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Mr. John Greenewald
The Black Vault
[redacted]

Dear Mr. Greenewald:

This is the final response to your electronic Freedom of Information Act (FOIA) request dated February 10, 2005, which you submitted to the Defense Technical Information Center (DTIC), for, "an official DTIC Bibliography: Title: (U) Impact of the RMA on Russian Military Affairs. Volume 1." DTIC referred your request, and one document to this office for review and direct response to you. We received your request on March 10, 2014, and assigned it FOIA case number 14-F-0563.

After a careful review, this Office determined the document is responsive to your request and appropriate for release without excision.

There are no processing fees associated with the processing of this request. Accordingly, this case has been closed in this office.

Sincerely,

for Paul J. Jacobsmeyer
Chief

Enclosures:
As stated

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.

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KEY RESEARCH FINDINGS

NATURE OF THE NEW 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.

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.

NATURE OF FUTURE WAR

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 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.

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.

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).

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.

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.

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.

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.

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.

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.

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 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.

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 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.

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.

ROLE OF "SMART" WEAPONS

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.

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 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.

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.

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; 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.

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.

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.

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.

The primary advantages of PGMs include the following:

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" 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.

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.

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.

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 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 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.

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.

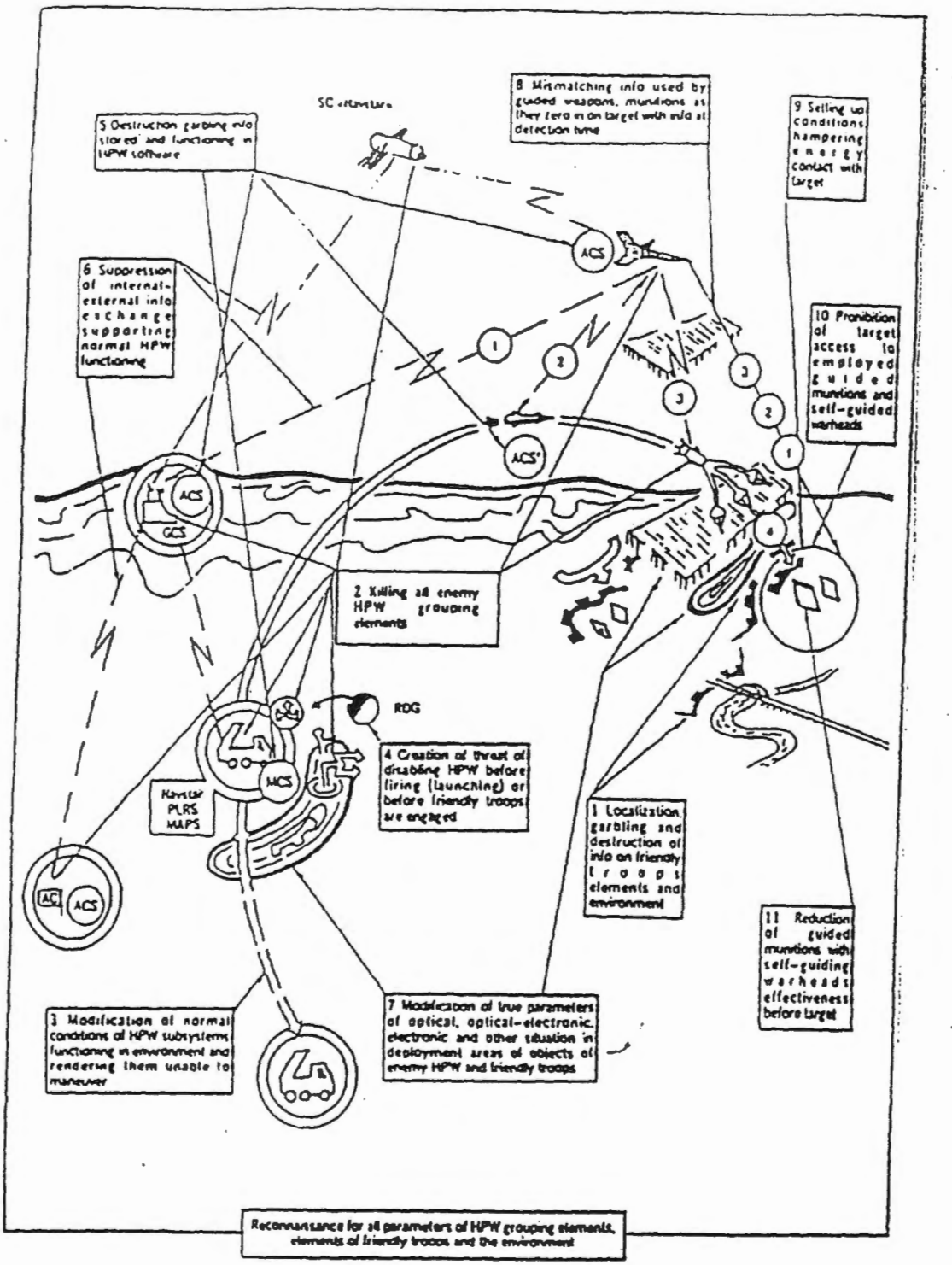
But entirely new flying craft are on the horizon. These new aircraft combine not only inconspicuousness, but also enormous, hypersonic speeds achieved owing to the use of non-traditional types of aerodynamic configurations and power plants. Proposals of "a leading U.S. firm" to create an unmanned hypersonic 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.

COUNTERMEASURES TO "SMART" WEAPONS

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 1).

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.



The matter of «combating enemy HPW» phenomenon

FIG 1

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;

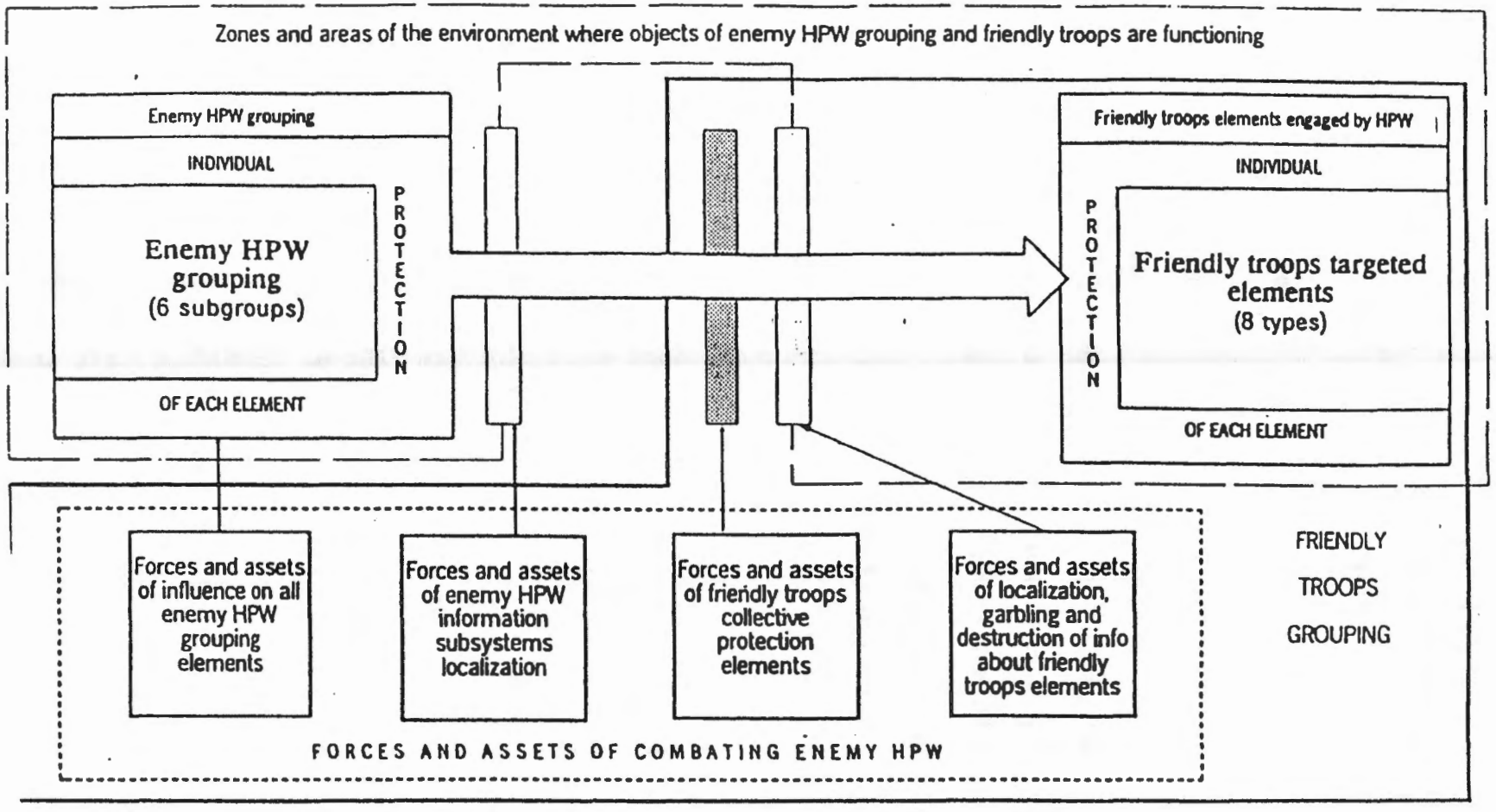
- displace information used by guided weapons and self-guiding warheads as they become targeted on friendly facilities compared with the initial information received by the reconnaissance assets at the moment of detection or information available to the enemy;

- 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 2).

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.



Participants in combating enemy HPW grouping

FIG 2

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.

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?

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."

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.

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

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.

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.

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

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.

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.

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. [NOTE: SEE APPENDIX]

ROLE OF "NON-TRADITIONAL" 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." 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. 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.

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." 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."

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.

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.

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 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

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.

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. Furthermore, tests 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.

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.

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.

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

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.

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." 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.

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.

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.

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

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 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.

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."

ROLE OF SPACE

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.

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

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.

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.

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.

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."

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 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.

NATURE OF INFORMATION/ELECTRONIC WARFARE

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.

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.

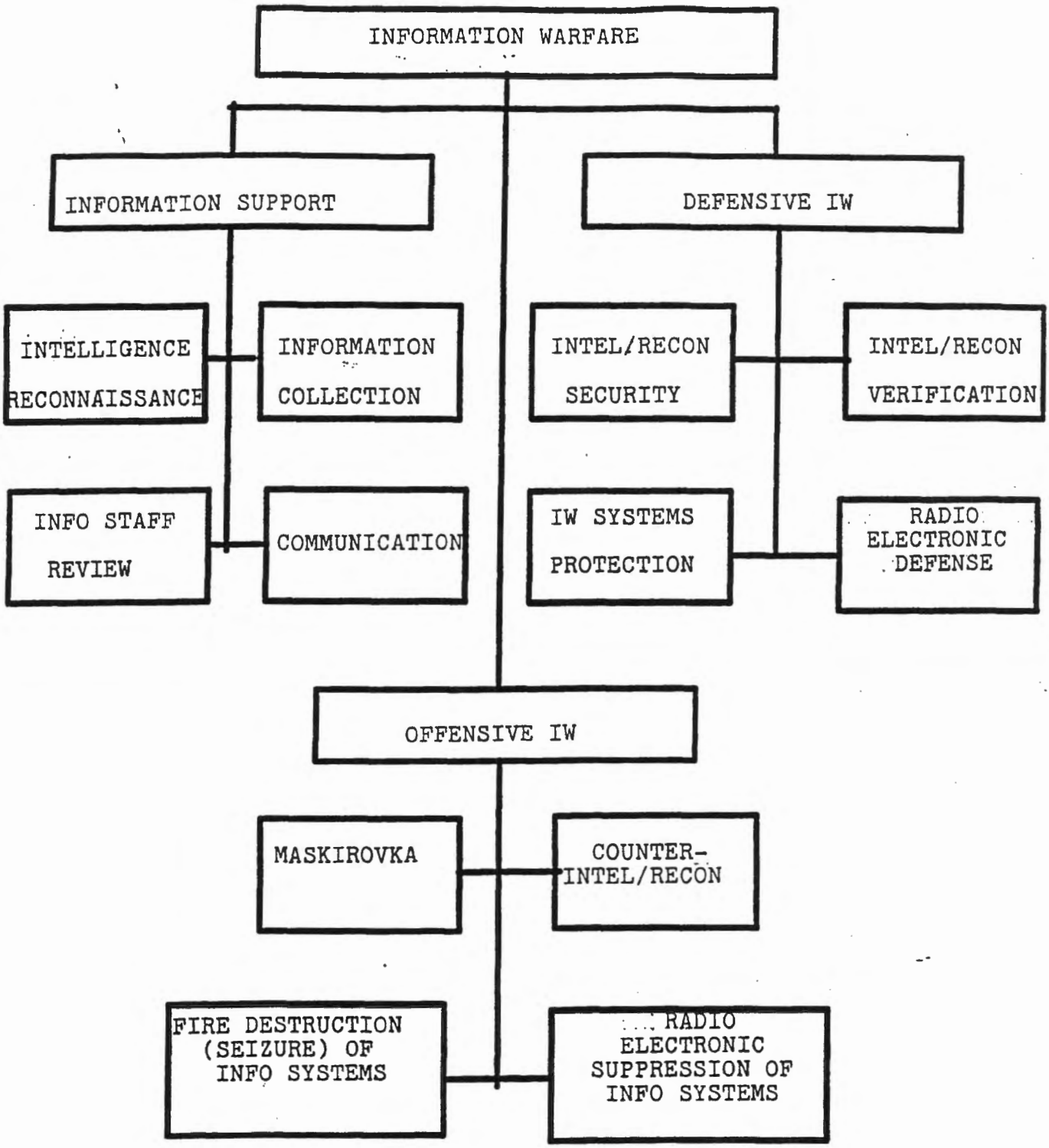

INFORMATION WARFARE
INFORMATION SUPPORT
DEFENSIVE IW
INTELLIGENCE RECONNAISSANCE
INFORMATION COLLECTION
INTEL/RECON SECURITY
INTEL/RECON VERIFICATION
INFO STAFF REVIEW
COMMUNICATION
IW SYSTEMS PROTECTION
RADIO ELECTRONIC DEFENSE
OFFENSIVE IW
MASKIROVKA
COUNTER-INTEL/RECON
FIRE DESTRUCTION (SEIZURE) OF INFO SYSTEMS
RADIO ELECTRONIC SUPPRESSION OF INFO SYSTEMS

DIAGRAM 1

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.

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.

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.

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.

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.

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			→→→→→

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 Russians have come to the following tentative conclusions regarding the Gulf War:

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.

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	

"INFORMATION WEAPONS"

"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

NEW OPERATIONAL CONCEPTS

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 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.

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.

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.

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.

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.

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.

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.

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.

NEW ORGANIZATIONAL ADAPTATIONS

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.

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:

- 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.

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.

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.

- 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 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.

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

in his district. This makes it possible to strictly implement the principle of a single command of different types of armed forces.

NEW MILITARY-TECHNICAL POLICY

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.

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 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.

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 new federal program, the draft of which was discussed by Goskomoboronprom's Scientific-Technical Council, is called the "National 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.

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 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 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.

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 service infrastructure; and a mobilizational deployment infrastructure and technical facilities for training troops (forces) and preparing the reserve.

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.

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 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.

In June 1993, then Defense Minister Grachev announced that the Russian Defense Ministry now has "prototype development plans for all types of armaments." 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.

CURRENT POLITICO-MILITARY PRIORITIES

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. 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.

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.

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 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.

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 rearmament of the army by 2025. 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 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.

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 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 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."

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. 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 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.

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 Maskirovka