IMPACT OF THE RMA ON RUSSIAN MILITARY AFFAIRS:

VOLUME II

BY

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FALL 1997

SUBMITTED IN PARTIAL FULFILLMENT OF CONTRACTS #DASW01-94-C-0075 AND #DASW01-96-M-2850

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EXECUTIVE SUMMARY

In the early 1980s, the Soviet military was perhaps the first to argue that a new "revolution" was occurring in military affairs. Today the Russian military argues that precision-guided, non-nuclear, deep-strike weapons and the systems used to integrate them are revolutionizing all aspects of military art and force structure -- and elevating combat capabilities on the order of 10^6. According to the Russian military, superiority in the new Revolution in Military Affairs (RMA) proceeds from superiority in C^4ISR systems: 1) reconnaissance, surveillance, and target acquisition (RSTA) systems, and 2) "intelligent" command-and-control systems. Information technologies are now said to be "the most formidable weapons of the 21st century" -- and comparable in effects to weapons of mass destruction. Indeed they constitute the essence of the new, 4th RMA. The Russian politico-military leadership is therefore engineering a dramatic shift away from material-intensive systems and toward science-intensive systems: away from ballistic missiles, submarines, heavy bombers, tanks, and artillery and toward advanced C^4ISR and EW systems.

According to Russian military experts, a Revolution in Military Affairs (RMA) consists of fundamental and qualitative changes in the methods of warfare generated by scientific-technical progress. But an RMA must occur through strategy; if the strategy of war as a whole does not change, then no RMA occurs--only the results of scientific-technical progress or a Military-Technical Revolution (MTR). The current RMA appeared for the first time in the Persian Gulf War, where the coalition forces indeed changed the strategy of war as a whole.

The RMA is said to be a continuous process that is demarcated by certain "leaps" in the development of weaponry. There can be no culmination because next in line is the next "leap." The Russians thus predict that 1) in 8-10 years, precision-guided munitions (PGMs) and "weapons based on new physical principles" (NPPs) will squeeze out nuclear weapons; 2) in 15-20 years, a mass infusion of 3rd- and 4th-generation nuclear weapons will occur in advanced armed forces; and 3) in 10-20 years, "space-age wars" will become the norm. While human psychology may act as a brake on military-technical progress, the RMA will continue to evolve in the direction of increasing the "intellectual" and destructive capabilities of weaponry--thereby liberating man from the battlefield.

These qualitative changes in the material base of war are generating dramatic changes in the forms and methods of future war. Warfare is shifting away from the horizontal and toward the vertical, airspace coordinate. In future wars the main combat theater will be the airspace, while continental and maritime theaters will become supporting vis-a-vis air-space operations. As a result, the Russian Armed Forces will consist of two primary components by the year 2000: strategic strike forces and strategic defense forces, with a C^2 system identical for both. A new branch--conditionally called the EW/Information Warfare Troops--will operate with either component depending on the nature of operations being conducted.

Russian experts argue that these so-called "Strategic Non-Nuclear Forces" (SNNF) stem from the new PGMs and NPPs. The SNNF will consist of a triad of 1) strategic aviation armed with high-tech ALCMs, 2) surface ships and submarines armed with high-tech SLCMs, and 3) ground-based intercontinental non-nuclear missiles. When linked to highly accurate reconnaissance assets and intelligent C^2 systems, the SNNF form the so-called "reconnaissance-strike systems" said to constitute the nucleus of future "air-space offensive operations." The Russians calculate that about 50,000-70,000 cruise missiles, RPVs, and NPPs will be required to conduct such an operation. Because these systems are capable of destroying the enemy's retaliatory means and military-economic potential, the seizure and occupation of his territory are said to be unnecessary.

The changing nature of future war is generating corresponding changes in the "law-governed patterns" of war. For example, the offense will dominate the defense, and maneuver will replace positional warfare. Because the first air-space offensive operation can achieve the war's strategic objectives, the war's initial period can also be its culmination. Previously a factor that could be surmounted by heroic efforts, surprise has become an irreversible factor that cannot be absorbed.

Future war will be a war of "technological surprises," characterized by the massive application of new technologies. Its duration will be short, and dependent on the quantity of new systems stockpiled at the outset of war. The success of these systems is in turn dependent on the effectiveness of their information support. The Russians thus conclude that warfare has indeed shifted from being a duel of strike systems to being a duel of information systems.

The Russian military hierarchy clearly understands the strategic and tactical implications of the new RMA, and has developed a detailed planning framework for generating appropriate responses. The need to spend a disproportionate share of scarce military resources on developing such responses is recognized by all senior military officers. Notwithstanding the high priority assigned to the RMA, Russia is unlikely to possess the economic and technological resources to match the U.S. in advanced military technologies for at least 10-15 years. This deficiency may force the General Staff to continue relying on more territorial, "brute-force" solutions to military challenges, most notably the employment of nuclear weapons.

But the current strategy of selective investment coupled with careful analysis of U.S. vulnerabilities could enable Russia to compete with and even surpass U.S. forces in specific operational niches -- such as information/electronic warfare -- long before the RMA is generalized throughout the Russian military. Current U.S. military doctrine refers to such niche threats as "asymmetrical warfare." The U.S. vulnerabilities that Russia has chosen to exploit are technological, doctrinal, organizational, and cultural. Even when the vulnerabilities in question are not technological (e.g., American aversion to casualties), Russia may be able to use emerging military technologies to more fully exploit them. Over the longer term, a restoration of economic vitality may enable the Russian military to "leapfrog" U.S. capabilities because many of the technologies in question involve dual-use applications that are readily available in global commerce.

Russian military scientists note that they have fully developed the theory of information warfare, as well as the methodological foundations for conducting a future "reconnaissance-strike operation." But "the pragmatic Americans," they say, "have undertaken the resolution of individual issues without having resolved general issues." Indeed the U.S. government currently views Russia as a Third World country -- albeit with massive nuclear megatonnage. This research provides a basis for a more prescient vision of the nature and capabilities of the Russian Armed Forces in the 21st century.

TABLE OF CONTENTS

I. NATURE OF THE NEW RMA

PRIOR STAGES IN WARFARE

According to General-Major M.A. Borchev, the evolution of warfare has proceeded in eight stages. The first stage (from ancient times until the 15th century) is characterized by the use of edged weapons used individually or collectively; and by the exploration and development of the expanses of dry land, rivers, and inland seas in separate areas of civilization. Armed struggle at that time was confined to localities and boiled down to clashes between groups of forces and means on the battlefield. Its outcome as a rule determined not only the military, but also the final political results. During this period, the fleet played an auxiliary role.[1]

The second stage (from the 16th century to the middle of the 19th century) is connected with the use of firearms by individuals and collectively, the exploration of the oceans, the appearance of sailing vessels, and their employment to conquer overseas territories. The battles on land and on sea as a rule ended in general engagements whose outcome determined the achievement of the final political objectives. The results of a war depended largely on the economic, political, and other types of struggle.

The third stage (the latter half of the 19th century) began with the appearance of the steam engine and the creation of the first types of automatic weapons -- machine-

[1] General-Major M.A. Borchev, "Military Science: Development and Contemporary Structure," Voennaya mysl' (hereafter cited as VM), No. 12, 1993, pp. 35-44.

guns. It included the use of railroads, armored fleets, and air balloons for support actions. Air balloons were used in the 1848-1849 war between Austria and Italy for bombing Venice with incendiary and explosive bombs.

The fourth stage (from the start of the 20th century to the 1930s) is connected with the use of new means of armed struggle and support of military actions. This period sees improvements in automatic firearms and artillery weapons; as well as the use of aviation, tanks, and chemical weapons. Armed struggle becomes more dynamic, and the possibility of making an impact on the enemy's operational depth emerges. Naval forces undergo qualitative changes: not only are the expanses of the oceans becoming mastered, but also their depths. The airspace becomes a sphere of armed struggle. The role of military coalitions becomes considerably enhanced. Armed struggle comes to involve huge regions, and naval operations come to acquire independent strategic importance.

The fifth stage (the 1940s) is remarkable for the creation of qualitatively new aviation, tank, artillery, and other equipment. Their emergence leads to the development of the theories of engagement in depth and operations in depth, which are given a priority importance. Armed groupings on land become highly maneuverable, capable of overcoming tactical and operational zones and also of operating detached from the main body of forces. The more developed countries create a powerful military-industrial complex that ensures the development of equipment and weapons not only in preparation for the conduct of military operations but also when they are in progress. For example, combat aviation and tanks appeared during World War I, and missiles and nuclear weapons appeared in the years of World War II.

The struggle that unfolded on the expanses of a number of continents and oceans assumed a local-volume nature. Military actions on ocean expanses and in the air-space gained an independent significance, but the armed struggle on land remained as before of decisive importance.

The sixth stage (the 1950s) is connected with the emergence of masses of the latest land-based (rocket-propelled) aviation and naval weapons, the first models of operational and tactical missiles, and improvements in nuclear weapons. They seriously altered the nature of military actions on the tactical and operational levels because they facilitated strikes against aircraft and naval vessels at their bases and at targets in the rear. The exploration of outer space for military purposes began, and armed struggle began to acquire a global nature.

The seventh stage (the 1960s and 1970s) was marked by the emergence of strategic nuclear forces based on land, sea, and in the air; and by the exploration of outer space in the interests of the organs of political and military control as well as of an effective employment of troops and naval forces. The nature of armed struggle became definitively global.

The eighth stage (from the beginning of the 1980s) is characterized by a build-up of the scientific and technological knowledge accumulated in the last years of the Cold War. The implementation of those achievements in the 1990s and at the start of the coming century will inevitably turn terrestrial outer space into a fresh sphere of armed struggle which consequently will become fully global.

According to Russian military scientists such as General-Major V. Slipchenko, warfare has evolved through the following five "generations": 1) infantry and cavalry without firearms; 2) gunpowder and smoothbore arms; 3) rifled small arms and tube artillery; 4) automatic weapons, tanks, military aircraft, signal equipment, and powerful new transport means; and 5) nuclear weapons. The impending sixth generation of warfare, with its centerpiece of superior data-processing to support smart weaponry, will radically change military capabilities and, once again, alter the character of warfare. Future wars will see smart conventional weapons destroying precisely located targets and limiting casualties while defeating the enemy militarily and politically with, in most cases, no need to occupy enemy territory. Military operations will be space-based with greatly expanded command and control, electronic and air defense warfare, automated data communications, and reconnaissance capabilities.

Sixth-generation warfare has thus changed the laws of armed combat and the principles of military art -- changed the very coordinates of war. In wars of past generations, the main efforts of the warring sides were confined to the earth's surface: the width and depth of the offense or defense; the vertical coordinate (primarily air) was auxiliary or only supporting. But in future wars, the emphasis will be reversed. The main efforts in future armed combat will be concentrated on the vertical or aerospace coordinate, and efforts on the ground will become supporting.

Accepted military-scientific knowledge at a certain stage often suppresses the fundamental novelties of other scientific schools that do not agree with the basic professional education directive. But the time comes when these novelties can no longer be ignored, and practice based on existing military science comes into conflict with them. The whole process finally leads to the formation of another basic paradigm - - a new basis of military science. Thus the regularity of its development reveals a scientific picture of the objective essence of armed struggle expressed in the shape of an empirical, or in current conditions, an unobservable or idealized object of research.

Hence research into the essence of armed struggle and its connections with the other types of struggle should be the starting point of military science. The global nature of differences and therefore of armed struggle, their complexity and collateral subordination have led to the need to regard the strategy of resolving differences, the preparation for and conduct of war and armed struggle not only in unity, but also as an hierarchical multilevel system that allows skillful control of strategic operations on land, sea, in the air, outer space, theaters of war, and strategic sectors.

In this system of strategies, the top level hands over its coordinating decision to the lower level which, in turn, influences by its actions the implementation of the decisions of the upper level of strategy. The lowest of all levels in the hierarchical multilevel system of strategies in one or another sphere of armed struggle is the top level of immediate control of military actions in it, whereas the lowest operational level is the top level of tactical control over the preparation for and conduct of military operations.

But at any strategic, operational, and tactical level in various spheres of armed struggle and at its different stages, the tasks are being fulfilled by corresponding groupings and by the formations, task forces, units, and subunits they comprise, so one can speak about strategic, operational, and tactical actions of these groupings rather than about the actions of branches of armed forces as is accepted at the present time. The latter's function is organizational development and training of homogeneous formations coordinated on the basis of activity and the system of arms and equipment.

The indissoluble bond between the lower level of strategy in every sphere of armed struggle and the levels of operational art and tactics provides reasons to regard their totality as a subject for research into such branches of military science as the theory of military-ground (strategic missile forces, air defense forces, ground forces), naval, air forces, and military-space art.

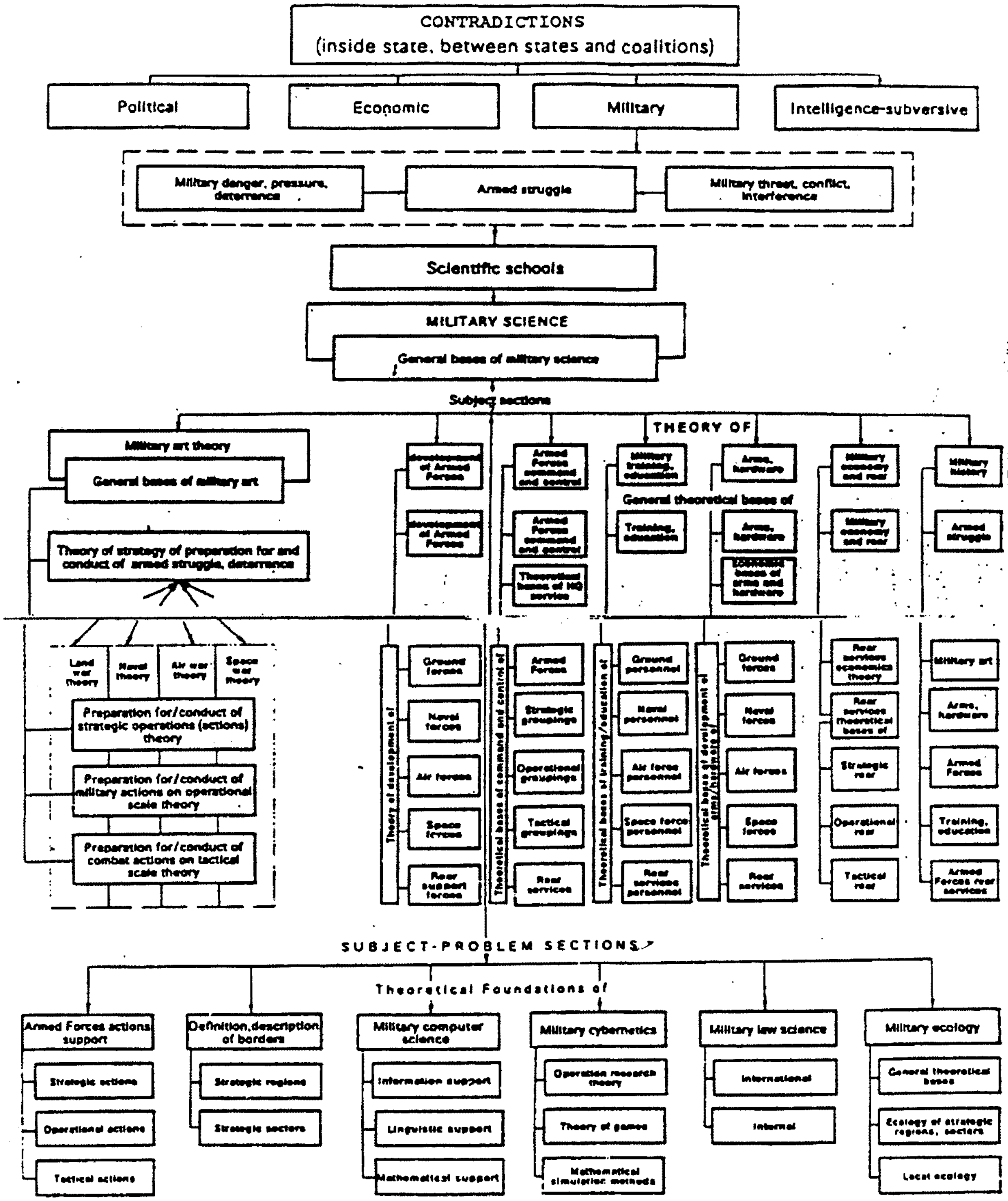
It is not hard to notice from the foregoing that the general theoretical foundation of military science and military art is the font of the initial knowledge which is then used for theoretical substantiation of organizational development and the employment of armed forces, their training, education, and command and control. Objective knowledge acquired by scientific schools about these and other processes of preparing for and conducting armed struggle form in their totality the structure of subject and subject-problem sections of military science (see Figure 1).

EVOLVING KEY TRENDS

Russian military scientists assert that the evolution of the means of armed struggle has been affected primarily by the following key trends.[2]

- First, the accelerated equipping of troops and improvements in information systems have resulted in a great leap in the degree of

[2] Colonel Yu.D. Ilyin, "On Some Trends in the Development and Ways of Balancing the Army Weapons System," VM, No. 6, 1994, pp. 38-46.



The Structure of Military Science

FIG 1

coordination among branches and combat arms during preparations for and in the course of combat operations. The scale and effectiveness of information warfare have increased immensely. Given that, the prompt determination of the enemy's intentions and operational objectives acquires particular significance.

- Second, the scale and depth of operations have increased significantly; in addition, operations have been characterized by a wide-scale, comprehensive engagement of diverse forces and weapons, with a stress on air attack equipment.

- Third, the main emphasis in operations is laid on a balanced combination of powerful fire support, electronic suppression, and close coordination between troops and technical supersystems. Groupings that have been created tend to have a considerable numerical superiority in the areas of the main thrust, act in an unconventional fashion, and use new methods that ensure the least possible losses among their personnel.

- Fourth, combat operations are carried out around the clock, under any weather conditions, and in extremely maneuverable forms. The long-standing principle of cyclical preparation and delivering strikes on targets is being replaced by a new spot-and-hit principle based on real time.

- Fifth, measures related to the identification and protection of troops from high-precision and other weapons of the enemy, to an increase in survivability, and to the ability to fulfill missions with the requisite effectiveness are taking on an ever-increasing importance. At the same time, one of the most important missions is combatting assault-sabotage forces (forces of special operations and rapid reaction; army and naval sabotage-reconnaissance formations; airborne, air-mobile, and naval assault forces; and also band formations cooperating with them).

- The sixth trend has an economic bottom line. Further improvement in the Army's weapons systems will presumably proceed under conditions of austere financial restrictions on the development of weapons and military hardware. This necessitates not only the efficient spending of appropriations and their allocation among priority sectors in accordance with long-term prospects, but also a systematic analysis of already obtained or forecast results of the performance of models and systems of weapons and military hardware on the battlefield in service with troop formations acting in coordination. For instance, following a lop-sided investment in the development of high-precision weapons, particularly in the improvement of their strike and guidance modules, a situation may arise wherein the combat employment of high-precision weapons will be useless or inadvisable. This will be a possibility when the development of environmental control equipment is neglected: high-precision weapons tend to have enhanced sensitivity to the geophysical conditions in which they are used. This is why it is essential to closely monitor the progress of foreign research in the area and to be ready to counter measures aimed at purposefully changing geophysical conditions by using equipment and methods of actively influencing the environment.

Another fairly urgent objective is the establishment of a rational balance between high-cost and low-cost systems; that is, between types and classes of weapons that differ substantially in terms of cost invested throughout their life cycle. It is necessary to point out that the use of partial future cost indicators in military-economic analysis (for instance, by calculating only development and quantity production costs) often gives rise to distorted conclusions, because in this case operating costs, the costs of recycling weapons and military hardware, and so forth are left outside the analysis. According to the systematic approach, not only should models and systems of weapons and military hardware that are in service with troop formations and located in arsenals and bases be analyzed, but also the entire infrastructure employed for the storage, repair, servicing, and operation of the equipment.

One of the ways of creating an effective reserve is to set up the quantity production of dual-purpose equipment. At present, priority should be given to achieving a scientific-technical head start in the area of critical technologies and dual-purpose technologies that would also contribute to the development of the country's civilian industry. Solving the dual-purpose technology problem will be a matter of national importance that requires a completely new mechanism of dealing with it.

THE NEW REVOLUTION IN MILITARY AFFAIRS (RMA)

According to Russian military experts, a revolution in military affairs (RMA) consists in fundamental and qualitative changes in the methods of warfare generated by scientific-technical progress. These fundamental changes have a tremendous impact on how armed forces are structured, trained, and employed.

But an RMA can only occur through strategy. Inasmuch as strategy encompasses the theory, practice, and conduct of war on the whole, it is the level from which all other changes proceed. New technologies may exist, but their military application is not apparent except through strategy. It is the symbiosis of these two elements that generates an RMA. If strategy does not change, then no RMA occurs -- only the results of scientific-technical progress or a military-technical revolution (MTR).

Not every MTR will engender an RMA. An MTR must pass through strategy -- through military doctrine and the strategy of the state -- and generate changes in the forms and methods of waging war as a whole. If an MTR occurs only through tactics and operational art, then it remains an MTR and simply introduces new elements into the old forms and methods of warfare. An RMA, on the other hand, must change the strategy of warfare as a whole.

The appearance of new weapons does not automatically generate new methods of warfare -- a specific theory of their employment is required. And here military doctrine or military theory can either drive the RMA or retard it. For example, a defensive, passive military doctrine doomed the Iraqi army to defeat despite its impressive combat potential. A state can thus accumulate mountains of weapons and still suffer bankruptcy in future war. Military doctrine must be a derivative of military-technical progress; if it is developed subjectively, it is neither filled with content nor backed up technically and politically.

The first stage of the current RMA is said to be the emergence of nuclear weapons; the second stage is the emergence of non-nuclear PGMs, which are radically changing the principles of tactics, operational art, and strategy. But theory continues to lag behind practice: weaponry moves forward while human psychology acts as a brake on the development of military affairs.

For example, new weapons often acquire a certain fetishization and become "absolute weapons." This phenomenon occurred in the case of nuclear weapons and will perhaps occur in the case of PGMs. But the history of arms development consists in a constant struggle between offensive and defensive weapons. Hence "information weapons" emerged to neutralize the most vulnerable components of PGMs.

An RMA is thus a constant, evolutionary process that is demarcated by certain boundaries. There can be no culmination because next in line is the next leap: robotics, artificial intelligence, weapons based on new physical principles (NPPs), etc. Some of these systems have already been adopted into the inventory, but an RMA occurs only when they become mass weapons; i.e., when they are introduced to both the lower and operational-strategic echelons. Russian experts predict that a mass infusion of NPPs will occur within 10-20 years. The next RMA will occur when NPPs are based in space.

For the United States and Russia, the RMA will end when the new technologies, a new armed forces, and a new theory of warfare are fully assimilated. This process may continue for 10-15 years or even longer. But new technologies and new theories of their employment will inevitably appear -- and a new RMA will again be required.

Today, the main threat to a state's national security is a technological lag in the development of the new weaponry. The state that can quickly rearm and transform its armed forces will have no opponents on the planet. The costliness of the new systems must therefore be weighed against a state's assessment of the value of its own sovereignty. Russian experts assert that those states capable of competing in the RMA and conducting a future war include the United States, Russia, Japan, China, Taiwan, Israel, South Korea, and later India and Pakistan. They predict that a mass infusion of PGMs will occur in these countries within 10-15 years.

Not one state can yet assert that the RMA has already occurred, and many are uncertain about whether or not to implement it. A continuous struggle is occurring in most countries, and the military-industrial complex will play a decisive role. It must reject completely the present generation of cheap weapons that can be manufactured quickly but are obsolete, and shift to the output of completely new arms for future war.

Certain processes in the U.S. and Russian Armed Forces are currently impeding the progress of the RMA. It is difficult to give up systems and missions that were the linchpin of past wars but which have become obsolete in future war. For example, Russian experts are now assimilating the experience of the Persian Gulf War, but through their own perspective. At the same time, these experts acknowledge that scientific-technical progress cannot be stopped.

Not every state has the capability to compete in the RMA. For an RMA to occur, it is necessary to combine progress in science -- including military science, with progress in engineering and technology -- including military technology. Progress in these two spheres must produce a new product: military-technical progress, which in turn must engender an MTR.

Yet if a state has the required objective, internal conditions for conducting an RMA -- scientific, intellectual, industrial, and financial potential -- but lacks the requirement dictated by its strategic situation and foreign policy, then it will not transform its potential into an RMA. Preventing the appearance of new weapons therefore requires eliminating the motivations that drive a state to acquire new weapons and implement an RMA. According to some Russian experts, this now is the crux of the new international relations that must form in the world community. The RMA is therefore not inevitable, but proceeds from those abnormal international relations that generate the need to ensure one's security with military force.

During the next 10-15 years, say Russian experts, Russia will achieve some successes on the theoretical plane, but economically it will hardly be able to produce the required mass numbers of weapons. There will be some elements for future war, but Russia will be forced to rely on past wars and drag behind it a train of ground forces and other traditional branches. For example, Russia produces state-of-the-art ALCMs and SLCMs, but is economically incapable of massively rearming with them. Some kind of potential for a later re-arming could be created by producing these systems in small quantities, selling them, and thereby expanding the VPK's production potential. Theoretically, Russia substantiated the need for new weapons; technologically it can develop them; but economically it lacks the funds to mass-produce them.

In the foreseeable future, the main danger to the United States will come not from Russia but from new centers of economic strength and especially from aspiring members of the nuclear club. Russian experts argue that such lesser powers could choose certain sectors of the RMA and use them very cleverly not to be victorious but to impede the progress of bigger powers. Certain states could acquire sufficient quantities of specific weapons components simply because they can afford them. For example, oil-rich Arab countries could acquire these weapons to at least blackmail their enemies.

Russian experts assert that the United States is intentionally downplaying the importance of the RMA in order to conceal the true focus of developments in the U.S. Armed Forces. At the same time, Russia is said to be downplaying the RMA in order to conceal mistakes already made in both the organizational development of the Russian Armed Forces and the methods of their future employment.

In summary, Russian experts assert that the current RMA will be characterized by more frequent leaps in the development of weapons in shorter time intervals. The RMA is thus an endless chain of stages generated by ever-newer weapons. It will be a continuous process -- albeit with boundaries -- but always in the direction of increasing the intellectual and destructive capabilities of weaponry, thereby liberating man from the battlefield.

"U.S. VIEWS" ON THE RMA

In early 1995, the Russian press published a Washington Post article that focused on the new RMA. The following are excerpts from that translation.

Washington Post Correspondent Bradley Graham reports that U.S. Secretary of Defense William Perry and General John Shalikashvili, chairman of the Joint Chiefs of Staff, have come to believe that a genuine revolution in military affairs is possible right now. Seventy-three year-old Andrew Marshall, who has been in charge of long-term planning at the Pentagon since Nixon's time, is the intellectual father of the restructuring that is coming into being and Perry's deputy, John Deutsch, and Shalikashvili's deputy, William Owen, are carrying out its practical management. Marshall has long argued that the United States has entered an historic period, similar to the 1920s-1930s, when rapid technical progress resulted in the development of new aircraft, internal combustion engines, radio transmitters, and radar systems that produced a revolution in military affairs. At that time, Germany developed the *tactics of the Blitzkrieg and the United States -- the concept of strategic area bombing, carrier-based aviation, and modern amphibious assault landings.*[3]

The current technical revolution consists in the development of more powerful transmitters and computers, precision-guided munitions that are capable of ending up in the stove pipe of the building being fired at, and fiber-optics communications systems and coatings that are invisible to enemy radar. The innovators argue that generals need to abandon the habit of employing clumsy and easily located ground armies and naval armadas with aircraft carriers in order to fully exploit the potential of these miraculous technologies and to defend themselves from an enemy who has mastered them.

Compact, mobile military units armed with the new equipment and super-modern electronics will go out onto the battlefields of the future in place of them. As an example, Graham mentions the miniature television cameras installed on the assault rifles of some American soldiers in Haiti. These cameras are capable of transmitting images from the battlefield to the command post and, from there, via satellite -- directly to the Pentagon. The U.S. Navy is developing a missile whose course will be corrected in flight based upon reconnaissance data that is arriving from the battlefield.

American soldiers, who instantaneously receive current information on the disposition of the enemy on a screen and who fire at the enemy from beyond the

[3] Vladimir Kozlovskiy, "A Revolution in Military Affairs Permits the American Army 'To Defeat Not With Numbers but With Skill'," SEGODNYA, March 1, 1995, p. 4.

horizon without having caught sight of the whites of their eyes figure in the dreams of the innovators. General Shalikashvili notes that the Persian Gulf War was "an instantaneous snapshot of the revolution that is taking place." "The very nature of modern warfare is changing," states a written statement by Shalikashvili to the Congress.

According to Russian military experts, the following are becoming principal components of the "new revolution in military affairs" for the United States: predominance of mobile operations, which will be supported in the Navy, for example, by the creation of various combat and auxiliary seaborne and airborne platforms for new kinds of weapons and their supporting assets. It is expected that in the first half of the 21st century the U.S. Navy order of battle will have up to 450 ships and vessels. One can judge their characteristics based on the requirements being placed on the surface ship of the 21st century. She must be multipurpose -- employ precision weapons; provide fire support in conducting amphibious landing operations; provide ABM defense in a theater of military actions (TVD); oppose the air, surface, and subsurface threat; conduct battle both in the open ocean as well as in coastal areas; possess high survivability; provide a base for helicopters and drones; and have standardized launchers for employing missiles for various purposes, including ABM interceptors. The missile unit of fire aboard them will be up to 500-1,000.[4]

Inasmuch as the delivery of precision strikes is considered to be the basis of success in the modern battle, engagement, campaign, and war as a whole, the U.S.

[4] Major M. Boytsov, "The 21st Century and the U.S. Navy," Morskoi sbornik (hereafter cited as MS), No. 7, 1995, pp. 74-78.

Navy and Marines will have a considerable quantity of precision weapons already in this decade. Ideas were advanced for creating multipurpose assets for the Navy with consideration of lessons from the war against Iraq. These are general-purpose ballistic missiles with calibers of 83, 30, 21, and 12 inches launched from SSBNs or from general-purpose vertical launchers, with various platforms. Like the employment of SLCMs their employment is considered effective in delivering strikes against shore, intercepting ballistic and aerodynamic targets, combatting enemy satellites, inserting friendly assets into space, and destroying submarines. It was presumed that general-purpose ballistic missiles will have a range of up to 3,000 km, subsonic SLCMs up to 3,700-13,500 km, and supersonic SLCMs up to 1,600 km.

Projects were advanced for creating gliding ballistic missiles with an effective range of up to 1,400 km against shore targets and up to 630 km against submarines. The creation of a global SLBM (range 15,725 km) with 2-4 maneuvering MIRVs with a conventional charge on each and accommodation of 2-4 such missiles on SSBNs was assessed as possible. Their target kill probability is expected to be no worse than 0.9 with a CEP of about 3 m. It was proposed to have ship electromagnetic guns in particular for delivering a 203-mm hypersonic guided projectile with kinetic munitions to a range of 185-925 km and electrothermal guns for air/ABM defense of ships in the closest zone. Possibilities of using laser, beam, kinetic, and EMP weapons in the Navy were confirmed. It was deemed possible to arm ships with high-energy lasers for combatting satellites and tactical ballistic and cruise missiles with a killing range of 600-800, 200-400, and 20 km respectively. Questions were studied as to the expanded use of kinetic munitions which penetrate soil, water, and ice; shaped-charge, including multiple-stage, munitions (directional, aimed, and deforming explosion); solid-propellant pressure-effect munitions; and munitions using "reactive metals and elements" which, compared with conventional fougasses, increase the level of damage inflicted on ships and other armored targets by 2-4 times.

In accordance with this, at the borderline of the 1990s the United States advanced the following options for creating 21st-century ships:

- a large nuclear-powered submarine of modular design with a displacement of 8,200-10,700 tons with 8-24 launchers accommodating 8-96 general-purpose ballistic missiles or up to 216 SLCMs;

- a small nuclear-powered submarine with a displacement of up to 5,000 tons with 4-36 SLBMs, general-purpose ballistic missiles, and SLCMs;

- air-cushion aircraft carrier displacing 9,000 tons with a speed of about 80 kts and capable of carrying 27 aircraft and helicopters;

- double-hulled catamaran aircraft carrier (29,700 t, 28kts, 27 aircraft and helicopters, and 244 general-purpose ballistic missiles);

- surface combatant with 158 vertical launchers;

- attack destroyer (8,700 t, 28 kts, 212-288 vertical launchers with a unit of fire of up to 320 missiles);

- semi-submersible surface ship (4,800 t, 30 kts, 30 general-purpose ballistic missiles);

- strategic missile catamaran platform (9,800 t, 28 kts, over 180 general-purpose ballistic missiles) and attack missile catamaran platform (8,600 t, 28 kts, over 180 general-purpose ballistic missiles);

- attack ship with electromagnetic guns (7,600-10,200 t, 24 kts, 2 guns);

- general-purpose assault ship (30,000-40,000 t, 20-25 kts) in the following versions: amphibious assault, air-capable, air defense, and logistic support;
- catamaran module--a mobile floating supply base (a cluster of three 600 t modules with a deck length of about 1,500 m in a cluster of 3 modules, speed 18-20 kts);
- reconnaissance-strike air-cushion ship (450 t, 33-35 kts, 20 general-purpose ballistic missiles, 4 antiship missile launchers, and 2 torpedo tubes);
- remotely controlled naval target simulator craft (81 t, 35 kts, and simulation and deception electronics);
- air-cushion platform for operations under Arctic conditions; and many others.

Options for creating flying craft for the Navy included the following: new land-based patrol aircraft with standard armament or with general-purpose ballistic missiles; outfitting of patrol, attack, and fighter aircraft with ABM interceptors in vertical launchers or on horizontal suspension; an advanced short takeoff and vertical landing fighter; and several types of manned and unmanned reconnaissance aircraft, including 3 types of high-altitude reconnaissance aircraft with great endurance (altitude to 21-26 km, speed 100-500 km/hr, endurance 2-60 days) launched from ships, short airfields, or with the help of rockets. In addition, options were examined for creating high-altitude reconnaissance dirigibles (20 km, 140 km/hr, endurance up to 30 days) and reconnaissance balloons (21-36 km, duration of operation one year). It is considered realistic to create an ocean-going wing-in-ground-effect transport vehicle weighing 5,000 tons having a payload of 1,500 tons and capable of delivering 1,200 tons of military equipment and cargoes and 2,000 servicemen to a distance of 20,000 km at a speed of 400 km/hr.

LESSONS OF THE PERSIAN GULF WAR (PGW)

Russian military experts list several causes of the coalition's victory over Iraq. First of all, the stereotypical, dogmatic thinking and passive strategy of the Iraqi leadership. Given his southern group of forces, Saddam could have conducted the war differently. Even in mid-August 1990, when the Multinational Forces (MNF) were concentrating strike groupings, Iraq could have launched a preemptive strike that would have disrupted the coalition's plan. At that time only the 82nd airborne troops and other covering forces had been deployed in Saudi Arabia.

Second, the MNF's absolute technological superiority over Iraq. The essence of this superiority lay above all in the space-borne assets that gave them a total picture of Iraqi troop deployments, etc., whereas Hussein lacked this advantage. But at that time, space-borne reconnaissance assets were not protected against countermeasures. If Hussein had possessed such capabilities, the MNF would have been deprived of this advantage.

The air forces played the decisive role in this war. And here the MNF's technological superiority turned out to be complete. The overall correlation of MNF air forces was 4.3:1; fighter aviation was 2.8:1; tactical strike aircraft was 4.8:1; reconnaissance aircraft was 6.4:1; and strategic aviation was 10.8:1. This technological superiority played the decisive role in the course of the air offensive operation. Only 10-15% of the Iraqi Air Force consisted of modern combat aircraft. The third factor that conditioned the MNF victory was absolute superiority in electronic warfare (EW) systems.

Russian military scientists argue that the Persian Gulf War (PGW) is the prototype of the new RMA. The PGW was characterized by many features of future war. These included above all the massive application of new military technologies: about 100 new systems were introduced in the PGW. This represented a revolutionary technological leap in the means of warfare. The majority of these means were unknown to the Iraqis; as a result, they lacked any countermeasures and remained absolutely passive.

The weapons used there are weapons of the 21st century, because the armies of other countries will be able to incorporate mass quantities of these technologies only within 10-15 years. Such weapons as reconnaissance-strike complexes, JSTARS, Apache helicopters, Pioneer RPVs, ATACMs, and a whole series of other weapons are only now being tested by the armies of other countries, but they will eventually define the face of future war.

According to Russian military experts, the PGW has radically changed the forms and methods of warfare. First, space has become a real and active TVD: the PGW was the last war of attrition and the first "space-age war." Wars of attrition have become an anachronism, and Russian experts predict that "space-age" wars will become the norm within 10, 15, or 20 years.

What particularly amazes Russian experts is the unusual new relationship between the electronic-fire phase of warfare and the ground phase of warfare: 40 days of the former and 4 days of the latter, which has never occurred before. They have concluded that this will be a typical law-governed pattern of future war because such operations ensure the preservation of manpower and the accomplishment of missions by weapons systems.

Such new and independent forms of warfare as the electronic-fire operation are therefore being generated; i.e., the combination of electronic suppression with fire. This is a new form of military operation. The MNF used EW to suppress and deny the opponent his capability to retaliate, and fire to destroy him. This phenomenon has led the Russians to conclude that victory can be achieved without the ground forces.

New forms of operations such as air-mobile, vertical envelopment, and a whole series of others are also changing the principles of warfare. First, the principle of massing forces and means. Compared with WWII, the concentration of forces and means was 10 times less in the PGW. Here the principle of massing was implemented not by mass, but by new technologies: high-precision weapons, JSTARS, Apache, etc., which themselves created a concentration of firepower.

Another example is the principle of surprise. It played the decisive role in this operation. Here there were above all political, diplomatic, technological, and purely military factors that together supported achievement of this principle. It clearly seemed that a threat was being created for Iraq: masses of troops were being concentrated, it was not being concealed over radio and television, and it all indicated that military operations were beginning. What surprise can there be when troops are being concentrated, etc.? Nevertheless the factor of surprise was achieved on the tactical, operational, and even strategic levels.

Even in nuclear warfare, they argue, surprise was a temporary factor that could be absorbed and then overcome by heroic efforts. But in future non-nuclear war the side that achieves surprise achieves information dominance and consequently air supremacy. Surprise thus ensures the achievement of not only the strategic initiative, but also victory.

Russian experts also stress the growth in importance of the human factor in modern war. The qualitative superiority of U.S. Armed Forces personnel permitted the United States to fully realize its military and technical advantages. A professional army taking part for the first time in a war of such a scale proved its combat effectiveness and advantage vis-a-vis the criterion of cost-effectiveness. One of the conclusions that follows is that the use of modern, sophisticated weapons is possible above all on the basis of professional armies.

Another lesson involves the growth of the role of strategic mobility of the armed forces. The potential of U.S. mobility that was achieved has a global character and permits creating the necessary grouping of forces and assets in practically any part of the world.

Russian experts also describe the numerous innovations that characterize the PGW. First, the coalition forces developed a method for rapidly winning air superiority: Iraqi air defense was suppressed in the first 24 hours, and in a week it essentially stopped functioning. Second, 240 of the 900 sea-launched cruise missiles in the theater were employed, and over 90% of these missiles hit the most important military targets. Third, for the first time precision weapons performed those missions which had been accomplished in past wars by manned aircraft. And the probability of accomplishing those missions was more than 90%. Fourth, for the first time there was coordination of strikes by manned aircraft and cruise missiles. Finally, the coalition forces for the first time employed F-117A stealth aircraft very widely. They struck over 40% of all targets which were hit in this war, although they flew only 3% of the sorties.

As already noted, Russian experts argue that Iraq was defeated even before the war began -- above all in the sphere of information warfare (IW). These experts thus stress that the PGW represents the prototype of the new RMA because the coalition forces changed the strategy of war as a whole.

II. NATURE OF FUTURE WAR

KEY TRENDS

Russian military scientists stress that it is impossible not to take into account the radical changes in the nature of modern war. At the borderline of the 1980s and 1990s, for example, "U.S. military specialists" concluded that the "air-land operation" no longer takes full account of the objective requirements for military operations. In their opinion, the concept of "battlefield" should be replaced by the concept of "operational space," in which ground, air, and space components of the armed forces work closely together. Under those conditions the "air-land operation" turns into the "universal operation." This was the name given to the new concept whose basic provisions were reflected in the 1994 U.S. Army Field Manual FM 100-5 "Operations. New Edition."[5]

The work Fourth-Generation War (published in the United States) asserts that a future war will be waged primarily by new means of warfare. This means above all traditional precision weapons as well as laser, beam, accelerator, and other weapons. Space combat systems, unmanned aircraft, robotized precision weapons, reconnaissance-strike complexes, and so on will see further development.

The Persian Gulf War (PGW) has both transformed Soviet/Russian military art and validated some of its central concepts regarding the nature of future war. One of

[5] Colonel Nikolay Dukin, "War Experience Which Must Not Be Forgotten: It Is Possible to Learn from Mistakes, but Impossible to Forget Them," Armeyskiy sbornik (hereafter cited as AS), No. 5, 1995, p. 27.

these concepts is that in future war, the decisive role will be played not by ground force groupings but by "high-precision weapons" (PGMs) and "weapons based on new physical principles" (NPPs). Another concept is that in 8-10 years or more, PGMs and NPPs will squeeze out nuclear weapons. Although nuclear weapons will remain in limited numbers, their functions will be replaced by the new systems. The capabilities of PGMs and NPPs already approach those of nuclear weapons in terms of their target sets. At the same time, the new systems could detonate a nuclear war since they can precisely strike the opponent's nuclear facilities.

If two states are capable of fighting two different types of wars, then the side that fights the new war will be victorious. The other side will be compelled to fight with older forms of warfare, and compelled to employ its ground forces in a defensive mode even if the other side is not using its ground forces. The defending side will wait for a golden opportunity to use all of its capabilities, but that opportunity may never come. Those states unable to fight the new, sixth-generation war will only be able to repel the new, massive air-space strike.

Future war will be characterized by radical changes in the laws of war. For example, the system of spatial coordinates will change. In past wars, the main coordinate was the horizontal; i.e., the width and depth of fronts in offensive and defensive operations. The vertical coordinate basically supported combat actions on the ground. But the reverse is true for future war. The main forces will be concentrated on the vertical coordinate, while the horizontal will be supporting.

Thus the ground forces were still needed in the PGW for a variety of reasons; e.g., to demonstrate combat readiness, demarcate the FEBA, and conduct strategic maskirovka (cover, concealment, and deception). These functions will remain necessary in conventional wars. The ground forces may also be needed in future war in the concluding phase, but they will accomplish supporting missions to exploit success rather than the main missions of the war.

Future war will also be characterized by radical changes in the forms and methods of war. If in past wars the emphasis was on achieving tactical objectives, then the majority of missions in future war will involve achieving strategic objectives throughout the depth of the opponent's deployment. A large quantity of PGMs will be required to fulfill these missions. Future war will therefore be characterized not by the massed firepower of all types of weapons but by the precise use of PGMs against specific high-value targets.

Russian military experts base their prognosis of future war on changes in the "law-governed patterns of the material base," the means of warfare. One such pattern is the transition from an evolutionary, gradual development of weapons to sharp leaps in their development. Future war will therefore be a war of technological surprises, characterized by the appearance of a massive number of super-new weapons -- e.g., robotics, artificial intelligence, NPPs -- all of which are leaps in the RMA. As a result, radical changes are occurring in the means, forms, and methods of warfare.

Several law-governed patterns will determine these changes. First, a dramatic change is occurring in the relationship between the means of offense and defense: a clear dominance of offensive over defensive means. The dominance of dynamism and maneuver over positional warfare proceeds from this change, which in turn changes such categories as the initial period and surprise. Today, the war's initial period can immediately become its culmination. And surprise -- considered even in nuclear war to be a temporary factor that could be absorbed and overcome by heroic efforts -- is now said to be decisive, an irreversible factor that is insurmountable.

Finally, future war will be short; its duration will be determined by the amount of PGMs stockpiled at the outset of the war. But if both countries have PGMs and exhaust both of their arsenals, then both must return to the rules and conventional arms of past wars. And if there is further escalation, they will resort to nuclear weapons. In short, the Russians assert that future wars and armed conflicts will be "wars of weapons" -- especially robotized weapons systems -- characterized by a fierce contest for electronic-fire and information dominance in all spheres of actions.

Writing in 1997, General Vorobyev stressed that wars of the new technological era will not resemble the past two world wars, because the material-technical base of armies of leading world countries has been updated radically during the postwar decades. Thus, while the reach of strategic weapons, and particularly of long-range aviation, was 500-800 km during World War II, there are practically no spatial limitations for present missile and the newest types of boost-glide aircraft. This means that the territory of any country can become a theater of military actions and, on a global scale, the entire planet. The destructive power of conventional weapons has increased hundreds of times, and this is far from the limit, inasmuch as the appearance of new kinds of superweapons is expected.[6]

The integration of weapons and of automated reconnaissance and fire-control systems in the form of reconnaissance-strike and reconnaissance-fire complexes using cruise missiles and remotely piloted vehicles permit surgically precise operations with the goal of selective destruction of the most important installations, on a guaranteed basis and in a matter of minutes regardless of distance. EW assets have acquired exceptional effectiveness -- they are changing from supporting means to active weapons. Space assets are entering the arena of warfare. Electronics and computerization are invading military affairs across a broad front. While the U.S. Army had 800,000 computers in 1995, it is proposed to increase their number to two million in 1996; i.e., figuring one for each serviceman.

Along with classic weapons, much attention is being given to the development of non-traditional weapons such as non-lethal technologies and electronic and electromagnetic means intended for disabling communications systems, power systems, and computer networks. Means are being developed for creating all kinds of obstacles blocking the movement of transportation, including various foaming agents and unbearable odors and sounds. That is far from a complete list of innovations in military affairs. All this dictates the need to take a different look at the nature of a future war.

[6] General-Major I.N. Vorobyev, "What Kind of Wars Threaten Us in the Next Century?" VM, No. 2, 1997, pp. 18-24.

It is difficult to say specifically which of the enumerated (and not enumerated) kinds of weapons will prevail in it and determine its character. Some military theorists call it the war of information science; others the war of the space era; and still others the war of electronics, robotization, and artificial intelligence. It can be assumed that the nature of warfare will depend on a complex of the means of combat effect.

It is proposed to achieve a bloodless victory in many ways -- political, diplomatic, economic, military (if possible, without conducting combat operations in the usual understanding). A new term, "information-psychological opposition," has appeared. Its essence is that the main efforts in fighting an enemy are directed not at physical destruction of each individual weapon, but at destruction of the state's information resources, command-and-control system, and navigation and guidance channels. The pressure of force is not excluded, but is to be used first indirectly; i.e., by demonstrating military might in order to prompt the enemy not to engage in armed opposition and force him to surrender without a war (the ideal option).

But "Western experts" believe that for operations from a position pf strength it is necessary to have a decisive technological superiority over the enemy above all in science-intensive kinds of weapons -- electronics, robotization, computerization, space assets, and information science. Herman Kahn presented the idea of a "controlled war" for the first time (1960s). In the West the Persian Gulf War is considered its prototype. Forecasts are being made and corrections are being introduced to military-technical programs and military-strategic concepts based on its results; i.e., it is a standard for wars of the post-industrial era, the era of information science.

In fact, the Multinational Forces [MNF] command demonstrated the ability to make effective use of an advantage both in the military-technical as well as the information-psychological sense. While inferior to the Iraqi Army in the number of divisions, tanks, and artillery, the coalition grouping managed to utterly defeat the enemy, and with minimum losses. The advantage in aviation played a special role. Thus, MNF superiority over Iraq in the newest combat aircraft was 2.8:1 in fighters, 4.8:1 in tactical (strike) aviation, 6.4:1 in reconnaissance and EW aircraft, 10.8:1 in strategic aviation, and 16:1 in combat helicopters. In addition to aviation, the MNF also had superiority in the newest types of tanks (4.3:1), in EW assets, and in combatant ships (20:1).8 This permitted them to unilaterally seize the initiative in choosing the forms and methods of military operations. It is typical that the Americans put approximately a hundred of the newest combat systems into action in Iraq, while only a few fundamentally new kinds of weapons were used in preceding local wars. Consequently, a very important condition for success in a "controlled war" is to take advantage of the enemy's technological unprotectedness, inasmuch as there is practically nothing to compensate for this in the course of combat operations.

The next trump in a "controlled war" is the advantage in use of space assets, which also was shown by the Persian Gulf War, where space assets played an important role in the successful conduct of MNF combat operations, especially in improving the effectiveness of reconnaissance. Space assets provided exhaustive information about the enemy's status and measures he was taking. By thoroughly knowing the status of Iraqi troops, the MNF command paralyzed their operations and stunned them with the unexpectedness of steps being taken. In the future the role of space in war will rise sharply, since the capabilities of strategic means of warfare are realized to the maximum extent in the air-space sphere. It is presumed that in the not-too-distant future unavoidable strikes by precision weapons and weapons based on new physical principles can be delivered from space against any targets regardless of their degree of hardening. Thus, a country not having the capability to counter space weapons may turn out to be doomed.

A special place is reserved in a "controlled war" for information-psychological opposition. The mission posed is to achieve a substantial weakening of enemy military potential by non-force methods. The concept of "information-psychological opposition" is very capacious. It includes achieving surprise in an attack, deceiving the enemy, demoralizing the population and armed forces personnel, winning information superiority, suppressing the information system, and using operational maskirovka. Information struggle is not a new method of indirect effect on the enemy. Intimidation, deception, bribery, threats, blackmail, and the attempt to send him down a false path and thereby control behavior has been used in one form or another from time immemorial.

Information-psychological operations are becoming an integral part of miliary operations. At the strategic level it is planned to conduct them secretly long before the beginning of an invasion. The mission posed is to ensure covert control in peacetime over enemy information resources comprising the basis of state and military command and control. Capabilities for undermining state foundations from within before the beginning of military operations have risen through wide-scale use of the mass media.

Using the enemy mass media by bribing them is being counted upon. It is believed they can introduce a split in society, destabilize the domestic political situation, weaken state and economic structures, activate the work of opposition forces, exacerbate the population's dissatisfaction, achieve a disintegration or discrediting of the armed forces and other power structures, cause the people to distrust the leadership, and as a result provide political cover for aggression.

The following are principles of subversive psychological actions: covertness, a systematic nature, activeness, diversity of techniques, plausibility, a knowledge of enemy psychology, and reflexive control of his behavior. Experience shows that the covert phase of an information-psychological war may last for several years, during which time intelligence activity is stepped up to determine the enemy state's actual military-economic potential and identify vulnerable places in the state and military command-and-control system. These measure are combined with political and diplomatic actions aimed at discrediting the hostile state's foreign and domestic policy, at isolating it internationally, at depriving it of allies, and at establishing a political and economic blockade.

With the beginning of military operations, the information-psychological effect is accelerated sharply, the machinery of lies and disinformation begins operating at full power, and attempts are made to exacerbate national-ethnic, territorial, economic, and religious contradictions to the limit with the help of domestic opposition. The goal is to create a constantly operating front of struggle against the hostile country and an atmosphere of political and economic chaos, uncontrollability, doom, and hopelessness.

It is possible to judge how information-psychological operations are conducted based on the experience of the Persian Gulf War. Iraq lost the war before combat operations began. As a result of diplomatic activity and thorough political support of the military action, the United States succeeded in achieving Iraq's international isolation, including even among neighboring Arab states. The Iraqi Army was subjected to a massive psychological effect. It was deafened, blinded, and demoralized. According to Pentagon data, the Iraqi psychotropic losses significantly surpassed physical losses in Operation Desert Storm. Thus, Iraqi losses comprised 10 percent in aviation, 18 percent in armored equipment, and 20 percent in artillery in the course of the 38-day air campaign, but the personnel's morale and fighting spirit dropped 40-60 percent as a result of counterpropaganda. The Americans disseminated 30 million leaflets with the goal of demoralizing Iraqi servicemen, and 2,500 radio transmitters were put to use for disinformation.

Using Persian Gulf War experience, say the Russians, the United States continues to improve psychotropic weapons and information technologies. Thus, of 22 strategic-level critical technologies specified for the future, 12 (over half) directly concern information science. It is typical that the overall share of U.S. Defense Department budget expenditures connected with the development of command-and-control, communications, intelligence, EW, and computerization systems -- which comprise the basis of informatization -- has reached 20 percent of late compared with 7 percent in the 1980s.

Thus, actions of force fade into the background in a "controlled war." They are viewed as the concluding phase of military operations, when political, diplomatic, and other capabilities for a bloodless crushing of a hostile state have been exhausted. It is planned to resort to them when there is a prediction of guaranteed success and brief operations. Reliance is placed on the first powerful surprise attack, which will be disarming and crushing. It follows from this that a state that professes a doctrine with a strictly defensive direction can end up in an extremely serious if not critical situation.

The conditions and methods of initiating war are becoming more and more diverse. "Electronic shock" before the first round is fired is one of the effective strategic techniques to which the attacking side resorts. Thus, Israel's aggression against Arab states in 1967 began with a massive activation of EW assets. But while preliminary ECM lasted two hours in this six-day war, it lasted 24 hours in the Persian Gulf War, and a large number of the newest EW assets were used. As a result, supremacy was achieved on the airwaves, and command and control of Iraq's air defense and aviation was disorganized in the very first hours.

One of the most important factors determining the further development of forms and methods of warfare is an increased imbalance between means of attack and defense. Military experts are arriving at the conclusion that the modern defense is incapable of opposing an attacker's massive strike. Its stability turns out to be problematical. The offensive capabilities of more and more powerful kinds of weapons will grow in the future. As a result, the proportion of positional forms of warfare will decrease compared with maneuver forms. This means that counting on repelling aggression by passive defensive retaliatory actions with the beginning of war means dooming oneself to defeat in advance. At the present time more and more signs are showing up permitting the belief that a possible large-scale war will be brief. This is determined by the presence of exceptionally powerful, destructive kinds of weapons.

In their forecasts, Russian military theorists connect the duration of a war with the effect of the law of "diminishing strength" of states in the course of military operations; i.e., with their capability to compensate in a timely manner for human losses and material costs suffered in the process of operations. According to this law, war continues until a catastrophic disproportion is created in the overall balance of forces of front and rear, as a result of which a country will end up completely exhausted and incapable of supplying the army.

Regarding military operations, says Vorobyev, it is important to direct attention to the clear-cut trend toward their increased spatial scope and the prevalence of remote actions over contact actions. Troops will be forced to act under conditions of an "expanded battlefield," often in the absence of direct contact with the enemy and of a clear-cut front and rear. The remote nature of opposition presumes the delivery of strikes from afar. The sides will attempt to hit the enemy before entering into direct contact with him. This means that with other conditions being equal, success in such opposition will be on the side of the one who has the capabilities for conducting deep reconnaissance, has the advantage in long-range weapons and means of command and control, and is capable of making a decision in a sharply changing situation.

Soviet/Russian military scientists have long stressed that the present stage of scientific-technical development and the informatization of all aspects of public life are engendering a genuine revolution in military affairs. Wars of the 21st century will be of a different nature, will change in content, and will require qualitatively different armed forces. Therefore it is natural that a discussion of a new concept of war has unfolded among military theorists of a number of countries.[7]

The concept now prevailing was engendered by industrial civilization. It appeared in the era of machine production, social-class and inter-state antagonisms, the cult of armed violence, and the appearance of mass armies based on universal military obligation. Its essence is that the course and outcome of war are decided by mass armies in battles. Clausewitz initiated that understanding of the problem. In generalizing the experience of the Napoleonic wars, he arrived at the conclusion that it was not maneuvering and seizure of territories that determined the outcome of war, but destruction of enemy armed forces. He wrote: "Enemy armed forces must be destroyed; i.e., brought to a state in which they no longer can continue to fight ....The bloody resolution of a crisis and the striving to destroy enemy armed forces are the first-born son of war."

These provisions, to a certain extent correct for their time, became predominant in the understanding of the content of war during the 19th-20th centuries. Western military theorists and later also Soviet military figures transformed ideas about the

[7] V.P. Gulin, "On a New Concept of War," VM, No. 2, 1997, pp. 13-17.

decisive importance of the battle into an absolute, moving all other methods of winning victory into the background. Dogmatic use of the principle of employing armed force without any restriction and without considering what this would cost, advanced by Clausewitz, gradually led to the appearance of the theory of absolute, total war. "Total war...is the concept of preparing and fighting an aggressive war that envisages subordinating all spheres of the material and spiritual life of society and using any means and methods of mass destruction of enemy armed forces personnel and the civilian population."

Such an interpretation means that war devours all the country's economic, political, and spiritual life and presumes mass deaths of belligerent servicemen and civilians. The total war concept ended up as the basis of strategic guidelines for World Wars I and II. World War II was the fullest realization of this concept. It lasted six years, the population of countries taking part in it was 1.7 billion persons, and there were 110 million persons in tanks. This war was the bloodiest and most destructive in the history of mankind. The barbarous nature of total wars also lies in the fact that weapons employed in them do great damage to the civilian population, and the destructive direction of such wars is growing. Thus, over 10 million persons perished in World War I -- 95 percent of them servicemen and 5 percent civilian population; in World War II 52 percent of the 50 million killed were servicemen and 48 percent civilians; in local conflicts during 1945-1982 35 million persons perished, 30 million of them from the civilian population.

The total war concept, retained as the basis of strategic guidelines of many world states including Russia, became historically obsolete and an anachronism at the end of the 20th century. Further large-scale use of weapons against armies and peoples in modern wars leads to global disaster and to the death of civilization and the habitat. Mankind will not be able to survive one more world war. There are serious grounds to assume that the world is entering a period of wars of a new generation aimed not so much at direct destruction of the enemy as at attaining the political objectives of war without the battles of mass armies.

When the old concept of war becomes unacceptable and new means and methods of armed violence are created based on the achievements of social progress, the replacement of the concept of war becomes real. This requires above all a new understanding of the correlation of war and warfare, of the place and role of armed violence in the content of war, and of the importance of direct and indirect military operations in its course and outcome. Under conditions where ideas of bloody battles and direct military clashes dominated, violence was reduced to its one form -- warfare. It was believed that specifically warfare is a sign of and the chief form of war and that war begins and ends with military operations. But the essence of war lies in an acute opposition of sides with the help of violent means in the name of achieving certain political objectives.

It is possible and best of all to win a war and attain ultimate objectives and desired results without employing military operations. It should be noted that even such a champion of direct violence as Clausewitz believed it possible to impose one's will on the other side also by using political and other coercion without smashing its armed forces. The "cold war" indicates the arrival of the era of "civilized" wars, in which political goals are achieved not by direct armed intervention, but by using other forms of violence and undermining enemy might from within. Here the military sphere was an acute area of opposition, but the struggle was waged not in the form of armed clashes but by "painless" use of armed forces and by undermining military might and military organization from within.

In terms of basic signs and especially in terms of its results, the "cold war" generally can be called World War III. It resulted in disintegration of the world system of socialism and collapse of the Warsaw Pact Organization as one of the world centers of strength. Large-scale geopolitical shifts; a redisposition of forces, coalitions, and alliances; and a change of political regimes occurred -- as a result of which about 30 new states appeared. The past war not only is comparable with, but even surpasses the past two world wars in terms of the change in the world order. It appears that in the course of a confrontation of powers in a multipolar world of the 21st century, a "bloodless" war will take its place as a means of resolving contradictions among countries and world centers of strength.

A decisive turn of "Western military theorists and strategists" toward elaborating a new concept of war and new forms of warfare occurred in the last decade. They proceeded from the assumption that the nature of war inevitably will change with the qualitatively different means of warfare being created based on the newest technologies. In the opinion of the chief American ideologist A. Marshall, in the next three decades the methods of waging a war of attrition will lose all meaning, and combat equipment that is most modern as of today will lose its importance. Based on this, Marshall considers even the 1991 Persian Gulf War to be one of the last actions of the industrial era, inasmuch as despite the use of precision weapons, it was waged by old methods. According to "U.S. military" calculations, the outfitting of troops and naval forces with precision weapons dictates the appearance of fundamentally new forms of warfare. Thus, in future military operations the U.S. military leadership intends to reject arms whose use entails enormous human losses, destruction of material values, and disruption of ecology. In "the Americans' opinion," qualitatively new armed forces must be used not so much for conducting traditional military operations as for depriving the enemy of an opportunity for active resistance. This can be achieved by "surgical" precision weapon strikes and mass use of electronic countermeasures.

Great hopes in future warfare are placed on information weapons and other kinds of "non-lethal" weapons. It is believed that modern armies, especially armies of the future, depend so heavily on information that they can be placed in a fully non-combat-effective state by deafening and blinding them using ECM assets. Reliance is being placed on the development of electromagnetic weapons. Without killing people, such a weapon can disrupt the operation of telephones, radars, computers and other means of communications, guidance, navigation, and command and control. It is also proposed to use "combustion inhibitors," which stop vehicle engines, and chemicals which destroy vehicle and aircraft tires if sprayed on roads and airfields. Emphasis is being placed on using such means to paralyze troops without destroying them. These forecasts of a qualitative improvement of means of warfare and methods of their use reflect a trend in the development of military affairs. Of course, a transition to wars of a new generation will not occur swiftly. Lethal weapons will also be used along with non-lethal ones even in the future, and the possibility of a direct clash of troops in some kind of form is not precluded.

According to Russian military experts, it is with an orientation toward wars of the 21st century that the reform of the armed forces of NATO countries is being implemented today. The United States is laying a foundation so that its Armed Forces remain unsurpassed henceforth. Germany and England are modifying their armies with considerations of the new realities of military affairs. In February 1996 the president of France announced the beginning of total military reform designed to increase military effectiveness.

KEY PRINCIPLES

According to Colonel-General A. Nikolayev, the nature of armed engagement in local, regional, and larger-scale conflicts will be dramatically different from that of past wars. Potential military clashes will have a clearly recognizable air-land character and will be distinguished by fierce fighting for air, space, and sea superiority, and only at the concluding stage will the ground troops be brought into the battle.[8]

[8] Colonel-General Andrey Nikolayev, "The Military Aspects of Ensuring the Security of the Russian Federation," Mezhdunarodnaya zhizn' (hereafter cited as MZH), No. 9, 1993, pp. 16-20.

One may assume that military actions will be distinguished by the absence of clearly defined lines of engagement between the troops of the warring sides, open flanks, and large gaps and stretches of space in the operational deployment of troops. Protracted positional fighting between groups of forces will no longer be needed, which will lead to a reduction in the proportional weight of such types of action as penetrating a deliberate defense with the inevitable concentration of large contingents of troops at bottleneck sections of the front. The most typical type of combat will be "remote-control" combat with the utilization of high-precision weapons rather than close-range combat. Maneuver will be a prevalent component in all forms of military actions.

The Russians assume that combat "super-systems" (on the scale of regional groups and armed forces as a whole) -- created on the basis of the integration of modern and future means of intelligence, command and control, precise targeting, effective engagement, and radioelectronic jamming -- will become the material foundation and the theoretical basis of war and military conflicts. In this way, war becomes a battle of "high technologies," where the decisive role in achieving victory belongs to information and automation systems.

Colonel-General G. Kondratyev notes that the experience of recent wars and conflicts, including the Gulf War, shows that wide-scale and massive use of offensive air-space weapons is assigned the main role in ensuring the success of a military campaign. Ground forces do not embark on active operations unless these weapons have engaged the opposing grouping.[9]

The emphasis is obviously shifting toward the creation and use of unmanned, high-precision, low-signature offensive air-space weapons that can operate from space and the air at the same time. The fact that the combat potential of the whole arsenal of these weapons is being constantly enhanced is convincing evidence that the bulk of the initial period of war will be determined by fierce air and space warfare. So what is needed is a well-organized and unified air defense system for the country and the Armed Forces.

General M.A. Gareyev, president of the Academy of Military Sciences, has described the contours of future war. First, the most significant changes will involve not only and not so much the external indicators of warfare, which are usually the first to be addressed (although they will undergo considerable change as well). The main changes making warfare dissimilar from its previous form ensue from its internal content, from the place where the actions of different combat arms and branches of troops executing an enormous quantity of highly complex, interrelated strategic and operational-tactical missions will be formed. In this case the actions of strategic resources and the ground, air, and sea combat and engagements will have a decisive influence upon the overall course of military activities not only in the vertical direction

[9] Colonel-General Georgiy Kondratyev, "Second Stage of Reform: What Lies in Store for the Army. Colonel-General Georgiy Kondratyev, Russian Deputy Defense Minister, Answers Krasnaya zvezda's Questions," Krasnaya zvezda (hereafter cited as KZ), 22 March 1994, p. 2.

(from strategy to tactics and back) as in the past, but also in many other directions as well.[10]

The principal objectives of defeating the enemy will be achieved not in the course of collisions between forward units, but rather by delivery of conventional fires from a distance. As a result all combat and engagements will acquire a dispersed, three-dimensional nature, embracing all spheres of military activity in front, in depth, and in height. The intensity of fire effects upon all participants of war will grow dramatically, evoking unprecedented nervous and psychological loads, now possibly at the limit of endurance. The novelty of future warfare will also ensue from the internal saturation, stress, and dynamism of combat activities, and the high pitch of military confrontation of the sides.

Second, the influence of weapons, especially nuclear weapons, upon the determination of political and strategic objectives will grow. The role of conventional strategic weapons -- which provide for indirect attainment of strategic results as a means of deterring warfare -- will also grow.

Third, the spatial scope of warfare will increase. Weapons of the future and the greater combat possibilities of armed forces permit delivering powerful strikes against the entire depth of the dispositions of the warring states and achieving not only successive, as before, but also simultaneous destruction of the opponent's important

[10] General of the Army Makhmut Akhmetovich Gareyev, "The Contours of Future Warfare," MZH, No. 4, 1994, pp. 75-84.

groupings. While in the Second World War the United States and some of the warring countries of the British Commonwealth (India for example), and in the Persian Gulf War the bases of the Multinational Forces in Europe and on U.S. territory were beyond the enemy's reach, in a future war with a well-equipped, strong opponent all bases and facilities will be subjected to missile and air strikes, even in the most remote regions. And for practical purposes the concepts of "front" and "rear" will be rather arbitrary.

Fourth, the need for coordinating the efforts of all combat arms and branches of troops requires their joint use within a system of unified strategic operations. The employment of a large quantity of diverse weapons and equipment in warfare makes the engagement of the future exceptionally complex, creating new conditions for their use and interaction. In addition, the rapid development of progressive technology will increase the military-technical gap between the leading states and other countries. Therefore military art must be designed not only for war between opponents that are approximately equal in technical respects, but also for war between opponents at different technical levels.

Fifth, of the three most important elements of combat and engagements -- fire, strike, and maneuver -- the importance of delivery of conventional fires is increasing sharply. Conventional fires must prepare more dependably for the attack, and increase the force of the attack, so that troops will not have to overcome the enemy at the price of large losses as in the past. In this case the back-up echelons and reserves will be destroyed before they even reach the battlefield.

Decisive engagements will occur not only on land and at sea, but also in the air, and operations and combat activities will assume an air-land nature, where fire and electronic strikes by ground and air forces against the entire depth of the enemy's disposition will be combined with numerous landings of air-mobile units and their penetration into the depths of enemy defenses in order to attack not only from the front and the flanks but also from different directions in the enemy's rear. On the whole, operations and combat activities will develop swiftly, without the presence of continuous fronts , or only in the presence of temporarily stabilized fronts: they will be highly fluid.

Great changes will occur in the nature of the initial period of war, in the means of preparing and conducting offensive and defensive operations, in the means of conducting meeting engagements, in the means of delivering conventional fires and maneuver, and in the approach to creating the needed densities of men and equipment and concentrating the main efforts in the decisive sectors. Swift and abrupt changes in the situation and introduction of automated command-and-control systems complicate and fundamentally transform the activities of commanders and staffs in managing troops and naval forces. A tendency for losses of personnel and combat equipment to increase can be discerned.

Discussing the elements of continuity in the development of military art, Gareyev emphasizes that there are of course no general "permanent" and unchanging principles, but there are principles of military art (for example, surprise, massing of forces in the decisive sectors etc.), which by their essence have survived several millennia, and will obviously live even longer. But as military art develops, these universally recognized principles will be filled with new content and new meaning, and the forms and means of their implementation in preparing for and conducting military activities will change.

For example, the principle of concentrating forces and resources in the decisive sector, which has existed since ancient times, must be implemented under the new conditions not by drawing together a large number of troops in a selected sector, but mainly by massing weapons. This pertains also to strategic maneuver of forces and resources in the course of war. Not only are new weapons not replacing strategic reserves and the need for maneuvering them during war, but they are also raising their significance. However, in this case the questions of concentrating troops and naval forces, and carrying out measures to protect them from the enemy's mass-destruction weapons, cannot be resolved by the old methods -- they must be resolved with regard for new requirements.

The outcome of war in the future will depend to a significantly greater degree than before on the quantity and effectiveness of efforts applied in the very beginning of the war; however, the strategic principle of economy of forces generally remains intact, inasmuch as in a war between large states with enormous potentials, it will be difficult to count on a fast war. Consequently states must also be ready for a relatively long, stubborn, and fierce armed conflict.

One of the most important and difficult problems is foreseeing the possible nature of the enemy's actions in the very beginning of the war, and developing the corresponding means of elevating combat readiness and deploying armed forces. The book Military Strategy says in this regard: "The existence of the idea, up until the Second World War, that strategic deployment of armed forces involves a complex of measures -- implemented successively and according to a plan during a time of danger or with the beginning of war -- to cover, finish mobilizing, concentrate, and deploy armed forces in the theater of military actions is now clearly obsolete. Today most of these measures may be carried out ahead of time, and they need only be concluded in the time of danger." (Such views have recently been reviving.) Such a recommendation does not in principle evoke any objections. When the possibility exists, this is something states should of course strive for. But while it is correct theoretically, in the practical aspect this recommendation does not account for the entire complexity of fulfilling all the tasks.

First of all, this approach does not take account of the fact that aggressive states usually place their main hope in war on a surprise attack, without preliminary deployment of all of the forces and resources necessary for this. Second, despite all of the advantages it offers in purely military respects, anticipatory strategic deployment of armed forces prior to a war is not always possible out of political considerations. Mobilization, not to mention the entire complex of measures for strategic deployment, has always been considered to be equivalent to a state of war, and it is very difficult to turn back from it to a peaceful status. It is no accident that Marshal B.M. Shaposhnikov called mobilization "the opium of war." If war is generally politics, then the political aspects will prevail even more on the eve of and at the beginning of a war.

Considering all of this, the system of strategic deployment cannot be oriented solely upon one of the most advantageous variants; instead, it must be more flexible, and provide for organized deployment of troops (forces) no matter what the conditions under which aggressors initiate war. The strategic organization of armed forces must provide for their swift reaction to any military conflicts and other aggressive actions. As a rule it must include: covering (forward-based) troops, mobile forces, and reserves. In this system there is no need for committing large forces to the most important strategic sectors ahead of time, inasmuch as the main forces will be located at a certain depth, ready to quickly advance to the threatened sectors.

It must be assumed that the role of the initial period of war will increase even more in the future. It may be the main and decisive period, predetermining the outcome of the entire war in many ways. In contrast to the past, war need not necessarily begin with an invasion by land groupings. Moreover, it may begin even before ground troops are fully concentrated and deployed in the TVD.

The war may begin with a rather lengthy air operation or even campaign (consisting of a large number of air operations), in which air and naval forces first make massed bombing, missile, and electronic strikes chiefly against aviation, missile troops, and naval forces of the enemy; his air defense system, command-and-control posts, and industrial and other highly important objectives; and subsequently against the main ground troop groupings. Aviation and naval forces can conduct these missions from remote bases, and without having to first concentrate in the TVD. Airplanes and ships will travel only to within cruise-missile launch range. Cruise missiles can automatically find and destroy targets at any depth in enemy territory. As a result the entire warring country will be transformed into a continuous battlefield. All of this creates conditions for the attainment of great surprise.

Under the cover of massed attacks by aviation and naval forces, combined-arms (ground) major formations and combined units will be transferred and concentrated. Their offensive can begin only after devastating suppression of the enemy with the purpose of depriving him of the possibility for organized resistance. This means of action is also dictated by the fact that everything will be done to protect a very expensive regular professional army, which is highly sensitive to large losses. As a rule, an effort will be made to create favorable conditions for its use.

Some military experts making predictions about the development of the means of warfare suggest that in the future, the use of ground troops and the seizure and occupation of enemy territory will no longer be needed in a number of cases. In cases where -- as a result of powerful air operations -- the enemy is soundly thrashed and surrenders, this variant cannot be excluded. But in most cases finishing a war without the use of ground troops is not very probable in a war against a strong opponent. A graphic example of this is the 1991 Persian Gulf War. Iraq formally surrendered, but because its territory was not occupied by ground troops, many of the military-political objectives in pursuit of which the United States and its allies began the war were not achieved. Only an invasion by ground troops supported by air and naval forces can secure the enemy's defeat and make his further resistance impossible.

Another problem is that in the course of a war with a strong and active opponent, it is difficult to count on winning the war only by means of air strikes. The defeat of large enemy groupings may require lengthy and intensive efforts, the conduct of a number of successive operations, and a combination of different means of warfare. In this connection forms of strategic actions such as the strategic offensive and strategic defense will apparently not lose their significance in the future, though of course with regard for the new means of preparing for and conducting them.

Discussing the problems of offensive and defensive operations, Gareyev stresses that a tendency for further convergence of the means of actions in offense and in defense is manifesting itself with increasing clarity. In this case the modern offensive is viewed as a combination of fire strikes and swift advance of tanks and armored infantry, supported by aviation and helicopter gunships from the air and daring actions of airborne troops within the defenses and on the flanks of enemy groupings. In contrast to the offensives of World War II, this will consist not of successive advances of troops from line to line, but of decisive simultaneous destruction of the enemy throughout the entire depth of his formation.

According to Russian military experts, military conflicts of recent years have brought to light new "traits" of present and future conventional wars. The primary efforts of opposing sides most likely will be concentrated on selective destruction of the enemy's economic base in order to reduce direct human victims (out of purely humane motives). Considering the constant threat of enemy use of nuclear weapons (even in the presence of powerful deterrence mechanisms), belligerent groupings will strive for preemptive, massive use of the newest precision weapons in combination with reliable means of their delivery, for there are no restrictions here for now, and the effect can be striking.[11]

Large-scale armed clashes between developed countries in the future can cast doubt on the very possibility of the survival of all mankind. Therefore in the future the chief means of waging war will be air-based, sea-based, and space-based precision strike systems, the primary elements of which will be low-signature aircraft and long-range cruise missiles with a conventional filling integrated with the newest systems for command and control, information, reconnaissance, communications, prompt input of the flight mission, and vectoring to the target.

Among others, Colonel-General V.M. Barynkin stresses that modern aviation is a multifunctional branch of the armed forces. Experience shows that in military conflicts of any scale, the air force performs missions of winning air superiority, giving air support to troops and naval forces, and isolating a combat operations area; it supports the landing of airborne assault forces and the airlift of troops and materiel; it carries out operations to undermine the enemy's military-economic potential; and it performs aerial reconnaissance. It was with the help of aerial reconnaissance that the greatest amount of information on the enemy was collected in past conflicts. The Persian Gulf War experience highlighted the serious advantages of new-generation

[11] Leonid Malyshev, "Precision Weapons: An Alternative to Nuclear Weapons?" AS, No. 5, 1994, pp. 70-73.

stealth-type aircraft. Lately aviation forces also have been used as part of reconnaissance-strike and reconnaissance-fire complexes.[12]

Missions of naval forces will be determined by the specific conditions of a developing military conflict. They can include delivering strikes (above all with precision weapons, and for naval aviation with guided-aircraft bombs) against military ground and industrial targets, groupings of ground troops, and their lines of communication; convoying and landing amphibious assault forces; participating in air and artillery support to ground troops both in offensive as well as defensive operations; accomplishing a coastal naval blockade; supporting troop sealifts, redeployment, and evacuation; destroying enemy naval forces at sea and in bases; defending a seacoast; and participating in anti-landing operational missions. A growth in the role and scope of missions performed in support of ground troops is becoming the main trend in employment of naval forces in military conflicts.

The majority of local wars and armed conflicts essentially have been test ranges for new means of warfare, which helps to identify certain trends in their employment in wars of the future. For example, military space forces will be employed for conducting space reconnaissance in support of all branches of the armed forces and the military leadership; the functioning of all kinds of navigation systems and space

[12] Colonel-General Viktor Mikhaylovich Barynkin, "Military Conflicts: Historical Experience and Lessons for the Future," Vooruzheniye, politika, konversiya (hereafter cited as VPK), No. 3(10), 1995, pp. 7-11.

communications systems at the strategic, operational, and tactical levels; and the functioning of reconnaissance-strike and reconnaissance-fire systems and complexes.

The following are characteristic features of modern military conflicts: continuous, integrated reconnaissance with the use of space, air, ground, and naval assets; high effectiveness of electronic means of warfare permitting the essentially total disruption of enemy command and control of troops and weapons; well-organized coordination of branches and combat arms; use of highly effective means of engineering and operational maskirovka of troops and installations; and lengthy, thorough preparation and delivery of a powerful initial surprise attack.

The experience of modern wars and military conflicts demonstrates a number of principles which should be made the basis of the combat and operational training of troops. The following are the most important ones:

1. Attainment of high combat and mobilization readiness of troops earmarked for resolving a military conflict. This involves overall planning and preparation of a state's armed forces for possible military operations back in peacetime; a determination of the necessary makeup of troops, forces, and assets; their prepositioning in accordance with operational purpose; and timely placement in requisite degrees of combat readiness. It is also necessary to have trained human resources and reserves of arms, military equipment, and other materiel. The majority of missions in modern armed conflicts can be performed by mobile forces (rapid or immediate-reaction forces). Many Western powers have such forces and they already have received a baptism of fire. Hence their evolving establishment in the Russian Armed Forces.

2. Maximum reduction of time periods for fighting a local war or armed conflict. This principle reflects the military leadership art of fighting local wars and armed conflicts. The choice and use of the most effective methods of combat operations, timely reinforcement of troops or forces, employment of methods of executing missions unexpected by the enemy, a skillful maneuver of troops (forces) and assets, presence of a trained reserve, and so on are of great importance here. Following this principle is also very important for maintaining a high morale-psychological state of troops.

3. Comprehensive support to military operations. The experience of military conflicts attests that the role of all kinds of operational and combat support of troops is growing steadily. Already the numerical strength of support units and subunits reaches half that of a troop grouping established for conflict resolution.

Russian military scientists note that the process of the development of military art theory is continuous and has an evolutionary character. Its every stage begins with the discovery of new, or a deeper cognition of already known, properties of matter, methods of deriving and concentrating energy, and technology which can be used to impact on the enemy in warfare. On this basis, new means of warfare are created or old ones are thoroughly modernized; methods and ways of their combat employment are developed as are forms and methods of action by troops equipped with these means; new strategic and operational employment concepts are developed, and the existing ones are upgraded. All this is commonly known as simple direct logical connection.

Until the mid-1980s the evolution of the military-political situation in the world stimulated the formation and upgrading of military art theory as a theory of warfare between two large groups of states, or a big war theory. The results of scientific and technological progress, although oriented toward enhancing the military power of the conflicting blocs, had not time yet to manifest themselves in the military sphere (with the exception of nuclear weapons). In these conditions simple direct logical connection corresponded well to the required direction of theory development: a niche was searched for and found in the big war theory for each type of weapon in order to ensure a certain, usually potential superiority over an officially named enemy.

However toward the end of the 20th century a situation is emerging in the world wherein the traditional evolution of big war military art cannot produce the desired results owing to a number of objective factors. These, say the Russians, include the following. In the political sphere -- the transition from a bipolar to a multi-polar correlation of military-political forces on the planet and the renunciation of the practice of officially declaring enemies among the industrialized countries; in the economic sphere -- on one hand, a substantial reduction in the effective capabilities of military-industrial complexes in a number of states while preserving their potentials in many spheres of high technology for peaceful and military applications, and on the other, scientific and technological breakthroughs[13] as a result of dramatic advances in the development of fundamental sciences and technology; and in the military sphere -- the creation of new types of weapons, including weapons based on new physical principles.

[13] A scientific-technological breakthrough is a dramatic increase in the defining parameters of elements and processes resulting from the realization of the military scientific-technological potential. It manifests itself in a cumulative enhancement of the effectiveness of weapon systems resulting from the introduction of new technology.

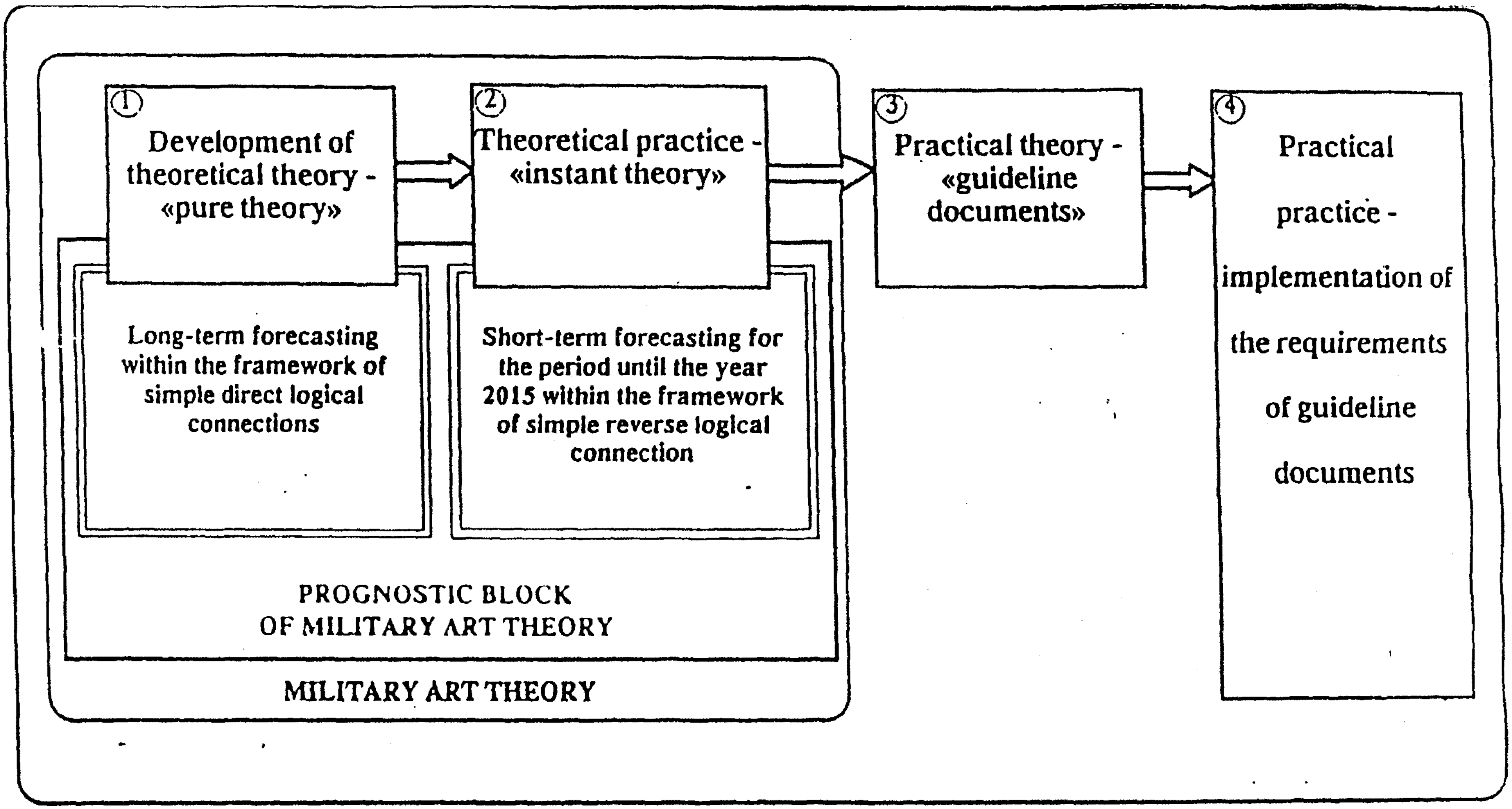
No less important is the elaboration and implementation by developed states of new concepts for conducting military operations, ensuring military breakthroughs.[14] The above factors lead to the emergence of new strategic, operational, and tactical tasks whose resolution will achieve victory in warfare.

According to Russian experts, a solution lies in forecasting the evolution of military art theory in the weapons research and development sphere. This is based on their approach toward the structuralization of theory and practice in any sphere of human activity, including warfare (see Figure 2). It consists in dividing (for the sake of systematization and streamlining of scientific research) the entire human activity into four spheres (blocks): the development of theory (pure theory), theoretical practice (instant theory), practical theory (guideline documents), and practical practice -- i.e., activity to implement the requirements of guideline documents.

Within the framework of this approach it is essential to create a forecasting block -- including operational-strategic forecasting theory as a component of military art theory. In present-day conditions forecasting will allow states to avoid many mistakes in allocating resources for military security.

This block can be formed on the basis of knowledge accumulated by military art theory in the course of many years of research and practical activity. The leading role

[14] A military breakthrough is a dramatic increase in the effectiveness of the combat employment of troops (forces) and weapon systems resulting from a scientific and technological breakthrough.



Structuralization of Human Activity in the Sphere of Military Art

FIG 2

here belongs to analyzing the evolution and development of nuclear weapons, which can be regarded as unlimited capability weapons (UCW). Experts call other types of weapons limited capability weapons (LCW).

Seven principles can be identified for defining the content of both operational-strategic forecasting theory and forecasting blocks.[15] First, for each developing type of weapon (within the first and second forms of connection) its own "large-scale employment theory" needs to be developed, taking into account the necessity and regularity of its use in accomplishing certain -- either newly arising or already existing -- tasks, but with greater effectiveness. The "large-scale employment theory" should include not only weapon employment theory proper but also a theory for combat action by troops (forces) of branches and special troops, and should find its place in the current military art theory either as its developing (supplementing) or reforming element. At the same time a similarly structured counteraction theory is developed which is also fitted into the existing military art theory.

Second. In developing the "large-scale UCW employment theory," it is advisable to provide for their use only in addressing extraordinary tasks whose implementation will force the enemy to abandon the continuation of the armed conflict it has unleashed. The development of the LCW and the "large-scale employment theory" is normally forecast only in addressing newly arising tasks -- usually on a

[15] Colonel A.N. Zakharov, "On Forecasting the Evolution of Military Art Theory," VM, No. 5, 1995, pp. 37-43.

tactical and operational level. Third. The use of any weapons should be forecast with respect to a particular army level.

Fourth. There can be no concept for using weapons of any type that would incorporate uniform methods for their employment in armed conflicts of any scope by army units at all levels. The "large-scale employment theory" should be developed with respect to a particular type of weapon, as an underlying basis for working out concepts for its use in each particular armed conflict by each particular army level involved in it.

Fifth. A strictly definitive number of models (units) of each type of weapon, including developing ones, is forecast with respect to the armed forces of a particular state. Sixth. Forecasting the lines of the evolution of military art theory should be based on the assumption that any armed conflict with a state possessing UCW will inevitably grow into a global one with catastrophic consequences for all mankind.

Seventh. The probability of the enemy's using UCW can be realistically minimized only by creating a threat of preemptive action against it with analogous weapons -- "retaliation weapons." To this end, military art theory apparently needs a retaliation concept with underlying theories of countering UCW of all types. The decisive role of the retaliation concept in ensuring a state's national security predetermines its role in military art theory, which permits implementing this concept at any moment in peacetime or in war. The main military-political propositions of the retaliation concept are made known to the world public.

To realize the idea of the modular theory of multi-dimensional conflicts, it is advisable to classify all weapons not by the method that the destructive energy is created, as is the case at present, but by the operational-strategic criterion. In other words, weapons should be divided not into conventional and mass-destruction weapons but into unlimited and limited capability weapons. UCW should be regarded as mainly strategic while LCW as tactical, operational, operational-strategic, and strategic. UCW include strategic nuclear, chemical, and strategic high-precision weapons while LCW include traditional firearms, tactical high-precision weapons, laser and other types of weapons, including tactical nuclear weapons.

In the interests of ensuring a link between the existing foundations of military art theory (pure theory) and the emerging situation, and in order to ensure further development of the "instant theory," it is expedient to move from a limited-area -- service- and branch-related -- view on warfare to the spatial, combined-arms, "synchro-polyspheric" one. Then the space of war can be considered at four hierarchical levels/zones -- combat, local, regional, and global.

MILITARY FUTUROLOGY

In February 1995, President Yel'tsin signed the following edict regarding the newly created Academy of Military Sciences:

In order to develop and deepen fundamental and applied research on defense problems, and to stimulate publicly supported military-scientific activity, I resolve:

1) To approve the initiative of scientists dealing with the problems of studying and using the defense potential to establish the Academy of Military Sciences as an independent public military-scientific creative association setting the following as its main objectives:

-to study the nature of military threats to the security of the Russian Federation and the ways of averting wars and armed conflicts;

-to prepare proposals on providing for more economical and more effective execution of defensive missions;

-to develop the scientific principles of military doctrine and military reform, and to organize the principles of collective defense of member nations of the Commonwealth of Independent States;

-to strengthen scientific ties with military-scientific organizations of member nations of the Commonwealth of Independent States and other countries; and

-to assist in the training of qualified specialists for the Armed Forces of the Russian Federation and for its military-industrial complex.

2) To propose to federal bodies of executive government that they utilize the scientific developments and specialists of the Academy of Military Sciences when dealing with defense problems.[16]

According to General-Major I.N. Vorobyev, the new Academy of Military Sciences now serves as Russia's center for "military futurology." In the developed states of the world, especially in the United States, a real military futurology "boom" has been observed in recent years. Not only individual scientists but also whole

[16] Edict No 173 of Russian Federation President B. Yel'tsin "On the Academy of Military Sciences," 20 February 1995, Moscow, The Kremlin, Rossiyskaya gazeta (hereafter cited as RG), 1 March 1995, p. 14.

corporations are doing military-political, military-technical, and military-economic forecasting for 20-25 years ahead. Promising concepts have already developed from this -- "Army-2000," the "radar war," "information and psychological warfare," the "offensive air operation of the future," the "massed strike with precision weapons," and "computer wars of the information age." Tens of analogous long-term programs are under development in other NATO countries, as well as in China, India, and Israel.[17]

All of this suggests that military forecasting has now reached the state level. Its successful implementation cannot be hit-or-miss as it was earlier, in the form of private initiatives of individual scientists or even through the efforts of scientific research institutions and institutes of higher education. One cannot casually make fundamental, reasoned predictions about entire decades of a terribly complex phenomenon such as war. A special science must be engaged, one which may rightly be called military futurology.

How does it differ from intuitive prediction and calculated forecasting, and why has the time come to segregate it in a specialized field of military-scientific knowledge? Military futurology is, as it were, a third level of prediction, in terms of its complexity. While the first two have a utilitarian, chiefly practical tendency, military futurology is intended to determine remote strategic reference points of military progress, and to discern the profound tendencies of development of the defense sphere in order to promote the development of rational military policy, doctrine, and expensive defense

[17] General-Major Ivan Vorobyev: "What Sort of Wars Threaten Us in the Coming Century? Military Futurology Might Supply the Answers," KZ, 23 August 1995, p. 2.

programs, as well as to caution politicians and military leaders against possible errors in military development and reform and against impetuous voluntarist decisions. It is a symbiosis of many scientific fields, which includes the attainments of military-scientific methodology, philosophy, logic, mathematics, military-engineering psychology, and cybernetics.

Indeed, no general staff of the warring states in the First or Second World Wars managed to specify even approximately their duration, content, course, or outcome. The errors were simply amazing. For example, when Germany entered the war in 1914 Kaiser Wilhelm promised his people to end it "before Fall." In fact the war continued for more than four years. Analogously, when hatching plans for the "Blitzkrieg," Hitler hoped to conclude the eastern campaign in 6 weeks.

But does this mean that futurology is helpless to foresee the future? No, it does not. Realistic problems must be set for it, corresponding to its capabilities. Undoubtedly it cannot devise a precise scenario of armed conflict of the remote future. No one can. But it can and must determine the basic tendencies of development of its forms and methods. It is important to discern in a timely manner the new law-governed patterns in improvement of arms and military equipment. In the last decades very vital changes have occurred here.

If one analyzes the experience of local wars of the 50s through the 90s, one can see that a smooth, gradual evolutionary process of modernization of arms is giving way to spasmodic innovation. This finds expression in the fact that new combat systems are now put into commission not just quickly, but in an avalanche. Examples? During the Korean War (1950-1953), nine previously unknown types of military equipment were used, while by the Vietnam War (1964-1975), the number was already 25; in the wars in the Near East (1967, 1973, 1982) and in the Falklands, around 30; and by the Persian Gulf War (1991) it was already more than 100. The upshot has been that even a small-scale local war has become a great event, a milestone in the development of military art.

Thus the use of jet aviation in the Korean War brought about vital changes in the battle for air superiority. Mass use of helicopters in Vietnam left a great mark on the nature of the combined-arms battle, giving it an air-land character. In the Near East, where experimental models of precision weapons were tested, the foundation was laid for a new stage of development in tactics and operational art. The genuine technological breakthrough achieved in the conflict in the Persian Gulf served notice that the era of "classical" wars was ending, and the era of electronic, space, and information wars has begun.

Unfortunately, in all of these wars, military theory had not been the prophet of the innovations. In most cases, it only extracted the lessons from combat experience later on. This clearly shows that military futurology has not been duly formulated as a scientific discipline.

But it would have been possible, in tracing the tendency of development of the means of electronic warfare, for example, to predict that the result of their massed use in an operation or battle would be that electronic suppression would become an important structural component of armed conflict -- as actually happened in the Persian Gulf, where a new form of the operation, electronic-fire, was born. Nor should it have been hard for military theory to predict the advent of non-stereotypical forms and methods of action: the information blockade, reconnaissance-strike operations, ground-attack raids, actions in depth, psychological operations, remote-mining warfare, etc, which also were used widely in the Persian Gulf.

The conclusion to be drawn from this is as follows: the key to preemptive discovery of new forms and methods of armed conflict is at the disposal of futurology. It lies in a profound understanding of the law-governed patterns of development of the material-technical basis of the war, operation, or battle. Thus even now futurology research must be launched on a wide front in order to discern how known and presently unknown types of weapons will influence the development of military art.

Vorobyev notes that futurology research is not the domain of the lone scientist. The prospects for development of this science touch the interests of all military cadres. This is why it is right to raise the question, so that the new military-science discipline might become an object of study in the highest military-educational institutions of Russia, and that futurology may be acknowledged by the military community as soon as possible. Scientific treatises, training aids, and military-theoretical papers are urgently needed on this topic. Thus, in the recently formed Russian Academy of Military Sciences, the prospective problems of defense development occupy an important place.

Writing in 1996, Vorobyev reiterated that the war in the Persian Gulf heralded the end of the era of "classical" warfare and the advent of wars based on a wide-scale employment of information science, outer space, electronics, and robots. Relatively small by the territorial scope and length (in effect, local), that military action upset the long-established canons of military theory and practice. The structure of Operation Desert Storm (a 38-day air campaign and a four-day ground action phase), the new forms and methods of operational-tactical action (information blockade, EW, effective target engagement, and the high proportion of "remote action" -- delivery of strikes from a distance), as well as wide-scale psychological operations, remote mining, and so forth all came as a big "surprise."[18]

These facts show that the existing methods of forecasting do not fully measure up to the dictates of the times. So military thought only follows in the wake of events, recording occurrences and developments, although by its designation it should be a searchlight illuminating the way for practice. True, in the past few decades military theory has certainly not been marking time; one of its major branches -- military forecasting, which was born in the era of the scientific-technical revolution -- was given a strong impetus. At first, in the 1950s-60s, it concentrated on determining the prospects for the modernization of weapon systems, but in the 1970s-80s it also comprised the processes of military policy, military economics, force development, combat readiness of the armed forces, and their training and preparation as well as

[18] General-Major I.N. Vorobyev, "Military Futurology as a Special Form of Military-Scientific Foresight," VM, No. 2, 1996, pp. 65-69.

social processes and developments. In the 1980s-90s military forecasting evolved as an independent, generally recognized branch of military science. By the late 1980s, more than 150 various methods of forecasting were elaborated.

And still, in spite of some achievements, it proved impossible to overcome the "barrier of the unknown" in the military domain. Success stories in the sphere of military forecasting were noted in those areas that relatively easily lend themselves to calculation (for instance, the evolution of weapon systems; and the determination of the combat capability of troop groupings, the sides' military-economic capabilities, and the correlation of forces and assets). Yet in those areas where it is necessary to use qualitative indicators -- and this constitutes the core of operational-strategic forecasting -- forecasting is clearly lagging behind. The use in long-term military forecasting of cybernetic methods and mathematical modeling, on which great hopes were pinned, did not produce the expected results either. These methods accelerate the operation with random factors, variables, and models, but they have an instrumental, not a constructive character. Computer-assisted games thus far have only a limited application in large-scale military forecasting.

The aforementioned circumstances point to the imperfection of the scientific apparatus and the methodology of military forecasting. Meanwhile, the experience of force development persistently demands from military science sufficiently accurate and well-substantiated forecasts for 15-20 years, and for a longer term with respect to innovations in warfare that can possibly result from the advance of science-intensive technology; the changing forms and methods of military action; the evolution of the services and branches of the armed forces; and the system of military command, control, and supply, etc. Without long-term guidelines it is impossible to consistently elaborate military doctrine or a military-technical program, to reform the armed forces, to upgrade the military economy, or to develop the country's infrastructure. Forecasting has always been inseparably linked with force development. At present its importance has especially grown because the price of mistakes and miscalculations has immeasurably increased: it will hardly be possible to correct them in the course of war.

It can be stated, without stretching the point, that the need for long-term military forecasting has today acquired a statewide importance. At the same time individual initiative by separate scientists or even collective efforts by scientific and research centers today are insufficient for making fundamental, well-substantiated predictions for the evolution of such an extremely complex phenomenon as war, not for years but for whole decades to come. Therefore long-term large-scale forecasting of military processes should be the domain of a specialized branch of military science: military futurology. Because this term has not as yet gained broad currency here, it will be appropriate to explain the difference between futurology and intuitive forecasting or prediction.

The Encyclopedic Dictionary of the Russian Language gives the following definition: "Futurology is a field of knowledge that aims to predict the future evolution of mankind and particular spheres of the life of society." During the Soviet period futurology was not recognized as a branch of knowledge. It was stated that "Marxism-

Leninism rejects bourgeois futurology because it has no subject of study." Such nihilism with respect to futurology caused damage to its development in domestic Russian science. There is no way it can be justified because forecasting consistently expands its scope, enveloping newer and newer spheres. Therefore it is necessary to upgrade its methodology and look for new forms.

The boom in futurological activity cannot be considered accidental. It is predetermined by objective circumstances. Rampant scientific and technical advancement, the accelerating development of weapon systems, the broad dissemination of information technology, and the growing complexity of military science have expanded the horizons and scope of military planning, calling for an appropriate scientific foundation, a greater role of long-term normative prediction, and its greater accuracy, substantiation, and validity. This brought about the need to create a more diversified and profound system of forecasting, and futurology was in effect such a system.

If, for the sake of convenience, forecasting is graded by the complexity and scope of tasks and the methodology applied by it, then the heuristic form of forecasting based on experience, intuition, and surmise could be ranked as level one; forecasting based on calculation and the use of more sophisticated methods, including mathematical modeling, computing equipment, and automated systems will be graded as level two; and futurology, as a special form of forecasting, will be graded as level three. They are designed to provide a glimpse into the future. At the same time each of them has its own specifics: the different extent and depth of penetration of the future, different methods of research, and different principles. The interrelation between forecasting and futurology is based on the principles of the general and the particular.

Unlike intuitive forecasting and forecasting/prediction, futurology is called upon to look far ahead into the future: to define the prospective strategic lines of defense organization and development; and to identify the trends, patterns, and regularities of the evolution of military processes related to the adoption of new types of weapons and equipment, thus contributing to the elaboration of a rational state military policy and the appraisal and substantiation of costly military programs. Not least, futurological conclusions should warn politicians and military leaders against possible mistakes in force development and in military reform. At the operational-tactical level, the task of futurology is to identify the major trends in the evolution of the operation (combat).

Military futurology does not deal with applied military tasks. It does not produce ready-made solutions, programs, or plans. Its essence is different: to elaborate general methodological principles; to provide a "basic groundwork" for forecasting, primarily for a long term; and to help military theory avoid unproductive concepts, thus contributing to the development of military art along the correct path. Futurological studies are designed to optimize the resolution of complex tasks that are distinguished by a high degree of uncertainty. This is the first level of long-term planning.

Methodologically, futurology concentrates the advanced achievements of scientific thought. It is especially important to stress the organic link between futurology and philosophy. The reliability and validity of futurological forecasts depend directly on the level of cognition of the general patterns of the evolution of nature, society, and the world as a whole. Philosophy helps to gain a comprehensive understanding of the in-depth character of the changes in the military domain, and to obtain basically new scientific results. Dialectical methods play a very large role under the present conditions, as a drastic reappraisal of values is under way in the military sphere, as the old perceptions are reviewed, and as past experience is rapidly losing its relevance.

The evolution of military futurology as a branch of military science calls for the main efforts to be focused on the elaboration of its methodological tools -- the basic principles of research. Thus far they have not been formulated, so it appears advisable to present them by way of discussion. These principles could be as follows: objective; the scientific validity of conclusions (innovations); consistency and comprehensive scope of research; the unity of analysis and synthesis and of inductive and deductive methods; the impartiality of background assumptions; assertiveness of research; the alternative character of forecasts; and the use of military-historical experience.

Objective consists in the concentration of efforts on achieving the main result: cognition of the conditions, content, and character of warfare in large-scale or regional wars of the future. It is important to identify its space-and-time parameters and scope, and to establish what new types of weapons could be used; how the interrelation and correlation of offensive and defensive actions and their positional and mobile forms will change; and what changes should be expected in the structure and equipment of services and branches and in the military command-and-control system.

As concerns scientific validity, futurology has nothing to do with groundless guesswork. The recommendations made by it should be strictly verified and substantiated. However, many difficulties and obstacles arise here because processes in the military domain are characterized by a certain degree of unpredictability, with a substantial role being played by subjective and other hard-to-identify factors.

Military action wherein the rival sides pursue directly opposite aims and seek to disrupt each other's plans does not easily lend itself to formalization. But here too the future is not beyond cognition. Its predictability is based on the existence of objective trends, the identification of which is precisely the task of futurology. It has at its disposal the crucial key of cognition: the evolution and development of the material and technical base of warfare (operation, combat) -- the "prime generator" of all innovations in strategy, operational art, and tactics. Weapons are a concentrated accumulation of scientific and technological advances, the prospects of which are more or less predictable. Yet there should be no self-delusion here. The evolution of military hardware far from always occurs systematically: increasingly there are leaps and technological breakthroughs, and occasionally "supermodern" weapon systems emerge. So the efficacy of futurological forecasts is related to the identification of new patterns and regularities in this sphere.

Futurology will serve its purpose if its scientific quests are conducted continuously, actively, and creatively, with the employment of the whole spectrum of military-scientific research methods. Of special importance for futurology are the methods of research and normative forecasting that identify the trends and directions of the evolution of military developments, processes, and events. The most essential among them are the methods of mathematical modeling, systems analysis, operations research methods, the "tree of objectives," the network method, extrapolation, and factorial and economic analysis.

Forecasts and conclusions by futurologists can often be sensational and scientifically daring because this process involves the unknown and the untested: the use of "super-weapons" and the basically new conditions of warfare. Futurological endeavors are characterized by ascension to the point of fantasy, but this process is necessarily accompanied by the sobriety and objectivity of appraisal. The principle of objectivity is called upon to bar the subjective and the arbitrary.

As already noted, futurological studies are not the domain of lone scientists. Their methodology should be mastered by all military cadres that have to do with advance planning, reform, and preparation and training of the armed forces. There is an urgent need for teaching aids and military-theoretical works on these subjects. To be sure, a broad discussion on the subject could provide a powerful impetus to the resolution of this problem.

III. ROLE OF "SMART" WEAPONS

"U.S. VIEWS" ON PGMs

Russian military scientists note that the further development of precision-guided munitions is being carried out in the United States according to the following main directions:[19]

- Increase range by developing more effective rocket motors and new types of fuel (specifically, it is considered possible to increase the range of the Tomahawk sea-based cruise missile to 3,000-4,000 km);

- Reduce the impact of enemy air defense, anti-ballistic missile defense, and electronic countermeasures (ECM) on PGMs by developing aircraft utilizing Stealth technology and equipping them with electronic counter-countermeasures systems;

- Equip the missiles with qualitatively new warheads, the destructive properties of which will be based not upon the utilization of the chemical energy of the detonation as at the present time but on "short-duration surges of microwave radiation;" and

- Increase guidance accuracy to the target using the latest "artificial intelligence" systems. Specifically, the "American press" has reported on the development of a "universal task-solver" that is the basis of the missile's precision-guidance system. The universal task-solver guarantees the automatic identification and destruction of a target while guiding the missile to the area where the target is located. It is anticipated that accuracy at long distances will be from 0.3 to 0.9 meters.

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[19] Colonel Boris Nikolayevich Sibirskiy, "A 'Surgical Strike' Against the Enemy: Precision-Guided Weapons Guarantee It," Nezavisimoye voyennoye obozreniye (hereafter cited as NVO), 14 December 1995, p. 6.

The development of "artificial intelligence" systems in the United States merits especially rapt attention. In fact, it is precisely artificial intelligence systems that guarantee the high effectiveness and reliability of weapons and reconnaissance, command-and-control, and communications systems; that is, the entire PGM complex. Incidentally, this has also caused the total computerization of all branches of the U.S. Armed Forces.

On the whole, one can already assess the prospects for the further development of PGM systems in the United States as the development of a new generation of precision-guided munitions proceeds. And although these new PGM systems are still at the R&D stage, the Pentagon is already examining various scenarios of their echeloned utilization in future armed conflicts.

The existing experience of the combat utilization of precision-guided munitions, their capabilities, impact on strategy, and direction of development provide the basis to suggest that PGMs both in an operational-tactical context and on a strategic scale are extremely effective and especially dangerous first-strike (disarming) weapons. Essentially, PGMs are a new type of strategic offensive weapon that present an insurmountable threat for a state that does not have adequate countermeasure systems.

Russian naval scientists note that the term "precision weapon" is understood to mean a tactical, operational-tactical and, in the future, also strategic guided weapon ensuring a hit on a target with each munition (projectile, bomb, missile) with at least a 0.5 probability at any time of day under any weather conditions and with intensive enemy countermeasures. "Navies of foreign states" presently are armed with various kinds of precision weapons. These are attack, antiship, air defense, and anti-radiation missiles; air-launched guided missiles; and guided bombs. In the future it is proposed to make guided artillery projectiles operational in navies.[20]

Massive employment of precision weapons by naval forces of Western countries was seen for the first time during the Persian Gulf War. Tomahawk SLCMs with conventional (non-nuclear) warheads were the main kind of such weapons for delivering strikes from sea against shore. The experience of their first actual combat employment showed that they are most effective in delivering first strikes in the initial period of war: over 70 percent of the overall number of missiles used during the conflict were launched during massive strikes in the first three days of combat operations. As a result, in the estimate of the MNF's space reconnaissance, the Iraqi air defense system was 50 percent neutralized and over 85 percent of missiles hit the desired targets.

The high accuracy of Tomahawk missiles also was confirmed: according to a statement by U.S. specialists, their degree of target destruction essentially was 100 percent. Thus, 50 out of 51 targets assigned to them for destruction in the first massive strike were destroyed, and Iraqi air defense weapons shot down only two cruise missiles (U.S. specialists explain this by the fact that they were among six missiles sent to targets along the same route). Thus, the employment of Tomahawk cruise missiles, successful on the whole, confirmed the increased role of general-purpose naval forces in the course of combat operations in a continental TVD using conventional weapons.

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[20] Captain-Lieutenant A. Vazhov, "Precision Weapons," Morskoi sbornik (hereafter cited as MS), No. 7, 1995, pp. 79-82.

Harpoon (USA) and Sea Skua (UK) antiship missiles were the primary weapons in combat clashes at sea. In particular, over 30 percent of ships and fast craft lost by Iraq in the war were destroyed or damaged using Sea Skua antiship missiles employed from Royal Navy deck-based Lynx helicopters. Air-launched HARM and ALARM anti-radiation missiles of American and British production respectively, Maverick air-to-surface guided missiles (UK), and also aerial bombs with laser and television guidance systems demonstrated high effectiveness in the course of the war (up to 90 percent of aerial bombs with laser guidance systems hit their targets).

In addition to series models of precision weapons, their newest types still in the development stage were tested in the course of Persian Gulf combat operations. In particular, combat launches of two SLAM guided missiles were conducted successfully from a deck-based U.S. Navy A-6E Intruder attack aircraft. This missile is being developed for the U.S. Navy based on the Harpoon antiship missile and is intended for engaging both surface as well as shore targets. A feature of employing these missiles was that the Navstar satellite navigation system was used for the first time to guide them to the target; at a range on the order of 100 km it took the guided missile accurately to the target area and supported its hitting the target with the help of an infrared homing head. Use of the Navstar satellite navigation system for guiding missiles showed such high effectiveness that in the future satellite navigation system receivers will become a basic component of the guidance and control system of the overwhelming majority of advanced models of attack weapons.

Simultaneously with this, the Persian Gulf War identified a number of substantial shortcomings of individual types of precision weapons -- specifically that television and laser guidance systems are subject to interference due to smoke and dust screening of targets, and that thermal imaging guidance systems are subject to the influence of mass fires. Thus, poor effectiveness of shipboard radars in acquiring small surface targets was a weakness in the use of Harpoon antiship missiles, because of which their launch range did not exceed 40 km. Instances were noted where the missile could not descend enough to hit the side of such a target; it would penetrate only its light superstructure and the explosion would occur only after overflight of the target. The Russians also note that precision weapons were used in the Persian Gulf War under conditions of essentially total absence of Iraqi opposition to their platforms and their weapons, although the Iraqi side declared that in the conflict its air defense weapons shot down 29 Tomahawk cruise missiles; i.e., 10 percent of all missiles employed.

In addition, "Western specialists" declared that one lesson of the conflict was the absence of standardized, versatile precision weapons, which appreciably reduced the effectiveness of delivering missile-bombing attacks. Nevertheless, at the present time the following are the most advanced types of precision weapons:

- Tomahawk SLCMs of all modifications supporting a 0.9 probability of hitting the target;
- Harpoon, SLAM, Exocet, Otomat, ANS, Sea Skua, and SSM-1 antiship missiles with a 0.9-0.95 probability of hitting the target;
- Standard, Sea Dart, and Masurca long-and medium-range SAMs and Sea Sparrow, Seawolf, and Naval Crotale short-range SAMs, which support a 0.7-0.8 probability of hitting the target;
- Maverick, Shrike, Standard ARM, and HARM air-launched guided missiles for various purposes with a 0.75-0.9 probability of hitting targets; and

- GBU-15, GBU-22, GBU-24, and GBU-54 guided bombs with a bombing accuracy of from 1 to 5 m.

An overall characteristic feature uniting all of the aforementioned weapons is the sophistication of their guidance systems, which support such a high accuracy of delivering the munitions to the target that it brings them close to tactical nuclear munitions in terms of effectiveness against a target. And still the process of developing precision weapons continues in the West. Although the primary characteristic of this family of arms is their high accuracy in hitting the target, upgrading the guidance systems continues to be the main direction. In the majority of cases, the problem of making offensive precision weapons more versatile against strike targets has been solved by using modern homing heads: thermal imaging, radar, and laser in combination with remote control. It is planned to achieve an increased accuracy of inertial systems through the use of laser gyroscopes.

According to the Russians, a number of U.S. RDT&E projects are coming to an end, and the massive entry into the Navy inventory of a new generation of precision weapons for engaging both shore targets and naval targets will begin in the second half of the 1990s. Two types of cruise missiles are undergoing the most upgrading at the present time: Tomahawk SLCMs and Harpoon antiship missiles. The creation of a general-purpose model, the Tomahawk Block IV for engaging shore targets (underground command posts, mobile ballistic missile and SAM launchers, airfields, bridges) and naval targets resulted from more than 20 years of developments. The platforms for these missiles are nuclear-powered multipurpose submarines, cruisers, and destroyers. The flight range has been increased to 1,850 km and in the future will reach 3,200 km by using the new F107-WR-402 turbojet bypass sustainer engine and by upgrading the homing system.

The use of remote control (in the future with transmission of a television image of the target from the missile to the platform) and the upgrading of the homing system through introduction of a number of new technologies, including a target identification system based on various types of sensors -- SAR synthetic aperture radar, IIR image-forming IR sensor and LADAR laser radar -- will lead to a decrease in CEP from 10-15 to 3 m. Upgrading of software and of the hardware base of computers will reduce strike planning time from several hours to 20-30 minutes.

The evolution of an air-launched version of the Harpoon antiship missile (AGM-84) led to the creation of the AGM-84E SLAM general-purpose cruise missile intended for engaging electrical power stations, plants, bridges, small shore targets, ships, and vessels. The employment of this missile in the Persian Gulf War was successful, which naturally caused it to be further upgraded. It is expected that series production of a new model of the cruise missile, SLAM-ER, will begin in 1998. The missile will have an increased range of fire (up to 440 km) and increased accuracy in hitting the target (down to 3 m). These data will be achieved through an improvement in fuel quality, in engine characteristics, and also in the guidance system (inertial with adjustment from the Navstar satellite navigation system plus thermal imaging with remote control).

Series production of the TSSAM missile made with stealth technology and standardized for all branches of the U.S. Armed Forces will begin in 1999. It is expected that the missile will have a range of fire of up to 500 km with a CEP of 3-10 m, carry a warhead weighing 454 kg, and be intended for destroying airfields, aircraft, armored equipment, air defense weapons, command posts, and ships. But the production plan and RDT&E financing of this weapon model was cut almost in half in the last two years in view of the high cost ($1-1.5 million per missile).

Development of the JSOW and JDAM all-weather guided bombs, standardized for all branches of the U.S. Armed Forces and intended for engaging tactical ground targets and ships, was a new step in creating guided bombs. Series production of these two kinds of guided bombs will begin in 1996, and by 1999 they evidently will replace the Maverick guided missile and Walleye guided bomb. The U.S. Navy assumed direction of the JSOW project. It is expected that this guided bomb will have a glide range of up to 80 km and a combination guidance system (inertial with correction from the Navstar satellite navigation system plus laser or radar homing head). The 225 kg warhead will be employed in one of three versions: cluster (basic model), consisting of 145 BLU-97 bombs; advanced BLU-108 warhead, now undergoing tests; and in the future a multiple warhead with individual guidance of warheads to the target (remote control with final guidance).

The JDAM guided bomb is being created under Air Force direction and will differ from the JSOW in glide range (30-64 km), homing system (thermal imaging with remote control), and also by the 427-kg Mk 84 warhead or advanced BLU-109. Its accuracy will be 13m, which subsequently will be reduced to 3 m. It can be presumed that in view of the low cost (around $125,000 per bomb), the JSOW and JDAM guided bombs will find wide-scale use as most fully meeting the cost-effectiveness criterion in their class.

To standardize existing kinds of weapons, in 1992 the U.S. Navy command began studying three versions for outfitting the Navy with Army ATACMS operational-tactical missiles:

- use Tomahawk missile vertical launchers for the ATACMS (true, a number of engineering problems connected with the difference in missile dimensions will have to be solved);
- mount MLRS launchers, used by Army formations for firing ATACMS missiles, on the deck of large landing ships; and
- install the MLRS system on one of the ships which have been decommissioned and use her only for performing missions of fire support to ground units and subunits.

In addition, since November 1994 Navy specialists have been testing the possibility of equipping submarines with ATACMS missiles. This short-range ballistic missile is intended for engaging armored equipment, communications centers, depots, and other fixed shore targets. It has an inertial guidance system with a CEP of 285 m, which in the future is planned to be reduced to 25-30 m, and a range of fire of 135-300 km. In the Block I version the missile's cluster warhead is equipped with 1,000 M-74 bombs. In the Block II version the warhead consists of homing antitank munitions.

Naturally, creating the kinds of precision weapons standardized in terms of platforms and versatile in terms of targets also is leading to a change in tactics. Here is how "U.S. specialists" see a possible version of the integrated use of advanced precision weapon systems: "Based on intelligence (this can be mobile reconnaissance groups, space assets, or aircraft), the data on a detected target (base, airfield, air defense weapons, and so on) are transmitted to the command post in real time using satellite communications channels. Employing long- and medium-range cruise missiles (Tomahawk, SLAM-ER, HARM, TSSAM), a strike is delivered against the target which neutralizes the area defense system and command-and-control system. Then the local defense system is destroyed and the planned target is destroyed by a strike of ATACMS operational-tactical missiles and JSOW or JDAM guided bombs."

Such tactics most fully meet the cost-effectiveness criterion and will be characteristic of low- and medium-intensity conflicts, so the incorporation of the following numbers of new-generation precision missiles and aerial bombs is expected in the next few years:

- TSSAM guided missiles -- 525-2,250 (beginning of production in 1999);
- JSOW guided bombs -- up to 16,600 (beginning of production in 1996);
- JDAM guided bombs -- several tens of thousands (beginning of production in 1996);
- ATACMS operational-tactical missiles -- several hundred (beginning of production in 1999);
- Tomahawk Block IV SLCMs -- up to 3,600 (beginning of production in 1998); and
- SLAM-ER guided missiles -- 829-994 (beginning of production in 1998).

In addition to these new kinds of precision weapons, by 1998 the U.S. Navy will have the following number of precision missiles and aerial bombs previously produced or being produced now:

- Tomahawk Block II and III SLCMs -- 3,162;
- Maverick guided missiles -- 4,013;
- SLAM guided missiles -- 642; and
- guided bombs with laser guidance system -- 13,186.

In 1983 the United States created a fundamentally new SAM complex, Aegis, which became part of a multifunctional automated ship battle management system by the same name. "The Americans" presently view it as the primary means of air and ABM defense of a ship formation in the 1990s, inasmuch as its high-speed response, effective rate of fire, anti-jam protection, and automation of the entire intercept process permit repelling massive air strikes effectively from any direction. The new Standard-2-ER Block IV missile with a range of fire of up to 170 km became operational for this complex in 1994. This will give the complex a new quality and will permit greater use of its capabilities for intercepting and destroying targets in the far air defense zone, and after upgrading of software also for repelling operational-tactical and tactical missiles. This modernization will make the Aegis SAM complex, to be created by 2000, a basic element of the theater ABM defense system.

Russian experts stress that the command elements of armed forces of Western countries propose to continue to increase the outfitting of their armed forces with precision weapons, and by 2000 will fully eliminate the shortage of precision weapons identified in the war against Iraq in 1991. It is believed that this will ensure the capability of reliably engaging a considerable number of fixed and mobile targets without having platforms enter the enemy point defense zone. All of this work is based on the most current achievements of science and engineering and attests to the firm intentions of the leadership of the United States and NATO countries to achieve their unprecedented superiority in the military area in the next 10-15 years.

RUSSIAN VIEWS ON PGMs

According to Russian military scientists, an analysis of the evolution in military technologies shows that in the 21st century the role of the military factor in ensuring global security can be played by precision weapons, whose combat possibilities were graphically demonstrated during the war in the Persian Gulf. These weapons are capable of addressing the tasks of containment not only through their presence in the arsenals of multinational forces but also as a result of their selective use, which does not lead to perilous consequences -- i.e., so-called surgical strikes. Therefore one should talk about a different scale of containment and localization of armed conflicts -- regional -- and according to a formula that is safe for civilization.[21]

It is quite probable, say the Russians, that in a contemporary war the primary strategic objectives will be destroying the enemy's military-industrial base, damaging the state infrastructure, crippling communication and energy supply systems, and isolating troop groupings and combat action areas. In conducting combat operations, the use of all types of weapons is not ruled out, provided that this implements the attainment of said strategic objectives with minimum losses of friendly troops. Of course, the implementation of strategic objectives is determined above all by the superior quality of such armaments as aviation; high-precision weapons; and also reconnaissance, control, and electronic warfare assets. Precision weapons are becoming truly strategic weapons in the non-nuclear period of a war because they effectively solve the tasks of destroying primarily strategic (especially stationary) installations, infrastructure elements, and sensitive military and other installations which

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[21] Colonel A. N. Zakharov, "The Military Factor in the Global Security Concept," VM, No. 9, 1993, pp. 18-22.

are vital for the existence of the state. This in particular has been vindicated by the experience of the war in the Persian Gulf when strikes with Tomahawk cruise missiles; AGM-142 Popeye, AGM-84E SLAM, ALARM, and HARM guided missiles; and the Gisac guided-missile system were delivered exclusively against strategic (for the most part stationary) installations located in major Iraqi cities or near them.[22]

In an era of very sophisticated technological processes and integration of production, even selective missile and bombing strikes against the most vulnerable targets -- industrial installations, command-and-control centers, storage facilities, and so on -- can inflict damage on any state that is perhaps comparable with the consequences of a nuclear catastrophe, thereby throwing it many years backward in economic development. Armies of many thousands are unnecessary for this; it is enough only to have precision weapons and means of delivering them. The buildup observed in developed countries in rates of development and production of such weapons and their platforms -- low-signature aircraft -- suggests such conclusions.[23]

The technosphere -- the production infrastructure artificially created by mankind -- is extraordinarily fragile and vulnerable. With the destruction or damage of its key elements such as atomic electric power stations; state area power plants; petrochemical, chemical, biotechnological, metallurgical, and other enterprises; storage facilities;

[22] Colonel-General I. V. Fuzhenko, Colonel Ye. V. Malyshev, and Lieutenant-Colonel N. S. Olesik, "On the Role of Cities in Achieving Strategic Objectives in Modern Wars and Military Conflicts," VM, No. 11, 1993, pp. 21-27.

[23] Leonid Malyshev, "Precision Weapons: An Alternative to Nuclear Weapons?" AS, No. 5, 1994, pp. 70-73.

transportation hubs; and so on, significant changes are possible in nature and in human society (as they also are with vast natural disasters) which at times are irreversible.

Today a similar effect can be caused by precision weapons used even on a small scale. Their newest models -- Tomahawk sea-launched cruise missiles, Walleye heavy guided bombs, SLAM cruise missiles (with a probable error of no more than 5 m), as well as cluster weapons and fuel-air explosives -- underwent a test during Persian Gulf military operations. Not only troops, but also atomic power installations; plants producing chemical, bacteriological, and conventional weapons; oil pipelines; and storage areas were subjected to combat effect. The destruction of key elements of the technosphere of developed countries which are in conflict can lead to irreversible changes both in the natural environment as well as in their production infrastructure, which practically erases the distinction between the consequences of using conventional weapons and nuclear weapons.

The Tula Design Bureau of Instrument-Building, for example, has worked a great deal on precision weapons in recent years. (All complexes with guided missiles are precision weapons, but this term basically is used for complexes intended for engaging point targets [including armored targets] on the battlefield using guided munitions.) The future belongs to smart weapons, among which the Russians include precision weapons, various offensive air weapons, and space weapons. They will determine the nature of future wars, as was shown by combat operations of the Multinational Forces against Iraq in 1991. Iraq could place nothing in opposition to these weapons and lost the war, and the losses of the warring sides were absolutely incomparable.[24]

An important property of precision weapons is selectivity; it follows from this that because military targets are chiefly engaged, losses among the civilian population are minimal. Precision weapons turn out to be very economical -- although a precision munition itself costs 30-50 times more than a conventional one -- because the expenditure of conventional munitions to kill a target is 300-500 times greater. In addition, an enormous amount of transportation assets is required for transporting such an amount of munitions, as well as large depot spaces, with all consequences stemming therefrom. Conducting an army or front operation in the Great Patriotic War required tens and even hundreds of ammunition trains. Thus, precision weapons not only influence the nature and methods of combat operations, but change the approach to their organization and preparation. Precision weapons essentially are leading to a revolution in military affairs. It must be said that a new type of armament always possesses this property. One can recall the works of F. Engels, which show that new armament entails new tactics. Chief Marshal of Armored Troops P.A. Rotmistrov wrote in the book Tanki i vremya [Tanks and Time] that the army with the advantage is always the one whose leadership is the first to understand the role and significance of a new kind of weapon, and the first to use it skillfully before the enemy realizes this.

The enormous importance of precision weapons was correctly understood during the Soviet Union's existence. The Tula Design Bureau made a major contribution to

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[24] Arkadiy Georgiyevich Shipunov, "Tula Design Bureau of Instrument-Building in Mid-1995," Vooruzheniye, politika, konversiya (hereafter cited as VPK), No. 2(9), 1995, pp. 13-17.

their creation. It developed precision weapons for armored equipment (tank-guided missiles and antitank-guided missiles) which can engage not only tanks on the battlefield, but also other military targets. Its Krasnopol is the first step contributing to a reform in artillery armament. When precision weapons are present it is unnecessary to conduct area fire; one can engage targets as they appear.

Russian military scientists note that in recent years, the opinion that precision weapons may be an alternative to nuclear weapons has spread in the press and among specialists both in the Russian Federation and abroad. It is impossible to disagree with that conclusion. In fact, to destroy an enemy target or group of targets it is possible to use either a nuclear weapon or one or more precision-guided weapons.[25] Today there already is a sufficient scientific and technical backlog, a number of precision munitions have been developed and have become operational for various types of arms, and real preconditions have been created for posing the task of replacing tactical nuclear weapons with precision weapons.

The term "precision weapons" is rather abstract and does not reflect the essence of the matter without establishing generally accepted concepts. As a matter of fact, the evolution of the development of any kind of arms attests to a striving for a continuous increase in accuracy in hitting the target (accuracy of fire). Whether it be small arms, artillery, antitank, missile, antiaircraft, aircraft, or other weapons, design thinking and its real embodiment always have been aimed at improving accuracy characteristics. The term "precision weapon" must therefore be considered from two

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[25] Arkadiy Nikolayevich Zakharov, "Precision Weapons and Combatting Them," VPK, No. 2(9), 1995, pp. 51-53.

standpoints. In the narrow sense it is a munition (artillery projectile, rocket projectile warhead, cluster submunition of MLRS warhead, missile, aircraft bomb, cruise missile, and so on) intended for engaging ground (surface) targets according to the "fire-forget-kill" principle that also has information and control systems in its composition which support its guidance to the target.

But the concept of "precision weapon" is considerably broader than the concept of "precision munition." To make effective use of precision munitions in combat operations, the involvement of a large number of standard combat assets must be supported, and specifically those assets:

- for obtaining information on targets;
- for controlling weapons that permit promptly transmitting and processing data, making a decision for engagement, and transmitting initial firing data; and
- for firing a precision munition.

Thus, in the broad sense a precision weapon is a system of combat and technical assets which include reconnaissance equipment, control equipment, combat assets, and precision munitions permitting objective data to be obtained promptly on targets, transmitting necessary target data to command posts, distributing targets to available combat assets, and precisely killing targets in the shortest possible time.

Only the introduction of precision munitions into the existing system of armament can bring the entire system to the level of a precision system. Therefore the main efforts of scientists and designers must be concentrated on developing precision munitions for a particular weapon system. The weapon system itself (artillery, missile, aircraft, and so on) is developed permanently and all its components (reconnaissance, control, weapons) are upgraded continuously. Thus, it makes no sense to develop specialized precision weapon systems which include all components from reconnaissance to engagement in their makeup. Weapon systems must be developed under approved programs, but the development of each element ("little brick") of the system must be subordinated to a unified ideology for creating precision weapons.

That approach to understanding precision weapons avoids confusion in terminology and precludes the inclusion of a large number of weapon systems among precision weapons. Thus, at present it is customary to consider all weapons which precisely engage a target as precision weapons: antitank, antiaircraft, antimissile, air-to-air missile, and so on. In fact, these are precision weapons in their essence -- they initially appeared and developed revolutionarily as precision weapons, were never intended to replace nuclear weapons, and occupy their own niche in the overall systems of armaments. If all kinds of arms develop in the direction of increased accuracy, then artificial inclusion of the aforementioned systems among precision weapons leads to a situation wherein the entire system of armaments is turned into a precision system and one arrives at the absurd conclusion that the problem of creating precision weapons is entirely absent.

In fact the problem does exist, and it is to replace tactical nuclear weapons on the battlefield with weapons that perform all combat missions using munitions only with a conventional (non-nuclear) filling. But including antitank defense, air defense, antimissile defense, and other systems among precision weapons shades the problem itself and does not permit concentrating efforts, including financial efforts, on solving the really new scientific and technical problems of creating precision weapons.

The main scientific-technical task of combat employment of precision munitions can be formulated as follows: a precision munition must detect a target randomly situated on the earth's (water's) surface from a random point in space and support precise guidance to the target and its kill. To perform this task the munition must have a system supporting a target search against the background of the earth's surface and a control system for guidance to the target. The homing head performs this role.

The targets are tanks, BMPs, BTRs, artillery pieces, MLRS, missile complexes, air defense weapons, command posts, reconnaissance assets, communications equipment, and many others. The homing head discriminates them by different signs -- thermal and radiometric emissions, radar reflection, and others. Each target has a combination of signs which have been insufficiently studied at the present time. The problem of detecting a target based on different signs is exacerbated by the very complex background of the earth's surface, which changes constantly depending on time of day and year, weather conditions, geographic position, and so on. Detection of targets is considerably complicated in instances of enemy use of jamming and means of maskirovka. In this connection a constant study of the target-background situation is one of the difficult and extremely necessary tasks without which it is impossible to create homing heads that meet the requirements of combat employment (all-hours, all-weather, jam-resistant).

One of the requirements for homing heads is the need to design them with small dimensions and low weight. This requires not only a microminiature electronic element base, but also various mechanical devices, diverse sensors (including fiber-optic), power sources, waveguides, microcryogenic devices, and much more. And this element base must be impact-resistant for use in a precision artillery munition. Insufficient attention presently is being given to creating such an element base.

Another difficult task is to create data-processing software. Many organizations have been doing research in the area of artificial intelligence. A rather good scientific backlog has been created and there is an understanding of the problem. The question turns on the creation of onboard miniature special processors supporting such a high speed as 150-200 million operations per second.

It is impossible to develop precision munitions without creating the necessary experimental and research equipment and outfitting scientific research institutes with the necessary material-technical base. Mathematical and half-scale modeling is a necessary stage in developing precision munitions, which also requires creating a corresponding material base. Half-scale modeling in particular requires the presence of precision multistage beds, good software, powerful computers, and corresponding target-background situation simulators. While elements for creating half-scale modeling complexes basically have been created at the present time, target-background situation simulators which adequately reflect a change in the situation and the dynamics of the munitions's movement do not exist yet. This problem is the most difficult one and requires a comprehensive involvement of various specialists.

Solving the aforementioned problems will not in itself lead to the creation of a precision munition. Considerable efforts of scientific and design organizations, industrial organizations and ranges, and their equipping and financing are required. Based on scientific research performed by various organizations, it appears possible to describe certain characteristics of those precision munitions that meet all-weather, all-hours, and jam-resistant requirements.

The range of target detection is primary. This is dictated by a number of factors. First of all, as noted earlier, the background and targets on it represent a complex, constantly changing picture. In this connection specialists both here and abroad have substantiated the need to create combination (infrared and millimeter) homing heads. With the positive and negative qualities inherent only to it, each band will supplement each other, ensuring maximum opportunities for detecting targets. Secondly, in terms of target detection range, millimeter waveband homing head capabilities are limited by transmitter power and antenna system aperture. Thirdly, the range of target detection by an infrared homing head depends substantially on the state of the atmosphere, dust-smoke interference, and height of cloud cover. Based on an analysis of the enumerated factors, the Russians see the need to establish a target detection range not exceeding the lower mean statistical boundary of cloud cover.

One of the most important characteristics of a homing head is the method of organizing target search and detection. Considering the diversity and complexity of the target-background situation and the dynamics of a munitions's motion, it is necessary to inspect as large an area as possible repeatedly in a short time with real-time data processing. This can be achieved only with level flight of the precision munition and terrain-scanning by a homing-head beam, or with vertical flight of the precision munition with all-around scan of terrain by a wide beam. Vertical flight of the precision munition with its preliminary deceleration is said to be preferable. Based on cited conditions of the munitions's functioning, either pulsed vernier motors or gas-dynamic control can be used for guiding it to the target. In view of the problematical nature of realizing the principle of gas-dynamic control, it is preferable to select pulsed vernier motors as a source of control forces.

The munitions's functioning on the flight path can be shown in the example of a homing warhead. The launch (or firing) is accomplished according to the standard scheme. The warhead opens up at the calculated point on the flight path and munitions are introduced to the airstream. Simultaneously (or earlier), the power unit switches on and photosensitive elements of the IR homing head are cooled (if necessary). A brake chute and stabilizers open up at a given altitude. Deceleration and stabilization (quieting) of the munition takes place after which the parachute is jettisoned and the homing-head infrared and millimeter channel systems switch on. In the presence of several targets and target-like objects in the search zone, data from them is processed in the central processor and the target is discriminated (selected). The direction to the target is stored in the system of coordinates formed by onboard gyroscopes and the munition begins to be guided to the target by the operation of one or simultaneously several pulsed vernier motors. Remote detonation of the warhead and destruction of the target occurs at a given height from the target.

Strictly speaking, say the Russians, all arms using guided munitions can be included among precision weapons; i.e., surface-to-air guided missiles, antitank and tank-guided missiles, air-launched and ship-launched guided missiles and bombs, and so on. But the term "precision weapon" began to be used widely when applied to guided munitions of missile-cluster warheads and to guided artillery projectiles. These weapons are intended for destroying point targets -- above all tanks and other armored vehicles -- directly on the battlefield as well as in the operational depth and in concentration areas; i.e., chiefly for engaging small ground troops targets. A comparison with tactical nuclear weapons was made specifically for cluster warheads, but precision weapons are a complex that combines means of reconnaissance, control, guidance, and sometimes also electronic warfare that function in real time, which sharply reduces the time required for killing a target and achieving victory over an enemy who does not have such complexes.[26]

This was demonstrated by the Multinational Forces in 1991. Before the beginning of combat operations the Multinational Forces planned them as an 18-day offensive air operation and then a 14-day ground offensive operation. The course of combat operations introduced a substantial correction, as a result of which the first operation grew to 42 days and the second was reduced to 4 days. It turned out that offensive air weapons and precision weapons are capable of independently performing if not strategic, then at any rate operational missions determining the outcome of a conflict. As a result of the 42-day offensive air operation, the Iraqi Army was routed and demoralized, and ground operations became only a finale.

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[26] Yuriy Georgiyevich Sizov, Aleksey Leonidovich Skokov, Aleksey Ivanovich Korshunov, "Precision Weapons and Combating Them," VPK, No. 2(9), 1995, pp. 54-57.

Of course, the Multinational Forces employed not only precision but also conventional munitions. In all likelihood this is connected with the fact that saturation of modern NATO armed forces with precision weapons is still insufficient. Time periods for the development and delivery of a number of types of precision weapons to the troops are increasing considerably. In particular, Brilliant-series artillery munitions capable of independently detecting and engaging armored vehicles were not used in 1991. Nevertheless, the main role was given to precision weapons. Losses in the 1991 war also are impressive; they were hundreds of times fewer for the Multinational Forces than for Iraq, and losses of the civilian population proved to be slight.

The primary advantages of PGMs include the following:[27]

1) With massive employment, the combat effectiveness of PGMs approaches the effectiveness of low-yield tactical nuclear weapons.

2) The selectivity of the impact on targets and the absence of radioactive contamination of the terrain permits the employment of PGMs from any distance beyond friendly troops without the risk of their accidental destruction.

3) The need for adjustment of fire, which is typical for unguided munitions, ceases to have significance -- which guarantees surprise when conducting the delivery of conventional fires.

4) A minimal quantity of munitions is required for accomplishing assigned missions, which substantially eases logistics support of troops. If an average of 9,000 munitions was required for the destruction of one target during the Second World War, it was 300 during the Vietnam War, and one "smart"

[27] Colonel Boris Nikolayevich Sibirskiy, "A 'Surgical Strike' Against the Enemy: Precision-Guided Weapons Guarantee It," NVO, 14 December 1995, p. 6.

bomb (missile, projectile) accomplishes that mission right now. Consequently, in modern war that colossal quantity of munitions which, for example, was produced in the USSR during the Great Patriotic War (775 million artillery projectiles and mines alone) will not be required.

5) The employment of PGMs together with other weapons significantly enhances their effectiveness and supports automated command and control.

During the course of Operation Desert Storm, the United States tested Tomahawk sea-based cruise missiles; the Patriot air defense missile complex; Abrams tanks; Bradley infantry fighting vehicles; F-117, F-18, and Tornado aircraft; attack helicopters; an airborne reconnaissance radar system; artillery and aircraft guided munitions; and command-and-control and communications systems for the first time under actual combat conditions on the territory of Iraq and Kuwait -- which actually turned out to be a gigantic test range. Russian military experts often focus on the role of electronic countermeasures (ECM), Tomahawk sea-based cruise missiles (the "most effective" PGM system), and airborne and space-based reconnaissance in Operation Desert Storm.

ECM systems are not weapons that destroy targets, but their employment precedes the initiation of combat operations in modern war. Figuratively speaking, ECM clears the path of obstacles for the unimpeded employment of PGM combat systems. ECM, being the most important element of electronic warfare (EW), is called upon to prohibit or impede the functioning of enemy electronic systems through radiation and reflection of electromagnetic, acoustic, and infrared signals. ECM is carried out using automatic ground-based, ship-based, and aircraft jamming systems. For several days prior to the initiation of Operation Desert Storm, the United States conducted electronic countermeasures against active air defense systems, command-and-control elements, and other important targets on Iraqi territory on a large scale for the first time. "Western experts" have noted that there was a "storm on the airwaves" -- the Americans conducted such a powerful electronic strike against Iraq that even certain radio links on the territory of the Soviet Union's southern military districts were jammed.

American surface combatants and submarines are armed with "smart" Tomahawk missiles. Sea-based cruise missiles have a launch weight of 1,500 kg, length of 6.25 meters, flight speed of up to 1,200 kph, range of 1,250 kilometers, and accuracy of up to 10 meters. The warhead of the sea-based cruise missile (with a conventional warhead) is produced in two types: single warhead (high-explosive) and a canister warhead that contains 166 bomblets weighing 1.5 kg each. According to the assessments of military experts, the greatest physical damage to Iraq was caused precisely by massive Tomahawk missile strikes from American battleships, cruisers, and submarines and also by carrier-based ground attack aircraft.

In 1992, 94 ships in the U.S. Navy (including 62 submarines) were equipped with Tomahawk missiles. It is planned to have 138 such ships, including 107 submarines, by the year 2000. By the end of the century, the total number of sea-based cruise missiles in the United States could reach 4,000. Sea-based cruise missiles turned out to be outside the frameworks of the START I and START II treaties, which represents a substantial strategic advantage for the United States.

The effective employment of sea-based cruise missiles in Operation Desert Storm made a strong impression on Iran, China, and Syria. These countries have already taken steps to develop or acquire similar missile systems that can appear in their armed forces by the end of the current decade. Great Britain also plans to have sea-based cruise missiles; specifically, it intends to purchase 50 Tomahawk missiles from the United States and equip attack submarines with them.

As already noted above, PGM systems are employed together with various support systems. For example, the American command utilized 35 reconnaissance satellites of various types and 70 long-range reconnaissance aircraft equipped with optical-electronic, photo, and radio equipment for reconnaissance support of Operation Desert Storm. This permitted the Americans to discover the location of troops, command posts, communication hubs, air defense systems, industrial facilities, electrical power plants, nuclear and chemical weapons research centers, depots, and other important targets on the territory of Iraq. The coordinates of all of the detected targets and facilities were determined with great accuracy and entered into the PGM guidance systems which guaranteed their most effective employment. The Americans even prepared special "electronic dossiers" on Iraq's 300 most important military and economic facilities. Destructive strikes using PGM systems were conducted against them in the first hours of the operation based upon these dossiers.

Equipping troops with precision-guided munitions not only substantially expanded their combat capabilities but also imparted a new qualitative characteristic to them: rapidly depriving the enemy of the capability for effective resistance. And this, in turn, entailed a fundamental change of strategy, the essence of which consists in a real capability to utilize fundamentally new methods of armed combat. In future military operations the "U.S. military leadership" considers it advisable to reject the employment of weapons that cause enormous casualties, destroy industrial enterprises and infrastructure, and disrupt the ecology. In the opinion of "the Americans," qualitatively new armed forces must be utilized not so much to conduct traditional combat operations as to deprive the enemy of the capability for active resistance -- which must be achieved precisely through PGM "surgical strikes" and the massive employment of ECM. In the process, the conduct of ground operations must be minimal or should not occur at all.

ROLE OF PGMs IN CHECHNYA

The improving weather enabled the Russian Air Force to use precision bombing of the gangs in Chechnya, a highly placed military official told Interfax in late 1994. He said that laser air-to-surface missiles and guided bombs were used. As a result, there would be virtually no civilian casualties, the official said.[28] In his words, the Air Force targeted artillery positions, strongholds, and armored vehicles of Dudayev's supporters. The official said that the use of precision weapons had noticeably improved the combat support to land units. He said that the Russian Air Force destroyed Dudayev's helicopter and two bridges on the River Argun.

Also in late 1994, the Russian press reported that preparatory measures were being completed in the group of Russian forces to use new high-precision systems and weapons which will selectively hit only military targets. Su-25TK attack planes with air-to-ground guided missiles, "Nona-SVK" 120-millimeter self-propelled guns, and

[28] "Air Force Uses Laser-Guided Missiles in Chechnya," Moscow Interfax, 29 December 1994.

"Shturm-S" anti- tank systems would be used.[29] According to General-Major Ye. Nikitenko, it would have taken several massive bombardments to completely destroy the kind of mini-army that Dudayev had set up -- which included combat aircraft (Su-24M bombers and Su-25 ground-attack aircraft) and various kinds of helicopters. Every aircraft and helicopter has 8-10 hard points which can be fitted with high-precision rockets and bombs, rocket pods, rapid-fire guns, tanks of incendiary fuel, and other weapons.[30]

The Ground Forces' latest rocket systems with a range of around 300 km could have taken part in the delivery of fire. Their powerful, high-precision warheads on average deviate just 10-15 meters from the target. The very effective "Uragan" and "Smerch" salvo-fire systems with a range of 34 and 70 km respectively would have been used with the "Grad" salvo-fire rocket systems. The Russians thus planned to employ modern munitions with tremendous destructive force and would also have blockaded enemy groupings by remote minelaying in the area.

The Russian General Staff issued the following directive on 15 February 1995:

With the onset of favorable meteorological conditions, to maximize the employment of aviation for strikes against the militants with the use of self-guidance high-precision weaponry. To destroy Dudayev's strongholds in mountainous areas and

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[29] Igor Korotchenko, "Initiative in the Hands of Russian Troops," NG, 31 December 1994, p. 1.

[30] Interview with General-Major Yevgeniy Nikitenko, "Groznyy Is Not the Desert; First Attempts To Derive Lessons from Army's Actions in Chechnya," KZ, 27 January 1995, p. 2.

in the south of Chechnya. To demoralize the enemy with the aid of on-going air raids. To destroy transport links across mountain passes and roads. To prevent the approach of mercenaries and caravans carrying weapons from the territory of Georgia. To impose on the hostile forces the tactics that are unacceptable to them. In a number of areas, to utilize up-to-date compact infrared and remote-controlled night vision equipment and instruments. To practice the conduct of operations primarily during night hours. To lay air mines across the hostile forces' routes of retreat, blocking these routes of retreat, and totally destroying these hostile forces should they refuse to lay down their arms.[31]

According to Russian military experts, at various times the Russian air grouping included up to 140 various military aircraft, not counting military transports. Basically these were Su-27 multipurpose fighters and Su-25 attack aircraft. These aircraft are capable of carrying precision aircraft weapons guided on the trajectory: laser-guided missiles and bombs, etc. Unfortunately, the unfavorable weather (fog, solid overcast from the ground to altitudes of 6,000 m or more) hampered the use of precision weapons.[32]

When the weather improved these weapons were used rather effectively. In addition to conventional aerial bombs, munitions containing spherical projectiles were used outside of built-up areas against major concentrations of bandit forces armed with

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[31] "Russian Army Directive on Chechen Campaign Objectives," Kiev Uniar, 22 February 1995.

[32] Colonel Gennady Lisenkov, "The Air Force Performed the Mission: It Provided Air Support to Federal Troops," AS, No. 3, March 1995, pp. 42-43.

Grad launchers and modern small arms. This was a forced measure. Assertions of the use of needle-filled bombs do not conform to reality. Flare bombs also were used to neutralize the fire of Stinger and Strela portable missile systems, which Dudayev's personnel had in great quantity. They are capable of "leading away" the heat-seeking heads of these missiles.

According to Colonel-General P. Deynekin, CINC of the Russian Air Force, as soon as the weather improved Russian forces started using guided missiles, laser-guided missiles, and laser-guided bombs to destroy road bridges over the Argun River and to prevent Dudayev from bringing up reserves to Groznyy. The results of the bridge bombing were clearly visible on one photograph -- a bomb had scored a direct hit. Precision weapons were also used against military targets in Groznyy -- mainly the tank repair plant, gunmen's strongholds, and centers of resistance.[33] In May 1996, a precision weapon struck Dudayev as he sat in his own vehicle.

CRUISE MISSILES

The Russian military was surprised to hear reports in January-February 1992 that ALCMs launched from B-52G strategic bombers were used to suppress Iraq's air defense system. In practically two hours, the crews were basically ready to carry out the assigned mission, since employment of cruise missiles in the conventional configuration did not require them to completely master new and unusual techniques, and the experience gained during the many years of training in the use of cruise missiles in the nuclear configuration was actually also applicable in the new circumstances. In

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[33] Interview with Colonel-General Petr Deynekin, "Flying in Your Dreams and in Reality," RV, 17 August 1995, p. 3.

essence, there are only minor differences in the software and certain peculiarities in the onboard equipment.[34]

According to Russian military theorists, the strike was made against important targets of the air defense system, including electric power stations, power lines, communications centers, and radars. Thirty missiles hit them, demonstrating a sufficiently high degree of effectiveness. Destroying the radars and communications centers "blinded" Iraq's air defense and made it considerably easier for the crews of the allied strike aircraft participating in the first strike to carry out the combat missions.

In analyzing the use of B-52G bombers as cruise missile platforms, the "Air Force leadership" especially emphasizes their ability to destroy small targets in virtually any areas of the world. Combining heavy bombers, conventionally armed cruise missiles, and tanker aircraft makes it possible to make strikes "without the support of bases located outside the continental United States."

Thus, say the Russians, Air Force command authorities sought to emphasize the capability of turning strategic bombers into a means of extending U.S. military might on a global scale. Air-launched cruise missiles in the conventional configuration have greater accuracy and a more powerful warhead than Tomahawk sea-launched cruise missiles with a conventional warhead, which also were used in the first strike against certain highly protected targets located deep in Iraqi territory.

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[34] Colonel V. Olgin, "Use of B-52G Strategic Bombers in Operation Desert Storm," Zarubezhnoye voyennoye obozreniye (hereafter cited as ZVO), No. 3, 1993, pp. 38-40.

Staging airfields of Iraqi Air Force combat aviation were selected as the primary targets of American bomber strikes, whereas command centers and command-and-control posts -- including Hussein's residence -- were not. After making the first strike, the weapons were to be shifted to certain military industry installations.

Russian military analysts note that during Operation Desert Storm, the American Armed Forces made fairly extensive use of their "smart" weapons for the first time. This enabled the Pentagon to evaluate their capabilities and effectiveness realistically. At the same time, significant defects inherent in such models of first-generation weapons also became obvious. Among them, in particular, is the short range -- approximately 6-10 miles -- of the laser guidance systems. Consequently, aircraft carrying missiles equipped with such systems are forced to operate within range of enemy air defense weapons. As a result, they either sustain excessive losses or begin making launches at distances from which it is difficult to hit pinpoint targets.[35] As far as can be judged from "American military press materials," Pentagon leaders are devoting increasing attention not to creating new combat aircraft, but to developing a new generation of high-precision weapons intended for making strikes against heavily defended targets from outside the range of enemy air defense weapons.

Above all, this involves creating new long-range aviation missiles. They will be able to be used, as before, from the same F-16, F/A-18, and F-15E fighters and ground-attack aircraft that are in service in the American Air Force today. But they will no longer need to get within range of enemy air defenses. Consequently, this will increase

[35] Matski Ponomarev, "The Pentagon Makes a Choice," KZ, 17 March 1995, p. 3.

the survivability of aircraft platforms, reduce their losses, substantially expand combat capabilities, and increase the effectiveness of weapon employment.

According to Russian analysts, the Pentagon is considering up to 10 different programs for producing such missiles. The details are being kept in strict secrecy. It is known, however, that this involves, in particular, air-launched cruise missiles with Stealth technology. However, special emphasis is placed on equipping them with jam-resistant sensors, an improved guidance system with a high resolution, and warheads able to disable the enemy's electrical power installations.

The jam-resistant sensors are supposed to ensure stability of missile control in conditions of active countermeasures, when highly effective means of electronic warfare are widely used. So-called "general-purpose problem solvers" are to become the heart of the high-precision guidance systems. These devices will make automatic target identification possible -- initially partial and subsequently unrestricted. In other words, it will be sufficient to lead the missile to the target area, and the missile itself will be able to find it perfectly. It is expected that the accuracy at long ranges will be from 1 to 3 feet.

As far as new warheads are concerned, the destructive properties of many will be based on using the chemical energy of the explosion, as is practiced now, and on other factors. For example, reports have surfaced about the development of high-intensity microwave weapons. Hitting in the vicinity of the target, with the aid of a brief splash of microwave radiation the warheads are to overload the sensitive electrical circuits on enemy installations, including underground, and knock them out of commission. The warheads, which are equipped with fine carbon fibers or specially treated wire, are also designed to disable electrical power systems. Dispensed in the vicinity of the target, clouds of these fibers cause short circuits of electrical equipment which cause it to catch fire.

Extremely long-range cruise missiles are to make a strike first against enemy facilities -- especially his low-frequency radars -- which are able to detect Stealth aircraft. Then Tomahawk missiles with warheads filled with carbon fibers will knock out enemy electrical power supply systems and antenna systems for command and control, communications, and air defense assets. After this, a line of F-117 or B-2 Stealth aircraft makes a strike against fortified command posts and command-and-control centers with heavy penetrating bombs. Finally, new-generation high-precision and jam-resistant types of weapons launched from outside the coverage area of air defense weapons destroy surface-to-air missile launchers and key strategic installations.

According to Russian military scientists, the cruise missiles in service today have acquired fundamentally new combat performance characteristics previously unattainable for them. They can perform a programmed mid-course maneuver, execute a flight at extremely low altitudes with terrain following, and also possess a high accuracy of guidance and good jamming protection. Work is being conducted to further reduce the radar cross-section, which was not very large before. All these innovations cannot help but be reflected in the tactics of employing cruise missiles, which have become more diverse.[36]

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[36] Professor A. Krasnov and Lt. Col. N. Bessarabov, "Use of Cruise Missiles and Combating Them With Air Defense Fighters," ZVO, No. 6, 1995, pp. 31-33.

In the opinion of "Western military experts," the basic variants of employing cruise missiles are a massive strike on a broad or narrow front and single or group strikes against a limited number of targets. The U.S. plans to use them at NATO exercises together with tactical, carrier-based, and strategic aviation aircraft. In doing so, they can operate simultaneously against pre-assigned targets, but more often the missiles are tasked with neutralizing protected air defense facilities before air strikes. In particular, cruise missiles were employed this way during the Persian Gulf War one hour prior to the launch of aviation strike groups. They made a massive strike against fixed air defense, state, and military command-and-control facilities. Thus the tactics of employing modern cruise missiles are based on a high density of the attack (resulting in supersaturation of the opposing side's air defense system), use of the missiles's combat performance characteristics, and accomplishing various measures to deceive the air defense system.

The flight to the targets at extremely low altitudes decreases the effectiveness of radar. For secrecy and surprise, they proceed over broken routes, changing their heading every 100-200 km and bypassing previously detected powerful air defense dispositions. The capability of accomplishing such actions and maneuvers, as well as the high accuracy of guidance, is ensured thanks to onboard automated flight control systems. The latter make it possible to periodically eliminate accumulated errors in the terrain contour matching areas by comparing a radar image of the terrain with information stored in the onboard computer memory.

Judging from articles in the "Western press," the following picture of a massed strike is taking shape. Before it starts, submarines and surface ships carrying sea-launched cruise missiles secretly head for the launch points, and aircraft carrying cruise missiles head for planned lines in frontal battle formations. In order to make it difficult for the enemy to predict directions from which to expect missiles, these lines are designated on vast territories, in water areas of the seas, and beyond detection zones of enemy air defense radars.

To achieve a high density of attack, cruise missiles are launched simultaneously or in short intervals. Then the missiles approach the planned routes and proceed to the targets at altitudes of 60-100 meters with terrain following. Depending on the importance and degree of protection of the target, the strike is made by one or several missiles.

Measures aimed at diverting air defense forces and assets away from the missiles occupy a large place in cruise missile tactics. Individual diversionary groups of aircraft, having on board unmanned AN/ADM TALD dummy targets, operated in this way. They simulated the flight of cruise missiles on diversionary headings, which considerably complicated the air situation. The missile actions were also supported by specially assigned jammer aircraft, which conducted jamming from alert zones located above friendly territory. Use of a certain portion of cruise missiles as dummy targets, for which it is envisioned to place jammers on them, is becoming something new in tactics.

Thus, say the Russians, today the tactics of employing cruise missiles have been defined sufficiently clearly. In the opinion of the "U.S. and NATO military leadership," they will continue to remain effective and relatively inexpensive weapon systems in the future. Further improvement of their tactics will proceed along the path of expanding the area of effect of cruise missiles, expanding the range of targets that can be destroyed (down to the smallest targets), and increasing capabilities for air defense penetration. Great hopes in this respect are placed on new small-sized missiles being created using Stealth technology. They were tested recently in the United States.

STEALTH TECHNOLOGY

According to Russian military scientists, the Americans made intensive use of a new low-signature aircraft -- the F-117A manufactured under the Stealth program -- during the PGW. Guided aerial bombs with laser homing were used by and large for the destruction of targets using the F-117A. These aircraft, while performing five percent of the overall number of aircraft sorties on the first day, destroyed one third of all strategic targets. The reduction in radar detectability of this aircraft was achieved through the choice of special shapes and elements for its design, the use of radio-absorbing and composite materials, and a reduction in the number of antennas.[37]

Russian military analysts note that "foreign military specialists" foretell a great future for the hard-to-detect aircraft built using the Stealth technology. They possess, to a greater extent than other aircraft, the ability to operate in secrecy, overcome the resistance of powerful air defense (AD) systems, and inflict surprise strikes against

[37] Colonel L. Vasylevych, "'Desert Storm': Electronic Warfare," Narodna armiya (hereafter cited as NA), 20 July 1993, p. 2.

various targets owing to their small radar signatures, low threshold of thermal emissions, and low visual/optical and acoustic detectability.[38]

F-117A Stealth aircraft were widely employed in the war in the Persian Gulf, and not one of them was lost. These aircraft were entrusted chiefly with the destruction of AD targets and the execution of strikes against especially important but small targets in the depth of Iraqi territory -- command posts, communications centers, missiles complexes (see Figure 3).

The role and place of Stealth aircraft will depend on three principal factors--the ability to penetrate an AD system, the choice of variant for the start of combat operations, and the correlation of the types of aircraft in an air group. The ability of Stealth aircraft to surmount the opposition of AD systems is felt to be the most important factor determining their capabilities to perform a whole set of combat missions. "Foreign military theoreticians" ultimately conclude that the use of Stealth aircraft should be concentrated on striking at those targets and in those sectors where the greatest resistance from enemy AD is expected. That also defines their place in the aviation forces.

The variant for the start of military operations is also considered to be an important factor defining the role and place of Stealth aircraft within air power. In the principal variant for unleashing a war using conventional weaponry--an incursion and

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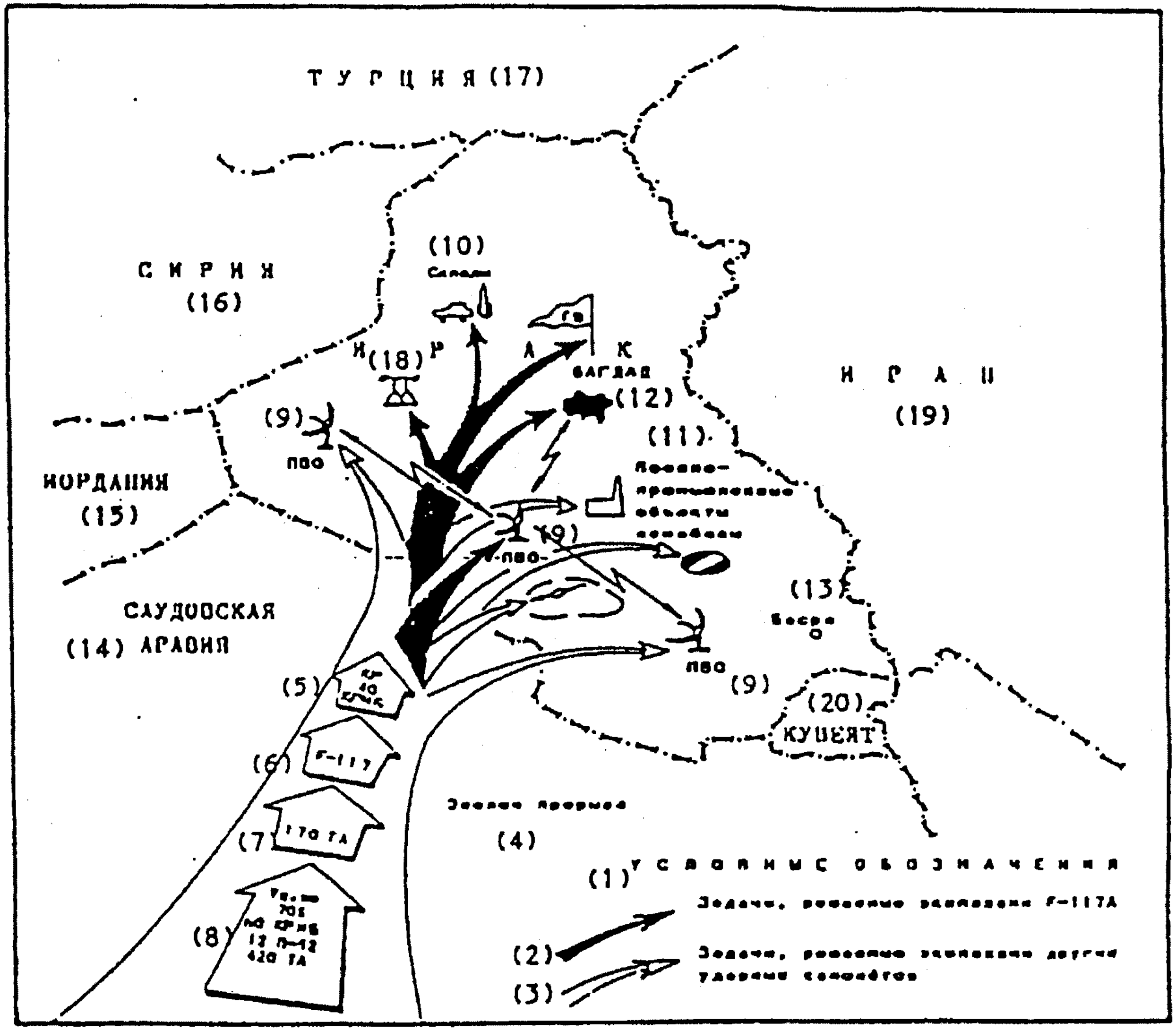
[38] Professor A. Krasnov and Colonel O. Safronov, "Stealth Aircraft in the Combat Operations of U.S. Aviation," ZVO, No. 8, 1993, pp. 36-40.



Distribution of combat missions among Stealth and other aircraft in the war with Iraq in 1991

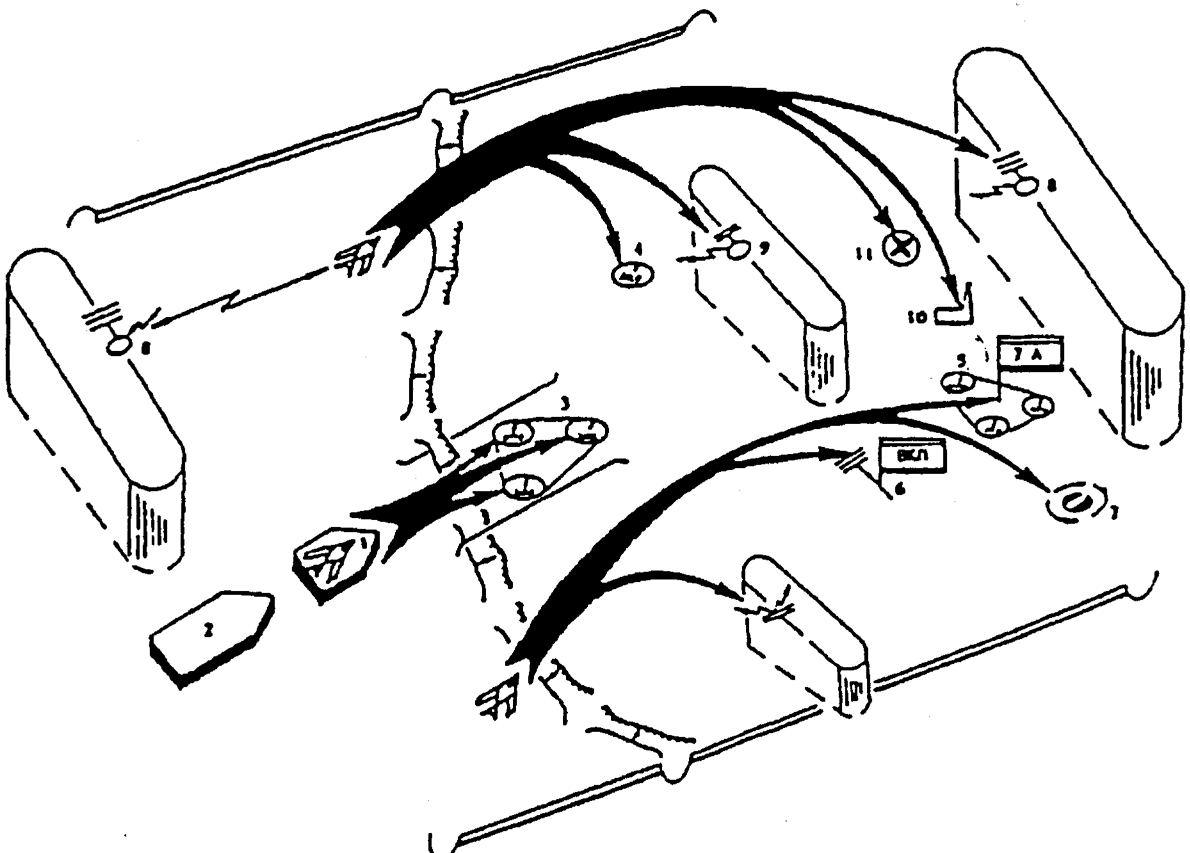
Key:
1. Symbols: 2. Tasks performed by F-117A crews; 3. Tasks performed by crews of other strike aircraft; 4. Breakthrough echelon; 5. 40 sea-launched cruise missiles; 6. F-117s; 7. 170 TA; 8. Strike echelon, 70%, 60 sea-launched cruise missiles, 12 B-52s, 420 TA; 9. PVO; 10. Stores; 11. Military-industrial facilities, air bases; 12. Baghdad; 13. Basra; 14. Saudi Arabia; 15. Jordan; 16. Syria; 17. Turkey; 18. Iraq; 19. Iran; 20. Kuwait.

FIG 3

the delivery of a first, massed firepower strike by the forces of tactical aviation, cruise missiles, and artillery by which an air offensive operation can begin--the F-117A aircraft are planned to be included in the overall operational-tactical disposition of airpower. They can operate either independently, interacting with other aircraft via the distribution of strike targets and times of operation among them, or in groups for various tactical purposes. The place of Stealth aircraft in the battle formations of strike aviation, in the opinion of the U.S. Air Force command, should be in the echelon for AD suppression. Operating in conjunction with F-4G and F-16 fighters, they should create a corridor for the passage of subsequent echelons to the strike targets.

Independent actions by Stealth aircraft are considered to be preferable, since they can reach the target area undetected without other aircraft giving them away. The pilots, being in sectors and areas where there are no other aircraft, can moreover undertake more unrestricted maneuvers without fearing a collision, even though the likelihood of that is quite high owing to the "invisibility" of the F-117A in an airspace saturated by aircraft.

When the strike targets are being distributed, the Stealth aircraft are assigned not only AD assets but also those targets whose likelihood of destruction by conventional tactical fighters requires a considerable detail of forces and entails large losses, owing to the strong resistance of enemy AD. Armed with guided aerial bombs with laser homing systems, they will destroy strongly protected enemy targets in the operational and sometimes the strategic depth whose destruction requires great bombing accuracy (see Figure 4).



Tasks and place of Stealth aircraft in overall operational-tactical air formation

Key:
1. PVO breakthrough echelon.
2. Strike echelon.
3. PVO breakthrough corridor.
4. SAM systems.
5. Command posts.
6. Airborne command posts.
7. Airfields.
8. Long-range radar and command-and-control aircraft.
9. Airborne elements of reconnaissance and strike systems.
10. Facilities with a nuclear power installation.
11. Enterprises in the military-industrial complex.

FIG 4

One variant for the start of military operations in regional conflicts that potentially threaten vitally important interests is considered principally apropos of remote areas during the first days after its outbreak, when there are still no EW aircraft, AD suppression forces, or cover fighters there. B-2 bombers under those conditions could prove to be the sole means of making strikes against the targets of the opposing side without the risk of substantial losses, and will play an important role in defeating the enemy. The F-117A aircraft themselves do not possess sufficient range, and can take part in military operations considerably later. Three B-2 aircraft, in the estimation of American analysts, are able to halt the advance of an armored division in march formation and inflict irreparable losses on it in a single sortie.

Stealth bombers in a large-scale war should make strikes against remote targets in the deep rear areas of the enemy, operating in conjunction with B-1B and B-52H heavy bombers (but not in the same strike group) and forcing breaches for them in the AD system. The role of Stealth aircraft in air combat operations, in the opinion of "foreign military specialists," thus consists of suppressing enemy AD assets and augmenting efforts in the decisive sectors to defeat well-protected targets. Their place should be both in the sectors covered by powerful enemy AD, and immediately in the battle formations of groups of other aircraft that make up the AD breakthrough echelon. The appearance of the F-22 fighters as part of air groups in the beginning of the 21st century will allow the Stealth aircraft to perform a fundamentally new task for them--destroying the most important airborne targets: command-and-control, long-range radar, and control aircraft and the airborne elements of reconnaissance-strike systems, among others.

Russian military experts stress that the influence of new technologies is most noticeable in military aviation. While Russian electronic equipment for aircraft is still comparable with American equipment, they say, a significant lag exists in the area of applying a technology such as Stealth. The fact is, this is what made a revolution in aviation comparable with the transition from piston to jet engines. Now it is not speed, but "invisibility" that has become the chief factor. Even the most imperfect F-117A fighter, built with this technology and called a "lame dwarf" for its external homeliness, became a real star in combat operations against Iraq. Practically invisible on radar screens, F-117As easily penetrated the initially rather strong Iraqi air defense system. They accounted for only 5 percent of combat sorties by multinational forces aircraft and approximately one-third of all strategic targets struck, and this with an ordnance payload several times less than that of conventional fighter-bombers.[39]

But entirely new flying craft are on the horizon. These new aircraft combine not only inconspicuousness, but also enormous, hypersonic speeds achieved owing to the use of non-traditional types of aerodynamic configurations and power plants. Proposals of "a leading U.S. firm" to create an unmanned hypersonic aircraft flying at speeds ten times that of sound and intended for pinpointing air defense systems also attest to the aggressiveness of the new direction in development of combat aviation. According to statements by a number of experts, the scientific-technical base for creating such an aircraft already exists.

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[39] Aleksandr Vasilyev, "U.S. 'Flying Triangles': New Technologies," Inzhener, No. 3., 1994, pp. 14-15.

IV. COUNTERMEASURES TO "SMART" WEAPONS

COUNTERMEASURES TO PGMs

Russian military scientists note that the presence in an AD group of air-defense systems of a certain type ensures its stability under the conditions of exposure to EW equipment. The development of second-generation systems was begun at the end of the 1960s and beginning of the 1970s.[40] These air-defense systems received concrete designations and missions:

- S-300V SAM system (General Designer V.P. Yefremov) -- for the defeat of ballistic and aeroballistic missiles, EW and command-and-control aircraft in their patrol zones, aircraft of strategic and tactical aviation, and other types of targets;
- the Buk SAM system (Chief Designer Ye.A. Pigin) -- for the defeat of aircraft of tactical and strategic aviation, cruise missiles, and other types of targets;
- the Tor SAM system (General Designer V.P. Yefremov) -- for the defeat of aviation missiles and other combat elements of high-precision weaponry, aircraft of tactical aviation, cruise missiles, and other types of targets;
- the Tunguska air-defense missile and artillery system (General Designer A.G. Shipunov) -- for the defeat of combat helicopters, aircraft of tactical aviation, cruise missiles, and unmanned equipment; and
- the Igla portable SAM system (General Designer S.P. Nepobedimyy) -- for self- defense against attacking air-space attack forces.

[40] Yu.G. Sizov and A.G. Luzan, "Military Reform," VPK, No. 1, 1993, pp. 45-48.

Clearly, say the Russians, combating PGMs calls for the same measures employed in combating traditional types of weapons -- destruction of the weapons and providing individual protection against the weapons, among other things. These measures constitute one part of the effort. The other measures take into account the special qualities of PGMs (HPW) that differentiate them from conventional weapons (see Figure 5).[41]

The most important quality of PGMs is their greater dependence on information about their targets, their location, terrain, and the atmosphere. The information is necessary to make most of the warhead's combat capability. This is because the process of controlling PGMs, unlike the discrete process used for conventional weapons that consists of one detection-target designation cycle, is uninterrupted and consists of two, three, or even four such cycles. On the whole, this most important quality of a PGM makes it possible to call them the first type of a new information-intensive weapon calling for a non-traditional method of warfare.

Another distinguishing quality closely linked with the previous one is that constant reconnaissance and additional reconnaissance of the target to be engaged -- which form the basis of PGM functioning -- is being done by technical equipment. Therefore the effectiveness of PGM employment depends on normalcy of the position and state of each PGM subsystem, each target, and the environment (the atmosphere, terrain, vegetation, and so on) in the area of location of high-precision weapons; the target; and the warhead's flight path.

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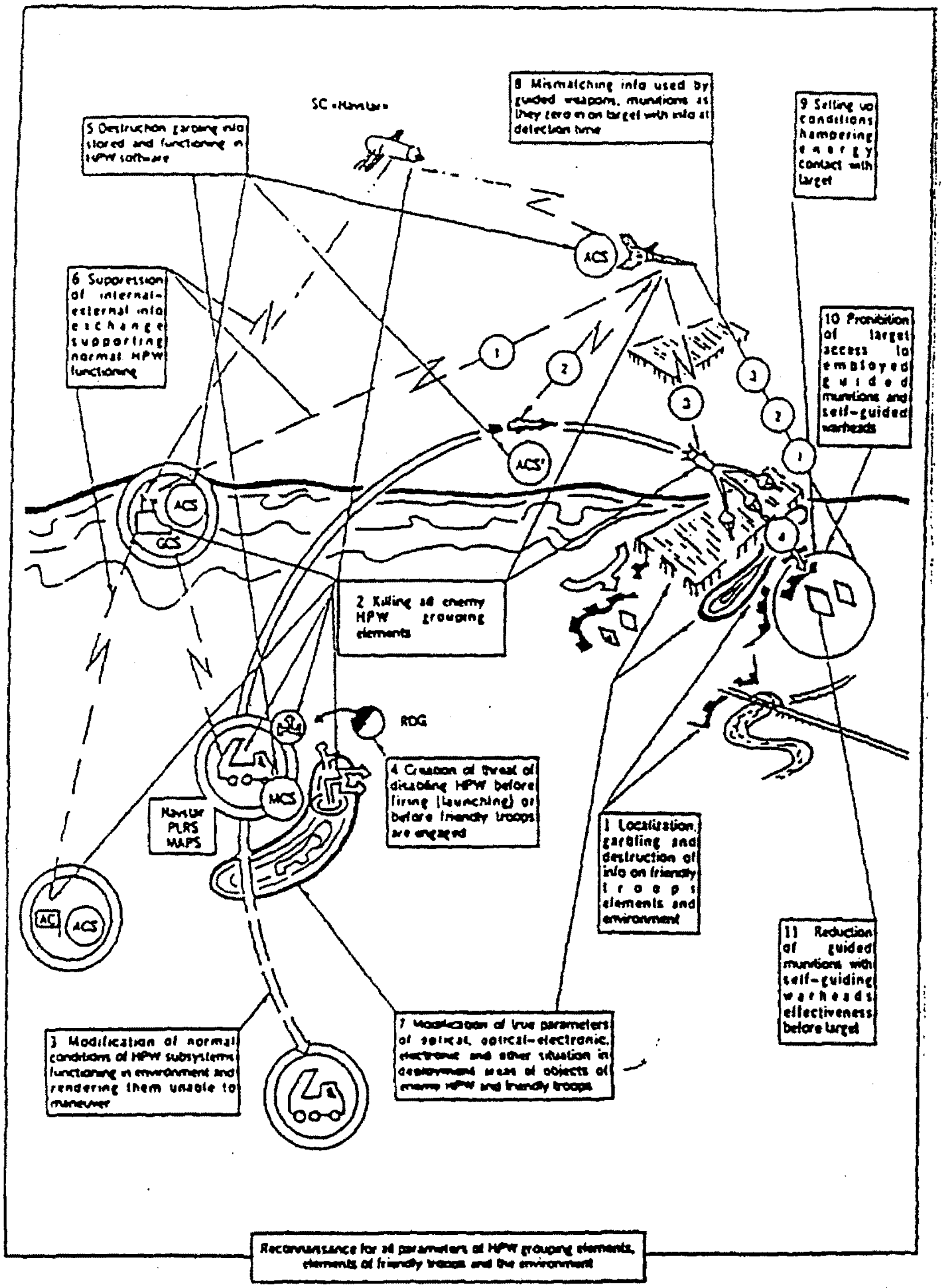
[41] Yu.G. Sizov and A.G. Luzan, "Military Reform," VPK, No. 1, 1993, pp. 45-48.



The matter of «combating enemy HPW» phenomenon

FIG 5

Combating enemy PGMs in an operation, as well as the process of employing these weapons, should have a multi-dimensional character. It can be defined as integrated combat consisting in consecutive and simultaneous, joint and disjointed actions by large strategic formations, large units, units, and subunits to:

- localize, garble, and destroy the orientation of information weapons; warheads; munitions; facilities for obtaining, gathering, processing, storing, distribution, and transmission of information; orientation of weapons, warheads, and other PGM subsystems in space; internal and external control; collective protection; basing and logistics systems;

- modify normal conditions for the functioning of the above systems in the environment and deny them the capability to maneuver;

- create the threat of PGMs losing their qualities before having been fired (launched) or before they hit friendly targets;

- destroy and garble information functioning in PGMs and suppress the exchange channels;

- modify the true parameters of the optical, optical-electronic, electronic, radar, thermal, and other situations in the places of deployment and functioning of PGM targets;

- displace information used by guided weapons and self-guiding warheads as they become targeted on friendly facilities compared with the initial information received by the reconnaissance assets at the moment of detection or information available to the enemy;

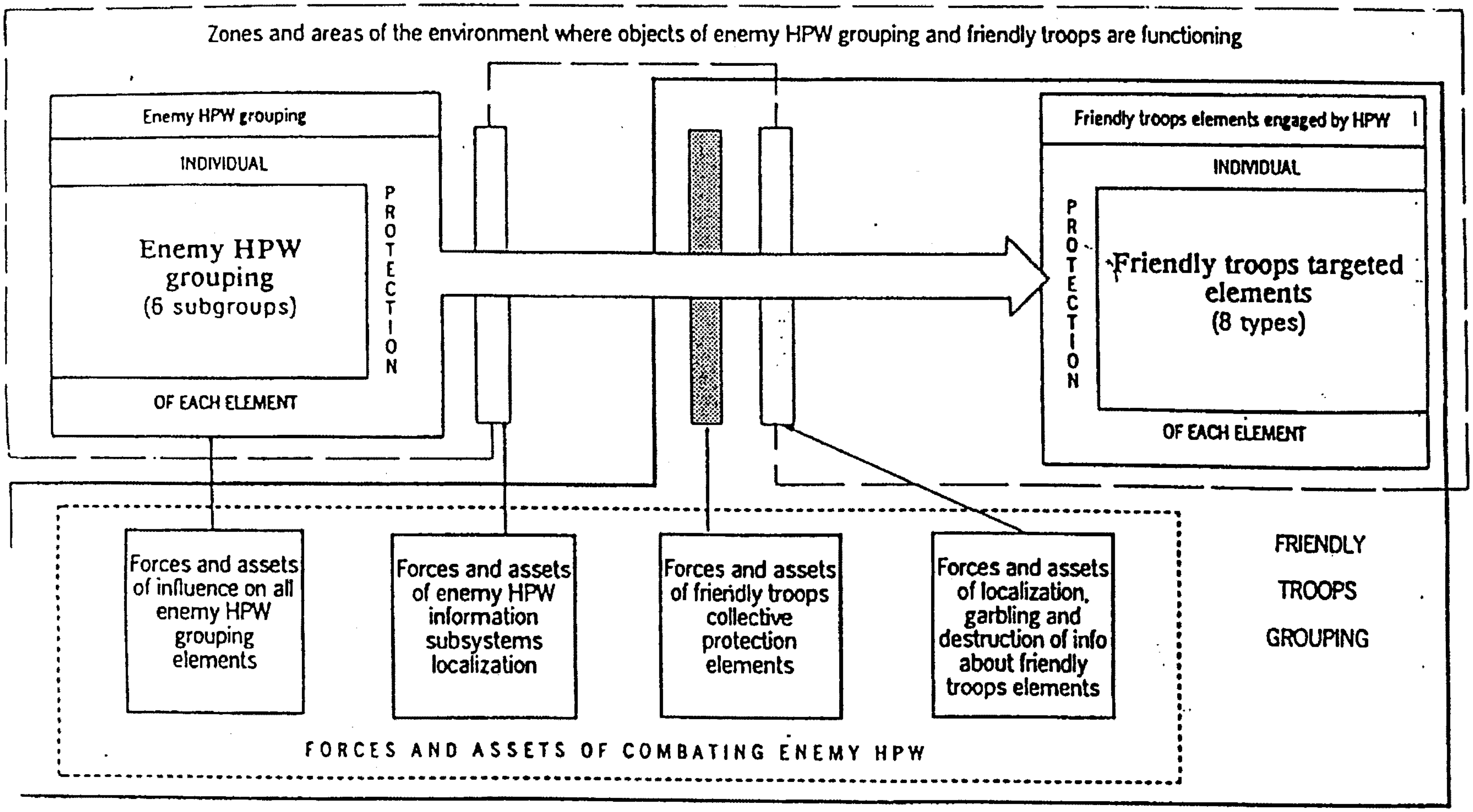
- create conditions hampering the process of getting into energy contact with the target by the already employed PGM;

- interdict the excess danger to friendly targets by already employed guided warheads and self-guiding warheads; and

- minimize the effectiveness of their action near the target.

The composition of participants in the combating process varies with the makeup, qualities, and potentialities of its first and most important group -- the grouping of enemy PGMs. This includes the deployed and maneuvering formations of high-precision weapons munitions and complexes of weapons; guided weapons and munitions; other military hardware, systems, installations, and subunits of combat arms and special troops; and enemy fortifications and elements of operational equipment which are employed in supporting their combat functioning. A PGM grouping may include up to six subgroups of installations, zones, and areas of the environment (see Figure 6).

The first subgroup is comprised of weapons (PGM systems) -- combat ships, submarines, and combat aircraft with cruise missiles and other PGMs; artillery and tanks; employed guided warheads; assets for remote mining of terrain; and other military hardware. Existing and future PGM systems are remarkable for their combat effectiveness (they practically guarantee the destruction of targets), enhanced range of kill, high precision of guidance, quick reaction time, short cycle of destruction, and the use of warheads using various systems of guidance and homing. According to military specialists, high-precision weapons are supposed to effectively engage underground control stations, runways, air defense and aviation control radar stations, operational-tactical missiles and tactical missiles on positions, groups of armored targets (including mobile ones), artillery groups, and individual facilities of various designation. Each PGM system has three functionally connected main elements: reconnaissance, control,



Participants in combating enemy HPW grouping

FIG 6

and effective engagement. They are either separated from each other or are united under one hard shell.

Increasing popularity is being gained in "the armies of developed countries" by the concept of the multi-functional reconnaissance-strike complex. A multi-functional reconnaissance-strike complex unites weapons, support assets (reconnaissance, communications, navigation, and meteorology), assets of electronic suppression, and control of troops and weapons. One proof of this tendency is the experience of combat operations in the Gulf zone. Right from the start of the conflict, the multinational forces command created a unified system of informational support on the basis of technical assets of all types of reconnaissance. Virtually all types of PGMs employed in the hostilities switched on to it when necessary.

The second subgroup comprises the systems of reconnaissance involved in the process of PGM functioning. They include space vehicles of photo, optical-electronic, photo-television, and electronic reconnaissance; aerial reconnaissance assets; tactical aircraft; and ground reconnaissance assets (electronic, optical-electronic, acoustic reconnaissance and systems of the Rembass reconnaissance and signalization instruments). It is necessary to especially single out the systems of high-precision electronic reconnaissance.

The third subgroup comprises control facilities -- control stations of large strategic formations and large units, tactical aviation control centers, reconnaissance-strike complex ground control centers, forward air controllers, reconnaissance-fire complex launchers, launchers of battalions, and batteries that employ PGMs. The fourth subgroup comprises navigation, precise-time, and meteorological support facilities: the Navstar space navigation system, as well as a system for locating the targets of combined-arms and artillery subunits.

The fifth subgroup comprises targets of collective protection of PGM systems: security subunits, electronic warfare assets (including reconnaissance-jamming systems), air defense assets and subunits, technical reconnaissance and security systems, fortifications, and other artificial installations. The sixth subgroup comprises targets of material-technical support and basing: naval bases, airfields, and tactical aviation and combat helicopter pads; depots of guided weapons and munitions; areas of deployment of PGM group targets; and roads, cross-country routes, and elements of operational equipment on them.

The seventh and special subgroup comprises zones and regions of the environment where it is possible to modify the normal state of the optical, optical-electronic, electronic, radar, thermal, acoustic, and seismic situation with the objective of disrupting the functioning of the targets comprised in the first through the sixth subgroups.

According to the Russians, the second set of elements for combating PGMs comprises the targets of friendly troops that have a certain level of individual protection, and the environment where they exist and conduct combat actions. There are nine types of targets. The first group includes targets detectable through electromagnetic radiation and neutralized by guided weapons with radar homing heads:

air-defense radars, aviation homing radars, aviation command-and-control radars, electronic assets of large strategic formations, and so on.

The second group includes poorly protected simple and complex targets detectable mainly by self-guiding optical-electronic assets and neutralized mainly by single warheads and by warheads of cluster charges of the usual blast effect: ICBM subunits at launch sites; petroleum, oils, and lubricants (POL) depots; airfield runways; planes and helicopters on open parking lots; logistic bases; rail junctions; chemical industry enterprises; and so on.

The third group comprises individual fixed targets detectable in accordance with the principle of radar, thermal, and radio-metrical contrast and neutralized by guided warheads and self-guiding warheads of precise aiming (homing) munition type: tanks, self-propelled howitzers, infantry fighting vehicles, antitank missile systems, combat vehicles of command-and-control stations, and so on. The fourth group comprises fixed group targets detectable through the radar contrast principle: tank and motorized rifle subunits, heavy rocket launcher platoons, ground-to-air missile launchers, and antitank guided missile batteries on firing positions and in deployment areas. The fifth and sixth groups comprise targets of the third and fourth types on the move.

The seventh group comprises poorly protected fixed spot targets detectable by a majority of reconnaissance assets and neutralized by guided weapons with the usual blast effect weapons: bridges on the most important rail and motor roads, river crossings, water-treatment stations, individual non-armored targets, and so on. The eighth group comprises well-protected fixed targets detectable by a majority of reconnaissance assets but only effectively engaged by penetrating warheads: silos of the Strategic Missile Forces, stationary control stations of large strategic formations, nuclear warhead depots, planes under cover, atomic electric power station generators, and so on.

The ninth (special) group comprises zones and areas of the environment employed by the enemy in gathering and transmitting information on friendly targets of the first through the eighth types: deployment areas and strips for the movement of group targets, areas of garbled operational-strategic situation (dummy areas of troop deployment, positions, weapons, military equipment, routes, theater operational equipment elements), zones of airspace, and areas of terrain that should be altered in terms of the optical, optical-electronic, electronic, radar, thermal, acoustic, and seismic situation -- including parts of terrain that can be used for correcting the path of cruise missile flights.

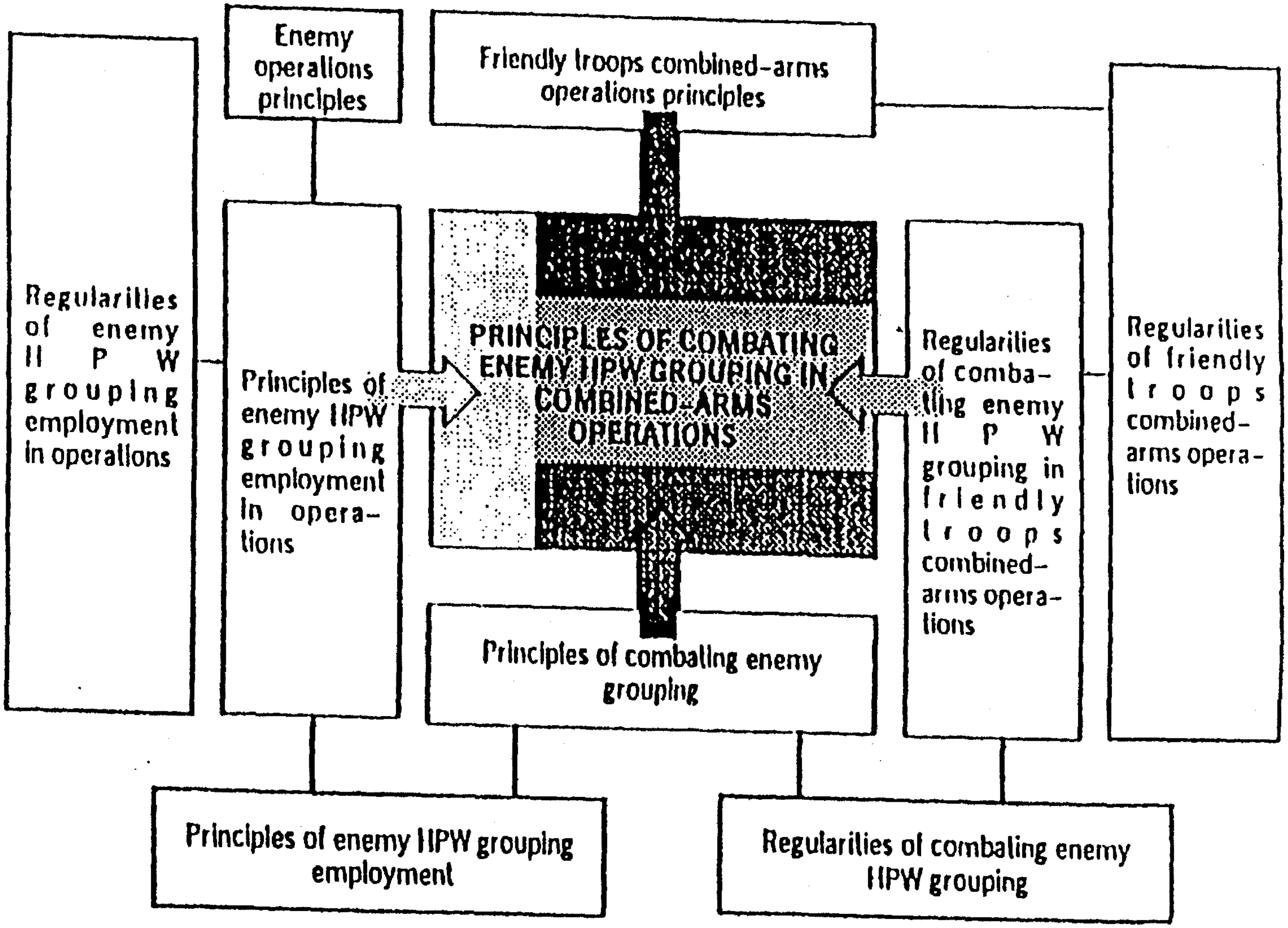
The third set of elements includes four subgroups: forces and assets of impact on all elements of enemy PGM groupings; forces and assets for localizing information subsystems of PGM systems; forces and assets for collective protection of a large strategic formation's targets; and forces and assets for localizing, garbling, and destroying information about targets (information transmitted by friendly troops characterizing not only their state, but also the nature of their actions and the situation in the operational lineup of troops). This group comprises reconnaissance units and subunits of all services and combat arms; fighter and fighter-bomber, bombardment, attack aviation, and aviation of the Ground Forces; operational-tactical and tactical missile battalions; reconnaissance-strike and -fire complexes; missile, cannon, and antitank artillery; air defense systems; combined-arms units and subunits; engineering troops, electronic warfare, and CBR defense troop subunits; and guerrilla and other formations operating on enemy-occupied territory.

Central to Russian methodological foundations are the principles of combating enemy PGMs in combined-arms operations. These are general, scientifically substantiated rules and recommendations for the practical activities of commanders, staffs, and troops in preparing for and waging combat with enemy PGM groupings. The logic behind the formation of these principles is shown in Figure 7.

At this stage of development of the problem under review, more than twenty principles have been formulated. First, the principle of operational subordination and expediency. It recommends that combat against enemy PGMs be conducted within the framework of a combined-arms operation and in line with the objectives, missions, character, forms, and methods of combat operations conducted by combined-arms large strategic formations, large units, and units in accordance with a unified plan and concept in order to take (retake) the initiative; to achieve firepower, electronic, and information superiority; to unbalance combat operations of the enemy PGM grouping; and to disrupt his surprise actions.

The principle of correspondence implies the waging of combat in correspondence with the combat efficiency level of each component of a PGM grouping, the methods of their employment, the deployment of enemy groupings, the combat readiness of forces and fires of friendly troops, and the targets to be engaged by high-precision weapons.

Combating Enemy High-Precision Weapons in Operations



The logic behind the formation of principles of combating enemy HPW grouping in combined-arms operations

FIG 7

The high level of saturation of enemy operational configurations with PGM components, which would typically be concealed by all available means, makes it necessary to formulate the principle of guaranteed reliability. Combat should only be waged against reliably reconnoitered and identified components of a PGM grouping, and against information flows inside and between them as well as between weapon assets and friendly targets.

One of the most important regularities of combating PGMs is reflected in the priority principle. It recommends a resolute concentration of efforts on combating information that functions inside the contour of a PGM grouping and is radiated by its components, on disrupting the energy contact of guided weapons and munitions with components of friendly troops, and on influencing those enemy weapons which determine the level of its combat capability at some moment while tackling the given operational mission.

Considering the high dependence of PGM efficiency on the normalcy of all parameters of its employment process, one can single out the principle of constancy. It expresses the necessity of making an impact on the environment, especially on the atmosphere, to constantly change the normal deployment of friendly troop components in the operational lineup, and to destroy or garble information radiated by them.

The principle of individual sequence reflects the complexity of PGM systems and their substantial structural differences. It calls for the selection of a sequence, individual for each component of a PGM grouping, and for the disruption of its functioning in time and space -- ranging from destroying its information through suppression of guidance to the destruction of weapon assets. Finally, there is the principle of a comprehensive impact. It calls for a simultaneous and comprehensive impact upon all the energy and robotic systems of PGM components, arrays of information, and the flows and links which are involved in the process and which determine the combat efficiency of components in the given stage of an operation.

The main measures for combating enemy PGMs in combined-arms operations should be viewed through the prism of the actions of troops that conduct these measures. They should be aimed at executing (by corresponding methods and in certain forms) a certain set of combat missions in four areas. In the area of impact upon the elements of a PGM grouping -- an effective engagement of the reconnaissance subsystems of the PGM grouping; command-and-control centers; PGM systems; guided weapons and munitions; and command-and-control centers of the Ground Forces, the Air Force, reconnaissance, and radioelectronic warfare; the elements of navigation, precise-time, and meteorological support systems; and collective protection of PGMs, guided weapons, and munitions depots, as well as their transportation on supply routes. The objective of impact includes entry by combined-arms subunits into the areas of PGM subsystems deployment; the maintenance of close contact by the first-echelon subunits with the advanced elements of enemy combat lineup; the killing and garbling of information constantly stored in the carriers of all PGM subsystems and obtained by the enemy; and disruption of the software work.

The objectives as regards localization of PGM information subsystems are to suppress the technical assets and channels of information exchange in reconnaissance subsystems, navigation and precise-time support, and command and control between the cited subsystems and between them and command-and-control centers of the Ground Forces, the Air Force, reconnaissance service and radioelectronic warfare assets, and collective protection assets; and to create zones that exclude the employment of PGM systems.

The objectives as regards collective protection of friendly troop elements are to deflect guided weapons and munitions approaching targets, fortifications, and other artificial facilities in the area, positions, and lines; to protect facilities of friendly troops by combined-arms subunits; and to create systems of technical protection and ensure their functioning.

The main objectives as regards garbling and destruction of information about friendly targets are to conceal deployment and movement of troops, areas of terrain, and elements of operational equipment with the aid of various means and methods of camouflage; to use the camouflaging and protective qualities of the terrain; to create dummy troop deployment areas, positions, targets, routes, sections of terrain, and elements of operational equipment; to simulate troop operation in the dummy areas; to conduct misinformation; and to eliminate the revealing qualities of friendly targets.

It is possible to simultaneously combat PGM groupings in the field by both collective protection of friendly targets and localization and destruction of information emitted by them. To be specific, this means to make the armaments and military hardware less detectable in all emission bands; to fortify and equip areas, positions, and lines; to impact the environment within the confines of the large strategic formation combat space; to sensibly line up marching and prior-to-combat orders and disperse the troops; to change deployment areas, lines, and positions; to perform maneuvers; to withdraw troops from under PGM strikes; and to eliminate the aftermath of enemy PGM employment.

The saturation of modern armies with high-precision weapons has a steady growth tendency. It ought to be expected that early in the 21st century, PGM systems will account for the bulk of the conventional assets of belligerents. Warfare will correspondingly assume the forms described above. Therefore the most important task of military science today is a detailed study of combating enemy PGM assets on an operational-strategic scale as the basis and precursor of combined-arms operations of the future.

For convenience in examining questions of combating precision weapons, Russian military scientists introduce a classification of them by type of guidance system. Some authors consider only those types intended above all for engaging small military targets on the battlefield both in the tactical and operational depth. Here it is possible to single out three groups of precision weapons. The first includes those equipped with electro-optical guidance systems with a range of no more than 10-12 km.[42]

These are the most numerous types of precision weapons. They are intended for killing targets on the battlefield, in concentration areas or on the march. Guidance is

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[42] For example, see Yuriy Georgiyevich Sizov, Aleksey Leonidovich Skokov, and Aleksey Ivanovich Korshunov, "Precision Weapons and Combating Them," VPK, No. 2(9), 1995, pp. 54-57.

accomplished with the help of homing heads or sensors. Such precision weapons are launched from airborne platforms (including from ballistic missiles) or ground platforms.

Second-generation SAM systems have been introduced into the inventory of air defense groupings. These are standard division air defense weapons as well as SAM battalions of army assets (Buk) and a SAM battalion of front assets (S-300V) covering motorized rifle division operations. The overall number of target channels in the air defense grouping was 52 in the initial position, not counting regimental air defense assets. The possibility was envisaged of using loader-transporters to reload systems in the period between attack waves.

Modeling results show that if measures for protecting SAM systems against precision weapons are not taken, then the first wave of offensive air weapons destroys essentially all the main air defense assets, and the second wave inflicts that damage on division targets which makes it noncombat effective (they destroy command-and-control facilities and approximately 30 percent of combat assets). If effective measures for protecting SAM systems are taken, then approximately 40 target channels are preserved for repelling the attack of the second wave, the probability of precision weapon launches is reduced, and losses of no more than 5-8 percent are inflicted on division targets.

Several conclusions can be drawn based on results obtained from modeling. First of all, considering that a large portion of the precision weapons are launched from airborne platforms (aircraft, combat helicopters, tactical ballistic missiles), all ground units should be provided with modern air defense assets; secondly, these air defense assets themselves must be protected against destruction by radar missiles; and thirdly, one cannot rely only on air defense assets -- it is necessary to provide for other measures as well.

The measures and means of protecting targets against precision weapons can be active and passive. Active ones include SAM systems above all. Many types of modern SAM systems are capable of killing airborne precision weapon platforms before their launch point -- including ballistic and other missiles before the moment the cluster warhead opens, as well as a large portion of the precision weapons themselves. Destroying submunitions after this point is a considerably more difficult mission and in all probability cannot be executed completely. Precision weapons can be launched not only from airborne platforms, but also from ground platforms -- artillery systems, MLRS fighting vehicles, ATGM fighting vehicles, and so on. Such platforms should be destroyed by conventional fire-delivery systems, but systems which are included in the loop of friendly precision weapons; i.e., interfaced with reconnaissance and command and control and functioning in real time. Inasmuch as precision weapons have electro-optical and electronic reconnaissance and guidance systems, they also can be combated actively by electronic and electro-optical countermeasures.

Passive protection against precision weapons is possible through the use of the high mobility of ground vehicles and the employment of measures for reducing signature, and also with the help of individual and group protective complexes. With respect to complexes of protective means, they can be of two types: individual and group protection. The makeup of complexes can change depending on the importance and features of objects being protected. The makeup of both types must include sensors of an object's laser illumination and means of reducing the signature.

There are smokes and aerosols which can conceal an object well in different electromagnetic wavebands, but to use them it is necessary to know when an aerosol screen should be laid and from what direction. The very same information is necessary for taking advantage of fired decoys. To obtain it, protective complexes definitely must have means of detecting the attacking precision weapon submunitions. This role can be performed by radars, thermal direction finders, and laser illumination sensors. In all likelihood one cannot get by without a radar, but the difficulty of the task is connected with the fact that it must be sufficiently simple, reliable, and inexpensive. Therefore the radar should be included only in the group protective complex.

The question is being discussed of introducing fire-delivery means to this complex in the form of close-range SAM systems or weapons especially created for this mission. It should be noted that there is experience in creating these complexes such as in the form of the Zhavelot MLRS.

The Russians emphasize the importance of creating a protective complex above all for air defense systems, since the latter will be able to assume the main burden of combating precision weapons only when they themselves are protected against destruction by anti-radiation missiles.

In an assessment of the PGM danger for Russia, experts proceed from the following factors and considerations. First, in the event of war, the massive employment of conventional PGM systems could cause (provoke) the employment of nuclear weapons if the enemy conducts precision-guided munitions strikes against the positions of the Russian strategic nuclear forces. In this situation Russia, in order to prevent the destruction of its strategic nuclear forces which are the "main guarantor to provide the security of the state," will be compelled to resort to the employment of nuclear weapons first.

Second, Russia already does not have the "spatial immunity" that permitted the Soviet Union to carry out the unprecedented gigantic maneuver of productive forces and manpower to the East in the first year of the Great Patriotic War -- which ultimately permitted them to withstand, reorganize the military-industrial complex and the armed forces, and score a victory. Now, in the event of war, Russia will not have the capability to complete a similar maneuver: all industrial and military facilities, including the strategic nuclear forces, are within reach of conventional weapons and PGMs, and the destruction of these facilities could be carried out without the PGM platforms entering into the air defense and anti-ballistic missile defense zone. Launches of sea-based cruise missiles could be conducted from the base of surface combatants and submarines that are located far from the borders of Russian territorial waters, and these launches could be conducted without the entry of aircraft platforms not only into the air defense zone but also into Russia's airspace.

Third, there are major inadequacies in the Russian missile and aircraft strike warning and repelling systems which are being talked about quite a bit in the Russian press. But the current state of the country's missile-attack warning system and air defense system -- that are specifically called upon to warn about enemy strikes from the air and to neutralize them -- causes special alarm.

The missile-attack warning system transmits information about missile launches, identifies them during the initial stage of the trajectory, and computes launch and warhead impact points. At the present time, the missile-attack warning system consists of eight radar complexes of which five are located in the near abroad (two in Ukraine, one in Azerbaijan, one in Kazakhstan, and one in Latvia). These five radar complexes cover the Western, Southwestern, and Southern missile-danger axes. After the disintegration of the USSR, the situation in the missile-attack warning system changed dramatically for the worse. Although the system is still operating, its prospects are very gloomy. Recently, the functioning and supply of foreign radar complexes is being increasingly impeded for political, economic, and technical reasons.

As a result of the dismantling of the Krasnoyarsk Radar Complex, a breach has turned up in the over-the-horizon detection systems on Russia's Northeastern axis. They dismantled the Krasnoyarsk Radar Complex and then "retooled" it into a furniture factory at a time when the United States is preserving and even modernizing its radar complex in Greenland, which is a gross violation of the 1972 ABM Treaty.

Fourth, the paralyzing capability of ECM, which precedes the employment of PGMs and is actually an integral component of it, poses a special danger. ECM does not produce ordinary noise, does not cause physical losses of troops or damage to industrial facilities, but can, as it occurred during Operation Desert Storm, rapidly disable the command-and-control systems of the country, the Armed Forces, air defense, and antiballistic missile defense. The ECM-PGM tandem is thus an enormous potential threat, especially for a country that does not have adequate countermeasures systems.

In light of the enumerated dangers that arise from the possible employment of PGMs, Russian military theorists pose a legitimate question: what to do? How can Russia parry these potential threats?[43]

1) Don't hurry with the elimination and restructuring of the strategic nuclear forces, which under conditions of the current serious strategic situation must remain a convincing deterrent weapon and a factor of restraint that exclude the possibility of enemy employment of PGMs against Russia.

2) Restore the country's missile-attack warning system and air defense system.

3) Develop Russia's own PGM systems and weapons to combat them in an adequate quantity.

Russia already has quite a few of the latest PGM systems that greatly surpass similar foreign models. For example, the qualitatively new MiG-29M combat aircraft that is equipped with the latest guided missiles: the S-300V air defense missile system about which Jane's states that it "has those properties that not a single Western air defense missile system will have until the end of the current decade."

Another consideration that affects the possible neutralization of potential PGM threats is political means. This is a question of enhancing the processes of limiting and

[43] Colonel Boris Nikolayevich Sibirskiy, "A 'Surgical Strike' Against the Enemy: Precision-Guided Weapons Guarantee It," NVO, 14 December 1995, p. 6.

reducing strategic offensive weapons in a new way while taking into account the intensive build-up of the qualitative superiority of the conventional armed forces in NATO countries, mainly in the United States (wide-scale equipping of the armed forces with PGM systems). The essence of this new approach consists in extending the provisions of the next START Treaty (START-III) to PGM systems, which in their effectiveness approach the effectiveness of nuclear weapons. Another variant for the political neutralization of PGM systems is the development and conclusion of a separate treaty between interested parties on the limitation and reduction of PGM systems (similar to the INF Treaties).

Both variants of the political neutralization of the potential danger of PGMs must provide for the adoption of mandatory provisions: the Russians consider the employment of PGMs (with conventional warheads) for the destruction of the strategic nuclear forces and nuclear power plants as the initiation of a nuclear war.

Russian military scientists write that the term "organization of action to counter PGMs" in a defensive operation per se can be interpreted either gnosiologically or methodologically. The gnosiological interpretation, in its turn, has two aspects (Diagram 1): Organization of anti-PGMs (PWS) action can be regarded as a specific phenomenon of a defensive operation; i.e., as methods of action in an operation, its internal structure, space and time characteristics, and other parameters; or as the process of including corresponding forms of action in the structure of a defensive operation in the course of its preparation and conduct. The methodological approach

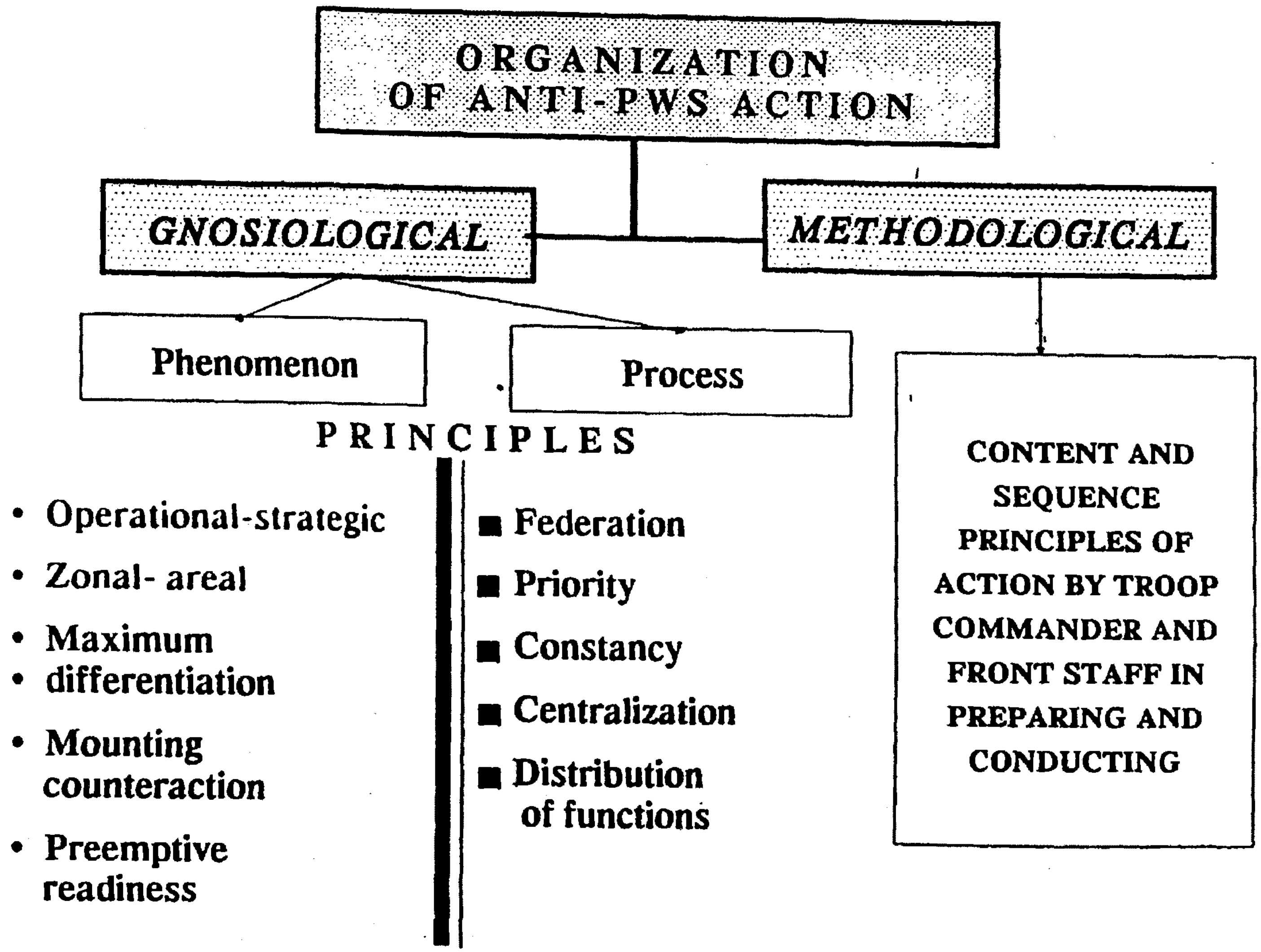


Diagram 1. Principles of Organizing Action To Counter PWS in Combat Operations

comprises the methods and scope of activity by commanders and staffs in organizing anti-PGM action in the course of the preparation and conduct of an operation.[44]

Some organizational principles that can be recommended to an operational commander and his staff within the framework of the gnosiological interpretation of the term include the following:

The operational-strategic principle. This principle arises from the fact that anti-PGM action is a specific part of action by an all-arms unit in an operation, its characteristics depending on its scope and other parameters. It states that anti-PGM action should be organized in conformity with the principles of operational art, the assigned mission, the concept and design of an operation, and its scope and structure, namely: by the operational missions, lines of action, areas of responsibility, and the powers of the command echelons of the armed services, branches, and special troops.

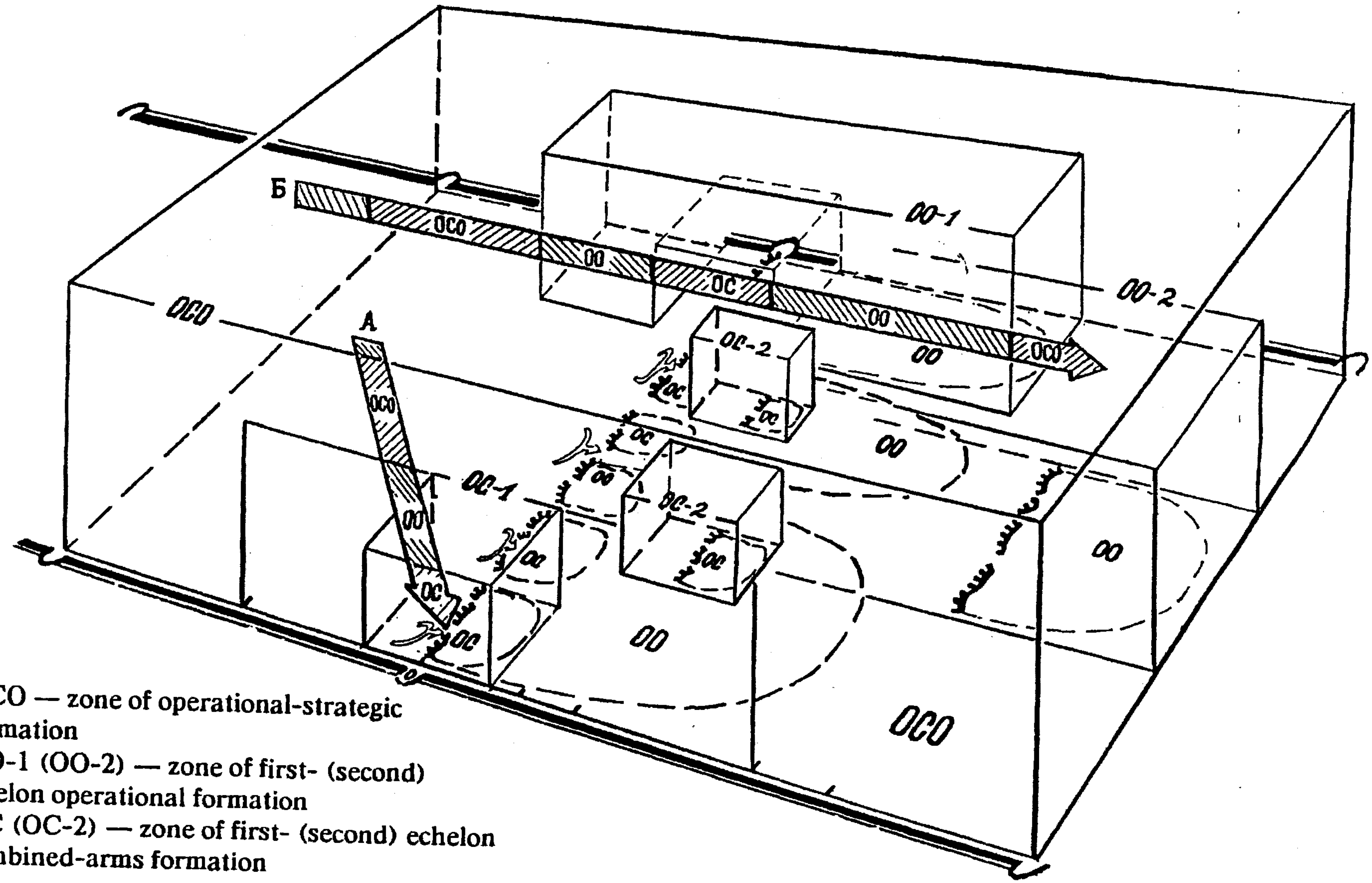
The zonal-areal principle. The use by the opposing sides of multifunctional guided missile systems, the maximum shortening of the detection – target allocation – effective engagement cycle with respect to all PGM systems, and the ambiguity of the notion of missile-danger sector -- all of these factors call for the creation of a single and continually operating anti-PGM system both in peacetime and at the outbreak of war. The system should be built on the waiting-in-the-zone-or-area principle; i.e., on the zonal-areal principle, which means that counteraction is prepared in particular zones of the airspace and ground areas, and is activated only at strictly defined moments.

[44] Colonel A.N. Zakharov, "On Principles of Organizing Action To Counter Precision Weapon Systems In Combat Operations," VM, No. 2, 1996, pp. 47-53.

The effectiveness of this method was borne out by military operations in the Persian Gulf War. They showed that the best results are produced by the delivery of a massed strike with various PGM systems in a localized area. This calls for advance warning in zones and areas likely to become targets of enemy impact; planning anti-PGM action in these areas; and commencing this counteraction as soon as these weapon systems are detected in a particular zone or area.

A comparative analysis of the location of enemy PGM assets, and the capabilities of combined-arms formations for ensuring their effective engagement shows that areas of responsibility for anti-PGM action should be assigned to combined-arms formations at three levels: operational-strategic and operational (operational-tactical) formations of the first and the second echelon; first- and second- echelon formations; and the reserve. The following zone parameters are recommended: laterally -- across the frontage of combat action; in depth, toward enemy positions -- to the boundary of the detailed reconnaissance zone; to the depth of friendly force formations -- to the rear boundary of large formations and combined units; and by the altitude -- to the effective range of the basic air-defense assets of a corresponding combined-arms formation. Diagram 2 shows one possible option for the allocation of the combat space of an operational-strategic formation by the areas of responsibility for anti-PGM action in a combat operation for the main defense line.

The principle of maximum differentiation. The intensifying power of PGMs, the growing efficacy of their reconnaissance and target designation subsystems, the increase in the number of PGM assets in armed formations, and their legitimate place in the operational formation of the opposing forces necessitate a greater differentiation



OCO — zone of operational-strategic formation
OO-1 (OO-2) — zone of first- (second) echelon operational formation
OC (OC-2) — zone of first- (second) echelon combined-arms formation

Diagram 2. A Possible Allocation of the Combat Space of an Operational-Strategic Formation by the Areas of Responsibility for Anti-PWS Action of the areas of responsibility by combined-arms formations in combating PGMs. It is appropriate in this process to be guided by the three following sub-principles: unequal danger and importance, informational diversity, and apparitional space linkage. Thus, in the zonal-areal principle of organizing anti-PGM action by formations at any level the following zones and areas can be assigned: zones and areas of continuous, systematic, and periodic impacts; zones and areas of assured kill and selective target engagement; zones and areas of emergency strikes; zones and areas of comprehensive and selective, same-type defense; and localization zones and areas.

The principle of mounting counteraction. It recommends an organization of anti-PGM action whereby, as PGM assets penetrate deeper into the area of responsibility of a combined-arms formation and as they approach their targets, the intensity of anti-PGM action will be mounting. It is important that anti-PGM action be intensified both vertically -- from higher altitudes to the surface; and horizontally -- from the far-flung boundaries of the formation's combat space to its rear boundaries. It is also essential to ensure an automatic and continuous relay (transfer) of PGMs from anti-PGM assets in the previous zone to the next, until it is disrupted or until the effectiveness of its impact is diminished to the degree possible.

The principle of preemptive readiness. The speed of combat action, especially at the early stage of aggression, calls for all anti-PGM assets to be maintained in a state that ensures the constant and sufficient readiness of combined-arms formations to repulse the first massed PGM strike or to thwart it by preemptive action.

The following principles can be recommended to commanders and staffs in directing efforts to include anti-PGM action in the operational concept and plan:

<u>**The principle of federation**</u>. The current difficulties of providing modern armies with PGM assets show that their wide dissemination, let alone their massed employment, should not be expected before the year 2000-2005. Therefore today, with respect to PGMs, it is appropriate to use the principle of federation. The gist of it is that, in the interests of countering PGMs, the existing system for the preparation and conduct of the defensive operation (principles, content, priorities, and procedures) is not revised all at once, in its entirety, but that additional elements are gradually introduced into it, allowing the anti-PGM effort to be organized to the extent that it responds to current conditions.

<u>**The principle of priority**</u>. Because anti-PGM action is a key tool for gaining the initiative and winning fire, EW, and intelligence superiority, it is appropriate to supplement the principle of federation with the principle of priority: in preparing an operation, the commander should primarily address organization of anti-PGM action.

<u>**The principle of constancy**</u> is naturally predetermined by the evolving situation whereby anti-PGM action begins to permeate the entire structure and content of the defensive operation. Therefore the commander should constantly -- practically at each stage of his activity in decision-making and directing troops in the course of an operation -- deal with matters pertaining to the organization of anti-PGM action.

No less important is the **principle of centralization** that presupposes obligatory centralization of the organization and planning of anti-PGM action on the operational level. These requirements arise from the fact that the use of PGMs is planned and implemented by a group of armies -- "above the corps." This is why the organization and planning of anti-PGM action needs to be centralized at a corresponding level; i.e., at the level of an operational-strategic formation.

The principle of distribution of functions. In employing PGMs against an operational-strategic formation within the framework of an air-land operation, the enemy intends to achieve its objectives through a simultaneous or consecutive delivery of massed and other strikes in corresponding combat zones.

The diversity of both PGM systems themselves and methods of their employment (from various sectors of space) necessitates advance preparation and implementation of a whole range of counter-PGM measures. Naturally, these measures should be no less diverse -- in place, time, assets, and methods -- than those of the enemy. The requisite result can be achieved only if methods of countering individual components of a PGM grouping are selected by the same commanders that have corresponding assets at their disposal.

Therefore the principle of centralization should be supplemented with the principle of distributed functions whereby along with centralization in organizing and planning anti-PGM action, counter-PGM missions should be allocated along the chain of command in an operational-strategic formation in such a way as, on the one hand -- to ensure a differentiated employment of counter-PGM methods in the front's combat space and in all zones and areas; and on the other -- so that the entire responsibility for anti-PGM action in zones and areas of impact, effective engagement, destruction, delivery of strikes, protection, and localization rests with the commanders of units and subunits that have corresponding assets available.

COUNTERMEASURES TO CRUISE MISSILES

Russian military analysts assert that numerous experiments conducted in the course of tactical exercises, including test exercises (Gorizont, Zaslon, and others) have proved the effectiveness of employing mobile, low-altitude radars for combating enemy cruise missiles. And practical experience in detecting and tracking cruise missile analogues furthered the organization of series production and the output of several types of mobile, low-altitude radars with high specifications and performance characteristics. From 1989 on the concept of constructing a radar system according to the principle of "guaranteed low-altitude target detection areas" began to be implemented.[45]

According to Russian military theorists, various ground, maritime, air, and space-based reconnaissance forces and assets are used to detect cruise missiles and other offensive air weapons. Their data are used to predict probable avenues of attack by cruise missiles, their launch points, and where the efforts of fighters will be concentrated next. However, according to the estimates of "Western experts," modern air defense radars are able to detect cruise missiles at a distance of 30-40 km. Other reconnaissance assets also do not ensure an effective range of detection, and those that

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[45] Colonel Yevgeniy Sukhoverov, "My Opinion on the Subject," AS, No. 4, October 1994, pp. 20-21.

have sufficient range either are unable to receive reliable data (OTH radar) or are still in the stage of improvement (space-based radar).[46]

It is equally difficult to obtain information about the flight of cruise missiles for vectoring fighters. It must be continuous, accurate, and have a minimal time delay. In addition, it is necessary to identify missiles among dummy targets and against a jamming background. These requirements are necessary when the radar field at extremely low altitudes has a clearly pronounced clustered nature and the time the missiles stay in the radar detection zones is counted in seconds. Therefore, the problem of timely detection of cruise missiles is still considered unresolved today. "Foreign military theorists and engineers" see improvement of the methods of combating the cruise missile platforms before they reach the launch point as ways to solve it at the current level of development of technologies.

The formation of special air patrol groups (CMDCAP--Cruise Missile Defense Combat Air Patrol), performing missions of detecting cruise missile platforms and their immediate destruction, is considered a variant. According to the experience of U.S. Air Force exercises being conducted, such groups should include two to four F-15C fighters, an E-3A AWACS aircraft, and two or three tanker aircraft. The fighters patrolled in pairs on assumed directions of flight of aircraft carrying cruise missiles and operated according to commands of the AWACS aircraft at a distance of up to 3,000 km from the coastline.

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[46] Professor A. Krasnov and Lt. Col. N. Bessarabov, "Use of Cruise Missiles and Combating Them With Air Defense Fighters," ZVO, No. 6, 1995, pp. 31-33.

It would seem that destruction of cruise missiles after launch does not pose any special difficulty for fighters possessing modern aiming systems, powerful weaponry, and high maneuverability. However, in analyzing the tactics of employing cruise missiles and citing the statements of pilots who participated in their flight test, the majority of "Western military experts" emphasize the extreme complexity of the problem. Above all, this is explained by difficulties in searching for small-sized targets, especially missiles with Stealth technology.

COUNTERMEASURES TO STEALTH

Russian military scientists note that the crews of Stealth aircraft should respect the AD radar operating in the long-wave band (the operating range against the F-117A is 54km). Air-defense artillery and short-range SAMs with optical detection and sighting systems also pose a serious threat to the crews. The pilots were prohibited from flying below 6,300 meters during the war in Iraq so as to avoid entering the lethal zones of those weapons. The appropriate measures and tactics to protect against them have still not been found.[47]

A number of "foreign sources" moreover also allow for the possibility of using over-the-horizon radars in the defensive system. It is noted that those stations emit pulses that are reflected off the ionosphere, and are effective only outside of 900 km or more. Even though Stealth aircraft can thus be detected ahead of time, they cannot be tracked at lesser ranges or, consequently, have AD fighters or SAMs vectored to them.

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[47] Doctor of Military Sciences Professor A. Krasnov and Colonel O. Safronov, "Stealth Aircraft in the Combat Operations of U.S. Aviation," ZVO, No. 8, 1993, pp. 36-40.

According to Colonel-General A. Kornukov, by the end of the eighties a decision was made to create a new Soviet AD system. Now the Russians can wage a controlled air defense missile battle with all flight equipment attacking both from the air and from space. Therefore the air defense system itself will soon be called an air-space system. The basis of this system is the S-300 air defense missile complex with various modifications. Field trials were held in 1993: more than 100 aircraft were "launched" over Moscow and all of them entered the capital zone at the same time. The air defense battle lasted a few minutes, and all the targets were conventionally fired upon and destroyed.[48]

The new air defense missile complex can engage in combat with air attack equipment created under the Stealth program. Using Moscow's air defense system it is possible to fire on 500 aircraft of various classes at the same time and destroy them simultaneously with one volley. These weapons are every bit as good, and in terms of many parameters (for example, the target location system) they surpass the renowned American Patriot complex, which proved itself so well in Desert Storm operations.

In keeping with the new military doctrine, the Russians are relying not on the quantity but on the quality of new military equipment. For example, they are replacing the obsolete MiG-23, SU-15, and MiG-25 aircraft which cannot successfully resist cruise missiles. But the SU-27 and MiG-31 are said to be quite excellent at this. At

[48] Interview with Colonel-General Anatoliy Kornukov, "The Duty of the Moscow Air Defense District. R15 Billion for Defense Enterprises: Rust Will Fly No More," Argumenty i fakty (hereafter cited as AF), No. 4, 1994, p. 7.

the present time 95 percent of the air defense missile forces are equipped with various modifications of the S-300 arms system.

Some Russian military theorists argue that the Stealth aircraft are not all that invisible. For example, reports appeared in the Western European press during the use of the F-117A aircraft in the Persian Gulf that the French TSE-50 radar from the firm of Thomson picked out the aircraft in the air several times. There were also reports that the long-range radar tracking gear of the E-3A aircraft of the AWACS system of Saudi Arabia were able to glimpse the Stealth. Pentagon spokesmen confirmed this, stating that the aircraft has a special device on its combat surfaces when making training flights in order to increase radar detectability for the purpose of increasing flight safety.[49]

The F-117A nonetheless can be tracked using meterband radar, as well as special acoustic sensors at distances of up to eight km. It has a quite characteristic acoustic "signature" therein. An aircraft that is approaching an observer has a weak sound of a high tone that is given off, most likely, by the engine air intakes. An aircraft that is receding has a sound in the medium frequency band.

Since the main reason that the Stealth is undetectable involves energy, say Russian military experts, one would think that the problem of identifying it is not that complex. Increase the power of the radar enough to "break through" any coating that makes the aircraft invisible. But just for Russian borders such devices would require

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[49] Colonel Leonid Podnosov and Narodna Armiya special correspondent Lieutenant-Colonel Nykfor Lysytsya, "The 'Stealth' Aircraft--Myths and Reality," Narodna Armiya, 10 March 1995, p. 2.

more energy than all electrical power stations could provide to support their operation. So traditional methods of identification are not suited for Stealth. New and cheaper ones are needed.[50]

"We have succeeded in finding them," says the Deputy Director of the "Rezonans" Scientific and Technical Center, I.P. Nazarenko. "Modern computer equipment helped. Today we can select data-processing modes such that, while using quite long waves, we can obtain a detection error which is nearly as good as in radars in the decimeter and centimeter wavelengths. Of course, a long wave can also be attenuated in a protective layer, but then its thickness has to be very great."

It must be stressed that the new radars do not replace the traditional ones. The new ones have their own missions -- identification of targets at long range, roughly 500 to 900 km, where especially great accuracy is not required. That is needed only when guiding missiles to an approaching adversary, when he is 50 to 100 km away. But until that moment, the information put out by the new system is quite sufficient for air defense systems.

What is more, air defense radars have a comparatively small field of view, and a lot of time is required to scan the entire space. So much that a target might fly by undetected. The task of the "Rezonans" radar is to report the preliminary aim to the missilemen. Then they can concentrate their surveillance beforehand in the required

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[50] Yuriy Medvedev, "Hunt for the 'Stealth'"; "Russian Scientists Test Experimental Models of Simple and Inexpensive Radars That Make It Possible To Identify Inconspicuous Targets, Including Those of the 'Stealth' Type," Tekhnika i molodezhi (hereafter cited as TM), No. 3, March 1995, p. 4.

direction. It is not for nothing that it is called "Rezonans," says Nazarenko. It not only emits long waves, but also uses the phenomenon of resonance. As a result, the signal reflected from the target is even amplified.

"This important feature of its operation first of all made it possible to greatly reduce the energy consumption of the radar," says the Chief Designer of the radar, E.I. Shustov. "Second, it [made it possible] not simply to detect planes at long range, but also to identify them. Now we can tell the missilemen what sort of target is out there: a bomber, missile, fighter, helicopter, or sports aircraft like the one Rust flew to Moscow."

Here is another problem -- an adversary has been detected, but how many are there -- one, two, a group? If, for example, the planes are flying quite close to one another, the resolution of the current equipment does not allow the Russians to answer this. "Rezonans" can because it picks up even small changes in speed. If two adjacent planes are flying at the same speed, then you cannot distinguish them on the radar screen. But if even one of them hits an air pocket, for example, then the received signal is split. That is, the system begins to count the targets.

Today the airspace of Russia is protected by powerful high-frequency radars. The cost of each runs in the billions of rubles. The cost of the "Rezonans" is lower by factors of ten. It has no moving parts, and its phased antenna is made of ordinary metal pipes. For this reason it has higher reliability, and is lighter, smaller, and simpler to operate. The small dimensions and simple apparatus make it possible to build the entire observation system generally in a different way. For example, to create flying radars. When raised to a height of 25 km, they will have a viewing radius of 500 km. This greatly reduces their total number and makes it possible to survey the territory of the adversary to a sufficient depth.

Such systems are today well known -- aircraft of the AWACS type. In them the antenna is mounted on a finished aircraft. However there is a much more effective variant: combining a radar and plane structurally, making a kind of flying square. Built-in antennas are arranged along its perimeter in order to radiate in all directions at once, providing all-around scanning, and making it possible to do without complex mechanics.

A similar aircraft, controlled by an operator on board, has already been tested in the United States. A group of Russian engineers, under the supervision of A.Kh. Karimov at the "Aerobot" company, took a different path. They are developing a pilotless plane at one tenth of the cost. The areas of its application are most diverse: searching for mineral resources, reconnaissance of navigational conditions, etc. Now the work is advancing rapidly. The main problem is to build a high-powered, quiet piston engine with a power of around 450 HP.

According to Russian military experts, the functioning of radars in the metric radio waveband realizes a number of important advantages compared with centimeter and decimeter band surveillance radars. First of all, they are invulnerable to anti-radiation missiles. Secondly, air defense radiotechnical subunits use "metric" radars to detect invisible targets made with Stealth technology. One reason for the announced "invisibility" of aircraft of this type lies in the special shape of their airframe, which creates a small return reflection of the ground radar's sounding signal. Use of the metric band makes the size of the aircraft comparable with the wavelength, and its shape loses its "magical" properties.[51]

According to the chief designer, Russia uses the meter band in the production of mobile radars. This band offers certain advantages that have become particularly important in recent years. The prime advantage is the ability of these radars to detect aircraft using Stealth technology. These radars are also more efficient compared with other wave-band radars in detecting small-dimension targets -- i.e., high-precision weapons, cruise missiles, and other small-dimension targets.[52]

In addition, these radars are least affected by the enemy's electronic countermeasures. In order to organize effective electronic countermeasures against such radars, the opponent has to have relatively big antennas. This is fraught with specific engineering problems from the viewpoint of the installation of these systems on aircraft and missiles and even on the ground. Meterband radars are also the least vulnerable to anti-radiation missiles. The reason is the same: a precisely aligned antenna is needed. To install this on a missile is a relatively difficult engineering task. Therefore, according to Russian information, the potential enemy at the moment has no high-precision missiles self-homing on radiation in this wave band. These are the reasons which enable them to claim that these radars at the moment offer important advantages over other radar systems.

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[51] Colonel Igor Yatsenko, "Killers of the Stealth Program," AS, No. 4, 1995, pp. 62-64.

[52] Video Report by Sergey Tibilov, chief designer of the Nizhniy Novgorod NITEL Joint-Stock Company, Moscow Russian Television Network, 14 April 1995.

Russian experts repeatedly discuss the future of the Su-34 front-line bomber. Its supreme performance, two reliable engines, and range of modern air weapons -- high-precision laser-guided missiles, teleguided and heat-seeking missiles, and heavy cannon armaments; midair refueling system; and state-of-the-art navigation equipment convincingly indicate the Su-34's supreme competitiveness. In terms of its scientific and technical level this aircraft is a landmark,. The design of the Su-34 can act as the basis for the development of front-line reconnaissance aircraft and jamming aircraft. The development of a bombing-navigation system, based on advanced computer architecture using a multiplex information exchange channel, enables the system's potential to be "gradually" built up in the future and adapted to enable new attack systems to perform their mission. The actual ideology behind the development of an automated ECM system is the basis for the subsequent development of similar unified systems.

Today decimeter [UHF] and centimeter waves are being utilized for detection of targets in radar. However, thanks to Stealth technology, they are not being reflected from the airframe of the aircraft but ostensibly canceled by it. In the words of Nazarenko, scientists have managed to sort out those modes of information processing whereby even with utilization of long waves a detection error is obtained that is nearly the same as that of decimeter and centimeter radars.[53]

Russian military experts stress that the appearance of aircraft and missiles with reduced radar and thermal signatures has considerably increased the combat

[53] Yuriy Medvedev, "New Wave: 'Rezonans' Counts Stealth Aircraft," Segodnya, 4 May 1995, p. 9.

capabilities of aircraft for air defense system penetration and concealed delivery of strikes. Air defense capabilities for combating low-signature offensive air weapons began to be increased almost from the moment of their emergence. Conventional radars, which are the basis of acquisition equipment of air defense systems in armed forces of all developed countries, were used for this. Military experts proceeded from the assumption that low-signature targets are not absolutely "invisible" to these radars, but are detected at substantially lesser ranges.[54]

Therefore, to preclude gaps in the continuous radar field it is necessary to have sufficient radar saturation of a specific area. According to expert calculations, with a range of assured acquisition of offensive air weapons of approximately 20 km, the distance between adjacent radars should be 30-35 km (it presently reaches 100-150 km). For this it was necessary to put enormous funds into constructing new systems over a number of years, which turned out to be unrealistic. In addition, there is an increased danger of the enemy discovering and neutralizing such an intensively emitting system.

The first low-signature aircraft already were flying by the mid-1980s, and only conventional radars were being used to track them. Their combat and technical capabilities did not support the mission of acquiring offensive air weapons at acceptable ranges. Attempts at using passive detection and position-finding also proved unsuccessful. Multiple-position and over-the-horizon radars were considered the most effective.

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[54] A. Krasnov, "The Air Defense System and Low-Signature Offensive Air Weapons," ZVO, No. 5, 1995, pp. 46-51.

Multiple-position radars consist of a system of several interworking transmitters and receivers located at great distances from each other. Airborne targets are acquired and tracked in an area where transmitter beams intersect the coverage area of receivers. The likelihood of detecting low-signature targets increases from the reception of signals which they reflect away from the radars, and the enemy cannot detect and suppress non-emitting elements of such a system.

OTH radars operating according to the principle of the reflection of sounding signals from the ionosphere were known even earlier. For example, they have been developed in the United States since 1975. The advisability of their use in support of early acquisition of low-signature targets was established in the course of tests, when flying craft with a radar cross-section of 0.1-0.3 m^2 and a flight altitude of from 150 to 7,500 m were acquired at a range of 2,800 km and more.

The problem would appear to be resolved: low-signature offensive air weapons can be acquired in advance using OTH radars on distant approaches to defended territory and targets, and by multiple-position radars on close approaches. But it was established from an analysis of the capabilities of these means conducted by "U.S. and Western European" specialists that they also have fundamental shortcomings which do not allow creating a sufficiently stable, reliable acquisition system as a whole.

The high dependence of airborne elements of multiple-position radars on ground elements; the need for precise (and for now unattainable) synchronization of the operation of transmitters and receivers, low resolution, and low accuracy in determining target coordinates by OTH radars; dependence on time of day and year; poor protection against interference; and vulnerability (presence of large fixed installations stretching for several kilometers) -- all this was unable to ensure sufficient reliability and high quality of data being received. In addition, using automated methods of interfacing these means with air defense command-and-control facilities was not envisaged in the acquisition and tracking of targets. This circumstance in turn lowered the command element's capability to react promptly to operations of low-signature offensive air weapons and destroy them.

A new stage in developing means of combating low-signature offensive air weapons began at the borderline of the 1980s and 1990s, basically after the Persian Gulf War, and continues even today. It was there that F-117A aircraft persuasively demonstrated invulnerability to air defense weapons, and not one was shot down. Moreover, in the words of pilots who took part in delivering strikes against Iraqi targets, anti-aircraft fire was not even opened up against them. Now specialists consider the basic method of combating low-signature offensive air weapons to be a dense, deeply echeloned air defense system with different kinds of equipment for acquiring and engaging such targets. As before, ground-, air-, and space-based radars are customarily believed to be the most effective.

Ground-based equipment chiefly consists of radars optimized for operations against offensive air weapons. Various methods of increasing the acquisition range of low-signature targets based on increasing the radar's energy potential and improving the quality of signal processing are used in creating them. Use of phased arrays (this permits reducing the signal-to-noise ratio and increasing directive gain), development of metric and decimetric wavebands (this more than doubles the target acquisition range), and introduction of multiple-frequency radar methods (this enables selecting optimum working wavelengths, inasmuch as means of reducing signature are effective in a limited frequency band) can be included among them.

Air-based equipment -- early-warning aircraft radars -- conducts surveillance of low-signature targets not from the forward, but from the upper hemisphere, where re-radiating elements of the structure of offensive air weapons are unshielded and therefore the target's radar cross-section is considerably larger. The effectiveness of using IR equipment increases for the very same reason, since air intakes and exhaust nozzles of the engines of low-signature aircraft are located on top, particularly on B-2 bombers. Using new signal shapes with compression, improving digital processing of signals (AWACS system E-6A aircraft), using metric and decimetric wavebands, and combining radar with IR equipment (E-2C Hawkeye aircraft) are envisaged in programs for modernizing onboard radars of radar early-warning aircraft to increase their capabilities of acquiring low-signature targets.

Space-based equipment is least vulnerable and can perform the mission of acquiring low-signature targets from the upper hemisphere in vast areas of air space. "U.S. specialists" believe these missions should be assigned to the space system for detection and early warning of a raid of bombers and cruise missiles being created jointly by the United States, Great Britain, and Canada. Subsequently it is considered possible to use it also to perform a qualitatively new mission -- to output target designations on low-signature targets to air defense assets. The United States and other countries also are continuing research to upgrade the existing systems of electronic warfare support measures and the passive detection and position-finding complexes, which in certain situations can detect emissions of various onboard equipment of low-signature aircraft from long ranges.

Multifunctional radars, radioaltimeters, IFF systems, and onboard EW complexes are viewed as emission sources. All this equipment may be turned on for operation in individual sectors of a flight route to update the aircraft's position when proceeding at extremely low altitudes in nap-of-the-earth flight or after establishing the fact that it has been acquired by the air defense system. Use of radiometry methods based on detection of the target's thermo-microwave emission is a new point in the development of passive detection and position-finding complexes.

In assessing air defense weapons, experts indicate their insufficient capabilities for acquiring offensive air weapons, which do not permit realizing the full engagement envelope -- this leads to missing low-signature targets. At the same time, new SAM complexes, particularly Patriot, already are capable of engaging targets when the range of detection of those targets by their own radars is considerably reduced. Antiaircraft artillery and short-range SAM complexes with optical sights can be used to destroy such targets, inasmuch as low-signature aircraft are observed visually, just like all other flying craft. The capabilities of air defense weapons using IR equipment are limited to a greater extent inasmuch as the thermal emission of targets is reduced in the lower hemisphere. Specialists believe it is necessary to outfit SAMs with heads for homing and lock-on of targets with low thermal signature and also to develop missile guidance modes for engaging them from the upper hemisphere in order to increase the capabilities of these assets.

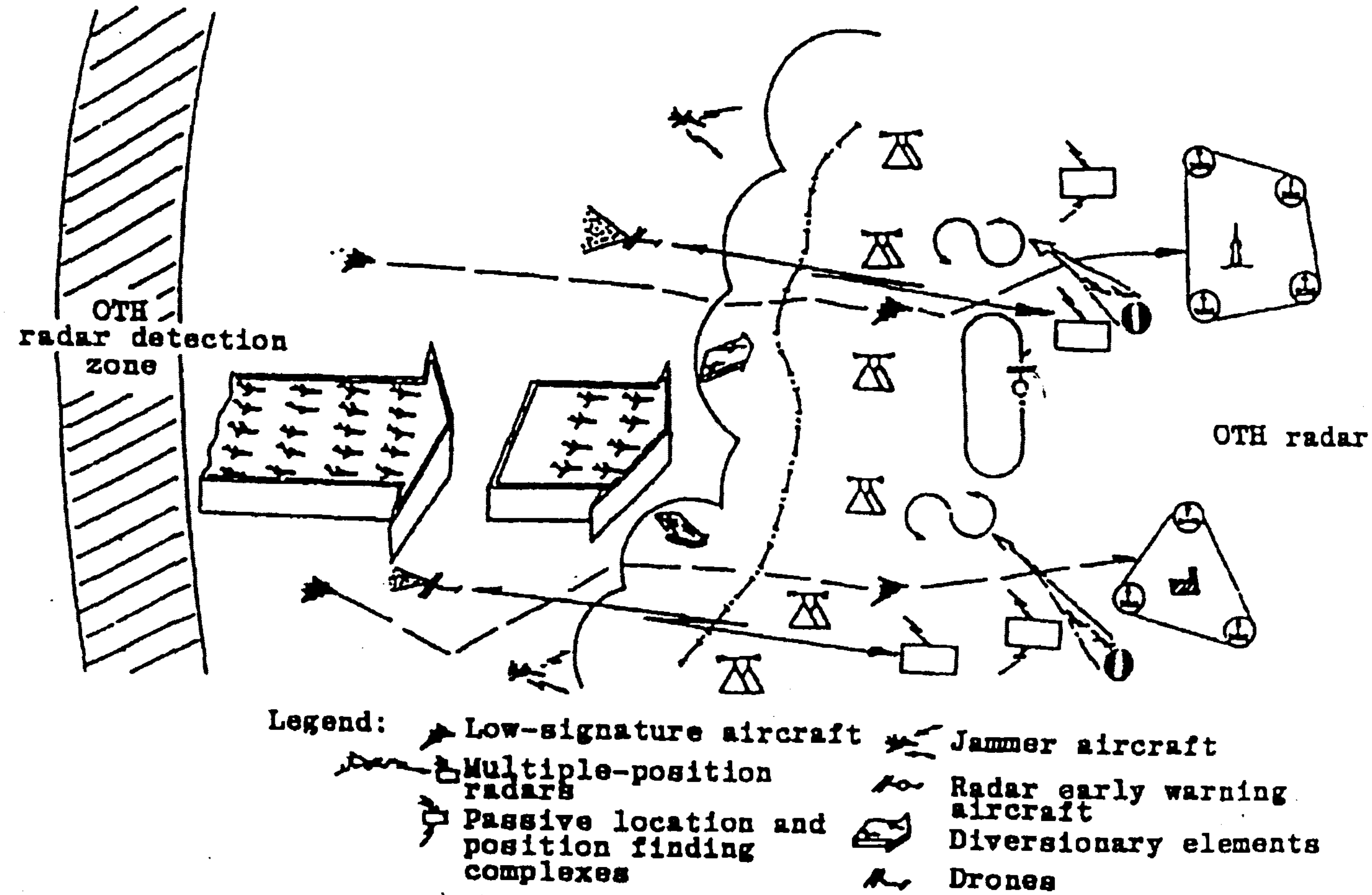
Modern fighters are equipped with multifunctional radars and thermal direction finders, permitting airborne targets to be intercepted and controlled weapons to be guided to them. But the use of onboard radars to search for offensive air weapons is extremely hampered due to the short acquisition range and instability of lock-on; moreover, IR devices are restricted in terms of aspect. Therefore a successful attack on a low-signature target using long-range and medium-range guided missiles is unlikely and, in the apt expression of pilots, is like "chasing a ghost and fighting its shadow." The target mark first disappears during abrupt maneuvers, then appears on the radar screen where it was not expected at all. This is why for now only close-in air-to-air combat with visual contact with the enemy is considered sufficiently productive.

In developing close-in air-to-air combat tactics it is recommended that fighters conduct it using guided missiles and cannon. Use of medium-range guided missiles is considered inadvisable because of the insignificant distance between aircraft. To improve a fighter's capabilities to effectively engage low-signature targets, research is being conducted "abroad" aimed at upgrading onboard aiming equipment and weapons. It is proposed to achieve an increased range of acquisition of offensive air weapons through a buildup in energy potential of radars, use of the newest signal processors, and expansion in functioning modes. Multi-mode and combination homing heads are being created for air-to-air missiles.

In just what way is it planned to use all forces and assets for combating low-signature offensive air weapons? Many military researchers and theorists believe the grouping of these forces and assets should be an inalienable part of the overall air defense system, should rely on a single information basis and automated data-collection and transmission links, and have common command-and-control entities (see Figure 8). They assume that acquisition equipment operating in the widest possible frequency band should be disposed at spaced positions to ensure simultaneous observation of low-signature targets at various aspects and for a long enough time for timely commitment of air defense weapons. The latter should be at forward lines, should cover the most important installations, and should have compact battle formations echeloned in depth on expected avenues of operation of low-signature offensive air weapons.

Just what arguments are cited by opponents? First of all, such a system will not be created in the foreseeable future because of enormous financial outlays. Secondly, it is doubtful as to such a system's suitability for operations in a difficult air situation, with the enemy delivering massive air strikes and with a set of concealing, disinforming, and supporting measures being conducted to cover the operations of low-signature offensive air weapons -- including concealment of their areas and time of operations, saturation of air space with real targets and decoys, delivery of strikes against command-and-control facilities, and so on. This is why some specialists consider the not-yet created system nothing more than an illusion.

In this connection new approaches have appeared to solving the problem of combating low-signature offensive air weapons. One of them, not an alternative but a supplement to the aforementioned system, is the use of various indirect signs facilitating identification of low-signature flying craft. Persian Gulf War experience was made the basis of that approach.



Grouping of Forces and Assets for Combating Low-signature Offensive Air Weapons

FIG 8

For radar operators, identifying a low-signature target means recognizing it based on some kind of trajectory signs (speed, flight altitude), characteristics of reflected signals (shape, size, contrast, nature of pulsation on radar screens), and acquisition range (comparing it with calculated acquisition range for low-signature targets). It is important for commanders who make the decisions and for personnel of air defense command-and-control facilities who control fighters and SAM complexes to know the tactical indicators with the help of which it is deemed possible not only to detect the location of low-signature aircraft in the overall enemy grouping and determine the extent of their danger to defended installations and to the air defense system itself, but also to divine the opposing side's concept (see Figure 9).

Recognizing the low validity of tactical indicators, especially the fourth and fifth ones, air defense analysts of "Western countries" nevertheless believe that these are the most realistic methods. At any rate, skills in identifying them will not prove superfluous even in the presence of the most sophisticated system of technical assets. The development of equipment and of a system for combating low-signature offensive air weapons is being combined with an upgrading of the training of leadership personnel and teams of command-and-control facilities, and both of these directions by no means exclude but supplement each other.

The problem of protecting Stealth aircraft against fighter-interceptors, especially when they attack from the rear, should be addressed specifically. In addition to short-wave radars, they have missiles with thermal heads which home in on the engine nozzle. For this reason, it is necessary to cool the nozzle so that it does not differ from the other parts of the aircraft in terms of temperature. For example, in the F-117A the

Tactical Indicators of the Use of Low-Signature Airborne Targets

Indicators	Notes
Single aircraft flying in the direction of distant important installations (primarily at night). Absence of other aircraft nearby	Flights in a group increase the signature of aircraft because of the summation of revealing signs (during the day they are detected visually). Missions of close air support to troops are not assigned to low-signature aircraft. They operate independently to avoid colliding with friendly aircraft whose crews cannot detect them with radars
Flight altitude of tactical fighters is at least 6,300 m, that of strategic bombers no more than 15,000 m (the aircraft's ceiling) and that of cruise missiles is extremely low	Entry into engagement envelopes of AAA and SAM complexes with optical aiming systems is excluded in the first instance; capabilities of reaching distant targets and obtaining their images for aiming and for monitoring strike results are realized in the second instance; the hampering effect of reflections from local objects is used in the third instance
Nature of jamming from aboard aircraft	Imitative jamming is used "which does not leave a trace," i.e., it is perceived as malfunctions of air defense radars or the effect of geophysical factors; and decoys and active jamming with the minimum necessary power for cover are used on detection of a SAM or attacking fighters
Presence of brief emissions of onboard electronics	Support to operation of multifunctional radars on the approach to mobile targets, of radioaltimeters in a terrain following mode, and of individual-protection EW complexes during attacks by fighters
Stepped-up operations of tactical fighters—jamming, delivery of strikes against radar positions, escalation of the noise background on individual axes	Flight routes, time of approach and time of passing through air defense weapon engagement envelopes are coordinated with operations of strike and diversionary elements and also jammer aircraft, which are disposed around the perimeter of the area of operations of low-signature aircraft

FIG 9

exhaust stream is broken up into 12 parts and emerges through a flat, wide slot that speeds up its mixing with outside, cold air.[55] There is also another method of protecting an aircraft: create a false thermal target away from it to "lure" missiles. This is what Soviet pilots did in Afghanistan by jettisoning self-igniting thermal decoys from their planes. It is clear that a reduction in conspicuousness is only one of the alternatives for the creation of highly effective protection, but in no way the only possible means.

Is it feasible to make a plane absolutely invisible to air defense systems of the third stage? Of course not. But the plane is tasked to perform its combat mission. And toward this end it has antennas and windows for infrared and laser systems which may be used for target search and for aiming. Their total reflective surface is high enough so that the Stealth aircraft can be detected, and fighter-interceptors and SAM systems have time to engage.

Of course en route to the target the Stealth aircraft can conceal this "illumination." For instance, to reduce its radar cross-section it retracts its antennas inside, and the optical heads of the infrared and laser-sighting apparatus are covered by special screens. But try as they might, when attacking the adversary they still have to open the radio-absorbent shutters which protect the windows of the airborne apparatus, and extend the external missile or bomb racks which have been retracted into the fuselage. And the B-2 bomber must turn on the terrain and target-search radars. In short, as soon as the Stealth aircraft begin to perform their combat mission, they are much simpler for the air defense system to detect, and the chance of engaging

[55] Oleg Antonov, "Stealth Aircraft: Myth and Reality," TM, No. 6, 1995, pp. 8-9.

them appears. For this reason, the Stealth aircraft are by no means a miracle weapon -- they are quite vulnerable to modern air defense launchers.

The question arises of why not a single F-117A aircraft was shot down during Operation Desert Storm. The reason was that before the war Iraq had moved practically all of its aviation to Iran. For this reason, the American ground-attack aircraft were not attacked by Iraqi fighters. The few fixed long-range detection radars of SAM systems were suppressed, and the air defense system was left only with those SAM means against which the F-117A had been made invisible. Thus to this point the Stealth aircraft has simply not encountered a situation in which it would undergo a serious test of attack by modern SAM systems and fighter-interceptors.

Of course one must admit that in the eternal struggle of "projectile" and "armor," Stealth aircraft have now shot to the lead. In order to increase the effectiveness of air defense systems, one must invest tens of times more resources in them than were required for the development of the Stealth aircraft. However it is quite feasible to get by with much smaller sums. Why improve the air defense systems if it is possible to confuse the sensors of the Stealth aircraft with which they find the targets? For example, use well-known methods of distorting the map of the terrain illuminated on the screen in front of the pilot. Against an F-117A which uses an infrared surveillance system, these include bonfires, smoke, cooling of targets, thermal decoys, etc. Against the B-2, which has a radar on board, these include ground jammers, absorbent coatings on targets, radar reflectors, etc.

According to General-Major O. Barak, the production of Stealth aircraft has become senseless since the "Tamara" Czech radar appeared. In principle absolute Stealth aircraft do not exist at all. Any stealthiness consists only in the reduction of the reflective capability of the target -- in other words, it partially begins to absorb the radar's radiation. Therefore, ordinary radars cannot catch sight of the Stealth or aircraft similar to it. Tamara also cannot plot that target at a standard range of approximately 150 km. It is possible that identification will occur closer, at a radius of 20 km. But it will nonetheless occur.[56]

The "Tamara" radar operates on a chronometric-hyperbolic principle. This is sort of a passive system which itself does not radiate any waves or signals. But then again, it receives any pulse signals in the frequency band from 18 to 82 Gigahertz. A chronometric axis is created based on three radars that are 10-30 km from each other. Each radar is a focus of the hyperbola, at the point of intersection of which one can detect the position of the targets. In its turn, any source of pulse radiation or any equipment that is operating at a given moment can be a target. Tamara accurately determines the position of any "radiating" equipment. Moreover, it is capable of determining if it has previously encountered that target and, if "yes," it is capable of predicting its anti-radiation maneuvers.

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[56] General-Major Oldrzhikh Barak, " 'Tamara' Picks Up Stealth Aircraft," Komsomol'skaya pravda (hereafter cited as KP), 30 January 1996, p. 6.

V. ROLE OF "NON-TRADITIONAL" WEAPONS

According to Western analysts, Russia is forging ahead with large-scale research into the development of high-tech weapons despite the nation's economic crisis. Many of the country's top scientists are employed on a wide range of major arms projects, not just to boost domestic defense but to capture lucrative overseas sales. British and Western experts are said to be anxious to get their hands on top-secret scientific data. "Weapons research is continuing in all areas -- the range is extensive," said Robert Hall, editor of Jane's Intelligence Review.[57]

For example, the Russians have already demonstrated that they can generate 10 times the electromagnetic energy which the United States has achieved and with much smaller equipment. This could be used in a variety of weapons, such as tank guns and an air "bomb" that could disable all electronics over a wide area. There is also speculation that the Russians have developed an ultra-quiet submarine propulsion system that uses electromagnetic forces to draw in water through a duct and squirt it out the stern. Some of their electronic systems have confused Western experts, including the Zaslon radar fitted to MiG-31 aircraft. Leading electronics expert Mike Witt said: "This system puzzled Western experts when it was unveiled in 1991 because it appeared to be able to see backwards."

Russian scientists are also working on a system known as Infrared Search-and-Track that detects aircraft by their heat and, therefore, overcomes Stealth technology.

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[57] Charles Miller, "Major Efforts to Develop Advanced Weaponry," London Press Association, 1 March 1994.

Britain is developing a similar system for the four-nation Eurofighter project, and scientists would be very keen to establish how the Russian system works.

Russia is making significant progress in missile technology and in 1993 unveiled its equivalent of the U.S. Patriot anti-missile system known as the S-300V. During a demonstration at Abu Dhabi, four missiles were fired and successfully destroyed targets in the air almost 20 miles away. It is said to be able to track 24 targets simultaneously and then prioritize the targets before firing four missiles from two launchers. Advanced work is being carried out to develop affordable anti-aircraft missiles such as the new shoulder-launched Igla, which should bring in desperately needed hard currency from sales abroad.

THIRD- AND FOURTH-GENERATION NUCLEAR WEAPONS

Russian military scientists stress that the research on third-generation nuclear weapons being conducted in the leading U.S. and Russian laboratories indicates that weapons with very diverse destructive characteristics can be created on the basis of nuclear weapons. It appears that there are no limits to the development of such weapons. This applies in particular to neutron weapons, electromagnetic pulse (EMP) weapons, earth-penetrating nuclear warheads, directed shock wave weapons, nuclear-pumped x-ray lasers, nuclear shrapnel, and a series of others.

As a result of ongoing work to create a global defense system, for example, a renewed interest in the development of neutron warheads for ABM defense is very likely. Enhanced EMP weapons have a counter-force character, and their primary function will be destroying state and military C^2 systems. Russian experts say that the detonation of a 10-megaton device at about 300 km above the state of Nebraska would knock out radioelectronic communications throughout practically the entire U.S. territory for the period necessary to disrupt a retaliatory strike. Earth-penetrating nuclear warheads are designed to destroy such hardened targets as missile silos, state and military C^2 points, communication centers, etc.

Like its Soviet predecessor, the Russian military views third-generation nuclear weapons as a critical component of the RMA. Colonel-General I. Rodionov, then head of the General Staff Academy, mentioned "the possible appearance of third-generation nuclear weapons in the next few years."[58] V.N. Mikhaylov, Russian minister for Atomic Energy, has argued that third-generation nuclear weapons will be "capable of destroying enemy strategic targets both in space and on earth," and may be usable "in any conflict."

Unlike today's warheads, third-generation weapons will have a small fraction of the global contamination effects, but with the same destructive capability. They will be weapons of directional, selective emission of energy on a target. Such a weapon works like a scalpel. A laser-beam, electromagnetic, X-ray, or microwave radiation; a shock wave: the force of any of these factors is concentrated in the direction of the target.[59] Their development is now under way, and they may well appear within ten years or so. The only barrier to this would be the total prohibition of nuclear tests.

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[58] Colonel-General I. Rodionov, "On Several Problems in the Development of Military Science," VM 11-12 (1991): 47.

[59] V.N. Mikhaylov, "The Keys from the Nuclear Arsenal," Pravitel'stvennyi vestnik 12 (1991): 12.

General-Major V.S. Belous has repeatedly warned of the continuing U.S. development of third-generation nuclear weapons.[60] He notes that special charges (munitions) in which the energy of the explosion is redistributed in favor of one of the casualty-producing factors because of a special design served as the origin of third-generation nuclear weapons. For example, the neutron weapon is said to have met the requirement of the Pentagon to develop tactical nuclear weapons capable of destroying enemy personnel with "minimum collateral effect."

Belous claims that when the United States resumed nuclear testing after World War II, a new physical phenomenon was discovered -- the creation of a powerful pulse of electromagnetic radiation (EMP) -- that proved especially effective in high-altitude bursts. The frequency spectrum of the EMP, corresponding to the radio waveband, is capable of disabling electronic gear, communications and power lines, radios, and radars at great distances.

He charges that in the early 1980s, U.S. military scientists began research aimed at creating one more kind of nuclear weapon -- a super-EMP with intensified electromagnetic radiation output. They plan to use it to increase the intensity of the field at the earth's surface to several hundred kilovolts per meter. In their calculations, the explosion of a 10-mt warhead at an altitude of 300-400 km above the geographic center of the United States (state of Nebraska) can disrupt the operation of electronic

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[60] For example, see General-Major V.S. Belous, "Third-Generation Nuclear Weapons," VM 11-12 (1991): 117-121.

equipment on virtually the country's entire territory for the time necessary to disrupt retaliatory measures.

The casualty effect of the SHF microwave weapon, which has been under development at Sandia National Laboratory beginning in 1983, is based on the use of powerful pulses of electromagnetic energy with a wavelength from a millimeter to a meter. The goal is to create a weapon distinguished by aim and narrow directivity of effect. The diameter of the casualty field on the earth's surface should be around 10 km. One design of this weapon consists of three successively arranged explosive electromagnetic generators in which high-speed compression of the magnetic field occurs with the help of the explosion of a small nuclear device. In using this weapon special significance is attached to combating "targets which may change their positions."

According to Russian military experts, the search for reliable destruction of highly hardened targets has led U.S. military specialists to the idea of using underground nuclear devices. With their detonation there is a considerable increase in energy going to form the crater, areas of physical destruction, and seismic waves. The first model of a penetrating warhead was developed for the Pershing II missile in the early 1980s. The casualty effect of such a warhead depends on the TNT equivalent of the charge and degree of its submergence. Theoretical calculations relying on results of underground nuclear bursts showed that for reliable destruction of hardened targets it is necessary to ensure a considerable submergence of the nuclear charge in the soil. For example, the destructive effect of a 200-kt nuclear charge detonated at a depth of 15-20 m is equivalent to the surface burst of the 600-kt warhead of an MX missile.

Russian experts also assert that in delivering a penetrating warhead to the target with an accuracy characteristic of the MX and Trident II missiles, U.S. military specialists figured that the probability of destroying the enemy missile silo or command post is near 100 percent, and instead of the two warheads now planned for each target, one will be sufficient. In other words, the probability of destroying targets will be determined only by the technical reliability of delivering warheads to them. They are ear-marked above all for destroying enemy military and state command-and-control centers, ballistic missiles in silos, command posts, communications centers, and so on. Consequently, missiles with such warheads will be used in a first strike. The importance of this kind of weapon grows even more in the event of a further reduction in strategic offensive arms, when there will be decreased combat capabilities for delivering a first strike and it will be necessary to increase the kill probability of a target by each weapon. "U.S. specialists" are examining the possibility of creating penetrating warheads equipped with a system of homing in the terminal flight phase for high accuracy in striking the target.

The United States is also said to have begun work to create a "21st-century anti-missile weapon" -- a nuclear-pumped X-ray laser -- which is designed for use as the primary weapon for destroying missiles in the boost phase and during warhead separation. Its combat performance characteristics must ensure disruption of a probable enemy's massive retaliatory strike. Therefore, even before its creation the X-ray laser was called a "salvo-fire" weapon.

As a variant, say the Russians, it is proposed to accommodate nuclear-laser warheads on missiles of nuclear submarines. In a "crisis situation" or in a period of preparation for delivering a first strike, these submarines must move to patrol areas and take up battle positions as close as possible to the enemy missile basing areas. When a warning of their launch comes from the system, missiles are launched from the submarines. As soon as the nuclear-laser warheads arrive at line-of-sight distance, the control system will begin directing the rods to enemy missiles. When each rod occupies a position in which the radiation will hit the target exactly, the computer will give a command and the nuclear device will detonate. Inasmuch as X-ray radiation is absorbed rather effectively in the atmosphere, the nuclear-laser devices can be used at altitudes of more than 80-100 km. There also is another option envisaging the advance insertion of nuclear-laser warheads into near-earth orbits, but both options continue to be in a study stage because of the high vulnerability of orbital objects, the considerable increase in the requisite number of warheads, and the difficulty of both focusing laser radiation and creating a high-speed system for training laser rods on their targets. Russian experts have also noted that the X-ray laser is above all a nuclear weapon, and if detonated near the earth's surface it will possess the very same casualty effect as a "conventional" thermonuclear warhead of identical yield.

To eliminate warheads and decoys in the phase of their free flight on a ballistic trajectory, "U.S. specialists" also propose to use small metal particles accelerated to high velocities by the energy of a nuclear explosion and arbitrarily called nuclear shrapnel. A small, dense particle possessing great kinetic energy because of high velocity is the basis of the new weapon. In striking the target such a particle is capable of damaging or even piercing the casing of a warhead or decoy, which will be demolished on entering dense layers of the atmosphere as a result of intensive aerodynamic heating.

According to the Russians, the "nuclear shrapnel" can be used only in outer space under conditions of airless space, since the particles will burn up at velocities of over 4-5 km/sec. Its use as an anti-space weapon for destroying military satellites is not precluded. Therefore, its combat use is possible for "blinding" the enemy in a first strike.

Russian military and scientific experts have also focused on the combat capabilities of low- and high-yield miniaturized nuclear devices. V. Mikhaylov, Russia's minister for Atomic Energy, has noted that "You can drop a couple of hundred little bombs on foreign territory, the enemy is devastated, but for the aggressor there are no consequences."[61] When based in space, such weapons are said to be capable of generating a "directed shock wave" accurate enough to strike even hardened underground targets such as military and state command-and-control centers, nuclear facilities, etc. In late 1992, General-Lieutenant Ye. A. Negin announced that Russia has already developed a mini-nuke whose yield has more than doubled and whose weight is one-hundredth of what it was. In the words of Yu. Khariton, it has "many subtleties and much elegance."[62]

In a 1994 interview, Atomic Energy Minister V.N. Mikhaylov noted that while atomic munitions using the effect of fission of heavy nuclei can be included in the first generation and thermonuclear weapons operating on the principle of the fusion of light

[61] V. Mikhaylov, Komsomol'skaya pravda, 19 July 1990.

[62] Cited in M. Rebrov, "Three Generations of Bombs...," KZ, 27 October 1992.

nuclei in the second, the third generation consists of weapons with a selective effect, which act using a superpowerful electromagnetic pulse, superpowerful nuclear-pumped lasers, an intense neutron flux (the so-called neutron bomb), and so on. An electromagnetic pulse is capable of damaging or disabling all kinds of electronics-based armament; thus, it acts above all on the most sophisticated armament and command-and-control and communications systems. Third-generation nuclear weapons realistically can appear in the next century. They should possess a significantly lesser damage effect on the environment, but a greater selective effect -- they probably will gradually replace first- and second-generation nuclear weapons.[63]

According to Colonel-General Ye.P. Maslin, nuclear weapons are the sole economically solvent means of ensuring Russian Federation military security at the present time. They serve to deter possible enemies against initiating nuclear conflicts and a wide-scale conventional war. If necessary, nuclear weapons can (in exceptional cases) be used to repel aggression and create conditions for the most rapid termination of war.[64]

In determining the most advisable requirements for nuclear weapons, MOD Main Directorate specialists constantly work together with specialists of Minatom [Ministry of Atomic Energy] and its scientific, experimental design, and industrial organizations; i.e., with nuclear munitions developers, tying Armed Forces requirements in with

[63] Interview with Viktor Nikitovich Mikhaylov, minister of Atomic Energy of the Russian Federation, "Russia Is a Great Nuclear Power," VPK, No. 4(7), 1994, pp. 4-10.

[64] Colonel-General Yevgeniy Petrovich Maslin, "Nuclear Weapons: Results and Prospects," VPK, No. 4(7), 1994, pp. 31-35.

technical capabilities. A detailed analysis of technical capabilities facilitates the selection of optimum versions of requirements for models of nuclear munitions coming to replace those which have served the warranty periods.

Nuclear weapons have passed through several stages in their development. The main task in the first stage was to reduce the size-weight characteristics of nuclear munitions and the amount of plutonium necessary for them. This permitted the development of tactical nuclear weapons. Work in the second stage was done to increase the power of strategic nuclear-missile weapons, and powerful thermonuclear ("hydrogen") munitions were created.

The situation changed somewhat in the third stage, beginning in the mid-1960s, and only nuclear munitions with those characteristics needed by the country's Armed Forces were put into development. The primary missions for upgrading nuclear munitions in this stage were an increase in specific yield (ratio of yield to weight) for missiles being created with MIRVs, and especially an improvement in operating characteristics. In the mid-1970s the United States officially announced the development of neutron munitions and their deployment in Europe (as the press later reported, the first such munition was tested in 1963, but did not become operational).

Neutron munitions belong to a fundamentally new variety of nuclear weapons, which can be called selective-effect weapons. There can be several types of such weapons. A distinguishing feature of neutron munitions is the substantial increase in neutron yield per unit of power. In addition, the neutrons which form during the explosion are distinguished by increased energy, which reinforces their casualty-and-damage effect. The casualty radii of neutron munitions for personnel are the very same as in the explosion of a conventional atomic munition of ten times greater yield. At the same time, casualty radii for shock-wave and thermal radiation turn out to be somewhat less than from an atomic munition of equal yield, since a significant portion of explosion energy is carried off by neutrons. As a rule, the size of the area of physical destruction and consequently of possible obstacles in the path of advancing troops from the explosion of a neutron munition turns out to be several times less than from the explosion of a conventional atomic munition.

As "American specialists" wrote, neutron munitions were predecessors of proposals to create fundamentally new kinds of nuclear weapons, to which the "foreign press" gave the overall name "third-generation weapons" (atomic munitions to the second). In their essence, third-generation weapons are selective-effect weapons characterized by a sharp reinforcement of certain casualty-and-damage elements of the conventional nuclear weapon. The United States linked the broad expansion of work to study ways of creating third-generation nuclear weapons with the Strategic Defense Initiative program.

Like any other explosion, a nuclear explosion is a powerful source of energy which in principle can be converted and used most effectively in a specific, special situation. Conversion of the nuclear explosion's energy into any given form naturally is a very complex S&T task because of extremely high energy density and the extremely brief time of its release. But there are no fundamental limitations on solving this problem; therefore it is theoretically possible to create devices converting the energy released in a nuclear burst into specific casualty-and-damage factors such as electromagnetic emission of the radio frequency or x-ray bands of wavelengths or the flux of high-speed plasma or metal particles.

The formation of a narrowly directional beam of such casualty-and-damage-producing elements is a further development of these kinds of weapons. This permits the development of directed-effect weapons having a large casualty radius with minimum effect on oneself. But its realization requires solving a large number of technical problems dictated by the difficulties of preserving the converting devices under the strong effect of a nuclear explosion during release of the energy of this explosion.

One of the most familiar versions of directed-effect weapons with conversion of one nuclear explosion's energy is the x-ray laser. The press has reported that the principle of its operation was checked for the first time in a U.S. underground nuclear test on 14 October 1980, and there is information about a large number of other similar experiments being conducted, but a combat version of an x-ray laser was not created. In the assessments of "U.S. specialists," its creation will require several tens or hundreds of additional underground nuclear tests.

The principal trend in work to create the majority of versions of third-generation directed-effect nuclear weapons is the attempt to ensure high effectiveness in damaging enemy technical equipment with minimum collateral effect on friendly nearby systems. Versions of selective-effect weapons also are being examined which provide for disrupting the working capacity of electronic equipment at distances of tens and hundreds of kilometers with relatively little effect on the environment and on friendly technical equipment, which must have necessary resistance for this.

Versions of directed-effect weapons form a localized damage radius at great distances, but in a narrow beam, and they support obtaining a guaranteed damage-producing effect. Versions of selective-effect weapons such as electromagnetic pulse munitions, used to create an electromagnetic pulse with an intensity of up to 400-500 kw/m or more, lead either to a temporary loss of working capacity of the target's sensitive components and interruptions in operation or to malfunctioning of sophisticated technical systems over a large expanse.

Developing the majority of versions of third-generation nuclear weapons requires a large number of nuclear tests, which in this instance essentially are large-scale scientific experiments. But nuclear tests are needed not just to create new kinds of nuclear weapons or new types of nuclear munitions not belonging to the third generation. As a rule, nuclear tests also are needed to check the working capacity of nuclear munitions being modernized or, more precisely, the working capacity of their main element, the nuclear charge, and to confirm the reliability of nuclear charges reproducible over a lengthy time.

Nuclear munitions, say Russian military theorists, have not been ignored by the United States. The following requirements were placed on their next generation: yields from 10 KT to 1 MT; capability of changing yield in the course of employment; capability of penetrating soil, water, and through ice into water; use as neutron weapons and as a source of powerful electromagnetic pulse; and reduction of radioactive contamination by an order of magnitude. The proposal was advanced to create a modular warhead for missiles which could be fitted with a conventional or nuclear munition aboard ship in five minutes. It was deemed realistic to create a nuclear-pumped "radio-frequency" munition intended for disabling seaborne, air-space, and ground-based electronic equipment with EMP from an altitude of 50-100 km within a radius of up to 500 km (up to 50 km with shielding). Judging from materials of 1992-1994, they say, the majority of these proposals on nuclear warheads were either frozen or sharply limited, but the capability of realizing them within 3-5 years is retained.[65]

The main problem of a "clean" warhead is the problem of the detonator. Its solution could be obtained in several ways: the employment of laser detonators, the employment of detonators made from non-traditional trans-uranium elements, or the employment of detonators from traditional nuclear fuel but with an additional source of neutrons to reduce the critical mass to the maximum extent possible. The latter is the so-called "neutron warhead."[66]

While talking about tactical nuclear weapons, one must rule out neutron charges for tube artillery. The fact is that during the detonation of a kiloton warhead that is based on a fission reaction, the radius of the zone of effective destruction is approximately 450 meters. That same radius of destruction is provided with the detonation of a neutron warhead with a yield that is 50 times smaller and is a total of

[65] Major M. Boytsov, "The 21st Century and the U.S. Navy," MS, No. 7, 1995, pp. 74-78.

[66] Valeriy Konovalov, "The 'Clean Warheads' Have Finally Been Written Off: Something About Tactical Nuclear Weapons," Zavtra, No. 40, 19 October 1995, p. 5.

20 tons. The ratio of the area of destruction of the strike wave to the area of effective radiation destruction is 80 percent for a nuclear warhead. The possibility thus exists for the development of warheads, the lion's share of the detonation energy of which is directed toward obtaining an electromagnetic pulse that destroys the enemy's electronic weapons and his communications equipment.

As regards fourth-generation nuclear weapons, Russian scientists have long warned of the appearance of new trans-uranic/trans-plutonic elements. The half-life of such new elements can extend for about 10 years for a critical mass of from 25 - 500 grams. This means that with the use of such elements it is possible to develop nuclear charges for infantry (hand-held) weapons. If such artificial elements are actually developed, then the tactics of conducting battles on the battlefield would change dramatically.

Serious work is currently being conducted on the possibility of developing anti-matter, particularly at the European Center for Nuclear Research in Switzerland. The existence of anti-matter was first proved theoretically, and later experiments led to the development of materials anticipated by the theory. By its very nature, anti-matter contains tremendous energy. If, for example, 1/1000 of a gram of anti-matter is combined with matter, the energy released would be equivalent to the explosion of several dozens of tons of TNT. According to Mikhaylov, third-generation nuclear weapons are "highly effective," while fourth-generation nuclear weapons are "directed-effect" weapons.

WEAPONS BASED ON NEW PHYSICAL PRINCIPLES

In analyzing the destructive properties of various types of weapons, General-Lieutenant A. Paliy notes that despite their diversity, the effect on targets is determined primarily by three basic forms of energy -- physical, chemical, and biological. Depending on the forms of destructive energy, it is possible to define the kinds of weapons being used at the present time (or which may appear in the future), the means of protection, and the kinds of warfare equivalent to them.[67]

General Paliy gives principal attention to analyzing means of physical destruction, which can be represented as the result of casualty-and-damage effects of physical energy capable of disrupting the functioning of or destroying personnel, means of warfare, military installations and structures, and also affecting people's minds, behavior, and their delayed hereditary, carcinogenic, fetal, and other effects. In a number of cases the effect of powerful physical energy can alter the state of the natural environment, stimulate natural disasters, and disturb the ecological balance in nature.

Based on the forms of energy used, it is possible to describe physical destruction in mechanical (kinetic), acoustic, electromagnetic, radiation, and thermal terms. Inasmuch as there are common properties inherent to acoustic, electromagnetic, and partially radiation kinds of destruction which are of a radiated (wave) nature, in classifying them this permits consolidation into one kind which can be conditionally called "radiated destruction." The energy not of substances but of physical fields is

[67] General-Lieutenant A.I. Paliy, "A Methodology for Classifying the Means and Forces of Warfare," VM, No. 2, 1993, pp. 53-60.

issued here in contrast to means of mechanical (kinetic) destruction. In connection with this the effect of the radiated energy on electronics, weapons, military equipment, targets, and people as well as protection against radiated destruction can be called "radiated warfare."

Contemporary armed forces chiefly employ weapons which act by kinetic, nuclear, and thermal energy. But even now means of radiated destruction -- laser, radio-frequency, accelerator, and infrasonic -- are beginning to enter the inventory which possess significant destructive capabilities and essentially instantaneous action (see figure).

Kinds of Casualty-and-Damage Effect (Destruction)	Kinds of Means of Destruction (Weapons)	Nature of Casualty-and-Damage Effect on Targets
Acoustic	Infrasonic weapons; acoustic generators; explosions generating (forming) acoustic energy; means of acoustic (sonar) suppression	Functional and structural disturbances in living organisms and demoralization or death of people; suppression of operation or disabling of acoustic equipment, diversion from targets of weapons guided by acoustic (sonar) means; destruction of earth's ozonosphere
Electromagnetic	Laser and radio-frequency weapons; nuclear weapons (electromagnetic pulse); means of electromagnetic suppression	Destruction of cells of living organisms; charring, partial fusion, or vaporization of surface of objects; structural changes of equipment materials; suppression of operation or disabling of electronics and of electrical and optical devices; effect on minds, behavior, and reproductive function of humans
Radiation	Particle-beam weapons; nuclear weapons (ionizing); elementary particle accelerators; nuclear power plants; radiological weapons; radioactive substances	Ionization, structural changes (destruction), other disturbances of physical and chemical processes in organisms, military equipment materials, structures, and environment; radiation sickness; genetic changes in populations

Radiating weapons and equipment for electronic countermeasures (ECM) use one and the same kinds of energy, but depending on the magnitude they can either suppress the operation of electronics or destroy their sensitive elements, cause personnel casualties, and also damage certain kinds of weapons and military equipment. Therefore ECM should be considered one of the degrees (a level) of radiated destruction, and electronic warfare (EW) should be considered the content or a component part of radiated warfare and consequently also of warfare as a whole.

It is believed that success in EW is equivalent to achieving superiority over the enemy in combat power and can become the key to victory in the operation (battle). Thus, with electronic suppression of reconnaissance and command-and-control systems, precision munitions, surface-to-air missile (SAM) systems, aircraft, ships, and spacecraft, their combat employment becomes altogether impossible.

Reconnaissance also should be viewed as an inalienable element of any battle, engagement, or operation and <u>not as a kind of support</u>, since effective destruction and protection in warfare are possible only with timely identification of the composition and operations of forces and the coordinates of enemy targets. The <u>unity</u> of reconnaissance and destruction as bases of combat operations is clearly visible in the introduction of "reconnaissance-strike" and "reconnaissance-fire complexes" to armed forces. According to Soviet and Russian military scientists, reconnaissance-strike (strategic) and reconnaissance-fire (operational and tactical) complexes consist in a triad of 1) highly effective ground-, air-, and space-based reconnaissance, surveillance, and target acquisition (RSTA) systems; 2) deep-strike systems; and 3) intelligent command-and-control systems that ensure the delivery of strikes in <u>real time</u>.

Similar reasoning also is applicable when determining the place in warfare of <u>maskirovka</u> (cover, concealment, and deception). Its means and techniques contribute to protection against destruction and ECM, to increased survivability, and to preservation of the combat effectiveness of forces. For this reason it is also legitimate to include maskirovka among measures for protection against destruction and to consider it a component part of combat operations. Maskirovka is outgrowing the framework of a kind of combat (operational)) support and is becoming a form of day-to-day activity of troops in peace and wartime. In connection with this, a number of authors are proposing more aggressive operations to combat enemy reconnaissance instead of using reconnaissance countermeasures.

PSYCHOLOGICAL WEAPONS

In the absence of reliable global security mechanisms for regulating the appearance of new weapons, they will appear according to dominant law-governed patterns. The appearance of new weapons will exert a deep influence not only on the methods of conducting war, but also on the definition of its ultimate objectives and the definition of victory itself. In both the past and present, victory has meant the results of employing armed forces on the battlefield to achieve the physical destruction of the opponent and the seizure and occupation of his territory. The use of new weapons or threat thereof will be directed above all at achieving the most important political and economic objectives without the direct contact of opposing forces and without combat actions as we traditionally know them.

For example, slow-acting means that exert a concealed influence on the opponent's armed forces and population may appear in place of traditional weapons. These means can be designed to undermine immune systems, destroy the life-sustaining elements of the human organism and human society, and seriously limit or destroy the population's ability to survive.

The most important objective of military conflicts in the near-term future may become affecting the psychology of the opponent -- individual, collective, and mass. The results of using several types of psychological weapons can either be direct and occur immediately after their use, or indirect and occur only after many years. Such weapons can be designed to destroy state and societal institutions, create mass disorder, degrade the functioning of society, and ultimately cause the collapse of the state. To achieve real victory in such a war, it is necessary to acquire a deep knowledge not only of the opponent's armed forces, but also of his state and political system, the most important decision-making processes and mechanisms of the military-political leadership, and in general how leadership functions are performed. The selectivity of the destructive capabilities of new weapons can result in the destruction of only the opponent's troops and population with no feedback effect on friendly troops and population.

[NOTE: SEE ALSO "NON-LETHAL" AND "PSYCHOTRONIC" WEAPONS]

DIRECTED-ENERGY WEAPONS

Like their Soviet predecessors, Russian military scientists view "non-traditional" weapons as the next stage in the ongoing RMA. They continue to examine the role of air-, sea-, and space-based directed-energy weapons, as well as the role of systems termed "non-lethal" in the West.

Russian experts thus agree that a laser weapon is not at all a dead-end direction in the development of new military technologies. It has been worked on in other areas of the military-industrial complex for creating considerably more practical jamming systems--combat positions were illuminated by a laser, and a blinding sun appeared before the eyes of everyone who had optical devices.[68] In the Gulf War the Americans demonstrated how else lasers can be used--in precision weapons. Laser guidance to the target ensures almost a one-hundred percent hit.

According to prominent military scientists, a promising direction for the development of military operations is their "electronization," connected with the increasing scale of introduction of various electronic (radio-electronic) devices and instruments to modern weapon systems and to tactical and operational support means.[69] Electronic countermeasures, reconnaissance, and electro-optical weapons guidance are becoming new elements of the battle and operation. In the future it is expected that "electronic weapons" with a direct damaging effect -- which a number of "foreign specialists" consider "absolute" -- will be introduced to the troops. Greatest successes in this area are said to have been achieved in the United States, where at the present time several models of a tactical laser weapon have been created and are being tested. Such weapons facilitate one other form of battle --"electronic-beam" battle -- which will be characterized by a transient nature, high accuracy of strikes on targets, instantaneous nature of damage effect, and impossibility of maneuver to get out from under a "strike" by a beam weapon.

In the USSR, say Russian military experts, work on an individual laser weapon was conducted under the leadership of General-Major V.S. Sulakvelidze. In the first

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[68] L. Mlechin and V. Shildyayev, "Generals Dream of a Hyperboloid....," Novoe vremya (hereafter cited as NV) 26 (1992): 41-43.

[69] For example, see Krysanov, "Features."

stage, they established that a moderate energy of radiation -- 1-10 Joules was sufficient -- is needed to disable sensitive elements of optical systems and to blind the enemy. This is explained by the fact that the eye and the optics focus it, increasing the density hundreds and thousands of times.[70]

As is known, any laser consists of an active medium, an excitation source, and a resonator. As a medium, the Russians initially selected yttrium-aluminum garnet crystal that generates a beam in the infrared band with a comparatively low excitation output. The mirrors that coated its ends served as a resonator. They utilized a small fluorescent flashbulb, like those that photo-reporters use but with a much greater energy of radiation, for optical excitation. Since even the most compact electrical power source weighed 3-5 kilograms, they had to mount it separately from the pistol.

At the same time, they were involved with searches for new active mediums. For example, the designers preferred fiber-optic elements -- in them, as in the yttrium-aluminum garnet, ions of neodymium initiated the radiation. Thanks to the fact that the diameter of that "thread" totaled approximately 30 mkm, and the surface gathered from its fragments (from 300 to 1,000 pieces) of filament was large, the generation threshold (the least excitation energy) was reduced and the resonators became unnecessary.

During the course of research, they ascertained the energy and spatial specifications of various crystals and active fiber with a different length of filaments and studied the specific features of their operation in the single pulse, frequency, and

[70] Boris Duvanov and Mikhail Pavlushenko, "They Fire Light," Tekhnika i molodezhi, No. 12, 1995, pp. 18-19.

continuous modes. As was expected, fiber had the lowest generation threshold -- approximately 10 Joules in the six-meter filament of 400 "threads." It was simpler to cool it -- the large ratio of surface to size has an impact. To obtain radiation energy of 1-5 Joules, the length of the filament must total 4-10 m with a diameter of 1.5-3 mm. However, the active fiber had one but quite substantial shortcoming: the dissipation of radiation increased by nearly $2\ 10^{-1}$ radians which reduced the weapon's effective range by several meters or required equipping it with additional focusing adapters or the utilization of new physical effects in the fiber that are associated with the manipulation of a wave front.

In the second stage, the Russians were involved with the development of a laser pistol that was not distinguishable from an Army firearm in weight or dimensions. To do that, they needed a small optical excitation source that was mounted like a cartridge clip. They decided to employ disposable pyrotechnic flashbulbs filled with oxygen and metal in the form of foil or powder as a clip. Ignited by an electric spark, it will burn for 5-10 ms at a temperature of approximately 5,000 degrees Kelvin. Of course, all of the components had to be non-toxic and not subject to self-initiated detonation. Although the "flashbulb" was in principal ordinary, its "yield," the exciter energy, had to be increased by a factor of 5-10. Among the proposed variants they selected one with zirconium foil instead of the conventional magnesium, which increased the average light energy by a factor of three, and with additives of metal salts permitted them to "drive up" the bulb's radiation to the spectrum of absorption of the active element.

The first homemade bulbs were in the shape of a 1-cm diameter bulb, inside which was a tungsten-rhenium thread that was covered with combustible paste to ignite the pyrotechnic mixture (zirconium in oxygen). A filament of active fiber in a thick wrapper was wound on the bulb itself. Hollow pyrotechnic bulbs with external and internal coils of fiber, which enhanced the effectiveness of the excitation, were employed in later designs.

A third variant was also prepared -- a combined pistol. In the center of a hollow bulb is a crystal, a filament of active fiber is wound on it, and all of this is packed in an illuminator with a selective covering. The optical bolt ensures a separate or simultaneous "shot" from the crystal and fiber. A coating has been applied to increase the effectiveness of excitation and to reduce the generation threshold on the illuminator, the bulb, and the fiber that transforms part of the exciter radiation into strips of absorbing ions of neodymium and "escaping" ultraviolet that is harmful for glass.

Russian military theorists note that so far, laser systems do not exist that are so powerful that they could shoot down ballistic missiles in the boost phase and at a distance of up to thousands of kilometers. However, their development is only a question of several years and tens of billions of dollars. The following types of laser weapons actually exist. First of all, a ground-based ground-to-air missile destruction system has been successfully tested and will soon be placed in series production. The Russians have managed to shoot down a high-speed cruise missile with it, and also a high-altitude air defense missile -- at an altitude of 18 kilometers.[71] Furthermore, tests

[71] Mikhail Rybyanov, "A Laser in a String Bag," Komsomol'skaya pravda, 9 February 1996, p. 6.

of an airborne laser achieved excellent results against air-to-air missiles. Optical guidance heads are utilized for the majority of contemporary missiles of this class. It is sufficient to disable it even using a low-power laser -- and the missile is transformed into a blind dummy.

GEOPHYSICAL/ECOLOGICAL WEAPONS

Russian experts continue to examine the nature of weapons based on new physical principles (NPPs). In particular, scientists warn of the danger connected with the possible development of "geophysical (tectonic) weapons." These are weapons that generate natural catastrophes such as earthquakes, torrential rains, tsunamis, and destruction of the ozone layer. It is possible to trigger earthquakes with underground explosions of powerful nuclear charges, particularly in areas of high seismic activity. It is also possible to trigger tsunamis with an explosion of nuclear charges in certain areas of seas and oceans.

According to Russian military experts, the history of Russia's scientific development of tectonic processes caused by underground nuclear blasts dates back to 1954. Already at that time, a scientist-seismologist from the Interdepartmental Council on Seismology under the USSR Academy of Sciences Presidium, Yakov Berfeld, made a discovery -- a large part of which consisted of fears about "the effect of seismic processes caused by underground nuclear blasts on the status of the regions of the polar ionosphere which were located a great distance away from the points of the seismic phenomena." Berfeld's discovery was officially recorded, but the manuscript of his scientific work vanished without a trace from the USSR Academy of Sciences Committee on Science and Technology. Even in those years, the scientist reported to the Academy of Sciences leadership that underground nuclear blasts had an obvious effect on earthquakes. As Russian experts have learned from one secret report on the scientific-research work on geophysical weapons, "in the 1970s, it was not geological surveys which were being conducted in the Pacific Ocean with the aid of ocean-bottom seismographs, but a search for places to plant explosive devices."[72]

Judging by all evidence, the active development of geophysical weapons began somewhat later. Moreover, this work was sanctioned at the highest level. Thus, on 30 November 1987, the appropriate decree was adopted by the CPSU Central Committee and the USSR Council of Ministers. The head enterprise for development of the program, under the code name "Mercury," was to be the AzSSR Academy of Sciences Institute of Geology in Baku. Aside from this, around 22 scientific and production organizations throughout the former Soviet Union were included in the program.

Today the associates of project "Mercury," the specialists engaged in fulfillment of the "specific technical assignment for scientific-research work 'Mercury 18,' " on the topic of "development of models for the process of functioning of technical systems with consideration for geophysical factors," were faced with the following global tasks:

- Definition of the basic parameters of operative and long-term prognosis;
- Development of tactical-technical data for prediction apparatus installed on board spacecraft;
- Development of a methodology for long-range effect on the focal point of an earthquake with the use of weak seismic fields; and

[72] Denis Baranets, "Project 'Mercury': Earthquake on Demand," Moskovskiye novosti, 22-29 September 1996, No. 38, p. 4.

- Study of the possibility of transfer of seismic energy of a blast with the aid of weak seismic fields.

One of the scientific research institutes prepared the summary report "Methodologies of Long-Range Effect on the Focus of Earthquakes and Transfer of Blast Energy." At that time, the deputy chief of the Institute for Scientific Work, Doctor of Technical Sciences Professor L. Tuchkov, was in charge of the technical portion of the assignment for "Mercury 18." In the course of the research, sensational scientific discoveries were made. Thus, for example, scientists from the Azerbaijan Academy of Sciences concluded that "following nuclear blasts, underground energy may be accumulated at a great distance from the epicenter, and may reach unheard-of capacity, after which a subsequent directed blast is capable of fully liberating it." It was specifically from here that the term "technogenic targeting" arose. In the summary report on scientific-research work for 1994 under the secret program "Volcano" ("Mercury" was a component part of this program), developers focused attention on the grave nature of experiments with geophysics: "According to the calendar plan of work and the performers of experimental blasts for studying the response of the environment to external effects, we cannot exclude the possibility that, as a result, problems may periodically arise in the Far East (which, in turn, will have an effect on oil and gas drilling)...."

All research was conducted under the rubric of "Development of the Problem of Tectonic Earthquake Prediction." 1990 was scheduled to be the final year for conclusion of the research and the start of testing. A group of scientists under the leadership of Azerbaijani Professor Akram Kerimov began the initial tests. The work utilized a reception center and three portable digital system stations, manufactured by special order in Great Britain.

Subsequently, it was specifically this electronic filling, in combination with a nuclear blast detonated at a great depth underground, that began to comprise the Strategic Seismological Technical Complex (STC). The tests were conducted successfully, and proved that "...even with a very dense grid of digital registration in Japan, which in the seismologically hazardous regions of this country forms square grids with sides of one kilometers, the influence of a number of factors is underestimated in determining the point rating of seismic perturbations of the earth's core."

Just as the scientific-research work was approaching its conclusion, the disintegration of the USSR occurred, and Azerbaijan became a sovereign state. At the same time, all of the scientific potential of the previously performed work on this program was concentrated in Russia. The head enterprise on continuation of the research became the Special Design Bureau of the Russian Federation Academy of Sciences Institute of Earth Physics. Three special test sites were created in the Far East "for conducting the concluding stage of development and testing of the scientific-research work under the 'Volcano' program." Having passed the stage of scientific research in 1992, scientists began to examine the already finished project of the Strategic Seismological Technical Complex, and parallel with this -- to begin final preparations for formulating the "tectonic section" in strategic doctrine. The last tests of the complex were held in 1992-1993 in the region designated by the code number

S36NZ-OKh (presumably the Far East), with the application of a low-power underground nuclear blast.

After this, the history of the development of a geophysical weapon goes into the category of being a "state secret." The concept of a "tectonic weapon" has not yet been included even in the textbooks of higher military academies, and it is unlikely that it will appear there in the near future. According to the estimates of specialists, the development of an analogous program in the USA lags about five-six years behind that of the Russians. Nevertheless, there is reason for concern, say the experts: even the testing of a tectonic weapon may pose the threat of serious upheavals to the world -- in the literal sense of the word.

In 1982, American seismological stations recorded a mild jolt with its epicenter in the vicinity of the Soviet nuclear test range on Novaya Zemlya. Satellites got a fix on a flash in the atmosphere simultaneously. Both of these phenomena were classified by American specialists as a test of low-yield nuclear devices. This was nothing unusual for that time, had it not been for one detail -- the explosions were carried out on the surface and in the atmosphere synchronously. The devices were of minimum yield, and they did not have direct destructive power, which led the Pentagon to the conclusion that Soviet tests had become qualitatively new.[73]

According to Russian military sources, U.S. Defense Department analysts had not erred in their conclusions. A completely new type of weapon -- ecological -- was

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[73] "Ecological Bomb," Ogonek, No. 16, April 1995, p. 39.

in fact tested in 1982 on Novaya Zemlya. The principle of the new "miracle weapon" is simple. Blast waves from two nuclear devices collide to form a short-lived "hole" in the atmosphere through which direct cosmic radiation is able to burn everything living on the surface. People familiar with this experiment in one manner or another assert that the rocky region of the archipelago subjected to this weapon was transformed into an ideally level stone-strewn plain.

Russian military scientists note that the first stage of the military-technical revolution consisted of a transition from weapons of multiple destruction (firearms) to weapons of mass destruction, whose effect was based on completely different principles. The creation of weapons of mass destruction became possible thanks to the active introduction to military affairs of the S&T revolution and especially the achievements of nuclear physics, electronics, organic chemistry, microbiology, and so on.[74]

A characteristic feature of the second stage of the military-technical revolution that has been taking place most intensively in the last decade was the creation of non-traditional weapon systems (with a simultaneous upgrading of conventional kinds of arms and military equipment and weapons of mass destruction) whose scale and effectiveness signal the emergence of a new class of weapons -- weapons of global destruction. A fundamental distinction of non-traditional weapon systems vis-a-vis those previously created lies in the fact that they are intended not for destroying man

[74] Colonel Vladimir Grigoryevich Andreyev, "A Mortal Blow to Nature and Man: Some Features of the Modern Stage of the Military-Technical Revolution," NVO, No. 18, 24-30 May 1997, p. 6.

but for affecting specific segments of his habitation. If one arbitrarily divides human habitation into three segments – biosphere, technosphere, and infosphere then it is possible to define just as arbitrarily the kinds of weapons being created for affecting these segments for military purposes as ecological, non-lethal (destroying the technosphere but not man), and information weapons.

The future comprehensive use of these kinds of weapons for a systems effect on human habitation will ensure the global nature of destruction of a given medium in armed conflicts of the 21st century. It is natural that with the appearance of weapons of global destruction there also will be a change in the forms of Armed Forces organization and in methods of waging warfare. It should be admitted that ecological weapons are the most dangerous kind of weapons of global destruction, inasmuch as they affect the most critical segment of human habitation -- the biosphere -- whose resources are vitally necessary, very limited, and essentially nonrenewable. As shown by military practice of past decades, even conventional kinds of arms are capable of inflicting enormous damage on nature.

The Russians emphasize that the term "ecological weapon" denotes a weapon being created especially for damaging nature. It is the specific nature of effect on the target that distinguishes it from other kinds of weapons. Ecological weapons are created for the purpose either of directly affecting components of the natural environment (for example, phytotoxic war agents that damage vegetative ecosystems), or disturbing their mechanism of interaction with other components of the natural environment (for example, special emulsions that disrupt the mechanism of infiltration when they get into the soil surface). As a rule, such a weapon acts on man indirectly, through a breakdown of the natural environment.

An analysis of "foreign literature" reveals possible directions of creating different types of ecological weapons having various energy sources and mechanisms of effect on the natural environment, but the common goal of employment is a disturbance of the ecological balance. Development of the following methods can be included among such directions: generating natural disasters (earthquakes, floods, typhoons, and so on); initiating natural phenomena (volcanic activity, snow avalanches, downpours); a local change of climate (such as by forming ozone holes); modification of weather conditions; destruction of sources (and even reserves) of natural resources; creation of new means of damaging flora and fauna; and so on. General properties of different types of ecological weapons such as the possibility of remote and concealed action, difficulty of detection of means of effect and of protection against them, and so on can acquire special value.

On the whole, in the opinion of "foreign military experts," the possession of ecological weapons will make this kind of weapon of global destruction a powerful geopolitical threat factor in the 21st century and, under conditions of sharply increased resource consumption, will permit (without committing direct violent actions) control over the richest key sources of natural resources and biosphere processes over enormous territories. The nature of future conflicts will change as a result. The experience of local wars in Indochina, Afghanistan, Somalia, and Chechnya demonstrated the poor effectiveness and even lack of prospect of combat operations for sides having overwhelming military-economic superiority. Therefore in the 21st century preference will be given to remote, non-contact methods of opposition capable of locally (in the future globally) deforming human habitation.

NON-LETHAL WEAPONS

In the search for an exit from the "dead zone" in which traditional means of armed combat were unusable, say Russian military analysts, the military turned to a weapon that is designated "non-lethal" or "weapon of non-lethal action."[75] They are supposedly able to stop and neutralize the enemy's manpower without causing death. One cited example of such weapons is an infrasonic device emitting radiation causing convulsions, vomiting, uncontrollable diarrhea, and a sense of fear in man. Some sort of adhesives that could be applied to a road to stop the movement of armored equipment apparently exists already. Scientists have come up with polymer aerosols able to clog the air and mixed with dyes, the clouds they create will become a dependable air raid screen.[76]

The so-called non-lethal weapon probably can be called a particular kind of precision weapon with a certain amount of lenience. It is being created in the United States and is intended for all branches of the Armed Forces. It is expected that such weapons will become the most utilized means for performing not so much tactical as strategic missions. They will provide the United States with "powerful new concepts

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[75] Sergey Grigoryev: "Non-lethal Weapons -- Is a Humanization of Coercion Possible?" Nezavisimaya gazeta (hereafter cited as NG), 13 November 1993, p. 6.

[76] "Ecological Bomb," Ogonek, No. 16, April 1995, p. 39.

of effect" and will permit "achieving political and military goals by ways previously impossible."[77]

While at a tactical level the "non-lethal weapon" will begin to be used, for example, to "neutralize servicemen who have intermingled with civilians and to control crowd actions," at a strategic level it will be used to show U.S. resolve with respect to a certain country. It is believed that the weapon possesses high selectivity in opposing, for example, mobilization of forces or escalation of a conflict, in destroying weapons (including mass-destruction weapons) and means of their production, and also in disabling regional infrastructure systems of civilian and military communications, transportation, power supply, and so on.

According to the Russians, the U.S. plans to use "non-lethal weapons" both independently as well as in combination with "lethal" ones to achieve the greatest result. To combat personnel it is possible to use sound-emitting, light-emitting, and laser units, as well as sprayers of substances acting on the physiology and mind. But EMP generators, short-circuiters of power transmission lines, computer viruses, chemical substances which eat away rubber and metals and make surfaces slippery, and quick-hardening adhesive, obstructing, concealing, and other substances can be used to combat equipment. Many kinds and models of so-called non-lethal weapons that exist and that are under development remain top secret.

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[77] Major M. Boytsov, "The 21st Century and the U.S. Navy," MS, No. 7, 1995, pp. 74-78.

Radioelectronic Counteraction. The general designation "non-lethal weapons" is understood to mean weapons operating under various principles that are capable of disabling the enemy or depriving him of a combat capability without irrevocably destroying personnel or physical assets and without inflicting serious environmental damage. Some types of these weapons appeared some time ago. The first large-scale operations with radioelectronic counteraction date back to the time of World War II. Today, radioelectronic warfare is changing from a means of support to an independent form of waging combat actions. The technologies developed in the scope of radioelectronic warfare are giving rise to new means of defeating an enemy. For example, research is being conducted on the effects of powerful microwave radiation on the human being (SHF weapons). Quite promising, from the point of view of specialists, is the use of generators of an electromagnetic pulse to disable electronic and, in the future (with the increase in the power of the radiation), electrotechnical equipment. If a special nuclear device exploded at a high altitude is utilized as the source of the electromagnetic pulse, it will be possible to disable antenna systems and receiving tracts of radio equipment in areas the size of countries.

Lasers. Lasers, the use of which to destroy hardware has not yet passed the experimental stage, have found a battlefield application in disabling organs of sight. The basic specifications (dimensions, weight, and range) of combat laser systems are comparable with analogous characteristics of hand-held firearms, and the inflicted damage may or may not be reversible depending on the conditions of illumination and protection of the eyes. In the United States, the application of blinding laser devices is presently being curbed not by technical problems but by debates in Congress about the humaneness of such weapons. Powerful sources of conventional light may be used as sources for the temporary disabling of enemy soldiers. The selection of the radiation characteristics makes it possible not only to affect the organs of sight but also to cause reversible changes in the psycho-emotional state of the individual. There have been reports that the Russian internal forces have illuminating grenades that cause the temporary (for several dozen seconds) blindness of violators.

New Chemical Formulas. New kinds of chemical weapons can be a quite effective means of non-lethal action. The development of chemistry makes it possible to create not only toxic substances that temporarily disable people but also chemical receptors affecting technical systems. The targets of such means may be rubber elements of equipment, fuel, and engine lubricants. The development of gene and cell engineering makes it possible to create non-lethal biological weapons. There are known bacteria created for industrial purposes that can break down petroleum products. The application of such means can deprive the enemy of fuel supplies. In the United States, in the course of the destruction of missiles in accordance with the INF Treaty, they made use of microorganisms that break down solid missile fuel. The culture medium for bacteria may be various kinds of semiconductors used in electronics. An important feature of biological weapons is the fact that they are now being created in the scope of industrial research programs. At the same time, international agreements that prohibit or limit such weapons are a serious obstacle to the development and application of chemical and biological weapons of non-lethal action.

Virus Programs. Contemporary means of armed combat are technologically saturated. The forces are practically lacking a combat capability without computerized systems for the transmission and processing of data. The information support and software for automatic and automated systems may be quite vulnerable to program viruses, program stowing, or false information introduced into the system. It has been reported that such means of affecting the enemy have already been used in military actions in the Persian Gulf. The growing dependence of arms systems and control processes on computer technology and the snowballing increase in the complexity of software establish the preconditions for a successful attack on the "nerve systems" of contemporary armies.[78]

Psychological Weapons. An essential element in the arsenal of "non-lethal" arms is that of psychological operations, which is understood to mean the use of systems, methods, and forms of information dissemination to influence the behavioral and emotional attitudes of people. Individual techniques of psychological pressure on the enemy have been practiced since time immemorial. But only today does the increased information dependence of humanity and its military forces -- as well as the greatly increased number of channels for the dissemination of propaganda -- make psychological operations a military weapon. Surveys of Iraqi prisoners in 1991 showed that leaflets and radio broadcasts had an influence on the combat morale of the troops that was comparable with that of bombing and strafing. To a considerable extent, this was the result of the proliferation in the 1980s of forces and systems for psychological operations in the tactical and operational echelons of the U.S. Armed Forces.

Other Russian military theorists offer the following classification of non-lethal weapons:

[78] See Mary C. FitzGerald, Russian Views on Electronic and Information Warfare, Hudson Institute Report, September 1997.

Laser weapons. Laser equipment for disabling organs of vision has already been developed in the United States and can be adopted in the near future. In addition to those weapons, the United States and other foreign countries are creating high-power air-borne, shipboard, and ground laser units intended for disabling electro-optical gear. The main problem of developing weapons based on laser equipment which cause only temporary blinding is the wide range of change in radiation energy. Damage can be reversible or irreversible with one and the same amount of energy depending on the angle of sight, degree of the eye's adaptation to conditions of illumination, and protection of organs of vision.

Incoherent light sources. Bright sources of blinking, incoherent light can cause temporary blinding and hamper aiming and movement over terrain. With certain values of pulse frequency and relative pulse duration, the sense of well-being deteriorates sharply and phenomena are observed that usually precede epileptic attacks. The effect increases with a combination of coherent light sources (for blinding) and incoherent ones (for disorientation) with other kinds of non-lethal weapons.

SHF weapons. The mechanisms of SHF emission on the human body can be divided arbitrarily into energy and information mechanisms. The thermal effect of relatively large SHF emission power fluxes has been studied the most. Depending on frequency and power, radio-frequency emissions disturb brain and central nervous system operation, temporarily disable, cause a feeling of noise and whistling difficult to endure, and damage internal organs. In the latter instance there is the likelihood of a fatal outcome. At the same time, some "foreign experts" believe that the development of such non-lethal weapons is very problematical (difficulty of obtaining requisite outputs with acceptable dimensions and cost of the unit, and the short effective range).

SHF generators can be used to disable electronic gear, but there are relatively simple methods for the latter's protection. "Foreign specialists" deem use of superpowerful SHF generators to be more acceptable as a means of EW power; i.e., means that do not disable gear, but create heavy interference for it by penetrating through defensive filters, along "parasite" receiving channels, through unshielded openings and slits of the gear, and so on.

Infrasonic weapons. The influence of infrasonic oscillations on the human body and mind was studied intensively in the United States during the 1960s and 1970s, including for police purposes and as weapons. This work demonstrated the possibility of infrasound affecting a person's sensory as well as internal organs and disabling him in the presence of a certain combination of conditions. It was shown that small output levels can cause an unaccountable feeling of fear and create panic in a crowd, and that at high levels the disturbance of psychomotor functions and appearance of a state usually preceding an epileptic attack is possible. It is believed that infrasonic weapons will be effective against personnel in shelters and inside combat equipment.

New mass-destruction weapons can be developed on the basis of high-frequency radio/electromagnetic waves. Here the main form of destruction is to attack all physiological functions that sustain life -- the circulatory system, nervous system, internal organs, etc. One well-known project is the development of a massive sonic generator that can generate several infrasonic vibrations per second. Infrasonic waves can exert a powerful destructive effect on the human organism. These vibrations are capable of causing alarm, desperation, and even horror. According to some specialists, the effect of these vibrations can cause such dysfunctions as epilepsy. They can also destroy various organs and physiological systems, and cause a mass onset of myocardial infarction among the enemy's troops and population. Infrasonic weapons can penetrate concrete and metal structures.

In recent years electronic warfare has become a relatively independent, specific form of warfare. Data checked many times in exercises and during local conflicts show that by using wide-scale, well-coordinated EW measures it is possible to substantially alter the force ratio, disorganize command and control of the enemy's troops and weapons, deprive him of reliable situation information, and force him to act by a previously known method favorable to one's own side. Not long ago, these EW capabilities were proposed to be used chiefly to create optimum conditions for delivering damaging attacks against enemy personnel and equipment for purposes of destruction.

At the present time, non-lethal weapons can be delivered without losses to targets by using EW systems and equipment. In addition, conditions are created ensuring their most effective employment to sharply reduce or totally exclude friendly losses. In combination with means of information warfare and new-generation precision weapons, EW essentially can paralyze the armed forces and state command-and-control points of a less technologically developed enemy.

Means of information warfare. Wide use of computers in weapons and military equipment in all processes of warfare has also predetermined the appearance of new methods of affecting the enemy, whose results, in the assessments of "U.S. military specialists," are comparable only with mass-destruction weapons.

At the present time it is possible to tentatively single out several types of special effect on enemy computers:

1. Include appropriate elements in the software of weapon, command-and-control, and communications systems in advance which disable the computers being served (the elements are activated at the expiration of a certain time interval, by special signal or by another method). The failure may be perceived as a natural equipment malfunction.

2. Introduce computer viruses by agents, over communications channels, or by other methods to destroy data in data banks and combat system software.

3. Enter communications channels between computers and introduce false data in them.

4. Disable computers and erase data by a powerful SHF emission, by electromagnetic pulse, or in another way.

Electromagnetic pulse (EMP) weapons. Theoretical work and experiments conducted "abroad" show that non-nuclear EMP (super-EMP) generators can be used effectively to disable electronic and electrotechnical equipment, erase data in data banks, and impair computers.

Using non-lethal weapons based on non-nuclear EMP generators, it is possible to disable computers; key enemy radiotechnical and electrotechnical equipment, electronic ignition systems, and other automobile machine units; and detonate or inactivate minefields. The effect of these weapons is rather selective and politically fully acceptable, but their precise delivery to the vicinity of the target to be engaged is required. Modern achievements in the area of non-nuclear EMP generators permit making them rather compact for use with conventional and precision means of delivery.[79]

PLASMA WEAPONS

In April 1993, Russian military and scientific spokesmen began to publicize the existence of "plasma weapons," which "can hit any object moving in the earth's atmosphere -- be it a missile, a warhead, an aircraft, or some other artificial or natural heavenly body such as a meteorite." This is accomplished using an existing technological base without putting any components into space and using the kinetic energy of the object itself, which is intercepted electronically by a plasmoid created by facilities on the ground -- microwave or optical (laser) generators, and antennas and other systems.[80]

The energy directed by the earth-based components of the gun is focused not on the target itself but on its flight path in the area of the atmosphere directly ahead of it. It ionizes that area of the atmosphere and totally upsets the aerodynamics of the missile or aircraft. The object leaves its trajectory and is destroyed by enormous stresses. It

[79] For example, see Colonel S. Vybornov, "U.S. Non-Lethal Weapons," Zarubezhnoe voennoe obozrenie 4 (1993): 10-14.

[80] "Joint Testing of 'Plasma Weapon' Proposed with U.S.," in FBIS-SOV-93-065, 7 April 1993.

is virtually impossible to counter this effect of terrestrial energy. In addition, it is possible for the first time to combine in a single unit radar observation systems and systems for the electronic delivery of the plasmoid -- the kill mechanism -- to the target at the speed of light. This makes the plasmoid a "virtually invulnerable weapon providing guaranteed protection against any attack from space or the upper or lower strata of the atmosphere."

Ballistic targets include not only the warheads proper but also decoy targets. Their identification is said to be a complicated task that has gone unresolved until now. But radiation means of destruction -- laser and SHF weapons -- seemingly resolve this task in principle since the number of equivalent responses is unlimited. In other words, all targets -- both genuine and false -- could be destroyed consecutively, and with non-nuclear means of interception.

The radar observation systems can lock onto a target or group of targets at a distance of 100 km, and the plasmoid destroys them at an altitude of up to 50 km according to the task in question. Furthermore, one does not need to build great power stations for this -- the energy output of a few dozen domestic storage batteries for each of the powerful generators belonging to the complex is quite sufficient to make such protection feasible.

According to experts such as Admiral V.S. Pirumov, this gun was created in Russia. The research on it has gone beyond the laboratory walls and is being tested in real life. But a full-scale experiment against real targets -- ICBMs and supersonic planes -- requires great financial outlay. Russia is therefore proposing that the United

States pool its efforts and jointly create a global anti-missile protection system. Such an experiment could be conducted on the U.S. island of Kwajalein in the Pacific, where the appropriate material and technical base exists and where the U.S. military has already conducted a number of tests for the SDI program.

Russia would supply the necessary equipment on board aircraft carriers and other ships. It is well known that Russia has considerable achievements and advantages in the sphere of creating powerful microwave generators (potential components of the plasma gun) and in the sphere of the new science of plasma-gas dynamics. The United States would supply the solid-state electronics and computer technology. The missiles for the experiment could be launched either from the territory of Russia or from U.S. test ranges.[81]

The Russians claim that plasma weapons have already been created in Russia. Their action is based on focusing beams of electromagnetic energy produced by laser or microwave radiation into the upper layers of the atmosphere. These beams would be able to defeat any target flying at supersonic or near-sonic speeds in the near future. A cloud of highly ionized air arises at the focus of the laser or microwave rays, at an altitude of up to 50 kilometers. Upon entering it, any object -- a missile, an airplane -- is deflected from its trajectory and disintegrates in response to the fantastic overloads arising due to the abrupt pressure difference between the surface and interior of the flying body. What is fundamental in this case is that the energy aimed by the terrestrial components of the plasma weapon -- lasers and antennas -- is concentrated not at the

[81] Moscow Conversations, May 1993.

target itself but slightly ahead of it. Rather than "incinerating" the missile or airplane, it "bumps" it out of trajectory.[82]

Academician Ramiliy Avramenko, the chief designer of the Scientific Research Institute of Radio Instrument-Making and the scientific director of the efforts to create plasma weapons in Russia, believes his brainchild -- the plasmoid -- to be invulnerable. Besides that, in his opinion plasma ABM weapons will not only cost several orders of magnitude less than SDI, but will also be many times simpler to create and control. A plasmoid has a dual purpose. Such a unit can be used to "patch" ozone holes in the atmosphere, and to knock space garbage out of orbit.

The Russians claim that they have already conducted tests in which a projectile flying through plasma discharges was deflected from its normal trajectory and self-destructed. Proposed tests on a Russian plasma weapon run jointly with the USA against real targets -- ballistic missiles and supersonic airplanes -- were initiated by Russia's most prominent scientists -- Nobel Prize recipient and creator of lasers Academician Aleksandr Prokhorov, Russian Academy of Sciences President Yuriy Osipov, and plasma researcher Academician Andrey Gaponov-Grekhov. This is known as the "Trust" experiment. Scientists from the All-Russian Scientific Research Institute of Experimental Physics at Arzamas-16, the Central Institute of Aerohydrodynamics, the Central Scientific Research Institute of Machine-Building in

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[82] "Plasma Shield Able To Protect Entire Planet From Nuclear Threat," Ogonek, No. 16, April 1995, p. 35.

Kaliningrad, and the Scientific Research Institute of Radio Instrument-Making took part in its development.

Russia would be able to deliver components of the plasma weapon to the U.S. ABM test range in the Pacific: microwave generators and a few tens of thousands of phased arrays. The United States would supply its electronics and computers, in which it has the lead. The missiles could be launched both from Russia and from American missile test ranges. In the opinion of Russian scientists the experiment could cost around $300 million. This is four orders of magnitude less than what was planned in the U.S. budget for the development of its own plasma weapon.

"Low-powered phased arrays are well known in radar today," says Avramenko. "It consists of several hundred individual generators, and by shifting the phases of the generator emissions relative to one another, it is possible to change the direction and focusing of the beams almost instantly." Phased arrays can thus be used to create at an altitude of 50 km a spot of powerful (about 10 MW) microwave or laser radiation 1 meter in diameter. The energy is focused not on the target, but under the wing of the aircraft or ahead of the missile. In this area, the strength of the electromagnetic field increases and an electrical discharge takes place. As a result, a very rapid heating of the air occurs, and its density drops sharply. The emerging "air pockets" and non-uniform air flows break the wing, swirl around the object, and it breaks up.[83] A temperature of 1000 degrees C is sufficient to decrease the air density to a third.

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[83] Yuriy Medvedev, "Dig an Air Pocket," TM, No. 8, 1995, pp. 2-3.

Consequently, the power of the unit is about 1 GW. This is quite sufficient to destroy the target in a fraction of a second.

But in principle, heating up the air is not the best solution to the problem. There is a more perfected method. Having selected the operating mode of the phased array, one can generate non-equilibrium plasma at a given place -- like in daylight lamps. It does not heat up the air, but ionizes it in such a way that the drag of a flying object in it decreases sharply. The Russians observed this phenomenon repeatedly in experiments conducted in wind tunnels at the Central Institute of Aerodynamics.

They created a plasmoid in front of a bullet, blasted it with a flow of air, and the drag decreased 40 percent. Such a plasmoid will also be generated by a phased array in front of a missile and under an aircraft's wing. Then various parts of the target end up in different environments, which results in its very rapid breakup.

The mission of plasmoid weapons is to prevent a massive attack, to destroy many targets in fractions of a second. A phased array is capable of doing this -- either by running a beam across them, or by creating several beams. According to the strategy of conducting combat operations that has been adopted throughout the world, it is advisable to subject enemy missile bases to a massive strike so that he does not have time to take identical actions. That means that every missile base must be supplied with the system being proposed.

Russian military scientists note that the components of plasma weapons are UHF (or optical) generators, directional antennas, and an electrical power source.

Together they make up canister modules that are linked by a common command-and-control system. The advantage of this system is the fact that in it radar surveillance and detection systems have been combined with the system that creates the kill mechanism. A plasma weapon has the capability to practically instantaneously destroy an enormous number of targets with very high accuracy, without requiring their selection-separation into decoys and actual targets. This makes the new weapon practically invulnerable and guarantees protection against any attack from space or the upper and lower strata of the atmosphere (ballistic missiles of various classes, aircraft, cruise missiles, etc.).[84]

PSYCHOTRONIC WEAPONS

Russian military scientists also note that throughout the 1980s, abroad and above all in the United States, there was an increase in the activity of certain military and civilian scientists in studying problems of bioenergy associated with so-called paranormal human capabilities. The division of research devoted to the study of paranormal phenomena has been given the name parapsychology. It examines methods of receiving and transmitting information without using the normal organs of sense, as well as mechanisms of man's influence on physical objects and phenomena without muscular efforts. The term psychotronics is widespread -- the creation of various technical devices based on energy from a bio-field; that is, a specific physical field existing around a living organism. This is how the concept of psychotronic weapons,

[84] Mikhail Rebrov, "Russian Weapons: 21st-Century Designs: Plasma Weapons: Fantasy or Reality?" KZ, 18 May 1996, p. 6.

created based on using the paranormal properties of the human organism, entered military terminology.[85]

Presently, one can single out four basic directions of military-applied research in the field of bio-energy. First, the elaboration of methods of intentionally influencing a person's psychic activities. The second direction includes an in-depth study of paranormal phenomena that are of greatest interest from the standpoint of possible military use -- clairvoyance, telekinesis, telepathic hypnosis, and so forth.

The framework of this phenomenon is quite broad: on a strategic scale, it is possible to penetrate the enemy's main command-and-control facilities to become familiar with his classified documents; on the tactical level, reconnaissance can be conducted on the battlefield and in the enemy's rear area (the "clairvoyant-scout" will always be located at a safe place). However, problems do exist -- the number of individuals possessing these abilities is limited, and the data received cannot be checked.

According to Russian military experts, using psychokinesis to destroy command-and-control systems and disrupt the functioning of strategic arms is already feasible. The ability of a human organism to emit a certain type of energy has been confirmed by photography of a radiation field known as the Kirlian effect. Psychokinesis is explained by the subject's generation of an electromagnetic force capable of moving or destroying some object. Studies of objects destroyed as a result of experiments

[85] Lt. Col. V. Pavlychev, "Psychotronic Weapons: Myth or Reality?" ZVO, No. 2, 1994, pp. 17-19.

conducted have shown a different form of breakage than under the effect of physical force.

Discovering the mechanisms of controlling telepathic hypnosis will make it possible to conduct a direct transfer of thoughts from one person or group of people (telepathic subjects) to a selected audience. It is important here that the subjects not be aware that thoughts are being implanted from an external source. They must think that these are their own thoughts. For example, personnel of an enemy formation executing a sudden breakthrough of defenses, instead of exploiting the success, will try to consolidate on the line achieved or even return to the starting line.

The third direction is studying the effect of bio-emissions on command-and-control systems, communications systems, and armament, especially electronic equipment, and also the development of artificial bio-energy generators and plants for affecting enemy troops and population in order to create anomalous psychic conditions in them. The fourth and last direction includes developing systems for detecting and monitoring artificial and natural dangerous bio-emissions and also methods of active and passive protection against them.

In the opinion of "foreign scientists," the current level of development of physics, chemistry, and biology makes it possible to place the study of the bio-field on a scientific basis, which will help accomplish a number of important tasks of applied importance, including in the military field. Various sensors are used in experiments on bio-energy. They are able to register certain manifestations of the bio-field and transform them into electrical signals that are easily recorded by appropriate instruments, a large number of which have been developed recently. High-capacity computers are used to process the data. "American experts" have stated that they are close to solving the problem of controlling a person's ability to emit and receive bio-energy. The development of technical devices for detecting bio-emissions will continue in the United States in the 1990s, and studies of mathematical modeling of bio-energy interaction between people will develop further.

Today, there is evidence that parapsychological phenomena are real and can be controlled under certain circumstances. An attempt has been made to assess the military potential of such controllable parapsychological phenomena. Claims that psychotronic weapons already exist, although their capabilities have not yet been fully determined, are appearing more and more often in the "Western press."

Many "Western experts," including military analysts, assume that the country making the first decisive breakthrough in this field will gain a superiority over its enemy that is comparable only with the monopoly of nuclear weapons. In the future, these types of weapons may become the cause of illness or death of an object (person), and without any risk to the life of the operator (person emitting the command). Psychotronic weapons are silent, difficult to detect, and require the efforts of one or several operators as a source of power. Therefore, scientific and military circles abroad are very concerned over a possible "psychic invasion" and note the need to begin work on taking corresponding countermeasures.

"For the past twenty years our enterprise has specialized in manufacturing psychotronic devices for arms systems and control systems for intercontinental missiles and space vehicles," the deputy director of a Russian defense enterprise told the Moscow News weekly. Deputy director Martynov also said that his enterprise and another company, whose name he did not disclose, have begun to produce a physical amplifier (metathrone), Miranda, developed on the basis of fundamental achievements in the field of psychotronics.[86] The weekly then conducted independent research, which revealed that work indeed had been done at the plant to produce metathrones, which are regarded as a side branch of psychotronic weapons. Such devices have long been used in American industry to locate and establish the causes of any systemic failures. The weekly cites specialists as saying that "on September 24, 1990 an agreement was signed between the Central Intelligence Agency (CIA) of the United States and the KGB of the USSR on joint research in the field of psychotronics." The weekly said, however, that cooperation in this field has not developed.

Russian scientists note that experiments are being done in Russia in the sphere of directed non-contact electromagnetic fields in the SHF hydrogen bomb or chemical and bacteriological weapons. Psychotronic generators are capable of suppressing human willpower and imposing a criminal will. These weapons are continuing to be developed, tested on people, and improved.[87]

"Radio waves," the journal ZVO says, "can disrupt the brain and people's central nervous system. An infrasonic weapon, even at low power, is capable of generating

[86] " 'Psychotronic Devices' Developed For Military, Space," ITAR-TASS, 24 March 1994.

[87] Andrey Ivanov, "Intelligence Official Denies 'Psychotronic Weapon' Report," Rabochaya tribuna, 5 August 1994, p. 4.

an involuntary sense of fear and creating panic in a crowd...." The psychotronic effect is said to be the directed irradiation of people with electromagnetic fields from electronic equipment. This generates changes in their behavioral functions and their reactions to various kinds of events and situations, disrupts their functional systems, and brings about morphological changes in their cell tissue. Brick walls, concrete ceilings, wood, and other materials and structures can be "transparent" to electromagnetic radiation of a certain wavelength and strength.

The term "biological electronic device" (BED) has entered Russian military usage. It involves:

- A fifth-generation computer -- in other words, a computer which communicates in ordinary human language rather than in machine language;
- An artificial biological field generator;
- A bio-electronic transceiver;
- Electronic or SHF radiation sources; and
- A holographic laser.

Research has shown that a BED is capable of sensing the specifics of biological radiation from diseased human organs, of influencing the physical and chemical processes taking place within the organism, and of revealing the connections between the cortex and subcortex of the brain,. A BED detects a diseased organ, receives its signal, boosts it many times over, and creates a field of the given type of radiation with a large effective range. A BED as it were lifts human biofield imprints. Each person has their own "fingerprint," which can be recorded in a computer. And each person can be identified even from part of this "fingerprint."

It is particularly easy to identify people with diseased organs, and even easier if they have a number of diseased organs which together provide certain pain reactions in the shape of frequency characteristics. Identification can even be done over incredibly long distances by using a telephone, TV, or radio communications system in conjunction with a satellite system for transmitting the data with the help of extrasensory influence. This, for instance, is how an electronic fingerprint differs from the physical variety, which requires the person in question to be arrested. It is this BED capability that makes it possible to develop systems to carry out a search for people with certain radio-wave frequencies.

But the psychotronic device with the greatest applications at the moment is the electronic monitoring device. The baggage examination machine at airports is quite a close analogy. Without opening a suitcase the controller can see everything inside. The principle is based on illuminating the suitcase with electromagnetic waves of a certain band and transforming the reflected signal into a visual display. An apartment, home, office, district, or street could become just such a "suitcase." The force of the impact on the organism is comparable to exposure to radioactivity. The same kind of structure as is used in the baggage examination device is used for this "illumination." There is a radiation generator, a receiver, and a device to transform the reflected signals. A generator designed for a single apartment or office would be the size of a tape recorder, and the radiation source could be an electrical fitting, wiring, or heating or water pipes. The VHF receiver could be an incandescent lamp or a telephone wire.

There was once a great deal of talk about the "radioson" hypnoradiation source. This device is capable of putting people to sleep from a long distance away. But this is far from its entire range. It can also be lethal -- causing cell degeneration, cancer, radiculitis, and paralysis. It is just a question of the exposure time and the density of the waves directed at the target.

Here the Russians include infrasonic acoustic devices. The principle of their operation lies in the fact that, for example, special acoustic emitters near a group of hostages and terrorists are used to create a powerful field of infrasonic frequencies that are inaudible to the human ear, but are sensed well by its body and cerebrum. If the terrorists lose self-control as a result, individual means of pressure can be used. But infrasonic acoustic devices are very complex and cumbersome systems, though working to improve them can be of benefit in fighting terrorism.[88] For the present there are preconditions for creating quite effective physiological weapons. Their use should lead to a temporary, but completely restorable disturbance of certain physiological functions of the human organism which can also sharply reduce the activities of terrorists.

Admiral V.S. Pirumov, science advisor to President Yel'tsin, notes that a threat which usually is ignored, but which can be either local or global, is the possibility of mass or individual altered states of consciousness (ASC) in the society or within separate territories and projects (launching sites, nuclear plants, etc.). ASC can be initiated globally through mass media or with special technological and pharmacological methods and locally through "acts of terrorism." The threat in

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[88] Interview with Vladimir Alekseyevich Vasilyev, "If Budennovsk Were Abroad.... (Foreign Trends and Experience in Combating Terrorism)," Granitsa Rossii (hereafter cited as GR), July 1995, No. 25, pp. 12-13.

question acquires special importance due to the "economization" of warfare -- reversible defeat is more profitable.[89]

Lately the term "psychotronic weapon" has come into usage, he notes, meaning the use of parapsychological phenomena and generators of so-called psifields (whose nature is still obscure) to disturb the actions of the enemy's manpower to provoke ASC and even lethal result, and to get information about the enemy using non-traditional methods. Non-interceptible communication channels can also be organized in this way. However, the reproducibility of parapsychological phenomena is too low to use them in practice, to say nothing of global usage. As to psifield generators, they affect individuals of neurotic type, specially prepared before the experiment.

Meanwhile, there are means and methods, which do not seem to be concerned with military systems, that can be used both in combination and individually to induce ASC, including mass ASC. When used in combination, the efficiency of parapsychological phenomena is increased; in fact, occasionally they can become an important means of human destruction. The threat is evident when (even) individual ASC are induced in the personnel of anti-aircraft systems, nuclear plants, etc. Pirumov has delineated the factors which contribute to initiate and control ASC (the division used is conventional, since many ASC can manifest themselves in two or even three of the roles).

Contributing "physical" factors include:

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[89] V.S. Pirumov, et al., Problems of Regional and Global Security at the End of the 20th and Beginning of the 21st Centuries (AVIAR: Moscow, 1993).

- *Natural.* These are solar activity, seismic activity, the state of the ionosphere, geophysical and geochemical factors (e.g. zones of active fracture), meteorological phenomena, etc. These factors can promote ASC by influencing the central nervous system directly or indirectly. Thus, zones of active fracture promote ASC due to electromagnetic effects (high gradient values, seismoelectric effect), released gaseous organic and inorganic compounds, noble gases, and atomic metals (Hg, Rn, hydrocarbons). The above effects make a considerable contribution to the occurrence of ASC and, if above normal, can themselves cause hallucinations and other kinds of ASC.

- *Antropogenic.* These are the consequences of meteorological and seismic warfare, low-frequency radiation of the ionosphere due to demodulation when heated by artificial sources of modulated SHF radiation, powerful radio station areas, range coverage, modulated neutrino flows (there are efforts to use the latter for submarine communication and navigation systems), etc.

- Factors initiating ASC are:
  - mass poisoning by psychedelic preparations
  - prolonged exposure of territories to complex modulated low power EMF (from sputniks or special stations)
  - use of methods of unconscious information input through mass media
  - use of neurolinguistic programming methods through mass media
  - introducing initiators of ASC into society, etc.

On the one hand, the danger of the threat discussed is evident; on the other hand, the society has to be prepared to a certain extent -- it is in this case that the mechanism of distant interaction of individuals will work and psychic epidemics will begin. This threat is most dangerous for underdeveloped peoples and communities of the "stone-age level" and, strange as it might seem, for highly developed associations where the social factors, environmental effects (especially those induced artificially), and the use of new techniques of ASC production, all taken together, contribute to their high vulnerability to the threat in question, which is economically profitable for an aggressor.

Mass ASC can be triggered by the mechanism of interaction of ASC individuals in the society. Thus, the mechanisms of interactive alteration of SC would be most efficient under conditions of an artificial or natural alteration of the environment by factors such as earthquakes (seismic warfare), bright meteorological phenomena (meteorological warfare), alterations of the electromagnetic background (both natural and artificial) combined with external psychic influence through mass media, threats (beginning of military operations), and artificial creation of ASC hotbeds.

Thus, the occurrence of "psychic epidemics" triggered by a combination of a number of methods of disrupting the environment and of affecting the human mind seems to be the most probable way. This whole complex can be called "psychotronic weapon," taking into account the fact that this term itself is semantically "empty" and does not emphasize parapsychological phenomena which might play a merely subsidiary part in the complex overall pressure on the society.

The danger of this threat, albeit realizable by different means, is promoted by the following processes in many developed and underdeveloped countries:

- the use of neurolinguistic programming methods and other ways of unconscious information input in mass advertising and pre-election campaigns
- an increase in the number of individuals who experience ASC regularly as a result of drug-taking, participating in mystical rituals, and psychotherapeutic treatment

- involving masses of people in collective ASC during collective sermons with healing, TV hypnotic seances and mass hypnotherapy, collective meditations in sects (the latter are particularly dangerous as they involve a (not always positive) parallel programming of behavior/state).

Considering the obscurity of the mechanisms of the phenomena in question, the availability of empirical information pointing to their existence, the great danger involved in their employment (which is due to the difficulties in controlling them, forecasting their consequences, and resisting them), as well as the interdisciplinary aspect of the problem, it is proposed to form an international advisory board on "psychotronic weapons" based on the Geopolicy and Security Section of the Russian Academy of Natural Sciences.

The Board is to work out suggestions and recommendations dealing with the foundation of an international center for the theoretical and experimental investigation of the problem of "psychotronic weapons" as well as methods of their limitation and control. Current Russian RDT&E of psychotronic weapons is conducted largely at the Center for Psychotronics under the direction of Eduard Naumov.

VI. ROLE OF SPACE

SPACE AND FUTURE WAR

Like its Soviet predecessor, the Russian military argues that outer space must be viewed as a potential theater of military actions (TVD). The Persian Gulf operation showed the heightened role and importance of supporting military space systems (communications, navigation, reconnaissance, missile launch warning, and so on). At the same time the nature of threats from space is being revised in connection with the appearance in a number of developing countries of the capability of inserting objects into space for support purposes.[90]

Russian military spokesmen have repeatedly warned that the militarization of outer space requires responsive measures. It is presently impossible, they argue, to ignore that the emphasis of warfare may be shifted, or already is shifting, into outer space. The United States is said to be striving to achieve supremacy in space, for space means reconnaissance, communications, command and control, target designation, tactical satellite and space systems, as well as the opportunity to exert influence with these weapons. But according to the Russians, their own scientists and economy are capable of creating corresponding systems and countersystems. A need has matured for Russia to have its own space forces to oppose the enemy, to create ABM systems,

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[90] For example, see Captain 1st Rank V.M. Golitsin, "Foreign Military Doctrines," VM 7 (1992, Special Edition): 14-20.

and to conduct space surveillance. It is necessary, they argue, to prepare for space warfare.[91]

The Military Space Forces (MSF) were formed in August 1992 as a centrally subordinated combat arm on the basis of space forces and fires of the Russian Federation Defense Ministry. According to Colonel-General V.L. Ivanov, then CINC of the MSF, their creation was a manifestation of the objective process whereby the use of space forces has an ever-increasing influence on preparations for and the conduct of armed operations. The MSF make it possible to significantly raise the level of utilizing available combat potential, and also provide the possibility of organizing them according to modern requirements for timely strategic deterrence, a high level of combat readiness to immediately repel aggression, promptness and reliability of combat command at all levels, the wide-scale use of high-precision weapons during combat operations, mobility, and constant readiness to use the forces at any strategic sector.[92]

The following factors have exercised significant influence on the development of the MSF:

- The threat posed by local wars and military conflicts that has escalated against the background of the decreasing likelihood of a nuclear world war, primarily in areas adjacent to the borders of the Russian Federation. This is why the timely detection of military preparations by a potential enemy and

[91] For example, see Colonel-General V. Ya. Abolins, "Certain Problems of Preparing the Country and the Russian Armed Forces to Repel Aggression," VM, No. 7, 1992 (Special Edition), pp. 84-92.

[92] Colonel-General V. L. Ivanov, "Military Space Forces: Prospects For And Problems of Organization," VM, No. 9, 1993, pp. 2-8.

the prompt discovery of the time when aggression is launched has acquired particular importance;

- A substantial decline in the level of nuclear weapons -- which are still relied upon as the main factor of strategic stability -- which increases the importance of space equipment that ensures the warning about a missile attack, combat command and communication, and the increase in efficiency and reliability of the nuclear deterrence forces;

- Cuts in the strength of the Armed Forces and in defense appropriations. This increases the importance of weapons incorporating to the highest extent possible the achievements of modern science and technology, so that they are capable of functioning automatically with enhanced survivability and a high degree of economic efficiency, drawing on spinoffs from the development and utilization of dual-purpose technologies; and

- The increasing number of states with high scientific-technological and economic potentials that actively assimilate outer space in their national interests (presently a total of 21 countries), as well as stepped-up efforts by the leading states to develop state-of-the-art space weapons and elements of missile and space technology. Russia faces a real threat to lose its leading position in the assimilation of space and, as a result, its influence on the strategic stability in the world may decline.

The capabilities of space systems and their high efficiency were convincingly demonstrated during the Gulf War. They made it possible to tear the Iraqi defense system open well in advance, to ensure operational control over the movements of troops, to conduct reconnaissance, to obtain precise coordinates of the key military and industrial facilities, and to coordinate the use of diverse fire means for the purpose of an assured destruction of point targets.

The aforementioned circumstances are yet additional proof that giving priority to the development of space systems serves the best interests of Russia's national security and military policy. The existence of a space component in the structure of the Armed Forces makes a significant contribution to the successful performance of their basic missions. Moreover, space systems make it possible to find qualitatively new ways (compared with the use of ground systems) to resolve emerging problems -- for instance to fully offset the weakening of the Russian military's combat capabilities owing to the loss of a number of ground missile-attack warning and outer space control stations as well as elements of radio-navigation systems.

Ivanov stresses that currently, deterring a surprise attack has taken on vital importance. Space systems are equipped to exercise continuous worldwide control over military preparations in the most effective fashion, to promptly detect incidents of an enemy space-missile attack, and to ensure prompt transmission of warning and command signals. In addition, space systems for surveillance and target location; communication and combat command; navigation, topogeodesic, and hydrometeorological support systems enable the army and the navy to operate effectively without being tied to the formerly created ground infrastructure facilities. The combined utilization of space systems and high-precision weapons opens up a path toward creating reconnaissance-strike complexes and various-purpose systems.

A characteristic feature of the MSF is not only that they constantly remain on alert status, but that they daily carry out complex missions related to preparing delivery vehicles with space vehicles (SV) for launching and exercising control over orbital groups. These functions have been performed by launching and control troops. In 1992 alone, they helped launch 55 delivery vehicles, and established communication with SV on the orbit several hundreds times a day.

According to General-Major V.G. Bezborodov, it has been proved that upgrading orbital systems and equipment as well as the forms and methods of their employment increases the operational efficiency of troops and naval forces by 1.5-2 times. In many instances, space complexes have become simply irreplaceable. Today they act as a powerful factor for stabilizing the international situation and deterring aggression. They are used to monitor fulfillment of international treaties and obligations for the limitation of strategic and conventional arms and to establish "hot" lines of inter-governmental communications. And from them comes the most up-to-date information on early signs of practical preparation for military operations, on launches of booster rockets or tests of live ballistic missiles, and on the appearance of dangerous situations in near-earth space. Data will come from orbit about preparation for a first attack in or from space and about the beginning of a nuclear-missile first strike.[93]

Just what is the advantage of space systems over traditional (air-, sea-, and ground-based) ones? It is linked above all with their globality and promptness, which enables receipt (or communication) of any necessary data at any point on the globe continuously (or with requisite periodicity). Orbital equipment already is being tested that is capable of performing combat missions independently (ABM defense and anti-satellite warfare, for example).

[93] General-Major Vyacheslav Georgiyevich Bezborodov, "Competition in Orbit: It is Becoming Increasingly Fierce and Creating a Real Threat to Russia's National Interests," AS, No. 12, 1995, pp. 20-23.

How the correlation of forces of opposing sides can change was shown by Persian Gulf events. Iraq's entire defense system was uncovered in advance, precise coordinates of the most important installations were received, and troop redeployments were constantly monitored from space. The use of satellite data for reconnaissance, target designations, navigation, and other missions facilitated the destruction of small targets (with revealing signs down to tens of centimeters) from hundreds of kilometers away, discerning the type and number of tanks and determining whether a transport vehicle was carrying people or ammunition. As a result, the employment of heterogeneous weapons managed to be coordinated for massive engagement of area and point targets.

Small, portable (weighing 11 kg) and mobile space communications stations and digital terrain maps were employed widely for the first time. By using Navstar navigation system pocket receivers (weighing 1.3 kg), soldiers of the multinational forces could determine their coordinates at any moment with an accuracy of 25 m (in the desert!). Only prompt satellite data (coming practically in real time) on the launches of Iraqi Scud ballistic missiles permitted the Americans to intercept them with the Patriot SAM system. The effectiveness and scope of utilizing space systems were so great that the "U.S. military leadership" called this war "the first space war or first war of the space era."

Colossal attention, say the Russians, is given to the operational preparation of near-earth space, which is considered a most important sphere of military confrontation. The main elements of such preparation are the creation and deployment of reconnaissance, communications, battle management, and navigation systems in support of all branches and combat arms, including space forces. Work continues on orbital ABM defense, on anti-satellite and electronic warfare systems, and on the increased survivability and resistance of the systems being operated.

According to Y.M. Baturin, then secretary of the Defense Council, missile and space equipment is so unique and intrinsically valuable that it cannot be viewed as something secondary. Moreover, the skilled use of space forces and assets can now increase the effectiveness of operations of different branches and combat arms by 2-3 times. In the final account it is not so important for the country's security specifically who is capable of neutralizing an attacker; the main thing is how and with what this is achieved. Suffice it to say that the use of space technologies increases the number of targets engaged (neutralized) and simultaneously reduces friendly losses by several times. And the very presence of such technologies embodied in modern orbiting systems and equipment serves as a deterring factor. In this context it is difficult to overestimate the role of the Military Space Forces and Strategic Missile troops.[94] It is Russian space capabilities, he claims (plus a number of other S&T achievements), that will permit Russia to retain great-power status.

In late 1996, Ivanov noted that in the near future new generations of space systems together with computer technologies will radically alter the planning and command and control of all combat operations at any point on earth, be it on land, on sea, or in the air. Preparing initial firing data; determining the sphere of permissible and preferable decisions; assigning combat missions to individual units and subunits and to

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[94] Interview with Yuriy Mikhaylovich Baturin, "Space is One of Our Priorities," AS, No. 4, 1996, pp. 17-19.

crews of aircraft, ships, and submarines and adjusting them as they are being executed; obtaining data on results of combat operations of any scale; and so on will become possible in so-called real time.[95]

The steady reduction in the time of collecting, processing, and delivering space data to immediate users, bypassing intermediate levels, can serve as proof. There already are experimental models of small, mobile equipment (portable ones also are needed) which combine the functions of receiving, processing, and communicating data. Outfitting a tank, aircraft, ship, automatic precision-weapon delivery vehicle and, finally, the individual serviceman with such user equipment will permit maintaining two-way communications, determining one's position with high accuracy, exercising command and control, and even giving assistance at any point in time. And the weight of such equipment for the soldier will be less than 300 grams. The S&T backlog that has been created and results that have been obtained as of the present time confirm the possibility of achieving the cited reference points.

Thus, the priority development of space systems is a vital and decisive condition for the effectiveness of the basic principles of Russia's military doctrine. According to expert estimates, the aforementioned systems -- which have entered the routine life of the army and the navy, may increase the effectiveness of their utilization between 1.5-fold and two-fold.

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[95] Interview with Air-Space Forces Commander Colonel-General Vladimir Leontyevich Ivanov by Armeyskiy sbornik correspondent Lieutenant-Colonel Anatoliy Bukharin, "We Are Standing and Will Stand on That," AS, No. 10, 1996, pp. 2-6.

SPACE MISSIONS

According to Russian military scientists, the scientific-technical potential accumulated by the United States will allow it to deploy orbital groupings by the beginning of the year 2000 capable of the following: effectively combatting strategic missiles in flight and if necessary sealing off outer space; "seizing" the most important spheres of near-earth space; and delivering strikes from space with precision weapons or new-generation mass-destruction weapons against ground, sea, and airborne targets in order to "deter enemy attacks" and also "reinforce operations of U.S. and allied forces."[96]

Conditions will also be created for conducting real-time (at any time of day), all-weather scanning and highly detailed reconnaissance from space and navigational, meteorological, and other kinds of support to Army and Navy forces and to ground-, sea-, air-, and space-based weapons systems. Command-and-control entities are being supported by space communications and relay channels even at the present time.

Under certain conditions the basic forms of military operations in near-earth space can be the following: operations to destroy strategic nuclear (or conventional) weapons in flight and to seal off outer space; strikes from space against ground, sea, and airborne targets; operations to defeat orbital and ground space groupings and to seize and hold strategically (operationally) important spheres of near-earth space; and operations to suppress radio-technical equipment of orbital and ground groupings of

[96] For example, see General-Major M.A. Borchev, "On the CIS Military Organization," VM, No. 3 1993, pp. 2-10.

space units. Military space operations can acquire operational or strategic significance depending on the scope of warfare and the forces and assets used in operations.

In the Russian view, an increased dependence of success in military operations on land, at sea, and in the air-space on the degree of effectiveness and stability of orbital groupings will be typical of conventional warfare. Precision weapon strikes against ecologically dangerous targets located in any region of the globe can produce the effect of using nuclear weapons or toxic chemical agents. In addition, strikes can be delivered from outer space by "supernew weapons of mass destruction capable of paralyzing the command and control of a state or coalition of states and groupings of its (their) armed forces for a certain period of time, or attaining a mass effect on the country's population without destroying installations and the environment."

The increased power, accuracy, and swiftness of strikes against enemy forces as well as the struggle for superiority in the air-space above ocean and sea areas will be typical of military operations at sea. All-weather space reconnaissance and other kinds of space support will permit detecting the heading and speed of weapons, surface ships, and submarines at any time of day with high probability and providing precision weapons systems with data for essentially real-time engagement. The importance of maneuver and concealment increases under these conditions, and submarines are forced to operate at a great depth. In the future, missions of delivering strikes against naval targets also can be accomplished from space.

According to Colonel-General Ivanov, the Military Space Forces as a whole have performed their assigned missions despite exceptionally difficult conditions. For example, over 50 booster rockets were launched and 65 spacecraft were inserted into operational orbits for various purposes in 1994. The orbital grouping deployed in space functions normally and successfully performs the missions of missile-attack warning, reconnaissance, communications, battle management, navigation, and meteorological and topogeodetic support. A large amount of work also has been done in support of the national economy, science, and international cooperation.[97]

The soldiers and civilian personnel of the Plesetsk and Baykonur space launch facilities and of the Main Center for Tests and Control of Space Assets also accomplished their missions. They supported tests of advanced military, scientific, and national economic spacecraft. Russia has succeeded not only in keeping its space potential at the previous level, but also in building it up in a number of directions. It is especially important, said Ivanov, to note the placement of the GLONASS global navigation satellite system into operation, which permits users to determine their coordinates at any point on the globe with great accuracy. The development of other fundamentally new space complexes also is nearing completion. On the whole, the Russians view this work as a very important part of the plan for implementing Russian Federation military doctrine -- which envisages the establishment of qualitatively new Armed Forces outfitted with the most modern weapons.

Measures for joint use of GLONASS and the U.S. NAVSTAR system similar to it are being carried out within the framework of international cooperation in the space field. A corresponding draft agreement has been prepared at the Russian and

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[97] Colonel-General Vladimir Ivanov, "Training Year Results: Reflections, Analysis, Experience: Earthly Concerns of Space Toilers," AS, No. 1, 1995, pp. 28-29.

U.S. government level, but the performance of missions in support of national defense using space assets cannot depend on other states, even those friendly to us. Therefore great attention has been given to developing a space infrastructure on Russian territory. It is common knowledge that on 11 November 1994 Yel'tsin signed the edict establishing the Plesetsk space launch facility. A draft edict also has been prepared on performing top-priority work to construct the Svobodnyy space launch facility in the Far East. It is needed for a phased transition from Baykonur to Russian territory of launches of all types of booster rockets. The Russians are convinced that the Svobodnyy space launch facility constitutes their space future.

The decisions made by Yel'tsin, the Government, and the Russian Federation Ministry of Defense leadership basically solved the problem of Russia's use of Baykonur. Its legal status has been determined unequivocally. An agreement signed on 28 March 1994 by the presidents of Russia and Kazakhstan provides that the Russian contingent of Military Space Forces shall support the functioning of the space launch center, that Russian Federation laws shall be in effect on its grounds, that the head of the administration of the city of Leninsk shall be appointed by Russia, and that the entire Baykonur complex shall be transferred to the Russian Federation on a twenty-year lease.

The ground grouping of spacecraft control forces has continued to be built up. This has compensated for the loss of a number of command-and-control facilities in Kazakhstan, Uzbekistan, and Ukraine. Now control of all spacecraft is exercised only from Russian territory. The Russians consider this development to be extremely important for their conduct of an independent space policy.

The Military Space Forces will have to perform even more difficult and important missions in the future. According to the booster rocket launch plan, the Russians envision increasing their number by 1.5 times. Reliable, stable control of orbital groupings must be provided in support of the Russian Federation Armed Forces and other ministries and departments. Russia needs guaranteed access to outer space, above all through development of the Plesetsk space launch facility and creation of the Svobodnyy space launch facility. The Military Space Forces will continue to be reformed as a combat arm of central subordination and their table of organization will continue to be upgraded. In the Russian view, it is vitally important to improve their coordination with other branches of the Armed Forces and to elevate the effectiveness of using space data.

Russian general officers stress that an active process is under way in Russia today, as in other leading world countries, of developing and establishing a new system of views on ensuring national security. Taken into account here are changes in the military-political situation, in the level of development of military theory/ practice, and in the means of warfare -- particularly space assets, whose role in supporting military operations (both in peacetime as well as wartime) is growing steadily. This is explained on the one hand by the specific nature of outer space. Its exterritoriality and globality facilitate constant surveillance of all areas of the earth's surface, water areas, air space, and outer space; supporting continuous communications among users (including with submarines) regardless of their location; and using space assets in support of various troop elements (right down to the individual soldier supplied with "pocket" -format communications and navigation gear). It is explained on the other hand by the sharply increased potential of space systems, whose use does not simply increase the effectiveness of operations of troops and naval forces, but in many cases also predetermines success of the mission. The course and outcome of the Persian Gulf War can serve as persuasive proof.[98]

Thus, the U.S. supreme military-political leadership and the multinational forces (MNF) command element used intelligence received from satellites for decision-making. It also was taken into account in developing specific combat operations plans, selecting point targets, and guiding individual bombers and cruise missiles to them. Approximately 80 percent of the most important targets were hit specifically in that way. Data coming from IMEWS spacecraft warned allied troops about an attack by Iraqi operational-tactical missiles and issued target designations on them to Patriot missile complexes. The effectiveness of intercepting operational-tactical missiles reached 90 percent as a result -- and such an intercept was conducted for the first time under combat conditions.

According to the current Russian civil-military consensus, the effective performance of missions by the Russian Armed Forces is inconceivable today without the development and use of space forces and assets, above all strategic missile-attack warning systems, reconnaissance systems, battle management and communications systems, navigational systems, and so on. The missions of deterring an aggressor in space and from space, reconnoitering the space situation, providing comprehensive information support to operations of the Mobile Forces, and so on may become the main missions of the Military Space Forces in the future.

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[98] General-Lieutenant Stanislav Yermak, "The Hour of Cosmonautics Has Struck," AS, No. 2, 1995, pp. 14-17.

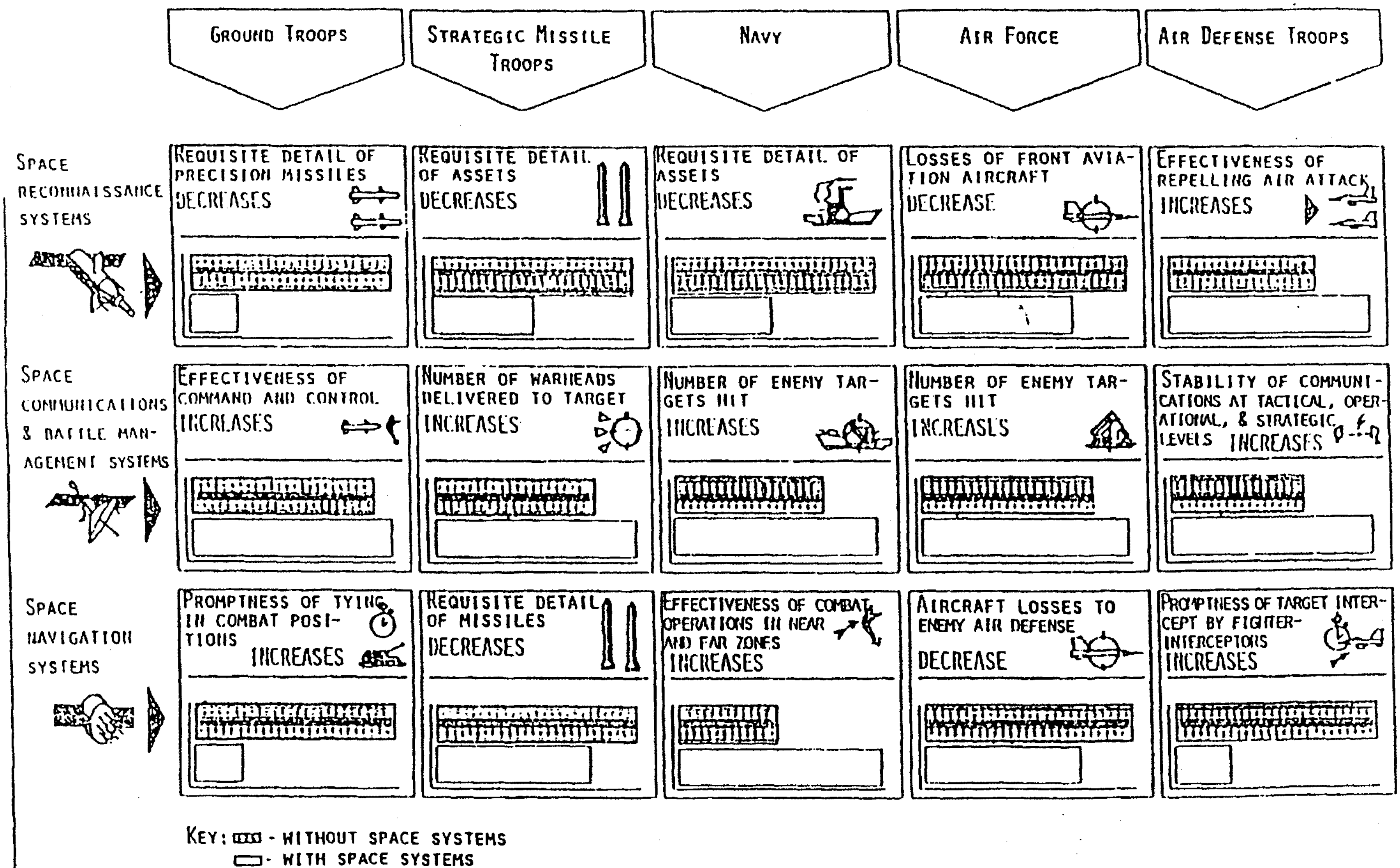
Modern combat operations presume integrated fire damage of targets with precision weapons, employment of mobile force elements, great depth of active influence on the enemy, a rapid transfer of the efforts of attack groupings, and their presence in considerable isolation from the main body and on territories not prepared in an operational sense. As shown by the experience of field training exercises and military conflicts, traditional means of reconnaissance and other kinds of support turn out to be insufficiently effective under such conditions.

In the assessments of independent experts, during the preparation of a first massed fire strike tactical reconnaissance is capable of discovering only around 20 percent of targets subject to destruction. Very important enemy targets remain undetected: reconnaissance-strike complexes, means of nuclear attack, and command-and-control facilities and centers. In addition, aiming errors can reach 70 percent in preparing artillery and missile systems for use on unprepared territories. As a result, ammunition expenditure unjustifiably increases (up to 30 percent), an additional detail of weapons and reconnaissance assets (up to 20 percent) is used, and the time they are present at combat positions also increases.

Under conditions of rigid time and other constraints characteristic of operations by mobile forces, conventional communications equipment also does not fully meet the requirements placed on it for promptness of deployment, reliability, anti-jam protection, traffic capacity, and global nature of coverage. But the advantages of space systems and complexes -- promptness, precision, reliability, sufficiency of data and globality -- permit them to become the basis for comprehensive support of present armies, and above all of future armies.

Specifically how is the contribution of space to an increase in combat effectiveness characterized? Above all by a significant decrease in forces and assets required for performing combat missions, by increased stability of communications and reliability of command and control, and by other indicators (see Figure 10). The effectiveness of command and control of strategic nuclear forces can be increased by 60-80 percent (depending on conditions of their employment) through orbital communications complexes. Using space reconnaissance assets it is possible to observe essentially the entire earth's surface and also to collect approximately 20 percent of intelligence needed by the Navy. The advanced space navigation system is capable not only of enabling users to make a prompt, precise determination of their position, but also of detecting and fixing nuclear bursts and transmitting centralized battle management signals. And how can one obtain hydrometeorological data (on cloud cover, precipitation, condition and temperature of underlying surface, wind velocity and direction) over enemy territory without space systems? An absence of this data sharply degrades the effectiveness of employing the newest artillery, missile, and tactical and operational-tactical airborne complexes.

Based on their assessment of the consequences of using space systems for military purposes, the Russians assert that states which have achieved superiority in space also will gain advantages in other spheres of potential opposition. It is obvious that this is what prompts leading world countries to concentrate efforts on applied military space research. Their result may be the creation of a "critical mass" of technologies, which will lead to the appearance of qualitatively new space warfare capabilities.



GROUND TROOPS
STRATEGIC MISSILE TROOPS
NAVY
AIR FORCE
AIR DEFENSE TROOPS
SPACE RECONNAISSANCE SYSTEMS
REQUISITE DETAIL OF PRECISION MISSILES DECREASES
REQUISITE DETAIL OF ASSETS DECREASES
REQUISITE DETAIL OF ASSETS DECREASES
LOSSES OF FRONT AVIATION AIRCRAFT DECREASE
EFFECTIVENESS OF REPELLING AIR ATTACK INCREASES
SPACE COMMUNICATIONS & BATTLE MANAGEMENT SYSTEMS
EFFECTIVENESS OF COMMAND AND CONTROL INCREASES
NUMBER OF WARHEADS DELIVERED TO TARGET INCREASES
NUMBER OF ENEMY TARGETS HIT INCREASES
NUMBER OF ENEMY TARGETS HIT INCREASES
STABILITY OF COMMUNICATIONS AT TACTICAL, OPERATIONAL, & STRATEGIC LEVELS INCREASES
SPACE NAVIGATION SYSTEMS
PROMPTNESS OF TYING IN COMBAT POSITIONS INCREASES
REQUISITE DETAIL OF MISSILES DECREASES
EFFECTIVENESS OF COMBAT OPERATIONS IN NEAR AND FAR ZONES INCREASES
AIRCRAFT LOSSES TO ENEMY AIR DEFENSE DECREASE
PROMPTNESS OF TARGET INTERCEPT BY FIGHTER-INTERCEPTORS INCREASES
KEY: - WITHOUT SPACE SYSTEMS
- WITH SPACE SYSTEMS

FIG 10

SPACE ORGANIZATIONAL ADAPTATIONS

According to Colonel-General Ivanov, then CINC of the MSF, these forces have a unique infrastructure at their disposal that was created to fulfill the requirements for promptness, globality, and reliability of the command of space vehicles in peacetime and wartime; for precision in determining the parameters of space vehicle orbits; and for precision in allocating land for the fall of detachable parts of space missiles. The elements designed to maintain, launch, and control space vehicles are located mostly on Russian territory.[99]

The organization of the Military Space Forces is being carried out in a phased fashion. In the first stage (1992) the organization of the Military Space Forces as a centrally subordinated combat arm was completed, their functions were finalized, the fundamentals of their organization were devised, and an action plan to maintain and to develop a space infrastructure was drawn up.

In the second stage (1993-1995) the Russians planned to create the requisite conditions for the guaranteed protection of Russia's interests in space, to continue the modernization of a space infrastructure, to ensure the creation of a qualitatively new generation of general-purpose space systems, to bring the MSF table of personnel and equipment into line with their missions, and to improve coordination with the other combat arms and services.

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[99] Ivanov, "Military Space Forces," op. cit.

In the third stage (up to the year 2000) the Russians plan to equip the troops with promising space systems and to upgrade Russia's space infrastructure, to ensure that missions entrusted to the Military Space Forces are fully executed, and to complete the centralization of command and control over military space activity in the Russian Federation.

When implementing the aforementioned plans, primary importance will be attached to the technical improvement of space weapons: increasing the active life and autonomy of space vehicles, improving the qualitative performance and technical characteristics of onboard equipment and its components, switching to a new element base, modifying delivery vehicles, increasing the capabilities of command-and-control equipment and its standardization, and improving the reliability and performance characteristics of space systems.

One of the key areas of the organization of the Military Space Forces is the modernization of command-and-control systems. The Russians plan to set up a system of command-and-control posts at various levels, as well as specialized centers and posts to control space vehicles, to improve the communication system, and to switch to promising space control technologies. Efforts to enhance the survivability of ground and orbital groups and to improve the operational, technical, and rear services support for the utilization of the Military Space Forces will also have an important role to play.

Russian military experts note that the loss of an entire range of installations of the Russian space forces in the wake of the breakup of the Soviet Union called for new, unconventional moves to ensure control over spacecraft. Despite considerable financial difficulties, the command of the Russian space forces has succeeded in ensuring reliable control over groups of satellites designed for a variety of purposes and maintaining the necessary infrastructure.[100]

Only two countries in the world -- the United States and Russia -- have a developed infrastructure for operating systems in space. The Russian Defense Ministry has reshuffled all available resources and compressed research and development projects to ensure the provision of the latest technologies to the space forces.

The space forces closely collaborate with the Russian space agency, leading enterprises, the state committee for the industry, and the Communications Ministry. One result of their close cooperation is the full-scale functioning of the global satellite navigational system Glonass, which is superior to the U.S. system Navstar in a number of respects.

According to Chief of the General Staff A. Kvashnin, the Military Space Forces have the appropriate structure for performing their assigned missions. They include above all space units of the Plesetsk Range (city of Mirnyy, Arkhangel'sk Oblast) and the Baykonur Space Launch Center (Republic of Kazakhstan). Training is conducted and spacecraft for various purposes are launched here. Only at Baykonur Space Launch Center are launch complexes built for heavy booster rockets, which insert spacecraft into a geosynchronous orbit. One other large command is the Main Center for Testing and Control of Space Assets (Golitsyno-2). Subordinate to it are fixed space command,

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[100] Vadim Byrkin, "Kokoshin Speaks at Conference on State of Space Forces," ITAR-TASS, 15 October 1993.

control, and telemetry complexes scattered throughout the territory of Russia from St. Petersburg in the West to Petropavlovsk-Kamchatskiy in the East; and also vessels of the floating space command, control, and telemetry complex. Military Space Forces also include the Ministry of Defense Central Scientific Research Institute of Space Assets and the A. F. Mozhayskiy Military Space Engineering Academy (St. Petersburg).[101]

The Military Space Forces have a ground infrastructure unique in its technical outfitting; it includes computer centers outfitted with modern equipment; complexes of radiotechnical equipment for controlling onboard gear and receiving telemetry data from spacecraft; and equipment for measuring orbital parameters and for communications, television, and optical observation.

The Plesetsk Range and Baykonur Space Launch Center are very complex economic organizations supporting the receipt, storage, technical servicing, and testing of booster rockets and spacecraft before launch and during the launch itself. A broad network of railroads and highways; storage areas for booster rockets, spacecraft, and missile fuel components; an oxygen-nitrogen plant; fueling stations; installation and test wings; and launch complexes have been created for these purposes.

SPACE PROGRAMS/FUNDING

The development of proposals for the immediate support of Russia's space sector indirectly confirms the strategic line of Russia's political leadership, which is geared to

[101] General-Lieutenant Anatoliy Kvashnin, "Military Space Forces (This Means Not Only Secret Orbits; It Means Russia's World Priority)," KZ, 6 August 1994, p. 3.

ensuring the technological and engineering autarky of the national space industry and the independence of its enterprises in the CIS countries. The enterprises of Russian's rocket and space industry which will be allocated priority credit include:[102]

- Khrunevich GK NPTs
- Samara Progress Plant
- Frunze SMO
- Perm Motor Stock Company
- Voronezh Machinery Plant
- Energomash Research and Production Organization
- Energiya Research and Production Organization

According to Russian military experts, the Russian Government plans to drastically revamp the space industry sector. In late 1993, Viktor Chernomyrdin signed the decree "On State Support for and Provision of Space Activity in Russia: The Russian Federal Space Program for the Period up to the Year 2000:[103]

- **Telecommunications, information exchange, and navigation systems.** The Russians plan to increase the number of telephone channels 20 times and to cover Russia's entire territory by multichannel television by the year 2000 by carrying out 8 state projects and 11 programs with mixed financing.

- **Remote-control sounding of the earth.** The Russians plan to increase the period of warning about natural disasters to 24 hours. In addition, the period of meteorological accuracy will reach 10 days (instead of the current 3).

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[102] Nikolay Podlipskiy and Ilya Bulavinov, "State Support for Space Industry: The Leaders of the National Rocket Industry Have Been Determined," Kommersant daily (hereafter cited as KD), 6 November 1993, p. 2.

[103] Nikolay Podlipskiy, "Space Program Adopted. The Russian Government Approves Seven-Year Space Research Plan," KD, 17 December 1993, p. 3.

- **Space technology development.** The Russians plan to organize semi-industrial production of semiconductor monocrystals and super-pure proteins.

- **Manned space flights.** The Russians plan to operate the "Mir" orbital station until 1997. They also plan to launch two scientific modules. After the station reaches the limit of its life in orbit, manned flights will take place within the framework of the project for creating the "Alpha" international station.

- **Spacecraft delivery vehicles.** The Russians plan to modernize the "Proton" carrier rocket with a view to increasing the effectiveness of its guidance system and minimizing the hazardous effects of carrier rocket launches. In addition, they plan to create the "Rus" rocket and to design the "Energiya M" rocket on the basis of the "Soyuz" carrier rocket.

- **Fundamental research.** The Russians plan to carry out a program for researching Mars, to conduct astrophysical research according to the "Spektr" program, and to research the sun.

- **Multiple-use space systems.** The Russians plan to create the requisite materials and equipment for this kind of spacecraft. No utilization of the "Buran" system is foreseen.

- **Space center development program.** This program calls for the Russian Space Agency and the Defense Ministry to concentrate on the utilization of the Baykonur and Plesetsk space centers.

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VII. NATURE OF INFORMATION/ELECTRONIC WARFARE

INFORMATION WARFARE DEFINED

Russian military scientists argue that the course and outcome of modern combat actions on any scale is determined by the art of waging information warfare. Therefore a recognition of the objective law-governed patterns and principles of information warfare, as well as the intensive development of its scientific theory is an extremely urgent problem that requires broad discussion and a rapid resolution.

It is expedient to begin examining the theoretical questions by precisely defining the content of information warfare. Russian military scientists assert that IW has three components that encompass the totality of actions which ensure victory over the opponent in the information sphere.

The first component is the complex of measures for acquiring information on the opponent and the conditions of the conflict (radioelectronic, meteorological, the engineering situation, etc.); the collection of information on his troops; and the processing of information and its exchange between command-and-control organs (points) in order to organize and conduct combat actions. Information must be reliable, precise, and complete, and its transmission must be selective and timely. A logical name for these tasks is "information support of troop and weapon control."

The second component of IW is opposition to the information support of the opponent's troop and weapon control ("information opposition"). It includes measures to block the acquisition, processing, and exchange of information as well as the insertion of disinformation at all levels of the information support of the opponent's troop and weapon control.

The third component consists of measures to defend against the opponent's information opposition ("information defense"), which includes actions to unblock information required for fulfilling the tasks of control, and to block disinformation disseminated and inserted into the control system. Information defense enhances the effectiveness of information support under conditions of the opponent's information opposition (see Diagram 1).

The ultimate objective of IW is to achieve information dominance over the opponent; i.e., a situation wherein the information quotient of one's own troop and weapon control organs is more complete, precise, reliable, and timely than that of the opponent's corresponding control organs.

Thus, the Russians define information warfare as a complex of measures for information support, information opposition, and information defense conducted according to a single concept and plan in order to seize and maintain information dominance over the opponent in the preparation and course of combat actions.[104]

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[104] Colonel S.A. Komov, "The Information Struggle in Modern War: Questions of Theory," VM, No. 3, 1996, pp. 76-80.

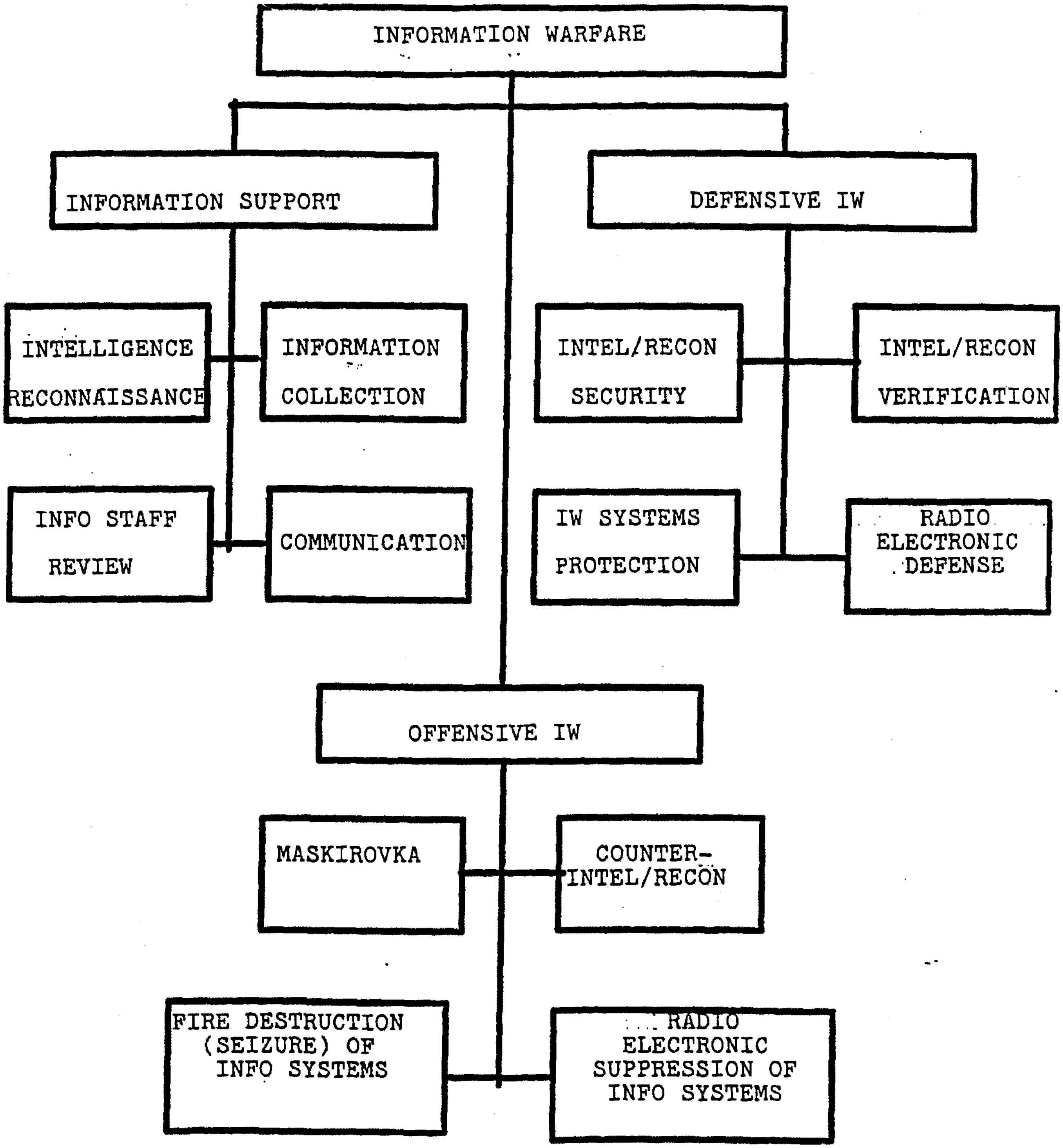
INFORMATION WARFARE
INFORMATION SUPPORT
DEFENSIVE IW
INTELLIGENCE RECONNAISSANCE
INFORMATION COLLECTION
INTEL/RECON SECURITY
INTEL/RECON VERIFICATION
INFO STAFF REVIEW
COMMUNICATION
IW SYSTEMS PROTECTION
RADIO ELECTRONIC DEFENSE
OFFENSIVE IW
MASKIROVKA
COUNTER-INTEL/RECON
FIRE DESTRUCTION (SEIZURE) OF INFO SYSTEMS
RADIO ELECTRONIC SUPPRESSION OF INFO SYSTEMS

DIAGRAM 1

VIEWS ON INFORMATION TECHNOLOGIES

According to the Russian military, superiority in the RMA proceeds from superiority in information systems: 1) reconnaissance, surveillance, and target acquisition (RSTA) systems, and 2) "intelligent" command-and-control systems. For example, Rear-Admiral V.S. Pirumov explains that combat potential is an objective integral (generalized) index of the aggregate capabilities of a grouping of troops (forces), on the basis of a comparison of which the degree and nature of the superiority of one side over the other can be determined. Needless to say, in calculating a given index it is necessary, out of all the diverse characteristics of weapons and military equipment, to count only those that influence definitively the nature of armed conflict. Here one should keep in mind that some of them can have a direct effect on the enemy (for example, means of fire destruction), and others an indirect effect, by building up the combat potential of the means of direct effect. These include, especially, information systems and resources, as well as electronic warfare (EW) resources.[105]

According to Russian experts, the principal shortcomings in information technology in the armed forces of the Russian Federation are:

- *a sharp lag in information technology of lower levels of command and control and, as a consequence, the absence of a real information base;*
- *the adoption of various hardware and software that are not compatible;*

[105]"Rear-Admiral Pirumov: Defining Defensive Sufficiency," in JPRS-UMA-91-008-L, 22 August 1991.

- *the insufficient level of the capabilities and characteristics of the computer technology being used, and the low degree of saturation of subunits and services with modern computer hardware;*

- *the insufficient utilization in the armed forces of contemporary achievements in the field of new information technologies, methods of mathematical modeling, and artificial intelligence.*[106]

These experts state further that the principal directions and aims of the dissemination of information technology in the armed forces are:

- **in the field of military construction:** the fuller utilization of information resources for the scientific substantiation of armed forces structures, their necessary size, sophistication, development prospects and support, through the broad-scale incorporation of modern means of information technology for the accelerated use of the achievements of science and technology in the interests of the armed forces, predicting the military-political situation, and performing measures for the preparation of the armed forces and the country as a whole to repel aggression, based on the development of multifunctional information-management systems;

- **in the field of armed combat:** increasing the effectiveness of the development of plans for the employment of the armed forces, reducing the times and raising the quality of decision-making in preparing for operations, and providing a flexible response to changes in the military-political situation;

- **in the field of command-and-control of the armed forces:** increasing the operatibility, reliability, and concealment of the command and control of troops (forces) through the adoption of improved means of automation;

[106] V.N. Medvedev and S. K. Lopukhov, "Information Technology in the Armed Forces of the Russian Federation," Vooruzheniye, politika, konversiya (hereafter cited as VPK), No. 1, 1993, pp. 57-60.

- **in the field of supporting the troops:** raising the qualities, completeness, and operatibility of all types of support for the troops, under any conditions, through the widespread and comprehensive incorporation of means of information technology and new information technologies, and the creation of favorable conditions with the aim of supporting the everyday activity of units and subunits in peacetime for the organized and timely conduct of operations under conditions of a combat environment;

- **in military-scientific activity:** raising the effectiveness of the fulfillment of scientific-research work on the basis of equipping the subunits (units) for military-scientific information with the latest means of information technology, uniting them into information networks, priority research of problems in the preparation and waging of modern operations and combat activity connected with the increasing influence of information technologies, intensification of the creation of new means of armed combat and command and control of troop support, substantiation of efficient forms and methods of combat preparation of the troops, and optimization of the ways of achieving the required characteristics of arms and military hardware;

- **in the field of military education, military training, and indoctrination:** enhancing the quality of training of military specialists on the basis of efficient information support for the tasks of training personnel, creating an information-technological base for the restructuring of military education through a deepening of scientific research, the intensification and individualization of training, and adaptation to the abilities of the trainees and the activation of their creative potential;

- **in the field of routine activities:** raising the quality of decision-making in the process of everyday activity of the subunits, units, and institutions of the armed forces, the performance of garrison and guard duty, the escort of military freight, the observance of regulation order, and the reinforcement of military discipline;

- **in the military-legal and social realm:** the information technology of the armed forces pursues the aim of a substantial rise in the quality of information-legal support for the everyday activity of the troops, improvements in law-making activity, and assurance of a greater level of awareness on questions of social protections for servicemen and their families.

The dissemination of information technology, along with the development and improvement of traditional information technologies, presupposes the adoption into active military practice of new information technologies that support the automated resolution of poorly formalized tasks in various fields of activity of the armed forces, including by a user who does not have special training in the field of computers. The new information technologies are the foundation for resolving applied tasks in the command and control of troops; the creation of robotized weapons systems; and the support of the everyday activity of the troops, services, and the training of personnel.

The directions for the dissemination of information technology in the armed forces also encompass priority problems, within the framework of which the following tasks should be resolved in the near future.

- *the gradual creation of a telecommunications environment for the armed forces and its link-up with nationwide communications and data-transmission systems, and the further development of communications equipment;*

- *the development and incorporation of base problem-oriented systems, software, and hardware for the structuring of local and global information and computer networks;*

- *the fastest possible equipping of armed forces staffs and organizations with base means of information technology and personal computers, advanced communications and telecommunications gear, and improved organizational techniques as the foundation for the adoption of "paperless" information technologies;*

- *the improvement of methods and tools for the development of software and the use of CASE technologies, without which progress in the creation and adoption of subsequent generations of automated systems and ASUVs is impossible;*

- *assurance of the technical, information, linguistic, and program compatibility of the means of information technology;*

- *improvement of the system of training, retraining, and skills enhancement of military specialists in the realm of information technology;*

- *the creation of standardized, advanced means of information technology with a regard for the requirements of ensuring the security of the information.*

IMPLICATIONS OF INFORMATION WARFARE

The military-technical direction of Russian military reform -- oriented toward the highest world level where cutting-edge technologies hold the leading place -- therefore becomes one of the determining factors. In other words, it is a matter not only of precision weapons for priority development of strategic systems, qualitative changes in conventional weapon systems, elimination of distinctions between nuclear and conventional weapons, and military use of space, but also of military-information technologies. They are what will become the most formidable weapon of the 21st century.[107]

The assessment of information as a strategic resource by the military-political leadership of a number of countries, above all the United States, becomes

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[107] "New Trends in Power Deterrence" (Roundtable Discussion on Power Deterrence), AS, No. 9, 1995, pp. 12-19.

understandable. Herein lie the causes of a constant increase in appropriations for development of information technologies. The greater the information capacities a state possesses, the more likely it can achieve strategic advantages with other conditions being equal. The growth in the need for information actually has led to where it is not legitimate to estimate a state's military might and security without considering the information component.

A new power deterrence factor -- the threat of inflicting irreparable damage on a particular country's information resources -- is forming in the system of confrontation of new geopolitical associations of states. This can be done overtly or covertly, in the form of information opposition. The most complicated form of such aggression is to control the decision-making process in state structures under the effect of specific information or disinformation. The following types of information subversion can occur: disrupting the information exchange procedure and illegally using and collecting information; having unsanctioned access to information resources; manipulating information (disinformation, its concealment or its distortion); illegal copying of data from information systems; and theft of information from data bases and banks.

For sides possessing more developed information resources, the losses also will be more appreciable in case of large-scale use of means of special software damage. This is why, in assessing the possibilities of deterring a probable aggressor with the threat of retaliatory nuclear and conventional damage, the possibilities of information damage; i.e., of a special software engineering effect on the enemy, also must be borne in mind. It is this factor that may become a deterrent to the initiation both of a nuclear as well as of an information war. Thus, the development of information means of warfare becomes an additional guarantee of peace and of development of coöperation among countries for strengthening military-strategic stability. But this in no way means that the military threat has been eliminated. This is why, in developing the Russian military reform concept, it is also necessary to take into account new methods of waging a quiet (information) war.

According to Russian general officers, achieving superiority in information opposition, with the tendency of its importance to grow as levels of nuclear opposition decrease, is becoming the most important factor in the nature of modern warfare. Therefore a traditional analysis of the state of strategic balance with consideration only of quantitative-qualitative characteristics of strategic forces can provide worse results than with a more realistic account of the influence of the sum total of parameters of strategic forces.[108]

New criteria are thus needed for estimating the effectiveness of strategic forces and arms under conditions of information warfare. Development of weapon systems also is an incentive for this. The criteria are oriented both toward strategic offensive as well as defensive systems -- and above all reconnaissance-information systems, toward development of weapons based on new physical principles, and toward a shift of the center of gravity of warfare from continental and ocean theaters of military operations (TVDs) into the sphere of space.

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[108] General-Lieutenant Aleksandr Skvortsov and General-Major Nikolay Turko, "Strategic Stability: Key to National Security," AS, No. 1, 1996, pp. 4-8.

Russians military scientists argue that information war occupies a position between a "cold" war, which includes in particular an economic war, and a "hot" war. In contrast to an economic war, the result of an information war is actual disrupted functioning of elements of the enemy infrastructure (command-and-control facilities, missile and launch positions, airfields, ports, communications systems, depots, and so on.) In contrast to a "hot" war with the use of conventional and/or mass destruction weapons, it is aimed not at material, but at "theoretical" objects, symbolic systems, or their physical media. At the same time, such objects and systems can be destroyed while their material basis is preserved.[109]

All branches of the Russian Armed Forces have designed blueprints for reorganization in the new information environment. Russian naval theorists, for example, understand the information revolution to mean the process of ever-greater use of information and knowledge as a third type of asset (in addition to material and energy) that involves the introduction of systems to automate the processing and employment of information in all areas of life and social activity. It is not specialists in cybernetics and computers who give the forms and means of acquiring and processing information but the information revolution that is determining the paths of development of research, production improvement, productive forces, etc.[110] On the basis of systematizing and generalizing domestic and foreign trends of development in information science, they think it expedient for the Russian Navy to take the following

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[109] Major D. Pozhidayev, "General Problems," Zarubezhnoe voennoe obozrenie (hereafter cited as ZVO), No. 2, 1996, pp. 2-4.

[110] Captain 2nd Rank A. Tutushi and Captain 2nd Rank O. Turovtsev, "The Objective Logic of Bringing About the Information Revolution in the Navy," Morskoi sbornik (hereafter cited as MS), No. 6, 1993, pp. 24-28.

strategic lines on information development: 1) Developing a single Navy information environment, organically a part of the armed forces information environment; 2) Making the structures of information facilities and information-processing equipment general-purpose; 3) Developing architecture concepts, global standardization of functional design, interfaces, and inter-system protocols; 4) "Intellectualizing" information systems, development of semantic structures and inclusion of rules of data interpretation, and expert derivation logic as part of data- and knowledge-bank systems; 5) Introducing technological processes of hardware-software components, local and global information-computing nets, graphic data-processing equipment, optical disks, etc.; and 6) Introducing information systems for mass users on a wide scale.

The Russian military ultimately argues that the primary objective in future war is to gain control over the enemy's information resources -- and thereby over all of his other resources. The war's initial period thus becomes a mandatory struggle for information dominance. And the modern formula for victory is to achieve superiority first on the airwaves, then in the airspace, and only later (if necessary) on the ground. Warfare has indeed shifted from being a duel of strike systems to being a duel of information systems.

ELECTRONIC WARFARE DEFINED

According to Russian military scientists, electronic warfare (EW) is an inalienable part of operations (combat) under modern conditions. The scope of EW forces and assets used in wars and armed conflicts is constantly expanding owing to the ever-increasing role of electronic assets (EA), which enhances the combat capability of troops. This entails a continuous broadening of the range of organizational and technical measures which enhance the efficiency of EA in the course of combat operations. As a result the contents and forms of EW have changed radically -- especially over past decades. The Russians analyze them and start by the contents as the most "susceptible" to equipping arms and equipment with electronics, as well as to changes in the contents, forms, and methods of military operations.[111]

The experience of the very first years of using EA in combat operations made it possible to discover 1) EA objectives (to gain superiority or prevent the enemy from gaining it), and 2) the elements comprising the contents of EW (disruption of radio communication between EA through generation of jamming, protection of friendly EA from jamming, and support of actions aimed at generating jamming and protection against it).

The main element of EW contents is disruption of radio traffic between EA by generating jamming. Up until the start of World War II, screening jamming was used against some EA. Effective methods of generating passive jamming simulating real objects and foisting on the enemy false information were developed to fight early EA intended for extraction of information (radars). As EA continued to improve, there emerged prospects of using against EA active misinformation jamming in such a way that even if it may be possible to separate the true information from false information, the presence of the latter sometimes makes it considerably more difficult to assess the situation in the course of combat operations. Furthermore, an impact on modern electronic systems which include computers may be carried out by infiltrating, using

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[111] Colonel V.K. Zarubin, "Expanding Contents and Forms of Electronic Warfare," VM, No. 2, 1996, pp. 33-40.

a radio channel, very similar messages containing computer viruses which penetrate via computer nets to reach top troop and arm command-and-control bodies. Alongside with this, a massive employment of jamming assets in a locality results in insulating one set of EA from the other. Finally, modern EA use not only screening jamming but also distorting, misinforming, and blocking types of jamming to disorganize the functioning of EA on a global scale, whereas organizational-technical measures consisting of generating various types of jamming degrade the functioning of both local EA groupings and large-scale electronic systems.

Another element of EW contents is protection of EA from jamming. This was initially done through technical measures based on the use of the selective property of radio-receiving devices. As the range of EA employment broadened, organizational jamming protection measures were taken that consisted in maneuvering surplus EA and their operating modes. Improved methods of signal analysis made it later possible to enhance selection effectiveness through noise compensation. The incorporation of computers in EA opened the possibility of using complex surplus structures of signals and corresponding processing algorithms. Therefore, modern EA can work efficiently with noise being hundreds and more times more powerful that the desired signal.

The third element of EW contents is generation of jamming and protection from it. It consists of a set of measures which include lining up the necessary forces and assets, provision of electronic equipment for position areas, EW dataware, and concealment from the enemy of important information about friendly EA. In peacetime these measures form the basis of EW, whereas at time of war they have mostly support functions. The biggest progress in EW support was achieved in connection with the improvement of electronic reconnaissance assets (ERA). For example, the width of a frequency band monitored at any given moment has increased (compared to the World War II period) one thousand times over, space-based reconnaissance that began in the 1960s made reconnaissance global, and the inclusion of high-speed computers in reconnaissance systems made it possible to process reconnaissance information almost in real time. Electronic reconnaissance substantially limits and paralyzes actions of the opposing side both in peacetime and in wartime.

The evolution of EW contents can be described with the aid of the quantitative and qualitative characteristics of its elements. The most important of them are the scale of troop missions to be executed; the composition and origin of forces and assets; the scale of maneuver with forces and assets in the course of EW; the spatial scale of operations; time of reaction to change in the situation; the extent of paralyzing the enemy in the course of systematic EW operations; the extent of detail of reconnaissance of EA signals and parameters; the character of depth of electronic impact; and the EA provided with jamming protection measures. An analysis of EW contents is presented in Diagram 2.

As EW contents evolved over a number of decades, there appeared its new forms. EW form organization is the use of forces and assets in accordance with a single concept and plan for achieving a certain goal of electronic warfare in a concrete operational-tactical situation, as shown in the Table.

Evolution of electronic warfare contents

Characteristics of EW contents elements		Years		
		1900	1950	2000
		Application levels		
Scale of troops' missions tackled with use of EW forces and assets		Tactical	From tactical to operationa	From tactical to strategic
Composition and origin of forces and assets for attaining EW goals		Individual TF	Division, army, front EA groups and EW assets	EA and EW assets up to Supreme Command
Scale of maneuver of forces and assets in EW		Tactical	From tactical to operational	From tactical to strategic
The spatial scale of EW		In limited areas in sea and dry land	In all areas of combat operations in sea, dry land and air	Globally, in sea, dry land, air and space
Situation change reaction time		Minutes	Seconds — fractions of a second	Milliseconds
Scale of paralyzing enemy in course of systematic EW operations		Tactical	From tactical to operational	From tactical to strategic
Extent of detail in EA signal and parameter reconnaissance		Frequency, direction	Frequency, direction, cyclogram	Frequency, direction, cyclogram, modulations and spectrum parameters
Character and depth of impact penetration	Suppression	Up to tactical level weapons		Up to operational-tactical level weapons systems
	Misinformation	—	Up to strategic level weapons and top control echelons	
	Blocking	—	—	All EA in locality
EA with jamming protection measures		Individual Data transmission EA	Air Defense radars, combat control and communication EA	All military-purpose EA

DIAGRAM 2

Development of Forms of Electronic Warfare

EW forms	Years		
	1900	1950	2000
Separate electronic impacts	→→→→→	→→→→→	→→→→→
Electronic attack		→→→→→	→→→→→
Electronic-weapon impact		→→→→→	→→→→→
Electronic-weapons attack		→→→→→	→→→→→
Containment of electronic impacts	→→→→→	→→→→→	→→→→→
Maneuver of EA and their operating modes	→→→→→	→→→→→	→→→→→
Electronic-weapons combat		→→→→→	→→→→→
Systematic actions on EW	→→→→→	→→→→→	→→→→→
Robotic Electronic-weapons combat			→→→→→
Ground-space electronic-weapons attack			→→→→→
Electronic attack for effect			→→→→→
Electronic blocking			→→→→→

The idea of maneuver of electronic assets and their modes of operation came into being and was put into effect as early as the turn of the century and, in accordance with contemporary views, it consists in changing positions and modes of operation; the use of standby (duplicating) electronic assets and systems; and the creation of false positions, EA groupings, and networks.

The high effectiveness of EA maneuver was convincingly demonstrated in the Persian Gulf zone. Following 10 days of combat operations by the Multinational Forces to disable the Iraqi air defense and command-and-control systems, 20 percent of Iraq's air defense radars remained intact owing to the presence of reserves, and the Iraqi command managed to retain command and control of troops through setting up dummy radio lines. Despite a five-month reconnaissance conducted on the ground, in the air, and outer space, the American reconnaissance services failed to uncover the true sites of mobile enemy missile systems and establish their precise number. Such a camouflage was achieved by Iraq through setting up a great number of emitting dummies of missile launchers. Thus, the scale of maneuver of EA and modes of their operation in the interest of conducting EW was put into effect during the operational and tactical level of combat operations.

In addition to containing electronic impacts and protective maneuvers of EA and modes of their operation, there are usually vigorous EW actions in the shape of retaliatory electronic impacts and attacks. Exchanging them leads to an organized armed clash of big units and subunits (including EA units and subunits) whose form is determined as a battle. Therefore, an aggregate of coordinated individual electronic impacts, electronic and electronic-weapons attack, containment of electronic impact and maneuver of EA in order to inflict damage on the enemy and (or) to prevent damage done to friendly forces can be defined as electronic-weapons combat. Such a form of EW, as the practice of combat operations has shown in recent years, is especially effective in organizing protection against enemy high-precision weapons. The objective of electronic warfare against high-precision weapons consists in restricting to the maximum the enemy's possibility to procure and transmit information and thus eliminating their main advantage over the other types of weaponry. This can be achieved through electronic impacts and strikes against reconnaissance assets and homing, navigating, and control elements of high-precision weapons, as well as the disruption of the usual state of the atmosphere and outer space (if need be) in organizing a maneuver of friendly forces and assets and in effective engagement of high-precision weapons delivery vehicles.

Russian military scientists also single out the main tendencies that determine the development of the contents and corresponding forms of EW. It is necessary to include among them: 1) a sharp increase in the level of automation of reconnaissance and electronic suppression processes and the broadening of the methods of artificial intellect in systems controlling EW facilities; 2) a rapid development and introduction among troops of electronic reconnaissance-and-control systems used as a data component of reconnaissance-attack and reconnaissance-weapons systems; 3) a considerable growth in the massive employment of EW forces and assets -- which increases the space covered by electronic impacts through a bigger number of assets and greater power of electronic impacts created by individual EW assets; 4) a greater integration of EW forces and assets with conventional weapons in delivering combined electronic-weapons attacks; and 5) a wider space that can be covered and gradual extension of EW methods to outer space.

The above tendencies make it possible to define areas of further development of the contents and forms of electronic warfare. The intensive use of robotics in military equipment is also showing in EW equipment. Marked advances have been made in creating unmanned reconnaissance planes, generators of jamming, and carriers of emission-homing weapons whose employment in the course of combat operations adds appreciably to the other EW flying and lifting assets. However, greater maneuver capacity, survivability, and ability to carry out missions in extreme situations would apparently make it possible in the future to widen the range of missions that can be tackled by robotic assets of EW. Their massive employment by both sides would result in the exchange of electronic and weapons attacks in separate areas that may represent in form a robotic electronic-weapons attack.

The increased scope in which electronic reconnaissance is possible through the employment of space-based systems and the use of its results to organize EW on the ground, in the air, on sea, and in outer space provides grounds to describe such EW systematic actions as global. The joint employment possible in this case of space-based and other types of reconnaissance, as well as of electronic suppression assets make it possible to speak about a fundamentally new future form of attack -- a land-space electronic attack. It will be distinct for instant reaction to changes in the electronic environment, and the substantial size of space covered by single sources of electronic impacts in any area on earth or in space.

The formation of dense EA groupings and the aspiration to raise the effectiveness of electronic impacts will result in further enrichment of EW contents along the road to creating new methods and assets of electronic warfare which could suppress EA groupings rather than single facilities. Belonging to such assets are sources of powerful high-frequency super-short pulse emission, whose employment may lead to disabling EA electronic devices in localities on a mass scale. Since such electronic impact in the shape of an attack leads to an effective engagement of EA (component parts of armaments and military equipment), it will have the form of an electronic effective attack. Another possible area to increase a massive impact of electronic assets is the employment of so-called geophysical assets for the formation in the atmosphere and (or) in outer space of artificial regions of increased ionization, which hamper the propagation of radio waves and block exchange of information through radio lines of a locality on earth or in outer space with the other regions.

The scale of EW measures in this case covers groupings of forces and assets of operation-tactical level localities and can expand to become global in the event there is an information exchange breakdown on the most important space radio lines. The contents of EW in this case is characterized by the fact that one or several electronic impacts are coordinated in place and time with an objective to "cut off" EA in a locality from other ones, to exclude the most important links from the command-and-control or information interaction, and to block the sources or consumers of information. Such operation-tactical methods are widely used in the combat operations of air and naval forces. One or several electronic impacts and (or) attacks coordinated in place and time carried out by a separate set of EW forces and assets in order to rule out information exchange using radio lines of a locality with other regions has a specific form of electronic blocking.

Thus, with the emergence of new assets for forming electronic impacts; the widening of areas on which they can be employed; the extension of areas of their possible employment to include outer space; the scale, speed, and depth of impact; and measures of protection against them -- EW can range from systems of tactical-level arms and local groupings to large-scale electronic systems of upper echelons of command and control of troops and arms in a global action. Further development of EW contents and forms call for an in-depth analysis and a purposeful synthesis of new qualities of electronic equipment, the broadening of the range of methods, and the production on this basis of new approaches to preparing, planning, and waging electronic warfare -- a revision of the principles of equipping troops with EW facilities.

According to Colonel-General V. Semenov, CINC of the Russian Ground Troops, the effectiveness of employing EW forces and assets is acquiring a special urgency. Such forms of operations as the electronic-fire engagement, electronic-fire strike, and electronic strike -- in which means of electronic engagement will be widely used -- will fill operations and combat operations of combined-arms units with new content. In the aggregate they can comprise a special operation to disorganize enemy command-and-control and fire-control systems on the axis of concentration of main efforts.[112]

ELECTRONIC WARFARE LESSONS FROM DESERT STORM

The Russians have come to the following tentative conclusions regarding the Gulf War:

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[112] Colonel-General Vladimir Semenov, "Main Directions of Ground Troops Development," AS, No. 3, 1995, pp. 9-15.

1. The modern "electronic-fire" concept of combat operations was demonstrated once again. Operations aimed at ensuring superiority over the enemy in reconnaissance, control, and electronic warfare constituted its basis. Radical changes in the nature of the armed struggle are becoming more and more obvious. During this struggle the superiority in information of one side over another becomes the indispensable factor ensuring victory. The concept "information war" increasingly acquires real meaning. One can trace a historic law of ensuring success in combat operations. In World War I it was achieved by superiority in fire means of troops (forces), first of all in artillery ("fire superiority"). In World War II, as well as in the local wars of the fifties and beginning of the sixties (Vietnam, Korea) it was achieved by superiority in the means of air attack (gaining of "air supremacy"). Today's reality is actions aimed at gaining superiority over the enemy by disabling control systems and means, or "gaining of radio and electronic superiority," because now the basis of armaments and military equipment is electronic means and systems.

Thus, in order to succeed in modern combat operations, it is necessary above all to gain "radio and electronic superiority" during fighting, then to obtain "air superiority" and "fire superiority," and after that to engage troops to seize the enemy's territory. Taking into account the destructive capabilities of modern weapons, combat operations without these measures will always be characterized by heavy losses in personnel and materiel.

2. The success of the MNF in many respects was achieved by the effectiveness of disorganizing the enemy's control of troops and weapons, which was conditioned by punctual organization of a complex employment of reconnaissance forces, main

attack forces, and electronic warfare means based upon a wide-scale use of automated control systems. Today actions against the enemy's reconnaissance and control of troops and weapons, as well as protection of one's own troops against the enemy's high-precision weapons and radio interference are becoming the most important tasks of forces.

3. The primary importance of electronic warfare forces and means in the armed struggle -- as the main component of the struggle for superiority over the enemy -- proved correct. This principle manifested itself particularly in the struggle between air forces and air defense, which was the essence of combat operations in the initial period of the war. The availability of a large number of different types of electronic warfare means required punctual coordination between them in the interest of ensuring their massive use in the decisive stage of combat operations. The corroboration of this is the coordination of the operations of electronic warfare means of the MNF ground and air force groupings in time, place, and object of actions, which ensured reliable neutralization of the electronic means of Iraqi air defense systems.

4. The level of electronic countermeasures of air defense EW means becomes the factor that will determine their combat stability and combat employment effectiveness. Special importance is attached to such air defense countermeasures as multifrequency of the employed electronic means; the capability to counteract the enemy's interference; the availability and organization of reconnaissance and destructive means based on the use of various physical principles; and the integration of electronic warfare units into air defense groupings, their rational deployment and use in operational formations of air defense forces, etc.

IW/EW CURRICULA

According to then Defense Minister Grachev, many people know that Operation Desert Storm had been thoroughly "rehearsed" well before the start of its implementation, using modern computer technology for all aspects of training and for all possible options as regards the development of events. This is what enabled the Americans to achieve effective success. Furthermore, they had no need to conduct detailed and large-scale exercises and "rehearse on the spot" the forthcoming operation. Vast sums of money were saved in this way.[113]

Until very recently Russia did not have such technical means for operational development. Today, say the Russians, they have them. Regardless of the well-known difficulties, at least one organization has managed to assemble brilliant scientists from the defense complex and offer them all the conditions they need for their work. Their labor has produced electronic simulators, whose virtual-reality display screens make it possible to forecast and almost experience for real all possible events in the various theaters of military action. "Had this computer technology been available to us a couple of years earlier, had we made use of it to plan the operations in Chechnya," said Grachev, "the effectiveness of Russian actions would have been incomparably greater. Such modern means of group training must henceforth become the basis of the material and technical backup for Army and Navy reform."

The following are some of the IW/EW curricula currently being offered:

[113] Maksim Yurchenko, "The Army on the Eve of Reforms," TRUD, 18 April 1996, p. 2.

- The Military Academy Imeni F.E. Dzerzhinskovo.

  Specialties: Applied mathematics. Mathematical method and research operations in the economy. Ballistics, Electrical supply of space missile systems. Rocket manufacturing. Aircraft testing. Laser systems. Instruments and systems for orientation, stabilization, and navigation. Metrology [science of weights and measures] and metrological support. **INFORMATION-MEASUREMENT EQUIPMENT AND TECHNOLOGIES. ELECTRONICS AND AUTOMATION OF PHYSICAL PLANTS. RADIOS. ELECTRONIC WARFARE SYSTEMS, CONTROL AND INFORMATION SCIENCE IN TECHNICAL SYSTEMS. AIRCRAFT CONTROL SYSTEMS. COMPUTERS, COMPLEXES, SYSTEMS, AND NETWORKS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS. COMPUTER AND AUTOMATED SYSTEMS SOFTWARE.** Chemical technology of polymer composites, propellants, and solid rocket fuels. Safety of vital systems. Safety of technological processes and the production of polymer composites, propellants, and components of rocket fuels.[114]

- Mikhaylovskaya Artillery Academy.

  Specialties: **AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS. ELECTRONIC INSTRUMENTS AND DEVICES.**

[114] "Russian Federation Ministry of Defense Military Educational Institutions," Voennoe znaniye, No. 3, 1996, pp. 20-22.

- Russian Federation Ground Forces Air Defense Military Academy.
  Specialty: **ELECTRONIC SYSTEMS**.

- Air Defense Military Academy.
  Specialties: **ELECTRONIC SYSTEMS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS.**

- Military Air Engineering Academy.
  Specialties: Technical operation of aircraft and engines. Technical operation of aircraft electrical systems and avionics packages. **ROBOTICS SYSTEMS FOR AIRCRAFT WEAPONS**. Gas Dynamic Pulse Devices. Metrology and metrological support. Technical operation of transport radio equipment. **ELECTRONIC WARFARE SYSTEMS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS. COMPUTER AND AUTOMATED SYSTEMS SOFTWARE.**

- Military Engineering Academy.
  Specialties: Electrical power engineering systems and networks. Multimission tracked and wheeled vehicles. **COMMAND-AND-CONTROL AND INFORMATION SCIENCE IN TECHNICAL SYSTEMS.**

- Military Engineering-Space Academy.
  Specialties: Geophysics. Technology and physics of low temperatures. Ballistics. Modeling and research of operations in organizational-technical systems. Electrical power supply of space systems. Industrial thermal-power

engineering. Technical operation of aircraft and engines. Electric rocket motors and power plants. Spacecraft and boost pods. Aircraft testing. Launch and technical complexes of missiles and spacecraft. Instruments and methods for monitoring quality and diagnostics. OPTICAL-ELECTRONIC INSTRUMENTS AND SYSTEMS. Metrology and metrological support. COMMUNICATIONS NETWORKS AND SWITCHING SYSTEMS. ELECTRONIC SYSTEMS. ELECTRONIC WARFARE SYSTEMS. AUTOMATION OF TECHNOLOGICAL PROCESSES AND PRODUCTION. AIRCRAFT CONTROL SYSTEMS. COMPUTERS, COMPLEXES, SYSTEMS, AND NETWORKS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS. COMPUTER AND AUTOMATED SYSTEM SOFTWARE. INFORMATION ORGANIZATION AND PROTECTION TECHNOLOGY. Industrial and civil construction. Heat and gas supply and ventilation.

- Military Institute of Electronics.
  Specialty: ELECTRONIC WARFARE SYSTEMS.

- Krasnodar Higher Military Command Engineering School of the Missile Forces.
  Specialties: Electrical power engineering systems and networks. Electrical power supply of missile-space systems. Technical operation of aircraft and engines. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS.

- Perm Higher Military Command Engineering School of the Missile Forces. Specialties: Launch and technical complexes of missiles and spacecraft. Electronics and automation of physical plants. AIRCRAFT CONTROL SYSTEMS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS.

- Rostov Higher Military Command Engineering School of the Missile Forces. Specialties: Launch and technical complexes of missiles and spacecraft. Metrology and Metrological support. Radios. ELECTRONIC WARFARE SYSTEMS. AIRCRAFT CONTROL SYSTEMS. COMPUTERS, COMPLEXES, SYSTEMS, AND NETWORKS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL-SYSTEMS. COMPUTER AND AUTOMATED SYSTEM SOFTWARE.

- Serpukhov Higher Military Command Engineering School of the Missile Forces. Specialties: Launch and technical complexes of missiles and spacecraft. Motor vehicles and motor vehicle management. Instruments and systems for orientation, stabilization, and navigation. INFORMATION-MEASUREMENT EQUIPMENT AND TECHNOLOGIES. ELECTRONICS AND AUTOMATION OF PHYSICAL PLANTS. AIRCRAFT CONTROL SYSTEMS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS.

- Stavropol Higher Military Engineering School of Communications.
  Specialties: **<u>COMMUNICATIONS NETWORKS AND SWITCHING SYSTEMS. MULTICHANNEL TELECOMMUNICATIONS SYSTEMS. RADIO COMMUNICATIONS, RADIO BROADCASTING AND TELEVISION. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS</u>.**

- Orenburg Higher Air Defense Missile Command School.
  Specialty: **<u>RADIO EQUIPMENT</u>.**

- St. Petersburg Higher Air Defense Missile Command School.
  Specialty: **<u>RADIO EQUIPMENT</u>.**

- Tomsk Higher Military Command School of Communications.
  Specialties: **<u>COMMUNICATIONS NETWORKS AND SWITCHING SYSTEMS. ELECTRONIC SYSTEMS</u>.**

- Nizhniy Novgorod Higher Air Defense Missile Command School of Air Defense.
  Specialty: **<u>ELECTRONIC SYSTEMS</u>.**

- Yaroslavl Higher Air Defense Missile Command School of Air Defense.
  Specialties: **<u>ELECTRONIC SYSTEMS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL-SYSTEMS</u>.**

- Krasnoyarsk Higher Command School of Air Defense Electronics.
  Specialty: **ELECTRONIC SYSTEMS.**

- Moscow Higher Command School of Air Defense Electronics.
  Specialty: **ELECTRONIC SYSTEMS.**

- Pushkin Higher School of Air Defense Electronics.
  Specialties: Electrical power engineering systems and networks. **COMPUTERS, COMPLEXES, SYSTEMS, AND NETWORKS. COMPUTER AND AUTOMATED SYSTEM SOFTWARE.**

- St. Petersburg Higher School of Air Defense Electronics.
  Specialties: Metrology and Metrological support. Electronic systems. **AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS. COMPUTER AND AUTOMATED SYSTEM SOFTWARE.**

- Stavropol Higher Aviation Engineering School of Air Defense.
  Specialties: Technical operation of aircraft electronic systems and avionics packages. Technical operation of aircraft and engines. **ROBOTICS SYSTEMS FOR AIRCRAFT WEAPONS. TECHNICAL OPERATION OF TRANSPORT RADIO EQUIPMENT. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS.** Air transport operations and air traffic control.

- Irkutsk Higher Military Aviation Engineering School.
  Specialties: Technical operation of aircraft and engines. Technical operation of aircraft electrical systems and avionics packages. **ROBOTICS SYSTEMS FOR AIRCRAFT WEAPONS. AVIATION INSTRUMENTS AND MEASUREMENT-COMPUTER SYSTEMS. TECHNICAL OPERATION OF TRANSPORT RADIO EQUIPMENT.**

- Tambov Higher Military Aviation Engineering School.
  Specialties:.**ROBOTICS SYSTEMS FOR AIRCRAFT WEAPONS. RADIOS. TECHNICAL OPERATION OF TRANSPORT RADIO EQUIPMENT. ELECTRONIC SYSTEMS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL-SYSTEMS**

- Higher Naval Engineering School.
  Specialties: **RADIOS. COMPUTERS, COMPLEXES, SYSTEMS, AND NETWORKS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL-SYSTEMS. COMPUTER AND AUTOMATED SYSTEM SOFTWARE.**

- Krasnodar Higher Military School.
  Specialty: **INFORMATION ORGANIZATION AND PROTECTION TECHNOLOGY.**

- Kemerovo Higher Military Command School of Communications.
  Specialties: <u>**COMMUNICATIONS NETWORKS AND SWITCHING SYSTEMS. MULTICHANNEL TELECOMMUNICATIONS SYSTEMS. ELECTRONIC SYSTEMS.**</u>

- Novocherkassk Higher Military Command School of Communications.
  Specialties: <u>**COMMUNICATIONS NETWORKS AND SWITCHING SYSTEMS. ELECTRONIC SYSTEMS.**</u>

- Ryazan Higher Military Command School of Communications.
  Specialties: <u>**COMMUNICATIONS NETWORKS AND SWITCHING SYSTEMS. ELECTRONIC SYSTEMS.**</u>

- St. Petersburg Higher Military Engineering School of Communications.
  Specialties: <u>**MULTICHANNEL TELECOMMUNICATIONS SYSTEMS. ELECTRONIC SYSTEMS. COMPUTERS, COMPLEXES, SYSTEMS, AND NETWORKS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS. COMPUTER AND AUTOMATED SYSTEM SOFTWARE.**</u>

- Ulyanovsk Higher Military Engineer School of Communications.
  Specialties: <u>**COMMUNICATIONS NETWORKS AND SWITCHING SYSTEMS. MULTICHANNEL TELECOMMUNICATIONS SYSTEMS. ELECTRONIC SYSTEMS. COMPUTERS, COMPLEXES, SYSTEMS,**</u>

AND NETWORKS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL SYSTEMS.

- Tula Higher Artillery Engineering School.

  Specialties: Gas dynamics pulse devices. Electrical engineering. **RADIOS. AUTOMATED INFORMATION-PROCESSING AND COMMAND-AND-CONTROL-SYSTEMS. COMPUTER AND AUTOMATED SYSTEM SOFTWARE.**

TECHNOLOGY CATALOGUE

ADVANCED COMMAND-AND-CONTROL SYSTEMS

"U.S. SYSTEMS"	RUSSIAN SYSTEMS
*EC-130 E	*FIELD-AUTOMATED C^2 SYSTEMS
*EC-135	
*E-3A AWACS	
*E-3C	
* "ORION" REMOTE RADAR SURVEILLANCE (RRS) & CONTROL AIRCRAFT	
* "STRATEGIC COMPUTER INITIATIVE" (E.G., FIFTH-GENERATION COMPUTERS)	
*NEUROPHYSIOLOGICAL/NEUROCYBERNETIC	
* "INTELLECTUAL COMMAND-AND-CONTROL SYSTEMS" (ICCS)	
*WWMCCS	

COMMUNICATIONS SYSTEMS

"U.S. SYSTEMS"	**RUSSIAN SYSTEMS**
*COMMERCIAL COMMUNICATIONS SYSTEMS (E.G., INTELSAT-5)	
* "MICROSAT" SMALL-SCALE SPACECRAFT	
*MILSTAR	
*TACSAT	
*DSCS STRATEGIC SATELLITE SYSTEM	

"ARTIFICIAL INTELLIGENCE" COMPONENTS

"U.S. SYSTEMS"	**RUSSIAN SYSTEMS**
*TOMAHAWK CRUISE MISSILES	*S-300 SAMs
*GUIDED AERIAL BOMBS WITH LASER ILLUMINATION	*SELF-CONTAINED SUBMERSIBLES
*PATRIOT MISSILES	* "NANO-TECHNOLOGIES"
*F-117A STEALTH AIRCRAFT	*NEUROCOMPUTERS
*M1A1 ABRAMS TANK	
*JSTARS	
*MOBILE UNDERSEA SYSTEM TESTBED/ "SOVA"	
*EXPERT SYSTEMS	
*NEURAL NETWORKS	
TRANSPUTERS	

MILITARY ROBOTS

"U.S. SYSTEMS"	RUSSIAN SYSTEMS
*RECON ROBOTS (E.G., PROWLER)	*DRONES
*TANK / ANTI-TANK	
*MISSILE	
*AIR DEFENSE	
*LOW- AND MEDIUM-POWER LASERS	
*DIRECT / INDIRECT FIRE ARTILLERY	
*ATTACK DRONES	
*REMOTELY CONTROLLED HELICOPTERS	
*REMOTELY CONTROLLED RECONNAISSANCE-WEAPON COMPLEXES	
*ROBOTIC VEHICLES FOR SIMULATING COLUMN MOVEMENT	
*WATER OBSTACLE RECON ROBOTS	
*RADIATION / CHEMICAL RECON ROBOTS	
*ROBOTIZED EW	
*MINING / MINE-CLEARING	

RECONNAISSANCE, SURVEILLANCE, & TARGET ACQUISITION SYSTEMS (RSTA)

"U.S. SYSTEMS"	RUSSIAN SYSTEMS
*PEGASUS LV	*TU-95 RTs AIRCRAFT
*RECONNAISSANCE RPVs & DRONES (E.G., "PIONEER-1")	*TU-16R AIRCRAFT
*E-2C HAWKEYES	*TU-16RM AIRCRAFT
*OPTICAL, RADAR, & ELECTRONIC SMALL-SCALE SPACECRAFT	*SU-24 AIRCRAFT
*IMEWS SPACECRAFT	*ASW DETECTION (BISTATIC & MULTISTATIC / INFRASONIC / NON-ACOUSTIC)
*RF-4C TACTICAL RECONNAISSANCE AIRCRAFT	*SQUID MAGNETOMETER (?)
*TR-1 STRATEGIC RECONNAISSANCE AIRCRAFT	
*TORNADO AIRCRAFT	
* "AURORA" STRATEGIC RECONNAISSANCE AIRCRAFT	
*LACROSSE, KH-11M, DSP SATELLITES	
*FIXED DISTRIBUTED SYSTEM	
BSY-1 / BSY-2	
*EMSP	
*NAVSTAR	
*SOSUS	
*NOSS	

"PSYCHOLOGICAL WEAPONS"

"U.S. SYSTEMS"	RUSSIAN SYSTEMS
*LEAFLETS	*SHF WEAPONS
*RUMORS	*INFRASONIC WEAPONS
*ANONYMOUS PHONE CALLS	*PSYCHOTRONIC WEAPONS (E.G., "BIOLOGICAL ELECTRONIC DEVICE")
*ANONYMOUS COMPUTER MESSAGES	(SEE ALSO "NON-LETHAL WEAPONS")
*MASS MEDIA	

<u>"INFORMATION WEAPONS"</u>

"U.S. SYSTEMS"	RUSSIAN SYSTEMS
* "21st - CENTURY SOLDIER" GEAR (MICROCOMPUTER, INFRARED SENSORS, ETC.)	
*COMPUTER VIRUSES - "TROJAN HORSE" - "FORCED QUARANTINE" - "OVERLOAD" - "SENSOR"	*SHF WEAPONS *EMP WEAPONS *MINI-NUKES (CATEGORIZED AS "THIRD-GENERATION NUCLEAR WEAPONS")
*LOGIC BOMBS - "TROJAN HORSE" - "ALGORITHM BOMBS" - "SOFTWARE BOMBS"	*ACCELERATING (BEAM) WEAPONS *GEOPHYSICAL/ "ECOLOGICAL WEAPONS" (CATEGORIZED AS "WEAPONS BASED ON NEW PHYSICAL PRINCIPLES")
*PORTABLE EMP GENERATORS	*NON-LETHAL WEAPONS
*MK-ULTRA ("zombifying"/pharmacological means/psychotropic generators)	*PSYCHOLOGICAL WEAPONS
*INTERNATIONAL TELECOMMUNICATIONS NETWORKS / INTERNET	"SPECIAL PROGRAMS" (E.G., MICROBES)
*COMPUTER- / MICRO- "CHIPPING"	
*BIOLOGICAL AGENTS ("SPECIAL MICROBES")	
*ELECTRONIC MASS MEDIA	
*DATABASE ON PROFESSIONAL HACKERS	

ELECTRONIC WARFARE (EW) SYSTEMS

"U.S. SYSTEMS"	**RUSSIAN SYSTEMS**
*EF-3A AIRCRAFT	*ELECTROMAGNETIC WAVE WEAPONS
*EA-6B AIRCRAFT	*ARGMs
*EC-130 AIRCRAFT	
*F-4C EW AIRCRAFT	
*F-117A STEALTH AIRCRAFT	
*DECOY GLIDERS (E.G., A-6 MEDIUM BOMBERS)	
*HARM ANTI-RADIATION MISSILES	
* "TACIT RAINBOW" ANTI-RADIATION DRONE	
*ALL GUIDED MISSILES WITH PASSIVE RADAR HEADS HOMING ON RADIO-FREQUENCY EMITTERS = MOST EFFECTIVE EW	

RADARS

"U.S. SYSTEMS"	**RUSSIAN SYSTEMS**
*E-3 AWACS	*SPACE-BASED SYNTHETIC APERTURE RADAR
*E-2 HAWKEYES	*OVER-THE-HORIZON (OTH) RADARS
*AFP-888 SATELLITE & SPACE-BASED RADARS	*MULTI-POSITIONAL / MULTI-FREQUENCY RADARS
*PHASED-ARRAY RADARS (E.G., AN/MPQ-53)	*HOLOGRAPHIC RADARS
*EHF-BAND RADARS	*AIR- AND SPACE-BASED RADARS
	*EM, INFRARED SYSTEMS

VIII. NEW OPERATIONAL CONCEPTS

NEW TRENDS

Russian military scientists argue that at the present time quite different trends are beginning to emerge in military art, essentially different from the traditional views on the organization and conduct of combined-arms operations; the content of combat missions; their sequence; and order of priority in the analyzed dialectic unity of reconnaissance, fire, and maneuver. Their emergence is conditioned by a number of political, social, military-technical, and military factors.

- First, the negotiating processes on arms, along with the aspiration to lower the levels of combat potentials of armed forces, have led to a substantial change in the structure of the combat potentials themselves, including those of the ground forces. With respect to the latter it has become impossible to conduct combat operations by traditional methods in view of the substantial cuts in their numbers -- and especially in view of the RMA's requirement for an expanded scope of operations.

- Second, the public attitude toward methods of warfighting is also changing. Such slogans as "Victory at Any Price" or "Not a Step Backwards" no longer find support either among the military or among the civilians, increasingly giving way to "technocratic" trends in the military sphere. This in turn calls for a deep revision of the role of the individual in war, and the realization that modern war must be "intelligent" and "civilized."

- Third, the combat capabilities of modern arms and combat equipment, primarily weapon systems, are changing drastically. Their effective range, accuracy, and high rate of fire allow fire support systems to be transformed into systems for conducting independent fire operations and combat action, while in terms of their destructive factors weapon systems are beginning to approach nuclear weapons.

- Fourth, the sharply increased mobility of enemy troops, their protection, and target maneuverability on the battlefield compel a search for such methods of neutralizing them which can be realized only through an efficient coordination of actions by a large number of heterogeneous forces and means.

- Finally, modern warfare -- even with conventional weapons, owing to their tremendous destructive impacts -- should be objectively geared toward lightning-like speed and the objective, as soon as possible, should be to render the opposing side incapable of continuing the war further, and to transition to non-military means of addressing and managing the crisis. [115]

In the Russian view, the main trends in the evolution of the unity of reconnaissance, fire, and maneuver in modern conditions include the following:

- A substantial increase in the role of reconnaissance in present-day conditions. Reconnaissance is becoming capable of creating conditions for averting war or ensuring the earliest possible prevention or termination of a military conflict at its outset. The main criterion of this is the comprehensive nature and constant combat readiness of reconnaissance bodies at all levels and their high technical equipment standards. Whereas in the past the situation allowed systematic reconnaissance mainly on the strategic scale, a contemporary enemy may not allow this. In combined-arms operations the increased role of reconnaissance will strengthen the "technocratic" character of troop and weapon control processes, thus intertwining fire and maneuver still closer. The scope and content of reconnaissance missions in providing weapon systems with data about enemy targets and monitoring the results of their engagement will expand sharply, which will become a determining factor in the process of decision-making by commanders for further action.

- Expansion in the forms of combat employment of weapon and strike systems and a sharp growth in the role of fire as a component of combat action. This

[115] Colonel V.I. Filippov, "A Trend Towards the Unity of Reconnaissance, Fire, and Maneuver in Combined-Arms Operations," VM, No. 7, 1994, pp. 34-40.

is related primarily to the fact that in modern warfare a growing importance is being assumed by its initial period -- especially the first stage in which the warring sides will undoubtedly seek to seize the strategic initiative through a powerful fire delivery with precision weapons and to create within the shortest possible time an overwhelming superiority over the opponent, thus ensuring success in the war as a whole. Fire impact on the enemy in the initial period can escalate into independent forms of combat action by weapon and strike systems in the shape of fire operations, engagements, and battles. This will influence the traditional perceptions vis-a-vis a consecutive (including mobilizational) deployment of weapon and assault systems, as well as the methods of deploying combined-arms forces.

- Growth in the extent of effective enemy engagement with weapons in undertaking maneuver. Importantly, this will affect not only the traditional forms of fire combat support for combined-arms elements, units, and forces but also the period of their deployment in the interests of creating troop contingents and their operational and tactical formations (combat order). Because such a trend can also be characteristic of the opposite side, combat action will begin with fierce fire battles at distant approaches -- which will effectively become a component part of combined-arms operations.

- Expansion of the frontage and depth of fire and fire maneuver and the growing frequency of its employment. This is due to the increased range of weapon and strike systems, their high costs, and quantitative limitations -- which require centralizing the structure of weapon and strike systems.

- Changes in the methods of troop deployment prior to entering battle, and changes in the objectives of maneuver. This was caused by a reduction in the authorized strength of combined-arms groupings and an increase in the width of their areas of responsibility, with a simultaneous growth of the threat of losses from enemy weapons. In modern conditions troops will have to occupy the most dispersed areas, at a great distance from the line of contact -- which precludes their detection by most reconnaissance systems, their engagement with the bulk of weapon systems, and a surprise enemy strike with motorized infantry and tank units and subdivisions. Moreover, concentration areas will be periodically changing owing to the increasing capabilities of space reconnaissance. In some cases the main objectives of troop maneuver at the initial stage of combat action will be withdrawing troops from under enemy fire and ensuring their survivability.

- The growth of the spatial scope and scale of maneuver, the upgrading of its methods, and the expansion of its objectives. This trend emerges objectively following reductions in arms and armed forces and changes in their structure. The impossibility of having large troop groupings created in all strategic sectors presupposes the presence of mobile structures and the rapid redeployment of troops to any sector of threat, especially by air. Cuts in the numerical strength of combined-arms forces objectively necessitate highly maneuverable combat action in the process of combined-arms operations, a buildup of aeromobile forces, an increase in the scope of tasks addressed by them, and a diversification in the forms and methods of their combat employment. Therefore such a component as an air echelon composed of air-assault and landing units will be used not occasionally but will become a constant feature. At the tactical level, combat action by motorized infantry and tank units will gradually merge with the actions of aeromobile units and combat helicopters, becoming combat action by consolidated air-ground tactical groups.

- Changes in operational troop formations (combat order). The striving to avoid heavy losses by the main attacking or defense forces before contact with analogous enemy forces in the process of fire exchanges compels the sides, at the start of an operation to use -- instead of first echelons -- special forward echelons: small in number, but highly mobile and capable of covering the deployment of the main forces, repulsing strikes by substantially superior enemy mechanized forces, and conducting decisive mobile attack operations in advance of attacks by the main forces. In the future, the foundation of forward echelons should be constituted by reinforced standard aeromobile elements and units.

- Changes in the order of organization and character of maneuver. Traditionally, in organizing combat action in a combined-arms operation, the order and character of maneuver by combined-arms units have constituted the basis for planning the combat employment of artillery, aviation, and other branches. The weapon system was also "adjusted" to fit the order of maneuver by infantry and tanks. In contemporary conditions this will not always be expedient. Thus, in a number of instances (especially at the tactical level), the choice of specific axes of attack can be done not in advance but based on the assessment of engaging enemy forces in the course of combat. Maneuver both in preparing an attack or defense and in the course of combat will acquire the character of mutual counter-maneuver. Maneuver itself will become more decisive and will be less dependent on earlier prepared plans. There is no question that the winner will be that side which takes the upper hand in the exchange of fire and manages to maneuver more successfully, preserving the combat potential of its troops.

Russian analysis of the dialectics of reconnaissance, fire, and maneuver -- as well as trends toward their evolution in modern combined-arms operations -- has led to the following conclusions. First. Reconnaissance, fire, and maneuver -- although they have their own objectives and their own content -- are at the same time closely interrelated. In the course of evolution, the upgrading of one element has always led to a change in the role and essence of another. In modern conditions the interrelation between these elements will become even more complex, passing from strict consecutive subordination "reconnaissance - maneuvering - fire" or "reconnaissance - fire - maneuvering" into a mutually supporting category. Second. As a result of a substantial growth in the role of reconnaissance, its effectiveness becomes one of the determining factors in achieving success in an operation -- while it itself is gradually exceeding the boundaries of operational support and organically becoming the essence of combat action.

Third. As the capabilities of weapon and strike systems grow, effective enemy engagement, especially at a great distance, will acquire greater priority, in some instances giving combat operations by combined-arms units a finalizing character. Fourth. Maneuver has always essentially conditioned and will continue to condition the success of combat operations; but its objectives, concept, forms, methods, and order of conduct will change substantially. Fire maneuver, air maneuver, maneuver in the interests of ensuring the survivability of troops, and counter-maneuver by combined-arms units will become decisive for a successful operation.

According to General of the Army M. Gareyev, of the three most important elements of battle -- fire, strike, and maneuver -- the RMA generates a sharp increase in the importance of fire, which must reliably lay the groundwork for a strike without forcing troops, at the cost of great losses, to overcome the enemy. The primary missions in defeating the enemy will be accomplished not in the course of clashes between forward units, but through fire from afar. As a result, all battles will take on a dispersed character, encompassing all spheres of military operations in terms of fronts, depth, and altitude.[116]

Russian military scientists note that the stunning efficiency of high-precision weapons was demonstrated in the Gulf War -- and their capability to influence the course and outcome of military operations requires revising many of the priorities in operations. Whereas in the past the priority was to achieve the operation's objective through strikes by large combined-arms units, the emergence of new highly effective high-precision arms -- for example the ATACMS operational-tactical missiles, the Copperhead, the SADARM guided artillery shells, and others -- the priority now is effective engagement. Today there is an opportunity to inflict considerable damage on the adversary at the start of hostilities -- and only after this to achieve the operation's

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[116] General of the Army Makhmut Gareyev, "The Experience of Past Wars Has Not Lost Its Value," KZ, 20 April 1995, pp. 2-3.

objectives through strikes by combined-arms large units. This is said to be the fundamental role of effective engagement of the adversary in modern conditions.[117]

But the continued provision of new high-precision arms to the troops, the large-scale cuts in the armed forces in Europe, and changing views on the methods of conducting the first operations in the initial period of hostilities lead to certain contradictions between the established theories of military art and the contemporary views of the nature of warfare that call for constantly updating the theory of effective engagement of the adversary (EEA) in operations.

In the Russian view, the EEA structure in an operation should mean a spatial-temporal sequence of effective engagement of the opposing group using all possible forms and methods. According to the current theory, the EEA structure in an operation has two components: an effective engagement of the adversary along the entire large unit zone in the interests of the operation as a whole, and on the area-by-area basis -- with the objective of fulfilling the operational tasks one by one in the course of the operation. Analysis indicates that this structure could be acceptable also in the nearest future.

As the Russians see it, one should make a distinction between a consecutive and a simultaneous mode of effective engagement of the adversary. Analysis of the Great Patriotic War operations, as well as of the post-war EEA guideline documents shows

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[117] Colonel A.Ya. Chernysh, Colonel V.I. Levshin, and Colonel N.A. Pinchuk, "Some Questions of Effective Engagement of the Adversary in Operations," VM, No. 7, 1994, pp. 22-26.

that the consecutive mode was and remains paramount. At the same time a steady tendency is evident in the armed forces of advanced countries wherein this mode is evolving to become simultaneous. To this end there is being developed a long-range high-precision weapon of great destructive power capable of functioning in real time. Given a sufficient number of long-range high-precision weapons of a destructive power commensurate with that of low-power nuclear weapons, it would become possible to transition to the mode of a simultaneous effective engagement of adversary groups.

In the Russian view, the transition from one mode to the other will be evolutionary because the stock of high-precision weapons increases in large units. Since accumulation processes proceed gradually as a rule, simultaneous effective engagement of the adversary along the entire zone of a large unit would be used in the interests of the operation as a whole, and the consecutive effective engagement of the adversary sector by sector.

According to General-Major I.N. Vorob'yev, the conditions of warfare in armed conflicts are extremely varied. The means of action that were developed for a "large" war, for example, cannot be mechanically transferred to local wars. In addition, the opposing sides usually have a different level of military organization, training, and technical equipment. At the same time, this does not at all mean that one must be oriented toward "simplified" tactics. Indeed local wars have generated the development of many new and effective means of combat operations. During the Korean War, for example, the tactic of "funnel warfare" emerged and was widely used; the tactic of air-mobile operations emerged in Vietnam; and the tactic of remote combat emerged in the Middle East (1967, 1979, and 1982).[118]

A special feature of local wars is that they usually become a range for the testing of new tactical concepts and kinds of military hardware. The Americans conducted mass tests of combat equipment and arms during the war in the Persian Gulf: systems of highly accurate weapons; SLAM and ATACMS missiles; Patriot antiaircraft missiles; the heavy bomber GBU-15; new means of communication and radio-electronic warfare; and new means of radio, radioengineering, and space reconnaissance.

Vorob'yev notes that in analyzing the experience of local wars in the 1950s through the 1990s, it is important to note that maneuvering forms of combat prevailed over positional forms. A long positional confrontation of the sides was noted only during the time of the war in Korea. In all other wars, if such a phenomenon occurred it was only for a short time and episodic. And the possible armed conflicts of the future will hardly be an exception to this rule. Such is the tendency in the development of military science: with the increase in the power and speed of weapons and in the maneuvering capability of the forces, there is an ever-greater displacement from the arsenal of tactics of such companions of positional confrontation as penetration and the use of unbroken, trench, and deeply echeloned defense. Naturally, the application of rigid methods in the operations of forces is receding into the past, and the "geometry"

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[118] General-Major Ivan Nikolayevich Vorob'yev, "War Without a Front or Rear, or Several Lessons in 'Non-Stereotypical' Tactics," KZ, 31 March 1994, p. 2.

of the battlefield is changing fundamentally in that it is becoming "nonlinear" and "multidimensional."

Operations of forces under the conditions of an "expanded battlefield" (that is, in individual points of combat, in the absence of a clearly defined front line and direct contact of units with their neighbors and with the enemy) apparently will become new features of contemporary tactics that may be manifested especially clearly in local armed conflicts. For it is usually rather limited forces and systems that are involved in such conflicts, and their action is concentrated in time and space. It can be expected that the opposing side will not always strive to engage in "open" combat. More often he will prefer to avoid a direct clash with an enemy with superior numerical strength and will try to "slip away" from the strike. It must be assumed that under these conditions the basic operational methods will be surprise attacks like a "swarm of bees" against individual facilities -- especially against unprotected command-and-control facilities, rear bases, truck convoys, guard posts and security detachments, checkpoints, and individual garrisons. It is possible that extensive use will be made of ambushes, the setting of traps, the mining of roads, and acts of terrorism. Nor can one rule out large-scale clashes that under some conditions may grow into large-scale operations.

Russian military scientists note that equipping troops with precision-guided munitions not only substantially expanded their combat capabilities but also imparted a new qualitative characteristic to them: rapidly depriving the enemy of the capability for effective resistance. And this, in turn, entailed a fundamental change in strategy, the essence of which consists of a real capability to utilize fundamentally new methods of armed combat.[119]

Thus, in future military operations the "U.S. military leadership" considers it advisable to reject the employment of weapons that cause enormous casualties, destroy industrial enterprises and infrastructure, and disrupt the ecology. In the opinion of "the Americans," qualitatively new armed forces must be utilized not so much to conduct traditional combat operations as to deprive the enemy of the capability for active resistance -- which must be achieved precisely through PGM "surgical strikes" and the massive employment of ECM. In the process, the conduct of ground operations must be minimal or should not occur at all.

Colonel-General V. Miruk notes that considering the increasingly greater effectiveness of airborne offensive resources, and the ever-greater significance of their first strikes, being first to act will not only ensure the seizure of the operational and strategic initiative, but will also decide the outcome of the war. Retaking the initiative in the course of combat activities may be impossible even at the price of considerable casualties.[120]

The main strategic objective of air defense operations in peacetime is to create conditions ensuring a guaranteed effective strike -- both a retaliatory surprise

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[119] Colonel Boris Nikolayevich Sibirskiy, "A 'Surgical Strike' Against the Enemy: Precision-Guided Weapons Guarantee It," NVO, 14 December 1995, p. 6.

[120] Colonel-General Viktor Miruk, "Reforming the PVO: Problems and Conflicts," Vestnik protivovozhdushnoi oborony (hereafter cited as VPVO), No. 9, 1993, pp. 1-3.

counterblow and a retaliatory nuclear-missile strike; and when aggression proceeds without nuclear weapons, achievement of the objectives and the missions of strategic deployment in the initial and subsequent periods of war. The main missions of strategic operations are: dependably revealing and providing timely warning of a missile and an air strike within an amount of time close to the flying time of ballistic missiles, reliably protecting strategic nuclear forces and the top levels of state and military administration against surprise air strikes, monitoring observance of the standard rules of using a state's (coalition's) airspace and outer space, and countering violations of them. Preparations must be made for the last mission with regard for the greater probability of provocative and terrorist actions employing aerodynamic and ballistic resources.

NEW VIEWS ON OFFENSE/DEFENSE

According to General-Major I.N. Vorob'yev, combat practice has confirmed that it is extremely difficult to regain the strategic initiative lost at the start of military operations. A shining example of this is the war in the Persian Gulf area. Apparently the Iraqi leadership adopted an operational plan similar to the one which was in its time brilliantly executed by the Soviet command in the battle of Kursk. In repulsing the strike by the coalition forces, it counted on using the strong features of its carefully prepared, deeply echeloned defense and imposing a protracted positional warfare tactic on the adversary; and neutralizing its advantage in the number and quality of aviation and cutting-edge precision weaponry. But in practice this design proved inconsistent. Having placed the initiative into the hands of the multinational command, the Iraqi leadership failed to influence the subsequent course of events, even though it possessed a considerable strategic capability.[121]

The lessons of the Desert Storm operation caused the Russians to question whether they, like the Iraqis -- in creating a modern retaliation and counteroffensive theory -- did not continue to think in terms of past wars, convinced that they would manage to reverse the course of warfare in their own favor. The substance and content of the modern counteroffensive will be largely different from those in the past wars. As is known, during the Great Patriotic War the turning point depended mainly on the condition of the ground forces -- the war-fighting capability of the armies and fronts which bore the main brunt of both repulsing the enemy's attack and subsequently routing it. Aviation played a supporting role. At present, as the experience of local wars has shown, priorities are being shifted: in resolving strategic tasks in the course of a non-nuclear war, the air forces are occupying center stage. With their forces and fires they can largely condition the outcome of military operations as, for instance, was the case in the Persian Gulf zone, where the ground forces were practically out of business: they were engaged at the final stage of the Desert Storm operation only when the Iraqi army was largely demoralized and incapable of fighting effectively.

Therefore to create favorable prerequisites for the troops to transition to the counteroffensive today it is not enough to stop the advancing adversary, to wear down his troops by attrition, and to weaken the strike grouping. It is also absolutely vital to gain air superiority.

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[121] General-Major I.N. Vorob'yev, "More on the Counteroffensive," VM, No. 1, 1994; pp. 9-14.

Apart from routing the enemy's air grouping, it is also vital to achieve fire superiority. Here it is not enough -- as was the case in World War II -- to create a colossal density of artillery units and mortars, delivering powerful preparation fire and suppressing the enemy in the main defense sector. At present this task has become extraordinarily more complex owing to the availability of a large number of various weapons with both short- and long-range action capability -- especially reconnaissance-strike/fire complexes (RSC and RFC) and cruise missiles. The destruction of precision weapon systems will be an especially formidable challenge. Therefore fighting to gain fire and air superiority, as the main preconditions for a successful counteroffensive, will now consume considerable time and demand tremendous efforts. To hope that the situation will be reversed soon after the start of military operations and the enemy's penetration into the immediate operational depth clearly means to delude oneself.

In analyzing the transition to the counteroffensive in contemporary warfare, it is essential to take into account the increased troop vulnerability to strikes by aviation, cruise missiles, and other enemy assault systems equipped with precision weapons. There are no more areas inaccessible to modern weapons, especially cruise missiles. Today the fact that installations may be located far from the front line does not in itself guarantee their protection. Other developments include the increased reconnaissance capabilities, especially space reconnaissance, for detecting troop groupings no matter where they might be concentrated, as well as electronic warfare assets for disrupting troop and weapon command-and-control systems. Thus, at present it will not be particularly difficult to thwart a prepared counteroffensive.

According to General-Major Vorob'yev, all this goes to show that there are no grounds whatsoever for viewing the counteroffensive as the optimal, let alone basic or desirable type of action for guaranteeing the recovery of the strategic initiative lost in the initial war period. The counteroffensive is an extremely difficult and very risky form of warfare, which should be conducted only in the most critical situation when there is no other option left. But one should not conclude that the development of the theory of the counteroffensive or its mastering in practice must be abandoned altogether. There must be no extremes. What needs to be understood is that current military capabilities for ensuring it must be assessed realistically.

The war in the Persian Gulf, says Vorob'yev, in which weapons of the 21st century were tested, can be regarded as a prototype of future operations. It demonstrated the absolute supremacy of air-land maneuver over passive positional actions. One can expect that the counteroffensive will most likely begin with large-scale maneuvering -- rapid, deep, enveloping, and bypassing actions; decisive penetration to the depth of enemy groupings by air and through the breaches in their operational formation; and combined strikes on defending and advancing troops from various directions -- from the front, flanks, rear, and from the air and ground. In other words, in a counteroffensive operation priority must be given not to accomplishing a breakthrough but to overcoming the enemy defense on a wide front, along separate axes.

Vorob'yev stresses that the structure and content of the contemporary counteroffensive operation and therefore the methods of preparing and conducting it will differ radically from those used in the two world wars. Apparently the prevailing form of the modern counteroffensive will be not close combat but remote fighting intended to inflict a defeat on each other over maximum distances -- while still in the period of forward movement and concentration of troops. Such a conclusion suggests itself because the proportion of all long-range means and facilities is growing steadily. This is due to the appearance of basically new automated combat systems (RSC and RFC) capable within minutes of detecting and engaging targets regardless of their distance from the front line; the enhanced effectiveness of aviation and its increased role in the effective engagement system; the use of ground-, air-, and sea-based cruise missiles and remote mining equipment; and the upgrading of salvo-launching rocket systems, other systems using cluster and precision-guided munitions, and vacuum or fuel-air explosives.

One can thus expect that the counteroffensive will begin with an electronic-fire battle -- a system of fire and electronic impacts, coordinated and interrelated in their targets, place, and time; and systematic combat actions by aviation and air defense forces to gain and maintain fire superiority over the adversary and bring about its informational paralysis. This paralysis consists in disrupting troop and weapon command-and-control systems; and disorganizing air defense, electronic warfare, and remote-mining systems. In the course of the counteroffensive, the electronic-fire battle can be conducted continuously and finally take the form of an electronic-fire operation, as was the case in the Persian Gulf zone.

A new element in the counteroffensive operation will be actions by air and in-depth echelons -- tactical and operational air assault forces consistently inserted into enemy rear areas; actions by mobile groups -- assault, advance, and enveloping detachments designed to create an active front in the enemy's rear areas; and restraining maneuver action with reserve forces, designed to destroy nuclear strike forces, ground-based elements of RSC and RFC, enemy command and control, and rear-service installations, thereby undermining the stability of the defense from within.

The basis of the counteroffensive operation will be constituted by deep strikes against enemy groupings, ensuring first-priority destruction of the centers of its operational stability; a continuous build-up of fire efforts in the course of battle; rapid maneuver with fire and strikes; and massing fire on vital axes. In this context the main methods of delivering fire for effect can be: area, selective, isolation, selective-restrictive, zonal-installation, fire-blocking, and barrage-fire methods.

Vorob'yev stresses that the main distinctive feature of the modern counteroffensive operation lies in the fact that the electronic engagement-fire delivery factor comes to the fore, whereas during the Great Patriotic War the decisive role was played by strike and assault actions by infantry and tank groupings -- fire delivery played an auxiliary and supporting role. Proceeding from this, in making a decision to launch a counteroffensive, the commander should give primary attention to the following questions: selection of installations and methods of strike; creation of a strike-and-fire grouping; massing weapons to accomplish the most essential tasks of the operation; timely maneuvering with weapons and their strike-and-fire effects; organizing continuous interaction between weapon systems and combined-arms formations (large units); stable and continuous control of weapon systems and their strike and fire control; and maintenance and timely restoration of the combat capability of troops and weapons.

One of the important conditions for the success of the counteroffensive is the organization of effective troop protection against the enemy's precision weapons. It is important that all measures related to this should be varied and preemptive with respect to enemy strikes -- especially with RSC/RFC and cruise missile systems. Protection must be ensured continuously to the entire troop formation depth, in all elements, and preferably in covert form so as to delude the enemy. The defense system must not restrain maneuver or lower troop combat capability.

Thus, the content of the modern counteroffensive operation is shaped by the influence of many interrelated operational and tactical factors, but a special place belongs to electronic fire- suppression and air- land mobile actions, which generate new methods of employing troops (forces), such as reconnaissance-strike operations, electronic-fire battles, air assault raids, air-land maneuvering, the aero-mechanized units raid, and strike and airborne assault actions. Vorob'yev concludes that it is essential to decisively stamp out the defensive-counteroffensive stereotype which has been deeply ingrained in past Russian military practice.

Russian military scientists note that the need to upgrade the structure of the notion "defensive operation method" is conditioned by a number of factors. First, the relationship between the weapons and military equipment being provided to the troops on the one hand, and methods of warfare on the other. In other words, the more one generation of weapons and military equipment differs from the previous one, the deeper and more diverse its impact on the content of defensive operation methods. Now and in the near future the emergence of new types of weapons -- especially precision, electronic, and energy weapons, as well as the shifting of efforts to the air (outer) space, can substantially impact on the structure of the defensive operation content. Therefore these matters should find their reflection in the theory of military art.[122]

Second, the content of defensive operation methods should evolve in correspondence with the forms of offensive action by the enemy. This is due to the fact that defense and offense are two aspects of one process: armed confrontation. If the interrelation is disturbed and the content of a defensive operation does not correspond to the forms of the offensive used by the enemy, failure is a foregone conclusion. A good case in point is the war in the Persian Gulf, in the course of which the Multinational Forces demonstrated new elements of offensive operations. The conventional methods of defense used by the Iraqi Armed Forces proved futile in this situation because their content failed to take into account the modern requirements and character of warfare. Therefore an urgent need has arisen to revise the content of defensive operations conducted by operational-strategic units. It should reflect the enhanced role of fire combat, the shifting of efforts to the air (outer) space, and the increased role of EW in disrupting the enemy's weapon and troop command and control.

Thus, the drastic changes in the military-technical equipment of units and in military specialist views on methods of offensive operations call for new approaches and further development of defensive operation methods and also for formalizing their structure in basic guideline documents and manuals. But this is problematic because the generally accepted military terminology, including the structure of the content of

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[122] Colonel N.K. Utkin, "On the Structure of the Notion Defensive Operation Method," VM, No. 3, 1995, pp. 42-46.

defensive operation methods, does not fully respond to the character of modern warfare. Furthermore, there is a belief that a defensive operation by an operational-strategic unit in effect more and more approximates an offensive operation and can include -- and actually does include even now -- actions (structural elements) characteristic of an offensive operation. This manifests itself especially graphically in the unit's participation in an air-defense operation in the theater or in fighting for air superiority, in electronic-fire combat, and in destroying a penetrating group or special task force. In order to accomplish the objectives of a defensive operation, part of a unit's assets can deliver counter-strikes, undertake the offensive (counter-offensive) in particular sectors, reposition or shift forces, conduct maneuvers to the flanks or the rear of the attacking enemy group, and so forth.

Evidently, the need to restructure the content of defensive operation methods by an operational-strategic unit is conditioned by modern defense specifics. The main ones among them are as follows: the increased scope of combat action (operational-tactical normatives); the growing importance of deep engagement as a main condition for ensuring success in an operation; and the enhanced role of defense as a form of warfare with respect to the offensive, especially in the initial period of war.

The first specific feature characterizes the operational art level of large units in a defensive operation: increased spatial parameters of an operation; qualitative and quantitative changes in the elements of the unit's operational formation; a substantial increase in the share of combat action in the third spatial dimension; the shifting of efforts to the depth of operational formations (fighting second echelons); dispersal of combat assets; and the timely ensuring of combat power superiority in major sectors.

The second feature is the enhanced role of deep engagement as the main condition for ensuring success in an operation. Thus, compared to the fifties, the effective range of artillery has increased by 1.5-4 times and antitank systems by 5-6 times, the effective range of tactical aviation has grown by 5-7 times, and the depth of impact by operational-tactical missile systems has doubled.

The higher accuracy and firepower of conventional weapons -- especially of integrated reconnaissance-strike systems -- allows one to strike the enemy's critical operational-tactical targets to the entire depth of an operational formation, to sharply change the correlation of forces in one's favor, and to disrupt the troop command-and-control system, thus predetermining the success of the defensive operation.

The third feature arises from the modern requirements for defense, which on the whole substantially affect its character and principles of organization and conduct. Whereas in the past the defense was considered to be a forced form of combat action designed to ensure conditions for an offensive and for routing the enemy, at present -- especially in the initial war period -- the situation is changing: the defense can be assigned the key role in engaging main enemy forces in the process of fire combat by the sides.

It is no accident that some "foreign military specialists" believe that the outcome of fire combat will lead one side to take up defensive positions while the other will proceed to attack. In other words, there may be no defense (in the traditional understanding); instead opposing groupings will be formed, ready to conduct both defensive and offensive action.

Changes in the character of a defensive operation show that a special importance in accomplishing its objectives in modern conditions belongs to winning air superiority, control of the air-waves, and fire superiority. Therefore, in defining the concept of an operation, the commander of an operational-strategic unit should first of all define the method of repulsing the enemy air (space) attack, neutralizing its EW strike (impact), preventing a weakening of one's own combat potential, maintaining command and control of the troops, and disrupting enemy command and control.

It follows from the above that such components can appear in the content of defensive operation methods as the option chosen for ensuring air (space) superiority or control of the airwaves or for disrupting the enemy troop and weapon command-and-control system. In the near future, in local and regional wars as well as in combat action in individual sectors, an operational-strategic unit can repulse air (space) attack, fight for air superiority and control of the airwaves, and disrupt the enemy troop and weapon command and control. In all instances these tasks should apparently find their place in the general structure of defensive operation methods. The Russians believe that the above generalizations can be included in the new structures of the content of defensive and offensive (counteroffensive) operation methods (see Figure 11).

Proposed Structures of the Content of Defensive and Offensive (Counteroffensive) Operation Methods

Defensive operation	Offensive operation
Operation method: options	
defensive operation	force organization
winning superiority in the air and airwaves	winning and maintaining superiority in the air and airwaves
disrupting enemy troop and weapon C^2	disrupting enemy troop and weapon C^2
repulsing enemy attack	switchover to offensive (counter-offensive)
effective engagement	effective engagement
fighting special operations forces, air assault forces/operational maneuver	delivering strikes/operational maneuver
delivering counter-strikes	exploiting air and air-wave superiority
completing the defeat of penetrating enemy forces	completing the defeat of opposing enemy forces

Figure 11

This option, they say, better responds to the requirements set for modern defensive operations. Of course in each particular case, in defining the method of conducting a defensive operation by an operational-strategic unit, not all of its components may be present; but on the other hand new ones can appear, which result from the shifting of efforts to the air (space), and the development of equipment and weapons based on new physical principles.

"ELECTRONIC-FIRE OPERATION"

According to Russian military scientists, the revolutionary nature of the Gulf War was manifested in the fact that it marked the origin of certain new forms and methods of operational and tactical actions such as the electronic-fire engagement, remote-controlled battle, air-assault raids, and deep mobile operations. The electronic-fire engagement played a special role in Desert Storm as the aggregate of massive, lengthy aerospace, missile, naval, and electronic strikes. It was the principal content of the operation and predetermined its successful outcome. In this case the novelty lay in the fact that electronic countermeasures acted as a special weapon that was equivalent to fire strikes in effectiveness.

First, Desert Storm was characterized by the significant duration of the electronic-fire phase (38 days), which surpassed the ground operations phase (4 days) by many times (ninefold). Second, a large amount of the latest EW equipment, airborne early-warning and control aircraft, and radar systems for aerial reconnaissance of ground targets and strike delivery control took part in the engagement. The employment of EW equipment previously unknown to the enemy ensured surprise in its use. Third, all the most important enemy targets were continuously subjected to electronic-fire pressure to the full depth of the operational alignment, which permitted disrupting the command-and-control and communications system simultaneously at all command echelons from tactical to strategic. Fourth, electronic and fire strikes were precisely coordinated by objective, place, and time. By being combined, they mutually supplemented and reinforced each other. Fifth, the Air Force played an especially important role in fire destruction. The intensity of its strikes (in some phases up to 2,000-3,000 sorties per day) had no precedent in any previous war.

All this together dictated the exceptionally high effectiveness of electronic-fire engagement of the enemy and the winning of the fire initiative and air superiority. Before the beginning of the ground phase of combat operations it became obvious that the opposing Iraqi force grouping had lost almost all combat effectiveness. The personnel were psychologically paralyzed. This considerably eased the task for the attacking mechanized and armored formations, which completed the enemy's defeat without encountering organized resistance. Therefore, one of the characteristic features of a "technological war" is that its objectives can be achieved under certain conditions even without ground troops invading enemy territory -- by conducting an electronic-fire engagement alone. This confirms the previous conclusion that, in the future, large masses of ground troops will not be required as part of an attack grouping.

Admiral Pirumov argues that the effectiveness of information systems has led "developed countries" to acknowledge the dominant role of the "electronic-fire" concept of waging war.[123] In force structure and equipment, this concept manifests itself not in competing for numerical superiority in motorized rifle (tank) formations for conducting ground battles, but in using industrial and technological advantages to create high-precision sea- and aerospace-based weapons and global C^2 systems that facilitate "surprise first and subsequent massed radioelectronic and fire strikes that decide the outcome of the war without the invasion of ground forces."

Pirumov stresses that a war's main objective is shifting away from seizure of the opponent's territory and toward 1) "neutralizing his political or military-economic

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[123] Rear-Admiral V.S. Pirumov, "Two Aspects of Parity and Defense Sufficiency," Ibid., pp. 26-34.

potential -- eliminating a `competitor'," and 2) "ensuring the victor's supremacy in the political arena or in raw materials and sales markets." The primacy of this concept has generated a new form of utilizing armed forces: the "electronic-fire operation."

This operation will typically begin with a surprise air attack rather than an invasion by deployed ground forces, which permits not only seizure of the strategic initiative but also disruption of the opponent's strategic deployment by striking a series of his most important targets with a first strike. In addition, losses of personnel are significantly lowered since ground troops are used only after achieving space and air superiority -- which guarantees their success. Pirumov concludes by arguing that parity thus requires calculations of not only the fire component of combat but especially the "information component" -- which must govern the allocation of scarce defense resources.

AIR-SPACE ATTACK OPERATIONS

In future war, say Russian military experts, the air forces will conduct an independent air-space offensive operation, which can actually begin and end the war. This operation will be conducted in combination with EW, and space will play a large role. Piloted aviation will be able to deliver a large quantity of PGMs to all targets. But piloted aviation will not operate over the opponent's territory. It will deliver the weapons to release points outside hostile territory and return for re-loading. The ground forces will remain, but they will be miniature, mobile, and designed to conduct peace-keeping operations and other LIC missions.

The following systems will be required to execute the first massive strike of the new air-space offensive operation:

- About 700 high-tech cruise missiles to destroy about 300 critical state and military targets
- About 3,000-3,500 high-tech cruise missiles to destroy about 500-600 key links of the military-economic potential
- About 2,000-4,000 high-tech cruise missiles to disorganize the energy sector

About 8,000 high-tech cruise missiles will therefore be required to execute the first strike in an air-space offensive operation. This operation will be conducted against the opponent's entire depth. Since the fronts will encompass all air axes of a state, the operation will essentially constitute a 360° attack. In past wars, the defender always expected an attack from specific axes at specific altitudes, and so designed his air defenses accordingly. But future war requires air defenses in all directions.

The air-space offensive operation can be conducted in two stages: 1) 10-12 days to destroy the opponent's retaliatory means, key military-economic objectives, and C^2 centers, and 2) 20-50 days to destroy the state's military forces and military-economic potential with massive numbers of PGMs. Russian experts calculate a requirement for about 50,000-70,000 high-tech cruise missiles, RPVs, and NPPs to accomplish these missions.

The following features of the combat employment of aircraft are taken into account in creating new air weapons:

- delivery of strikes against important enemy targets with conventional ordnance simultaneously to the full depth of his territory;
- convergence of the spheres of combat employment of tactical and strategic aircraft;

- decreased dependence of the intensity of air operations on time of day and weather conditions; and
- aviation's increased capabilities for delivering strikes against vulnerable elements of targets for suppressing but not destroying them.[124]

The main form of aviation operations in conflicts and wars that do not involve the use of weapons of mass destruction is the air offensive operation, the key element of which is seen as the first massive strike. That strike must have the element of surprise and be precise and powerful enough to preclude the enemy's use of weapons of mass destruction and ballistic missiles, as well as create preconditions for knocking out national and military control facilities, winning air superiority, blocking the advance of follow-on forces, and suppressing air defense systems. In the opinion of Russian military specialists, such a strike will be mounted for the most part at night.[125]

Military specialists are currently studying the following scenarios for mounting a first massive aviation strike at night:

- a strike mounted by stealth aircraft, some of which, before the operation begins, penetrate enemy territory in such a way that the fire effect on targets located at any depth is simultaneous and coincides with the onset of combat operations along borders and coastlines. It is believed that the psychological effect of such a strike on the enemy's military personnel and especially its population will be very substantial;

- a raid mounted in accordance with a preset plan without regard for the characteristics of stealth aircraft and new electronic warfare equipment; and

[124] Major P. Yelenin,"Air Force," ZVO, No. 11, 1994, pp. 30-34.

[125] Professor and Doctor of Military Sciences A. Drozhzhin and Major S. Anedchenko, "Night Aviation Combat Operations," ZVO, No. 1, 1995, pp. 36-42.

- a massive strike mounted by aircraft of all types (the mixed option), but in which stealth aircraft penetrate the enemy's airspace slightly in advance in order to suppress air defense installations and control systems.

Combat operations in a first night strike occur in the following sequence:

- First, heavy electronic jamming is created along the entire perimeter of the borders (front line) of the opposing state (coalition of states). Operations by electronic warfare forces and equipment may assume the character of an "individual electronic warfare operation."

- Strikes are inflicted by ground force and naval force weapons against detected air defense forces and equipment, as well as against installations of the enemy's command-and-control system located not only within the planned flight "corridors" but also, in part, in other sectors (for disinformation).

- Cruise missiles are launched across the border from various directions, striking key fixed targets densely covered by air defense systems, targets whose destruction requires high accuracy.

- Aviation, naval forces, and ground troops mount active combat operations in decoy sectors with the aim of diverting the enemy's attention. The American Armed Forces gained extensive combat experience in such operations during the start of the allied troop landing in Normandy in 1944, as well as in the war in Vietnam and Iraq.

Colonel-General V.A. Prudnikov, CINC of the Russian Air Defense Troops, stresses that the forms and methods of warfare are being perfected. The views of warfare as combat actions primarily by ground troop groupings where air attack and AD forces fulfill auxiliary tasks are becoming obsolete. The results of research programs and exercises point to a substantially increasing impact of confrontation in the airspace on the process and the outcome of modern warfare. Judging by the experience of recent wars and armed conflicts, even the ultimate objectives of military actions can be achieved with the use of air force groupings combined with the resolution of a number of auxiliary and logistical tasks within the general grouping of Air-Space Attack Forces (ASAF).[126]

Colonel-General Prudnikov also notes that basic trends in the development of the armed forces of a number of states include a reduction in financial resources for ground troop armament and an increase in the proportion of appropriations for developing aviation and space technology, electronics, and command-and-control and communications systems. This trend has been manifested stably for the last five years. The role of offensive air-space forces is increasing, since they can operate with both nuclear and conventional precision weapons in remote TVDs to support the prompt concentration of firepower and delivery of surprise strikes.[127]

Strategic aviation is being modernized. Its combat capabilities for engaging both area as well as single-point targets are increasing. New cruise missiles are being created with a conventional charge and a maximum range of fire of 3,000 km or more. In tactical and carrier-based aviation the Russians plan to create new types of flying craft, modernize flying craft, reduce the signature of aircraft and missiles by using stealth technology, and increase the range of fire of missiles along with their accuracy and target kill probability. Multipurpose fighters with supersonic cruising speed, high

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[126] Colonel-General V.A. Prudnikov, "The Main Directions of Organizing and Preparing the Air Defense Forces at the Present Stage," VM, No 10, 1993, pp. 2-6.

[127] Colonel-General of Aviation Viktor Prudnikov, "Aerospace Defense," AS, No. 4, 1995, pp. 6-10.

maneuverability, large radius of action, large ordnance payload and a short takeoff and landing capability will see development among the combat aircraft of tactical aviation.

According to Prudnikov, placing around 8,000 new-generation precision cruise missiles with highly effective conventional warheads into operation will permit the execution of missions in a conventional war that are comparable in scope to missions performed by nuclear weapons.

"Western countries" are actively developing reconnaissance-strike drones and systems with a range capability of from 30 to 650 km and an endurance of over 24 hours. New types of flying craft will include hypersonic craft with a cruising airspeed of Mach 5-6 or more. They are employed at altitudes of 30-120 km and will be capable of reducing the time of performing combat missions by 2-3 times, bringing it close to the time indicators of ballistic-missile strikes.

A special role is set aside for space systems that support the increased combat capabilities both of offensive as well as defensive components of armed forces not only in airspace, but also on land and at sea. They will be able to increase the effectiveness of employing air groupings by 2-3 times. Thus, integrating subsonic, supersonic, and hypersonic air- and space-based strike and supporting assets in the interests of performing strategic and operational missions turns the airspace into a unified sphere of warfare.

The views of military-political leaders in a number of developed states on the objectives and possible nature of military operations have changed. The military strategies of the United States and other NATO countries is oriented toward rapid, effective employment of military force in regional conflicts, and a process of reduction in the numerical strength of their armed forces is beginning in this connection. But all nuclear countries deem it necessary to preserve not only powerful groupings of nuclear forces, but also the capability for reconstituting the combat might needed for waging a conventional war. The beginning and conduct of military operations in the form of an air campaign now becomes more likely. Its objective may coincide with the ultimate objective of the war.

An air campaign is the aggregate of offensive air operations, combat operations of offensive air-space forces, and the operations of raiding and reconnaissance forces coordinated by missions, objectives, place, and time; conducted under a common concept; and designed to achieve intermediate or ultimate military-political objectives of war. This form of military operations can be used above all where there is no direct contact of ground troops. Therefore the airspace is becoming the major sphere of warfare.

The absence of large land groupings at Russia's borders reduces the danger of their invasion in the initial period of a war. At the same time, operations of offensive air forces can be expected from any direction (air groupings are established in 10-20 days and groupings of ground troops, such as those of NATO, in 80-90 days). Moreover, strategic aviation is capable of delivering strikes against Russian targets from airfields where they are permanently based.

Therefore the initial period of a modern war will be characterized by intensive use of air-space forces to the full depth of a country's territory, and in a large-scale war in the form of a strategic offensive air-space operation. Air campaigns and operations will precede the operations of ground troops; i.e., there is a natural growth in dependence of the course and outcome of military operations on the results of opposition in the airspace.

Thus, the following are very important features of the modern stage of development of offensive air-space forces and methods of their combat employment:

- priority of integrated development of offensive air-space weapons;
- increased effectiveness of employing offensive air forces because of combat support to their operations by space systems;
- capability of groupings of offensive air-space forces to perform strategic missions independently even in a conventional war;
- possibility of establishing powerful multinational strike groupings of offensive air-space forces in any region of the world in short time periods;
- use of these groupings in the form of air campaigns (operations) preceding operations by groupings of ground troops;
- capability of achieving maximum surprise of operations, especially by cruise missiles against key targets of the country and the Armed Forces to the full depth of Russian territory;
- increased proportion of unmanned offensive air weapons and increased possibilities of penetrating an air defense system; and
- use of offensive air-space forces in the first echelon of forces in any joint operations.

SPACE OPERATIONS

Russian military scientists stress that the ongoing changes in the character of military operations using orbital systems reveal a number of features of modern warfare. Primarily there is a marked trend towards the globalization of warfare, which now envelops all spheres -- including outer space. The steady quantitative and qualitative growth of orbital -based troops creates prerequisites for the emergence and operation in modern troops of a basically new element: the space echelon. In accordance with the functional structure of military space systems, two groups of objects can operate as part of such an echelon: satellites in orbits (orbital groupings) and ground-based installations of the space infrastructure (control and guidance; and information reception, processing, and transmission posts; and so forth). The basis of the space echelon will be constituted by the facilities of an orbital grouping which can be created with existing satellites or by additionally deploying them from the orbital reserve, by launching new satellites, and by using civilian (commercial) satellites operating as a single complex.[128]

A new feature of modern combat operations is the development and employment of space-based combat (engagement) systems. The trend toward creating combined ground and space weapons systems continues. This is characteristic not only of strategic weapons (whose use is inconceivable without space support), but also of operational and even tactical weapons. The main problem here is the technical feasibility of ensuring compatibility and automatic information relay from satellites to weapon systems in real time. Two types of integration can be considered. The first involves the transmission of navigation data and the second reconnaissance data (direct target guidance) to particular weapons systems.

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[128] Colonel V.V. Krysanov, "Topical Questions of the Modern Stage of Military Operations Evolution," VM, No. 6, 1994, pp. 67-73.

The first type includes combat and reconnaissance strategic and tactical aircraft, helicopters, ICBMs, and other guided rocket and combat systems. According to "foreign specialists," the PLSS-type reconnaissance-strike operational complexes can become more efficient following the replacement of the existing ground-based topographic survey facilities with the Navstar automatic radio-navigation satellite system. This will free them from tying in targets by survey to a particular theater and generally enhance their effectiveness. Predictably, space support will contribute to upgrading the standards of preparation for firing and the combat effectiveness of field artillery.

The second type includes weapon systems integrated with reconnaissance spacecraft and constituting in effect a basically new class of weapons: ground-space-based complexes operating on the principle of the well known air-to-ground reconnaissance-strike complexes. Such new types of weapons can be used to engage both ground and air targets. The first experience of using ground-space complexes was acquired in the course of the war in the Persian Gulf zone, based on the combined use of U.S. Patriot anti-aircraft missile systems and IMEWSS satellites, when the need arose to counter Iraqi operational and tactical Scud missiles.

"Foreign military specialists" link the further evolution of combat operations with enhancing the effectiveness of operational and tactical forces and means based on upgrading space support facilities and methods. "U.S. experts" see a solution to this important problem in the development of small satellites -- compact and low-cost spacecraft for reconnaissance, early missile-attack warning, control, communication, and so forth. The use of small satellites is geared toward addressing tactical and operational tasks within a concrete theater that features the capability of their quick and covert launching.

Small satellites can be launched into orbit both with ground rocket systems and with air-based missiles. (In 1990 the United States developed and tested the Pegasus three-stage rocket carrier launched from the B-52 bomber. It put into orbit two satellites weighing 179 and 68 kg respectively. Up to four launches can be made from one aircraft a day). The high rate of launches, low cost, and simplicity of small satellites enhance the effectiveness of space information support in the theater, and facilitate the deployment and replenishment of space orbital groupings with a view to amassing them and/or ensuring a quick replacement of satellites.

"Foreign military specialists" believe that the compact satellites can be used in creating new combat ground-space facilities (systems). Primarily, they are assigned the role of the main space component of ABM defense in the theater -- an idea that has been aired in the United States since 1987. Patriot complexes and, in the future, Arrow interceptor missiles can be used as weapons systems.

Much attention is being given "abroad" to developing compact surveillance (reconnaissance) satellites to warn tactical-level commanders about missile attacks and to obtain information about enemy targets. Small satellites can also be used for upgrading communication and control at the tactical level. To this end, it is planned to use on the battlefield small artificial earth satellites, such as TACSAT and MACSAT. The latter were tested for providing communications with marines in the course of the

Persian Gulf War. An important feature of small satellites is the possibility of their decentralized employment in the course of air and combined-arms operations.

With the introduction of orbital systems and a quantitative and qualitative growth of their arsenals, say Russian experts, new forms of military operations are bound to arise: space operations. They are characterized by the scope and type of spacecraft used, the complexity of tasks addressed, and the extent of coordination with air and ground force operations. In modern conditions, space systems address the tasks of providing information support in the process of employing troops and weapons in air and air-land operations. In accordance with the doctrine adopted in the United States, joint air strikes and space support operations are regarded as air-space operations conducted with common objectives.

At the same time space support operations can be viewed as an essentially new element of combined-arms operations. In the opinion of "foreign military experts," owing to space support a general information space will be created, which will contribute to coordinated effective actions by forces and fires engaged in a combined-arms operation within the framework of single space and time parameters, as well as in all spheres of military operations.

As weapons and support systems evolve, views on the conduct of combat operations change. Thus, a new concept is being aired in the United States: the air-land operation of the future which envisions space support as its essential component. Also, the role and place of branches and troop-arms could be revised; and new combat operation methods are emerging. The latter, as the experience of the war in the Persian

Gulf has shown, will include the delivery of a surprise first strike with subsequent massed missile, bomb, and EW strikes; and air-space operations in combination with actions by mobile and special task forces which on the whole can decide the outcome of the war without intervention by ground forces or with their limited participation in routing the enemy. "Foreign military analysts" connect further basically new changes in the evolution of combat operations to the development and employment of combat orbital systems, capable of effectively engaging enemy targets not only in space but also from space (in ground/air space). This can lead to the emergence and evolution of new forms: space strikes on ground (air) targets and space assault operations. Such actions are planned with the employment of the entire arsenal of Star Wars -- from space combat stations (platforms) to air-space aircraft and reusable Shuttle-type spacecraft.

In the Russian view, the main forms of military actions in the near-earth space can be as follows: action to engage strategic nuclear systems (with conventional charges) in flight and blocking outer space; action to engage orbital and ground space groupings to capture and hold strategically (operationally) important near-earth space areas; action to suppress EW systems of orbital and ground-based space groupings; and strikes from space on ground, sea, and air targets. Space strikes with laser and electromagnetic pulse weapons can pose a special danger in the event of a surprise outbreak of hostilities, when command posts are blinded, airfields and launching positions are paralyzed, and the capability to organize retaliation is impaired.

RECONNAISSANCE-STRIKE OPERATIONS

According to Russian general officers, the concept of fire damage of the enemy is proposed to be understood as a system of scientific views on the essence, content, structure, means, forms, methods, and principles of fire damage in operations and on ways of operationalizing them at a specific level of weapons development.[129] At the present time there are only individual provisions on fire damage of the enemy in operations, which are reflected in various official documents, scientific articles, and scientific research projects. They are largely obsolete and contradict the capabilities of new weapons. Meanwhile, under present conditions new trends have appeared in the development of fire damage of the enemy in operations.

- First. Active nuclear disarmament treaty processes may eliminate tactical nuclear weapons before long. Therefore missions of damaging enemy groupings and targets will have to be performed only by conventional weapons.

- Second. Successful developments in the sphere of precision weapons have brought them close to the damage-and-casualty effect of low-yield nuclear weapons and have made them the basic kind of weapon for the near term.

- Third. The high effectiveness of precision weapons demonstrated in the Persian Gulf War and their capability of influencing the course and outcome of an operation force a revision of priorities in an operation. While previously the priority in achieving the objective of an operation was given to an attack by combined-arms formations, with the appearance of highly effective precision weapons it began to be given to fire damage. The possibility appeared of inflicting significant damage on the enemy with the

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[129] Colonel-General I.K. Makarenko and Colonel A. Ya. Chernysh, "The Concept of Fire Damage of the Enemy in Operations: Views on Development and Realization," VM, No. 7, 1993, pp. 49-54.

use of precision weapons and then achieving the objective of the operation with an attack by combined-arms formations.

- Fourth. Along with the high damage-and-casualty effect of precision weapons, their capabilities for deep fire damage of enemy groupings are growing, which in turn influences a change in the procedure for fire damage -- a transition from the successive to the simultaneous procedure for fire damage.

- Fifth. The stunning accuracy of precision weapons also generates changes in the methods of fire damage of enemy troop groupings and targets. An opportunity appears for selective damage of the most important targets of the troop grouping or of their basic elements.

Relying on these requirements, the Russians believe that the concept of fire damage can consist structurally of two divisions. The first should reflect basic categories, terms, concepts, and principles of fire damage; i.e., a kind of conceptual apparatus of the concept. The second (as applied to each stage of the concept) should affect questions concerning the status and development of the means of fire damage and the proportional participation of weapons of each branch and combat arm in fire damage. It should also reflect the procedures, forms, methods, and social principles of damage of enemy groupings and the methods of planning and controlling fire damage of the enemy.

The first division of the concept should begin with a definition of the essence of fire damage of an enemy troop grouping, which is the effect on it by all weapons coordinated by time and place to reduce combat potential to the requisite level, deprive him of the capability of executing a maneuver, and disorganize the command-and-control system and comprehensive support.

The content of fire damage is determined by fire damage missions, of which the following are primary: destruction of the means of nuclear attack, nuclear weapons stockpiles, and elements of the precision weapon system (weapons and their control centers); damage (suppression and destruction) of facilities of the system for command and control of troops and weapons (not precision weapons), ground reconnaissance and EW equipment, and facilities of air defense, air force, and field artillery (not employing nuclear or precision munitions); and suppression of armored and mechanized groupings and installations of the operational and immediate rear.

The measure of effectiveness of fire damage is its qualitative and quantitative descriptor. For example, "the mathematical expectation of a 50-percent relative reduction in a grouping's combat potential" is one such measure of effectiveness. The criterion of effectiveness of fire damage is an attribute based on which an assessment is made of the significance of one or more measures of effectiveness. It describes the limiting value of the measure of effectiveness of the procedure for fire damage, which permits choosing its optimum variant. Thus, "a mathematical expectation of at least a 50-percent reduction in a grouping's combat potential" is the criterion of effectiveness of its fire damage.

The degree of fire damage -- which is understood to mean the result achieved from the effect of weapons on the enemy grouping -- is recognized as the basic generalized measure of effectiveness of fire damage. The experience of exercises and command-and-staff war games confirms that there is no precise unequivocal understanding in determining its content. Therefore Russian experts propose to express the degree of fire damage by one of three indicators -- mathematical expectation of the relative reduction in the grouping's combat potential; mathematical expectation of the relative magnitude of irrecoverable losses; and mathematical expectation of the relative number of reliably damaged targets in the grouping's makeup. It is advisable to apply the first two indicators in the stage of general planning of fire damage, when information about the grouping's targets is very limited. The last indicator is most applicable for the immediate planning of fire damage to perform a specific operational or tactical mission.

The second division of the concept should begin with the recognition that weapons and means of support are the physical basis of fire damage. The concept of fire damage must correspond to their development level. Consequently, the appropriate stages of its implementation should be specified.

A study of the development of the armament system provides grounds to assert that it will be accomplished in three periods: the first is connected with upgrading the traditional means of fire damage of the enemy; the second is connected with the appearance of reconnaissance-strike and reconnaissance-fire complexes; and the third is connected with reconnaissance-strike and reconnaissance-fire complexes being developed into a unified reconnaissance-fire system of large strategic formations. It is advisable to make the given periodization the basis for the stages of the concept of fire damage.

The first stage of the concept of fire damage will likely last until the appearance of reconnaissance-strike and reconnaissance-fire complexes in the troops; i.e., up to 2000 judging from the economic capacities of the Russian Federation. Along with traditional views on fire damage, new forms and methods of damage will be introduced in this stage that correspond to the level of weapons development and to views on the theory of their employment. In its structure, fire damage at the beginning of this stage probably will continue to be subdivided into fire damage accomplished throughout the large strategic formation area of responsibility in support of the operation as a whole, and fire damage by axes to accomplish primary operational missions. But it is impossible not to take into account the fact that a reduction in the fire capabilities of weapons (as a result of their significant reduction) may affect the structure of fire damage, reducing it only to fire damage by axes.

It should be noted that although the procedure for fire damage will remain successive throughout this stage, its accomplishment will change somewhat and may be conducted in the following forms: massed fire strikes; fire support of troops defending lines or zones in a defensive operation (based on missions of fire damage in the defense); and a fire offensive (based on periods of fire damage in an offensive operation and in conducting counterthrusts in a defensive operation).

The second stage of the concept of fire damage will be characterized by the adoption and mastery of single-function reconnaissance-strike and reconnaissance-fire complexes capable of damaging targets only of one type, such as only radar-signature targets, only electronic targets, or only firing batteries. The transition to unified weapon complexes should be completed in this stage. The launch or firing range of these standardized complexes should increase by at least 30 percent. Changes in weapons will dictate a gradual transition from the deep successive to the simultaneous procedure for fire damage. An opportunity also will appear for implementing new forms of fire damage -- the fire engagement and the reconnaissance-fire operation.

The fire engagement will represent the aggregate of coordinated operations of air defense troops and EW formations and units, systematic combat operations of reconnaissance-strike and reconnaissance-fire complexes, and deep massed and concentrated missile-air-artillery strikes of the front against targets of the system for command and control of troops and precision weapons, against aircraft at airfields, and against reconnaissance and EW assets. Winning fire superiority will be the primary objective of the fire engagement in a front operation. Its duration can vary from one to several days. The results of the first fire engagement will be especially important, since the success of the front's first operation largely depends on this. The front may conduct fire engagements independently or in a system of a reconnaissance-fire operation accomplished by several fronts.

The reconnaissance-fire operation will represent a system of air defense, air, and fire engagements; individual deep massed and concentrated missile-air-artillery and electronic strikes; and systematic combat operations by reconnaissance-strike and reconnaissance-fire complexes of large strategic formations and formations conducted under a unified concept and plan to win and maintain fire superiority over the enemy. In the Russian view, the reconnaissance-fire operation should become an adequate retaliatory measure for affecting an aggressor's offensive air operations, whose high effectiveness was confirmed by the results of the Persian Gulf War. The further course and possibly also outcome of a war will largely depend on a successful reconnaissance-fire operation. Options for executing the reconnaissance-fire operation as well as its duration can be quite varied.

Changes in the quality of weapons and in procedures and forms of fire damage inevitably transform the methods of fire damage of enemy groupings and targets. In this stage the selective-limited and area-point methods will become the basic methods of fire damage of enemy groupings. In addition, the area and selective target damage methods will acquire more and more importance. Within the framework of this stage it will become possible to have a gradual transition from the centralized method of controlling fire damage to a decentralized method.

An opportunity will appear in the final phase of the second stage of the concept for a transition to fulfilling the chief principle of fire damage -- reliable reconnaissance/continuous damage/constant maneuver. This stage can last at least ten years. In this period material and theoretical premises will be prepared for a transition to the final stage of implementing the concept of fire damage.

The third stage of the concept of fire damage will be characterized by the evolution of single-function reconnaissance-strike and reconnaissance-fire complexes into multi-functional ones and then, based on a new automated control system, into a reconnaissance-fire system of the large strategic formation -- a qualitatively new state of fire damage by the branches and combat arms. In this stage simultaneous deep damage will become the primary procedure for fire damage as the engagement and the reconnaissance-fire operation will be fully realized. The area and selective methods of fire damage will be basic. Fire damage will begin to be planned by the area method, and the decentralized method of controlling fire damage will fully usurp the centralized method. Thus, planning and damage will turn into a continuous process of immediate optimum damage. The final stage will last at least ten years, considering the high cost of technologies and the measures being carried out within its scope.

The planning and implementation of effective engagement by zones of responsibility will generate new forms of effective engagement. In the Russian view, the main forms will include a reconnaissance-fire battle and a reconnaissance-strike operation, the main objective of which will be to crush the enemy by fire before combined-arms formations and units come into close contact and engage in a close-range fire fight.[130] Russian military scientists suggest that the reconnaissance-strike operation should mean the whole range of air defense, air, reconnaissance-fire, air assault, air-mobile, electronic, and other battles, combat operations, strikes, and raids with coordinated objectives, missions, sites, and time periods that will be conducted in accordance with a single plan at a specified period of time for the purpose of crushing a given enemy grouping by fire.

The reconnaissance-fire battle, which is the foundation of a reconnaissance-strike operation, includes the whole spectrum of long- and close-range fire combat -- employing a wide variety of high-precision weapons, electronic suppression, and remote-control minelaying equipment that share the common operational concept of crushing a given enemy grouping by fire when fulfilling one operational mission or another. The main difference of such forms of effective engagement from the currently

[130] Colonel A.M. Fufayev, "Some Questions of Planning the Effective Engagement of the Enemy by Fire in Present-Day Operations," VM, No. 5, 1994, pp. 15-21.

existing ones will be that the stages of planning and effective engagement by electronic equipment and fire will merge into a single process, and fire will be delivered according to the fire-and-hit principle.

REFLECTIONS ON CHECHNYA

In analyzing lessons learned from the Chechen conflict, Russian military experts note that the air operations were sometimes unsystematic in nature because Russian generals had poorly mastered the lessons of the Persian Gulf War. First of all, they should have destroyed Chechnya's administrative and military command-and-control facilities, communications hubs, and key elements of the infrastructure. In practice, they bombed housing areas and the outskirts of Groznyy instead of the presidential palace and the television center. For example, what prevented them from conducting a massive strike against Dudayev's palace at night when a large portion of the people who rallied around him would be dispersed in their homes? In addition, the intelligence directorate of the North Caucasus Military District headquarters could not organize the receipt of timely and reliable data using agent sources and technical reconnaissance systems.[131]

In early 1995, the following recommendations thus emerged:

- Dramatically increase the role of special troops and especially electronic warfare units. Plan and conduct the suppression of the combat command-and-control channels of the Chechen formations that have been detected. Deprive Dudayev of all types of communications, blind his headquarters, disrupt command and control, and create a total information vacuum. In

[131] Igor Korotchenko, "The Operation in Chechnya: Success or Defeat of the Russian Army?" NVO, No. 1, 1995, pp. 1-2.

mountainous terrain, install remotely controlled portable jammers near guerrilla bases. Conduct suppression of the satellite communications channel being utilized by Dudayev to access the leaders of the Islamic countries and Islamic organizations abroad.

- With the arrival of favorable weather conditions, aggressively utilize aircraft to the maximum extent possible to conduct strikes against the guerrillas with self-guiding precision-guided weapons. Destroy the defensive positions of Dudayev's supporters in mountainous terrain and in the southern areas of Chechnya. Demoralize the enemy with continuous air raids. Destroy transportation lines of communication across mountain passes and mountain roads and prevent the arrival of mercenaries and arms caravans from Georgia.

IX. NEW ORGANIZATIONAL ADAPTATIONS

. KEY TRENDS

According to Colonel-General M. Kolesnikov, then Chief of the General Staff, Russia has outlined a set of measures for Armed Forces organizational development aimed at their qualitative transformation. First is an upgrading of the Armed Forces. The Armed Forces structure is to be upgraded in order to increase the efficiency of command and control and effectiveness in executing their assigned missions. The strength of troops (forces) must conform to their tasking and ensure strategic deployment of the Armed Forces.[132]

With respect to the numerical strength of the Armed Forces, it is directly dependent on a given level of readiness and the quantity of armaments that determine Army and Navy combat effectiveness. This concerns the Strategic Missile Troops, Navy, Air Defense Troops, and Military Space Forces to a greater extent, since it is connected with the complexity of command and control of different types of arms, with the difficulty and duration of training command and technical personnel, with their teamwork, and so on.

Second is an upgrading of the Armed Forces command-and-control system, which will be built and developed according to the following principles:

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[132] Colonel-General Mikhail Kolesnikov, "Colonel-General Kolesnikov on Russian Military Reform," AS, No. 1, 1995, pp. 4-9.

- preservation and maximum use of the existing Armed Forces command-and-control system infrastructure, with subsequent integration into the country's statewide command-and-control system;

- balanced development of all component parts of the command-and-control system of the supreme echelon and of branches of the Armed Forces and combat (naval) arms, giving priority to high-tech automated systems for command and control, fire control, communications, reconnaissance, navigation, electronic warfare, precision weapons guidance, and preparation of data for their combat employment; and

- a reduced time period and expenditures for creating modern command-and-control systems and equipment through their increased degree of unification and standardization.

The Russians plan to develop the command-and-control system under a unified concept and plan within the scope of an integrated program. The main efforts and resources are to be concentrated in the following basic directions:

- upgrading command-and-control entities and bringing their structure, makeup, and numerical strength into line with new missions based on the conditions and phases of Armed Forces reorganization and with consideration of troop (force) groupings being established for wartime and their operational tasking;

- ensuring stability of the system of Armed Forces command-and-control facilities under conditions of modern war, increased survivability of fixed facilities for command and control of strategic nuclear forces (at the strategic and tactical levels), and establishment of standardized mobile command-and-control facilities supporting troops (forces) under mobile defense conditions;

- modernizing and building up capabilities of automated command-and-control and fire-control systems with the goal of ensuring their compatibility and capability for subsequent integration within the framework of the combined military and state command-and-control system; and

- establishing territorial command-and-control systems of military districts on strategic and operational axes mutually tied in with the Russian Federation statewide automated communications system.

Third is the development of armament and military equipment. One of the main tasks in this direction is to increase the effectiveness of weapon systems and military equipment and the level of Armed Forces technical outfitting with modern models. The newest scientific-technical achievements and advanced technologies and materials must be used in conducting RDT&E to prevent a critical military-technical and technological lag behind developed world states. Kolesnikov notes the following as priorities:

- developing and producing highly effective, multifunctional weapon systems supporting real-time operations; systems for command and control, fire control, communications, reconnaissance, navigation, strategic warning, and electronic warfare; mobile non-nuclear precision weapons; and their information support;

- expanding the scale of the use of information from space systems by troops (forces);

- keeping the entire strategic arms complex at a level ensuring Russian Federation security, strategic stability, deterrence of nuclear and conventional war, and nuclear safety; and

- enhancing the soldier's outfitting with more effective weapons, individual protective armor, and communications and reconnaissance equipment.

Fourth is a reorganization of the system of orders for armament and military equipment. The present system of orders does not fully exclude parallelism and duplication in the development and production of armament and military equipment.

As a result, there is a rather large quantity of weapons of the same type in the troops (forces), and the expenditure of state resources is not always justified.

Fifth is mobilization preparation of the economy and the Armed Forces. Sixth is an upgrading of the system of all kinds of support. Three parallel and not always coordinated logistic support systems presently function in the country (Armed Forces, MVD Internal Troops, and Border Troops), which leads to the dissipation of personnel and assets. Seventh is an upgrading of the military education and cadres training system. Eighth concerns military science. An orderly system of military science has taken shape in the Armed Forces in recent years as a result of structural and functional transformations, but now the need has matured to concentrate the efforts of scientific subunits of the Armed Forces and other Russian Federation troops to solve problems of scientific support to their activity.

According to Colonel-General V.M. Barynkin, the planning of military re-organization in the Russian Federation proper should be conducted in stages. The first stage could be considered goal-oriented (long-term planning); the second as a program (medium-term planning); and the third as current (short-term planning).[133]

In terms of content, long-term planning (from 10 to 15 years) defines the general direction of military organization; specifies the sequence of resolving the most important problems of military organization; ensures the continuity, consistency, and coordination of various stages of organization; and calls for the drafting of documents

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[133] Colonel-General V.M. Barynkin, "The Planning of Military Organization: Experience and the Present Day," VM, No. 3, 1995, pp. 12-20.

that take into account the allocation of financial and material resources for defense purposes.

During the first stage, said Barynkin, it would be advisable to develop under the guidance of the Government and the Security Council a concept of Russian military organization on the basis of the National Security Concept of the Russian Federation, the Law "On National Security," the Fundamentals of the Russian Federation Military Doctrine, the Law "On Defense," and other legally enforceable documents in the area of defense. The concept should further develop and specify in detail the state's views on the development of a military organization that ensures its national security. At the same time, similar concepts need to be adopted (as appendices) for relevant ministries and agencies. The final element of this stage is the elaboration and approval by the legislative bodies and the president of the organizational concepts of the Armed Forces and other troops of the Russian Federation, the 10-year armament program, and a program for the development of the defense and industrial potential over a 10-year (15-year) period.

During the second stage ministries, agencies, and their subordinate structures develop similar programs and plans on the basis of the afore-listed long-term planning documents. Barynkin suggested that they develop a military organizational program that would detail the main provisions relating to the purposes, objectives, procedures, and sequence of implementing the planned measures, taking into account the requisite financial resources appropriated for the needs of the Armed Forces (for a medium-term period). Given the current circumstances, it would be preferable to work out the plan for the organization of the Armed Forces for a period of up to 5 years (medium-term planning) -- to be subsequently specified in greater detail in annual plans of work.

During the third stage, short-term planning (1 year) clarifies targets of the state program for military organization; takes into account the progress of its implementation, new requirements of the Armed Forces, and scientific-technical achievements; and calls for documents to be based on the financial and material resources allocated for defense purposes (see Figures 12 & 13).

The Russian military also plans to restructure the branches of the Armed Forces. Five branches exist at present: the Strategic Missile Troops, the Ground Troops, the Air Defense Troops, the Air Forces, and the Navy. The Military Space Troops and Airborne Troops are separate combat arms. According to then Defense Minister Grachev, a new structure for the Armed Forces will be established by the year 2000, under which they will be divided into four branches: the Strategic Deterrence Forces, the Air Forces, the Navy, and the Ground Forces. Beyond 2000, the Armed Forces could move to a three-branch structure: the Russians propose to merge the Air Forces and the Strategic Forces into the Air-Space Forces.[134]

Colonel-General Barynkin has noted that an analysis of the experience of local wars shows that the side which employs EW forces and assets, aviation, various new weapons, and airborne troops skillfully can perform the most important missions with a small number of combined-arms units. Therefore a priority direction of Russian

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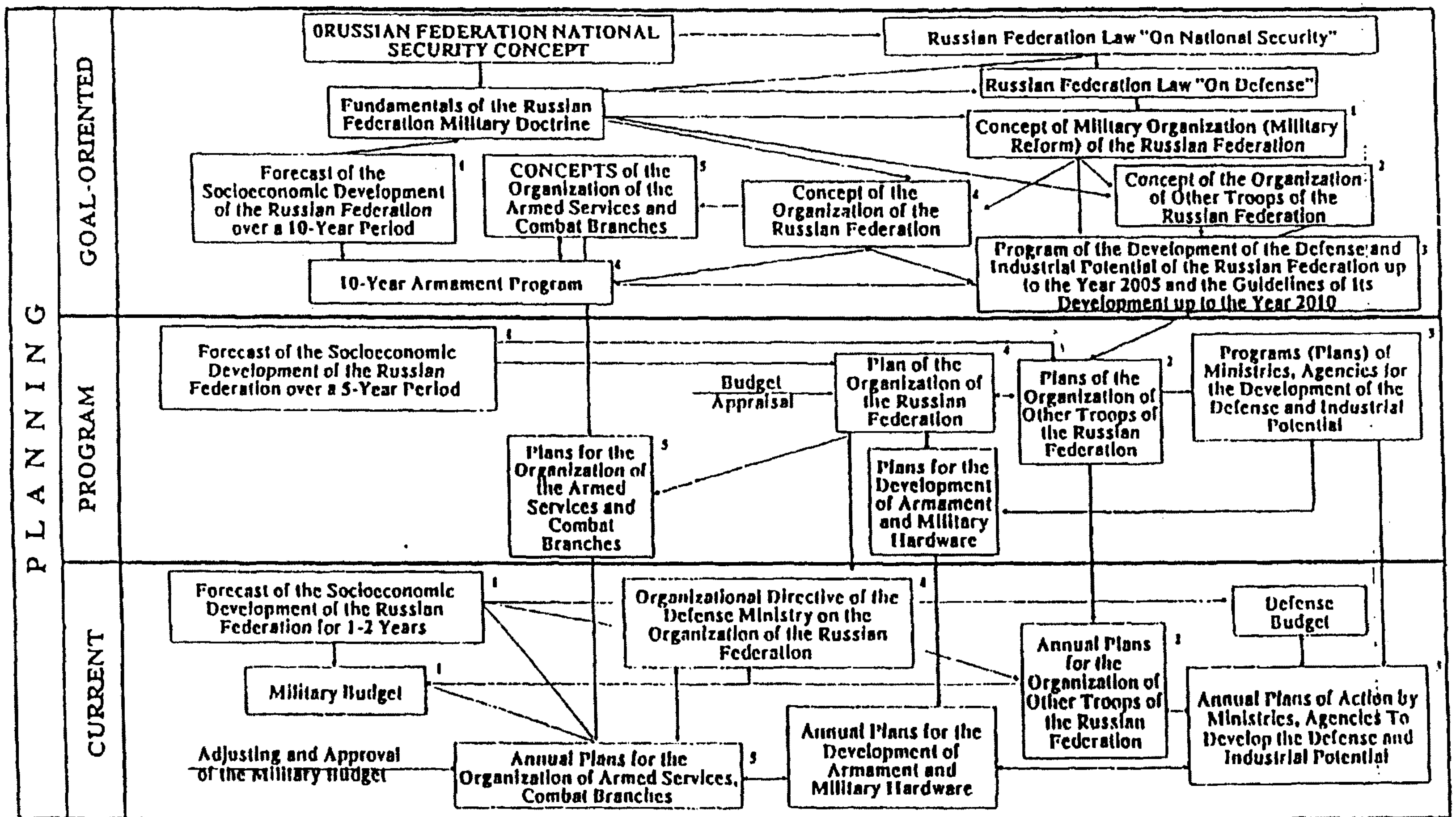
[134] Vadim Byrkin, "Grachev Says Military Budget Cuts 'Criminal'," ITAR-TASS, 8 July 1994.

			How Often	Basic Documents (Materials): Political	Economic	Military	Legal	Statistical
PLANNING	GOAL-ORIENTED	Long-Term	Drawing up documents containing forecasts of the development of the military-political situation in the world, economic and other capabilities of the state (over 10-15 years)	Forecasting the development of the military-political situation and determining the nature of threats for the Russian Federation over a 10-year period	Prospective appraisal of the state's economic development and its defense spending estimates A program for the development of the defense-industrial potential up to the year 2005 and the guidelines for its development up to the year 2010	Forecasting military organization in developed states of the world over a 10-year period Forecasting the influence of international treaties on military organization over a 10-year period Fundamentals of the Russian Federation military doctrine Concept of military organization in the Russian Federation Armed Forces Armament program over a 10-year period	Russian Federation laws, edicts (directives) of the Russian Federation president Decrees of the Russian Federation Government	Forecast of the demographic situation in the Russian Federation over a 10-year period Analysis of trends toward changing the ratio of the Armed Forces strength and the population size in developed countries of the world
PLANNING	PROGRAM	Medium-Term	Drawing up documents taking into account five-year programs of allocating financial and material resources for defense purposes (5 years)	Forecasting the development of the military-political situation and determining the nature of threats to the Russian Federation over a 5-year period	Five-year plan of socioeconomic development. Forecasting the allocation of material and financial resources for defense purposes	Forecasting the influence of international treaties on military organization over a 5-year period Plan for the organization of the Russian Federation Armed Forces for a 5-year period Orders (directives) of the Russian Federation defense minister	Russian Federation laws, edicts (directives) of the Russian Federation president Decrees of the Russian Federation Government	Forecast of the demographic situation in the Russian Federation over a 5-year period
PLANNING	CURRENT	Short-Term		Annual message of the Russian Federation president to the Federal Assembly				
PLANNING	CURRENT	Short-Term	Drawing up (finalizing) documents taking into account financial and material resources allocated for defense purposes (1 year)	Analysis of current developments in the world and assessment of real threats to the Russian Federation	Planned targets of the country's socioeconomic development and defense appropriations The military budget for the new financial year approved by the president and the Russian Federation parliament	Annual report by the defense minister to the Russian Federation President and the Supreme Commander in Chief on the results of the organization of the Armed Forces Orders (directives) of the Russian Federation defense minister, including on the results of the Armed Forces' training in the current year and the clarification of objectives for the new training year Reports by the commanders in chief of the armed services on the progress of organizing their armed services Analysis of the state of military organization in developed countries of the world in the current year Plans for the organization of the armed services and combat branches	Russian Federation laws, edicts (directives) of the Russian Federation president Russian Federation Government decrees	Analysis of the military commissariats' capabilities of calling up the youth for military service

FIG 12

Final documents on the planning of military organization (continued)



N o t e s : 1 - to be drawn up by the Russian Federation Government together with ministries and agencies; 2 - to be drawn up by other ministries and agencies of the Russian Federation; 3 - to be drawn up by the Russian Federation State Defense Committee; 4 - to be drawn up by the Russian Federation Defense Ministry; 5 - to be drawn up by the armed services and combat branches.

All documents, except for those targeting armed services and combat branches, are subject to approval by the Russian Federation president; the Russian Federation Government is tasked with supervising their implementation.

FIG 13

Armed Forces organizational development at the present stage is the rational development of their branch structure. Branches of the USSR Armed Forces were developed along an extensive path, based on the principle of creating new structures for fundamentally new strategic missions and armaments. Extensive development presumed the isolated upgrading of each branch of the Armed Forces and troop-arm without considering the possibility of merging their efforts in terms of warfare, missions, forces, and assets.[135]

As already noted, one possible option for reorganizing the Russian Federation Armed Forces is a transition from a five-branch to a four-branch structure. It is presumed that by consolidating the Air Defense Troops and Air Forces it will be possible to implement the principle of unified responsibility for combatting the enemy in the air-space sphere and achieving a more integrated employment of forces and assets -- but this idea, he says, requires serious interpretation and professional study.

The need for a balanced development of the Russian Armed Forces is dictated by the world's longest continental and water borders. This presumes the development of ground and naval groupings of troops (forces). In addition, it is obvious that Russia will remain one of the leading nuclear powers in the foreseeable future. Finally, the increased importance of the air-space sphere prompts the development of aviation and of systems of air defense and military space forces.

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[135] Colonel-General Viktor Barynkin, "Russian Armed Forces Balanced Development," AS, No. 2, 1996, pp. 16-21.

The Ground Troops will retain their primary role in local conflicts of any scale. Their missions are to defeat enemy ground groupings which have penetrated, seize and hold important areas and administrative-political centers, and participate in landing or anti-landing operations. Consequently, along with a reorganization of the Ground Troops, their sufficient outfitting with new means of warfare and intensified training are necessary. This means upgrading precision weapons; creating new, highly effective ones; and developing the methods of delivering them and the forms of their employment. It is advisable to have these weapons in constant readiness for redeployment to a conflict area or station them on the most dangerous axes.

Improving the Ground Troops' combat capabilities will require providing them with the newest Army aviation, especially combat helicopters. This will increase the infantry's mobility, "radius of action," and prompt concentration of forces and assets in decisive sectors; as well as their ability to capture favorable lines, localize penetrations, deliver counterattacks and counterblows, and execute a maneuver and surprise attacks.

The role of the Air Defense Troops should also be noted. In military conflicts they have to win air supremacy together with other branches and combat arms; protect important administrative-political and economic centers and installations against enemy air strikes; cover troop groupings, the staging and concentration areas of reserves, lines of communication, and rear installations against enemy air and missile strikes; and prevent bombings of airfields, naval bases, ports, and command-and-control facilities.

The Air Defense Troops must meet the following requirements. First of all, reliable air defense of installations must be established in an overall air defense system on an operational-strategic scale. Secondly, there must be a unification of air defense efforts of all branches of the Armed Forces and combat arms. Fighter aviation definitely must participate in repelling enemy air strikes. It is intended for destroying jammer aircraft, intercepting precision weapons before the launch point, disrupting combat formations of enemy strike aviation, and preventing the unhindered concentration of his aviation for suppressing SAM troops.

Thirdly, coordination among fighter aviation, SAM troops, AAA, Radiotechnical Troops, and EW assets which operate as part of the Air Defense Troops must be organized at the level of algorithms and programs aimed at improving the efficiency of combatting enemy offensive air weapons. Fourthly, the overall system and each air defense asset must be jam-resistant and survivable. Fifthly, in order to increase the effectiveness of air defense forces and assets in military conflicts, they cannot be turned into slow-moving, stationary ones. To the contrary, a portion of these forces and assets must continuously execute a swift and concealed maneuver, change launch positions, operate from ambushes, and employ "roving" subunits of SAM troops and AAA. Finally, the primary mission of the Air Defense Troops is their readiness to successfully combat an enemy capable of massive employment of precision weapons.

The Air Forces will play no less important a role in possible military conflicts. In the foreseeable future aviation will remain the only means capable of delivering strikes to the full depth of a theater of military actions. In addition, troop groupings on new, potentially dangerous axes can be reinforced in short time periods through aviation thanks to its high mobility. Moreover, in some military conflicts aviation may become the primary striking force. Such a situation has already occurred in South Vietnam, Libya, and Iraq.

Winning air supremacy and providing air support to troops and naval forces are among the Air Force missions. Performing these missions gains an advantage and in a number of cases also ensures the strategic initiative. For example, the supremacy of U.S. aviation in the air not only saved U.S. troops and the South Korean regime from total defeat in the Pusan perimeter, but also permitted them to launch a counteroffensive. Four decades later this very factor played a deciding role in the victory of the multinational forces in the war against Iraq. An analysis of air operations shows that as a rule air supremacy is achieved if enemy air defense as well as his aviation has been destroyed or neutralized. One important Air Force mission is interdiction of a combat operations area to hinder the enemy in replenishing supplies and redeploying reserves. In this case aviation will operate typically as part of reconnaissance-strike and reconnaissance-fire complexes.

Aerial reconnaissance also will remain a primary Air Force mission. The greatest volume of information on the enemy is collected with its help. Before a conflict begins, aerial reconnaissance as a rule is conducted using special aircraft. Sometimes E-3A, AWACS, E2C Hawkeye, Nimrod-2, and other control aircraft are used. Aerial reconnaissance aircraft are being upgraded continuously. In the Persian Gulf conflict the United States already was using two E-8 JSTARS aircraft equipped with side-looking radar which had not yet become operational. They can issue real-time target designations and they have an operating range greater than reconnaissance drones. The ATARS electro-optical aerial reconnaissance system, also operating in real time, may become operational in the future. The Persian Gulf War experience showed the great effectiveness of reconnaissance by F-117A aircraft. In military conflicts the "invisible" aircraft most likely will play a deciding role in aerial reconnaissance.

The landing or drop of airborne assault forces will continue to be an important Air Force mission. The landing of U.S. invasion forces in Grenada on 25 October 1983 can serve as a confirming example. U.S. military-transport aviation airlifted 5,000 persons, almost half of the personnel used, to the designated area.

A traditional Air Force mission of neutralizing enemy airfields and delivering selective preemptive strikes against the most important enemy installations also will not lose pertinence. The importance of its performance was confirmed by the Persian Gulf War. Thus, the development of military art and the experience of conducting local wars show that the Air Force role in warfare is growing.

This conclusion, say the Russians, can also apply to the Navy, but somewhat different missions determine its specifics. Above all it is the delivery of precision weapon strikes using sea-launched cruise missiles against military and industrial ground installations, groupings of ground troops, and their lines of communication; landing amphibious assault forces; participating in air and artillery support of Ground Troops both in offensive and defensive operations; executing a sea blockade of the coast; supporting sea lifts, redeployments, and evacuation of troops; destroying enemy naval forces at sea and in bases; defending a seacoast; and participating in anti-landing operations.

The scope of missions to be performed by the Navy in support of the Ground Troops is growing. EW, which has advanced from being from a means of combat support of the fleet into a specific kind of its combat operations, will play an important role in naval operations. On the other hand, Navy groupings must create an atmosphere of "increased persuasiveness of intimidation" and "military presence in peacetime" at necessary points on the globe.

Colonel-General Barynkin stresses that the development of the Russian Armed Forces is inconceivable without an improvement in Russia's military space potential. The Military Space Forces will be employed for space reconnaissance in support of all branches of the Armed Forces and of the Russian Federation political leadership; for ABM defense and space communications; and for determining the location of troops and individual targets.

According to Army General M. Kolesnikov, then Chief of the Russian General Staff, the areas and time-frames for performing the tasks of military organizational development were laid down by a Russian Federation presidential edict back in August 1995. The plan was to implement the edict in two stages. During the first stage, 1996 through the year 2000, the Russians planned to establish a normative-legal base and a system of unified state leadership of the country's defense; switch to new structures, composition, and the territorial system of command of and comprehensive support for the Armed Forces and other Russian Federation troops; organize mobilization preparation of the economy; stabilize its defense-industry potential; and complete the plans for the strategic deployment and use of the Armed Forces and other Russian Federation troops. More global tasks have been identified for the second phase, which encompasses the period 2001-2005 and culminates in the creation of the "army of the year 2005."[136]

As for the organizational development of the Armed Forces in toto, the plan is to focus efforts on the following main areas:

- Ensuring guaranteed deterrence by a rational level of strategic nuclear forces against a world nuclear or conventional war.

- The optimization of the authorized strength of the Armed Forces in accordance with the tasks assigned to them and the other Russian Federation troops.

- The improvement of the military's organizational structure. The Russians intend to determine the thrust of the structural reorganization of branches and troop-arms in the near future as a result of comprehensive research. Clearly, possible changes in structure, composition, and numerical strength require an intelligent, well-thought-out approach to the mobilization deployment base since a considerable number of combined units and units, primarily in the Ground Forces, will be maintained in a down-sized form at cadre strength.

- The provision of modern arms and military hardware to the Armed Forces. With a view to improving the procurement system the Russians intend to centralize control of this process to a greater extent, concentrate funds on the high-priority areas of equipment provision, and monitor their expenditure more effectively.

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[136] Army General Mikhail Kolesnikov, "Military Reform and the Organizational Development of the Russian Armed Forces," KZ, 25 May 1996, pp. 1, 3.

- The improvement of the system for the command and control of the Armed Forces and their operational-strategic groupings. The Russians intend to optimize the work of military command-and-control organs and to clearly and rationally assign their areas of responsibility and powers. Analysis of the current statutes on the Defense Ministry, the General Staff, and the directorates of the commanders-in-chief of branches of the Armed Forces and troop-arms has shown that there is already a demarcation between these organs in terms of their functions. However, the structure of military command-and-control organs needs to be adjusted to correspond with their assigned functions.

The law "On Defense" adopted by the State Duma and the Federation Council defines for the first time the General Staff's coordinating role in elaborating plans for the organizational development of Russian Federation troops and the numerical strength of the Armed Forces and other troops, troop formations, and organs -- and also for their operational and mobilization training. The Russian Federation State Commission for Military Organizational Development set up by decision of the president completes the elaboration of proposals for improving the state's military organization.

In order to enhance the General Staff's coordinating role, the Russians propose to create within its structure a department comprising representatives of the staffs and command-and-control organs of other Russian Federation troops (the Border Guards, Internal Troops, Civil Defense Forces, Railroad Troops, and the FAPSI [Federal Government Communications and Information Agency]) with clearly defined tasks of planning their development and employment with a view to ensuring military security. There could be similar departments with a corresponding thrust in the Armed Forces Rear Services, the Main Directorate for the Military Budget and Funding, and a number of other Defense Ministry managerial structures. But this is not an end in itself.

Approaches are currently being formulated for the creation of unified systems of rear services and technical support, cadre training, the military science infrastructure, and in other areas. Such departments are needed in order to harmonize views and promote closer cooperation, balanced development, and coordinated approaches to tackling the problems of military organizational development.

Given this situation, the General Staff will indeed be the main organ for the operational leadership of the Armed Forces and other Russian Federation troops, exercising this leadership via the main staffs of Armed Forces branches and troop-arms, the Internal Troops Main Staff, the Border Guards Main Staff, Federal Security Service and FAPSI command-and-control organs, and the Civil Defense and Railroad Troop staffs.

According to General-Major Slipchenko, the three branches of the Armed Forces will not be required in the same composition and relationship to each other. Essentially two branches of the Armed Forces will be required in future war: Strategic Strike Forces and Strategic Defense Forces, as well as some type of C^2 system that is identical for both. Indeed today the Russians are deciding which forces go where.

Future war requires a very substantive delineation between offensive and defensive forces. Today there exists a sharply increased quantity of strike troops and forces -- especially PGMs and NPPs -- which will constitute the basis of the Strategic Strike Forces. Means of national air-space defense such as air defense, anti-missile defense, and space defense will constitute the basis of the Strategic Defense Forces.

The main theater of military actions (TVD) in future war will be the airspace -- even though nuclear weapons may be reduced to an absolute minimum. Besides PGMs and NPPs, strategic non-nuclear weapons are now appearing. These "Strategic Non-Nuclear Forces" (SNNF) will consist of a triad of ground-, sea-, and air-based systems. In fact strategic aviation has already become a delivery vehicle for non-nuclear PGMs. The triad will thus include current strategic aviation armed with high-tech ALCMs and naval forces armed with high-tech SLCMs (on both surface ships and submarines). And later, within 10-15 years, the third component will emerge -- ground-based intercontinental non-nuclear missiles. These systems will have a CEP of 5-10 meters.

It will therefore be possible, with the help of these SNNF, to deliver a strike powerful enough to destroy the opponent's retaliatory means and military-economic potential. Prolonged massive strikes will then demoralize his armed forces. As a result, his political system will not survive and will likely collapse on its own. The war could thus end without occupation of the opponent's territory. Indeed if the United States needs raw materials, it can purchase them with dollars more easily than obtaining them through war. For those states prepared to wage it, the primary feature of future war will therefore be the exclusion of man from the battlefield.

Enhanced defensive capabilities will be required to withstand such strikes. These defensive forces will constitute a state's "air-space defense" and will be used to conduct a "strategic operation to repel the air-space offensive operation." They must be capable of defending all retaliatory means and the entire military-economic potential. In fact, such a defense requires that air defense forces destroy up to 70% of targets and anti-missile defense destroy up to 90% of targets. Indeed if a state's defensive forces cannot accomplish these missions, then they become altogether irrelevant.

The Russians also intend to eliminate the high commands of the branches of the Armed Forces -- they will be replaced by considerably more compact main directorates subordinate to the head of the General Staff. The structure of the Armed Forces will be somewhat different: battalion -- brigade -- corps -- district. The directive signed by Yeltsin on increasing the number of military schools, which are now seen as the source for supplying the army with contract personnel, is an element in the gradual switch to a more professional army.

In early 1994, General-Lieutenant G. Ivanov announced that new force groupings were being established and existing ones strengthened -- first and foremost the Moscow and North Caucasus Military Districts. The number of fully staffed, combat-effective combined formations and units had increased through a drastic reduction in the number of under-strength combined formations and units. The creation of Mobile Forces had begun. The transition to a mixed system of recruitment was being implemented. The system of military education had been restored, and reform in this sphere had begun.[137]

Then Defense Minister Grachev later stated that Russia intended to establish what was described as a "huge" military district in the North Caucasus that would boast mobile and other forces as well as powerful weaponry. Grachev said that Moscow had

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[137] General-Lieutenant Gennadiy Ivanov, "Military Reform: Assignment for Tomorrow," KZ, 8 February 1994, pp. 1, 2.

been working diligently over the past two years to transform the district into an army group capable of waging either small or large conflicts.[138]

One other element of military reform is a reform of troops based on a Territorial Command headed by a commander-in-chief in Komsomolsk-on-Amur. The goal is more effective command and control of all forces and assets in the Far East, including not only the Ground Troops, but also the Pacific Fleet, Air Force, Air Defense, and if necessary the Border Troops and Internal Security Forces. Then it is planned to set up such a command in Ulan-Ude for centralizing command and control in the Transbaykal and in Siberia. The reform of military structures in the North Caucasus was announced even earlier. This means that territorial commands -- operating within the limits of certain Russian territories and spearheading the reform of Russian troops -- are being established in place of previous commanders-in-chief of axes, which in terms of operational purpose were basically aimed at the West.[139]

According to Grachev in 1996, the Russians plan to create six territorial commands: Far Eastern, Siberian-Trans-Baykal, Ural-Volga, Southern, Central, and Northern. In these territorial districts all armed forces are subject to the commander of the district (who by his position is also a deputy defense minister). Subordinate to him are ground forces, air defenses, aviation, other units, and the fleet if there is one

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[138] Stephen Foye, "Huge Military District in North Caucasus Planned," RFE/RL Daily Report, No. 123, 30 June 1994, p. 1.

[139] General-Major Vadim Makarevskiy, "We and Our Expectations: Militaria: Military Reform is Proceeding, But More Slowly Than One Would Like,"Obshchaya gazeta (hereafter cited as OG), No. 13/38, 1 April 1994, p. 8.

in his district. This makes it possible to strictly implement the principle of a single command of different types of armed forces.[140]

AIR FORCE TRENDS

Colonel-General P. Deynekin, CINC of the Russian Air Forces, has explained that the concept for the Russian Air Force's development through the year 2000 includes three stages. In the first stage they analyzed the actual condition of the Air Force, took "stock," sorted out the organizational structure, and clarified the procedure for withdrawing aircraft and creating aviation groupings. In 1993 they embarked on the practical implementation of measures in the second and main stage of the reform.[141]

Deynekin notes that the following can be the main ways to improve the effectiveness of air operations and combat operations:

- upgrading aircraft and armaments, and above all creating low-signature flying craft and precision air weapons;
- developing various methods for maneuvering air formations (units) over great distances;
- increasing the effectiveness of a breakthrough (penetration) of enemy air defense on flight routes and in strike target areas by various air systems;
- upgrading systems of automated command and control of air large strategic formations, formations, and units;
- developing and upgrading EW forces and assets and methods of employing them;

[140] "Grachev: Not Yet Time for 'Deep Military Reform' in Army," Moscow INTERFAX, 1 May 1996.

[141] Colonel-General of Aviation Petr Deynekin, "Russia Has Been, Is, and Will Remain a Great Aviation Power," KZ, 19 August 1995, pp. 1-2.

- training highly skilled cadres (flight and engineering-technical personnel); and creating a stable aviation basing system.

According to Deynekin, the current organizational structure which has been created incorporates all the best that existed from May 1942 through 1980 and from 1988 up to the present. The principle of centralized command and control of the commands (long-range, front, and military transport aviation; reserves; and cadres training) by the Air Force commander-in-chief, and of the large strategic formations (formations, separate air units) by the commanders of long-range aviation, front aviation, and military transport aviation now constitutes the basis of that organizational structure.[142]

The principle of strict centralization of command and control of large strategic formations (formations) is one of the most important conditions for improving the effectiveness of combat operations of air formations (units) in view of the reduction in the Russian Armed Forces (and in the Air Force in particular), the multiple-option nature of the military danger, and the vagueness of the axis on which it may develop into a military threat.

The Russians have completed the creation of aviation groupings in the Western sector. On the territory of the Moscow and North Caucasus Military Districts they have reformed two Frontal Aviation air armies. They have established a new organizational structure, cutting administrative components. Instead of two Air Force

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[142] Colonel-General of Aviation Petr Deynekin, "The Homeland Will Not Be Left Wingless: On the Concept of Air Force Organizational Development and Employment," AS, No. 8, 1995 pp. 4-10.

military district administrations they have formed two aviation commands -- Frontal Aviation and the Reserve and Personnel Training Commands. Their emergence alongside the existing Long-Range Aviation and Military Transport Aviation means that the structure of administrative organs at the operational and strategic level has become logical.

Rapid maneuvering by air formations is becoming increasingly important for the Russian Air Forces. One of the promising directions in dealing with these problems is a switch to the territorial basing principle in aviation basing and support. It envisions the creation of aviation basing zones (ABZ) designed to ensure comprehensive (operational, technical, and rear-service) support for air formations, task forces, and units -- both those stationed permanently and those conducting maneuvers in these zones. The ABZ foundation is constituted by air bases established at the main airfields of frontal (FA), long-range (LRA), and military transport (MTA) aviation. They are characterized by multi-functionality and universality, which manifest themselves first, in that the air bases fulfill various tasks in combat, technical, and logistical support; and second, in their ability to accommodate any type of FA aircraft and, on some specially equipped airfields, also LRA and MTA aircraft.[143]

It is expedient to have two types of air bases depending on their location and the tasks tackled. Bases of the first type are created along the main strategic axes at a distance of 150 to 400 km from the state border and are designed to provide constant basing for 5 to 6 FA squadrons and to ensure the maneuvering by LRA and MTA units.

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143 Colonel V.B. Barayev and Colonel A.A. Gerasimov, "Problems of Upgrading Aviation Basing and Support Systems," VM, No. 11, 1993, pp. 28-30.

In peacetime they will ensure the combat training of air units based along these axes, and in wartime their combat actions -- as well as the actions by units arriving to reinforce the air groupings.

The general thrust of the development of aviation equipment and armament is to cut back to one or two aircraft types in each air component and to equip combat aircraft with new types of precision weaponry. In bomber aviation all versions of the Tu-22M and the Su-24 will be replaced by a multirole bomber with an expanded combat capability. Fighter and bomber aviation will be equipped with the new fifth-generation Su-27b combat aircraft, which is currently undergoing flight tests. Intelligence-gathering aircraft developed from this aircraft will be used in reconnaissance aviation.[144]

The Russians thus plan to develop a reconnaissance aircraft for Air Force front aviation based on the new fighter-bomber, in whose creation large amounts of money already have been invested. [145] From the beginning it was intended for operations in a full-scale war and chiefly in the operational depth. In the tactical depth, however, saturated to the maximum by unit air defense assets, it is more advisable to conduct aerial reconnaissance (above all in support of the Air Force) by other less costly means, particularly reconnaissance drones. Nevertheless, there is an urgent requirement for

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[144] Interview with Air Force Commander-in-Chief Petr Deynekin by Pavel Anokhin: "Flying in Your Dreams and in Reality. Tomorrow is Russian Air Force Day. Our Interviewee is Doctor of Military Sciences Colonel-General of Aviation Petr Deynekin, Commander-in-Chief of the Russian Federation Air Force," Rossiyskiye vesti (hereafter cited as RV), 17 August 1995, p. 3.

[145] Colonel Sergey Volkov and Colonel Yuriy Kovtunenko, "So as Not To Leave The Sky 'Untended'," AS, No. 5, 1994, pp. 8-10.

producing long-range reconnaissance aircraft arising from the need to monitor the situation in neutral waters surrounding Russian Federation territory -- especially because some Western countries are not curtailing the development of air-space combat aircraft, including reconnaissance versions. For example, the U.S. Project "Aurora" envisages the development of a reconnaissance aircraft capable of flying at an altitude of approximately 30 km and at a speed corresponding to Mach 8.

Today the accomplishment of such a unique, costly project is accessible only to a few countries. For a long time the USSR and United States were the main manufacturers of missile equipment, but now a number of other states are inserting their own spacecraft into outer space. The production of hypersonic combat aircraft as relatively inexpensive substitutes for space combat systems also will become fully realistic in the not-too-distant future. Work in this direction must be continued even under the present difficult conditions, especially considering the substantial amount of work already done in this area. Moreover, a hypersonic aircraft also capable of flying in a near-earth orbit can be used successfully not only for reconnaissance, but also for delivering strikes and intercepting airborne targets.

According to Deynekin, the Air Forces also need a promising all-weather ground-attack aircraft to replace the current model. Military-transport aviation will receive a modern aircraft with enhanced transportation and assault-landing performance. The new multirole front-line fighter which was recently sent for testing to Zhukovskiy near Moscow is expected to enter service soon.

Despite a marked fall in expenditures on defense, the development of new, promising types of armaments and combat equipment has been implemented much more intensively than has been reported in the open press. According to General Yatsenko, for instance, from 1992 (when the Russian Federation Air Force was formed) to 1996, 15 new equipment models were adopted, including an improved modification of the MiG-29 light frontal fighter with an offensive weapons system, the Ka-50 combat helicopter, the R-77 air-to-air guided missile, several types of new unguided weapons, and two types of guided bombs. The Su-27K carrier-launchable and recoverable jet fighter, the "Reys-D" remotely piloted air reconnaissance system, and the "Stroy-P" system have passed testing and been put into series production.[146]

In addition, work continues on the construction of the Su-27 KUB ship-based combat trainer aircraft, the A-42 search-and-rescue amphibious aircraft, and the MiG-AT and Yak-130 trainer aircraft. An experimental model of the modernized A-50 airborne early-warning aircraft is now under construction; the flight-testing of a Kamov-manufactured helicopter, having a similar purpose, is nearing completion; and work continues on the creation of a multipurpose aerospace system.

A special significance is being attached to the development of information warfare and reconnaissance means which would allow employing the Air Force to the extent required depending on the nature and scale of the task. Efforts in this area have been crowned with the development of various navigation systems and means, guiding

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[146] "Rearmament Program for the Russian Air Force Has Been Worked Out. Until it is Approved by the Russian Federation Government Its Cost Will Be Kept Secret," Segodnya, 11 July 1996, p. 2.

vectoring posts for frontal aviation, and the "Luch-7" mobile system (which ensures takeoff and landing on tactical airfields under instrumental weather conditions). The northern chain of the "Tropik-2" long-distance radio-navigation system has been put into operation, and the unified aircraft equipment of the GLONASS space radio-navigation system (a group of 24 satellites of this system was finally formed by the Defense Ministry's Aerospace Forces in 1995) has been tested and adopted.

The rearmament program for the Russian Air Force envisions the following priority tasks:

- Construct and test the Su-27B fighter-bomber, the Il-76MF, the Il-106, the An-70 military transport aircraft, the Tu-204P patrol aircraft, and the Ka-52 and Mi-28N combat helicopters;

- Modernize the Tu-160 and the Tu-95 MS strategic bombers in order to outfit them with new high-precision weapons;

- Work out new promising types of air-launched guided air-to-surface and air-to-radar missiles, unguided weapons, and guided bombs; and

- Implement programs for the construction of basic airborne equipment for fifth-generation aircraft, which will generate qualitative progress in the development of Russian avionics.

The Air Force rearmament program is to be implemented in the period until the year 2005. In addition to the Defense Ministry, the federal ministries of the economy and of the defense industry participated in its preparation.

AIR DEFENSE TRENDS

According to Colonel-General V. Prudnikov, CINC of the Russian Air Defense Forces (ADF), the main objective of ADF reform is the creation of a basically new type of Russian Armed Forces, whose composition and combat capabilities will correspond to the development level of Air-Space Attack Forces (ASAF) and the real extent of military danger. The ADF's numerical strength and structure should be determined based on the need for effective implementation of a complex of AD tasks both in peacetime -- to deter aggression, and in wartime -- to repulse it.[147]

Accomplishing this objective involves the implementation of the following principles: single responsibility for counteracting all air-space attack means at all altitudes and speeds with a maximum use of various air-space defense forces; concentrating the main efforts along the most important strategic air-space axes; defending the most important strategic nuclear force groupings, top-level state and military control installations, major economic installations, installations of the nuclear industry, ecologically hazardous facilities, and the main troop and fleet force groupings; and ensuring the capability for a rapid AD concentration in any region of Russia in the event of a crisis situation.

Therefore AD development presupposes first, an integrated use of all AD troops, forces, and means of various armed services according to a single concept and plan; and second, giving the AD system a capability to quickly build up its efforts in conflict

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[147] Colonel-General V.A. Prudnikov, "The Main Directions of Organizing and Preparing the Air Defense Forces at the Present Stage," VM, No. 10, 1993, pp. 2-6.

areas. Both are feasible with single and centralized control of all AD forces on the strategic and operational levels.

At the present time the main efforts should be concentrated in the following areas: transition within the operational level to organizing the AD system by AD zones and districts; creation of the requisite control, intelligence, and warning systems; preservation of the potential of the existing AD groupings and their use in building a single AD system; and the creation of mobile and fighter-aviation AD formations. The central direction in the practical activity of commanders and staffs at all levels in improving the AD system is organizing control in AD zones and districts in order to concentrate the efforts of all AD troops and forces based on single responsibility and single control.

According to Colonel-General G. Kondratyev, the Russians plan to make air defense an integral part of Russia's unified air-space defense system (ADS). The air defense organization is based on the territorial principle -- not coordination between associations of air defense troops and the air defense troops and forces of military districts, the Air Force, and Navy as before, but unified command and control of these forces in air defense zones and regions according to a unified concept and plan. The plan is to have a large mobile reserve of air defense forces in central regions of the country in order to promptly escalate efforts in crisis situations.[148]

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[148] Interview with Colonel-General Georgiy Kondratyev, "Second Stage of Reform: What Lies in Store for the Army. Colonel General Georgiy Kondratyev, Russian Deputy Defense Minister, Answers Krasnaya zvezda's Questions," KZ, 22 March 1994, p. 2.

Analysis of the experience of recent wars and conflicts, especially the Gulf War, shows that wide-ranging massive use of offensive air-space weapons is assigned the main role in ensuring the success of a military campaign. Ground forces do not embark on active operations unless these weapons have engaged the opposing grouping.

The emphasis is obviously shifting toward the creation and use of unmanned, high-precision, low-signature offensive air-space weapons that can operate from space and the air at the same time. The fact that the combat potential of the whole arsenal of these weapons is being constantly enhanced is convincing evidence that the bulk of the initial phase of aggression will be determined by fierce air and space warfare. So what is needed is a well-organized united ADS system for the country and the Armed Forces.

The plan is to develop an air-space reconnaissance system based on the reconnaissance information assets of all branches of the Armed Forces and other Russian ministries (in particular the Federal Reconnaissance and Air-Space Surveillance System) that is capable of detecting offensive air-space weapons and at the same time forming an integral part of the overall early-warning system. Thus, all forces within the ADS will receive unified information on a real-time basis.

Prudnikov notes that Yel'tsin's order and the corresponding order of the Ministry of Defense practically gave a new face to the ADF. In the future they will constitute the basis of Russia's air-space defense. This is a natural future, because the air and space spheres are so interrelated that they have long been viewed as an inseparable whole.[149]

The organizational principles of the ADF will also be changed. It will acquire a quite different content and will become territorial. Within the time periods designated by the defense minister, zones and regions of air defense will be created. It remains only to establish them legally, through the appropriate documents. All outmoded arms and equipment have been eliminated. Units and subunits are equipped now with the most modern and powerful systems and complexes, which will make it possible to retain efficient use while shrinking the combat formations.

AIR-SPACE TRENDS

In the Russian view, the boundary between the airspace and outer space is so arbitrary that it cannot be interpreted unequivocally. What unites them is the need to overcome the force of gravitation in the process of using them. Furthermore, for a fairly long time there has also been such a notion as Air-Space Attack Forces (ASAF). This is not a mere combination of weapon carriers but a certain class of airborne and space-based weapons, characterized by their own unique properties and capabilities. Moreover, aero-ballistic means are being developed which in the process of combat can shuttle repeatedly between the airspace and outer space.[150]

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[149] Interview of Colonel-General of Aviation Viktor Prudnikov by Aleksandr Ivanov, "Air Defense Troops Will Be the Basis for Creation of an Air-Space Defense," KZ, 9 April 1994, p. 3.

[150] Colonel G.S. Dementyev, "Air-Space Defense: Problems and Judgments," VM, No. 2, 1994, pp. 12-16.

The logical conclusion is that in organizing defense to protect installations from enemy ASAF strikes, the specifics of their use should be taken into account -- i.e., they must be complex and integrated, and capable of withstanding strikes both from the air and from outer space. In other words, there is a need to organize air-space defense (ASD).

ASAF feature a great diversity of application. They are capable of striking any chosen targets, including those located outside engagement areas. Apart from military installations, they can engage targets which are critical elements in the opposing side's infrastructure or its economic system, especially those whose destruction results in chemical or radioactive contamination of the environment, floods, and so forth. This circumstance prompts a state, even in peacetime, to take measures to minimize the vulnerability of the above installations. Therefore air-space defense includes state structures engaged in activities designed to reduce the vulnerability of installations to ASAF strikes, and also the actual air-space defense system which performs military functions. Based on the assessment of ASAF potential combat capabilities, corresponding survivability requirements (norms) are elaborated for installations (durability, relative arrangement and location, duplication of elements, and so forth); requisite material supplies are accumulated; and preparations are made to reconstitute the infrastructure or economic structures damaged. At the same time it is hardly possible, and inexpedient for economic reasons, to ensure the survivability of installations only by reducing their vulnerability to ASAF strikes. On the other hand, it is practically impossible to organize a defense which would guarantee that no damage will be inflicted on the protected installations. Therefore both ASD components manifest themselves in a certain combination.

Thus, air-space defense should be understood as a complex of state-wide measures and military activities designed to prevent (minimize) the damage and losses from air-space strikes on installations of the national economy, the infrastructure, and the armed forces. In studying ASD, a major role belongs to analyzing the system of installations which must be protected from ASAF strikes as well as the combat capabilities of the latter for delivering strikes. It should be noted that ASAF actions can be more effective when an air-space attack system is created, including structures organizing and ensuring its use.

In determining the required levels of coverage, it is expedient to divide all installations into the following groups: top-level state and military command-and-control posts; military installations; the infrastructure (with the exceptions of the above-mentioned command-and-control posts); and national economic installations. Each of them consists of subgroups differing in the importance of tasks addressed or their functional features. Thus, among the top command-and-control posts, installations can be singled out which accomplish the tasks of an operational or strategic nature, strategic tasks on a nation-wide scale or within a particular region, and so forth. Military installations can be strategic and general-purpose.

The air-space attack system unites strike-delivery and support elements into a single complex. The former are air-, ground- (sea-), and space-based ASAF. Their composition is inconstant, even with respect to the availability of the above components. Indeed, in developing an air-space attack system, some states may not have, for instance, special space-based facilities. The ASAF classification into subgroups according to the basing principle is attributable to their characteristics and their combat employment methods, as well as to the tasks addressed by them. For all their advantages -- high effectiveness and invulnerability to ASD forces, ground- or sea-based ASAF cannot be used to engage mobile targets, which necessarily call for additional reconnaissance.

Air-based ASAF -- those using aerodynamic aircraft as delivery vehicles -- are more susceptible to the impact of defense systems. This is primarily due to the fact that aerodynamic vehicles have a relatively low flying speed and their effective engagement is possible both in the air and on the ground. At the same time they feature considerable flexibility of use, can be quickly re-targeted to accomplish new tasks that emerge unexpectedly, and are very difficult to counter. Space-based systems are the most effective in many respects but are fairly expensive and vulnerable to defensive means, because practically at any moment the location of these installations is known exactly. Furthermore, their maneuvering is extended in time, which allows anticipating the attacking side's intentions.

Elements ensuring ASAF preparation and combat use include air-space strike, command-and-control, reconnaissance, and support systems. The absence of any of them or a deliberate disruption of their normal functioning sharply curtails the implementation of assigned tasks. For instance, de-activation of the navigation system renders certain ASAF elements inoperative, increases the strike time, and creates favorable conditions for the defending side to repulse them.

The proposed Russian ASAF system structure unites into a single complex not only the activities by ASD forces against ASAF, but also the actions by the defending side's offensive system designed to suppress the enemy's command-and-control, reconnaissance, and support systems. But offensive systems alone are not sufficient to thwart air-space operations, and therefore the main burden of struggle will after all fall on ASD forces.

In analyzing a possible ASD system structure in the Russian Federation, experts note that it must be based on the principle of single responsibility for countering all ASAF in the entire range of their altitudes and flying speeds and the maximum use of all ASD forces regardless of their subordination. This conclusion stems in particular from an analysis of the range of tasks which are to achieved by ASAF strikes. Research shows that there are groups of installations covered by multiple-branch ASD forces, the strikes against which are delivered according to a single concept and plan (command-and-control bodies, strategic nuclear forces, airfield networks, and so forth). Therefore the use of all means of protecting them must also be well coordinated. The lightning pace of space warfare calls for actions by ASD forces to be coordinated not on interaction principles but on the basis on command and control from a single center with a minimum of intermediary elements. This is ensured by using the territorial principle in building the ASD system; i.e., by creating air defense zones and districts.

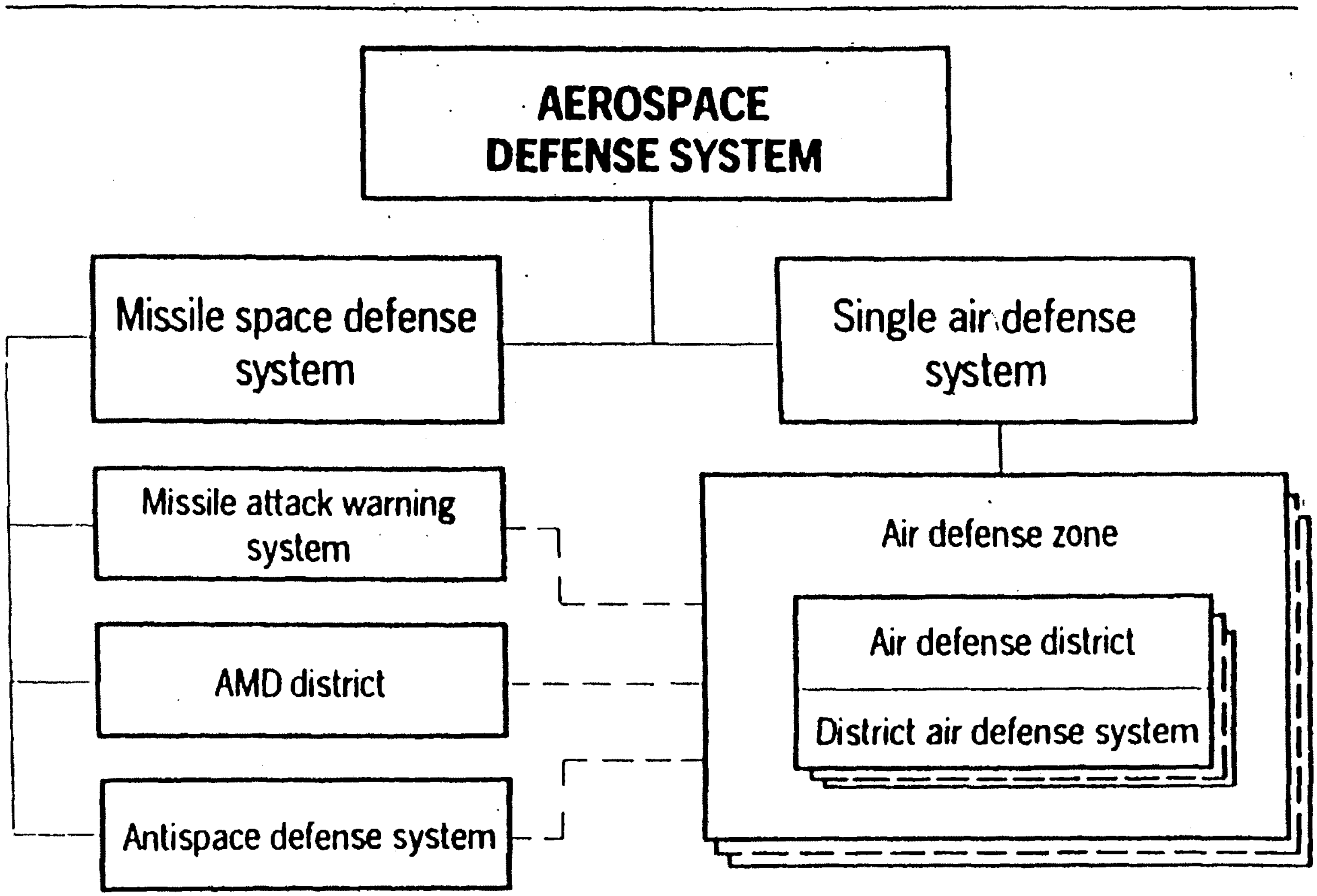
Air defense zones are established to conduct air defense operations to cover one or several economic districts of the country, and the troops and forces of military districts, fleets, and missile or air armies. Air defense districts are designed to ensure air defense of one or several industrial districts, and the troops and forces of military districts or combined-arms armies, flotillas, missile, and aviation divisions. The size of zones (districts) and the mix of troops assigned to their commanders depend on the number and location of installations to be defended, as well as on the allowed damage levels. In the North and East of Russia, air defense zones should include part of the water area over which air defense aviation can act. This is necessary in order to organize fighter aviation coverage of fleets in operation zones (air defense maritime districts are formed). As fronts are formed within air defense zones, front (army) air defense districts are created where the entire responsibility for air defense of the troops, infrastructure, and economic installations is borne by the front air defense commander.

In the process of implementing the territorial principle, questions arise relating to space-missile defense assets, which are functionally united into three systems: the missile-attack warning system, the anti-missile defense system, and the anti-space defense system. The missile-attack warning system operates in the interests of the whole state. Therefore within the ASD system structure it should be singled out as a separate element. The same goes for the anti-space defense system and the anti-missile defense system; the former involves orbital installations while the second, under the 1972 ABM Treaty, is limited to only one district on the territory of the Russian Federation.

Thus, the ASD system includes two main structural elements: 1) the space-missile defense system incorporating the missile-attack warning system, the anti-space defense system, and the anti-missile defense district; and 2) a single air defense system including air defense zones (districts) within whose framework assets are used to defend troops and installations which are capable of engaging ASAF within the altitude range of aerodynamic laws. The latter may not have a capability to counter blocks of strategic ballistic missiles because this would be a violation of the 1972 ABM Treaty (see Figure 14).

What unites the space-missile defense and the air defense systems? The essence consists in the specifics of countering medium- and shorter-range ballistic missiles, operational and tactical missiles, and hypersonic and other aircraft operating both in the outer space and in the atmosphere. The possibilities for using AMD and anti-space defense systems against the above-mentioned ASAF are limited on the one hand by spatial factors (deployment conditions), and on the other by their relatively high cost. Therefore the entire burden of action lies on air defense fires. However this involves the problem of their timely and accurate provision with information. It cannot be resolved reliably without committing corresponding space-missile defense assets (the information links mentioned are shown in the diagram by dotted lines). This is also evident from the experience of the Persian Gulf War, where the United States widely used space vehicles to ensure the efficient combat employment of troops (forces).

Russian military experts also examine the question of joint use of multiple-branch air defense forces and facilities in air defense districts where an air defense system is created, including general-purpose systems (reconnaissance and warning, command-and-control, technical and rear service logistics, and power systems); one or several systems of anti-aircraft missile fire; and fighter cover and electronic warfare systems. The central element here is the integration of the efforts of all air defense forces and facilities regardless of their subordination. For instance, the fighter cover system is generally built on the basis of Air Defense, Air Force, and Navy aviation forces.



The Structure of the Aerospace Defense System

FIG 14

Russian military scientists note that repelling enemy air-space strikes will require the immediate involvement of all command-and-control levels up to and including the strategic level. This is dictated by the regrouping of forces and assets, by their employment in airspace and outer space, and by the delivery of strikes against enemy air bases and other targets supporting the operations of air-space groupings.[151] Under such conditions it will be essentially impossible to divide command and control of air-space defense forces and assets into "general" and "direct," as now is customary between the General Staff and Main Commissariat of Air Defense Troops. They will begin to duplicate each other in decisionmaking for conducting an air-space operation, which will lead to "erosion" of responsibility for this decision.

But establishing a unified strategic air-space defense command and investing it with General Staff powers vis-a-vis organizing the state's air-space defense and command and control of its forces will permit exercising command and control of operations more effectively and attaining real successes in them. Not only defensive but also offensive forces, differentiated in terms of strategic air-space axes, should become part of the air-space defense makeup in conducting a strategic operation to repel an enemy air-space attack. This will conform fully to the nature of Russian military doctrine and will be a factor deterring a probable enemy from initiating war.

Colonel-General Prudnikov notes that considering the great length of Russia's state border, the importance and number of installations to be covered, the swiftness of air and air defense engagements and battles (which surpass the swiftness of

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[151] Colonel Aleksandr Rakhmanov and Colonel Vladimir Krivoruchko, "What Heritage To Renounce," AS, No. 6, 1994, pp. 20-22.

engagements and battles on land and sea by many times), and that essentially all branches of the Armed Forces have troops, forces, and assets capable of performing air-space defense missions, the conclusion can be drawn that they should be integrated to the maximum extent. This is possible only within the framework of a unified national air-space defense system based on a common responsibility and unified direction of training and operations of all air-space defense troops and forces.[152]

But how should this system differ fundamentally from the former USSR air defense system? First of all, by common programs for developing arms and training cadres for air-space defense in place of parallel resolution of these problems in other branches of the Armed Forces. Secondly, by unified planning and command and control of all air-space defense forces at the strategic, operational, and tactical levels instead of unified planning at the strategic level and coordination at operational and tactical levels. And thirdly, by deeper information, algorithmic, and fire ties among missile-space defense and air defense systems instead of their essentially independent existence. Implementing effective methods for combating existing and future targets operating under a unified concept throughout their range of air-space employment altitudes requires (especially with limited resources) a unification of the efforts of all troops -- above all reconnaissance and air-, missile-, and space-attack warning.

In addition, at the present time the air-space defense system must perform missions of non-strategic ABM defense of important installations against operational-tactical and tactical missile strikes. And this is inconceivable without information from

[152] Colonel-General of Aviation Viktor Prudnikov, "Air-Space Defense," AS, No. 4, 1995, pp. 6-10.

missile-space defense assets for target designations to air defense weapon complexes. Thus, creating a national air-space defense system presumes the integration of all troops and forces of the Russian Federation Armed Forces performing air-space defense missions based on a unified concept and plan of their organizational development and employment.

A strategic and operational mobile reserve of air-space defense forces, by which it is possible to react to the enemy's establishment (buildup) of groupings of offensive air-space forces, is another direction of air-space defense. A reserve will permit achieving a regional balance of air-space defense and offensive forces on a particular axis or in a particular theater. Its composition must include mobile formations, units, and subunits of fighter aviation; SAM Troops; Radiotechnical Troops; and EW outfitted with modern armament.

According to Prudnikov, the Russians have developed the forms of employing air defense troops and forces on the strategic as well as the operational and tactical levels, but they must be upgraded within the framework of a unified air-space defense system in the direction of integrated operations of air-space defense troops and forces. This is possible with the Air Defense Troops retained as an independent branch of the Armed Forces and with Air-Space Defense Troops established on the basis of Air Defense Troops, the Air Force, and the Air-Space Forces. Having studied both options, says Prudnikov, the Russians view the first option as preferable.

On 10 February 1995 all heads of CIS states (with the exception of Azerbaijan and Moldavia) signed the Agreement on Establishing a CIS Combined Air Defense

System. A combined air defense system is needed for performing the following missions: security of state borders in the airspace; joint control over the procedures for using the airspace; notification of the air-space situation and warning of a missile and air attack; and coordinated operations of air defense troops to repel an air-space attack.

An Air Defense Coordination Committee (chaired by Prudnikov) is being formed under the CIS Ministers of Defense Council to coordinate these efforts. The procedure for coordinating combined air defense system forces and assets is specified by a plan being drawn up by the Coordination Committee together with the CIS Staff for Coordination of Military Cooperation. This plan is approved by the CIS Ministers of Defense Council. Command and control of air defense (or air defense and air force) troops and forces of each state belonging to the CIS is exercised by the commanders of the air defense (or air defense and air force) troops of these states, with operations of combined air defense system troops and forces coordinated from the Russian Air Defense Troops Central Command Post.

Russian military scientists note that the creation of integrated air defense systems consisting of fighters (air defense), several radar early-warning and control aircraft, and ABM systems possibly will become the most intriguing project of the 21st century. All this equipment, interconnected through space satellites, creates an insurmountable shield above a given space. Such systems will cost billions of dollars and are not accessible to certain countries. Therefore it is not precluded that developing states will build an air defense through joint efforts.[153]

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[153] Vitaliy Zotov and Anatoliy Sautin: "Combat Aircraft Will Support Russia's Return to the Arms Market," Finansovyye Izvestiya, 22 August 1995, No. 58, p. VII.

GROUND FORCE TRENDS

According to Colonel-General Semenov, then CINC of the Russian Ground Troops, the principal goal of Ground Troop organizational development is to ensure their readiness and capability to conduct effective, highly mobile combat operations in wars and military conflicts of varying intensity. The primary mission at present is the establishment on strategic and operational axes of troop groupings adequate to the levels of military danger with consideration of planned numerical strength, established quotas, and treaty restrictions. With a significant reduction in numerical strength of the Ground Troops, the emphasis in forming troop groupings must be placed on improving their qualitative parameters.[154]

The Russians envisage that the Ground Troops will be built and developed along the following main directions:

- achieving balanced proportions of combat arms and special troops in the composition of Ground Troop groupings;
- developing a rational TO&E for formations and units;
- attaining a qualitatively new level in the development of combat arms (special troops) based on outfitting them with modern arms and military equipment and on upgrading their forms and methods of combat employment;

[154] "Colonel-General Semenov on Main Directions of Ground Troops Development," AS, No. 3, 1995, pp. 9-15.

- concentrating efforts in military-technical policy on integrated development of highly effective, standardized precision weapons and the reconnaissance, communications, and command-and-control systems supporting their use;

- manning the Ground Troops on a mixed principle of draft and voluntary contract;

- establishing an integral, flexible system of training military cadres meeting Ground Troop requirements and harmoniously combining a general scientific and military-professional education; and

- upgrading the organization and conduct of operational, mobilization, and combat training of command-and-control entities and the troops.

Semenov notes that it is necessary to preserve the basis of the Ground Troops -- military districts (fronts), armies, divisions -- but that a partial transition to a corps and brigade structure is envisaged based on a reduction in the numerical strength of Ground Troops groupings and the resulting increased probability of their independent operations on individual axes in the initial period of war.

To achieve a qualitatively new level of development, the main efforts will be concentrated in the following directions:

- creating a unified automated command-and-control and fire-control system and its subsystem;

- developing multipurpose, multichannel automated combat systems, including reconnaissance-strike and reconnaissance-fire complexes;

- developing models and complexes of arms and military equipment based on new physical principles and non-traditional engineering solutions using elements of artificial intelligence;

- ensuring high mobility, survivability, noise immunity, all-weather capability, and compatibility of armament complexes; and

- reducing the nomenclature of arms and combat equipment and the time periods and expenditures for their creation through standardization of elements, assemblies, instruments, and hardware.

In accordance with the adopted Concept for Russian Federation Armed Forces Organizational Development in Three Stages up to 2000, a Ground Troops Air Defense Troops organizational development plan has been drawn up and is being put into practice.[155] The tasks of the first and second stages basically have been fulfilled within the scope of its implementation. Top-priority measures have been accomplished for resolving problems of Ground Troops Air Defense Troops organizational development, withdrawing Ground Troops Air Defense Troops formations and units from countries of Eastern Europe to Russian territory, upgrading the system for command and control of Air Defense Troops in the Leningrad Military District, forming the Russian Federation Ground Troops Air Defense Military Academy and a training center in Yeysk, and developing a TO&E for air defense formations and units which are part of the Mobile Forces.

During the third stage (1996-1999), the Russians propose to further develop Ground Troops Air Defense Troops by outfitting them with modern models of arms and military equipment based on the achievements of science and cutting-edge technologies. The Russians plan not to limit themselves in development to specific

[155] Interview with Boris Innokentyevich Dukhov, "Ground Troops Air Defense Troops Under Conditions of Military Reform," VPK, No. 3(6), 1994, pp. 39-43.

time periods such as 1996 or 2000, but to organize this work based on the upgrading of capabilities of offensive air weapons and their operating tactics. In this connection, Ground Troops Air Defense Troops organizational development must proceed adequately, even outstripping the means of armed opposition in the air.

Further upgrading of radar reconnaissance equipment is aimed at increasing its capabilities of detecting advanced hypersonic and stealthy airborne targets under conditions of fire and electronic countermeasures based on the use of new engineering solutions, with a reduction in the number of radar equipment types to three (Nebo-SVM -- an alert mode radar, Gamma-SZ -- an operational-level combat mode radar, and Kasta-1 -- a regimental-level radar for creating a mobile low-altitude radar field).

They plan to upgrade SAM systems and complexes in existing structures of district (front), army (corps), division, and regimental entities. These will permit forming stable military district (front) air defense groupings in which complexes for various purposes and with various capabilities supplement each other, creating a multi-echeloned system for covering troops and troop installations over considerable expanses, and for local cover of especially important individual installations in the operational alignment of fronts and armies (army corps).

The number of types of developed SAM systems (complexes) of Ground Troops Air Defense Troops is deemed substantiated. These include the S-300V (VM) SAM system at front (district) level; Buk-M1 (M2) SAM complex at army (corps) level; Tor-M1 SAM system at division (brigade) level; and Tunguska PZRK, Strela-10M3 SAM complex, and Igla shoulder-fired SAM complex at regimental level. These systems and complexes, except for the portable ones, are precision reconnaissance-fire assets and ensure reliable engagement of present and future offensive air weapons.

The Russians plan to switch to three systems by the year 2000 -- a unified SAM system at the operational level, a unified SAM system at the tactical level, and a unified antiaircraft gun-missile complex for covering point targets against precision weapons. They envisage making the transition from rigid structures of Ground Troops Air Defense Troops to a structure permitting the creation of SAM units that ensure the requisite level of cover for troops and installations of the Ground Troops with minimum expenditures depending on the combat missions being performed.

Of all the air defense forces and assets, SAM systems and complexes are the only means of immediate cover of troops and installations, and there is no doubt as to the need for their presence on alert duty in peacetime and as a component of the combat-ready groupings of Air Defense Troops. In this connection, it is advisable to examine SAM cover under present conditions based on the principles of a two-component makeup of SAM troops (mobile-stationary and mobile versions of implementation):

- mobile-stationary SAM complexes (systems) are to be used for providing cover of strategic installations, supreme state and military command-and-control entities, the most important installations in sectors of the economy, and also troops when they are being deployed and placed in combat readiness (some forces of these SAM systems (complexes) may be used for alert duty in peacetime);

- mobile SAM systems (complexes) are to be assigned the mission of covering Russian Federation Armed Forces groupings, mobile forces, and installations in the zone of operational alignment of fronts and armies (army corps).

A significant expansion in the arsenal of offensive air weapons and the wide-scale use of ballistic and cruise missiles for neutralizing the air defense system and delivering strikes against troops and installations (based on the experience of armed conflicts, especially in the Persian Gulf) substantially complicates the missions of Ground Troops Air Defense Troops by advancing tactical ABM defense and combat against precision weapons to primary missions. But the Russians claim to have air defense complexes and systems which can become the basis of tactical ABM defense. These complexes (S-300VM, Buk-M2) have been demonstrated at many prestigious exhibitions, including international ones, and now are recognized as the best in the world.

The need for combating precision weapons became especially obvious during Persian Gulf combat operations. Precision weapons will have their widest use in an armed conflict between highly developed states, and ground operations can be successful only if protection is provided against these weapons. Semenov argues that the main contribution toward solving this problem must be made by Ground Troops Air Defense Troops.

The organizational development of the Russian air defense system on a territorial principle has been progressing since 1993 in accordance with the Presidential Edict and orders of the Minister of Defense. In accordance with orders, the organizational development of the Russian air- and air-space defense systems specifies the Ground

Troops Air Defense Troops as one component of the system for covering installations of the country and Armed Forces against enemy air strikes and precision weapon strikes, and the primary means of preserving the combat effectiveness of Ground Troops and mobile forces in the course of combat operations.

According to Semenov, the following are considered primary missions for Ground Troops Air Defense Troops organizational development:

- establishing military district air defense groupings in accordance with assigned numerical strength, district and army (corps) suites, and Supreme High Command reserves;
- bringing the manning level and the degree and state of combat readiness of Ground Troops Air Defense Troops into line with assigned missions;
- creating systems for command and control of military district air defense troops with the introduction of automation equipment and automated control systems;
- re-arming formations and units with present-day and future SAM systems (complexes) and radar reconnaissance equipment in accordance with appropriations allocated for procurement and delivery of new armament; and
- training troops to conduct combat operations under present conditions and seeking non-traditional ways and methods of training formations, units, and combat teams under conditions of financial limitations and economy of materiel and resources.

X. NEW MILITARY-TECHNICAL POLICY

"U.S./NATO" MILITARY-TECHNICAL POLICY

Russian military experts claim that according to the estimates of "American experts," the development of cutting-edge military technologies based on scientific and technical breakthroughs must ensure, above all, an increase in capabilities in the following seven areas: (1) global observation and communications systems; (2) making high-precision strikes; (3) air superiority, antiballistic missile defense (ABM), and air defense; (4) control of maritime theaters and superiority in antisubmarine defense; (5) advanced means of waging war on land theaters; (6) real situation modeling; and (7) economic acceptability of weapons systems. This will make it possible to minimize losses during the course of combat operations, decrease the number of service members, ensure more successful conduct of joint operations by the armed services, and preserve technological superiority.[156]

[156] Colonel V. Sergiyevskiy, " 'Key Technologies' of the U.S. Department of Defense," ZVO, No. 5, 1993, pp. 9-11.

The priority nature of the development of "key technologies" for implementing scientific and technical breakthroughs is shown in Figures 15 and 16.

Priority Nature of Development of "Key Technologies"								
Numbering of Key Technologies	Name	Potential Areas of Scientific and Technical Breakthrough						
		1	2	3	4	5	6	7
1st	Computer technology	+++	+++	++	++	+++	+++	+++
2nd	Software	+++	+	+++	+++	+++	+++	++
3rd	Sensors	++	++	+	+	++	+++	-
4th	Communications networks	+	++	+++	+++	++	+++	+++
5th	Electronic components	++	+++	++	+++	+++	+++	+++
6th	Environment	+++	+++	+++	+++	+++	+++	-
7th	Materials and processes	+++	+++	+++	+++	+	-	++
8th	Energy storage circuits	+++	+++	+++	+++	+++	-	-
9th	Engines and energy converters	+++	+++	+++	+++	+++	-	-
10th	Designing automation	+++	+++	+++	++	+++	++	+
11th	Interaction of system and operators	+++	+++	+++	+++	+++	+	+++
Legend: + highest priority; ++ second in level of priority; +++ high priority								

Figure 15

Correlation Between "Key and Critical Technology" Plans of the U.S. Defense Department

"Critical Technologies"	"Key Technologies"											
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	Total
Semiconductor materials and microelectronic circuits					10							10
Computer software		10										10
Computers with parallel architecture	10											10
Artificial intelligence and robotics		2	2	2						2	2	10
Simulation and modeling										5	5	10
Photonics			2		3							5
Radars for detecting and identifying low-observable targets			10									10
Passive sensors			10									10
Signal-and image-processing			10									10
Control of signatures of military equipment			1			1	4			4		10
Environment (environics) of weapons systems						10						10
Correlation processing of data										10		10
Computational methods of gas- and hydrodynamics									10			10
Air-breathing jet engines								10				10
Pulse energy sources							10					10
Hypersonic projectiles, means of their acceleration and ballistics								3	3			6
Materials with high-energy density								10				10
Composite materials							10					10
Superconductivity	1		2		4		1	1	1			10
Biotechnology			2				2					4
Flexible automated production										10		10

Figure 16

According to General-Major A.S. Sumin, achievements in microelectronics are used for civilian purposes on an especially wide scale in NATO countries. This direction has great financial, organizational, and cadre support from various structures of the armed forces. The creation or development of the following have achieved the greatest progress: new composite materials, diamond films, and materials with fiber filler; inertial measurement units and onboard digital computers based on small, lightweight elements with a speed of up to one billion operations per second; microelectronic sensors of multisensory recognition systems; software; expert systems; elements of an air-space profile (low-thrust engines of light-engine civilian aircraft, hypersonic power plants for air-space transportation); chip constructions; and fabrication of semiconductors based on gallium arsenide.[136]

From the viewpoint of a systemological approach, of the U.S. Defense Department's 20 critical technologies which encompass virtually all the main thrusts of scientific and technical advancement, top priority obviously belongs to disseminating the information technology of warfare: hardware (artificial intellect and robot technology, signal-processing, correlate data-processing, and parallel structure computers); and software (modeling, simulation, and programming support). Out of 11 Euclid cutting-edge technologies, prominence is given to R&D projects in the sphere of artificial intellect designed for military purposes, including the creation of work

[136] General-Major A. S. Sumin, "Analysis of Possible Directions for the Use of Dual Technologies," VM, No. 5, 1993, pp. 62-65.

places for commanders and operators of automated troop (force) control systems, imagery and speech recognition systems, and data bases.[137]

Therefore the mainstream thrusts of developing modern military technologies are disseminating the information and artificial intellect technology of military systems that are most orientated toward imparting to combat systems a highly important functional quality: intelligence. These technologies occupy a leading position in the production of various weapon types, from small arms to complex global systems.

In recent years there has been a sharp increase in the requirements for automated troop (force) control systems, for the development of basically new strategic and operational systems, and for the processing and transmission of large data arrays in real time. Related problems call for an extensive search for non-traditional approaches toward creating super-computers and furthering research in such important areas as artificial intellect, modeling and simulation, automated target identification, data synthesis, and so forth. The world's leading scientists see a possible technological breakthrough in this field lying in the super-miniaturization (to the level of 10^9) of computing equipment, or nano-technology.

Russian military scientists stress that the special importance of the military technologies under review is recognized both in the United States and Russia. But this recognition does not mean the renunciation of critical, key, and other types of

[137] Captain 1st Rank E.G. Shevelev, "The Problem of Adequate Perception of Threats to National Security and Priorities of Its Elaboration," VM, No 6, 1994, pp. 12-16.

technology whose implementation is capable of ensuring superiority and priority in creating highly efficient national combat systems.

Russian specialists relate the next revolution in military technology to the wide-scale application of composite materials in arms and military hardware production. In some Western-designed aircraft even now they constitute up to one-fourth of the mass. Superior in specific hardness and strength even to the most famous alloys, composite materials enhance resistance to corrosion, resistance to alternating loads, and reduce by 15-20 percent the weight of aviation structures, vibration, and the impact of the environment, thus ensuring their long service life.

But to achieve success in these areas for just one, even the most advanced country of the world is very difficult because the practical implementation of high-tech ideas in new arms systems calls for substantial material outlays and becomes possible only through joint research projects by leading world scientists. This, for instance, was the case in the 1941-1945 period, when the scientists of the anti-Hitler coalition countries created nuclear weapons.

Another extremely important feature of modern intelligent combat systems also needs to be highlighted: their efficient operation can be ensured only by well-trained officer cadres, who have a deep understanding not only of the character but also the law-governed patterns of warfare, and are capable of maximizing their professional knowledge, experience, intuition, and other professional qualities for achieving their assigned objectives. Taking this into account, it is not difficult to predict an inevitable change in interrelations between buyers and sellers on the world arms market. The purchase of the most sophisticated weapons -- unless they are integrated into a combat system capable of opposing an analogous enemy system, and unless an arms-importing country has well-prepared officer cadres possessing the requisite intellect -- will be senseless. Furthermore, because Third World countries have weapons and military equipment from various states, sooner or later problems will emerge related to their integration into single combat systems -- as well as to the training of corresponding cadres. Military academies (colleges) and schools should be capable of providing the students with knowledge which would allow them, in the process of using the arms and equipment procured, to create modern combat systems in their respective country. In other words, in the near future intellect will become just the same kind of commodity as combat equipment.

OFFICIAL GOVERNMENT MILITARY-TECHNICAL POLICY

On 2 November 1993, President Yel'tsin and his Security Council finally approved Russia's first official military doctrine. Like the May 1992 draft doctrine, the official document stresses Russia's need to acquire those cutting-edge military technologies most promising for the conduct of both local and large-scale wars.

For example, the new doctrine calls for the following:

- the priority allocation of appropriations for the most promising scientific and technological defense developments to ensure Russia's security and develop its economy;
- fundamental and applied research and experimental-design developments that ensure Russia's ability to react effectively to emerging military threats and military-technical breakthroughs;

- the development and production of highly efficient C^3I, strategic warning, EW, and precision non-nuclear weapons systems, as well as systems for their information support;

- the application of the latest scientific and technical achievements for developing new generations of weapons, and the maximum use of mathematical models for assessing their combat efficiency before starting series production.[138]

- increase in the individual level of technical equipping of service members with means of conducting armed warfare, communications, and protection; and

- improvement of the ergonomic characteristics of armament and military equipment in "soldier-machine" systems.

The doctrine demands that Russia continue to field world-class weaponry, creating "ahead of competitors" new generations of armaments and equipment. It is also vital to retain a mass mobilization capability in both personnel and industrial terms. To these ends, priority must go to the military in the allocation of financial and other resources. Defense conversion should be carried out "rationally," and it is clear from the context that this means as little as possible. The consequences of a move to a market economy are mentioned only insofar as it is necessary to minimize their effects on defense R&D and production.

Russia's official doctrine also declares the final demise of Gorbachev's "defensive doctrine," which was enunciated in 1987 and triggered the CFE reductions

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. "Basic Provisions of the Military Doctrine of the Russian Federation," Voennaya mysl' (November 1993 Special Edition): pp. 3-23.

in Europe. The Russian Armed Forces will henceforth prepare for "both defensive and offensive operations with a massive use of existing and future weapons irrespective of how the war starts and is conducted."

In President Yel'tsin's 1994 State of the Union Address, he stated that experimental-design work will be vigorously developed in military-technical policy, making it possible to provide a suitable response to existing and potential military threats and military-technical breakthroughs. The tasks of ensuring the country's nuclear security and equipping the Army and Navy with state-of-the-art command-and-control, communications, reconnaissance, and radioelectronic warfare systems are regarded as being of paramount importance.[139]

A number of important resolutions and edicts by Yel'tsin and the government were adopted based on the proposals of Goskomoboronprom (the State Committee for Defense Industries) and with its participation:

- The "State Program for the Conversion of the Defense Industry for 1992-95" was approved by the government and is part of the Federal Program for the Structural Restructuring of the Economy of Russia;
- two sessions of the Security Council were held under Yel'tsin's chairmanship with the agenda "The Defense-Industrial Potential of the Russian Federation" and "Programs for the Development and Production of Advanced Types of Armaments and Military Hardware," which approved the basic guidelines for

[139] "Russian Federation President's Message to the Federal Assembly: On Strengthening the Russian State. (Basic Guidelines for Domestic and Foreign Policy)," RG, 25 February 1994, pp. 1, 3-7.

the development of advanced armaments and military hardware through the year 2000, as well as defined the necessary supporting programs;

- measures to retain the core of the defense complex under federal ownership and basic guidelines for improving the methods of privatization and regulating the activity of joint-stock enterprises with a state share of authorized capital were defined by Yel'tsin's edict entitled "Specific Features of Privatization and Additional Measures to Regulate the Activity of Enterprises in the Defense Sectors of Industry;"

- the decree of the Russian government entitled "Enterprises and Organizations of the Defense Sectors of Industry Not Subject to Privatization in 1993-95, As Well As Transformed Into Joint-Stock Companies" defined the procedures and terms for the creation of joint-stock enterprises in the defense complex;

- Yel'tsin's edict entitled "Stabilization of the Economic Situation of Enterprises and Organizations of the Defense Industry and Measures to Support the State Defense Order" was adopted;

- the Russian government adopted the decree entitled "Paramount Steps to Support the Activity of State Scientific Centers;"

- the trilateral rate agreement was signed for 1994 among the Association of Russian Trade Unions of Defense Sectors of Industry, the State Committee of the Russian Federation for the Defense Sectors of Industry, and the Ministry of Labor of the Russian Federation, and was coordinated with First Deputy Chairman of the Russian government O.N. Soskovets, and much more.[140]

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[140] Viktor Konstantinovich Glukhikh, "The Defense Industry of Russia: The Situation and Tasks for 1994," Konversiya, No. 4, 1994, pp. 3-8.

The basic principles and postulates of an industrial policy for the Russian sector are enunciated in a conceptual framework that has been disseminated to all of the enterprises. Its most important provisions include the following:

- the creation of accelerated scientific work in progress, and the development and production of technically advanced and highly efficient systems and models of arms and military equipment. A military-technical and technological lag behind the developed nations of the world must not be permitted here, along with the simultaneous optimization of both the types of resources being created and the expenditures for their production;

- the integration of military and civilian production, with an orientation toward the widespread utilization of dual-purpose technologies. The grounding of mobilization potential on contemporary principles (using capacity freed up and in reserve for the output of market-competitive products);

- the restoration and expansion of cooperative ties with the defense complexes of the CIS member countries, and improvement of coordination with the regions of Russia; and

- the maximum development of the export capabilities of the defense sectors.

The 1993 military doctrine confirms the importance and urgency of developing fighter and interceptor weapon control systems as one of the primary means of deterring aggression, and of creating mobile forces based on precision non-nuclear weapons. The question of using the newest S&T achievements and advanced technologies is being resolved in a number of research projects and experimental development work aimed at further upgrading weapon control systems to increase their combat effectiveness in the world market. The following are the main problems being resolved in these projects:.[141]

- development of open-architecture systems with modular equipment design ensuring the possibility of standardization among different kinds;
- functional and hardware integration of the entire onboard equipment complex;
- increased concealment of operation, anti-jam protection, and effectiveness of electronic countermeasures;
- combating stealth targets and small airborne and ground targets; and
- use of artificial intelligence methods in command and control, data-processing, and a number of other original engineering solutions.

The development of an S&T and experimental base is a necessary condition for creating weapon control systems meeting present and future requirements. Despite financing difficulties, the Russians claim to have found an opportunity to create the necessary modeling complexes based on shielded anechoic chambers and multiprocessor supercomputers supporting both mathematical (including in real time) as well as half-scale modeling of systems under development. These investments unquestionably will be repaid through careful development and modeling of systems, which will substantially reduce the amount of very costly flight tests.

The new federal program, the draft of which was discussed by Goskomoboronprom's Scientific-Technical Council, is called the "National

[141] Anatoliy Ivanovich Kanashchenkov, "Control of Technologies Is Today's Main Task," VPK, No. 3(6), 1994, pp. 27-31.

Technological Base" program. Goskomoboronprom First Deputy Chairman Yuriy Glybin said that the main aim of the program is to preserve and develop Russia's technological base, which can ensure the development and production of competitive science-intensive output in the interests of resolving the top-priority tasks of the country's socioeconomic development and national security.[142]

The program envisages conducting comprehensive research and development work into base technologies in spheres of critical importance for the country's national policy. These include information technologies, technologies based on new materials, microelectronics, nano-electronics, optical electronics, laser and radioelectronic technologies, power generation and energy saving, advanced engines, highly productive industrial equipment, special chemicals, energy-intensive materials, unique nuclear technologies, biotechnologies, and environmentally safe technologies.

The implementation of the program will make it possible to overcome the dangerous lag that has developed over the past few years in a number of highly important technological areas, and will ultimately create conditions for the development of competitive science-intensive output in the sphere of modern technical systems (air, sea, and ground transport; communications and utility systems; space technology; medical equipment; etc.), which by and large guarantees the technological aspects of the country's security -- thus creating the scientific and technological foundations for a radical change in the export structure toward a science-intensive end product. The implementation of the program for developing dual-purpose technologies will "gear"

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[142] Aleksandr Yegorov, "National Technological Base," KZ, 29 April 1995, p. 4.

military expenditure to creating the scientific and technical groundwork, and will make it possible to focus efforts on developing what are purely military technologies with a view to dramatically boosting the functional potential of promising arms systems.

The plan is to fund the "National Technological Base " Federal Program by reallocating the funds envisaged in various sections of the budget and extrabudgetary funds. "In particular, in 1995," the Goskomoboronprom press release says, "around 1.5 trillion rubles [R] could be allocated for that purpose, including R1.15 rubles in federal budget funds. In the future the intention is to assign a separate section of the budget to fund the program and give it the status of a presidential program." Program officials estimate that funding levels through the year 2005 (at prices current during the first quarter of 1995) will be as follows: 1996-1997 -- R7,301 trillion; 1996-2000 -- R18,982 trillion; and 2001-2005 -- R18,982 trillion.

The use of dual-purpose technologies is often the focus of discussion in the Council for Scientific and Technological Policy set up on Yeltsin's initiative. Yeltsin has said that the use of dual-purpose technologies is now one of the key issues in the scientific sphere because, according to experts, such technologies account for more than 70 percent of all those used in the defense complex.[143] In late 1995 he therefore announced that a new presidential program entitled "Dual-Purpose Technologies" had been drafted, and urged Council members to evaluate the new program with maximum responsibility by approving the most promising projects in the presidential program.

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[143] Andrey Shtorkh, "Focuses on Dual-Purpose Technologies," ITAR-TASS, 15 August 1995.

Yel'tsin has also stressed that the potential of the military-industrial complex (VPK) must be used to win priority positions on the world markets, preserve and further strengthen the country's defense capability, and compensate in quality for what the country has lost in quantity through cuts in armaments and military equipment. He drew special attention to the development of radio-electronic equipment. According to him, this sector and its importance for the country's future is priceless.

Yel'tsin also told Council members that he would consider more allocations from the federal budget for funding research and development projects in Russia -- to amount to a total of about 5 percent of the GDP.

OFFICIAL MOD MILITARY-TECHNICAL POLICY

A commission to effectively develop proposals for determining the priority directions of financial support to the vital activities of the armed forces, created by an order of the Ministry of Defense, has been operating in the Ministry of Defense -- until 1997 under the chairmanship of Deputy Defense Minister Andrey Kokoshin. The membership of this commission includes the chief of the General Staff, deputy defense ministers, and the chiefs of a number of main directorates, including the Main Directorate of Military Budget and Financing.[144]

The main provisions of Russian military-technical policy were approved at a government session chaired by Yel'tsin in May 1992 following a report by Andrey

[144] "Financial Problems in the Spotlight," KZ, 30 April 1994, p. 2.

Kokoshin. This document became the foundation for the defense department in defining the strategy for pricing military equipment. One of the priorities in military-technical policy is optimization of the types of equipment ordered, which has already resulted in a two- to three- fold reduction in the number of arms types ordered in some branches and also a reduction in operating costs. Significant quantities of armored and air equipment, antiaircraft missile complexes, and battleships are being modernized. On the whole, the military-technical policy of the Defense Ministry is aimed at creating an optimal balance between emerging weapons of the 21st century and modernization of what has already proven itself for the troops.[145]

Andrey Kokoshin has noted that "Russia is not abandoning the development and production of world-level weapons." According to him, arms co-production arrangements will be preserved with enterprises in Belarus, Kazakhstan, Ukraine, and other CIS states. The arms program provides in particular for completing the development of and adopting combat and transport combat helicopters designed by the Mil and Kamov Design Bureaus (Mi-28, Mi-40, and V-80); equipping fighters with effective means of individual protection, coded communication means, and compact automated control systems; and developing means of electronic warfare. Information technology in the arms program will increase to 30-35 percent as compared with 20-25 percent in the previous program.

It is noteworthy that the new program has for the first time been oriented not toward a centralized economic structure and unlimited state subsidies, but toward direct

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[145] Ilya Bulavinov, "'There Will Be Fewer Weapons, But They Will Be Better," KD, 23 October 1993, p. 4.

and mutually advantageous cooperation of the Defense Ministry and industry. The ministry will conclude direct contracts with enterprises in the defense sector, allocating funds for specific programs and projects. The command of armed forces branches and military districts and many enterprise directors are against the restoration of the former system of the military-industrial complex, whereby unwanted arms systems or those failing to meet the requisite quality level were imposed on the Defense Ministry.

On 19 January 1994, the basic directions and priorities of a long-range program for arming the Russian Army were approved at a Security Council session. Low-intensity conflicts and local wars in which less-than-mass armies will take part are among the most likely kinds of armed conflicts. (This also was reflected in provisions of Russian military doctrine.) Obviously such an assessment also applies to the new kind of operations -- fighting terrorism. For example, the Russians have a three-stage program to the year 2005 for the fighting-man's personal gear and equipment and combat outfitting, which envisages different levels of outfitting from the motorized rifleman to officers of special reconnaissance subunits. Units of mobile forces earmarked for immediate or rapid reaction will be re-outfitted on a priority basis.[146]

Individual operational data-display systems are being developed: liquid crystal displays built into a helmet, whereby a combatant will precisely see his own position and that of his neighbor and the enemy; i.e., he will receive his own "portion of the information" on the situation around him. New types of assault weapons have been developed for "Spetsnaz" troops as well as new kinds of combat attire. It is very

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[146] Interview with Andrey Afanasyevich Kokoshin, "Andrey Kokoshin: Russian Army Is Preparing for Local Wars and Antiterrorist Activity," Segodnya, 18 February 1994, p. 9.

important that the armament program provide for upgrading the communications and tactical command-and-control systems. This means above all near-real-time transmission of data, communications among subunits according to the principle of a cellular telephone network (but with necessary and automatic scrambling of verbal information being transmitted), and the classic "commander's communications." The Russians already have systems for precise topographic tie-in of subunits to the terrain using satellite navigation systems. True, the individual combatant cannot be outfitted with that system now inasmuch as satellite communications ground elements have considerable weight-size characteristics and are very costly. The first individual systems of this nature may appear only after the year 2000.

In the overall scope of military-technical tasks, the Ministry of Defense envisages priority development of various precision weapon systems, from close-combat systems to operational-tactical and strategic systems. There is a program for tying reconnaissance, data-transmission, and communications systems of various levels and purposes into a unified information system. The predominant content of the effect exerted on the enemy in modern warfare has become not pulverizing his personnel, but throwing command and control and SIGINT systems into disarray and generally demoralizing troops, the command element, and state command-and-control entities.

By virtue of this, EW equipment development programs become even more important, both for suppressing enemy electronics and weapons and for protecting friendly weapon systems and data-collection and transmission systems. Today supremacy of the air waves is at the very least equivalent to the factor of air supremacy in wars of the mid-20th century, and in many cases today EW is no longer a supporting asset. A new concept -- the electronic-fire strike -- has emerged. Modern EW assets are capable not only of "blinding" the enemy for a certain time interval, but also putting some of the most important elements of his systems completely out of commission.

The Russian Defense Ministry thinks that "the program for a scientific-technical head start" in rearming the Russian Army should be financed on a priority basis. Kokoshin announced in 1994 that according to the Defense Ministry's military-technical policy approved by the president and the Security Council, a special program has been elaborated for this purpose. It is aimed first of all "at developing smart weapons and the means of protection against them, and also at achieving a high level of efficiency of a relatively small but formidable army." To this end, a working group at the Defense Ministry's Military-Technical Policy Council has been established.[147]

Russia needs a new armaments program, Kokoshin stressed in March 1995. Such a program should be aimed at ensuring "reliable nuclear deterrence and the development of strategic nuclear forces, including their naval component." As for the naval aspect of the program, "non-standard ways" should be found to ensure "Russian presence in the world ocean."[148] The creation of essentially new precision conventional weapons, reconnaissance-and-target indication technologies, and tactical-level communications in the ground forces must be the main points of the program, he continued. He said that his ministry and research institutes were also looking for ways

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[147] "Russian Military Gives Priority to Re-Armament," Segodnya, 24 May 1994, p. 2.

[148] Interfax, 11 March 1995.

to bring Russian armor up to world standards, trying to introduce new materials to reduce its vulnerability to the minimum.

In terms of groundwork for the future, the Russian military attaches paramount importance to the key technologies which are the cornerstone for developing the weapons of the 21st century. For this purpose they have elaborated and are implementing a special program for basic military technologies -- reconnaissance-and-targeting systems, navigation systems, and improved aviation weapons.[149]

The Concept of a Long- Term Armaments Program was elaborated in 1994 by the Ministry of Defense jointly with the State Committee for the Defense Sectors of Industry, the Ministry of the Economy, other departments, and the most senior scientists, and was approved by President Yeltsin. This is an extremely detailed document containing serious economic computations and graphs, rather than being a simply descriptive document. This concept served as a basis for formulating the state defense order for 1994-1995. It represents all basic weapons systems which will determine the Army's technical makeup in the 21st century. It is, in fact, also an armaments program in a compressed form.

This new long-term armaments program, which will help Russia arm itself with the best multipurpose missiles and other equipment in the world, is said to be nearing its completion. The Russian Ministry of Defense, the State Defense Production

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[149] "Exclusive" interview with Andrey Kokoshin, "Postscript to MAKS-95. Andrey Kokoshin: Expenditures on Arms Development and Procurement Must Be Increased," KZ, 23 September 1995, p. 3.

Committee, the Russian Space Agency, and other departments have done vast work to find new, non-standard solutions for producing defense equipment, using the most modern technologies. The strategy of concentrating resources in important directions has also been finalized. Together with a well-developed new cooperation system for the production of complex armaments, the strategy will help to produce arms and multipurpose missile systems for peaceful purposes that are capable of competing on the world market, as well as ensuring national security.[150]

RUSSIAN MILITARY-TECHNICAL REQUIREMENTS

As Russian military scientists have noted, the general requirements for modern Russian Armed Forces also predetermine the main priorities in military-technical policy for the near and more distant term, taking into account the country's economic capabilities. The main directions of military-technical policy should include the following list of priorities: highly effective weapon and electronic warfare systems; technical command-and-control, intelligence, and communication systems based on a wide-scale use of computing facilities and the latest achievements in the sphere of information science and cybernetics, which sharply raise the effectiveness of weapons and troops (forces); a ground- and space-based infrastructure ensuring command and control, intelligence, and communications in peacetime and in wartime; a system of transport facilities and a transport infrastructure enhancing the strategic, operational, and tactical mobility of troops (forces); mobile means and a comprehensive logistic

[150] ITAR-TASS, 24 January 1996.

service infrastructure; and a mobilizational deployment infrastructure and technical facilities for training troops (forces) and preparing the reserve.[151]

In the Russian view, the times when inadequate quality could be offset by the greater quantity of weapons are long past. In the foreseeable future, they envision a period of an all-encompassing competition between basic military technologies. For instance, the Gulf War in 1991 captured the attention of military specialists dealing with matters of arms development not only and not so much by its scale, quantity, and level of coordination between troops and forces involved in military operations, but rather by a wide-ranging employment by the multinational forces of state-of-the-art systems of reconnaissance, high-precision weapons, electronic warfare systems, and so forth. This is the reason why the war was nicknamed "the new war of technologies."[152]

Presently, as never before -- and even more so in the long run -- the combat capabilities of Army subunits, units, and formations will be determined by the quality of their electronic element base, new materials, new substances in weapons and military hardware, microelectronics and fiber optics, computers, high-accuracy picture equipment, and so forth. The vibrant development of science-intensive industries (informatics, radioelectronics, computers, robot equipment, and so forth) has brought about a situation wherein the orientation toward simplifying design solutions,

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[151] V. N. Tsygichko, "The Main Priorities in Russia's Military-Technical Policy," VM, No. 12, 1993, pp. 54-60.

[152] Colonel Yu.D. Ilyin, "On Some Trends in the Development and Ways of Balancing the Army Weapons System," VM, No. 6, 1994, pp. 38-46.

modernizing existing technology, and quick assimilation of weapons and military hardware by the troops has become obsolete in a global sense and is still valid only for a few types of weapons (for instance, small arms) where mechanics still retain their key importance. In these conditions it is essential to decisively overcome the trend toward developing weapons systems by small steps, incorporating the characteristics of similar models. The main stress should be placed on achieving significant superiority in the key characteristics of cutting-edge weapons and military-technical systems.

Russian military officials stress that among the key areas for improving Army weapons and military hardware the following ones should be singled out: the merger of fire (assault) and support models of various basing modes into multifunctional systems, such as reconnaissance-strike and reconnaissance-fire complexes; an increase in the range, precision, and effectiveness of munitions and the fire productivity of assault and fire weapons; the saturation of troops with high-precision munitions and weapons, particularly on carriers; an increase in the combat flexibility, mobility, survivability, reliability, autonomy, and camouflage characteristics of weapons; enhanced capabilities of information systems, including space-, air-, and ground-based systems, for supporting combat operations of troop formations, primarily those of lower levels; the development of all-weather reconnaissance, surveillance, and targeting equipment; the creation and adoption of combat and support systems of various purposes with artificial intelligence, and also weapons based on new physical principles; the prevention of lags in critical technologies and the creation of a future-oriented element base for weapons and military hardware; and standardization (primarily in terms of missions fulfilled) based on modular principles and a strict unification of weapons.

When considering the size of the country's territory and its frequently unpredictable neighbors, the Russian non-nuclear potential could prove inadequate to repel a large-scale non-nuclear attack. It is therefore entirely natural, say military experts, to rely on the country's nuclear might because it accomplishes the functions of deterrence -- of not only nuclear but also large-scale non-nuclear aggression.[153] If an enemy has nuclear weapons, then the nuclear strike that is inflicted in response to non-nuclear aggression must program retaliation to be insignificant in scale. First of all, the size of the losses inflicted on the aggressor cannot be excessive and second, strategic weapons must not be employed. The nuclear forces that are unused in the first strike, while threatening the enemy with a series of new and more destructive strikes, will deter the enemy from massive retaliation.

This means that the role of tactical nuclear weapons will increase in the future. A potential theater of military actions can turn out to be outside Russia's borders or in Russian regions where storage of tactical nuclear weapons is impossible in peacetime due to political considerations. Therefore, the Russians stress those types of weapons which can be airlifted to the theater in a short period of time. Tactical nuclear warheads installed on short-range ballistic missiles and also on airborne air-to-ground tactical missiles will acquire special significance.

The destruction of enemy nuclear weapons is another method to reduce the scale of retaliation. This method is most effective against a weaker nuclear power that has

[153] Aleksandr Pikayev, "Arsenal of the 21st Century: With What Weapons Will Russia Greet the 21st Century? This Is a Vital Question That Is Determining the Fate of the Russian Defense Industry," NV, No. 39, September 1994, pp. 12-14.

a small number of facilities that are subject to destruction. Since many nuclear facilities are hardened targets the weapons for their destruction must be highly accurate or have a high-yield warhead. The former is said to be preferable.

Delivery systems must also ensure surprise -- otherwise, they can destroy empty targets after the enemy has launched his own nuclear weapons. The primary factor that ensures surprise is undetectability in flight, "stealthiness" for enemy early-warning and defense systems. Long-range missiles, stealth aircraft armed with bombs with an autonomous guidance system, and short-range air-to-surface missiles meet all of these requirements. Ballistic missiles with short flight times can also play a role. However, even the most stealthy and accurate delivery systems will prove powerless without an effective target detection system -- above all a space-based system. Consequently, the modernization of reconnaissance satellites is one of the defense industry's priorities.

Non-nuclear weapons systems that are capable of destroying hardened targets will evoke increased interest. The development of precision-guided delivery systems equipped with high-yield conventional warheads can deprive the enemy of his nuclear potential without pressing the nuclear button. The priority will be not so much the purchase of new types of weapons as the introduction of organizational measures and technical systems which would increase the effectiveness of the armed forces without a large-scale re-equipping. At the same time, Russia is interested in preserving its position as one of the world leaders of scientific-technical progress in the military sphere. The Russians thus purpose to continue scientific research and experimental design work (NIOKR) and also tests of new models of weapons (which will not require significant financial expenditures) while delaying series production until better economic times.

During the second half of the 1990s the Russian military-industrial complex will therefore have to reorient itself away from the customary production of material-intensive ballistic missiles, submarines, heavy bombers, tanks, and artillery toward the development, testing, and future production of science-intensive products -- above all command, control, and communications systems and high-yield conventional weapons.

At the same time, the production of certain traditional types of weapons -- for example intercontinental ballistic missiles and heavy armored equipment -- will be continued, although in significantly reduced volumes in contrast to the past. An unprecedented number of strategic and conventional weapons as well as nuclear warheads will be removed from the inventory.

NEW WEAPONS SYSTEMS THEORY

For many years, Soviet/Russian military scientists argued that the scientific substantiation of Russian weapon systems necessitates precise coordination of comprehensive systemological developments of operational-tactical, technical, and mathematical profiles within the framework of weapon systems theory. There presently are preconditions for creating such a theory. Soviet/Russian MOD scientific research establishments have accumulated no small amount of experience in working on individual weapon systems and have developed a large number of models and methodologies for substantiating them. A centralized generalization of the results of the activity of all military-scientific collectives and coordination of their efforts based on unified initial operational-tactical data is required.[154]

One direction of research in weapons system theory is the selection of a rational option ensuring maximum effectiveness of the performance of missions with their given distribution among combat arms and special troops -- with special consideration of fire and information coordination among them. In accordance with operations research theory, a different statement of the problem can also exist, wherein a rational system is considered to be one which permits achieving a given level of effectiveness in performing missions with a minimization of resources expended for the system's creation and operation. Adopting one of these options depends on what is considered in substantiating a rational weapon system: existing models and time periods for their physical wear; scientific-technical and production-technological capacities for developing and producing weapons; availability of resources (including manpower) needed for their creation and operation in the requisite amount; troop capabilities for supporting given regimes of weapon operation; and the presence of specific complexes (models) connected with the problem of preventing an eventual enemy's military-technical superiority.

The Russians focus especially on the first of the limitations enumerated. Models existing (already accumulated) in the system have significant weight, while capabilities for mass production of advanced weapons are limited. In their view, a rational combination of accumulated and prospective complexes (models) is required in building

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[154] "Problems of Military-Scientific Research to Substantiate Weapon Systems of the Russian Ground Troops," VM, No. 5, 1993, pp. 51-57.

a weapon system. This is of paramount importance in peacetime, when priority is given to resource limitations. Scientific substantiation of the advisability of modernizing existing weapons to increase their effectiveness with minimal costs (compared with the development and production of new ones) remains an important specific problem. In speaking of scientific-technical capabilities for developing advanced weapons, Russian experts emphasize especially the role of scientific research into non-traditional systems and new physical principles of creating them as an important direction for achieving qualitative leaps and a substantial increase in effectiveness. But the leading role of basic and exploratory research must continue to be preserved.

A very important element of the process of substantiating a weapon system is forecasting (military-strategic, operational-tactical, military-economic, military-technical). Ensuring the necessary accuracy has been and remains the basic requirement here. The pros and cons of existing forecasting methods (heuristic, mathematical, combination) and ways of improving their accuracy already have been considered. So Russian experts dwell on the most difficult problem: forecasting leaps in weapons development -- transition to new physical principles of effect, integrating weapons, supporting a system of command and control of troops and weapons, and so on -- which lead to the creation of more sophisticated weapons and as a result to changes in their combat employment methods. Leaps are dictated by one of the law-governed regularities of the weapons development process -- controllability -- and essentially are a means of preserving a favorable regime with changing external conditions (achievements of science and technology, exacerbation of the competitive process between offensive and defensive means of warfare, and so on). The heuristic method was practically the only method of forecasting leaps until recently. The rapid development of mathematics and computers now also permits solving this problem by mathematical methods. It can be asserted that an integral combination of mathematical extrapolation and of optimization is the methodological basis for such forecasting. Increased forecasting accuracy is ensured here because it is not the full set of values of technically and economically realizable weapon characteristics that is represented as forecastable, but a significantly narrower subset of their rational values.

Creating a weapon systems theory requires solving two other major scientific problems: developing the theoretical principles and complex of interrelated models of combat employment of weapons in an operation or battle, and the methodologies for evaluating their combat effectiveness. The Russians note the following on the substance of these problems. Experience has shown that in developing mathematical models, enlarging them by simply accumulating data in accordance with an increase in the number of higher-level objects does not solve the problems posed even on modern computers. This is explained by the difficulties still existing in creating models of the combat employment of higher-level (division and above) weapons despite the rather lengthy work done in various organizations. Developing models whose operational-tactical level corresponds to the minimum necessary level of the kind of weapon being studied can serve as a way out of the situation. As a rule, it can be chosen as equal to or one step higher than the organic affiliation of the weapon whose combat employment is being modeled. Determining that level is an important operational-tactical research task. Thus, it is not a question of one model describing the combat employment of all models with an identical degree of detail, but of a complex of interrelated models, each element of which supports the influence of the specifications and performance characteristics of an individual kind of weapon on its combat effectiveness and provides an opportunity of illustrating with given accuracy its contribution to performing the assigned mission. All lower levels here should be modeled in an enlarged (generalized) way, and higher ones should be given in the initial data or limitations.

The proposed complex, which has a hierarchic structure, includes the following models: the technical functioning of weapons models, their combat employment, and the combat employment of weapon systems. The first are needed for evaluating the specifications and performance characteristics of weapons and should be created by specialized scientific-technical subunits of MOD scientific research establishments based on models of technical functioning focused on the conditions of their combat employment. The weapon systems combat employment model should take into account interaction with all other means conducted under a unified concept and coordinated by the missions, time, and goals of the operation or battle, which requires the involvement of operator specialists.

The importance of modeling command and control increases with an increased level of the models. Here it is important to put modern computer equipment to use with maximum effectiveness not only by taking into account its storage and speed capabilities, but also by realizing that simulation (man-machine) modeling systems permit the operator-specialist who is making decisions that presently cannot be formalized to be included in the modeling process. As such simulation systems are created, weapons combat employment models also can be used to upgrade the skills of commanders. Their development creates a foundation for the creation of expert systems for substantiating and making decisions, which already can be viewed as an effective information weapon.

Russian military scientists stress that the integration of mathematical modeling and troop exercises assumes great importance for improving the objectivity and validity of evaluating the effectiveness of weapons combat employment. It can be accomplished both with joint processing of the results of modeling and exercises and also using exercise data as modeling input data and vice versa.

The methodologies for assessing effectiveness should correspond to the hierarchy of the models, since the output data of each of them will be the starting data for an evaluation of effectiveness both of individual models as well as of the system as a whole. An important place is held by questions of evaluating the technical (range) effectiveness -- in which weapons developers also may take part along with specialists of Ministry of Defense (MOD) scientific research establishments -- while the leading role in creating methodologies for evaluating weapon combat effectiveness belongs to operator-specialists. In view of the fact that weapons development in different countries occurs to a certain extent in an interconnected manner, developing methodologies for comparative analysis of domestic and foreign weapons assumes great importance for determining the level of world standards -- more precisely for evaluating the advantages and shortcomings of domestic models and seeking rational ways of developing them.

In view of their extraordinary complexity and large "data mass," a very important direction for a cardinal improvement in the effectiveness of substantiating weapon systems is to substantially increase the degree of automation based on the implementation of a computerization program and wide-scale introduction of modern information science methods. An analysis of the content of scientific work to substantiate weapon systems permits singling out the following classes of problems requiring automated solution and determining the structure of the information-computing process: scientific-technical design problems; information-design problems (such as automated designing systems, automated systems for substantiating model requirements, and so on); automation of the development of applied programs and program systems; and creation and centralized maintenance of data bases for various purposes (information-reference systems).

NEW ROLE OF MILITARY-INDUSTRIAL COMPLEX (VPK)

According to the Russians, the military-industrial complex (VPK) -- far from being the source of national economic woes -- now constitutes the most viable source of Russia's economic rebirth. In late 1993, for example, the Atomic Energy Minister argued that if the state and society finally take an interest in the needs of the military-industrial complex and make intelligent use of its unique scientific and technical potential, the rebirth of industry and, consequently, the economic revitalization of Russia will begin in the military-industrial complex, because it is the country's only complex working on the level of the best world standards in machine-building and instrument-building. Russian enterprises design and produce various sensors of ionizing radiation, dosimetric monitoring systems, systems for the registration of high-speed processes, radioelectronic instruments, semiconductor laser beams, and equipment for scientific research. "Our basic and applied science in high-energy physics, thermonuclear synthesis, super-strong magnetic fields, and superconductivity are the property and the pride of our whole population," he stressed.[155]

Both civilian and military luminaries thus argue that the scientific-technical potential that has been accumulated in the military-industrial complex must become the basis of the restructuring of all Russian industry because only this will permit Russia to enter the world community as an industrially-developed power and not as its raw-materials appendage toward which the government's policy is leading.[156] Russia is not the world leader in a single of the world's 15 most promising technological fields, it was pointed out at parliamentary hearings on "The Manufacture and Sale of High-Technology Products in Russia and Reduction in Foreign Purchases of Such Products" by Yuligy Nisnevich, chairman of the State Duma Subcommittee on Communications and Information Science. According to his subcommittee, the high level of development in Russia -- a level that won worldwide recognition -- applies only to technologies connected with the defense industry (specialized chemicals, laser technologies, nuclear technologies, and high-energy materials technologies). Lagging farthest behind in comparison to the world level are civilian technologies (particularly computer and environmental protection technologies). In Mr. Nisnevich's opinion, it is the low level of technologies in the civilian sectors (with a lag estimated at 30-40

[155] Ya "Yastreb", Victor Nikitovich Mikhaylov, Kron-Press, Moscow, 1993.

[156] A. N. Shulunov, "The Defense Enterprise Assistance League Proposes the Structural Transformation of the Military-Industrial Complex -- A Pivotal Issue of the Reforms Being Conducted," NG, 25 October 1994, p. 4.

years) that determines the development of the economic situation and dictates the low standard of living of Russia's people.[157]

OFFICIAL RUSSIAN VIEWS ON THE VPK

According to the 1993 Russian Military Doctrine, development of the defense industry potential must be accomplished along the following directions:

- ensuring a level of fundamental, exploratory, and applied research; advanced scientific-technical and technological developments; and development of a scientific-experimental, test, and production base for enterprises guaranteeing fulfillment of the state defense order;

- rational, balanced development of a defense industry potential and its infrastructure ensuring the country's military security, implementation of a program of conversion of military production, and efficient functioning of the economy as a whole;

- creation and development of capacities for the production and repair of armament, special equipment, and gear necessary for the complete cycle of production of their main types; and

- development and implementation of a set of measures for mobilization readiness of the economy and creation of state mobilization stockpiles.[158]

As already noted, the basic defense principles and postulates of an industrial policy in the sectors are set forth in a conceptual framework developed by the State Committee for Defense Industry, which has been passed on to all of the enterprises:

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[157] Elmar Murtazayev, "State Duma Proposes Government Subsidize High Techologies: Legislators Intend to Verify Legality of Concluding Contracts with Foreign Companies," Segodnya, 5 July 1995, p.2.

[158] "Russia's Military Doctrine: In Light of the New Realities," ZVO, No. 2, 1994, pp. 2-9.

- the creation of accelerated scientific work in progress, and the development and production of technically advanced and highly efficient systems and models of arms and military equipment, along with the simultaneous optimization of both the types of resources being created and the expenditures for their production;

- the integration of military and civilian production, with an orientation toward the widespread utilization of dual-purpose technologies. The formation of mobilization potential on contemporary principles (using capacity freed up and in reserve for the output of market-competitive products);

- the restoration and expansion of cooperative ties with the defense complexes of the CIS member countries, and improvement of interaction with the regions of Russia; and

- the maximum development of the export capabilities of the defense sectors.[159]

ORGANIZATIONAL DEPARTMENTS OF THE VPK

The impact of the RMA is also reflected in changing organizational departments of various constituents of the VPK. For example, the Main Administration of the State Committee for Defense Industry includes the following industries (see Figure 17):

- Aviation
- Munitions and Special Chemicals
- Armaments
- Communications Hardware
- Radio
- Rocketry and Spacecraft
- Shipbuilding
- Electronics [160]

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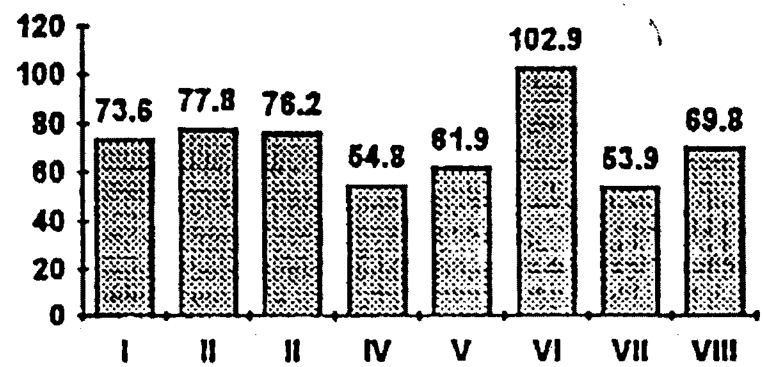
[159] Viktor Konstantinovich Glukhikh, "The Defense Industry of Russia: The Situation and Tasks for 1994," Konversiya, No. 4, 1994, pp. 3-8.

[160] Vitaliy Vitebskiy, "Statistics: The Military-Industrial Complex in February," KZ, 25 March 1995, p. 3.

Production of Output by the Main Administrations [MA] of the Russian Federation State Committee on Defense Industry in February 1995 in Comparable Prices (in percents)



I--aviation industry MA; II--munitions and special chemicals MA; III--armaments industry MA; IV--communications hardware industry MA; V--radio industry MA; VI--rocketry and spacecraft MA; VII--shipbuilding industry MA; VIII--electronics industry MA

FIG 17

The Podmoskovye defense complex, the largest component of the Moscow Oblast scientific-technical complex, includes five main sectors:[161]

- SPACE-MISSILE, the largest representatives of which are the cities of Kaliningrad (TsNIMASh [Central Scientific Research Institute of Machine-building], Energiya NPO [Scientific Production Association], IT NPO, Khimmash [Chemical Machine-building] Design Bureau, Kompozit NPO, Strela Design Bureau); Khimki (Energomash NPO, NPO imeni Lavochkin, Fakel MKB [Machine-building Design Bureau]); Reutov (Machine-building NPO); Sergiyev Posad (Central Scientific Research Institute of Special Machine-building, Scientific Research Institute of Chemical Machine-building Design Bureau); and Dubna (Raduga MKB);

- AIRCRAFT, the largest representatives of which are the cities of Zhukovskiy (TsAGI [Central Aero-Hydrodynamics Institute], Flight Research Institute, EMZ [Experimental Machine-building Plant] imeni Myasishchev, Scientific Research Institute of Aircraft Equipment, ZhMPO); Lyt-karino (a branch of TsIAM [Central Institute of Aircraft Engine Construction], Soyuz MKB, Zvezda MZ,); Ramenskoye PKB and Helicopter NTK [Scientific-Technical Complex] imeni N. I. Kamov; Lukhovitsy Aircraft Plant; and Solnechnogorsk Machinebuilding Plant;

- ELECTRONICS, uniting over 20 scientific research institutes and enterprises in the cities of Fryazino (scientific production associations and institutes Istok, Platan, Laminar, Tsiklon-Test, Elektronpribor and Tor); Solnechnogorsk (SEMZ [Solnechnogorsk Experimental Machine-building Plant]; Sergiyev Posad (Zvezda Production Association); and Pavlovskiy Posad (Eksiton);

- PRECISION MACHINE-BUILDING INSTRUMENT-MAKING AND SPECIAL CHEMISTRY, the largest representatives of which are the cities

[161] Vladimir Semenovich Bocharov, "Problems of the Russian Scientific-Technical Complex of Podmoskovye," VPK, No. 2 (5), 1994, pp. 39-42.

of Klimovsk (TsNITOCHhMASHh [Central Scientific Research Institute of Precision Machine-building Plant and Electrical Machinery Plant); Sergiyev Posad (ZOMZ, Scientific Research Institute of Applied Chemistry, Scientific Research Institute of Elastomer Materials, Scientific Research Institute of Bearings); Zheleznodorozhnyy (NITI [Scientific Research Textile Institute]); Krasnogorsk (KMZ [Krasnogorsk Machinery Plant]); Krasnozavodsk (KkhZ); Balashikha (Kriogenmash Production Association); Roshal (Chemical Combine); Dubna (Machine-building Plant, Atoll NPO, Tenzor NPO); Kolomna (Kolomnatekhmash Production Association); Lyubertsy (LNPO [Lyubertsy NPO] Soyuz) and others; and

- SPECIAL METALLURGY, enterprises of which produce special grades of steel and alloys for the atomic and aerospace sectors: metallurgical plants in the cities of Elektrostal and Stupino, and the Podolsk Giredmet Production Association.

Expressing concern over the status of research, development, and outfitting of the Russian Armed Forces with modern weapons, leading scientists in the area of missile-artillery sciences came out at the beginning of 1993 with the initiative of reestablishing the Russian Academy of Missile and Artillery Sciences (RARAN) as the successor to and continuer of traditions of the State Academy of Artillery Sciences, which at one time made an exceptional contribution to the development of artillery.[162] This initiative was supported essentially by all leading organizations of Russia's defense complex. The constituent assembly of RARAN was held in June 1993 and Academy restoration was officially incorporated in Russian Federation Presidential Edict No. 661 of 5 April 1994 "On Reestablishment of the Russian Academy of Missile and Artillery Sciences." In accordance with the Russian Federation Presidential Edict, the primary goals of RARAN are the following:

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[162] Viktor Valentinovich Selivanov, "Reestablishment of the Russian Academy of Missile and Artillery Sciences," VPK, No. 1(4), 1994, pp. 51-54.

- perform scientific research in the area of precision missile, artillery, and air defense weapons, electronic equipment, fire-control systems, and command-and-control systems;

- develop the theory and technology of creation of missile-artillery systems, including those used for peaceful purposes;

- participate in forming and developing basic scientific research programs for creating advanced armament systems and complexes;

- train qualified specialists for the Russian Federation Armed Forces and defense industry;

- concentrate and coordinate research and development on problems of missile and artillery weaponry;

- consolidate leading scientists and developers of armament systems;

- reinforce and support rational use of the potential of the scientific and production complexes; and

- maintain the historical traditions of artillery science and the social protection of scientists.

Thus, the Academy must perform basic and applied research and development on the most important problem-oriented directions of development, creation, and employment of missile-artillery armament, and unite leading scientists and developers of armament systems for rational use, preservation, and strengthening of the scientific-technical potential of organizations and educational institutions working in the area of missile and artillery armament.

To achieve the established goals, an entire set of tasks must be accomplished, the main ones being the following:

- determine and develop integral programs of basic, exploratory, and applied research and design developments in missile and artillery armament, and develop proposals for their financing from the state budget;

- perform scientific research and coordinate work being done by different collectives in the area of precision missile, artillery, and air defense armament; electronic equipment; fire-control systems; and command-and-control systems;

- assist in rational distribution of funds and material resources for development and creation of models of armament and missile equipment;

- develop the theory and technology of creating missile-artillery systems, including that which assists in using achievements of the military-industrial complex in support of the Russian national economy for the purpose of establishing and developing science-intensive sectors;

- accomplish scientific expert examination of decisions and projects, and provide certification and patent protection in the area of missile-artillery armament by the Russian statehood and management agency for placement of scientifically substantiated authorities;

- assist in stabilizing and supporting organizations and enterprises oriented toward the development and production of armament and military equipment under conditions of real economy;

- train qualified specialists and provide scientific certification of highly qualified scientists in the area of missile-artillery armament;

- assist measures for strengthening the social protection of scientists and specialists in the area of missile-artillery armament;

- study the history of development and propagandize traditions of domestic artillery; and

- bring in additional sources of financing for scientific research and assist in strengthening and broadening the material-technical support base for research.

At the present time the RARAN structure includes 16 departments and an artillery history section. There has begun the formation and gradual establishment of regional and scientific centers being organized for the purpose of coordination and accomplishment of basic and applied research and development in regions on the most important problem-oriented directions of the creation and employment of missile-artillery armament, and for the purpose of unifying leading scientists and developers of armament systems for the rational use, preservation, and reinforcement of the scientific-technical potential of organizations and educational institutions which are associate members of RARAN. The current structure includes the following departments:

- Missile-artillery systems and complexes
- Small arms
- Precision missile-artillery systems and complexes
- Ammunition and engineering weapons
- Powders and explosives
- Interior ballistics
- Ballistics and flight control
- Dual-purpose equipment and technology, recycling of missile-artillery armament
- Artillery reconnaissance equipment
- Automated missile-artillery fire-control systems
- Theory of fire and fire control of missile-artillery armament
- Combat employment and effectiveness of missile-artillery armament
- Tests and operation of missile-artillery armament
- Scientific methods support to training scientific and engineering cadres in missile-artillery armament
- Special missile-artillery systems and technologies
- Missile-artillery armament history section

Considering the great importance of defense problems, in May 1994 the Russian Engineering Academy's General Assembly established a military-technical direction consisting of three sections: Air-Space, Military-Technical Problems, and Engineering Problems of Stability and Conversion. Directions of the scientific-technical activity of the sections have been specified:

- AIR-SPACE SECTION: prospects for aviation technology, reusable space transportation systems, air-space means of insertion, satellite systems and orbital space stations conversion and space technologies, use of outer space for mankind's needs, and expert examination of advanced developments;
- MILITARY-TECHNICAL PROBLEMS SECTION: scientific research and development in military-technical conferences, expert examination, publishing activity, and establishment of certification centers;
- ENGINEERING PROBLEMS OF STABILITY AND CONVERSION SECTION: conceptual questions of strategic stability and conversion, prospects for strategic arms development, information security, new science-intensive technologies (including dual-purpose technologies and intelligent systems technologies), and ecologically clean technologies for recycling and eliminating armament and military equipment. (Figure 18 shows the spheres of basic and applied research.)[163]

VPK PRIORITIES

The Russian government has implemented a series of measures designed to strengthen the VPK as an institution. In July 1992, the government adopted a law prohibiting foreigners from visiting several regions and cities in the Russian Federation.

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[163] Interview with General of the Army Yuriy Alekseyevich Yashin, "Military-Technical Problems of National Security," VPK, No. 2(5), 1994, pp. 4-7.

MILITARY-TECHNICAL DIRECTION

SECTIONS

AEROSPACE	MILITARY - TECHNICAL PROBLEMS	ENGINEERING PROBLEMS OF STABILITY & CONVERSION

AREAS OF BASIC RESEARCH

AEROSPACE

- ANALYSIS OF DIRECTIONS OF DEVELOPMENT OF SUBSONIC & HYPERSONIC AIRCRAFT AND DEVELOPMENT OF RECOMMENDATIONS.
- ANALYSIS & COMPARISON OF DIFFERENT REUSABLE SYSTEMS FOR INSERTION, & DEVELOPMENT OF RECOMMENDATIONS.
- ANALYSIS OF PROSPECTIVE PAYLOADS & DEVELOPMENT OF RECOMMENDATIONS.
- R&D OF ADVANCED CONTROL SYSTEMS.
- DEVELOPMENT OF HYPERSONIC FLOWS THEORY.
- DEVELOPMENT & INTRODUCTION OF NEW MATERIALS. (INCLUDING "INTELLIGENT" COMPOSITE MATERIALS).
- MEDICAL-BIOLOGICAL PROBLEMS OF SPACE FLIGHTS.

MILITARY - TECHNICAL PROBLEMS

- FORECASTING MAIN DIRECTIONS OF DEVELOPMENT OF MEANS OF WARFARE (NONTRADITIONAL AND BASED ON NEW PHYSICAL PRINCIPLES AND ON DUAL-PURPOSE TECHNOLOGIES) IN CONTINENTAL AND SEA THEATERS OF MILITARY OPERATIONS.
- DETERMINING PRIORITIES IN DEVELOPMENT OF SOPHISTICATED MILITARY-TECHNICAL, MILITARY-ECONOMIC AND MILITARY-ECOLOGIC SYSTEMS AND OF WT (ARMAMENT AND MILITARY EQUIPMENT) ASSETS.
- SUBSTANTIATING DIRECTIONS OF MILITARY-TECHNICAL POLICY. FORMING FINANCIAL AND INVESTMENT PROGRAMS FOR DEVELOPMENT OF WT.
- PROBLEMS OF DISCOVERY AND LOCALIZATION OF EMERGENCY SITUATIONS, DEVELOPMENT & USE OF TECHNICAL & MILITARY EQUIPMENT FOR MOPPING UP IN THE AFTERMATH OF EMERGENCY SITUATIONS.
- DEVELOPING METHODOLOGICAL & ORGANIZATIONAL FOUNDATIONS FOR MANAGING THE DEVELOPMENT & CREATION OF WT.
- MILITARY-ECOLOGIC PROBLEMS.
- PROBLEMS OF GEOINFORMATION SCIENCE & SUPPORT OF INFORMATION SECURITY.

ENGINEERING PROBLEMS OF STABILITY & CONVERSION

- CREATING A SET OF MATHEMATICAL MODELS FOR STUDYING PROBLEMS OF STRATEGIC STABILITY.
- DETERMINING DIRECTIONS FOR IMPROVING COMBAT CAPABILITIES OF A BRANCH OF ARMED FORCES THROUGH USE OF SPACE INFORMATION SUPPORT SYSTEMS AND EQUIPMENT.
- DEVELOPING METHODS TO SIMULATE PROCESSES OF SUBSTANTIATING, DEVELOPING AND MANAGING WEAPONS SYSTEMS USING NEUROCOMPUTERS.
- DETERMINING PRINCIPLES OF ECONOMIC SUPPORT TO THE DEVELOPMENT AND PRODUCTION OF WT UNDER CONDITIONS OF TRANSITION TO A MARKET ECONOMY.
- CREATING A CONCEPT OF USING SPACE EQUIPMENT FOR PERFORMING ECOLOGIC MONITORING TASKS.

DIRECTIONS OF APPLIED RESEARCH

AEROSPACE

- DEVELOPING ADVANCED CIVILIAN AIRCRAFT AND AIRCRAFT CARGO SYSTEMS.
- CREATING HIGHLY EFFECTIVE AND ECOLOGICAL AIRCRAFT ENGINES (INCLUDING HIGH-THRUST ENGINES).
- CREATING THE MAKS (NOT FURTHER EXPANDED, POSSIBLY REUSABLE AEROSPACE SYSTEM) SYSTEM.
- CREATING A SUBORBITAL DEMONSTRATOR AIRCRAFT.
- DEVELOPING AND CREATING TRIPLANES, BENCHES AND CENTRIFUGES.
- DEVELOPING SYSTEMS FOR GETTING OUT OF EMERGENCY SITUATIONS WHEN INSERTING SPACE TRANSPORTATION SYSTEMS INTO SATELLITE ORBIT.
- DEVELOPING TECHNOLOGIES OF HIGHLY SENSITIVE TESTS OF SPACECRAFT FOR AIRTIGHTNESS WITHOUT USE OF PRESSURE CHAMBERS.

MILITARY - TECHNICAL PROBLEMS

- CREATING WT, INCLUDING SPECIAL-PURPOSE WT, ITS MILITARY-ECONOMIC ASSESSMENT, AND S&T ACCOMPANIMENT OF DEVELOPMENT, PRODUCTION AND OPERATION.
- DEVELOPING MILITARY-ECONOMIC RECOMMENDATIONS FOR CONVERSION OF THE DEFENSE COMPLEX.
- SUBSTANTIATING EXPORT POLICY PROPOSALS.
- SCIENTIFIC-METHODS ACCOMPANIMENT OF SPECIAL FEDERAL PROGRAMS.
- FORMING LEGAL FOUNDATIONS FOR PATENTING DOMESTIC DEVELOPMENTS.
- DEVELOPING MEANS OF PROTECTING INFORMATION.
- DEVELOPING AND IMPLEMENTING ADVANCED TECHNOLOGIES.

ENGINEERING PROBLEMS OF STABILITY & CONVERSION

- DEVELOPING RECOMMENDATIONS ON ALERT-STATUS REGIMES OF MISSILE SYSTEMS FOR CONDITIONS OF A REDUCTION IN THE LEVEL OF STRATEGIC NUCLEAR PARITY.
- DEVELOPING MEASURES ENSURING CONCEALMENT OF INSTALLATIONS AGAINST SPACE AND AERIAL RECONNAISSANCE ASSETS.
- DEVELOPING PROPOSALS FOR USING BOOSTER ROCKETS IN SUPPORT OF THE MINISTRY OF DEFENSE AND FOR NATIONAL ECONOMIC PURPOSES.
- DEVELOPING PROPOSALS FOR DUAL TECHNOLOGIES TO SUPPORT THE CREATION OF GROUND TROOPS' SYSTEMS AND CIVILIAN PRODUCTS.
- DEVELOPING A SYSTEM FOR SAFE ELIMINATION OF RDTT (SOLID-PROPELLANT ROCKET ENGINES).

The list comprises 16 regions, and reads like a litany of the "closed cities" of the former Soviet VPK: part of the Kamchatka Peninsula; the city of Komsomolskna-Amure; the island of Russkiy in the Maritime Region; several areas in the Moscow, Leningrad, Orenburg, Nizhny Novgorod, Arkhangelsk, Murmansk, Sverdlovsk, Chelyabinsk, Kaliningrad, Volgograd, Astrakhan, and Krasnoyarsk regions; Mordovia; and several other regions.[164]

In August 1992, both President Yel'tsin and the Parliament then signed a law that closed all regions of the country involved in developing, producing, storing, or utilizing weapons of mass destruction; processing radioactive materials; and accommodating military or other facilities that require a special security regime. The law contains provisions on procedures for the creation or abolition of such territories; for the redrawing of their borders; and for determining the budgets, administrative agencies, and social guarantees for their residents. The closing of these regions represents an attempt not only to stem the "brain drain," but also to isolate limited resources from the rest of the economy for high-priority R&D programs.

The closed cities develop nuclear-missile warheads, bombs, torpedoes, and explosives; they produce weapons-grade plutonium; they design and build special-purpose space systems; they design and make super-accurate electronic and radio-technical instruments and systems; they produce enriched uranium for nuclear power production; they develop modern military equipment; they conduct fundamental and

[164] "Several Regions Closed to Foreign Visitors," in FBIS-SOV-92-133, 10 July 1992.

applied research in controlled thermonuclear fusion; in laser, plasma, and X-ray technology; and in nuclear power plant safety.[165]

According to Kokoshin in 1993, the defense industry is in need of the state's special attention and assistance, both in the implementation of the state's defense order and in the implementation of conversion programs. Yel'tsin's decree, entitled "On the stabilization of the economic situation of defense industry enterprises and organizations in ensuring the state defense order," which was signed on 6 November 1993, is directed precisely toward this end.[166]

The implementation of this decree should reduce social tension in defense enterprise collectives. For example, this document means that a wage level of eight instead of four minimum monthly salaries may be established for workers in the military-industrial complex, and up to nine such monthly salaries for workers in the nuclear industry. According to Kokoshin, the Defense Ministry is also proposing that the Russian Government review the question so that the more highly qualified specialists of the military-industrial complex are paid as much as they would be for manufacturing profit-making "civilian" output.

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[165] Mikhail Rebrov: "The Market of Ideas and the Market of Problems: What Is Going on in the 'Closed Cities'," KZ, 17 November 1995, p. 2.

[166] "Kokoshin says Defense Industry Needs Special Attention," ITAR-TASS, 22 November 1993.

According to Russian military scientists, the process of balancing the weapons system can be efficiently carried out at five hierarchical levels that make it possible to set up promising organic structures of troop formations on the basis of modules, multifunctionality, and standardization of weapons and military hardware, with strictly determined objectives of the organization and combat use of troop groupings.[167]

First, an Inter-Service level. Within its framework a rational balance between types of weapons with regard to other branches will be established. Second, a Service level. It is designed to justify scientifically the military-technical concept of the Army and to balance the development of weapons subsystems of combat arms as part of their general weapons system. Third, a Combat-Arm level. Its aim is to rationally develop combat arms and to balance their weapons types. Fourth, a level of Troop Formations. It ensures a balance between organic structures of troop formations and their equipment with quality weapons and military hardware so that they can fulfill missions both independently and as part of ground troop forces. Fifth, a level of Military-Technical Systems and Models. It is aimed at balancing their characteristics and ensuring the requisite quality of weapons and military hardware.

In late 1995, President Yeltsin issued an edict entitled "On the centralized social and material-technical fund of the State Committee of the Russian Federation for Military-Technical Policy." The president thereby permitted this body to have a centralized social and material-technical fund. This envisages the allocation to the fund of up to 20 percent of the non-budgetary finances that the committee gains from its

[167] Colonel Yu.D. Ilyin, "On Some Trends in the Development and Ways of Balancing the Army Weapons System," VM, No. 6, 1994, pp. 38-46.

activity, including payment for the production and allocation of licenses, as well as the use of these and other revenues in accordance with the legislation of the Russian Federation.[168]

General of the Army V. Lobov, then Chief of the Soviet General Staff, stated in late 1991 that the changed nature of modern weapons dialectically entails a need for new views regarding their development, creation, and introduction. It can be assumed that not absolutely all the results of research and development can be implemented in specific defense programs. It is possible that Russia will create and build up a database, a kind of "state reserve of defense technologies" (which have not reached the stage of series production but display a high degree of potential readiness for it). This is a kind of "technological deterrence" and an additional element in a modern strategy.[169]

In a December 1992 interview, Deputy Defense Minister Kokoshin thus noted that the Russian military is trying to change the entire cycle between fundamental research and the final product (launching series production of a piece of military inventory.) One of the main objectives of Russian military-technical policy is to form a "scientific-technical reserve" in the sphere of "critical technologies," to include dual-purpose technologies. This "scientific-technical reserve" is equivalent to the Western concept of "hovering," which permits defense industries to "leap over" a generation of weaponry by focusing on the development of prototypes and avoiding costly series

[168] ITAR-TASS, 7 October 1995.

[169] Major A. Yegorov, "Policy, Doctrine, and Strategy in a Changing World: Army General Vladimir Lobov on Military Reform," KZ, 23 October 1991, pp. 1-2.

production. In other words, the R&D establishment fully develops a new technology or system concept without proceeding to the next stage of acquisition until the situation warrants. Thus the May 1992 draft of Russia's military doctrine called for 1) reducing procurement of arms and equipment in series production, and 2) maintaining R&D and production capacities to ensure the development and "rapid surge production" of emerging combat technologies.[170]

In June 1993, then Defense Minister Grachev announced that the Russian Defense Ministry now has "prototype development plans for all types of armaments."[171] As Kokoshin has noted, "We are also planning... the establishment of a scientific and technical capability that would permit us to achieve a qualitative leap and to expand mass production of the most modern equipment at a time when we are a little richer." Russia is moving away from blanket research into constantly updating weapons prototypes, favoring weapons modernization instead.[172]

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170 Kokoshin, "Contradictions."

171 "Defense Minister Grachev Interviewed," in FBIS-SOV-93-109, 9 June 1993.

172 Interview with First Deputy Defense Minister Andrey Kokoshin, "We Are Moving Away From Blanket Research Into Constantly Updating Weapons Prototypes," Rossiyskiye vesti, 25 August 1993, p. 7.

integrated into a single branch -- the Strategic Missile Forces. [NOTE: The completed merger was announced on 30 October, 1997.]

The General-Purpose Forces. One of the conditions for creating them is that the military districts are granted the status of operational-strategic commands. This means giving full power and balancing responsibility and rights in the hands of a one-man commander. In addition, it means securing the inclusion within the districts' "perimeter" of the formations of other power departments located on their territory.

The Air Force and Air Defense. These will also be integrated -- within the framework of the operational-strategic commands -- with the creation of unified rear support services, with an expanded cadre field, and with standardization of individual arms and hardware systems.

The Navy. It will probably be subjected to fewer changes than the other branches, although the search for its optimum strength and structure will be continued. The Navy is to retain ships with high combat efficiency, strategic guided missile submarine cruisers, support forces, and so on.

The Ground Forces. These are the basis of the Armed Forces. And yet the number of divisions in them will fall, while their combat potential will increase. They will primarily be equipped with new weapons and control systems. For example, the mobile command post created by Russian scientists and engineers. This mobile command post not only is not inferior to foreign analogues but also surpasses them in

XI. CURRENT POLITICO-MILITARY PRIORITIES

GOVERNMENT VIEWS

In his June 1996 election program, President Yel'tsin stressed that given the real economic conditions and the military-political situation, it will be necessary over the next four-five years to focus on resolving the task of creating by the year 2000 the scientific, technical, and technological groundwork required for Army and Navy rearmament.[173] While maintaining Russia's nuclear deterrent potential at the proper level, he continued, Russia needs to devote more attention to developing the entire range of means of information warfare, the development of precision weaponry, the individual protection of servicemen, systems for ensuring mobility, and the development of the defense infrastructure (the airfield network, roads, Navy basing systems, and so forth). The Defense Ministry and the General Staff must ensure the utmost level of technical equipment and strength levels for combined and other units in the most important areas and the main branches. Within the framework of overall defense spending, Russia must increase the share of resources allocated to research and development, to enhancing the level of technical equipment available to the Army and Navy, to modernizing armaments and military hardware, to combat and operational training, and so forth.

Major tasks set by the president thus include ensuring the maximum technical provision and manning of units and formations engaged in the main activities of the armed forces, maintaining the nuclear deterrence force at the proper level, and

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[173] "Text of Yel'tsin Election Program," Rossiyskiye vesti, 1 June 1996, pp. 1-16.

developing the whole complex of information warfare means, high-precision weapons, and mobile defense infrastructure.[174] He also called for an increase in R&D appropriations within the framework of general military expenses: "The strengthening of the scientific and military-industrial potential should allow Russia to independently produce all the necessary types of armaments and military hardware." Military education should be improved and certain provisions of military theory and art should be reviewed.

The Russian Military-Industrial Complex (VPK) will concentrate on designing new state-of-the-art equipment for the Air Force, the Navy, the Ground Troops, and the Air Defense Troops, Yel'tsin's adviser told INTERFAX in an exclusive interview. The VPK will focus on these "elite" areas because the present economic and financial situation in Russia prevents the country from attending to all areas of the complex's development at the same time. However, a selective approach has allowed Russia to create a number of vehicles, ships, and systems in high demand on the world arms market. In particular, Russia has developed the MIG-29 aircraft; an air defense system which is now being created by the Antey concern; and the Grad, Smerch, and Uragan multiple-rocket launchers.[175]

The elite group of the VPK will be formed during 1996 and 1997. These elite companies may become a basis for future "powerful transnational companies" due to their current success in foreign markets. A number of companies in Belarus, Ukraine, Kazakhstan, and other CIS member-states have contemplated joining the "prosperous

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[174] Andrey Shtorkh, Moscow ITAR-TASS, 18 July 1996.
[175] Moscow INTERFAX, 12 October 1996.

concerns in the Russian VPK." Some well-known companies in Eastern and Western Europe have also shown an interest in such cooperation.

In late 1996 then Defense Council Secretary Yuriy Baturin gathered together the luminaries of Russian defense science and technology for the first working conference. The defense order does not ensure full loading of enterprises, the participants in the conference said before it started. The creation, testing, operation, and recycling of arms take far more funds than the government can provide. The effectiveness of defense research is falling. Although Russia, along with the United States, Japan, France, and the FRG still possesses 17 critical technologies which enable it to preserve its defense potential, a real threat that this will be lost has emerged.[176]

In the opinion of academician Yevgeniy Velikhov, member of the Defense Council, there are at least two ways to preserve Russia's defense potential. First, to support at the state level those areas where it is possible to produce both defense and commercial output on the basis of dual-purpose technologies. Second, to carry out the full conversion of those production processes where dual-purpose technologies are impossible, leaving only micro-production facilities to create experimental models for the preservation and development of modern knowledge in the sphere of military hardware.

[176] Viktor Litovkin: "The Defense Council Gathered Leading Lights Together to Tell Them There are Insufficient Funds for Them," Izvestiya, 24 October 1996, p. 2.

"The strategic aim of military reform is to bring the size and combat potential of the Armed Forces and other troops into line with existing potential threats to the country's security and the state's economic abilities," Baturin stated in early 1997. At a meeting with journalists, he stressed that during his tour of Siberia and the Far East he was examining a wide range of issues, from draft problems to collaboration between units and subunits of the Armed Forces and other structures, and the preservation of the scientific, production, and mobilization potential of defense complex enterprises.[177]

In Baturin's opinion, it would not be expedient to "preserve the Armed Forces on the same scale, in the same forms, or in the same shape as today." Inadequate Army funding simply makes it mandatory to carry out reforms to remove the existing excess capacity in the current situation resulting from a duplication of functions by a number of structures. In order for the Russian Army to correspond to modern requirements, he considered it necessary to "allocate a relatively large amount of funds to R&D and the maintenance of corresponding defense industry sectors. Our Armed Forces should be smaller and more compact, but geared to a greater extent toward state-of-the-art armaments and hardware."

Baturin named among the tasks of the reform the preservation of professional personnel and the scientific-technical potential, as well as the ability to expand through mobilization. [178] The reform of the armed forces and other troops should be carried out in three stages. The main tasks of the first stage -- until the end of the decade -- should

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[177] "Yuriy Baturin: Russian Armed Forces Should Be More Compact and Modern. Russian Federation Defense Council Secretary Inspects Far East Region," KZ, 28 January 1997, p. 3.

[178] Moscow INTERFAX in English, 7 February 1997.

be the increase in funding for research and design, and the development of dual-purpose technologies. "Qualitative tasks" should be carried out at the second stage in 2001-2005. Spending should rise on combat training and the number of servicemen on contract should increase. "Large-scale rearmament" should take place at the third stage in 2005-2010.

MILITARY VIEWS

Then Defense Minister Rodionov has long stressed that military reform is not quantitative changes in the armed forces, but radical qualitative transformations in the very essence of the state's military system.[179] The military-technical policy is a most important direction in the country's activities safeguarding its security and also one of the elements of the national industrial policy. It is directly linked to the formation and execution of the state defense order for armament and military equipment. Work on the defense order today is assuming a most important significance for the country's future, since this is the only opportunity to preserve the nucleus of high technologies which are basically concentrated in the defense complex. Destroy this nucleus and the trend of turning Russia into a raw-materials appendage of the world market will become irreversible. Modern models of armament and military equipment are regarded as high-tech products, and they are the ones that determine the demand for high technologies. Russia's security today, tomorrow, and especially in the future requires precisely high-tech weapon systems.

[179] Colonel-General Igor Rodionov, "In Russia and for Russia: Basic Directions of Military Reform," NVO, 22 April 1995, No. 2, pp. 1, 3.

In addition, the defense order must preclude the possibility that many types of weapon systems for performing the same combat missions will appear in production. It is abnormal when there are 62 basic models and modifications of missile and artillery armament (37 in the United States), 62 models and modifications of armored equipment (16 in the United States), and 26 models and modifications of surface-to-air missile systems (4 in the United States) in service in the Ground Troops. From an economic standpoint, this raises the price of production quite a bit, and from the operational and tactical standpoint, it makes it more difficult to provide technical and logistical support to the troops when conducting combat operations.

Russian military-technical policy must make the most effective use of achievements in the area of computer science in order to eliminate the imbalance between individual components within the weapon system itself. Thus, having outstanding models of weapons, the Russians often lag behind in means of their information support, which leads to an increase in ammunition expenditure and levies an excessive load on the support system.

Shortly after his 1996 appointment as defense minister, General Rodionov unveiled a radical military reform plan that continues to generate debate. The plan apparently included slashing the Ground Troops from about 60 to 12 divisions, including a fifty-percent reduction in the Airborne Troops; altering defense budget priorities to focus on information and emerging technologies; and significantly delaying planned weapons procurement in order to increase R&D expenditures. If implemented, his reforms would create the basis for a gradual increase in Russian military capabilities over the next decade.

General Viktor Samsonov, then chief of the Russian General Staff, has stressed the emergence of a new element in the meaning of war: the erosion of distinctions between military and non-military means of struggle. He asserts that military confrontation has entered a new phase when the modern means, forms, and methods of this confrontation make it possible to attain the strategic objectives of war without the results which were traditional in the recent past (conquest of territory and so on). This specific approach was adopted by the United States when planning and implementing Operation Desert Storm.[180]

The concepts of information, economic, financial, ecological, and other types of warfare, which are now becoming increasingly widespread, extend beyond the strictly theoretical bounds and acquire a perfectly specific and practical meaning. For example, the Russian-U.S. scientific conference held in Moscow at the end of 1995 noted the high effectiveness of the "information warfare" systems, which in combination with the use of highly accurate weapons and "non-military means of influence" make it possible to disorganize the system of state administration, hit strategically important installations and groupings of forces, and affect the mentality and moral spirit of the population. According to Samsonov, the effect of the use of these means is comparable with the damage resulting from the effect of weapons of mass destruction.

Scientific and technical progress and the introduction of high technologies in the defense sectors of industry make it possible to develop highly effective systems based

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[180] Army General Viktor Samsonov, "A Different Interpretation of the Concept of War. Time Demands That Karl Von Clausewitz's Classic Formula Be Amended," NVO, No. 23, December 1996, pp. 1-2.

on new principles of physics. Intensive work is under way to develop geophysical, ozone (exotic), neutron, accelerator, plasma, laser, psychotronic, and other types of modern weapons. They are capable of significantly changing the material base of the armed struggle and the appearance, nature, and content of war.

On 1 October 1996 then Defense Minister Rodionov addressed a press conference and made the sensational statement that nuclear weapons were obsolete and were being replaced by more powerful weapons based on other physical principles. General V.I. Slipchenko has expanded on this theme. In none of mankind's wars have weapons performed an independent role in attaining the war's objectives. They were merely a means of destroying the enemy or defending against him. Victories depended on the size of the assembled mass of cavalrymen and foot soldiers and the talents of the Tamerlanes or Napoleons sending the masses into battle. That was before the advent of the nuclear era. It makes no difference to the atom bomb whom it destroys: an armed peasant or Alexander the Great. Fortunately, nuclear wars have not taken place, and they are unlikely in the future. But nuclear weapons are being replaced by something else no less dangerous -- the "perfect" weapons of the 21st century.[181]

In the wars of the future , the decisive role will be performed not by manpower and not by nuclear weapons but by precision conventional weapons and weapons based on new physical principles. These new weapons will form the basis of many states' armed forces in 10-15 years. New conventional weapons have appeared, with entire

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[181] Report by Aleksandr Khokhlov on conversation with military analyst General-Major Vladimir Slipchenko, "Secret Weapons of the Future: One Military Generator Can Turn a Division into a Herd of Idiots," Komsomol'skaya pravda, 15 October 1996, p. 5.

combat systems capable of doing the job of personnel and sometimes of nuclear weapons. The dynamics of the adoption of new types of weapons and means of employing them are as follows: in the 1950-1953 Korean War, nine previously unknown types of weapons were used. In Vietnam in 1964--1975 it was 25. In the Arab-Israeli wars of 1967, 1973, 1982, and 1986 it was around 30. In the 1991 war in the Persian Gulf it was 100. You can be sure that if there is another war, says Slipchenko, there will be an even greater surge in the use of the folowing new types of weapons:

Kinetic Weapons: "Fire and Forget". The main type of weapon in the 21st century will be a precision weapon. The accuracy of target destruction could be decided not only by the strategic aims of the war, but by the political aims as well. If you double the explosive force of a missile warhead the weapon's destructive capability increases by 40 percent. If you double the target strike accuracy, the missile's destructive capability increases by 400 percent. Explosives are currently being developed which will be 30-50 times more destructive than familiar, traditional ones, but this is nonetheless a blind alley in military evolution. The future lies with increased weapon precision.

The formula describing a human being's actions in the wars of the future will be a simple one: "Fire and Forget." Everything will be done by the "smart" weapons themselves. At the moment the advanced countries of the world are busy developing tactical, operational, and strategic reconnaissance-strike systems. The reconnaissance elements will be located on artificial satellites.

The main attack element will be high-speed (five to eight times faster than sound) air- and sea-launched cruise missiles. These missiles will be able to destroy targets at a range of 500-8,000 km. They will be "taught" to fly to their targets at altitudes of between 30 meters and 60 km in conditions of radio silence. Using observation, correction, and target designation systems installed on artificial satellites, the cruise missile will travel along a complex path, changing speed and altitude. It will be able to approach an object from the rear, giving the enemy no chance, and dive toward the target at high speed virtually from space.

A number of countries will evidently be arming themselves with massive quantities of these reconnaissance-strike systems in the next 10-15 years. The radiation-source-seeking systems installed on the combat elements of these weapons will make their accuracy of delivery absolute.

Laser Weapons. It is fruitless to pursue every enemy soldier on the battlefield with a laser. So work is geared toward developing laser devices that "blind" weapon-sight optics and combat system electronics. In the future it is most likely that military lasers will be used to disable military space systems. The strategy of nuclear wars provided for nuclear explosions at an altitude of 50-100 km not to destroy personnel, but to destroy electronic instruments with an electromagnetic pulse. Military lasers in future wars could be based on the same "lightning striking the antenna" principle.

Acoustic Weapons. The emission of energy at a certain frequency makes it possible to destroy enemy personnel and radioelectronic facilities. Military generators can be installed on delivery systems at sea, in the air, and in space. They have potential for use on balloons. By directing an energy emission at a target or creating a background energy emission it is possible to turn an enemy division into a herd of frightened idiots. People will experience inexplicable fear and a severe headache and their actions will become unpredictable. They may become totally and irreversibly deranged. Acoustic weapons are under active development, and laboratory versions already exist. Armed forces in a number of countries could have them in 10-15 years.

Electromagnetic Weapons. In theory these weapons can be combined with acoustic weapons, making something called beam weapons. They are based on the principle of emission of energy at different wavelengths. The probable delivery systems are artificial satellites. Little is known about their destructive effect, although active work is being done to develop them.

Radiation Weapons. These weapons are based on the use of ionizing radiation for military purposes. Very simply, in Dubna you have electrons and positrons running around the closed circuit of an accelerator. Would there be anything left alive in the area if the circuit were to be opened? It is hard to imagine at the moment the technology involved in using radiation weapons. But work is under way on developing them and the estimated timescale for the development of these systems is 25-30 years.

The new weapons will not just increase the combat potential of armed forces but will change their composition and structure. Operations by ground forces groupings will become a thing of the past, and nuclear weapons, although they will remain, will be supplanted by precision weapons and weapons based on new physical principles. Armies will be small and will have two categories of forces: strategic defensive and strategic offensive. The funds made available as a result of the inevitable reduction in numbers absolutely must be invested in science. To create "perfect" weapons the Russians need a scientific breakthrough in the spheres of microelectronics, fiber optics, and computers not only with a mathematical but also with a geographical memory.

Then Defense Minister Rodionov has stressed that the VPK has lobbied for the army to purchase technology and arms that it really does not need. All this has been explained by the need to maintain production and jobs in the defense complex. As a result of this faulty practice, funds have been spent irrationally, and there has not been enough money for research and design work. Rodionov has already echoed Yel'tsin's proposal to the government that a significant portion of the funds previously planned for the purchase of arms be spent on R&D. "We can put off rearming for ten years," he argues, "but get twenty-first century equipment and weapons."[182] It should be noted that the Russian government, including the Defense Council, has approved this proposal.

A session of the Russian Defense Ministry Collegium held 31 January 1997 comprehensively examined questions of improving the Russian military's management system. Leading employees of the defense industry and the Russian government apparatus participated in the session. The special priority nature of the task of improving the management system in the plans for building and reforming the armed forces was noted in speeches by I.N. Rodionov, then Russian defense minister; V.N. Samsonov, then chief of the Russian General Staff; A.A. Kokoshin, First Deputy

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[182] Interview with Defense Minister I. Rodionov, "Igor Rodionov: Unpopular Measures Can No Longer Be Avoided," Moskovskiye novosti, 11-18 August 1996, No. 32, p. 7.

Minister of Defense; other members of the Collegium; and heads of leading sub-departments of the Defense Ministry and the General Staff.[183]

In particular, Rodionov drew attention to the fact that questions of electronic warfare are assuming ever-greater importance in the development of the military's management system, and that the intellectual and organizational efforts of the Defense Ministry and of Russian science and industry must increasingly be concentrated precisely on resolving them. Reports on this very important topic were delivered by Colonel-General L.S. Zolotov, chief of the Main Operations Directorate and first deputy chief of the General Staff; Colonel-General A.P. Sitnov, chief of armaments; and other leading Defense Ministry employees.

The same Collegium session examined the state and prospects of the Russian military's command-and-control system. To all appearances this problem has been discussed by the Defense Ministry Collegium for the first time in the history of the Russian Armed Forces. Deep concern was expressed over the state of the command-and-control system: it was stressed that both the military department and the country's leadership should give a higher priority to this matter. The speakers were unanimous in upholding the need to increase the role of the General Staff in the command-and-control system, including by integrating the command-and-control systems of all the

[183] Report by Russian Federation Defense Ministry Press Service: "Russian Federation Defense Ministry Collegium Session Examined Questions of Improving Armed Forces Management System," 4 February 1997, p. 1.

five branches of the armed forces (the Ground Forces, the Strategic Missile Forces, the Air Force, the Navy, and the Air Defense Forces).[184]

The Collegium session and other recent events demonstrate that the Russian military is increasingly turning toward the most pressing, and at the same time the most complex problems of building a modern defense capability. Thus, the Defense Ministry and the Defense Industry Ministry sponsored a major exhibition -- "Computing Facilities and Information Technology in Military and Dual-Purpose Systems" -- which demonstrated the concrete results of the implementation of military-technical policy as formulated by Kokoshin at a Russian Federation Security Council session in 1994. At the time he stressed the special importance of work in the sphere of information warfare: command and control, communications, electronic warfare, intelligence, target designation, the missile-attack warning system, the space control system, and so forth. The principles of military-technical policy adopted by the Security Council were used as a basis for corresponding sections of the State Weapons Development Program, approved by a presidential edict in the fall of 1996.

ROLE OF MILITARY DOCTRINE

The current Russian Military Doctrine has been adopted for the period through 2005. Before the end of this period some of its provisions may be clarified in line with the changed nature of the military threats and the prevailing military-political situation. Implementation of the military doctrine's provisions is being achieved by executing

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[184] Kirill Batov, "Priorities of the Military Leadership: the Armed Forces Command-and-Control System is the Focus of Attention by the Russian Defense Ministry," NG, 5 February 1997, p. 2.

coordinated measures of a political, economic, diplomatic, information, legal, and military nature with the participation of all organs of state power and administration, public organizations, and Russian Federation citizens.[185]

Organizing leadership of the country's defense. Leadership of all the country's defenses, the armed forces, and other Russian Federation troops in peacetime is exercised by the Russian president and supreme commander-in-chief of the Russian Armed Forces -- administratively through the Russian government and the leaders of the appropriate ministries, and operationally through the Russian General Staff, which is the main organ for the strategic command and control of the armed forces and other troops in the interest of the country's defense.

In wartime a State Defense Committee headed by the Russian president on the basis of the Security Council is set up to ensure the fullest mobilization and effective utilization of all existing forces and means, and the centralization of the leadership of all state organs and departments with a view to ensuring the country's defense.

In wartime a Supreme High Command Headquarters based on the Defense Council and relying on the General Staff for the strategic command and control of the armed forces and other troops is set up to provide strategic leadership of the armed forces and other troops involved in the country's defense.

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[185] Army General M.A. Gareyev, "Russia's Military Doctrine. It Must Form the Basis of the Country's Military Reform," NVO, No. 29, 9-15 August 1997, pp. 1, 4.

The military staff organ coordinating organizational development, training, manpower acquisition, and the use of and comprehensive backup for the armed forces and other troops is the Chiefs of Staff Committee of the Armed Forces and other troops, headed by the chief of the Russian General Staff.

The main functions of the Chiefs of Staff Committee are:

- to draw up recommendations for distributing missions for the country's defense between the armed forces and other troops;
- to analyze the correspondence between the plans for the organizational development and use of the armed forces and other troops and the missions of safeguarding defense security, and to draw up the necessary proposals;
- to organize collaboration between the armed forces and other troops;
- to assess the Russian military's requirements for personnel, armaments, military hardware, and materiel with a view to balancing deliveries of them;
- to coordinate issues relating to the organization of the command and control of troops and organs;
- to coordinate joint operational and combat training measures; and
- to coordinate personnel training and the development of military science.

The decision to transfer all state powers to the State Defense Committee and all powers of military-strategic leadership of the armed forces and other Russian troops to the Supreme High Command Headquarters is made by the Russian president together with a declaration of war in the event of aggression against Russia or a direct threat of a large-scale attack, with the Russian Federal Assembly being immediately informed.

The main organ of command and control of a coalition grouping of troops (forces) is a joint command set up beforehand by decision of the supreme organs of state power in the coalition countries. The joint command includes representatives of the armed forces of each state.

In jointly performing missions to protect the constitutional system, ensure law and order, and localize internal armed conflicts using armed forces and other Russian troop formations, command and control is implemented by operational groups appointed by the Russian president and deployed at prepared command-and-control centers of the General Staff or Russian MVD [ministry of internal affairs] internal troops. Collaboration between the armed forces and other Russian troops, military formations, and organs is organized in coordination with the plan for employing the Russian Armed Forces.

The foundations of unified command and control of all the forces and means involved in defense are laid in peacetime. Agreed borders for military districts, internal districts, border troop districts, and other troop districts are established. On issues of territorial defense all troops and armed formations are operationally subordinate to the commanders of military districts (fronts).

Military threats and defense missions. A key military threat is the exacerbation of the struggle to divide up spheres of influence, raw material resources, and markets. The economic expansion that is increasing in this connection, the formation of new power centers in the most important regions, the increased economic and political role played by transnational associations, the desire on the part of certain powers to have a dominant position in the international arena and pursue a policy of diktat, and the attempts on the part of a number of states to strengthen their own security to the detriment of other countries and to resolve international contradictions through the use of military force are making all these new factors dangerous for the Russian federation's security and could escalate into clear-cut military threats.

The first group of threats is the long-term policy of certain international forces and powers aimed at depriving Russia of its independence; subverting its economic and other interests; undermining it from within; isolating it; making territorial claims against it; whipping up and supporting separatism, terrorism, and internal conflict situations from without; attempting to use them to interfere in Russia's internal affairs; suppressing the rights, freedoms, and legitimate interests of Russian citizens and compatriots in foreign countries; and carrying out other actions that infringe on Russia's national interests. Zones with conflict situations in regions adjoining Russian territory retain the potential for upheavals which, along with transparent borders, uncontrolled flows of weapons and munitions, and uncontrolled migration processes, directly affect Russia's security. All these things could prompt armed conflicts, local wars, and other aggressive actions against Russia.

The second and biggest threat is the ultimate targeting against Russia of the nuclear weapons of a number of countries having such weapons, and the spread of nuclear weapons and other types of mass-destruction weaponry. Another group of threats is the continuing world race in qualitative arms improvements and the desire on the part of the leading powers to effect a leap forward in the creation of qualitatively new, latest-generation weapons -- thereby achieving military-technical superiority.

Russia will also view as a direct military threat the introduction of foreign troops into the territory of neighboring countries or a buildup in groupings of troops (forces) adjacent to its borders.

Taking account of existing and potential threats, the main goals of defense policy are to defend Russia's national interests; to ensure the conditions for reinforcing the positions of this great power; to preserve the state's territorial integrity; to ensure national sovereignty and the inviolability of state borders on land, in the air, and at sea; to ensure strategic interests by maintaining peace and stability in the country and adjoining areas of Russia's vital interests; and to defend the country's population. In the event of armed conflicts arising or war being unleashed by an aggressor, the tasks include neutralizing or eliminating conflicts, repulsing aggression, inflicting defeat on an aggressor, and creating the conditions for the speediest ending of hostilities.

In order to implement these goals the Russian state requires the resolution of the following defense missions:

- countering the corresponding political, economic, ideological, psychological, informational, intelligence and counterintelligence, terrorist, and other actions by states aimed at undermining Russia's national security, and making the fullest use of all non-military means for the country's defense;

- strategic nuclear deterrence of a possible nuclear attack or aggression against Russia;

- priority readiness to carry out military missions in the course of emerging armed conflicts and local wars. It is also necessary to be prepared to conduct military operations in one or two armed conflicts and one local war. At the same time, mobilization readiness is required to repulse large-scale aggression in regional wars, the direct threat of which does not yet exist but cannot be wholly ruled out.

<u>The armed forces are tasked with:</u>

- revealing in good time, in conjunction with the foreign intelligence service and other departments, emerging military threats, conflicts, and possible preparations for an armed attack on the Russian Federation and its allies, and warning the country's top leaders about such preparations;

- promoting measures taken by state organs to oppose informational, psychological, and other subversive actions by other countries against the Russian Federation; and

- maintaining the proper combat capability and combat and mobilization readiness of command-and-control and troop (force) organs.

Priority attention here must be given to:

- maintaining strategic nuclear, space, and other forces and the means ensuring their combat use in a state of readiness that guarantees unacceptable damage to any aggressor;
- ensuring the constant readiness of the forces and means designed to protect the country's most important installations, armed forces, and other troops against strikes from the air and from space;

- maintaining army and navy general-purpose forces in a state of readiness to ensure the resolution of military conflicts and local wars, as well as their timely mobilization and deployment to accomplish missions in a large-scale regional war;

- reliably protecting the state border in the air and underwater in conjunction with border troops; and

- developing military science and military art and improving the use of the armed forces, taking account of prospects for the development of the nature of warfare.

The armed forces and other troops of the Russian Federation can also be involved for the purpose of:

- performing representative functions and supporting political actions by the Russian leadership;

- taking part in international actions of a military and humanitarian nature;

- clean-up operations in the wake of natural disasters, major accidents and disasters, epidemics, and epizootic outbreaks, and assisting the affected population;

- ensuring the safety of shipping in crisis-prone or dangerous areas of adjoining seas and the high seas, protecting economic activity on the continental shelf and in international waters, and protecting against piracy;

- freeing Russian citizens who have been taken hostage in another state; and

- evacuating Russian citizens in a zone of hostilities on the territory of another state.

Moreover, the armed forces can be tasked with helping the border troops to protect the state border and sea lanes in territorial waters, and with helping the internal troops to protect and defend important state installations and closed administrative-territorial formations.

<u>Thrust of military organizational development</u>. Russia intends to have comparatively small mobile armed forces and other troops rationally organized and technically well-equipped that are capable of accomplishing the aforementioned defense missions. The interests of defense require the creation of a balanced nuclear-missile, air-space, ground-force, and naval might for the state with a view to enhancing the <u>qualitative</u> parameters of their combat capability and combat readiness.

<u>Possible nature of armed warfare and means of using armed forces and other troops</u>. The new nature of wars and means of warfare require a substantial renewal of military science and military art, and of the forms and methods of armed warfare. Depending on the nature of the wars (conflicts) the main forms of employing the armed forces and other troops could be:

- strategic deployment (mobilization, operational deployment, and regrouping of reserves) -- partial for local wars, and full for a large-scale war;
- the use of the armed forces in armed conflicts and local wars. Depending on the scale of the conflict in a local war, combat action and operations by combined units designed for immediate response and by covering forces in conjunction with the Air Force, Air Defense Forces, and Naval Forces in continental strategic regions and areas; combat action and operations to repulse an enemy air attack; air and naval operations; and participation in the elimination of internal conflicts and the performance of peace-keeping operations. The possible limited use of nuclear weapons is not ruled out in local wars; and
- the use of the armed forces in a large-scale war during which strategic deterrence may be implemented using strategic nuclear (offensive) forces, air and air defense operations to rout enemy air-space systems and repulse their attacks with the participation of all branches of the armed forces, combined-

arms large strategic formations in continental theaters, and operations and combat actions in maritime and ocean theaters.

The military-strategic aspects of the military doctrine also take account of the fact that modern military confrontation is typified by a considerable increase in the role and importance of so-called indirect strategic operations. Under present-day conditions "indirect" strategic operations may be reflected primarily in political efforts to prevent wars and military conflicts. At this stage, aside from political measures, the economic sanctions widely employed of late; naval, air, and land blockades of communications routes; shows of force; the assignment of peace-keeping forces in order to disengage sides; and other types of operations can be of great importance.

Decisive battles will be fought simultaneously on land, at sea, and in the air. Operations and combat actions will be of an extensive air-land nature -- whereby weapons delivery and electronic strikes by ground- and air-based assets throughout the entire enemy depth will be combined with multiple landings by airmobile units penetrating deep behind enemy defenses and striking not only from the front and the flanks but also against various sectors in the enemy's rear. On the whole, operations and combat actions will be of a highly maneuverable nature, developing rapidly without any defined fronts, or with only temporarily stable ones.

The rapid development of advanced technology is increasing the military-technical gap between states. Consequently, military art must be geared not only to warfare between approximately technically equal adversaries but also between those with different technical equipment levels.

Economic and military-technical foundations of military doctrine. Russia's economic might is the basis of its defense and of the technical equipping of the armed forces and other troops. The Russian state will take the necessary measures to develop the economy and, primarily, advanced technology with a view to ensuring balanced economic potential and the requisite level of adequate defense. Above all, in directing armaments development and scientific research work it is important not to follow the arms race furrow plowed by other countries but to strive to choose a path that corresponds to the country's economic potential and strategic goals, and to uphold favorable conditions for Russia in the struggle for military-technical priorities.

It is of particular importance to prevent the dissipation of forces and resources in the desire to develop all types of weapons and hardware that other armies have or might acquire. If necessary it would be expedient to take certain risks. Skip a few generations of weapons, and strive really resolutely to concentrate on science-intensive systems. That would be of decisive importance and would neutralize or undermine other countries' long-term programs to achieve military superiority.

Given the real economic conditions and military-political situation, over the next four or five years Russia must focus on resolving the task of developing the scientific, technical, and technological groundwork needed to reequip the army and navy. Priority funding is required for research and development work; for the preferential development of fundamental and applied research and experimental design work to make it possible to react in a timely and effective fashion to emergent military threats and military-technical breakthroughs; and for preemptive operational, scientific, technical, and economic feasibility studies into the new requirements of armaments.

In arms development the main stress should be placed on creating not individual weapons types but combat systems. Modern conditions are such that the potential of even the most sophisticated weapons and best-equipped groupings of troops, air forces, and naval forces are most fully realized when they are integrated into unified combat systems with highly developed levels of organization, monitoring ability, undetectability, and precision of combat use. The main efforts in the armed struggle will be directed not into physically destroying every weapons unit but into destroying their single information area; intelligence sources; navigation channels; control and guidance; and command, control, and communications systems as a whole.

WHITHER THE VPK?

In early 1995, the Russian government unveiled a new federal program: the "National Technological Base" program. Reflecting both the country's current lags and long-term requirements, the program focuses on the development of the following:

- Information technologies
- Technologies based on new materials
- Microelectronics, nanoelectronics
- Optical, laser, radio-electronics
- Power generation, energy savings
- Advanced engines
- Highly productive industrial equipment
- Special chemicals
- Energy-intensive materials
- Unique nuclear, environmentally safe technologies
- Biotechnologies

Like the new military reform plan, the federal program emphasizes a shift away from material-intensive and toward science-intensive systems: away from ballistic missiles, submarines, heavy bombers, tanks, and artillery and toward advanced C^4ISR and EW systems.

According to Kokoshin -- recently elevated to Secretary of the Defense Council and Head of the Chief Military Inspectorate -- Defense Ministry analysts jointly with corresponding government subdivisions have accomplished much work to correlate the parameters of the development of the Russian Federation's economic capability with force development plans. This work comprises an in-depth appraisal of complex and interdependent military-economic, demographic, and financial factors. Another area of analysis was the character of future wars and armed conflicts, with due consideration for the growing role of aggregate information, including electronic warfare assets, precision weapons, and illegal means of warfare.[186]

Since the1970s-1980s, says Kokoshin, and then in the course of operation Desert Storm, the prime task has been to win superiority in the information sphere; then comes the struggle for air superiority; and only after that the struggle for fire and space superiority. The emergence of information warfare assets and means of impacting on the information space of another state necessitates the development of theoretical and practical foundations for conducting information warfare, and consolidating the theoretical basis of this form of warfare as part and parcel of military art. The center of gravity in modern warfare is shifting away from the large-scale effective engagement of enemy personnel, weaponry, combat hardware, and military installations toward the

[186] Interview with First Deputy Defense Minister Andrey Kokoshin, by Nikolay Ivanov: "Military Reform Plan Has Been Outlined. By the 21st Century Russia Should Be Ready to Meet All Military Challenges," NG, 24 July 1996, p. 2.

destruction (incapacitation) of elements that are key to the opposing side's ability to put up organized resistance. Priority needs to be given to building up the capabilities of friendly forces to defend against current and prospective weapon systems.

In considering the requisite technical supply level for the armed forces, it is essential to bear in mind that owing to the ongoing economic crisis, Russia's capabilities for building up the number of weapons to their optimal strength level and for modernizing and upgrading them are thus far limited. Therefore the main attention will be given to developing cutting-edge weapon systems and defense R&D projects. At the same, time everything needs to be done to maintain the existing equipment and to ensure its gradual modernization. Kokoshin points out that any armed conflicts today are rather politicized, and the use of force even on a very limited scale in most parts of the world immediately -- primarily via television -- produces a reaction from public opinion and the political establishment. Therefore all questions pertaining to the use of military force even on the tactical level should be carefully considered with due account for their impact on politics and the various direct and indirect connections.

Kokoshin notes that aspects of military reform were elaborated in a 1995 study by the General Staff Academy entitled "The Military Security of the Country and the Armed Forces: Problems and Ways of Addressing Them," as well as in a research project completed by the same academy on information warfare, which was supervised by Rodionov and included proposals by well-known Russian military leaders and military civilian specialists from the Academy of Military Sciences and the Russian Academy of Missile and Artillery Sciences.

Options for the combat composition of the armed forces were elaborated until the period 2000-2005. In particular, blueprints were considered for a multi-mission combined-arms division of the 21st century with various weapon systems designed for different theaters of military actions. Such units are designed to be used for a wide range of missions -- from full-scale combat action to peace-keeping operations. The number of such divisions will be relatively small, and they will be used as the basis for the deployment of large formations in wartime. On the whole it is vital to have a basis for mobilizational deployment, including by employing a new reserve (conscript and officer) training system, and accumulating mobilization resources -- both human and material. Much work is in hand to develop a new type of mixed ground and naval force formation.

According to Kokoshin, the appearance of means and systems of purposive information impacting on the information space of another state has raised squarely the question of the need for the development of the theoretical and practical fundamentals of an information confrontation and the use of information weapons in the armed struggle. The intensive development of new forms and modes of operation of the armed forces at the strategic, operational, and tactical levels under conditions of the use of information weapons is essential.[187]

Information confrontation should be an inalienable part of military art, and the armed forces should be ensured the possibility of conducting -- in conjunction with other troops and military elements and authorities (the Federal Government

[187] Andrey Kokoshin, "What Sort of Army Do We Need: Some Military-Political Propositions of the Reform of the Armed Forces in Russia," Segodnya, 7 August 1996, p. 5.

Communications and Information Agency, the Foreign Intelligence Service, the Federal Border Service, the Ministry of Internal Affairs, the Federal Security Service, the Ministry of Foreign Affairs, and others) -- information-impact operations coordinated in terms of goal, targets, place, time, types of information weapons, and methods of their application. This presupposes the need for the most in-depth study of the political and social structures of various countries, their systems of state and military command and control, psychological and behavioral stereotypes, etc. This study should be conducted on the basis of the latest achievements of the social sciences -- social psychology, political science, ethnography and ethnology, and so forth.

Instead of a reliance on massive effective fire against personnel, weapons, military hardware, and military targets, the main efforts should be concentrated increasingly on the destruction (disruption of the operation) of the components on which the enemy's capacity for organized resistance depends. The main efforts in determining the directions and priorities in the development of the means and methods of armed struggle within the framework of the long-term arms program proposed by the Ministry of Defense will, accordingly, be geared to the creation of forces and facilities of information warfare (electronic warfare, intelligence, communications, operational command-and-control systems, and facilities for the protection of command-and-control systems against enemy influence); the development of precision weapons of varying range and purpose; the development and adoption of non-lethal means of armed struggle; the improvement of facilities supporting the mobility of combined units and units of the armed forces; the development of the entire complex of forces and systems of nuclear deterrence; and the creation of a fundamentally new system of personal gear and equipment.

The difficulties of the first and subsequent stages of the organizational development of the Russian Armed Forces have been intensified by a whole number of problems which were inherited from the Soviet Armed Forces and which to a large extent have not been tackled for decades. These problems include the imbalance in the development of weapons on the one hand and a number of the systems supporting their use (facilities of intelligence, command, control, communications, electronic warfare, and concealment); and precision weapons on the other. This stems largely from the growing lag of Russian industry and science in the fields of microelectronics, computer technology, and communications facilities and from the fact that a civilian market for these products has not developed inside the country.

As already noted, the Russian government and Ministry of Defense plan to increase the share of funds allocated for research and experimental design, the modernization of arms and military equipment, combat and operational training, and so forth. This objective was clearly set once more by President Yeltsin at the meeting with the Collegium of the Ministry of Defense in July 1996. The military-technical foundation for the rearmament of the Army and the Navy is to be created thanks to this in the period 1996-2002. Considering that until the completion of this period the military's receipt of new equipment will be of an extremely limited nature owing to obvious budgetary and financial factors, it is essential to preserve in a state of combat readiness what is in the arsenals today. This will make it possible to embark on the relatively broad-based rearmament of the Army and Navy as of the period 2002-2007, when the country will have both the resources and a new military-technical base for this.

The army reform must not be reduced to the simple reduction of armed forces, Kokoshin told Interfax in an exclusive interview in late 1996. He said that the Ministry of Defense has worked out a program of reforming the army that would meet long-term conditions and needs. This document provides for setting up new types of units and formations -- it will be a new military organization with a new organizational structure, equipped with new types of arms and hardware. The reform also implies new approaches to military theory. This question is being intensively discussed at the Defense Ministry and General Staff.[188]

Also in late 1996, Kokoshin told ITAR-TASS that the military-industrial sector's dramatic problems with defense orders had not barred its research and development programs in recent years. He cited serious developments in hydro-acoustic engineering, radars, and computer hardware for control of troops and weapons. In the nearest future, new weapon systems will appear such as anti-aircraft missile systems and means for radioelectronic warfare that will bring the Russian Army to the level of the best models in the world.[189]

According to then Defense Minister Grachev, the "Single Armaments Program" was approved. "Priorities in the development of military technology and armaments were determined at last in the history of the Soviet and Russian armies. We have achieved a single approach to arming the units in the Russian armed forces," he said.[190]

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[188] Moscow INTERFAX, 14 October 1996.

[189] Anatoliy Yurkin, Moscow ITAR-TASS, 23 October 1996.

[190] "Grachev: Not Yet Time for 'Deep Military Reform' in Army," Moscow INTERFAX, 1 May 1996.

As his successor Rodionov noted later in 1996, "We can put off rearming for ten years but get twenty-first-century equipment and weapons."

According to Deputy Defense Industry Minister K.E. Buravlev, it was decided to increase the defense budget by six trillion rubles in 1997 -- R1.6 trillion will augment appropriations for the purchase of food and clothing and R4.4 trillion will go for the acquisition of new types of weapons. In addition, the priorities have already been designated. Among others, Viktor Chernomyrdin stated that financing scientific-research and experimental design work (NIOKR) is the "key issue" during the determination of the defense order's parameters.[191] These are the resources that today are minimally needed to guarantee the implementation of a key document -- the State Weapons Development Program to 2005 -- that Yel'tsin signed in December 1996. The Russians are attempting to follow two paths at once: increasing the allocation of budget resources and expanding commercial capabilities. These are two sides of the same coin and there is one goal -- to strive to increase the amount of resources directed to scientific-research and experimental design work to the maximum extent possible.

Today this issue is pivotal for Russia. One can briefly formulate the task of the military-industrial complex as follows: maintain the scientific-technological margin that the country has at all costs. It's no secret, says Buravlev, that a margin still exists in

[191] Interview with Deputy Defense Industry Minister Konstantin Eduardovich Buravlev by Ekspert Correspondent Andrey Chernakov, "The State and the Military-industrial Complex: Not All Is Lost for the 'Defense Industry' -- One Can Still Correct and Augment Much, Thinks Minister of the Defense Industry Konstantin Buravlev. It Seems That the Minimally Needed Money for That Has Been Found in the 1997 Budget," Ekspert, No. 48, 16 December 1996, pp. 12-13.

Russia that is capable of providing a real lead in specific types of the latest equipment, so it must first of all move out onto the world market as aggressively as possible with the offer of an expanded product list of modern types of weapons and military equipment. Second -- and this is now a mandatory condition -- invest the resources that are obtained from the expanded exports in scientific -research and experimental design work to not only preserve that very same margin but also increase it.

In mid-June 1997, the Defense Ministry leadership prepared and presented to the commission for financial and economic backup for military reform a draft for a radical change to the structure and development system of the Russian military-industrial complex, especially in the field of scientific research and development -- scientific research and experimental design work for promising military equipment. The Russian military-industrial complex will now be geared not so much toward the production of an "article" (a tank, for instance) as toward the development of promising technologies. The desire of the old Soviet military-industrial complex to produce as many tanks and guns as possible led to the point where in the West defensive technologies began to develop more rapidly than offensive ones. The result of this was some setbacks for Russian heavy hardware at recent arms fairs.[192]

For many technologies which are being declared promising by the Russian military-industrial complex, they admit that they have a guaranteed lag since Western firms have been engaging in these developments on the basis of military orders from their governments for several decades now. They include primarily the radar stations

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[192] Yevgeniy Krutikov, "Only a Tank 'The Size of a Cat' Has a Chance of 'Catching Mice,' " Segodnya, 25 June 1997, p. 3.

of the future (the qualitative improvement of onboard radar including phased-array radar to intercept airborne targets); facilities for detecting submarines and associated technologies (the study of the ocean noise conditions and the emission of low- and very low-frequency acoustic waves in the water); and optical-electronic instruments (the improvement of infrared reconnaissance sensors, the development of solid-state lasers and small-scale gas lasers).

Other priority technologies for the Russian military-industrial complex include structures from composite materials (the development of new composite materials and structures from them including light-weight armor for tanks and naval equipment, new heat-resistant composite materials for use in gas turbine engines and for aerospace equipment); microelectronic components made of silicone (the modernization of commercial silicone integrated circuits for military purposes); the raising of reliability and resistance to radiation; modular aircraft electronic equipment (including radar, navigation and communications apparatus, reconnaissance and electronic warfare facilities); and space observation facilities (primarily high-resolution optical systems, space radars with synthesized apparatus, and real-time data-transmission systems).

General-Major Slipchenko, director of the research department of the General Staff, told Komsomol'skaya pravda in late 1997 that such classes of arms as directed-energy weapons, automatic precision weapons, deep-penetration munitions, and equipment for conducting so-called electronic warfare are being created at this time. Kokoshin boasted in an interview that the program of military development up to the year 2005 would provide Russia with "weapons that have no counterparts in the world." It is for this that the 1,700 research centers of Russia's military-industrial complex are working.[193]

According to Komsomol'skaya pravda, some of the current high-priority strategic programs include:

- Topol-M2 mobile intercontinental ballistic missiles (an upgraded version of the SS-25 missile, which was put into mass production at the end of last year);
- a new tactical nuclear arms system capable under combat conditions of firing nuclear warheads over a distance of 400 kilometers (the system was tested successfully at the end of 1995);
- Ultra-small nuclear warheads weighing less than 90 kilograms, which are already being manufactured; and
- laser and radio-frequency weapons.

According to Defense Minister Sergeyev, it is planned to increase spending on equipping the army with arms and military hardware 200 percent by 2001 and 350 percent by 2005. In the upcoming years the defense ministry will gamble on conducting promising research and development work, since the military has no money to purchase large consignments of equipment, and buying individual items is expensive and pointless. Rearmament of the army will have to begin after 2005: it is planned each year to update up to 5 percent of army arms and equipment and to complete

[193] Denis Baranets, "12 Billion for Weapons That No One Has," Komsomol'skaya pravda, 7 August 1997, p. 1.

rearmament of the army by 2025.[194] Overall, by 2005 the structure of expenditure should look like this: 60 percent of the funds will go on maintenance, logistical support, and troop combat training (today 70 percent of the funds go on maintaining the army), and 40 percent will go on research and development work and the purchase of armaments.

According to Kokoshin in late 1997, the VPK will step up research and design work in the near future to develop new types of weapons. He emphasized that the 1998 draft federal budget provides for appropriating purpose-oriented funds for defense design offices and research institutions. At the same time, outlays to purchase outdated materiel will be brought to a minimum.[195]

EVOLVING MILITARY REFORM PLAN

Army General Petr Deynekin, CINC of the Russian Air Force, has advocated "radical measures" to carry out military reform in the country. Deynekin reported that the Air Force high command considers it necessary to switch to a three-branch armed forces structure -- the Ground Forces, the Navy, and the Air Force. As he put it, the transition from a five-branch structure to a three-branch structure could be implemented by uniting the Air Force, the Air Defense Forces, the Strategic Missile Forces, and the Military Space forces into a single new branch -- the Air Force -- and reducing parallel and duplicate structures as much as possible.

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[194] "Military Reform: Combat Preparation Is Over," Kommersant-Daily, 25 July 1997, p. 3.

[195] Nadezhda Potapova, Moscow ITAR-TASS, 22 August 1997.

"This reorganization option will make it possible to enhance the effectiveness of strategic nuclear forces by uniting their components (the strategic missile forces and long-range aviation); organically combining defensive and offensive operations on land, at sea, and in the air; and substantially simplifying the resolution of the tasks of preparing for and conducting operations," he noted. He also stressed that this reorganization would make it possible to "substantially reduce the size of the Russian Armed Forces, considerably cut expenditures on the upkeep of troops, and release funds for the development and purchase of new weapons types."[196]

According to Chief of the General Staff A. Kvashnin, by the year 2005 the Russian Armed Forces will include three groups of troops and "the structure of the Russian Armed Forces will be based on three factors: land, water and air." By the year 2001, the armed forces will pass on to a four-group structure, and only during the years 2001-2005 will they take on a three-group structure.[197]

In July 1997, Defense Minister Sergeyev provided the following clarification of the reorganization plan:

The Strategic Deterrent Forces. During 1997-1998 the Strategic Missile Forces, the Military Space Forces, and the Space-Missile Defense Forces will be

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[196] INTERFAX, "Deynekin Advocates 'Radical Measures'," NG, 5 May 97 p. 2.
[197] INTERFAX, 21 June 1997.

integrated into a single branch -- the Strategic Missile Forces.[198] [NOTE: The completed merger was announced on 30 October, 1997.]

The General-Purpose Forces. One of the conditions for creating them is that the military districts are granted the status of operational-strategic commands. This means giving full power and balancing responsibility and rights in the hands of a one-man commander. In addition, it means securing the inclusion within the districts' "perimeter" of the formations of other power departments located on their territory.

The Air Force and Air Defense. These will also be integrated -- within the framework of the operational-strategic commands -- with the creation of unified rear support services, with an expanded cadre field, and with standardization of individual arms and hardware systems.

The Navy. It will probably be subjected to fewer changes than the other branches, although the search for its optimum strength and structure will be continued. The Navy is to retain ships with high combat efficiency, strategic guided missile submarine cruisers, support forces, and so on.

The Ground Forces. These are the basis of the Armed Forces. And yet the number of divisions in them will fall, while their combat potential will increase. They will primarily be equipped with new weapons and control systems. For example, the

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[198] Oleg Falichev, "The Army's New Appearance: Realities and Prospects. Journalists' Meeting With Army General I.D. Sergeyev, Russian Federation Minister of Defense," KZ, 22 July 1997, p.1.

mobile command post created by Russian scientists and engineers. This mobile command post not only is not inferior to foreign analogues but also surpasses them in terms of many parameters. It makes it possible, for example, to practically double the effectiveness of a division's casualty effect and to increase sixfold its battlefield management potential.

The long-time civil-military consensus on the linchpin of Russian military reform has recently and recurrently been confirmed by Defense Minister Sergeyev. In the space of about three years Russia must ensure the advanced creation of scientific, technical, design, and production groundwork throughout the spectrum of arms and military equipment, producing experimental models. "The president has forbidden us to buy old equipment," he stresses. "Consequently, these will mainly be 'break-through' technologies. Even my brief familiarization with our research and development has shown me that we can look to the future with optimism in this area."[199]

Sergeyev notes further that the Russian military-industrial complex works in a coordinated way, developing not only advanced but also these "break-through" technologies -- that are really ten-fifteen percent ahead of all existing in the world.[200] In late September 1997 Sergeyev reiterated that the Defense Ministry is not going to buy military hardware of old models, "not a single piece of it." The money allocated for this purpose will be spent on scientific research and on design work, on the

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[199] Oleg Falichev, "Blueprint for Armed Forces Organizational Development Ratified. Press Conference by Army General I.D. Sergeyev, Russian Federation Defense Minister," KZ, 9 August 1997, pp. 1-2.

[200] Yelena Yugina, Moscow ITAR-TASS, 3 September, 1997.

development of "break-through technologies." The equipping of the army with new armaments and hardware will begin gradually after the year 2001. "If we do not provide modern armaments and military hardware for the army, it will become an exhibition army," he said.[201]

In mid-October 1997 Sergeyev asserted that Russian military technology does not lag behind the West -- and some innovations surpass existing state-of-the-art foreign arms. The most promising innovations have been developed in the areas of battle management and communications systems.

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[201] Mikhail Shevtsov, ITAR-TASS, 30 September 1997.

APPENDIX A: TECHNOLOGY CATALOGUE

THIRD-GENERATION NUCLEAR WEAPONS

Both Soviet and Russian military scientists have long discussed so-called "third-generation nuclear weapons" as a component of the new RMA. Their catalogue of these weapons includes the following:

- Neutron weapons
- EMP and "super-EMP" weapons
- SHF microwave weapons
- Earth-penetrating nuclear weapons
- Nuclear-pumped x-ray laser weapons
- Nuclear shrapnel
- Mini-nukes

WEAPONS BASED ON NEW PHYSICAL PRINCIPLES

Both Soviet and Russian military scientists have long argued that "weapons based on new physical principles" constitute the essence and future of the new RMA. Their catalogue of these weapons includes the following:

- Geophysical/ecological weapons
- High-frequency radio/electromagnetic wave weapons, infrasonic weapons
- Ethnic weapons
- Directed-energy weapons
- Psychotronic weapons
- Plasma weapons
- Non-lethal weapons

NON-LETHAL WEAPONS

Finally, Russian military scientists consider certain non-lethal weapons to be elements of the new RMA. Their catalogue of these weapons includes the following:

- Laser weapons
- Incoherent light sources
- SHF weapons
- Infrasonic weapons
- EMP weapons
- "Information weapons" (electronic news media, EW systems, special programs, computer viruses, etc.)

COUNTERING THE RMA

According to General Staff analyses, a classification of possible measures for protecting the Armed Forces against the new technologies of the RMA consists of the following:

- ACTIVE WARFARE
  -Destruction of platforms, command-and-control equipment, and weapons elements by SAM complexes (systems)
  -Electronic and electro-optical suppression of weapons systems by EW equipment

- PASSIVE PROTECTION
  -Reduction of own signature (radar, optical) and of emitted signals
  -Use of diversionary means
  -Mobility, armoring

- SYSTEMS PROTECTION
  -Creation of integrated air defense systems realizing the integration of air defense and EW assets

-Creation of alert radar field at high, medium, and low altitudes; support of information communications with reconnaissance systems of other branches of the Armed Forces

Russian military scientists have also examined the following specific counters to a variety of systems:

COUNTERS: AGAINST RECONNAISSANCE-STRIKE COMPLEXES

- Fighters Against "Airborne Elements" (Reconnaissance and Communications Relay Aircraft)
- "Front Air Operation" Against "Ground Elements"

COUNTERS: AGAINST STEALTH

- Detection: Radar, Acoustic, Laser Sensors
  -Multi-Positional and Multi-Frequency Radars
  -Over-the-Horizon Radars
  -Holographic Radars
  -Air- and Space-Based Radars
  -EM, Infrared Systems, etc.
  -Solid Radar Field
- Destruction: SAMs and Fighter Aircraft (S-300, BUK SAMs and MIG-31, SU-27, and Follow-ons)

COUNTERS: AGAINST "NEW PHYSICAL PRINCIPLES"

- Active: Detection and Destruction of Facilities
  -Strikes By Ground- and Air-Based Radiotechnical Systems
  -Jam Communications and Guidance Systems

- Passive: Troop and Equipment Protection (Fortifications, Aerosols, etc.)

COUNTERS: AGAINST C^4 ISR SYSTEMS
-"Perturbations of Environment" (Geophysical/Ecological)

-System Failures (Non-Lethal Weapons)
-Nuclear Weapons, PGMs, and Third-Generation Nuclear Weapons
-"Information Weapons"

COUNTERS: AGAINST EW SYSTEMS

- Active
  -Affect Software (e.g., Computer Virus)
  -Strike With Beam, Super-High-Frequency, and especially Electromagnetic Pulse Weapons
  -Advanced Anti-Radiation Missiles
  -Advanced Anti-Radiation Drones

- Passive: Electronic Protection and <u>Maskirovka</u>