RECORD COPY

FOREIGN DOCUMENTS DIVISION

TRANSLATION

Number 967 29 August 1966

SELECTED TRANSLATIONS FROM "VOYENNAYA MYSL',"

Issue No 3, March 1966

OFFICE OF CENTRAL REFERENCE

CENTRAL INTELLIGENCE AGENCY

Approved For Release 2000/08/09 : CIA-RDP85T00875R000300090024-0

SELECTED TRANSLATIONS FROM "VOYENNAYA MYSL',"
Issue No 3, March 1966

Voyennaya Mysl' (Military Thought) is a monthly organ of the USSR Ministry of Defense, printed by the ministry's Military Publishing House, Moscow. The articles translated below are from Issue No 3, March 1966 which was signed for the press 16 February 1966.

Table of Contents

Maj-Gen Engr-Tech Serv A. Matveyev

With the greatly increased range of action and power of modern armament, there has arisen the very serious problem of making intelligence equipment completely correspond to the combat characteristics of weapons. In this, radioelectronic gear is of special importance. Therefore we shall dwell only on those problems which have to do with the use of radioelectronics in the interests of intelligence, basing our article on data published in open Soviet and foreign publications.

Let us examine some of the principles which determine the role, under modern conditions, of technical equipment as used in the missions of strategic and operational intelligence. The latter can be divided into two major groups: first, the collection of information providing for the launching of attacks against the enemy (offensive operations), and, second, getting data for the repulse of enemy attacks (offensive operations).

The conditions of combat operations make different demands on the intelligence facilities which comprise these groups. For those which serve offensive operations there are usually set forth fairly clear missions, determined by the plan of the operation and the composition and armament of the forces which are to carry it out. In this case intelligence is required to discover targets of the enemy which are subject to destruction during the operation, the composition and disposition of his forces, and their armament. Thus intelligence for offensive operations is interested primarily in targets of the enemy and his capability to repulse attacks -- his defensive capability. When intelligence is to serve repulsing enemy attacks it has somewhat different missions. In this case principal attention is paid to the enemy's means of attack -- their characteristics, disposition, and plans for their use.

Despite the essential difference of the missions of the above two groups of intelligence facilities, they are united by the conditions of their use. In both cases intelligence must operate against objectives located in the territory of the enemy, and at great depth, corresponding to the range of the means of fire-power.

Time is a very important factor in intelligence, in many cases playing a decisive role, especially for the group serving the defense. The flight of ballistic missiles lasts only a short time. During that time the fact of their launching must be ascertained, the possible areas where they will land be determined, and measures taken to protect personnel and equipment. With the flight velocities which have been achieved, to prepare to repulse the attack even of airplanes, the

off is discovered. In these conditions rapid action by intelligence is of unquestionably decisive importance.

Speaking of the revolution in the military field brought about by the development of missiles and nuclear weapons, it must be kept in mind that it has equally affected the means of intelligence, without which the most perfect weapon may prove to be useless.

Under the new conditions there has been rapid increase of the importance of the technical equipment of intelligence, extensively applied in various fields of intelligence activity: the acquisition of data, transmission of it to collection centers, processing and analysis of intelligence data received from various sources, and, finally, putting the generalized data into a systematic form, convenient for use. In all these steps there is the most extensive use of radioelectronic gear, by means of which the facilities collecting data and those transmitting, analyzing, and processing it are united. Thus modern instruments of intelligence must be regarded as a single complex, consisting of receivers (datchiki) of information (which used to be considered the characteristic means of intelligence), means of transmitting the data obtained, and equipment for its processing.

The application of radioelectronics in technical equipment for discovering and identifying objectives in enemy territory has been brought about by great successes in the exact sciences, especially physics. We live in a world of fields and radiations, caused by the movement of material particles. It is through these fields -- electromagnetic, gravitational, acoustic, and others -- that the interaction of material bodies with the surrounding environment and with other bodies takes place.

Electromagnetic radiation is not the only characteristic of an object which distinguishes it from surrounding objects. In many cases other fields may be used for this purpose -- acoustic, magnestic, gravitational -- and in some cases use of these fields gives results which cannot be obtained by radioelectronic means. We may give as an example hydro-acoustic instruments, operating in water, in which electromagnetic waves are propagated with great absorption.

The use of the magnetic wave has made it possible to develop mine detectors, which discover metal objects under the ground, something which so far it has not been possible to accomplish by other means. There are great prospects for use of the gravitational field, but so far there are no methods known for detecting the weak gravitational waves with the movement of physical bodies.

The use of electromagnetic radiations has certain limitations, caused mainly by the conditions of propagation of radio waves of the selected frequency range. Waves shorter than 10-12 m are propagated in a straight line, undergoing no reflection in the atmosphere. Therefore the range of operation of radio equipment in this frequency band is limited by line-of-sight, and for reconnaissance in enemy territory it must be mounted on appropriate carriers: airplanes or artificial earth satellites.

Thus the means of reconnaissance intended for direct acquisition of information on targets and forces of the enemy are inseparably connected with the vehicles which carry them, and success of reconnaissance is determined by the capability of the vehicle to surmount the enemy's defense. From this point of view the role of radioelectronic gear in the acquisition of intelligence is growing beyond measure, in so far as aircraft and spacecraft are being provided with the most varied radio engineering equipment.

Some radioelectronic gear used in intelligence is well known, and there is no need to examine it in detail. We have in mind apparatus for the detection and interception of electromagnetic radiation (radio- and radio-engineering intelligence), radar stations for various purposes, television equipment, etc. As far as these are concerned, we will limit ourselves to considering some prospects for their development. Initially we will touch on the new demands on this equipment brought about by scientific and technical progress in armament. This has to do primarily with increase of range of operation and of accuracy of determining the coordinates of intelligence targets. Suffice it to say that the relative accuracy of determining the coordinates of targets for intercontinental ballistic missiles amounts to 10^{-4} - 5.10^{-5}, which corresponds to the micron accuracy of machining parts on the most highly-developed lathes. Such high relative accuracy of measuring coordinates requires search for new methods of fixing [the location of] carriers of the reconnaissance instruments, i.e., the development of much improved methods of navigation. It should be taken into account that such high accuracy of measurement has required the correction of maps, especially in making more precise the triangulation system of various continents, inasmuch as the methods of geodetic measurements used previously could not provide the required accuracy. We know that major work in this field is going on abroad, directed, particularly, at the development of geodetic satellites (the American Secor and Anna, for example) and navigation satellites (Transit), and at the compilation of accurate maps of the sea bottom for the method of geophysical coordinates (sovmeshcheniya) in sea theaters of operation. There has been a substantial increase in the accuracy of radio navigation and inertial navigation. These systems make it possible to fix the location of an aircraft or a ship within 150-200 meters at various distances.

In the light of the above considerations, let us dwell on some of the more concrete fields of the use of radioelectronic devices for the purposes of intelligence.

Electromagnetic radiation intelligence. Along with the traditional use of such means for interception and finding the direction of radio transmissions, they have come into extensive use for intelligence on radar stations, navigational systems, and other special-purpose radio engineering installations, particularly for determining the characteristics, composition and disposition of air defense (PVO) installations. This arises from the principles of construction of modern PVO, which are saturated with radar stations for the long-range detection of air targets and the guidance of ground-to-air missiles and fighter planes, and with communications and command radio stations. Improvement of intelligence equipment for this purpose has been in the direction of extending the range of frequencies, increasing the sensitivity of receivers and the speed of action and automation of the operations of receivers and direction finders, applying and improving new methods of recording and analyzing signals received, and a higher general engineering quality of the apparatus, increasing its reliability and decreasing its weight, size and power-supply needs by the use of semiconductors of modular and micromodular design.

Along with this there have appeared new fields for the application of apparatus for electromagnetic radiation intelligence, in which should be included, for example, the detection of nuclear blasts and even the launching of ballistic missiles. The tremendous energy released in a nuclear blast, the high temperatures and great volumes of products of decay, and the effect of these factors on the atmosphere, causes a number of phenomena, including powerful electromagnetic radiation, which can be detected and located as to direction from great distances. It has been reported in the press that a device for receiving the electromagnetic impulse radiated by a nuclear blast is included in the system, established on US territory, for the detection of blasts, which is being developed at the present time under the "Nudets" program.

Characteristic radiation and other side phenomena caused by the operation of a rocket motor has served as the basis of a method of detecting the launching of ballistic missiles which is being worked out by the Americans under project "Red Mill." In the operation of powerful rocket engines there occurs characteristic radiation of the column of ionized gases created by the flame of the engine and the effect of the products of combustion on the ionosphere, what which produce distinctive vibrations which radiate to a great distance. Utilization of these phenomena opens up the possibility of detecting missiles practically at the moment of their launching, which under modern conditions is of extremely great importance.

A new direction in the development of electromagnetic radiation intelligence apparatus is the development of space equipment for this purpose. Despite the secrecy in the US of the work on space reconnaissance, information has been published in the press about "Ferret," a radio reconnaissance version of the Samos satellite reconnaissance system. To estimate the capabilities of such an apparatus, one really does not have to have access to secret information, since its possible characteristics can be easily figured out. With broad-band and sufficiently sensitive apparatus, the space vehicles can detect PVO and PRO [anti-missile defense] radar stations at a distance of 1200-5000 km with a satellite height of orbit of, respectively, 100-1,000 km. Naturally, at such a distance, and with the enormous amount of radio installations on the ground, the problem arises of overloading the reconnaissance receivers; this problem, however, considering the level of development of electronic computing and data storage, can be solved successfully.

Radar intelligence. Radar has been used for the accomplishment of the most varied missions, beginning with the detection of targets on the battlefield and in the air and meteorological reconnaissance, and ending with the detection of IBM's and objects in space. Radar continues to be the reconnaissance basis of the modern PVO and PRO system.

There was a time when some specialists expressed the opinion that the possibilities of radar had been exhausted, and there could scarcely be expected any further progress in this field in the future. This opinion was based on the fact that the power of radar transmitters had reached a limit, and there did not seem to be any practical realizable way to increase the sensitivity of receivers. The susceptibility of radar stations to jamming played a considerable part in this pessimistic evaluation of the future prospects of radar.

Despite such predictions, radar has continued to develop at a fairly rapid rate. A number of scientific discoveries and technical improvements have made it possible to develop new models of radar with substantially improved tactical and technical features. The problem of increasing the power of transmitters was solved by the so-called phased antenna arrays, in which the power of several transmitters is combined in the required field of space. The solution of this problem became possible as a result of the development of electric vacuum oscillators with very high stability and electronic frequency control. The number of such transmitters arranged in a planer array can be very great (up to several thousand in one installation), and their total power is practically unlimited. Phased antenna arrays have also made it possible to solve the problem of electronic beam control and to increase substantially the traffic capacity of the radar station, inasmuch as shifting of the beam to a given point of space requires only millionths of a second.

amplifiers), the sensitivity of radar receivers has been substantially increased and has approached fairly close to the theoretical limit, determined by the level of noises generated in the antenna. Methods of processing signals have been improved, the capabilities of radar stations to identify targets have been substantially expanded, and their interference-killing features have been improved. All of this has made it possible to come close to the solution of the most important problems of PVO -- the detection of low-flying targets. Here it must be remembered that one of the main limitations of radar -- range of operation within the limits of optical sight -- remains in effect, and increasing the range of detection of low-flying targets so far is sought by raising the radar on airplanes or helicopters.

CPYRGHT

Since 1950 work has been carried on in the US on developing radar stations capable of detecting targets beyond the horizon (Projects "Teepee" and "Madre"). In speeches of the US Secretary of Defense during the past two years it has been stated that some progress has been made in developing such stations, and they are being constructed at the present time. The stations operate on a band of short waves, propagated to great distances by reflection from the ionosphere. The reflection of waves of this frequency range from the earth, and the phenomenon of back scatter, makes it possible to get a return signal characteristic of the scatter of radio waves by certain sections of the earth's surface. Deviation of these characteristics from the normal can serve as an indication of the presence in this region of moving objects or other causes of change in the nature of the wave scatter. It should be noted that work in this field has already been going on for 15 years. The great fluctuations in the state of the ionosphere make it scarcely possible to develop a reliable apparatus of this kind. However, the very disturbance of the state of the ionosphere may serve as a sign of the launching of very powerful ballistic missiles. Therefore it is no accident that beyond-the-horizon radiolocation is linked with the American project "Red Mill," in which are being investigated all possible means of detecting the launching of ballistic missiles, including, for example, the use of ultra-low-frequency acoustic vibrations.

One of the achievements in the field of radar reconnaissance is the development of airborne reconnaissance stations with lateral scanning, in which are used antennas with artificially created (synthesized) aperture. For a long time the use of airborne radar reconnaissance sets was limited by their inadequate resolution capability, caused by the small size of their antennas. This was partly overcome by the development of antennas along the length of the plane's fuselage and providing scanning on both sides of the planes line of flight.

However, the [illegible] also did not provide the required resolution. Then the method of lateral scanning was perfected by the application of the principle of synthesizing large antennas apertures by using the movement of the aircraft and by special processing of "packages" of signals emitted during a certain interval of time, comparatively, weakly by a directional antenna. Use of this method makes it possible to get effective antenna apertures of the order of tens of meters.

The method of synthesized antennas makes it possible to obtain clear radar charts of terrain, on which, after decoding, may be detected objects with dimensions of a few meters.

In foreign countries much attention is being paid to investigation of the possibility of using radar stations for reconnaissance from an earth satellite. Apparently the problem of creating such a station has not yet been solved, mainly because of the great weight and size involved. However, work in this direction is continuing, and it is possible that the creation of space radar reconnaissance stations is not so far off.

The possibilities for use of radar for reconnaissance are not exhausted by what has been mentioned above. Work has been done, and is going on, on the development of special-purpose radar -- meteorological, cartographic, etc. Deserving of special attention is the development of radar for reconnaissance of terrain -- the condition and traversability of ground, the nature of vegetation cover, etc. (Electronics, 28 December 1962, p 20). In these studies there are being investigated the characteristics of reflection and absorption of radar signals by the ground in various sections of the frequency range, on the basis of which it is contemplated that it will be possible to judge as to the condition of the soil to a depth of 40 cm.

One of the fields of development of radar technology is so-called passive radiolocation, in which objects' own radiation is used. The basis of this apparatus is a very sensitive receiver with an antenna having highly-directional reception, by means of which sequence scanning of the terrain is carried out. In view of the difference of temperature and reflection capability of various objects there is created radar contrast, by which it is possible to detect objects of interest. To a great extent this apparatus is similar to the means of thermal reconnaissance, with the difference that it uses a millimeter and centimeter wave range.

Television reconnaissance has been known for a fairly long time. In recent years it has undergone substantial changes. A great achievement in this field is the development of very sensitive electronic-optical devices which make possible the detection of objects under conditions of natural night illumination, when no other means of observation can be used.

Television engineering has had a very important place in photo-television means of reconnaissance, combining the high resolution capability of optics with the possibility of immediate transmission of the pictures to the ground, with a considerable decrease in the need for radio-link transmission of data in comparison with purely television apparatus. In these systems the aerial photograph is automatically developed on board the aircrafts and transmitted to the ground by the television system, which has low frame frequency, making it possible to use a relatively narrow-band radio link (radioliniya). The importance of using such systems is due to the great vulnerability of the reconnaissance apparatus carrier to the enemy's means of defense and the necessity of immediate transmission of the data obtained to the ground collection centers.

Infrared equipment is finding ever-increasing use for reconnaissance. Based on the reception of electromagnetic radiations in the infrared range (0.76-500 micron waves), they are most often used in a passive system, for the reception of heated objects' own radiations. From this point of view, infrared devices can give best results in the observation of objects having motors or other power installations. Of no less interest is the use of infrared for the observation of objects having relatively slight contrast with the surrounding environment. Actually such means have been used for the detection of submerged submarines, by the difference in temperature of the wake stream compared to that of the undisturbed water, amounting to tenths of a degree.

Infrared, too, like other means of reconnaissance, has certain limitations, due mainly to the high absorption of infrared rays in fog, clouds, and rain, and the insufficiently high sensivity of receivers, which is several orders lower than that of radio engineering means. The latter fact leads to the necessity of using methods of cooling the infrared ray detectors to very low temperatures, which greatly complicates the apparatus.

Along with passive infrared devices, the artificial illumination of a target by a source of infrared radiation is being used. Great impetus to the development of active infrared systems was given by the development of optical quantum generators (lasers), which have made it possible to use many methods of radiolaction in the infrared wave range. Lasers have made it possible to shift from incoherent infrared radiation of heated bodies, made up of a wide spectrum of frequencies, to radiation at specific (opredelennyye) frequencies (coherent radiation), which has the properties of monochromatic radiation in the radio-wave range. Besides the possibility of concentrating such radiation into very narrow beams, making it possible to get extremely high resolution in the observation of objects, lasers can be used for the transmission of the most varied information by the aid of proper

modification. Laser telemeters of very high accuracy have already been developed, but their use in the atmosphere is so far limited to short distances (Electronic News, 9 April 1963, p 19).

It must be borne in mind that the technology of coherent infrared radiation is in the beginning stage of its development, and at present it is difficult to name the concrete fields in which it is applied, but there is no doubt that this a very promising field, and one which may open the way to the development of new technical means of reconnaissance.

Consideration of the use of infrared techniques for reconnaissance purposes would be incomplete if we did not mention the possibility of using them for reconnaissance from space. There has been wide publicity in the US about the development of the Midas satellite, intended for the detection of the launching of ballistic missiles by the infrared radiation of the exhaust flames of their engines. It is known that this work has been complicated by the need for dependable selection of these radiations against a background of radiations from other sources, because of which the work has been reoriented in the direction of scientific research. Nevertheless, the solution of this problem is possible in principle, and putting the system into practice will be determined by its reliability of operation and cost.

In general it should be emphasized that the possibilities of using infrared radiations for intelligence have by no means been exhausted, and there are great prospects for development in this field. Research is going on also on the use of new sections of the wave range of electromagnetic radiations, particularly in the range of ultraviolet and even X-ray radiation.

This brief survey of the capabilities of radioelectronic and other means of detecting objects by no means encompasses all the fields of their use. However, all these possibilities are only potential. Most electronic means of reconnaissance have a range limited by line-of-sight. In using them there arises the unpleasant necessity of mounting them on carriers to bring them close enough to the enemy targets for detection to be possible. This has two main consequences: first, reconnaissance operations have to be planned as carefully as any military operations, and second, the aircraft -- the bearers of the means of reconnaissance -- must be provided with a certain minimum means of defense.

In the near future reconnaissance missions in operational depth will be accomplished mainly by piloted and pilotless airplanes. From this point of view the problems of organizing and carrying out reconnaissance have much in common with the combat use of aviation. It would be naive to think that the reconnaissance plane could operate in conditions where combat planes could not. Just like the combat

plane, the reconnaissance plane will encounter the enemy's strong anti-aircraft defense, which against solitary reconnaissance planes will be considerably more effective than against massed attacks of combat planes. The problem of support of the combat operations of reconnaissance aviation (these operations, essentially, should be considered combat ones) is attracting much attention from military specialists.

It is significant that in foreign countries in recent years there has been increased work on the development of reconnaissance-attack planes, which can carry out reconnaissance, and also attacks on individual targets. Among such planes is the multi-purpose F-111, developed in the US, the strategic attack-reconnaissance plane, SR-71, and others. The problem of protecting the operations of such planes is being met by shortening the time of their stay in the area of active air defense, by flight at low altitude, or by increasing their speed at high altitudes. It is known that these planes are equipped with means of jamming the radio engineering equipment of the air defense.

In foreign countries another way of providing air reconnaissance, mainly in tactical depth, is the development of pilotless reconnaissance planes, an example of which is the American type AN/USD. In this case it is believed that even if this relatively cheap plane should be shot down, it will still have been able to receive and transmit to ground points important reconnaissance data.

The transmission of reconnaissance data is the field in which radio-electronics is of specially great importance. So far the only means of communication with moving means of reconnaissance is radio communication, with all its inherent virtues and defects. Use of radio communication in reconnaissance imposes no special demands on it when its traffic capacity corresponds to the amount of information to be transmitted. The latter circumstance is always important and is difficult to achieve for short-wave radio links of long range communications, inasmuch as increasing the resolution of the reconnaissance apparatus results in a marked increase in the amount of information received. We know that the amount of information increases as the square of the increase of resolution of the reconnaissance apparatus. Increase in the amount of information to be transmitted by radio links involves expanding the frequency range used by them. The creation of such links is possible only in the ultrashort wave range, the communication range of which is limited by line of sight. The solution of this contradictory problem -- combining high traffic capacity of the radio link with long range -- presents serious difficulty; the solution is being sought in the direction of establishing relay points, on planes or earth satellites.

Wel means of communication are used in intelligence not just for the receipt of information from mobile objects. They also play an extremely great role in other fields of intelligence activity. Without dependable communication there could be no thought of any intelligence activity. In particular, means of communication are one of the most important elements of the systems of automation of intelligence operations, on which we will dwell somewhat more in detail.

The problem of automation in intelligence is just as acute as in many other staff activities. Information about the enemy has an exceptionally important place in the process of decision-making at all levels of command and in carrying out plans decided on. Therefore, timely processing of the enormous stream of intelligence data, coming in from the most varied sources, sometimes incomplete and contradictory, is a task of primary importance, and unless it is accomplished, the expenditure of great efforts to obtain intelligence information may turn out to be useless. This comes from the very essence of the intelligence process, in which the getting of information is only the first, although most important, stage. Next there must follow the stages of assembly, evaluation, analysis, generalization, and interpretation of this information, with appropriate systematization of it by fields and subjects of interest to specific agencies of the command.

The possibility of automating these stages of intelligence activity is due to the development of electronic computer technology and mathematical methods of describing various processes and phenomena. It must be said, however, that varying opinions are expressed on the matter of introducing automation into intelligence.

Many operations encountered in intelligence are capable of being automated. They include accumulation, storage and search of data by specific subjects; processing of materials requiring laborious calculations; and a number of other fields involving uniform, repetitive activities. The use of machines in these fields makes it possible to get in a short time objective information on the subjects of interest. For example, according to information published in the press, a new automated system of search of intelligence information being used in the office (apparat) of the Assistant Chief of Staff for Intelligence of the US Army produces the data in four-tenths of a second.

The automation of processing intelligence data for the accomplishment of specific tasks is giving good results. The following information, for example, is published in the press (Armed Forces Management, July, 1962): because of the introduction of an automated intelligence subsystem on the battlefield, linked up with the field artillery fire-control system, the expenditure of shells for the destruction of small targets, with a probability of 90 percent, was reduced from 25 to 2.

Possibly, these conclusions are inaccurate, but it cannot be denied that the automation of reconnaissance of targets makes possible a substantial increase of the effectiveness of fire weapons.

We have examined only some of the problems concerning the use of radioelectronics in the interests of intelligence. Of course, the problems of intelligence are not solved just by radioelectronic means. But it is perfectly obvious that further improvement of intelligence will proceed primarily on the basis of the most wide-spread application of radioelectronics, which is the connecting link uniting and organizing the work of the most varied elements making up the system of intelligence.

In direct acquisition of reconnaissance data, radioelectronic apparatus is one of the few means of detecting and identifying targets for weapons. In the accomplishment of this task, radioelectronic means to an ever-increasing degree are combining with the systems of weapons, and in many cases the boundary between means of reconnaissance and of fire power is being erased. This shows up especially clearly in air defense, where without target indication neither ground-to-air missiles nor fighter aircraft could be used. In other kinds of weapons this unity is not yet so obvious, as a result of which intelligence is still regarded as a means of combat support, and its capabilities are not always tied in with those of weapons. Apparently for these weapons, too, the problem of target indication is becoming as acute as for air defense, and it is possible that in the future, means of reconnaissance will become a part of the complex of weapons and of automated systems of command of troops.

It should be especially emphasized that the possibilities of radioelectronic means of reconnaissance are far from being exhausted, and prospects for their development are truly limitless. The general progress of radioelectronics assures the development of very compact, economical devices with self-supervising ('samokontrol') elements and primary processing of data on board. A problem already practically solved is that of developing self-adjusting equipment (sredstva) making it possible to solve assigned problems with the use of logical elements applicable to the existing circumstances. Awaiting action is the use of the principles of bionics for the development of still more improved means of reconnaissance, the use of which will greatly increase the capabilities of combat equipment.