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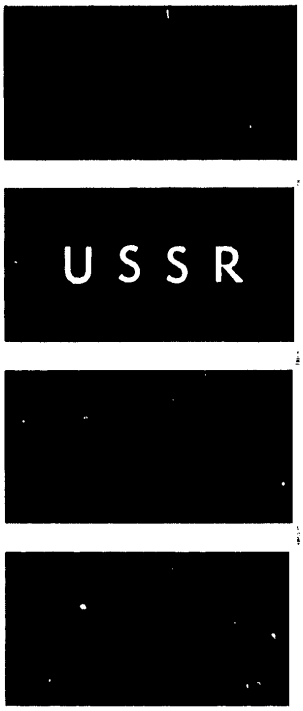

TRANSLATIONS ON USSR MILITARY AFFAIRS

(FOUO 3/79)

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TRANSLATIONS ON USSR MILITARY AFFAIRS

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CONTENTS PAGE

BOOK PRESENTS SOCIOLOGICAL STUDY OF SOVIET MILITARY ENGINEER

Moscow SOVETSKIY VOYENNYY INZHENER (SOTSIOLOGICHESKIY OCHERK) in Russian 1977 signed to press 18 Feb 77 pp 1, 2, 3-5, 40-111, 196-198, 199

[Table of contents, annotation, introduction, chapter II, conclusion of book "Sovetskiy Voyennyy Inzhener (sotsiologicheskiy ocherk)" published under the general editorship of Col M. P. Shendrik, doctor of philosophical sciences, professor, Moscow, Voyenizdat, 1977, 199 pages]

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Title: "Sovetskiy Voyennyy Inzhener (sotsiologicheskiy ocherk)" (The Soviet Military Engineer [A Sociological Study])

General Editor: Colonel M. P. Shendrik, doctor of philosophical sciences, professor.

Authors: Engineer-Colonel A. F. Volkov, candidate of philosophical sciences, docent; Lieutenant Colonel V. S. Gorbunov, candidate of philosophical sciences, docent; Lieutenant Colonel V. F. Kovalevskiy, candidate of philosophical sciences; Colonel N. Ya. Lysukhin, candidate of historical sciences; Lieutenant Colonel Ye. V. Malafeyev, candidate of military sciences, docent; Colonel I. V. Malyshev, doctor of philosophical sciences, docent; Colonel Yu. I. Rachev, candidate of philosophical sciences; Colonel G. S. Tkachenko, candidate of philosophical sciences, docent; Captain 2d Rank V. F. Frolov, candidate of philosophical sciences; Engineer-Colonel Yu. G. Fokin, doctor of technical sciences; Lieutenant Colonel E. P. Utlik, candidate of psychological sciences; Lieutenant Colonel I. S. Shatilo, candidate of philosophical sciences; Colonel M. P. Shendrik, doctor of philosophical sciences.

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Annotation:

The increase in the number of engineers and technicians in the army and navy is one of the most important manifestations and results of the revolution in military affairs. At the present time, almost half of the officers, and more than 80 percent of those in the Strategic Missile Forces, are engineers or technicians. It has become necessary to thoroughly study the place and role of the engineer within the structure of the military organization and to provide a thorough description of his personality, which is depicted by the combination of his ideological-political, social, professional and psychological qualities.

This book attempts to clarify the peculiarities of the social make-up of the Soviet military engineer. It was written for the officer corps and for a broad range of military readers.

Table of Contents:

Introduction:

While persistently and steadfastly pursuing a policy of peace, the Communist Party constantly concerns itself with strengthening the nation's defensive might. In the report, "The CPSU Central Committee's Report and the Party's Main Tasks in the Area of Domestic and Foreign Policy," which Comrade L. I. Brezhnev, general secretary of the CPSU Central Committee, presented at the 25th Congress, he states the following: "our party will do everything possible to see that the glorious Armed Forces of the Soviet Union continue to have at their disposal everything necessary to perform their responsible task, that of guarding the peaceful labor of the Soviet people and serving as a bulwark of universal peace."[1] The formulation and the performance of this task clearly reflect the class, socialist nature of the party's foreign policy and the concern demonstrated by the CPSU for the creation of favorable foreign political conditions for the successful building of a communist society in our nation and for strengthening the forces of socialism, peace and progress throughout the world.

The officer corps has an active role in the accomplishment of this task. The task of strengthening the power and combat capability of the Soviet Armed Forces depends to a considerable degree on their successful work. Soviet officers are active agents of party and government policy in the army and navy and of the class, revolutionary and military spirit of the army and its combat traditions.

Between the time they were created and the present, Soviet military personnel have undergone great changes based on the profound social and spiritual processes taking place in the development of the Soviet socialist society and in the improvement of the Armed Forces, which has been based on the achievements of science and technology. The successes achieved by developed socialism, the rapid flourishing of the socialist economy and culture, the unprecedented ideological-political and moral unity of the Soviet society have been reflected in the social, ideological, moral and professional make-up of Soviet military cadres. The revolution in military affairs has also greatly affected the structure and make-up of the work performed by army and navy personnel. An increase in the number of engineers and technicians in the army and navy has been one of its most important results. The large specific proportion of military engineers and technicians in the Soviet officer corps is one of the significant features of the Soviet Armed Forces at the contemporary stage. At the present time, almost one half of the officers are engineers or technicians. More than 80 percent of the officers in the Strategic Missile Forces are engineers or technicians. Their numbers are tending to grow in all services of the Armed Forces.

The increasing number of engineering personnel in the army and navy, which has had a considerable effect with respect to further improving the Armed Forces of the USSR, has also brought about the theoretical problem of studying the Soviet military engineer's personality.

The Soviet military engineer's personality is a combination of all the social, ideological-political, professional, moral and psychological qualities which make him like the rest of the officer corps and the Soviet society, of which he is a full member, and at the same time, reflect his specific characteristics, which are peculiar only to this group of military workers. Using a systematic approach, the authors analyze the problem of the Soviet military engineer's personality in a comprehensive manner. Such an analysis also requires clarification of those features of the Soviet military engineer's personality, which are common and identical for all representatives of the Soviet officer corps (specifically, the social-political, ideological and moral qualities). Without such an analysis, however, it is impossible to create an integral social portrait of the Soviet military engineer.

The sociological aspects of the Soviet officer's personality in general, and that of the military engineer in particular, have still not been adequately explained. A general description of Soviet officer personnel is provided in a number of works, but they are primarily of a historical nature. In the interest of a comprehensive approach to the analysis and elaboration of this problem, we need a broad study of the social, mental and professional qualities of Soviet officers. Even less has been writen about the Soviet military engineer: the list of works on this subject consists of articles published in military journals and newspapers.

In an attempt to analyze the Soviet military engineer's personality psychologically, the authors of this book have relied on the basic principles set forth by the Marxist-Leninist classics on matters of military organizational development and engineering work and on guiding documents provided by the CPSU, which formulate the most important principles of the party's cadre policy at the stage of developed socialism, the scientific and technological revolution and the contemporary revolution underway in military affairs.

The authors are cognizant of the complexity and of the multifaceted nature of this subject. A number of issues, which require further study and investigation, have naturally only been mentioned in this book.

Chapter II: THE REVOLUTION IN MILITARY AFFAIRS AND THE PROFESSIONAL QUALIFICATIONS OF ENGINEERING AND TECHNICAL PERSONNEL OF THE ARMY AND NAVY

1. Augmentation of the Requirements Made of Military Engineers in Connection With the Scientific and Technological Revolution

The process of creating and developing a military engineering corps is presently taking place under conditions created by the scientific and technical revolution underway in our nation and the closely linked revolution occurring in military affairs. It would therefore be impossible to properly understand the causes of the fundamental changes presently occurring in our engineering personnel, the nature of those changes and the trends apparent in them, without analysing the manner in which these changes are affected by scientific and technological progress and the revolutionary transformation of military affairs.

Army and navy engineering personnel form a special category of the nation's engineering cadres, on the one hand, and an integral part of the officer corps of the Soviet Armed Forces, on the other. Scientific and technological progress can therefore affect military engineers both directly and indirectly. In the former case, this influence assumes the form of general changes occurring in the nation's engineering cadres as a whole, a result of the scientific and technological revolution. In the latter case, it is a matter of specific changes occurring only in military engineering personnel, changes brought about by the revolution in military affairs, primarily the qualitative transformation of the Armed Forces' technical military base. In both cases, an analysis of this influence includes the disclosure of certain aspects of both the scientific and technological revolution and the revolution occurring in military affairs. Since this subject has been thoroughly covered in the literature, we shall discuss it only briefly.

The contemporary scientific and technological revolution constitutes a special phase, a concentrated manifestation, of scientific and technological progress, and represents an enormous advance in the understanding of nature and man's application of its laws, an advance characterized by the transformation of science into a direct productive force for society and the reform of the entire system of productive forces. The substance of this revolution is formed of the sum-total of scientific discoveries and technological achievements, which are of world importance, historically speaking, and have brought about the use of basically new machines and tools of labor, technological processes and materials in the production sector.

The peculiar nature of the modern scientific and technological revolution lies in the fact that it is developing with unprecedented speed, as a singly process embracing all of science and all of technology, transforming science into a direct productive force for society. Among the trends in the development of the modern scientific and technological revolution, special mention should be made of the development of the energy base and the growth of the power supply per production unit, the qualitative changes occurring in the production of materials, the improvement of tools of labor, based on total mechanization and automation, and the adoption of progressive new technology.

The scientific and technological revolution has significantly altered the conditions and the nature of public labor. An intensive process involving the shifting of a number of man's direct production functions, primarily those involving heavy, monotonous physical labor, to machine complexes and automated systems. In the process, man is dropping out of the technological cycle, rising above it, as it were, performing observation, physical control and regulation functions. Specific sociological studies have shown that the amount of time spent by skilled personnel on operations requiring predominatly physical labor is frequently reduced by up to 20 percent at enterprises thoroughly outfitted with modern equipment. From 70 to 95 percent of the time is spent monitoring, adjusting and regulating the equipment, and on the performance of analytical computations and other, primarily mental, work.[2] This means that the scientific and technological revolution is leading to the saturation of physical labor with intellectual elements and bringing the work performed by kolkhoz and other workers into line with that performed by the engineer and the technician.

All of this is making the work not only more productive but also more creative and attractive, changing people's attitude toward work and helping to transform work into a prime inner need for all members of society. At the same time, these circumstances are making it necessary to further develope public education and constantly elevate the technological sophistication and the occupational skills of the workers. The introduction of universal secondary education among the youth, improvement of the occupational training system and the implementation of a planned process of raising the workers' skills, taking the requirements of scientific and technological progress into account, are all having a profound influence with respect to elevating the general and work standards of the workers and the training of skilled workers for all sectors of the national economy. Suffice it to say that more than 76 percent of the workers employed in the national economy today have a higher or secondary (complete or incomplete) education.[3]

The problem of providing the national economy with highly skilled engineers and technicians has also been reformulated. The process of combining science with production and adopting new technological processes, automated systems and modern equipment is making the work performed by engineers, scientists and technicians considerably more important.

A new system of training engineers, acknowledged by the entire world, has been created in our nation during the years of Soviet government. While a total of only 8,000 specialists with a higher education worked in tsarist Russia's industry prior to World War I,[4] 9,441,000 specialists with a higher education and 13,306,000 with a secondary specialized education are presently employed in our national economy.[5]

It is not only the absolute number of engineers and technicians which is growing, but their relative strength as well. That is, their specific proportion is increasing both among production personnel in industry and among all specialists with a higher education. The scientific and technical intelligentsia in our nation has begun increasing in recent years at a rate outstripping that

any other social group. Between 1950 and 1970, for example, the number of workers increased 2.1-fold, while the number of engineers and technicians grew 2.9-fold.[6] The engineering profession in the USSR is also the most common among specialists with a higher education. While engineers accounted for one fifth of the total number of specialists with a higher education in the 1930's, the proportion had increased to more than one third by 1970.[7] At the present time, more than 40 percent of the students attending Soviet VUZ's are studying to become engineers, and almost one out of every two scientists deals with problems in the technical sciences.[8]

Another important point to be stressed is the fact that until recently the VUZ's mainly concentrated on increasing the number of engineering graduates, whereas, dispite the continuing increase in the need for engineers, the focus of importance is switching to the quality of their training, based on the demands of the scientific and technological revolution. The engineer now performs as a designer of machines, structures, instruments and mechanisms, as a mathematician utilizing high-speed computers, as a technologist creating and establishing progressive production methods, as an organizer and economist, as an operator and, finally, as a researcher utilizing theoretical achievements for practical purposes.

Engineers and technicians are the ones directly involved in combining science with production, developing, creating and introducing new equipment, studying and perfecting production control systems, investigating possibilities for transferring non-creative production functions to automatic machines, and performing the work of improving production organization and introducing scientific organization of labor at the enterprises themselves.

The main effect of the scientific and technological revolution on engineers is thus manifested in two dialectically contradictory and interdependent trends. In the first place, by contributing to the growth of the scales and complexity of production and the equipment, the scientific and technological revolution is thereby placing new and greater demands upon the quantity and caliber of engineering and technical personnel. In the second place, by altering the nature of public labor, inserting creative elements into it and contributing to the elevation of the Soviet people's general education and their cultural and technological sophistication, the scientific and technological revolution is thereby creating the conditions and expanding the possibilities for satisfying man's need for knowledge and creative activity. These trends are reflected in specific form in the work of military engineers and technicians as well.

Improvement of the Soviet people's welfare, their cultural standards and technical sophistication, which has resulted from party and government efforts during the course of the cultural and the scientific and technological revolutions, has resulted in the present situation, in which more than 75 percent of the fightingmen in the army and navy have a higher or secondary education. The young people entering the military service have a sufficiently broad technical perspective, a good general education and specific technical skills. More than 84 percent of the draftees have acquired one or another civilian specialty, and this applies to the technical specialties as well. Many of them also have

experience in working with the new equipment. Every third draftee has acquired a military skill in a DOSAAF training organization.[9]

At the present time, personnel of the Soviet Armed Forces have every opportunity to master rapidly and successfully the new military equipment which the troops are receiving, to competently service and maintain it in a constant state of trouble-free performance, to take an active and productive part in invention work and that of improving efficiency. In order for military engineers to realize these possibilities effectively, they must possess a great deal of knowledge, a good general education and good overall standards, a broad political and military perspective, and a high level of professional and pedagogical skill.

The development of the scientific and technological revolution, in conjunction with other factors, has resulted in a situation in which the engineering specialty, particularly that of the military engineer, has become one of the highly intellectual and creative lines of work. Combined with the population's high general education level, this has resulted in the availability of a large group of young people who not only desire to link their lives and work with the Armed Forces, but who also possess an education adequate for becoming a specialist in one or another military engineering field. The foundation for creating and replenishing the corps of military engineers is thus constantly expanding, which makes its possible to provide the personnel on a more goal-oriented basis, selecting candidates who satisfy to the greatest degree the present large requirements made of military engineers. Furthermore, many young specialists holding diplomas enter the army directly from higher civilian educational institutions.

We have now described the main trends in the area of the scientific and technological revolution's immediate influence on the development of engineering and technical cadres. The direct effect, however, describes only one aspect of the matter, an analysis of which makes it possible to reveal only certain general elements characteristic of the changes occurring in all engineering cadres, without considering their specific field of endeavor. And it is important for us to explain the specific nature of those changes occurring precisely in the area of military affairs. This is only possible with an analysis of the scientific and technological revolution's indirect effect on military engineering cadres (those occurring as a result of the revolutionary changes taking place in military affairs).

The nature of the present revolution in military affairs is revealed in the qualitative changes being made in military weapons and equipment, in the entire material and equipment base of the forces, forms and methods of conducting combat operations, the organizational structure of the Armed Forces and the caliber of the personnel. One of the most important peculiarities of the present revolution occurring in military affairs, as noted above, is its close interrelationship with the scientific and technological, which is transforming the military base of the army and navy.

In the first place, technology is being introduced in the forces in an intensive process; the quantity of combat weapons and equipment is growing; all services of the Armed Forces and branches of troops are becoming fully outfitted with modern equipment; and the amount of work performed by the fightingmen with technical equipment is rising. The soldier's work in the Soviet Armed Forces has been placed onto a base consisting of the latest technical equipment in the form of highly developed, electrically powered facilities, various automatic and semiautomatic systems, computers, reference instruments and mechanisms ensuring successful combat employment of the weapons. Naturally, the increase in the volume of technical equipment is also producing an increase in the number of engineers and technicians.

In the second place, the weapons and combat equipment are now more powerful and complex, and they operate at higher speeds than ever before. We know, of course, that a single 50-megaton thermonuclear bomb explodes with a force exceeding that of all the explosives used in previous wars waged by mankind. The combat capibilities of conventional weapons have grown. For example, it was announced at the session of the USSR Supreme Soviet which passed the Law "On Universal Mandatory Military Service" that the total power of an artillery and mortar salvo by a modern motorized rifle division has reached 53 tons, exceeding the total force of such a salvo by a 1939 division more than 30 times over. The power supply per unit for a modern motorized rifle division has increased 10-fold over the 1939 level.[10]

Modern military technology is such that it would now be practically impossible to enumerate all of the sciences connected with the creation and production of weapons. The combat equipment is constantly improving and becoming more complex. Just 15 to 20 years ago, a technical device of average complexity consisted of 700-800 parts and assemblies. By the beginning of the 1970's, such a device contained around 1400-1500 parts.[11] According to foreign data, the radio-electronic equipment carried by a modern bomber alone consists of 75,000 to 100,000 various components. It is clear from this why the production of a jet aircraft requires ten times more work on the part of engineering and technical personnel than that of an aircraft with piston engines.[12] That which applies to the production of equipment, however, applies to its operation to an equal, if not greater, degree. The complexity of the combat equipment and weapons and the need to make them highly dependable and constantly ready for combat naturally means that greater and more serious demands must be made of the caliber of operation of the combat equipment, the full responsibility for which is borne by the military engineers.

In addition, the increase in the power of weapons and the complexity of the equipment is causing them to cost more, and, consequently, military engineers have a greater responsibility to maintain the equipment in model condition, to preserve and care for it. Modern equipment is expensive. This explains why careful handling and careful operation of the equipment produces such a great saving for the national economy and explains why military engineers are expected to play such a major role in the matter.

In the third place, the increasing complexity of the equipment is resulting in diversification and increasing the complexity of military occupations, especially the technical specialties. The operation and servicing of the modern missiles, submarines, military aircraft and tanks demand specialists in engines, fuel and fuel equipment, radio and radio-electronic equipment, missile weapons, electric-power engineering, instruments and so forth. According to data compiled by American experts, 37 specialists are required to service medium-range missiles in the field. A total of 400 technicians and operators are required for a single missile unit of 10 Atlas missiles.[13]

It is therefore not surprising that there was a total of only 15-20 military specialties during World War I, the number increasing to 160 in World War II, but that there was more than 400 technical specialties alone in the army by the beginning of the 1970's.[14] The increase in the number of specialists in the forces has been accompanied by an increase in the number of specialties, the performance of which requires not so much physical as mental work. The nature and make-up of military work as a whole is changing: it is becoming increasingly technical, intellectual and creative.

In the fourth place, the quantitative and qualitative characteristics of military engineering personnel are being affected considerably with respect to increased demands being made of them by the process of rapid application of the latest discoveries in military affairs, the replacement of certain technical models, and sometimes, entire weapons systems, with new ones, and those, with even more modern ones, the obsolesence of equipement and its reduced service life. The time elapsing between the development of new equipment and its adoption for operational use is being reduced.

A period of 35 years (1867-1902), for example, was required before radio could be used as a means of communication; television required 14 years (1922-1936); the atomic bomb--6 years (1939-1945); and transistors--5 years (1948-1953).[14] At the beginning of our century, 20 to 30 or more years was required to develop an improved weapon and outfit armies with it, whereas this process in the armies of larger nations has now been accelerated 2- to 3-fold. Suffice it to say that two or three generations of missiles have been replaced during the past 10 to 15 years in our nation and abroad, a considerable portion of the fleet of military aircraft, surface ships and submarines has been renewed, and the surface-to-air missile and radar systems, control and communication equipment have changed several times. The time required to design this or that technical model sometimes exceeds its service life in the armed forces. A technical model sometimes becomes obsolete even before it is placed into operational use.

While the complexity and diversification of military equipment demand greater specialized knowledge and lead to diversification of the technical military professions and to increased specialization of military engineering work, the replacement of weapons systems is resulting in integration of the knowledge required by the specialist and demanding thorough theoretical training to permit the engineer to independently master the new equipment models, to rapidly grasp the new technical concepts underlying their designs, and so forth.

Scientific and technological progress and the revolution in military affairs have thus created a solid objective foundation for increasing the number and improving the caliber of military engineers, raised the role and the importance of engineers and technicians, produced qualitative advances in the nature of military engineering work, and placed new damands upon the military engineer's professional qualifications.

2. The Make-Up and Nature of Military Engineering Work

In the preceeding paragraphs, we have discribed the factors producing the growth and improvement of military engineering personnel of the Soviet Armed Forces. There is yet another, equally important aspect of the matter: What has the military engineer brought to the forces? This question can be answered by analyzing the make-up and nature of military engineering work.

The military engineer's work represents the socially conditioned, purposeful occupation of the military engineering cadres, which focuses on the creation, testing, analysis, operation and repair of combat weapons and equipment for purposes of raising their effectiveness and maintaining them in a constant state of operational efficiency and combat readiness.

The military engineer performs various functions in military units (chasti) and military institutions. In the sub-units (podrazdeleniya) and units of engineer troops, he may design weapons and direct the work of constructing them; at repair offices, he may be in charge of operations, develop technology, perform design work, detect defects, adjust and test armament systems; and at research institutes and testing grounds, he might investigate the combat and technical features of weapons and military equipment, summarize test results and develop recommendations for eliminating defects and improving methods of employing the equipment and weapons for combat and operating them. Military engineers help to creat methods for studying and programs for modeling the weapons systems being designed, using electronic computers, and methods of employing them for combat, and to compile instructions, quides and manuals on the operation and study of technical equipment in the military units.

The operation of combat and military equipment, however, is the most prevalent type of engineer work in the Armed Forces. The engineer may direct the work of crews performing various operations or he may participate directly in the performance of the more complicated and responsible operations involved in the technical servicing and readying of equipment, the detection and elimination of malfunctions and breakdowns and the control of the complex and crucial technical equipment. Regardless of the specific work performed by the engineer, his main task is one of ensuring technically competent operation of the combat weapons and military equipment and the timely and quality performance of measures to ensure that the weapons and equipment are maintained at the required high level of readiness for combat employment. And one should not lose sight of the fact that certain types of weapons are so complex that in mastering them, many line generals and officers become true scientists in their service field.

The concepts "the make-up" and "the nature" of military engineering work cannot be separated, because the functions performed by military engineers determine the structure, the focus and the specific qualitative aspects of their work. The nature of the work is at the same time greatly influenced by its materials and equipment base, the level of the specialists' scientific training, the objective of the work, and so forth.

The changes brought about in the make-up and nature of military engineering work by scientific and technological progress in general, and by the revolution in military affairs in particular, have been reflected primarily in the form of greater specialization by military engineers. The missions of the different services of the Armed Forces, the peculiarities of their military basis and the nature of the technical training received by the personnel determine the specific features of the work performed by the military engineer of a service of the Armed Forces and his professional characteristics.

Depending on the make-up of the engineer's work and his functional duties, the military engineer performs in one of the following main capacities: engineer commander, regimental engineer, deputy commander for technical affairs, weapons engineer, engineer of the technical engineering service, unit engineer, engineer operator, engineer programmer, design engineer, test engineer, staff engineer, and others.

Naturally, the nature of military engineering work is greatly determined by the type of engineer and his field of work, his specialization, the position he occupies, and the service of the Armed Forces or the branch of troops to which he belongs. The nature of the work performed by the design engineer, for example, approaches that of a scientist, while the work of an operations engineer is similar to that of a commander. The factors mentioned also have a major effect on the diversification of functions (functional duties) performed by military engineers. The functions of the missile engineer in the Air Defense Forces, for example, differ significantly from those performed by a squadron engineer of the Air Force or an engineer performing research on a weapons system in one or another research organization. None the less, it is possible to isolate several basic, dominant functions, which most fully depict the make-up of all military engineering work.

The fact is that the great variety of functions performed by military engineers have the same objective: to make the weapons and combat equipment more effective and to maintain them in a constant state of operational efficiency and combat readiness.

The task of improving the combat readiness of the army and navy in the age of nuclear weapons and missiles, jet aircraft and radio-electronics is a complex and multifaceted one. It is comprised of many factors and is achieved by means of an entire system of measures carried out by commanders and staffs, political organs, party and Komsomol organizations, by all personnel of the Armed Forces. Since the weapons and combat equipment comprise the material foundation for the combat readiness of any service of the Armed Forces, combat readiness depends greatly on the precise state of this equipment. This circumstance is responsible for the enlarged role of the military engineer, an important element of whose job of maintaining combat readiness is none other than that of constantly seeing to the state of repair, absolute reliability and trouble-free functioning of the combat equipment.

The state of the equipment defines only one aspect of combat readiness, however. The combat readiness of the Armed Forces is to a crucial degree determined by the people who control the equipment, by the personnel directly involved in the combat employment of the equipment, its operation and servicing. The era in which we live dictates the need for all army and navy to be skilled in the use of all types of weapons and equipment and to be able to employ them without delay and with maximum effectiveness. The military engineer, who bears full responsibility for the combat readiness of the equipment, must deal to an equal degree with the problems of training and indoctrinating the personnel in the interest of maintaining combat readiness. This is an important part of his work.

Finally, the collective nature of modern weapons demands skilful organization and efficient control of the work performed by the personnel operating the equipment and employing it for combat purposes, the two functions being required in the interest of improving combat readiness. Scientific organization of the work involved in operating, servicing and providing material support for modern equipment and weapons systems constitutes one of the important functions of military engineering personnel. The main task of military engineers, that of ensuring a high level of combat readiness and operational efficiency on the part of the military equipment and servicing personnel, has thus given rise to such functions as special professional, organizational and control, training and indoctrinational duties, which are shared by all categories of military engineers.

These functions are the most common and basic ones, in the first place, because they reflect most accurately the main objective of the military engineer's work and contribute to its achievement to the greatest degree.

In the second place, they are standard for all types and fields of military engineering work, regardless of the service of the Armed Forces of which the engineer is a member, and regardless of his position or specialization (although they are manifested in a specific form for the various categories of military engineers).

In the third place, these are collective functions. All other functions performed by military engineers are included in them as sub-functions. The manner in which these functions are related and correlated basically defines the structure of every type of work performed by the military engineer.

In the fourth place, the total group of the functions singled out, in combination, reveal most completely the basic essence of the military engineer's work, and the changes occurring in these functions as a result of the scientific and technological revolution and the revolution in military affairs reflect the corresponding changes occurring in the nature of the military engineer's work. A functional approach, which implies an investigation into the basic functions characterizing the military engineer's work, is therefore required for extensive analysis of the make-up and nature of military engineering work.

Since these functions are discussed in detail in subsequent sections of the book, we shall limit ourselves to only a general discussion of them at this point.

The special professional function of the military engineer's work is manifested in the creation, operation and combat employment of military equipment. In order to perform it, the engineer as a technical specialist must possess profound theoretical knowledge, good technical and engineering training and precise practical skills in the operation and servicing of the military equipment. This does not exhaust the group of requirements, however. In modern warfare, which is distinguished by exceptionally dynamic combat operations and the large scale of battles, operations and engagements, the military engineer's operationaland tactical perspective and his ability to understand and implement the commander's concept, utilizing the capabilities of the military equipment, are of great importance. The technical engineering specialist's military training becomes exceptionally important in this situation.

The military engineer's organizational and control function is reflected in his ability to organize precisely and scientifically the operation and servicing of the military equipment by the personnel and the mobilization and organization of his subordinates for the performance of the missions assigned by command.

Previously, matters of organization and control were not so acute for the military engineer, in addition to which he was in charge of fewer men and far fewer specialties. With the comtemporary revolution in military affairs, the military engineer, who efficiently organizes the work of large technical military teams, and the operation and repair of extremely complex equipment, must be able to freely use the skills, techniques and methods involved in supervising people.

Organizational measures to develop rationalization and invention work in the forces occupy a place of prominence in the activities of the modern military engineer. The search for more efficient means of training the troops and operating the military equipment and weapons are of basic importance in the age of automation and remote control, radio-electronics and electronic computers. Good technical erudition on the part of the personnel, their talent, native intellegence and initiative contribute greatly to the successful accomplishment of this task. This is why rationalization and invention work forms an important element of the military engineer's occupation.

The training and indoctrinational function of military engineers is manifested in their ability to work with people, to train them in the use of the complex military equipment and to develop in them a spirit of communist ideals, communist moral principles and standards, and the requirements contained in the military oath and regulations.

The collective nature of modern weapons means that each military specialist determines to one degree or another how reliably every unit and assembly operates, how well it is tuned and adjusted, and how promptly and well the preventive maintenance is performed. This means that the military engineer must take an active part in all types of practical training classes, show true concern for improving the personnel's ratings and pay close attention to the level of technical military information work.

The scientific and technological revolution and the revolution in military affairs have created new and greater demands not only with respect to the training of the personnel but also in the matter of indoctrinating them. The Soviet officer today is not simply an engineer or technician and not just a military specialist in the narrow sense of the word. He is also both a pedagog and an indoctrinator. In order to properly structure the training and indoctrination of his men, an officer must not only have good political and technical military training, but he must also possess a certain knowledge of the science of teaching and of technology. These needs make it necessary to provide extensive pedagogical training for military engineers, and army and navy engineers are provided with such training during their studies at a military VUZ, by the officer training system and by their practical service in the units and sub-units.

The following must be mentioned as we complete our functional analysis of the make-up and nature of the military engineer's work.

In the first place, the basic aspects of military engineering work which we have considered are extremely fluid and dynamic. Each of them acquires greater or lesser specific weight in comparison with the others, depending on the military engineer's field of specialization, the position he occupies and the service of the Armed Forces or the branch of troops in which he serves. The individual functions have specific substance, which differs considerably for the different categories of military engineering personnel. Finally, the substance of these functions is not the same for the different phases in the development of military theory and practice.

In the second place, these functions are closely interrelated; they influence each other significantly and are manifested in dialectical unity. Disregard for any one of them therefore has an immediate, negative effect on the others. In contrast, the successful realization of each specific function increases the probability that the remaining functions will also be effectively performed.

In the third place, the trend toward the convergence of the duties performed by the military engineer and those of the commander is becoming increasingly clearly defined under the effects of the revolution in military affairs. We are speaking of a peculiar synthesis of those features and qualities characteristic of the work performed by both the commander and the engineer within a single individual. While there were formerly certain grounds for distributing duties according to the principle "the commander works with people, while

the engineer works with equipment," the concepts "line commander" and "strictly an engineer" are now becoming archaic. Naturally, working with people is still one of the most important aspects of the commander's work, just as working with equipment continues to be the engineer's primary duty. This in itself is no longer adequate, however. The work performed by the commander with equipment, like the engineer's work dealing with people, is no less important.

This can be fully explained. The forces are extensively provided with technical equipment, and the acomplishment of the task of keeping the units and the sub-units in a state of readiness, which is now the main aspect of the commander's work, therefore depends significantly on the state and performance of that equipment. Victory in a battle will also be greatly determined by the ability "to extract" from the equipment everything it has to offer. The commander's performance of his operational and tactical missions is therefore linked to his ability to make good use of the diverse modern equipment. Furthermore, today's commander must not only know the technical specifications of the combat weapons and the possibilities for using them effectively under various battle conditions, but must also pay constant attention to the battle readiness of the technical equipment and delve into many of the finer points of the servicing, operation and repair work. The technical support aspect of keeping the units and sub-units combat-ready must therefore be considered an important element of the comtemporary commander's range of functional duties.

On the other hand, the military engineer today cannot keep the equipment operating smoothly and in a constant state of combat readiness or organize its operation without working with people, with the personnel servicing and operating that equipment, painstakingly and on a daily basis. In addition, many categories of engineering and technical personnel are directly in charge of military-technical collectives, of which they are the sole commanders. Finally, and this is especially important, the contemporary engineer not only organizes the operation of the equipment and readies it for combat, he also has a direct role in its combat employment. Engineers perform responsible and complex combat tasks in the process of performing combat alert duty in the Strategic Missile Forces, at the command posts of various air defense radar facilities, and so forth. In this case, the engineer's decision is at the same time the commander's decision in the full sense of the word. When he makes a decision as to the state of repair or disrepair of the airborne equipment on an aircraft, for example, the engineer is thereby also making a commander's decision as to whether the aircraft should be permitted to fly, and he bears full responsibility for his decision. The military engineer's range of duties is thus increasingly including elements which were always considered the exclusive prerogative of the commander.

This process is reflected in the daily affairs of the Armed Forces: many engineers now serve as commanders, and there are engineer commanders in the missile units, engineer pilots in the air force, technician commanders and mechanic commanders in the other branches of troops and services of the Armed Forces.

None of this means, of course, that every engineer should become a commander. Nor does it mean that the commander should be replaced by the engineer or that their functions should merge completely. The duties and authority of each are clearly spelled out in regulations, manuals, instructions and orders. We are speaking only of a certain degree of change occurring in the make-up of these functional duties. The changes indicated are also reflected and set forth in the proper military documents and are defined by those documents.

All of this means that the modern commander must possess the proper scientific knowledge permitting him to analyze problems pertaining to the operation of equipment, with technical competence, and that the engineer must have a basic knowledge of tactics, operational art, and so forth, to serve him as reliable guidelines for making proper decisions on the combat employment of the equipment.

Summing up what we have said, we can state that the military engineer now serves as a well-trained theoretician, who resolves complex scientific and technical problems, and as a practical operator, who understands all of the finer points of the equipment and gear and participates directly in the extremely complex technological processes. He embodies the qualities of the skilful organizer, scientifically directing the military team's work of servicing, operating, repairing, preserving and protecting the military equipment and combat weapons, and of an inspired innovator, a champion of everything new and progressive, directing the work of army efficiency experts and inventors and making a personal contribution to this work. Finally, he is a skilled pedagog and instructor, responsible not only for the technical training of all the personnel, but also for the effective combat employment of the weapons and combat equipment entrusted to the fightingmen, and a skilful and sensitive indoctrinator bearing full responsibility for the moral-political and psychological conditioning of those under him. The researcher, the practical engineer, the engineer inventor and efficiency expert, the engineer organizer, the engineer pedagog, the engineer indoctrinator and, finally, the engineer commander--these are only a few of the main facets of the military engineer's work.

In this section we have concentrated mainly on those factors which have influenced the changes occurring in the military engineer's work and the direction taken by those changes, and, consequently, on the make-up and nature of his work. The analysis contained therein was presented for purposes of demonstrating precisely what the engineer has to do, and why. Equally important is the question of precisely how the military engineer can successfully perform his numerous and multifaceted functions, what specific set of tools he has to work with, what methods and forms of professional, organizational, practical, training and indoctrinational work he should employ, what specific knowledge he should possess and what qualities he must develop in himself in order to achieve this.

3. The Military Engineer as a Technical Specialist

The military engineer's individual qualities are manifested to the greatest degree in his activities as a technical specialist. It is precisely this area of work which makes it possible to separate the engineer from the general group of servicemen, to reveal the military engineer's personality as

a subject of study. The technical engineering work performed by specialists in this category affects the work of sub-units and units of the Soviet Armed Forces in a specific manner.

The individual's main personal qualities can be revealed by isolating in the military engineer's work those operations which he performs as a technical specialist, and by analyzing the requirements made of him by this area of his work.

The main quality characterizing the military engineer as a technical specialist is his scientific erudition and the scope of his technical perspective. This quality is so important primarily because the work performed by the military engineer in the operation of complex modern equipment can in no way be reduced to a matter of carrying out ready instructions alone. The engineer operator has to rapidly resolve non-standard creative problems pertaining to the specific operating conditions of a facility consisting of many different devices. Missile facilities, for example, may include complex mechanical elements, pneumatic and hydraulic systems, electro-mechanical and electronic control systems, as well as radio, heat and chemical systems and devices. In order to provide optimal conditions for all of these complex devices, the soldier operating the complex equipment must have a high level of technical sophistication, and the engineer operator must demonstrate a high level of creative energy in his work.

Special studies performed in the United States for purposes of revealing the causes of low reliability on the part of various weapons have clearly demonstrated that an awareness by military operators of the technical and creative importance of their work constitutes an extremely important condition for improving the reliability of weapons and combat equipment. It would not be an overstatement to say that the trouble-free operation of the equipment is a service no less important than its development. This means that the engineer must have a detailed knowledge of the equipment and be able to apply scientific recommendations in practice.

The servicing and operation of modern military equipment, which incorporates the latest achievements of modern scientific and technical thought, require highly skilled specialists with a broad and thorough theoretical background and a thorough knowledge of special disciplines, a good mastery of design concepts, a familiarity with the basic principles of the technology employed in the manufacture of the equipment being operated and of the control and measuring instruments, and practical skill in working on the equipment.

Given the increasing complexity of military equipment and of the operating methods, there is increasing responsibility for the engineer's decisions, thorough and complete reasoning for which is provided by a detailed analysis of the specific situation and by the performance and study of a large number of mathematical computations making it possible to provide quantitative substantiation and to adopt the most optimal decision. This is impossible without a knowledge of and without skilful employment of such quantitative analytical methods as mathematical statistics, the theory of mass servicing, investigative theory, mathematical planning, mathematical modeling, and game theory.

Mathematical methods now penetrate deeply into military engineering practices and are becoming an integral part of the engineer's work. Mathematical statistics, for exmaple, permit the engineer not only to process information on equipment failures scientifically, but also to predict the possibility of their occurance. A knowledge of mass servicing theory permits the engineer to outline optimal plans for servicing the equipment, taking into account the capabilities of personnel under his command, and to properly determine the most important areas of the work.

The scientific and technological revolution has made it necessary for the engineer to deal with an enormous and constantly increasing flow of technical military information. The speed and accuracy of the technical decisions adopted depend greatly on the promptness and quality of the information processing. The extensive use of electronic computers is becoming highly important as a result. Electronic computers, however, are only a technical means of reinforcing the engineer's capabilities and improving the efficiency of his work. They are not capable of replacing the engineer's creative thinking, initiative or will. He alone, using all of the diverse information, including that which does not lend itself to machine processing, makes the engineering decision, assigns the tasks to the men under him, organizes and monitors their performance.

A thorough understanding of the peculiarities of the equipment being operated and the design of and the technology for servicing an element of a given type of equipment or weapon, and an understanding of the nature of the physical processes occurring in the machines and mechanisms and the principles of their interaction and functioning are of extremely great importance in the engineer's practical work. Engles wrote the following: "No aware soldier should be ignorant of the principles involved in the designing of his weapon or of how it should perform."[15] This is all the more essential for today's military engineer, since such knowledge, combined with practical skill, permits the engineer to work expertly on the equipment entrusted to him, to handle it freely, to perform its technical servicing well and in good time, to constantly maintain optimal operating conditions for the equipment, to skilfully eliminate this or that malfunction and to take timely steps to avert their occurrence. The engineer who lacks practical skills in working on the equipment is not capable of efficiently directing and monitoring the work of those under him, of providing them with prompt assistance or of filling in for this or that specialist in his service, should the need arise. It is one thing to know all of the mechanisms, units, assemblies and parts making up a certain technical system, and another--to be able to operate it with technical competence, to inspect it well at, the right time and using the proper methods, to check its performance, tune, adjust and repair it.

Practical skill requires knowledge but does not automatically result from it. As a rule, therefore, even military engineers with a good theoretical and technical background do not achieve good results in their work if they do not attempt to understand all of the finer points and peculiarities involved

in operating the equipment entrusted to them and do not attempt to acquire practical skills in servicing it. In order to achieve success, it is absolutely essential skilfully to combine theoretical knowledge with practical experience.

In order for the military engineer to combine theory and practice in his work, he must be able to perform well the entire range of jobs done by those under his command, to check and adjust any assembly in the equipment entrusted to him, to detect and eliminate a malfunction even when it is not within the range of his functional duties.

It is when he is actually working with the equipment that the engineer checks the validity and effectiveness of his theoretical knowledge, obtains and reinforces his practical skills, acquires confidence in himself and develops as an engineer. There is no other way for him to acquire those invaluable qualities out of which engineering intuition and professional perceptivity gradually develop and grow, and they are what help the specialist to determine the state of the equipment, to point out a malfunctioning part and determine the cause from barely discernable signs, from barely noticeable deviations in the parameters, sometimes at a single glance and sometimes by the sound.

We could give many examples of such professional skill. The following is just one of them. During an exercise, the repair battalion commanded by Engineer-Lt. Col. A. M. Yeromakhov was assigned the mission of entering the area of "combat" operations and repairing tanks which had been put out of action. One of the tanks was being repaired by a group of specialists headed by Sergeant N. Anisimov. The vehicle began operating again within the alloted time, and the commander was ready to turn it over to the driver-mechanic. Lieutenant Colonel A. M. Yeromakhov is an experienced specialist, however. He determined that something was wrong from the rumble of the moving vehicle. When, at his insistance, all of the final drive assemblies were checked, it was discovered that mistakes had been made when the pinions and bearings had been replaced. This had resulted in barely perceptible, extraneous noises, which had alerted the engineering officer.

Or take the following case. Upon examining the causes of a drop in voltage in the radar jammer, Engineer-Captain V. I. Shishov suggested that the valve diodes in the power supply unit were bad.

"I checked the diodes, and they are all good," Lieutenant Goroshkov objected.

"No, that is where the problem lies," the engineer-captain repeated. Two diodes were immediately replaced.

"You see, I told you..." Gorshkov could not refrain from saying, when he saw that the replacement of the two diodes had not produced the desired results.

"Bring me some more diodes. These have probable been at the warehouse too long," Shishov directed, and bent over the circuit again. When other diodes were delivered and inserted without eliminating the problem, the technician fell into a triumphant silence, waiting for the engineer to "capitulate."

"We shall just have to replace them again. Do we have more diodes"? This time, to the technician's great surprise, the voltage returned to normal.

This is what it means to be confident of ones knowledge and experience. This is what it means to be a real engineer. We can only add that it was natural for the officer in this case to have confidence: Engineer-Captain Vladimir Ivanovich Shishov is one of the best specialists in missile unit "X" of the National Air Defense Forces. During his period of service in the unit, he has received 20 rationalization proposal certificates. There has never been a time when Engineer-Captain Shishov has left his work station without completing the job or has refused to help a colleague. He generously shares his extensive know-how with the young officers and his subordinates, and serves as secretary of the party organization.

Not so long ago, when the technical equipment was not overly complex and was relatively standardized, the technical work performed by an engineer in a military unit consisted in periodically checking the technical state of the equipment used and the quality of the technical servicing. Malfunctions in such equipment could be identified and therefore, eliminated, by the battle crew, using the exhaustive instructions contained in operating documents. In the case of complicated malfunctions not covered in the instructions, the technical equipment was sent to repair agencies and replaced with items in working order from reserve stocks.

The situation is different when complex equipment is being used. It is expensive and impractical to keep in the unit a complete set of parts for replacing those which break down. The great range of possible malfunctions of such equipment, which consists of hundreds of thousands of elements, makes it a problem to compile documents which list all of the possible equipment failures and their indications. In many cases, the time required to remove malfunctioning equipment and replace it with equipment in good working order may considerably exceed the time required by a skilled specialist to search for and pinpoint malfunctions. At the same time, the interdependence and complex nature of this equipment reduces the unit's fighting capability when individual units of equipment break down: it is impossible to use even the good equipment without the malfunctioning units.

In this situation, breakdowns of the technical equipment must be prevented by skilful prognostication, and when they do occur, the defect must be detected rapidly and the malfunctioning device's efficiency restored by adjusting or repairing it. The detection of malfunctions requires competent technical diagnosis, a thorough understanding of the design arrangement of the technical equipment and a clear understanding of the physical processes involved in its operation. The engineer's search for defects can be compared with emergency treatment performed by a medic--there is no time for referring to manuals, the responsibility is great, and people expect skilled and effective decisions and action of the individual.

Experience has shown that it takes considerably more time to find a defect than to eliminate it. The possibility of reducing the time spent pinpointing a malfunction depends mainly on the engineer's erudition and skill, on his

capable application of the rules governing technical diagnosis. The engineer's skill is manifested in his ability to make a decision on the basis of a few indirect symptoms, without dismantling the equipment for a direct inspection or for testing.

Breakdowns of the complex equipment cannot be prevented by performing the regularly scheduled technical maintenance alone. The technical condition of the equipment being operated can only be actively controlled by carefully analyzing irregularities, determining the connection between the regular occurrance of malfunctions and the general pattern of irregularities, and performing additional technical servicing measures in connection with the occurrance of irregularities and changes in the technical performance of the equipment. We are essentially talking about the controlled operation of equipment. The object of control in this case is the technical condition of the equipment being operated. The irrelugarities dealt with are various changes occurring in the operating conditions: environmental conditions, rate of consumption of service life, transportation conditions and distances, and other similar factors. Various types of technical servicing serve as the controlling actions.

Systematic, quantative analysis of both the irregularities and the object's reactions to them is required in order to creat the conditions for controlled operation. Only this type of identification can provide a solid basis for working out and implementing control actions.

As a rule, the connections between the processes are not obvious. They are revealed by determining how the processes influence each other. This is accomplished by comparing and summarizing a large number of observations and measurements. Only the individual with a combination of the qualities of a practical specialist and a thorough investigator can make efficient use of such a volume of information and determine how the processes influence each other, without "drowning in the sea of information."

This information can, of course, also be generalized adequately outside the military unit--at the control center for the operation of a given type of equipment, but some irregularities demand that the operator engineer take immediate steps to confine their effects (technical confinement servicing), to prevent damaging effects from adverse actions which have already taken place (compensating technical servicing) and to eliminate defects (restorative technical servicing).

The situation which we have discussed graphically demonstrates how items of weaponry have changed qualitatively under contemporary conditions. They can no longer be regarded as simple technical devices. The technical condition of a weapon is inseparably linked with the work of the specialist servicing the item. This circumstance forces us to take a new approach to the study of an object and the ensurance of its functioning, regarding it as a "man-machine" system or an anthropo-technical system.

A change in the state of a complex system's operation can no longer be described by means of determinants. The reciprocal influence of the processes can only be revealed statistically by the combined processing of a large volume of data on a variation in the state of one or more objects over a long period of actual operation. This task can only be performed by using electronic digital computers and special, mathematical statistics methods, and regression, correlation and factors analysis methods.

Most specialists now have access to these means, due to the broad availability of electronic computers.

Electronic computers are extensively used in various stages of the engineer's work. They increase the engineer's capability with respect to the performance of logic, scientific and technical, engineering and organizational tasks, and are used to speed up the performance of various engineering and technical computations and as elements of automatic control systems.

By using modern computers, the military engineer can see the nature of various effects, which permits him to deliberately influence the processes involved in the operation of weapons and military equipment. Furthermore, a detailed understanding of the weapons systems and the processes occurring within their elements, and systematic observation of these processes permit the skilled specialist to detect changes occurring in the condition of the elements and to adjust them, deliberately and, sometimes, intuitively. Like the artist who is capable of distinguishing up to 20 gradations of a single color or a textile worker who can distinguish up to 40 shades of black, the skilled engineer operator develops an especially sensitive perception with respect to the condition of the unit operated.

All of these circumstances account for the fact that the dependability of weapons and military equipment is directly dependent on the skill of the personnel servicing it (see table).

Table. Reliability Index for Radio Equipment of Varying Degrees of Complexity Operated by Specialists with Different Skill Levels[16]

Specialist training level	Average time (hours) of trouble-free operation of radio equipment consisting of n elements		
	n_1=200,000	n_2=90,000	n_3=260
Alternating personnel who have completed brief training courses	0.74	1.7	960
Technicians	10	22	8,000
Engineers	70	155	56,000

It is clear from the table that the work performed by the engineer in the forces and his skill level are of state importance, since raising the reliability of weapons systems frees capacities at the enterprises producing those systems and spare parts for them, and these capacities can be used for other production purposes. The table also shows that the index of reliability is an extremely important operational factor. It determines the combat capability of the weapons systems and their elements and is a function not only of the quality of the technical equipment but also of the skill of the personnel servicing the equipment. This point is another graphic confirmation of the fact that modern equipment and the personnel servicing it must be regarded as a single "man-machine" system, the properties of which are determined by both components.

American experts believe that human error reduces the dependability of missile systems by 20-40 percent, and in some cases improper human actions are the cause of more than half of the mission failures.[17]

A high level of personal discipline and strict observance of technical and technological discipline on the part of the military engineer have an organizing effect on the personnel and are one of the chief factors responsible for maintaining a high level of battle readiness and fighting capability on the part of the troops. This is due to the fact that modern weapons and military equipment can only be in a battle-ready state and perform their functions at the required level, when the periodic technical servicing is performed well and at the proper time. The military engineer determines to a great degree whether the procedure for performing this work and for operating the equipment becomes a steadfast law for each technical sub-unit, for each specialist.

Specific aspects of military discipline, technical and technological discipline are reflected in this work of the military engineer. The former demands the substantiated resolution of problems, based only on current technical standards and methods set forth in orders and directives, while the latter requires careful adherence to the established technology for performing all of the jobs. The observance of strict technical and technological discipline ensures the precise execution of instructions contained in guiding and operating documents on maintaining prescribed operating conditions for the weapons and military equipment, periodic inspection and monitoring of their technical condition, timely and quality performance of periodic maintenance work and strict adherence to the procedure and the methods for performing it, including proper preparation of the combat equipment for use.

Careful monitoring of the performance of all operations required by the operating instructions is a manifestation of technological discipline. This is especially important, because these instructions are the result of a summarization of many years of experience in operating the combat equipment. Failure to perform the operations required by the operating instructions or violation of the set rules is a violation of the technology for operating weapons systems and can entail serious consequences.

Naturally, the instructions should not be regarded as dogma. Under the supervision of commanders, political workers and military engineers, the personnel constantly improve the standards set for the operation and combat employment of military equipment. And this is a natural trend in the development of the technical military might of the Soviet Armed Forces. It is furthered by the active rationalization work carried out in the forces. Technical and technological discipline must also be exercised in rationalization work, however. In this case, it requires that rationalization proposals which have been worked out not be adopted until the various effects of the proposed changes have been analyzed and they have been approved by the agency overseeing the operation of the given type of equipment.

The military engineer's professional technical activities are thus diverse and multifaceted. They require good performance and investigative qualities, initiative and a creative approach to the selection and performance of tasks, combined with thorough evaluation of proposals and strict technical and technological discipline, personal technical knowledge and skills, and the ability to utilize the information contained in operating instructions and to expand one's knowledge in a process of systematic self-education. The more highly developed these qualities are in the military engineer, the more successful is his professional work and the greater his influence on the process of operating the weapons and military equipment, which provides the technical support for accomplishing the combat missions assigned the military unit and the Armed Forces as a whole.

The importance and the guiding nature of the military engineer's technical work are also reflected in the fact that the role of the engineer, who ensures the mastery, effective use and trouble-free employment of the weapons systems, is highly valued by the CPSU Central Committee and the Soviet Government. A large number of military engineers have been awarded orders and medals for their successes in the testing and incorporation of the latest types of weapons and military equipment. The contribution made by military engineers to military science and to the development of military equipment has brought many of them Lenin and State prizes and the honorary title "Distinguished Scientist and Technician." The university degree of doctor or candidate of technical or chemical sciences had been conferred upon a large number of engineers.

4. The Operational-Tactical Training of Military Engineering Personnal

We have already said that two aspects of the military engineer's work, the strictly military, commander's work, and the engineering and technical side are increasingly merging in organic unity in his activities. It is already difficult to distinguish them on a practical level. This situation makes it necessary to provide military engineers with both technical and operational-tactical training.

A number of circumstances have brought about the enlargement of the role of operational-tactical training for military engineering personnel. In the first place, operational-tactical training makes the engineer of the Soviet

Armed Forces a military specialist. In the second place, it closely links all of the forms of his work with the missions performed by the forces to maintain combat readiness and to prepare for and conduct combat operations. In the third place, operational-tactical training develops, improves and expands the military engineer's perspective as a commander (his operational-tactical scope) and his officer qualities, and makes it possible for the engineer and the commander to perform each other's duties. Good operational-tactical training is especially essential for such groups of military engineering personnel as engineer commanders, deputy commanders for technical affairs, and so forth.

What do we mean by the operational-tactical training of the military engineer?

A military engineer's operational-tactical training is the system of military knowledge, abilities and skills necessary for him to successfully perform the functional duties required at engineering, command and staff posts for directing units and sub-units during preparations for and the performance of combat tasks in various situations and for maintaining the weapons and military equipment in a constant state of readiness for effective employment. It embraces the study of a broad range of matters pertaining to military affairs as a whole and to military art specifically.

An analysis of the work performed by a military engineer in the forces shows that his operational-tactical training includes, first and foremost, a knowledge of the basic principles of Soviet military science and military doctrine and of the role and missions of the various services of the Armed Forces and branches of troops and of this or that weapon system in a possible war of the future. An extremely important area of military knowledge for engineering personnel of the Soviet Armed Forces is their knowledge of the combat characteristics and capabilities of the weapons and combat equipment possessed by units (chasti, soyedineniya) of their service of the Armed Forces (or branch of troops), the procedure for readying them for combat employment and methods for using them effectively in combat.

The military engineer is required to have a thorough knowledge of the organization of the battle order of units in the various types of battles, of the methods and forms of combat operations performed by the troops in various situations in accordance with the requirements set forth in combat regulations and manuals, of matters pertaining to the control of units and sub-units in all phases of their work, and of the nature of measures providing all-around support for the combat operations of units and sub-units, and ways of accomplishing them.

The peculiarities of warfare in a situation involving the use of nuclear weapons make it necessary to know the procedure for taking steps to protect personnel against weapons of mass destruction and to protect radio communication equipment against jamming.

The military engineer is familiar with the techniques and the organizational forms of training for teaching the personnel to perform skilfully and with coordination in the acomplishment of combat missions. A good knowledge of the armed forces of likely enemies, the military-political nature and the substance of their military doctrine, the methods and means by which the enemy conducts and counteracts radio reconnaissance, and so forth, are of considerable importance in his work.

All knowledge naturally becomes valuable if it is skilfully applied on a practical level. There is a fairly broad range of jobs, in the performance of which the military engineer has need of military knowledge. This includes the practical implementation of the requirements set forth in field manuals and regulations during preparations for and the conduct of combat operations by units and sub-units, and the development of practical control documents and their use when preparing for and performing combat missions; appraisal of the radiation and chemical situation, and the development of proposals for deciding what action the personnel should take when there is contamination with radioactive or toxic substances; the adoption of a decision to restore the fighting capacity of units and sub-units following a nuclear strike by the enemy; the development of recommendations for the commander with respect to resolving problems arising during the course of combat operations; the development and performance of measures to increase the sub-units' ability to survive and to prepare the personnel for the performance of combat missions in any situation; control of subordinate sub-units; the planning and conduct of combat and political training classes in the units and sub-units, and others.

Military engineering personnel receive operational-tactical training both while studying in military educational institutions and during their practical work in the forces. The knowledge, abilities and skills acquired by the military engineer as a result of this training form the foundation which permits him to perform his vast and complex duties well at practically any post in the forces.

Naturally, the depth of the operational-tactical knowledge required by the military engineer depends greatly on his functional duties. Along with a knowledge of general military affairs, for example, it is important for the engineer filling the position of staff and armament service officer to have a detailed knowledge of the principles involved in organizing and planning combat operations and to know how to organize preparations for them and to conduct them under various conditions.

The ability to direct the work of subordinates is one of the Soviet military engineer's important and essential qualities, regardless of his post in the forces. Since all of the work performed by the commander and the engineer in the forces involves administrative work, we shall discuss this area of the military engineer's operational-tactical training in greater detail.

Scientific supervision of the troops requires the most accurate possible accounting of all of the conditions and circumstances under which the units and sub-units perform the assigned combat mission. "The commander's art is manifested in his ability to select from the variety of means at his disposal those which will produce the best results in a given situation and at a given time."[18]

The complexity of the weapons and equipment with which the troops are outfitted considerably heightens the demands made of all control agencies and officials. They must determine the combat missions for the troops promptly and accurately, in accordance with the troops' capabilities and the combat characteristics of the weapons, thoroughly plan impending combat operations, and direct them continuously and efficiently. The men must thoroughly grasp the assigned combat missions, have a clear picture of the methods to be used for conducting combat operations and demonstrate prudent initiative and persistence to ensure absolute and timely execution of the combat mission.

None of this can be achieved without a thorough understanding of the tactics of combat operations and the combat employment of various types of weapons and of the different aspects of troop control, and without a knowledge of the field regulations and instructions and their fulfillment by all military engineers. A solid understanding of regulations and the ability to apply them in the practical troop control work gives the military engineer the necessary courage, determination and persistence for the performance of any mission.

The highly dynamic nature of combat operations today and the frequent and abrupt alteration of situations resulting from the use of nuclear weapons require that the engineer, the same as the commander, be able to rapidly consider the changes, to efficiently summarize and thoroughly evaluate information on the situation, to make tactically competent decisions based on that information, to inform the troops of those decisions without delay, and to organize and monitor their execution. All of this is achieved by skilful control and well-conceived distribution of functions among the subunits and the personnel.

The following groups of issues, at least, must be decided by the military engineer in charge of a sub-unit when organizing preparations for the performance of a specific mission and for its execution.

In the first place, he must determine the level, degree and extent of his own participation in the performance of a given mission. When several missions are being performed simultaneously, the military engineer determines how much time he should spend on each of them, and, to some degree, he details the different aspects of his work.

In the second place, he determines the volume and nature of the information required.

In the third place, he uses the information obtained to determine those critical moments and points which require his personal intervention and decisions.

In the forth place, he must have a clear concept of the connection between the missions performed by his sub-unit (or unit) and the missions to be carried out at higher echelons, as well as those being performed by interacting units and sub-units.

Reality has demonstrated that the thorough preparation of military engineers for the performance of precisely these tasks of the commander is a substantial factor in the combat efficiency of units and sub-units.

The following is one example of this. An exercise was in full swing, when the "enemy" delivered a nuclear strike against one of the units, destroying the command post and some of the personnel, weapons and combat equipment. This created an exceptionally difficult situation. The deputy unit commander, an engineer by training, who was located in one of the sub-units at that time, assumed command. He assembled all of the other officers, sergeants and soldiers who were still able to fight, arranged for the wounded to receive aid, and took steps to reestablish communications with higher headquarters through an adjacent unit.

An appraisal of the radiation and chemical situation showed high levels of radiation. Possessing a knowledge of the technical specifications of the weapons used by the "enemy" and its tactics, the officer used a map to determine an area to which the personnel could be removed, arranged for engineer and radiation reconnaissance of the routes of movement and the terrain in the area selected, evacuated the wounded and removed the personnel to a safe area, conducted partial decontamination of the equipment and decontamination of the personnel, registered radiation doses received by the personnel, and created a group to restore the unit's fighting efficiency.

After radiation levels had dropped in the area occupied, the officer took steps to eliminate the effects of the nuclear strike. He formed a composite sub-unit of the remaining personnel.

The officer-engineer knew the missions assigned the sub-unit, and he decided to continue their execution, using the restored combat equipment.

Despite the fact that they were exhausted from many days of working under stress, the personnel in the sub-unit formed performed smoothly in the exercise and coped successfully with the assigned mission.

In the critique of the exercise, the director of the exercise noted the deputy unit commander's good tactical training and expressed gratitude to him and to all of the personnel.

Good tactical-operational training greatly helps the military engineer to develop such qualities as courage, will-power, determination and initiative,and

forms the basis for his operational-tactical thinking. The development and self-inculcation of these qualities requires that the military engineer have a knowledge of the principles and the basic tenets of military art and of forms and methods of conducting combat operations in various situations. The better informed the military engineer is on these matters, the more correctly and thoroughly will he be able to understand the nature of the assigned mission and to foresee the possible course of events and changes occurring in the situation, and therefore, the more focused and productive will be his operational-tactical deliberation.

As we have already stated, the future military engineers receive operational-tactical training in the process of their study of the operational-tactical disciplines at VUZ's. The programs for these disciplines call for theoretical and practical training for the students and cadets in the fundamentals of the preparation for and the conduct of combat operations today, of the combat employment of the various services of the Armed Forces, branches of troops and weapons, and of the study of the history of wars and military art, military administration and other areas of Soviet military science.

The officer-engineer's training in the troops has a practical focus. In order not to fall behind, in order to keep up with the development of science and technology, individual improvement of one's training in military science and military art is highly important, along with the planned officer training.

Determination of the optimal model of the military engineer as both a military and a technical specialist is becoming highly important at the present time. This problem can be resolved not by contrasting the two separate aspects of the military engineer, but by combining them in order for each of them to supplement and enrich the other. It is very important that both aspects of the engineer's work receive adequate attention in the training process.

The military engineer's operational-tactical training, like his technical training, is inconceivable without maintaining strict regulation order and the high level of demandingness expected of a commander in all types of training and in the process of all the service activities of engineering and technical personnel. A thorough knowledge of the regulations governing the Armed Forces, a high level of drill training, physical conditioning and training in methods are essential to the military engineer, as they are to the combined-arms commander--such is the dictate of the era.

5. The Military Engineer as the Organizer and Indoctrinator of the Men Under Him

Defining the qualities of a modern supervisor, the 25th CPSU congress stressed the following: "The modern supervisor must organically combine party-mindedness with thorough competence, discipline with initiative and a creative approach to the job. At the same time, the supervisor in any area is also required to consider socio-political and indoctrinational factors, to be sensitive to the men, to their needs and requests, and to serve as an example in his work and daily life."19 These requirements fully apply to Soviet military engineering personnel.

Every military engineer, whether it be the director of a military team or some other specialist, serves on a practical level as an organizer, an indoctrinator, a technical specialist and an administrator. One or another facet of military engineering work unquestionably predominates in each situation. The organizational and indoctrinational work of military engineers is organically merged in each case, however.

We can differentiate three levels of organizational work performed by military engineers[20] This designation of levels is arbitrary, since it is very difficult to define the work of military engineers in the different specialties within strict boundaries, but it permits us to indicate the main groups of military engineers and to indicate the degree to which they participate in organizational work.

The first and highest level is the organizational work performed by the military engineer serving in the position of engineer commander or his deputy. He organizes the work of individual people and the collectives, the work process and all combat activities, and also handles the scientific organization of his own work.

The second level of organizational work performed by the military engineer involves arranging the process of the men's work and the scientific organization of his own work. On this level, he directs the men and the collectives only indirectly. As a rule, this is performed by the chiefs of the various engineering and technical services and engineers specializing in the various areas, who are responsible for the complex and important areas of combat readiness of the units and sub-units, for the training of technicians and specialists, for monitoring the work of the men and the operation of the combat equipment and weapons, and for the care, repair and periodic servicing of equipment and weapons.

The third level of organizational work performed by the military engineer involves the scientific organization of his own work and the work performed at a specific action station or unit, or on a specific combat vehicle. At this level, the military engineer is mainly concerned with performing his personal combat task, improving his professional skill, improving the techniques and method employed in the work, caring for the combat vehicles and mechanisms and maintaining them in a constant state of combat readiness.

The requirements of the Leninist style of work as spelled out by Comrade L. I. Brezhnev in the Accountability Report of the CPSU Central Committee to the 25th Party Congress fully apply to all levels of the military engineer's organizational work which we have discussed. It states the following: "... the Leninist style is a creative style, a style to which subjectivism is alien and which is imbued with a scientific approach to all of the social processes. It requires a highly demanding attitude toward oneself and toward others; it precludes willfulness and resists bureaucracy and formalism."[21] The Leninist manner of working means taking a critical approach to all areas of one's work, combining trust in the personnel with a highly demanding attitude, with thorough control and verification of the implementation of party directives and of the decisions made. The main element of the Leninist style

of work on the part of military personnel is that of attaching prime importance to state interests and performing the tasks involved in defending the socialist homeland on the very highest level.

The general party line, which calls for quality and effectiveness in the work, requires strict fulfillment of the requirement for a high level of combat readiness on the part of the troops and for a level of combat and political training, order, organization, political attitudes and morale ensuring that the Armed Forces, which are outfitted with the very best equipment available, are in a position to come to the immediate defense of the homeland, if necessary. The army and navy's all-around preparedness to perform their historic mission is a specific reflection of the quality and efficiency of the work performed by our cadres.

The quality and effectiveness of the organizational work performed by military engineering personnel are manifested, in the first place, in the successful performance of the duties with which they are charged by military regulations, orders and instructions; in the second place, in their utilization of every possibility for providing the personnel with good training in the area of weapons and combat equipment; in the third place, in the organization of exemplary servicing of the combat equipment and in the quality performance of the periodic servicing and repair work; in the fourth place, in the application of all possible factors for successfully employing the military equipment in the conduct of combat operations; and in the fifth place, in the performance of indoctrinational work with the personnel, together with commanders, political workers, party and Komsomol organizations. The monitoring and verification of performance is an extremely important part of the organizational work performed by military engineers. They provide essential coordination in the work of the military collectives and develop a feeling of responisbility and seriousness on the part of subordinates.

It is one of the military engineer's direct service duties to train the personnel, to provide the fightingmen with thorough knowledge and solid skills and with a high level of technical sophistication. It should be noted that the revolution in military affairs has made a significant mark on this aspect of engineering work: the training of the personnel is performed differently, since the quantity and complexity of the combat equipment have grown, the number of technical specialties has increased, and the service terms of the soldiers and sergeants have been reduced. Since some skill is lost when one does not work with the equipment for even a trivial period of time, regular training and periodic retraining is necessary in order to maintain one's professional skills at the proper level.

The training and indoc[illegible]ination of the men are performed by military engineers while the sub-units are being maintained in a constant state of combat readiness, and this requires a common effort and coordinated action on the part of both the officer and the men under him.

The collective nature of modern weapons and military equipment has significantly raised the role and the responsibility of every serviceman, both with respect to the preparation of combat equipment for employment and to the actual performance of the sub-unit's combat mission. The importance of

technical and technological discipline has increased considerably. The trouble-free operation of the equipment and the effectiveness of its combat employment therefore depend greatly on the personnel's knowledge of the technology involved in servicing it and of modern methods of monitoring its condition. And it is the engineer's task to indoctrinate each specialist in a spirit of strict and absolute fulfillment of all norms, rules and requirements set forth in the manuals and instructions governing operation of the equipment.

The scientific and technological revolution has been accompanied by the creation of improved types of equipment with a high level of dependability and durability. Space technology, in particular, represents the forward edge of modern scientific and technical progress. At the completion of a space flight, German Titov expressed his faith in the reliability of his space ship in the following manner: "I hardly worried at all. Don't think that I am an emotionless individual or that I have a will of iron, that I surpressed my emotions. This is not the explanation. I had a great deal of faith. I had studied the ship in subtle detail. I became one with it, as though with a trustworthy friend. I had perhaps greater confidence in the ship than in myself. I had gone through the entire flight on the ground and knew what I would be doing at any given moment. The program was a complicated and difficult one, but it did not frighten me. I was confident that I would complete it."[22]

The personnel have the same sort of confidence in the military equipment made by the precious hands of Soviet workers, engineers and technicians.

The experienced engineer is able to maintain and develop in the personnel a feeling of great respect for the military equipment, to reveal to the officers, sergeants and soldiers the grandeur of the scientific and technical feat performed by the creators of this equipment. As a rule, a true mastery of the equipment and confidence in it have a positive effect on the psychological state of the fightingmen.

In describing the state of the crew on the atomic-powered submarine "Leninskiy Komsomol" during an important assignment, its commander, Captain 2d Rank L. M. Zhil'tsov, laid special stress on the fact that all of the personnel were imbued with "the most profound confidence in the equipment created by Soviet designers and workers, with infinite faith in the knowledge and experience of their superiors, and with a feeling of great responsibility...."[23]

The high level of perfection of Soviet military equipment only creates the possibility of successfully employing it in a war against an agressor. The personnel must possess thorough knowledge and solid skills, however, in order for this possibility to be realized, and these are developed through extensive work by the officers, including, first and foremost, the military engineers, focusing on the constant indoctrination of the soldiers, sergeants and warrant officers (praporshchiki), and on training them in the use and care of the complex military equipment.

The work performed by the military engineer to indoctrinate the personnel does not differ basically from the indoctrinational work performed by other categories of officers, but it does have certain peculiarities.

In the first place, the revolution in military affairs has resulted in a considerable increase in the role of moral-political and psychological conditioning of the troops, especially for the fightingmen of those services of the Armed Forces who perform combat alert duty. That is, those with combat missions even in time of peace. Accordingly, the indoctrinational work performed by the officers, the majority of which are engineers, has also assumed greater importance in those forces.

In the second place, the military engineer, more than any other specialist, must deal with the personnel of technical units and sub-units. The work performed by most of these personnel is individualized to a certain degree (they serve as operators, programmers, drivers, and so forth). There is a certain degree of isolation of the personnel in their work. and there has therefore been an increase in the proportion of individual work performed by military engineers and it has become highly important to develop an awareness of collectivism, troop comradeship and a high level of military, technical and technological discipline in the personnel.

In the third place, in the process of servicing the military equipment, the military engineer frequently has to be not only the organizer but also the actual performer of this or that operation. This places him into a specific interrelationship with the personnel servicing the military equipment. The range of his direct contacts with the men under him is expanding, and in a certain sense, the substantive side of the work performed by engineering and technical specialists is becoming similar to that performed by other servicemen.

The military engineer's technical competence and industriousness, his capacity for creative investigation and his performance have an enormous indoctrinational effect on the personnel. In other words, indoctrination by personal example is becoming exceptionally important in the practical work of military engineering personnel. No less important is their ability to establish uninhibited relationships with the men, a situation creating the necessary degree of trust and good will in the collectives. All of this is ruined, however, if the good relationships develop into familiarity and if, instead of being highly demanding of his subordinates, the military engineer overlooks all of their shortcomings.

In the fourth place, some military engineers are not in charge of personnel. This amplifies the importance of self-indoctrination for the officer-engineers and also increases the responsibility of commanders and political organs for involving this category of specialists in political-indoctrinational work in the sub-units. Experience has shown that engineer operators, programmers, designers and other categories of military engineers, who are not in charge of personnel, take an active part in the activities of lecture groups and theoretical seminars, in preparations for and the conduct of military-scientific conferences and in the organization of rationalization and invention work, which performs an important indoctrinational function.

All categories of engineering and technical personnel thus have a part in the indoctrination of the fightingmen and are responsible for it, and they must therefore possess a good knowledge of the methodological aspects of the theory and practice of communist indoctrination.

In psychological-pedagogical literature, skill in working with people is broken down primarily into three areas: pedagogical skill--the knowledge, abilities, skills and personal qualities necessary to accomplish the tasks involved in the training, indoctrination and psychological conditioning of the fightingmen; skill in supervising the personnel in organizational work (the art of supervision); the art of party-political work, particularly skill as a propagandist.

Considering the high level of specialization of man's work in the contemporary situation, it would be unrealistic to assume that man can assimilate various types of professional skills simultaneously, within a practically acceptable period of time. Experience has shown, however, that many technical specialists, relying on their knowledge as engineers and on their broad cultural perspective, simultaneously achieve good results in the training and indoctrination of the men, in organizational work and in other areas directly pertaining to their technical work. Consequently, with proper motivation, the engineer is able, through self-indoctrination and self-education and active, imaginative participation in public work, to develop those aspects of professional skill which are essential for working with personnel. As a result, he can effectively impart his own know-how to others, influence them and motivate them in their work.

The main facet of the work performed by an officer--a commander, political worker or military engineer, of course, is that of dealing with people. The three above-mentioned areas of the work are linked together inseparably in it. The general motives underlying the work of all categories of officers are also the same. Alongside these, however, there is a group of more limited motives characteristic of the specific military occupation.

The military engineer can develop a positive attitude toward working with people on the basis of a generally concientious attitude toward his service work as a whole, concern for all the areas and facilities for which he is responsible and a desire to make his section of the work the best and most progressive both with respect to the methods used and the results achieved.

If the engineer has such a desire, this will inevitably cause him to consider it necessary to raise the level of activity of the personnel in general and to work more vigorously himself to acomplish this.

Such factors as the engineer's awareness of his responsibility for the success of the collective as a whole, his realization of his own contribution to the indoctrinational work performed with personnel of the unit and sub-unit, a highly developed feeling of social responsibility and public action, and the need to take part in public work may also serve as motives of considerable importance for the development of a disposition to work with people.

An interest in human factors engineering and in an extensive range of engineering fields not pertaining directly to technical problems but embracing the entire "man-machine" system, including all of its technical and human elements, can serve as an important source of motivation in working with people. The engineer experiences a desire to study the crucial element in the system more thoroughly and to understand the human condition, the conditions necessary for him to work efficiently and dependably, the degree of coordination existing between his functions and those of the machine, and the extent to which the joint work performed by the group of fightingmen servicing the complex technical system is collectively performed.

An interest in human factors engineering helps to reveal psychological problems encountered in the work of the technical specialists, to learn the individual peculiarities of the soldiers and the qualities of the military team, and to make certain changes in their conciousness, conduct and working methods.

The engineer's desire for self-indoctrination and improvement of his professional training and his need to prepare himself for performing a broader range of work in the future, work involving more extensive responsibility and new duties, including supervisory, command functions, have a definite role in motivating the engineer in his work with the personnel.

The line engineer's work thus makes extensive demands of the individual's motivation: on the one hand, he must have highly developed technical interests and inclinations, and on the other--a great interest in people, a need for contact with them, a desire to come to their assistance when necessary, and the desire to give of his knowledge and experience.

A certain degree of passivity demonstrated by individual technical specialists in their work with the personnel is due, in addition to a lack of the necessary skills, to a shortage of time, to their heavy technical load. Claiming that they are too busy, some engineers and technicians request that they not be required to work with the personnel. Each of these cases should be carefully investigated. It is well known, after all, that an overload of work frequently results from a lack of experience, a low level of professional skill, because of which it inevitably takes more time to perform the job, the quality deteroriates, additional work is sometimes required, and the job sometimes has to be done over. The engineer's time is used inefficiently as a result, and some things are permitted to just drift along. Unfortunately, this is sometimes the case with the training and indoctrination of personnel. Consequently, a high level of professionalism is an important condition for overcoming a negative service utilization factor.

Since pedagogical skill, the art of supervising and propaganda work are discussed in detail in the special literature, it is only necessary for us to discuss certain general elements of pedagogical skill, those which are inherent to one degree or another in all variations of the work performed by military engineers with the men: primarily an understanding of people, their intellectual characteristics, training and indoctrination and the process of making their work more efficient.

In order to be able to work with personnel, the military engineer must know people and the psychological laws governing the actions of individual soldiers and military collectives, primarily the psychological peculiarities of collectives produced by the nature of their military profession. An education in human factors engineering and an understanding of the psychological laws functioning within the "man-machine" system and of methods of coordinating the equipment's requirements and the capabilities of the individual controlling it are especially important today. This knowledge is acquired by studying psychological literature, through observation and by comtemplating one's own experience and the impressions received from direct contact with people. M. I. Kalinin pointed out that reading is an important way to gain an understanding of people. "...If you want to be not just an engineer-technician but a supervisor and organizer as well, you must know literature...." After all, every organizer must be able to organize people, not machines but living people.... A knowledge of different types of people, the ability to distinguish them and to analyze each individual and to know exactly what he is like and what is possible... to make better better use of this or that individual in production--all of this requires a knowledge of literature."[24]

Since the modern technical systems are run by increasingly smaller groups of soldiers, whose interactions are prescribed by regulations and job descriptions, and since the interpersonal relationships are resulting in new bonds, it is useful for the engineer to understand and takeinto account the social-psychological patterns and the psychological peculiarities of the military collectives, and the various socio-psychological phenomena which have a considerable influence on the effectiveness of the joint work performed by the military specialists.[25]

In addition to an understanding of people in general and a knowledge of the general laws governing their behavior, the work performed with the military personnel in a given collective is impossible without a knowledge of that group, those specific people. The specific nature of this knowledge lies in the fact that it cannot be acquired in finished form but must be obtained independently, through the persistent and systematic study of the soldiers, in direct contact with them, by observing their actions and their communication with each other, by assigning them control and verification assignments, by talking with them and by studying the results of their work and other information.

In order to understand man's psychic make-up--his thoughts, feelings, aims and actions--it must be regarded as a result of the development and the activities of people in society. This is made possible by an excellent understanding of the fundamentals of Marxism-Leninism, the socio-political and economic laws of the Soviet society's development, current circumstances in military affairs, important political and socio-economic measures advanced by the CPSU and the Soviet Government, the successes achieved by our people in the building of communism, the most important events in the life of the Armed Forces, and international events. It would be difficult to find a common language for communicating with an individual without an understanding of current problems of moral, cultural and esthetic indoctrination, of everything which is being discussed with lively interest in the military collectives.

The knowledge employed by the engineer for developing and substantiating the tasks assigned the personnel plays an important role. This is the actual engineering and technical knowledge, particularly exhaustive information on the specific equipment which the sub-unit uses. This knowledge also includes all of the information essential to the engineer for training the personnel.

All of this diverse information permits the engineer to get his bearings in situations developing in the military collective and in the interpersonal relations of the fightingmen, and makesit possible for him to evaluate unresolved issues properly, to outline goals and make proper decisions.

Like any other work performed with people, which consists primarily in exerting an active influence on the conciousness of the fightingmen, motivating them to take the necessary steps or restraining them from taking undesirable actions, this work requires certain skills and abilities on the part of the individual performing it. These are developed by means of exercises and drills and through multiple repetition. The skills and abilities used in working with personnel frequently consist in repeating solutions previously used and remembered.

There are instances in which the engineer or technician is not aware of the need for the special elements of pedagogical skill, since he works only occasionally with personnel. And in fact, a certain measure may be carried out on the basis of one's general knowledge and common sense and the advice of the experienced commander or political worker. It is an error, however, not to consider the fact that working with people, supervising, training and indoctrinating them form an integral part of the engineer's work today. Working with people is not just a superficial part of the engineer's work, but an intrinsic element of this work.

An officer must possess many qualities in order to work skilfully with the personnel. Dispite their diversity, however, they have a certain intrinsic unity: when the engineer comes into contact with other people in a service capicity, he deals with psychic and socio-psychological phenomena. Success depends greatly on how correctly and promptly he is able to analyze these phenomena, to evaluate the degree of their influence on the performance of a combat or training task, to influence this or that psychic process and the dynamics of the psychic state as a whole in the interest of an objective. This means that psychological factors must be taken into account, thoroughly and in all the subtleties, for working with people. We are therefore interested primarily in considering those elements of the military engineer's professional skill which make it possible for him to accomplish this.

The concept of considering psychological factors is a natural outgrowth of the fact that in order for a separate technical complex[26] to function effectively and for the military work as a whole to be effective, there must be a certain correspondence between the total group of requirements made of the personnel by the equipment, by circumstances and by the tasks being performed, and the total capacity of the fightingmen and their capabilities for performing

these tasks. This conformity is achieved both by changing the conditions of the work and by mobilizing the efforts of each soldier and of the military collective. Psychological substantiation is provided in all cases, when the supervisor's decision or its implementation requires that the above conformity be retained or that it be achieved. In other words, the psychological factors are taken into account.

The process of substantiating the military engineer's decision psychologically includes two groups of actions: comprehension and evaluation for purposes of revealing, studying and evaluating the influence of specific psychological factors in a given situation (psychological analysis), and utilization of the information provided by this analysis for purposes of adopting and implementing a decision and their inclusion in the productive service work to make it more effective.

The psychological analysis has a number of variations, which depend on the tasks facing the engineer and the circumstances under which they are to be performed. Scientific studies have established the existance of at least four such variations:

1. The primary study of new soldiers for purposes of determining their job aptitudes (their area of work in the military and their abilities, and the expediency of teaching them one of the various military specialties). This work is called psychological military-professional selection,[26] that is, selection based on psychological criteria;

2. Continuous, systematic and comprehensive study of the service conditions of the fightingmen and the functioning of the military collective for purposes of obtaining information necessary for subsequently improving those conditions and for creating the preconditions necessary for the successful training and indoctrination of the personnel, for uniting the collective and strengthening discipline, and in the final analysis, for making the troops' work as a whole more effective;

3. A goal-oriented study of the soldiers from the standpoint of the requirements for a specific task, and evaluation of their psychological condition and capabilities at a given time. This is essentially a forcast of how people will function under the conditions of a future task comprehension of the new task and the selection of soldiers suited to perform it. Consequently, this is a specific psychological selection, which, unlike the job selection, is carried out within the bounds of specialties chosen for and assigned to the men;

4. Diagnosis of the behavior of a specialist in a military collective (an operator, for example) after the fact: an accident, an emergency or some other event of definite importance. Determination and investigation of the psychological causes and the conditions leading to the event being studied, determination of their specific importance within the total group of causes, summarization of the work experience, clarification of the motives behind a specific action, investigation of the reasons for difficulties and lack of success in indoctrinational work, and so forth--all of these are examples of psychological diagnosis, which has an important place in the military engineer's daily work.

A study of positive experience in the work of military engineers and technicians has shown that the results of the psychological study can be applied for the utilization of the favorable psychological conditions created; for creating the psychological conditions required for the successful performance of the assigned mission; and for creating good material-technical, operational and living conditions for the fightingman and the military collective in the course of their work and for their leisure-time activities.

Psychological conditions are taken into account for professional and operational selection, when the men are assigned to jobs in accordance with their qualifications and condition.

An engineer's decision takes into account the fact that it should be perceived by the men as convincing, thoroughly conceived, reliable and inspired. It sometimes occurs in the service that a decision which is essentially a good one is performed without proper enthusiasm only because the men regard it as a casually made decision. When performing the engineering study of this or that decision, experienced specialists attempt to see that it is convincing and does not creat doubts. Circumstances permitting, many specialists ask their subordinates to discuss the technical issues, confer with them and work out, together with them, a common opinion with respect to the necessary steps.

Another method of considering the psychological factors is that of organizing the work of the fightingmen so that it involves them immediately, ensures that they achieve inspiring successes, even small ones, in the initial stage of the job, and does not involve unnecessary comsumption of energy. The personnel have an agressive spirit, an interest in the job and good motivation throughout their work as a result of these organizational measures.

An important way to have highly efficient work is that of distributing the personnel according to the socio-psychological laws of joint, collective work (an easily perceived, common collective goal, which is not overshadowed by individual, not interrelated goals; interaction among the members of the collective in the course of their work and good conditions for their intercommunication; the opportunity to compete; retention of the stable structure characteristic of a given collective, and so forth).

When working with personnel, it is frequently necessary to assign tasks which the men are not prepared to perform immediately (due to fatigue, nerviousness, a lack of confidence in their abilities, over-exitement, fear, and so forth), because they lack experience, the required knowledge or abilities, or do not understand the importance and responsibility of the task. In such cases, psychological factors are taken into account by bringing the psychological conditions into conformity with the requirements for the forthcoming work. When he explains the procedure and the situation, the engineer supervisor helps the men to mobilize their efforts, to overcome psychological difficulties and to concentrate their full attention on the assigned task. Focused training, instruction and clarification of possible difficulties and ways to overcome them, as well as the practical rehearsal of modes of operation, as extensively practiced during the Great Patriotic War, are of great importance

in preparing the personnel for a specific task. Psychological conditioning is an essential element of the overall preparation of soldiers for specific operations. This is a combination of measures performed to bring the psychic state of the men into conformity with requirements for the task (renewal of strength, personal adjustment, motivation and emotional adaptation, strengthening the men's confidence in their abilities, and putting them into a state of combat readiness). All of this work is exceptionally important and essentially constitutes the main method of taking psychological factors into account, a method which requires vigorous action and skill in its performance on the part of all officers.

This brief description of certain methods of organizing engineering work, taking psychological factors into account, is far from exhaustive. In actual army work, the initiative and creativity demonstrated by the officers constantly result in new methods of actively influencing the psychological strengths of the fightingmen for purposes of developing them and making efficient use of them in the process of performing the combat and training tasks. The creation of new work techniques, taking psychological laws into account, and the employment of known laws requires a certain level of psychological education, special skills and abilities, and a vital and sincere interest in working with servicemen and military collectives.

6. Career Selection for Military Engineering Personnel

The problem of choosing a career for military engineering personnel is central among the numerous problems created by scientific and technological progress and by the modern revolution occurring in military affairs. This is a large-scale, complex and multifaceted task. In order to accomplish the task, it is necessary to thoroughly analyze the ramified mechanism of interaction among economic, social, political, ideological and other social relations, both general and specific, characteristic only of the military organization. This is due to the fact that the individual is multifaceted and reflects all social relations.

The vigor, creativity and high level of professionalism so characteristic of today's military engineering personnel in the Soviet Armed Forces are all a natural condition and a result of their educational level and world outlook and of the scientific substantiation of their selection and placement and their expedient utilization.

From the point of view of modern science, job selection for military engineering personnel is a dual process. On the one hand, it is a means of revealing and realizing the personal aspirations and desires of each "youth planning his life," and the selection of a profession is a complex and important social process. Reflecting on the selection of a career, the young Marx wrote the following: "...this choice constitutes an act which may destroy the individual's entire life, upset his plans and make him unhappy."[28] Extending this thought, the reverse is also true--it is capable of making a man's life brilliant and interesting, dispite thousands of obstacles, adversities and difficulties, "because what is life, if it is not activity?"[29]

On the other hand, the task of selecting careers for military engineering personnel consists in meeting the requirements of military engineering practice to the maximum degree possible. It is not our goal to analyze the first aspect of the problem, which pertains to the selection of a career--this has been discussed with adequate thoroughness in philosophical-sociological literature. The matter of revealing the individual's abilities and aptitude for a military career has been discussed far less thoroughly, both in the theoretical and the practical respects.

It is a difficult matter to reveal an individual's natural inclinations. Science has still not developed adequate methods for doing so. At the same time, we know that the intrinsic pattern of development of man's qualities is constantly changing under the influence of his social environment. Each time, however, man finds a unique mode of accustoming himself to the work. In the process, some traits of occupational importance develop, others are surpressed, and a third category--neutral but vitally important in the work process--are preserved.

There is no such thing as a natural, predestined pattern of development of human qualities, and the development of man's nature is determined by heredity and environment, the latter being the decisive factor. In making a selection, it is therefore very important to establish not only the individual's natural abilities, but also the possibility of developing them.

This conception of man and his occupational abilities is incompatible with the idealistic interpretation of natural, occupational predestination. Socialist reality has refuted the concept of man's natural occupational predestination, which is propagated in the capitalist world. This concept is scientifically unsound and is reactionary in the social respect. We have a different concept. V. I. Lenin taught us to find and encourage talented individuals, of which there are many among the people, to put them on their feet and advance them.[30] This posture forms the moral-philosophical foundation for the constitutional right of the Soviet people to select their type of work freely and guards career selection against dogmatism by stressing its relative nature.

It would be an error, however, to make a hasty conclusion from the preceding that people have equal capabilities and that there is no need to consider their individual characteristics in labor and military work. V. I. Lenin noted that it would be absurd to expect people in the socialist society to have equal abilities and capacities, that every job requires special qualities.[31]

The individual side of career selection for the military engineering specialties, that is, the individual's interests, his plans and aims in life, begins to be realized at that moment when the military commissariat sends him to a certain military engineering institution, based on the youth's aptitudes and desires. Another purpose, however, that of determining the young individual's suitability for military service in a given specialty of this or that branch

of troops, is partially acccomplished even then, in a very general way. A more specific and thorough selection process takes place within the walls of the educational institution.

This process essentially consists in forcasting the individual's suitability for a military engineering career from the personal traits revealed in the candidates: moral-political qualities, general education, physical development, individual psychological disposition and medical history.

Attaching great importance to the scientific organization of career selection for military personnel, M. V. Frunze wrote back in the 1920's: "If we send youth into the navy, special technical troops or aviation, who are psychologically unsuitable for serving in those services, we are thereby damaging the combat capabilities of those services severely."[32] The task posed by M. V. Frunze is still valid today, when we are dealing with the selection of people who will have to work with complex combat equipment frequently requiring very specific psychological qualities.

Many factors make it necessary to consider individual psychological characteristics in selecting the careers of future military engineers. These include objective conditionsstemming from the modern division of labor (which is also clearly manifested in the military field); the limitations of pedagogical possibilities for performing this task with military career training alone, while the individual is serving and training; and the extremely broad range of military engineering specialties, which make specific and at the same time, augmented, military occupational demands, which absolutely must be met for the individual to be suitable for a career as a military engineer.

Many procedures and methods have now been developed in the forces and military educational institutions, which make it possible to successfully forecast many of the individual's psychological traits.[33] Specialists in the area of military engineering psychology themselves, however, acknowledge that these methods are far from always effective. Testing, for example, may provide useful information for the selection of junior specialists for schooling--telegraph, radio and sonar operators, operators of various installations, and drivers of combat and transport vehicles, that is, narrowly specialized military-technical workers. The possibilities of testing are sharply reduced, however, when it is necessary to forecast an individual's suitability for a career as a military engineer, the training for which is extremely broad and multifaceted.

The procedure for selecting candidates for military engineering schools includes an entire system of measures, which, taken together, make it possible to determine the young individual's aptitude for a career as a military engineer. It is based on a dialectical-materialistic interpretation of the patterns of man's psychic side, an interpretation expressed in an individual approach as the basic principle of career selection. In the broad sense of the word, "the personal aspect of studying psychic processes consists in regarding them as a form of man's activity, stemming from certain requirements and motives and focusing on the accomplishment of tasks with definite importance to man. The motivation level of psychic activity is the prime expression of its personal aspect."[34]

The personal approach consists of an understanding of the individual and his separate psychological features as detected in his activity. In accordance with this principle, not a single psychological feature, whether it be a process, the individual's frame of mind or a feature manifested in his activity, and consequently, the activity itself and its elements--acts and deeds--cannot be properly understood without considering the personality factors dictating it.

This means, first of all, that in determining the individual's suitability for a career as a military engineer, we must consider the individual from the standpoint of his original growth and development (before entering a military VUZ and during his training). Only on this basis can we predict his chances of success in a military career.

Furthermore, the personal approach assumes that the individual's own confirmation in his chosen career represents an active, creative process, requiring more than the simple utilization of the individual's personal abilities and more than the mechanical adaptation to peculiarities of the military engineer's occupation. Professional growth consists of aware, transforming and creative work on the part of the personnel, both with respect to the object of the labor and to the individual's attitude toward himself as a whole and to all of his functions individually.

The separate features and functions revealed in the process of determining an individual's suitability for a given career are not self-sufficient. They are features and functions of the personality, related to the latter not as part of a whole but rather as phenomena with an essence of their own. They do not develop independently, but depend on the general development of the individual in the course of his social and professional activities.

The individual nature of the functions is manifested in the fact that they constitute that special and unique entity, the personality, in which the common element is manifested.

Take the operator's specialty, for example. One individual becomes a skilful operator as a result of his rapid sensory-motor reactions and good emotional stimulation and his ability to rapidly establish and register instrument readings. Another individual, who does not possess the abilities of the former, masters the operator's art with equal success by paying closer attention and applying his capacity for prolonged, heavy concentration and by gaging and checking his actions.

The personal approach to an individual with whom a certain relationship has been established or who is the specific object of study is, according to the views held by Soviet psychologists, an approach to the individual as a complete entity, which takes into account the full complexity of the personality, the history of its development and all of its individual characteristics. In other words, it is an approach taking into account the entire, dynamically functioning individual structure of a specific personality.[35]

Soviet scientist K. K. Platonov developed the most thorough and complete concept of career selection, based on a model of the dynamically functioning structure of the personality.[36] According to this concept, all of the individual's qualities and traits can be separated into four sub-structures.

The first sub-structure includes the individual's socially conditioned features: the various forms of goal-oriented endeavor, moral-political qualities and feelings of a higher order. Motivation in the form of propensities, aspirations, interests and goals, the objective source of which consists of needs, forms the foundation for the psychological mechanism by which this substructure functions in the individual's activities.

These are the motives which evoke, direct and control the activities both of individuals and of entire social groups. This is why the study of the individual, from the standpoint of his suitability for a military engineering career in our case, must be initiated by revealing the nature and the level of the individual's motivation. The first and chief task of career selection is one of establishing the true motives behind the selection of a military engineering career and the degree of military-professional goal orientation involved.

Dedication to the principles of communism, an awareness of the great social importance of the military engineer's work and his responsibility for the defense of the socialist homeland, patriotism and other feelings of a higher order, which characterize the moral-political aspect of the officer's personality, produce a positive motivational level at which the officer's capabilities and his functional resources and energy are manifested and utilized to the fullest degree in his military work. For this reason, good moral-political qualities are an extremely important, decisive indicator of the individual's suitability for a military engineering career. Conversely, inadequate ideological conviction, political apathy and the domination of personal aims create negative motivation with respect to military careers and make the individual unsuitable for such careers.

Many years of experience has resulted in the development of various forms and methods of selecting candidates for schools and academies, based on their efficiency and moral-political qualities. Selection is made by sampling and studying information contained in questionaires on social origin, living conditions and job history prior to entering the army. The following methods are used for investigating moral-political qualities: familiarization with information issued by that organization of which the candidate was a member; a psychological analysis of his personal history; and interviews with the individual to clear up specific questions.

An objective, psychologically efficient and thorough description (confidential report) is the main source of information on the individual. It contains a summary of many years of study by school teachers, workers with military commisariats, and directors of public organizations on the ideological-political development of the teen-ager or young man, his public activities, indications of an inclination toward a military career, and his psychological traits.

Unfortunately, far from all of the descriptions depict the candidate's personality thoroughly and correctly from the psychological standpoint. They frequently consist of a routine, superficial and depersonalized sketch, from which it is difficult to make out anything at all. Our task is one of improving the competence of those people charged with the responsibility for evaluating the individual qualities of youth entering the Armed Forces, relying on the achievements of psychological science.

A psychological study of personal histories is an important tool for establishing the individual capabilities of candidates for military engineering VUZ's. The experienced officer-teacher can derive extremely useful conclusions simply by familiarizing himself with the individual's personal history: information on the make-up of the family, social position, place of residence and environment.

An interview with the individual by members of the acceptance commission and the officer-instructors is an indispensible and, experience has shown, extremely informative method of determining a candidate's personal qualifications. The interview, following a plan worked out in advance, a plan ensuring that the necessary information on the candidate will be obtained, not only expands and adds to the thoroughness of information about his life, but also provides a rich body of information for deciding on the candidate's personal qualifications. The information obtained in the interview is of value not only with respect to determining the candidate's suitability for the career, but also as basic information for subsequent individual indoctrinational work with him as a cadet or student.

The second sub-group includes the knowledge, skills, abilities and habits acquired by the individual in the training process. The make-up and nature of the individual qualities in this sub-group are also environmentally determined. His personal knowledge, based on experience, in this area includes environmentally determined elements, although the influence of innate characteristics is begining to show, characteristics which manifest peculiarities of the individual's psychological disposition, his abilities and occupational capabilities. This sub-structure is sometimes referred to as the individual's level of development or training, but it can abbreviated to "experience." It is the task of career selection for future military engineers with respect to training level to reveal the elements forming this sub-structure. Examinations are the traditional method of performing this type of selection. Unfortunately, the results of these examinations are only of relative diagnostic and, especially, forecasting, value, because the examination methods used, at best, only establish the level to which the individual has assimilated certain information, but do not reveal the candidate's occupationally important, creative abilities. This indicates that the traditional methods should be suplemented with new and more effective methods related to the individual approach.

The third sub-structure is formed of features which depend on the individual peculiarities of thinking, perception, emotions, memory and will. This substructure is ordinarily referred to in short as the individual's functional characteristics. The qualities included in this sub-structure are influenced considerably by innate features. They must be taken into account for determining suitability for many occupations. It is not enough to evaluate the

characteristics contained in this sub-structure in the selection process, however, since the personality is made up of the sum-total of primarily environmentally determined qualities and attitudes, and not only, and not so much, of innate qualities.

Various tests are used to reveal individual psychological traits. Tests are most commonly used for selecting candidates for operator-type specialties, that is, the specialties which primarily consist of driving combat vehicles or operating technical systems. These include the specialties of technician-operator and power plant operator, for example. Due to their narrowly specialized nature, technical complexity and uniqueness, and to the especially great responsibility borne by the personnel, these jobs make special requirements of the individual, which not everyone is able to meet. The operator working a control panel of a missile launching facility, for example, has to follow the readings of various instruments and the condition of various devices. This requires a large amount of knowledge and a well-developed ability to shift one's attention in order to move rapidly from one operation to another. Little can be done to make up for a lack of these abilities.

Psychological experimentation (testing) is a means of revealing occupational suitability, based on individual psychological characteristics. The standard-form "compass," "dial," "maze," "black-and-red array," "adjustment trial-and-error," and "combination letter-and-number" tests, for example, can be used to reveal (with varying degrees of reliability) the attention span, the ability to switch one's attention, visual memory, memory for numbers, perceptual range, reaction time, and so forth. There are numerous other methods of experimental study not only of psycho-physiological functions, but also of the specific features of the creative thought process, speech and emotions, as well as such individual qualities as degree of ostentation, the individual's position in the social structure, and the dynamic facets of the personality.[37]

The fourth sub-structure of the personality consists of the complete group of organic features, or, representative features, as they are also referred to, in which far more is inherited than is acquired. In speaking of inherited characteristics, K. Marx used the terms "natural abilities" and "the natural being" of man. This is the genotype in the biological sense, temperament in the psychological, and a type of higher nervous activity in the physiological sense.

Using commonly known terminology, the inherited qualities are the foundation, and the acquired characteristics form the superstructure. Since these definitions are entirely conditional, the ratio of base to superstructure can vary: they may correspond, in which case we have a well-balanced individual, or they may be out of proportion, resulting in conflicts or, frequently, even an unbalanced personality.

The dependencies of abilities on the foundation are not always apparent, but the geneticists are now convinced that mental and creative abilities, artistic and musical talent depend on the combination of genes. Medical experts and psychologists are convinced that the physiological level of differentiation

between the first and second signal systems predetermines intellectual abilities to a great degree: artistic talent is found most frequently in those individuals in whom the first signal system is more highly developed, while powers of abstraction predominate in those in whom the second signal system dominates.

It is necessary to reveal the occupationally important features in each of the four sub-structures in order to study the individual for purposes of predicting his talent for military engineering work. This makes it possible to avoid the common error of reducing the selection process to a consideration of characteristics in the third sub-structure alone.

An analysis of numerous descriptions of the military engineer's personality in books and works by various authors leads us to conclude that the personality "model" which has taken shape in this process is the most suitable for use in selecting future military engineers for the most diverse areas of specialization. And although not all of the parts have an indisputable, logical foundation, the dynamic, functional structure of the personality can be successfully used as the theoretical basic for performing studies to determine an individual's suitability for military engineering work.

The dialectical demonstration (both quantative and qualitative) of an individual's talent for a certain, specifically military engineering, type of work is extremely important in career selection practices.

It should be noted that not only is talent manifested and developed in the process of performing a certain type of activity, but without activity it does not exist at all. The theory that there is no such thing as "talent for activity 'X' " has now become established in the sciences dealing with the personality. Until activity "X" assumes definition, the individual only possesses inherent traits in the form of potential capabilities, which become real only in the process of the specific activity. What specific abilities are necessary for military engineering work? We shall discuss only a few of the thoroughly studied ones.

One of the first groups of abilities has to do with the fact that the military engineer's work is intellectual. Clarifying the nature of the elements making up technical work, Soviet psychologist N. D. Levitov states that in the first place, they primarily pertain to the thought processes; in the second place, they denote, physiologically, that level of analytical-synthetic activity at which the complex relationships and the non-static relationship between the first and second signal systems are systematized; and in the third place, they include primarily those qualities which are designated as keenness of mind (mental orientation speed), deliberative ability and criticality.[38]

Many scientists consider the first component to be the intellectual level or intellectual ability, or, and this amounts to the same thing, cognative ability, the ability to understand concepts and to express one's thoughts verbally; the size of one's vocabulary; the ability to solve problems, to foresee and to

create a plan of action; the ability to apply one's experience and memory; the ability to make computations rapidly and correctly; the possession of spatial concepts and the ability to perceive spatial relationships and connections; the ability to discern similarities and distinctions between objects and between phenomena, and so forth.

One of the most specific abilities required for military engineering work is a capacity for creativity. Studies performed with engineering and technical personnel have revealed a broad spectrum of forms in which creativity is demonstrated in the work, forms which at the same time constitute features of the personality and elementary abilities which are a part of the structure of creative work: an interest in and a discriminating propensity for a certain type of work, self-sufficiency, initiative, the ability to think for oneself in the performance of specific tasks, the need to organize and plan one's work in the best possible manner, the establishment of good interpersonal relationships among the workers, rationalization and invention work.

It is doubtful that anyone today would object to the assertion that modern military engineering work is inconceivable without fundamental mathematical training. The science of mathematics has made a considerable mark on the most diverse types of military engineering work. The mathematical abilities of the "potential engineer" is therefore one of the important career selection criteria.

An analysis of statements made by scientists on the nature of mathematical abilities shows that the latter have a definite structure. According to V. A. Krutetskiy, for example, who is both a psychologist and a mathematician and has spent many years studying mathematical ability, this structure includes the following: a capacity for generalization; logical reasoning; keenness of mind and resourcefulness; a mathematical memory; a capacity for abstraction; mental flexibility; the possession of spatial conceptions; the ability to reverse one's train of thought; a desire to conserve one's mental effort; great endurance for dealing with mathematical problems, and so forth.[39]

Just how complete is this and other enumerations of such qualities? In general, is it possible to compile an exhaustive list for any specific ability? And there is yet another question related to these: Must every youth desiring to become a military engineer possess the "complete set" of characteristics included in the list?

With respect to providing an integral, personal evaluation of occupational suitability, it must be said that any such list and any detailed description of the structures of specific abilities, which is so badly needed, will always be only a general outline, and the individual abilities of this or that person will rarely include all of them. One must always be able to identify the connection between the specific abilities and to consider their mutual influence.

History contains some amazing examples of individuals who possessed both mathematical and other talents. We know, for example, that A. S. Griboyedov, N. V. Gogol', M. Yu. Lermontov and L. N. Tolstoy (who actually worked on methods of teaching mathematics) had good mathematical abilities and a marked propensity for mathematical activities. At the same time, A. S. Pushkin "shed many tears" at the lyceum but "did not achieve any notable success" in mathematics, and D. I. Mendeleyev regularly received not only "D's" but even "F's" in grammar school.

Organizational skills, made necessary by the present revolution in military affairs, are no less essential and urgently needed by the modern military engineer. "If one of you were to read all of Lenin's works at one time, volume after volume," M. I. Kalinin wrote, "you could not avoid noticing the enormous amount of attention Lenin devoted to organizational matters or how he made every possible effort to teach organization to the workers and communists."[40] Referring repeatedly to organizational skills, V. I. Lenin pointed out: "...administration requires special qualities. One may be the very best revolutionary and agitator, and be absolutely useful as an administrator."[41]

In our philosophical and psychological literature, the subject of organizational abilities has been most thoroughly expounded in the works of L. I. Umanskiy, who notes 18 typical features forming the structure of organizational skill: the ability to infect and stimulate other people with one's enthusiasm; the ability to understand and react correctly to psychological phenomena and the mentalities of people (psychological ingenuity); the ability to spot deficiencies in actions and deeds, or, criticality; psychological tact; initiative and demandingness; self-sufficiency; a capacity for work, and others.[42]

Every organizer needs all of these abilities. They are not specifically engineering skills, however, since they are also essential in other fields of professional endeavor.

Closely related to organizational skills and capacities for intellectual work are the pedagogical skills, which are also essential to military engineers, the duties of which include training and indoctrinating the men. The pedagogical skills required by the professional teacher naturally differ from those needed by the military engineer, both with respect to volume and to the extent of their utilization in the practical work. These have already been discussed in detail, however. There is no doubt as to the fact that a possession of such skills is a guarantee of successful work on the part of the military specialist.

We have enumerated certain, but far from all of the abilities required by the person preparing to choose a military engineering career. The lists can only be recommended in part, because, in the first place, it is impossible to provide them for all of the situations occurring in life, and, in the second place, because these requirements are continuously being developed and improved. This in no way means that it is not necessary to analyze abilities and to

select the most capable individuals for a career as military engineers. According to the foreign press, for example, the drop-out rate for cadets is reduced by more than 50 percent and up to a million dollars is saved by selecting candidates for military educational institutions on the basis of ability. This makes it highly important for every military engineering VUZ to accumulate and summarize experience in career selection based on specific individual abilities.

Requirements with respect to capacities for military engineering work are thus being refined and continuously modified. This is due to the fact that career selection is a developing process. The scientific approach to the organization of career selection for military engineers, however, requires the determination of certain constants, or more precisely, laws, inherent in this process. The general principles of career selection reflect these laws, and impulsive actions and many errors can be avoided in this work by observing them.

The first such principle is that of social determination of the basis for the selection, that is, making the selection on the basis of society's need for a certain number of military-technical specialists of a certain caliber. These requirements are, in turn, the result of specific historical conditions, the military-political situation, and the level and the requirements of scientific and technological progress. During the first years of Soviet power, the efforts were mainly concentrated on selecting and training various specialists for the cavalry and artillery. It then became necessary to initiate the large-scale training of specialists for the air force, the submarine fleet and the tank troops. At the beginning of the 1960's it became necessary to fill the ranks of the Strategic Missile Troops, and this required an enormous number of military-technical specialists.

The social determination principle determines the relative nature of the selection. The fact is that the selection criteria are not always the same. The general trend is toward determination of suitability for a certain military career based on the top criterion, that is, on those characteristics which can ensure excellent fulfullment of one's functional duties. The selection may be made on the basis of criteria at the middle of the list, or even lower, however, depending on the military-political situation, the state's needs and the level of prestige carried by the military-technical careers. The question of how far military prepardness can safely be reduced by increasing the number of specialists accepted becomes highly acute in the latter case.

The relative nature of this selection is also determined by its dependency on the level of career orientation and career consultation work. When the work is well organized, it is possible to limit the task of selecting those to be accepted at a VUZ to an individual study of the candidates.

It should be noted that this selection is relative in yet another sense: it is impossible to ensure complete reliability with the use of any of the selection methods. Finally, the limited and relative nature of this selection is determined by trends in and the outlook for the development of military work.

The nature and the structure of the military-technical specialties are undergoing further modification in the process of the scientific and technological revolution. The extensive use of automatic systems and devices is contributto the creation of specialties with a broad range of functions. Automation provides the material basis for combining previously limited operations into a single process controlled and directed by man.

The nature of the interaction occurring within the "man-machine" system is changing as the process of automation progresses. Man is increasingly removed from the direct combat process and is increasingly performing preparation, supervision and monitoring functions.

The requirements made of the abilities, knowledge and skills of military-technical specialists have also undergone considerable change. Abilities other than concrete ones are increasingly required: physical strength, precision of sensory and motor coordination, and so forth, as well as such qualities as a large store of job information, rapid adaptability for the performance of constantly changing assignments, and a feeling of responsibility for the equipment in one's charge. The role of political-moral qualities has increased considerably, qualities which, as we know, do not result from any sort of inherited characteristics but are a product of the individual's social development, indoctrination and training. All of this has resulted in a general trend in the development of the required qualities, taking the focus away from matters of selection to the development of job skills.

The fact that scientific and technological progress does not encourage the long-range and large-scale use of psychometric methods of career selection should not be taken as an argument against the expediency and great effectiveness of selection based on psycho-physiological characteristics for a large group of specialists. The need for special selection of people for many technical-military specialties, based on individual psychological qualities, is still a practical and important one. This is a valid form of selection, because the group of individuals learning a given specialty includes those who are not able to learn it successfully within the time allotted; because of the special importance of the operational tasks performed and the great possible danger created by errors; by the large numbers of individuals desiring to enter VUZ's and the limited time available for the selection, and the large amounts of money spent by the state on their training; and by the need to select the most suitable individuals from a number of candidates.

These conditions are essential for the selection of future military engineers to serve as operators. These military engineering specialties require such specific qualities as the ability to think clearly, a good memory, concentration and psychomotor skills, which are difficult to exercise, and little can be done to compensate for a lack of them. If the abilities can be easily developed in the course of training, however, or if they can only be revealed and acquired in the process of prolonged military engineering work, there is no need for preliminary selection. The above indications of the validity of selection make it possible to define the list of military engineering specialties for which the determination of individual psychological characteristics

is absolutely necessary. We have a practical need for such a list and for an actual procedure for the selection, backed up by proper normative-legal enactments.

The next principle of psychological selection is a logical outgrowth of the personal approach to the study of the individual's dynamic functional structure. It is based on the study of military career suitability and its active development in the first stage of training, at the end of the training and, finally, throughout the entire period of service. In other words, psychological selection is not an act but a lengthy process, the first significant phase of which takes place at the first encounter.

Extended selection, like all contemporary work carried out with personnel in general, requires that the command and political staff possess not just a familiarity with psychology and social psychology, but a thorough knowledge of them and proficiency in all of the forms and methods of career selection and the training of specialists for the technical military fields.

Extended selection makes it possible to rely upon yet another principle of military career selection--the active selection principle. Active selection implies organizing the selection in such a way that it is organically combined with maximum adaptation of the machine's control elements to man's functional characteristics, rational automation of a number of operations, the development of algorithmic training systems, optimization of training routines, and the adoption of nonspecific means of improving the specialist's functional characteristics.

From the standpoint of the active selection principle, we should stress the need and the importance of developing the imperfect psychic qualities revealed in the selection process. "Suitable," "not suitable" and "limited suitability" are passive conclusions. Active conclusions should contain psychological, functional, training and indoctrinational recommendations, with the focus on building up insufficiently developed occupationally important qualities. And in order to issue such recommendations, it is necessary not only to describe the characteristics revealed, but also to predict how they will develop in the training and indoctrinational process (the rate of their development, their developmental peculiarities and limitations).

The problem of predicting the military technical specialist's fighting efficiency presents the greatest difficulty. After all, the concept "military occupational suitability" primarily implies the ability to function successfully in a combat situation. Many researchers have rightly pointed out the inadequacy of evaluating on the basis of training results. In a battle, the individual must possess a large number of psychological combat qualities, in addition to his occupational knowledge and skills: fighting spirit, emotional-volitional stability, the ability to exert maximum effort, the ability to command sub-units in any situation, determination and a desire to execute the combat mission no matter what. It is precisely these qualities which make an officer highly active in combat. consequently, the methods used for selecting

and training military specialists must reveal and develop the qualities required not only in the training, but in combat as well. This circumstance gives rise to an extremely important principle of military career selection--the principle of adequacy. The latter is at the same time the most important principle and the most difficult to realize: it is a difficult matter to predict how an individual will behave in a battle. "Danger is an element of warfare. In a war, one is surrounded by danger every single minute."[43] Psychological manifestations brought out by combat are of an extreme and compelling nature: more rigid criteria of military professional suitability are in effect. The difficulty of forecasting combat efficiency is created by the fact that different people behave differently in dangerous situations. The threat of dying or being wounded can paralyze one individual, rendering him helpless. Another may feel a surge of physical and emotional energy at a time of danger. His imagination suddenly creates a special world in which he feels capable of destroying anything standing in his way. A classic example of the achievement of such a state by an individual was the feat performed by Captain Tushin at Shoengraben, which was described in L. I. Tolstoy's novel "War and Peace." When he finds himself in danger, the most timid officer, one who quails when confronted by superiors, may feel strong and invulnerable, master of the artillery's thunder and lightning.

Suddessful performance in a combat situation can only be predicted in a situation approaching actual combat. The functional tests used in laboratories are the least effective of all. Dispite this, it would not be correct to conclude that it is impossible to predict a soldier's behavior in combat. Such a conclusion can only be made with a functional approach to the evaluation of fighting qualities, when they are regarded as self-sufficient qualities which do not depend on the individual's other characteristics. In fact, however, fighting qualities do not exist in and of themselves. They are derivative qualities, always produced by other characteristics--soldiers are not born, after all.

A Marxist-Leninist outlook, ideological stability, devotion to the party cause, patriotism and loyalty to one's military duty determine the officer's level of motivation and constitute the decisive conditions for success, both in the training and in combat. This motivation ensures the functioning of the psychological mechanisms essential for success in combat. In this sense, ideals and feelings of a higher order inspire and motivate the fightingman to achieve victory over the enemy. One must first of all determine the level of development of precisely these qualities for forecasting an officer's combat efficiency. The so-called "physical-culture" methods developed by a team of researchers headed by T. G. Dzhamgarov are the most effective of the practical methods used for forecasting success in combat. They include the following methods: overcoming obstacle fields with simulated elements of a combat situation, multi-kilometer cross-country races and military sports games. When organized properly and in a well-conceived manner, they can provide extremely useful information on the level of the officer's emotional-volitional stability, initiative, militancy, self-control and other qualities.

The most reliable way to know the cadet or student's moral-fighting qualities, however, is that of studying the individual during his training. Experience which is being accumulated in the simulation of stress situations during exercises and th practice of making training tasks resemble actual combat as nearly as possible are creating increasingly better opportunities for this.

It must be noted that, since the forecasting of combat efficiency is a matter of probability, we should conclude that it is necessary, while continuing to search persistently for good selection methods, to focus attention on matters of improving moral-psychological conditioning, during the course of which the psychological mechanisms required for combat are developed. The task is one of improving the work of ideological-political indoctrination of the trainees and improving training methods, on the one hand, and of seeking methods of providing conditioning for performing in stress situations, on the other. The psychological mechanism, by means of which moral-political qualities and the training of the fightingmen are objectively developed in combat action, are only formed in the process of such practical training.

In conclusion, we would like to stress once again the need for persistent, continuous work to develop a military-professional orientation in the cadets and students at military engineering VUZ's and departments.

A fairly broad range of specialists are trained at the schools and academies. Profound and thorough theoretical knowledge make it possible for the graduates to be used in various positions, both as engineers and as commanders. Some of them see themselves in the future, however, as "purely engineers," designers and workers in research laboratories. And it is no secret that some young graduates of military engineering departments turn out to be psychologically unprepared to serve as commanders: at first, they avoid the personnel and demonstrate no special desire to learn to work with people. The situation sometimes takes a dramatic turn--the young officer experiences a feeling of disappointment in his career.

Consequently, the development of a military-professional orientation and a psychological readiness to command sub-units is an extremely important task of the training and indoctrinational process. Experienced officer-instructors see to it that each cadet receives good military training during his school years, masters the forms and methods of party-political work, acquires solid skills in commanding a formation, and learns how to conduct classes not only on technical military subjects, but in all of the other types of combat and political trainign as well.

It must be said that problems of career selection for military engineering work are still not being properly covered in military literature and that the level of their development, especially in the methodological sense, still do not meet the requirements with respect to providing students for schools and academies. The concept of career selection for military engineers which we have described naturally requires further refinement and thorough elaboration as applicable to specific specialties.

The military engineering field is, in a way, the "highest wave" of scientific and technological progress: specialties are becoming more complicated, new and unheard-of specialties are coming into being, and greater demands are being made of the level of professional training for engineers. It is precisely for this reason that investigations into problems of career selection are becoming an essential element of the scientific organization of military work and a subject of concern for the commanders and chiefs involved. The scientifically substantiated selection of military-technical specialists and its improvement are making it possible to structure training programs more efficiently and to train specialists for the Soviet Armed Forces in a more goal-oriented manner and on a higher level.

CONCLUSION

Soviet military engineering personnel embody the developed features of the Soviet engineering and technical intelligentsia and the basic features of the officer corps of the Soviet Armed Forces. The role of military engineers and their influence on the combat readiness of the Soviet Armed Forces has never been so great. This is due, in the first place, to the large number of military engineers: every second officer in our army and navy is an engineer or technician; in the second place, to the high level of technical equipment of the army, which has turned practically all services of the Armed Forces and branches of troops into technical troops; in the third place, to the qualitative changes which have occurred in army and navy personnel, who, today, as never before, need good military-technical training and the ability to successfully use and operate exceptionally complex military equipment and weapons; and in the fourth place, to the nature of modern warfare, which can begin absolutely unexpectedly, involve large areas of the planet, be extremely bitter and devastating, and be conducted in the form of rapid, highly mobile and and intense combat operations.

It is necessary to make maximum use of the military potential, including the military-technical potential, in order to repel an unexpected attack by an agressor, to respond with a devastating strike, and to successfully realize the great power inherent in the socialist system to defend the USSR and the entire socialist commonwealth victoriously. The successful accomplishment of this task depends greatly on the skilful work of military and technical personnel of the Soviet Army and Navy. Modern warfare requires that the engineer be not just a technical specialist, responsible for the combat employment and operation of the military equipment, but also a profound expert in military affairs, a good organizer and indoctrinator of subordinates and an ideologically mature and thoroughly developed individual.

The Soviet Army has remarkable cadres of engineering and technical personnel. This is primarily due to the social environment, which nurtures our Armed Forces and their officer cadres from an inexhaustable source. The building of a developed socialist society in the USSR and the successful realization of the party's economic, scientific and technological, social, cultural and ideological programs have affected the quality of the officer corps, including the military engineers.

In a class sense, Soviet military engineers are representatives of the working class, the kolkhoz peasantry and the socialist intelligentsia, and are linked to them by their origins, interests and aspirations. The popular nature of the Soviet Army creates an indestructable unity of fightingmen of all ranks and at all levels.

In the political respect, Soviet military engineers are active participants in all areas of our public-political life, performing the responsible tasks of strengthening the combat might of the Armed Forces. Performing in a single formation with all of the other divisions of the officer corps and guided by the Communist Party, the military engineers are making a large contribution

to the cause of defending our homeland. The real threat of a new world war being unleashed by the imperialists and the need to defend socialism are raising the political responsibility of Soviet military engineers to an unprecedented height.

In the scientific and technological respect, Soviet military engineers are highly skilled specialists measuring up to modern military-technical thought. A profound knowledge of Marxist-Leninist doctrine, the basic sciences, modern technical sciences and the principles and methods of scientific control make the military engineer an intellectual in the true sense of the word. Our outstanding successes in the development of military equipment and its successful operation are an indicator of the high scientific and technical sophistication of our military engineering personnel.

In the military respect, engineering and technical personnel are agents of modern military standards. They possess the required knowledge of Soviet military science and military art, military regulations and manuals, and set an example of discipline, performance and organization. The training system for military engineering personnel provides them with operational-tactical knowledge and skills and the ability to realize these on a practical level. The development of operational-tactical thought comprises an extremely important precondition for the development of command and other combat qualities in the Soviet military engineer. Without this, he cannot perform his functional duties.

In the cultural and ideological respect, Soviet military engineers are men of great sophistication and erudition, and agents of the Marxist-Leninist outlook and of the moral and esthetic ideals of the builders of communism.

Our party, as convincingly demonstrated by the 25th CPSU Congress, is focusing all of the main efforts and resources of the developed socialist society on the achievement of that most noble and humane goal--the building of communism. For the sake of this goal, the Soviet State is attempting to strengthen peace and security for all nations. At the same time, as documents from the 25th CPSU Congress state, "our security and the peaceful labor of the Soviet people must be reliably ensured and defended, since there are forces in the world which are hostile to detente and which reject the principle of peaceful coexistence as the foundation for relations between states with a developed socialist structure. We shall therefore continue to concern ourselves for our glorious Armed Forces--the pride of the Soviet people."[44]

Responding to the party's concern for the Soviet Armed Forces, Soviet military engineering personnel are increasing their political vigilance, improving the combat training quality and maintaining a state of constant combat readiness. There is no doubt that the continued development of the individual qualities of Soviet military engineers will make a large contribution to the work of strengthening the socialist homeland's defense capability.

FOOTNOTES

1. "Materialy XXV s'yezda KPSS"[Materials of the 25th CPSU Congress], Moscow, 1976, p 83.

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3. "SSSR v tsifrakh v 1975 godu"[The USSR in Figures for 1975], Moscow, 1976, p 17.

4. SOTSIALISTICHESKAYA INDUSTRIYA, 9 June 1969.

5. "SSSR v tsifrakh v 1975," p 184.

6. I. S. Magutov, "Inzhener"[The Engineer], Moscow, 1973, p 50.

7. S. A. Kugel' and O. M. Nikandrov, "Molodyye inzhenery"[The Young Engineers], Moscow, 1971, p 75.

8. VESTNIK VYSSHEY SHKOLY, No 12, 1972, p 6; No 4, 1970, p 71.

9. KRASNAYA ZVEZDA, 25 April 1974.

10. "Zakon SSSR o vseobshchey voinskoy obyazannosti"[The Law of the USSR on Universal Mandatory Military Duty], Moscow, 1967, p 35.

11. N. V. Kirichenko, "Tekhnicheskaya kul'tura sovetskogo voina"[The Technical Sophistication of the Soviet Fightingman], Moscow, 1971, p 31.

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13. Yu. M. Sheynin, "Nauka i militarizm v SShA"[Science and Militarism in the U.S.A.], Moscow, 1963, pp 81, 82.

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17. Yu. G. Fokin, "Nadezhnost' pri ekspluatatsii tekhnicheskikh sredstv"[Reliability in the Operation of Technical Equipment], Moscow, 1970, 28.

18. "Voyennaya inzhenernaya psikhologiya"[Military Human Factors Engineering], Moscow, 1970, p 24.

19. M. V. Frunze, "Izbrannyye proizvedeniya"[Selected Works], Moscow, 1965, p 70.

20. "Materialy XXV s"yezda KPSS," p 70.

21. Yu. I. Rachev, "Voinskiy kollektiv i yego rol' v ukreplenii boyevoy moshchi Sovetskikh Vooruzhennykh Sil"[The Military Collective and its Role in Strengthening the Combat Might of the Soviet Armed Forces], Moscow, 1972.

22. "Materialy XXV s"yezda KPSS," p 68.

23. N. A. Mel'nikov, "Na kosmodrome"[At the Spaceport], Moscow, 1964, p 35.

24. KRASNAYA ZVEZDA, 27 January 1963.

25. M. I. Kalinin, "O kommunisticheskom vospitanii i voinskom dolge"[On Communist Indoctrination and Military Duty], Moscow, 1967, pp 255-256.

26. "Voyennaya inzhenernaya psikhologiya," pp 205-217.

27. B. F. Lomov, "Chelovek i tekhnika," Moscow, 1966, pp 22-25, 32.

28. A more detailed discussion of this follows.

29. K. Marx and F. Engels, "Iz rannikh proizvedeniy"[From Their Early Works], Moscow, 1956, p 1.

30. Ibid., p 564.

31. V. I. Lenin, "Poln. sobr. soch."[Complete Collected Works], Vol 36, p 193.

32. Ibid., Vol 24, p 361; Vol 40, p 215.

33. M. F. Frunze, "Izbrannyye proizvedeniya," p 451.

34. "Voyennaya inzhenernaya psikhologiya," pp 229-250.

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41. M. I. Kalinin, "O kommunisticheskom vospitanii i voinskom dolge," pp 255-256.

42. L. I. Umanskiy, "Who Can Become an Organizer" in MOLODOY KOMMUNIST, No 9, 1966, p 80.

43. V. I. Lenin, "Poln. sobr. soch.," Vol 44, p 210.

44. "Materialy XXV s"yezda KPSS," p 154.

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