket Forces there are many advanced crews. Their successes help to find the way of increasing combat-readiness of other subdivisions. The experience of the best becomes worthy of others. Here then appears the persistence and operativeness of the engineering-rocket service. It not only notices on time the secret of success of an advanced crew, generalizes experience, but also without delays spreads it to the forces. In practice there are frequently used the most operational forms of propaganda of experience, such as showing directly the techniques carried out by an innovator of assignments and so forth.

Life requires all possible generalization of operational experience of the engineering-rocket service. On this, in many respects, depends a further increase of the quality of combat studies of missilemen, and supporting in highest readiness their powerful weapon.

And what can be done independently? One young officer-missileman said: in the forces there are no great possibilities for growth in one's speciality. Such an affirmation, it seems to me, is in evident error. Let us refer to the experience of the N-th unit. Very much is given its officers by technical propaganda. They actively participate in carrying out lectures, reports, conferences. Officer-specialists independently study new questions, tell their comrades about them. Thus, with the report "About the Application of Electronic Computers in Antiaircraft Defense" came forward Lieutenant Colonel Vavilin, "About Antimissile Defense of the United States" — Engineer-Captain Ivanov.

Now technical propaganda here attracts very many. This promotes an increase in the number of masters of rocketry. And the actual propagandists of the new technology grew not only in knowledge of the matter, but also in their own official position.

Major Kopylov in a letter to the editorial office of the newspaper "Red Star" set a very urgent question: how does one extend his own horizon to a young officer-missileman? Studying in educational institution, he learns contemporary branches of sciences and technology. Thus, at his service are basic libraries, experienced consultants, the virgin soil of technical information. And here he ends up in a remote subdivision. Formation of him as a commander requires, especially at first, great and tense work. He must think about training of subordinates, about keeping the technology in constant readiness, serve in combat duties. And in such conditions officers do not forget about broadening their horizon. Although, one would think, in a small garrison it is difficult with technical literature, qualified lecturers occur there rarely. But also in these conditions it is not necessary to hear from young officers as justification of their passivity words about the fact that, being in a remote subdivisions, it is impossible to follow the development of science and technology.

In the rocket units commanders, Party and Komsomol organizations do not miss the field of vision of questions of improvement of commander preparation. The situation favorable for growth of knowledge is increased because chiefs of all ranks, society manifest daily concern for special studies and its true aid, technical propaganda. For example, in the subdivision mentioned in the letter of officer Kopylov, every day studies give very much to the actual educators. Here by the hands of skilled missilemen of officers Rudovskiy, Tkachev and their assistants have been created aid, which barely yielding to those which are used in higher educational institutions. Coming from an educational institution, a young officer obtains all possibilities of continuously supplementing his theoretical knowledge with the freshest data of military technical thought. And the officer comes forward not simply in the role of a pupil. Every specialist here obtains individual assignments, independently prepares reports on questions of nuclear physics, cybernetics, rocket building, and himself becomes a propagandist of technical knowledge.

Great is the value of the wide attraction of officer specialists to technical propaganda in rocket units. Nuclear rocket weapons have swiftly developed, they represent the latest achievements of many

sciences. Any person, be he as wise as Solomon finds it difficult to follow the different directions of technical progress in the area of rocketry. The common efforts of officers of the subdivision have made it fully possible to hold onto personnel in the course of all which occurs in improvement of contemporary combat materiel, in development of methods of application of atomic weapons and means of protection from it.

Among operational forms of propaganda in rocket units, propagation of technical information short reports on the most topical questions of the new technology has gained ground.

Also confirming their vitality under conditions of small rocket garrisons are technical conferences, evenings of technology, lectures, reports, quiz games, group assignments. Certainly, during use of these forms of propaganda one must consider the specific character of the service of missilemen, overloading of crews with combat duties. Especially thoroughly one must prepare a conference, inasmuch as at them are discussed usually the most complex scientific and technical questions, which, so to speak, from this movement are simply impossible to solve.

This once again testifies to the high responsibility and interestedness of our commanders, staff officers in the best organization of technical propaganda. During checks of subdivisions by higher headquarters interest is extended to all that is connected with combat training, including questions of technical propaganda. Those checking penetrate the contents of lectures, reports, conferences and frequently consider it obligatory to themselves to take part in them. Representatives of headquarters, where the most qualified specialists are concentrated show an example in the noble matter of increasing military technical culture.

Party and Komsomol organizations struggle for an increase in combat readiness of rocket subdivisions. Every Communist and Komsomol member becomes an authentic expert of rocket technology, nuclear physics, radio electronics, a tireless propagandist of military technical disciplines among the soldiers. Party and Komsomol organizations sensitively react to all that is valuable in this area, support undertakings which promote the best mastery of rocket weaponry.

In all cases we are, undoubtedly concerned not only about an increase in the number of lectures, reports, information, but also about improvement of their quality, about an increase of ideological and scientific contents of every measure. It is very essentially that technical subjects be not abstract, that they arouse the inquisitive thoughts of listeners, arouse their desire to test their own forces in improvement of one or another equipment, methods of its service and preparation for battle. In this connection, very useful are appearances before soldier-missilemen of our designers, soldier-innovators, introducing their donation to the progress of Soviet weaponry.

Combat friendship - strengthen it! Soviet soldiers-missilemen have by the Native Land been entrusted a collective weapon - powerful contemporary rockets. Therefore not only does every soldier master



**GRAPHIC NOT
REPRODUCIBLE**

Missilemen at an evening in their club.

an individual skill, the crew on the whole comes forward as a single coordinated organism, in which each is connected by clear interaction with a comrade, and they can always rely on the other friend.

...The rumble of a starting rocket penetrated through the walls of the cabin. All who were there directed their glances to the screens. On a yellow-green field floated upwards a mark from a rocket. For a certain time thunder growled. After the first, a second rocket soared in the sky. It seemed nothing could disturb the movement of combat work. And suddenly the mark from a target vanished on the screens. In the cabin — silence. Hesitation lasted an instant. Then the screens lighted anew. But with the people there was striking change: their action forged nervousness. Especially this happened with operator Private Startsev who did not fulfill his assignment.

"Everything set," justified certain soldiers. "Operator did not process on time," considered another. However the technical firing leader officer Tolstykh on circuits and directly on equipment proved to the missilemen that temporary interruption in the work of one of the forms of technology is groundless.

"To explain the failure by confusion of the operator is also impossible," concluded the firing leader. "The rocket is a collective weapon. And was there collectivism in the actions of the crew? One person was mixed up. And what did the others do? Officers did not come to help the operator, did not interfere in that difficult minute. Therefore the cause of the failure is lack of new coordination."

Facts from practice of combat firing convincingly show that the success of a rocket crew in many respects is determined by its quality, coordination. This quality, undoubtedly, appears not suddenly and really, in any case, not of itself, as certain young crew commanders consider. Erroneous is the representation, as if it were sufficient that every man only mastered his functional obligations and were skillful in them to fulfill trainings, as a crew of robots turned into

a monolithic combat collective. No! A commander should manifest authentic persistence, high methodical skill, be foresighted, in order to ensure combat coordinatedness of his subordinates, weld them with a single thought, a single will, single action.

Indisputably, the skill of a crew as a combat unit rests first of all on excellent individual preparation of every man. Deeply knowing the technology, physical meaning of processes occurring during launch and in the flight of a rocket, a soldier will not be taken aback during a change of situation in his section, he will rapidly find a way out of an unexpected difficulty. However the collectiveness of actions of a crew will be better if individual preparation of a man includes presentation about adjacent professions. It is not accidental that the actual preparation of specialist-missilemen has a wide profile. These people better grasp the inter-connection of systems, the rocket, more distinctly understand the problem of the crew on the whole; they have more possibilities of rendering help to comrades, and even replacing them.

And yet, however strong the individual preparation of men, it does not decide the success of the matter. For this there are conducted purposeful systematic assignments specially on coordinatedness, with continuous complication of the situation. This goal serves overall trainings and teaching.

Seeking clear work of operators, a commander will take care that they not get lost in unexpected situations, skillfully pass from one method of target tracking to another. In training soldiers of fire crews it is very essential to gradually accelerate fulfillment of operations. Thoughtless pursuit of exceeding norms permits that man who has unfirmly mastered procedures of actions in a difficult moment to deviate, to err. And any inaccuracy of even one man of a crew can bring to nought the great efforts of the whole combat collective.

Developing the coordinattion of crews in rocket subdivisions, commanders usually allot basic attention to now, personnel put the technology in combat readiness, check its good condition, detect and track a target, conduct rocket fire. Not missed are other elements of preparation, such as shifting materiel from march position to combat and back, accomplishment of marches and so forth. And without this it is difficult to talk about real readiness of subdivisions for a highly manuevrable fight under conditions of nuclear rocket warfare.

In surface-to-air rocket troops there are many commanders who show their personal example in tactical and rocket firing preparation, skillfully heading the combat work of crews. About this the high results of recent firing give testimony. Thus, with a real sniper blow from a first rocket, the crew headed by officer Levenko struck a target. Almost all men here, high-class specialists, master allied specialties. The subdivision successfully fulfills its combat mission under the intense influence of factors of "nuclear explosion."

Achievement of combat coordination of missilemen - this is not a purely educational problem. Much depends on the development of moral-combat characteristics of personnel, training of them in the

spirit of military comradeship, mutual profit.

The good physical condition of each crew member is also very important. After all, our advanced crews work according to the same standards in the summer, in the winter, at night and by day.

A good influence on the formation of combat collectives of missilemen is rendered by socialist competition for the best execution of training problems, and the most responsible of these is combat firing. Those rocket units enter correctly which prepare for the organization of competition throughout all their studies, and not only just before firing. The spirit of competition multiplies the force of the missilemen and unites their efforts in striving for first place. Good results are given by the special contests in preparation of weapons for combat and the execution of rocket firing. Such contests are held successfully in the Moscow Antiaircraft Defense District. Crews which show the greatest accuracy in firing differ by exactitude and coordination, and their members understand firing literally at once.

Penetrating all facets of the studies of missilemen, Party and Komsomol organizations separate the questions on whose solution combat readiness depends first of all. Therefore for them concern is so important for the solidarity of combat calculations and of skillful instruction to soldiers regarding joint operations in contemporary combat when using a new collective weapon. All possible public support is deserved by the undertakings of these soldier-missilemen, directed towards their mastering specialties of a wide profile and related professions. Communists and Komsomol members are active fighters for the introduction of these valuable undertakings; they propagandize every grain of experience of the advanced collectives and demonstrate standard coordination upon fulfillment of training problems.

Not for a day does the intensity of combat studies of the missilemen weaken. Every minute is used, to comprehensively prepare news, to pour together the will and knowledge of the members and to harden them morally and physically. Every crew learns to strike any target with the first rocket. This is the best contribution of the missilemen to the combat readiness of our glorious Armed Forces.

Combat duty - the training school. The first-rate concern of antiaircraft defense missilemen is worthy of standing watch to protect the air boundaries of our Fatherland. And it is clear that every young soldier, a sergeant starting his service or a lieutenant who recently graduated from school dreams of joining a combat crew and becoming an equal to those who excellently perform at combat posts under the most complex conditions and who give an example of high vigilance and discipline, industry and skill. Commanders, the Party and Komsomol organizations of the rocket units attempt to render everything dependent on them in order to help the young soldiers carry out their noble desire to participate actively in the fulfillment of combat missions.

But, of course, a clearance for combat duty is not a formal act, but a strict test for any specialist or entire crew. Soldiers must deeply and thoroughly master all their functional duties and master the equipment in their entrusted section in such a manner so that in case of the appearance of a real target in the sky they can act without a hitch. Together with that they must know distinctly what is done in the crew on the whole, what the duties of the other members are, and how to interact correctly and clearly with them during intense combat work.

Besides this special knowledge, a soldier who becomes a part of a combat watch must have high esprit de corps, and, first of all, the greatest discipline and composure, accuracy and punctuality. The crew works with a weapon of unparalleled force and with fine and sensitive equipment; inaccuracy in actions, negligence, and inattentiveness can lead to a missed target. The training of high combat characteristics begins literally from the soldier's first steps in the unit. Of immense value in this matter is the even and comprehensive exaction of commanders, and the subjective and purposeful party-political work.

Bearing one's combat duty is the execution of a combat mission. And, as is often experienced at the front, a soldier on duty repeatedly meets with unexpected situations and gets into difficult situations. This is why those who are prepared to protect our air boundaries cannot manage without the skill to act independently, to manifest endurance, boldness and resoluteness. These qualities, of course, do not come by themselves. They are produced in training and study sessions which are conducted under near-combat conditions similar to those which the soldier will encounter when repelling an aerospace attack. The specific character of service of the missilemen permits their commander to be convinced of the correctness of his methods of crew preparation after their first duties. For this it is important to analyze attentively the lessons of combat work and, by all means, to consider them in the daily studies and training of personnel.

This is the way it is done in the advanced missile subdivision, which is headed by Communist officer Kulinich. Here combat duty has become the real training school of the soldiers in the spirit of conscious discipline and high combat-readiness as well as unfailing industry. The commander at his post embodies excellent knowledge of the matter at hand, resourcefulness and accuracy. Here both the experienced and beginner specialists know: any deviation from the manuals will be noticed. All incompleteness in crew preparation manifested on duty is the basis for further training, work and conversations.

Special attention is allotted to instilling the sense of responsibility. Let us take, for instance, the readiness of a crew to execute a combat mission. For checking it, here special groups of "aerial targets" are used. They "attack" a guarded object suddenly, from various directions, at various altitudes and using variable flight profiles. No one knows beforehand when and what will be checked. Thus a certain tension, combat tone and strict vigilance are maintained.

In advanced PVO subdivisions, the standard execution of duties is actively promoted by the Party and Komsomol organizations. They persistently strive for the exemplary quality of Communists, and Komsomol members in combat work, in maintaining discipline and industry, they also are concerned that the successes achieved at combat posts quickly became the property of all soldiers. Thus, in the subdivision where officer Ivanov serves on the initiative of Party organization the "Album of Memorable Actions" was created. In it, for example, it is told how the crew of Communist Kalynyuk reduced the time of one of the most complex norms by almost one third. This inspired the other soldiers to attempt to beat the norms.

In every subdivision all possibilities are present for the most successful training of soldiers in the course of their combat duties and to increase their esprit de corps. These possibilities should be used completely. A check of the troops' readiness to execute a combat mission is conducted as assumed, in order that the men were not weakened and in order that complacency was not engendered in them. After all, from complacency to negligence is just one step.

During duty an atmosphere of high exactitude, organization and accuracy is created. Now cases are very rarely encountered when the members of crews for some time weaken their vigilance, inaccurately determine targets and even miss them. The soldiers who head the crews sometimes use nonregulation commands and disregard safety measures. All these gaps in training the men and knitting combat collectives together are quickly removed.

PVO missilemen are constantly ready to repel the nuclear missile attack of an aggressor and skillfully to wage combat under conditions of the action of the means of mass destruction. They daily learn to execute missions in the most complex air and ground situations. The least indulgences in this respect are impermissible.

Party-political work conducted at the combat posts of crews, first of all is designed to increase the vigilance of the men, to promote their combat development and esprit de corps, and to strengthen inviolable military discipline. Communists and Komsomol members teach intolerance to any indulgences during the preparation and execution of duties. They show the example of worthy execution of combat missions and have great achievements in their own combat development and in standing an honorable and responsible watch.

Course - to the new! Missilemen prepare themselves for action in intense, difficult and complex situations. They harden themselves physically and develop in themselves high moral-combat characteristics - courage, stability, decisiveness and skill not to be lost under the most complex situation.

Every commander and every soldier in a contemporary combat situation encounters many new, and at the time unexpected factors. All of this creates additional problems for the workers of our military science and educational institutions. They improve theory, and, within the limits of that which is possible in peacetime, the practice of using new combat materiel, primarily all classes of missiles.

As was noted in the procedures of the Central Committee of the CPSU and the Council of Ministers of the USSR regarding graduates of military academies, young officers, during their period of studies, obtain sufficiently deep knowledge concerning questions of using the latest means of armed conflict in combat and operation and are fully capable of making a good showing for themselves the service, and like their predecessors, can show that they have excellently mastered the new rocket equipment. In tests the graduates show a creative approach to searching for the most expedient methods and forms of combat actions under conditions of the means of mass destruction.

Success in the training of personnel is promoted by changes in the educational process in higher educational institutions. Great attention is now allotted to the study of new and improved methods to control troops and combat equipment with the use of computers. Commanders and engineers skillfully use these machines, since many complex questions must be decided and delivered to the executors in very short periods, calculated in minutes and even seconds.

The general scientific preparation of students was improved, without which the successful mastery of contemporary equipment and armament is inconceivable. The physical and mathematical sciences as well as chemistry are deeply studied, due to which the importance of these disciplines has increased in the curricula of academies and schools.

Great prospects in the matter of improving the instruction of students, as the experiment of certain higher military educational institutions bears witness, are being unveiled by the method of programmed instruction with the use of electronic equipment. We must study the possibilities of programmed instruction in military educational institutions.

Teaching machines help to solve a problem which is becoming very sharp: developing technology requires more and more time for study. The time is near when without the use of cybernetic technology it will be impossible within set periods of time to prepare military specialists of full value. This is why the introduction of programmed instruction in higher educational institutions and units of the Rocket Forces is a vital necessity, and it is being conducted in ever widening scales.

The problems connected with the combat employment of all forms of missiles are new and rather complex problems.

Officers of the Rocket Forces; like officers of the other branches of the Armed Forces, constantly consider, as fast as science is developed and as fast as equipment and armament is improved, methods and forms of armed combat. They walk in step with life, do not lag behind it, look forward, and see the perspective. They sacredly fulfill their obligation to study deeply and to develop military science, to master in good time the newest and latest equipment and weapons which are under development and which will enter the service, to master new methods of waging war and conducting operations under conditions of a nuclear missile war which the imperialists will prepare.

Successes in the activity of a commander and engineer in the service to a decisive degree depend on the persistent mastery of the all-conquering teachings of Marxism-Leninism, the Lenin style in work, and learning the high qualities of a Soviet officer. After all, commanders and engineers deal not only with equipment, but also with the people who master the equipment. This is why they — in all possible ways — strengthen the ideological work, skillfully direct it toward communistic training of soldiers, toward strengthening discipline and increasing vigilance and combat-readiness.

The level of ideological work in the Rocket Forces is growing every higher. People of different military specialties are being attracted to it. The awareness of all soldier-missilemen is strong. They seek newer successes in combat and political preparation.

Now in the rocket units of different branches of the Armed Forces such remarkable initiatives are wide spread as competition in training problems and norms, reducing the schedules of missile preparation for launch, detecting a target at maximum range and tracking it without breaks, achievement by specialists of the 1st class of technician qualification and ensuring mutual interchangeability in crews. These undertakings are introduced ever wider in the life of rocket units and subdivisions, allowing an achievement of a further increase of their combat readiness, which will be a new contribution in safeguarding the defensive capability of our great Fatherland.

Soldiers of the Rocket Forces make use of the warm love of all the Soviet people. Soviet people see in the missilemen reliable protectors of peace and safety of the Fatherland.

* * *

In the Soviet calendar there are significant dates which our people note with special pride. They are the monuments of patriotic glory and the boundaries, whence the route passed is examined before the leap forward, to new successes and achievements. These holidays are Rocket Forces and Artillery Day on 19 November. On this day the Soviet people note the merits of the heroic artillery men during the years of the Great Patriotic War, pay homage to the military efforts of missilemen and artillery men who properly carry on today their difficult combat watch, and to the workers, technicians and engineers of the defense industry who ensure supplying the Army and Navy with perfect rocket weapons.

In establishing Rocket Forces and Artillery Day, the unprecedented growth of the military power of our Armed Forces — those radical changes which occurred in the means and methods of waging contemporary warfare — found its reflection. This holiday is the bright evidence of the constant care of the Communist Party, the Soviet government and our people for the glorious Soviet Armed Forces, standing on guard over the peaceful labor of all socialist collaboration, on guard over peace throughout the world.

Our country pays the tribute of respect to the new generation of missilemen and artillery men who will increase the combat glory of their fathers, and who will vigilantly guard the peaceful labor of the Soviet people.

The great confidence of the people inspires the missilemen and makes the missile watch one of the most honorably and responsible. It is a great honor to stand beside the mightiest weapon of our time and to presence the construction of Communism! All the soldiers of the Rocket Forces try to be worthy of this honor.

Soviet people can rest assured: the Rocket Forces vigilantly stand guard over the peaceful creative labor of the Soviet people and peoples of all the countries of the socialist camp. Tightly solidified around the Communist Party and the Soviet government, our soldiers are always ready to protect their great Fatherland, the builder of Communism. Our Armed Forces and their Rocket Forces, together with the fraternal armies of the countries of the Warsaw Pact, resting on the economic and defense powers of the socialist camp, are capable of crushing any aggressor.

U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	<i>А а</i>	A, a	Р р	<i>Р р</i>	R, r
Б б	<i>Б б</i>	B, b	С с	<i>С с</i>	S, s
В в	<i>В в</i>	V, v	Т т	<i>Т т</i>	T, t
Г г	<i>Г г</i>	G, g	У у	<i>У у</i>	U, u
Д д	<i>Д д</i>	D, d	Ф ф	<i>Ф ф</i>	F, f
Е е	<i>Е е</i>	Ye, ye; E, e*	Х х	<i>Х х</i>	Kh, kh
Ж ж	<i>Ж ж</i>	Zh, zh	Ц ц	<i>Ц ц</i>	Ts, ts
З з	<i>З з</i>	Z, z	Ч ч	<i>Ч ч</i>	Ch, ch
И и	<i>И и</i>	I, i	Ш ш	<i>Ш ш</i>	Sh, sh
Я я	<i>Я я</i>	Y, y	Щ щ	<i>Щ щ</i>	Shch, shch
К к	<i>К к</i>	K, k	Ъ ъ	<i>Ъ ъ</i>	"
Л л	<i>Л л</i>	L, l	Ы ы	<i>Ы ы</i>	Y, y
М м	<i>М м</i>	M, m	Ь ь	<i>Ь ь</i>	'
Н н	<i>Н н</i>	N, n	Э э	<i>Э э</i>	E, e
О о	<i>О о</i>	O, o	Ю ю	<i>Ю ю</i>	Yu, yu
П п	<i>П п</i>	P, p	Я я	<i>Я я</i>	Ya, ya

* ye initially, after vowels, and after ъ, ь; e elsewhere.
 When written as ѣ in Russian, transliterate as yѣ or ѣ.
 The use of diacritical marks is preferred, but such marks
 may be omitted when expediency dictates.