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16 June 1976

MEMORANDUM FOR: The Director of Central Intelligence

FROM : William W. Wells
Deputy Director for Operations

SUBJECT : MILITARY THOUGHT (USSR): Problems of Engineer Support for the Negotiation of Water Obstacles at High Speeds

1. The enclosed Intelligence Information Special Report is part of a series now in preparation based on the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". This article examines engineer support to river crossing operations in Western European theaters under nuclear war conditions in which water obstacles are to be negotiated from the march. The engineer measures emphasized by the author include forming an appropriate grouping of engineer troops and the equipment required for various conditions, and maneuvering crossing equipment throughout the depth of an operation while maintaining its survivability in the face of enemy strikes. The author feels more use should be made of helicopters to transport materials and perform engineer operations. This article appeared in Issue No. 1 (62) for 1962. [redacted]

2. Because the source of this report is extremely sensitive, this document should be handled on a strict need-to-know basis within recipient agencies. For ease of reference, reports from this publication have been assigned [redacted]

[redacted]
William W. Wells

[redacted]

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SUBJECT

MILITARY THOUGHT (USSR): Problems of Engineer Support for the Negotiation of Water Obstacles at High Speeds

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Summary:

The following report is a translation from Russian of an article which appeared in Issue No. 1 (62) for 1962 of the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". The author of this article is Colonel General of Engineer Troops A. Tsirlin. This article examines engineer support to river crossing operations in Western European theaters under nuclear war conditions in which water obstacles are to be negotiated from the march. The engineer measures emphasized by the author include forming an appropriate grouping of engineer troops and the equipment required for various conditions, and maneuvering crossing equipment throughout the depth of an operation while maintaining its survivability in the face of enemy strikes. The author feels more use should be made of helicopters to transport materials and perform engineer operations. Engineer reconnaissance utilizing aerial photography and television, the advantages of the PMP pontoon bridge set, and the need for effective traffic control also are touched upon.

End of Summary

[redacted] Comment:

[redacted], who was Chief of the Military Engineering Academy of the Ground Forces from 1961 to 1969, also wrote "Engineer Support for the Movement of Strategic Reserves from the Interior of the Country to a Theater of Military Operations and Their Commitment to an Engagement" in Issue No. 3 (76) for 1965 [redacted]

[redacted]

Problems of Engineer Support for the Negotiation of Water Obstacles at High Speeds

by

Colonel General of Engineer Troops A. Tsirlin

Without touching upon the whole diversity of problems connected with engineer support for high rates of advance, the need for achieving which has already been shown in a series of articles, we will dwell only on engineer support for the negotiation of water obstacles by troops.

Under conditions of missile/nuclear war, water obstacles will have a great influence on the conduct of operations and especially on the rate of advance of troops.

Our probable enemies attach great importance in operations of the initial period of a war to utilizing natural obstacles and to setting up in conjunction with them engineer obstacles, areas of destruction, and zones of radioactive contamination. They think that in this way it will be possible to disorganize the advancing troops, bring them to a stop, or force them to move slowly through those areas against which it will be advantageous to deliver strikes with nuclear weapons. According to the views of our probable enemies, the main preparatory work for setting up a system of obstacles and areas of destruction on these water obstacles and the approaches to them must be carried out in peacetime. They consider that carrying out this work in advance and stockpiling minelaying means will permit establishing in the course of operations high densities of mine fields and large areas of destruction on axes which are accessible to tanks.

According to available data, armies of the aggressive NATO bloc, in accordance with the plans of the infrastructure, are carrying out an entire system of measures to prepare for the reinforcement of water obstacles and the demolition of important installations on them. Therefore, it is necessary not only to systematically and thoroughly study the nature of the enemy preparation of theaters of military operations as a whole, the enemy's planned system of obstacles and especially his system of demolitions on bridge crossings on medium-width and wide rivers, but also to be prepared to prevent the setting up of these obstacles and to negotiate the obstacles at high speeds.

The nature of the water obstacles which must be negotiated by the troops during an offensive is determined by a series of indices, above all by the width of the obstacle and nature of the bottom. Depending on their width, water obstacles (rivers and their tributaries, canals, straits, flooded areas, and the like) can arbitrarily be divided into narrow -- up to 60 meters, medium-width -- up to 200 meters, and wide -- over 200 meters. In the Western European theaters of military operations narrow water obstacles comprise approximately 68 percent of the total number. During an offensive the troops will encounter them every 30 to 40 kilometers; they will encounter medium-width and wide water obstacles of operational importance every 200 to 250 kilometers. Therefore, in a modern offensive operation conducted to a great depth, it will be necessary to negotiate two or three water obstacles daily. With the ever greater development of tank crossings along the bottom, the contour and firmness of the river bed also are becoming very important.

It is apparent from the data cited that during an offensive operation in the initial period of a war the negotiation of water obstacles will be just as certain and regular an occurrence as the negotiation of zones of radioactive contamination, obstacles, and areas of destruction.

Not long ago, the assault crossing of water obstacles meant only a troop crossing with a battle. Under modern conditions this concept has changed substantially. At present, the negotiation of water obstacles includes the movement of the troops right up to the water obstacle along a wide front, the delivery of nuclear strikes against the most important targets, the landing of airborne landing forces in a number of cases to facilitate and accelerate the crossing of the troops, the crossing by units and large units, and their rapid advance on the opposite shore.

Comrade R. Ya. Malinovskiy, Minister of Defense and Marshal of the Soviet Union, demands that the troops master the methods of negotiating water obstacles at high speeds, and learn to rapidly develop the offensive into the depth after having negotiated the water obstacle, without allowing any delay at the bridgehead.

The main condition for the successful negotiation of water obstacles is the purposeful employment of nuclear warheads to deliver strikes, primarily against large enemy reserves assigned to counteract our offensive and, in conjunction with conventional means of destruction, also against troops on the defensive right at the water obstacle. At the beginning of and during the negotiation of water obstacles, tanks and artillery will continuously conduct massed fire against enemy ground targets from both the near and opposite shores. Accordingly, the ability of the troops to quickly exploit the results of nuclear strikes and the effects of conventional means of destruction against the enemy, and to rapidly negotiate a water obstacle without substantially changing the battle formations of large units or the operational disposition of formations, is of great importance.

At the same time, one of the decisive conditions for the success of an offensive including the negotiation of water obstacles at high speeds is engineer support. Its main task should be considered the conduct of measures directed toward creating conditions for the rapid movement of the troops up to the water obstacle along a wide front on separate axes, direct support of the troop crossing, including crossing via bridges which have been captured or cleared of mines, as well as support of an advance at a high rate on the opposite shore.

The capabilities for the employment of missile/nuclear weapons by both sides, the quality of modern combat equipment, the mobile nature of troop actions to a great depth in an operation -- all this has sharply changed former ideas concerning the organization of engineer support for an offensive including the negotiation of water obstacles and concerning the combat employment of engineer troops, and has introduced much that is new into them.

Under modern conditions, in order that high rates of advance of troops reaching 100 kilometers per day, not be decreased, all the water obstacles encountered must be negotiated from the march. Since missile/nuclear weapons will be employed in the interests of successfully negotiating medium-width and wide water obstacles, all calculations and the organization of engineer support should be carried out in peacetime, proceeding from the basic method of negotiating water obstacles from the march when an offensive is being conducted at high speeds. The design and improvement of combat equipment and transport and crossing means, as well as the combat training and operational training of troops and staffs, must be subjected to this requirement.

Of course, the negotiation of water obstacles after a short period of preparation, which could take place, for example, at the beginning of an offensive operation if the operation is conducted without employing nuclear weapons, as well as during an operation on several axes where for some reason the water obstacle could not be negotiated from the march, cannot be totally rejected. However, troops equipped with amphibious combat and transport equipment and improved self-propelled (on land and in the water) crossing means, as well as trained for the rapid negotiation of water obstacles from the march, obviously will carry out the crossing completely even when the preparation period is short.

In our opinion, new features in the organization and implementation of engineer support for the negotiation of water obstacles at high speeds include the totality of such measures as: the support of the approach of the troops on a wide front and on the distant approaches, which eliminates the formation of "traffic jams", and enables movement at increased speeds even over swampy floodplains; the timely support of operations by forward detachments and airborne landing forces, which are being more widely employed for the specific purpose of seizing bridges and clearing mines from them; the simultaneous setting up and maintenance of crossings on a number of water obstacles, under conditions in which a deep operation is being conducted; the maneuvering of engineer forces and means within a limited time period; and, finally, the integrated employment of several types of crossings and the utilization of various crossing means.

Engineer reconnaissance of water obstacles within short time limits, operational camouflage, provost and traffic control service, and also troop control at the moment the water obstacles are being negotiated, are different under modern conditions. Let us examine some of the enumerated theses in greater detail.

It seems to us that the new concept in the combat employment of engineer troops in an operation is above all the formation of an appropriate grouping of them which would be capable of ensuring the advance of the troops to the water obstacle along a wide front on separate axes, their immediate crossing, even in unsuitable sectors, following nuclear strikes, and the continuous development of the offensive on the opposite shore. In forming a grouping of engineer troops which meets these requirements, it is necessary to thoroughly reason out the distribution of engineer forces and crossing means along the axes of troop actions so as to ensure the independence not only of divisions, but also of regiments of the first echelon, and establish appropriate reserves of crossing means in the armies and in the front with the goal of maneuvering them while negotiating the water obstacles.

The independence of regiments, divisions, and armies in negotiating water obstacles can be ensured by including in them organic crossing means and by allocating such an amount of engineer forces and means, in a timely manner, as would allow a troop crossing to be organized on the most important axes without decreasing the rate of advance and, in addition, would allow minimum reserves to be established in order to reconstruct crossings which have been put out of service.

It is known that deep operational tasks and the necessity to fulfil them within short periods of time require that the entire large unit or operational formation, including their rear services units, cross rapidly to the opposite shore. Since the amount of non-amphibious combat equipment and transport in a motorized rifle division is 1,850 pieces of equipment, and in a tank division 1,905 pieces, moving them across on amphibious and ferry means takes a great deal of time.

Calculations show that the organic crossing means of a present-day motorized rifle (tank) division ensure the fulfilment of these requirements only during an assault crossing of narrow (up to 60 meters) water obstacles. During an assault crossing of wider rivers, the first-echelon divisions of an army need to be reinforced with crossing means. Naturally, there is a limit to the number of crossing means which can be concentrated in the divisions.

If we consider that 800 to 1,000 trips of pieces of amphibious and ferry means are necessary for moving across an entire division, and that in the course of an hour three or four turn-arounds of these means can be provided for, then it will be necessary to utilize an average of 300 pieces of crossing means per hour. In order that a division cross within three hours, it must be allocated up to 100 amphibious vehicles and ferries. Obviously, even the maximum number of means which the division will receive will be about one third of this figure, and the crossing by the division by the amphibious-ferry method will take eight to nine hours.

As calculations show, when an adequate number of forces and crossing means are allocated, the routes for driving tanks under water are skilfully utilized, and the approach of the troops to the water obstacle is correctly organized, the negotiation of this obstacle by a motorized rifle (tank) division within five hours becomes possible. It is true that even such time limits do not completely correspond to high rates of advance. It is necessary as quickly as possible to revise the equipping of divisions and regiments with crossing means and to improve the methods for using them. This must be done in order to ensure a swift crossing by not only forward detachments, but also regiments of the first echelon on amphibious and ferry means, in conjunction with the immediate selection and preparation of fords for tanks, the laying of routes for driving tanks under water, as well as the laying of bridges for moving the main forces of the army across.

Among combined-arms commanders and engineer chiefs, existing views on tank crossings, in accordance with which driving them along the bottom is either recognized as the only method or completely ignored, could be harmful to the development of the entire theory and practice of negotiating water obstacles.

In working out methods for negotiating water obstacles, it is very important to provide for the efficient combination of the driving of tanks along the bottom with other types of crossings, and for the utilization of all modern amphibious, ferry, and bridge means. Only the integrated employment of amphibious combat and transport equipment, engineer crossing means, and equipment for driving tanks under water and for swimming crossings, as well as the development of devices to increase the cross-country capability of transport means (non-amphibious armored personnel carriers, prime movers, trucks) through deep fords, can ensure high rates of advance of troops during the successive negotiation of a series of water obstacles in an offensive operation.

Engineer support for the negotiation of water obstacles using the entire arsenal of modern means is the duty of the engineer troops, regardless of who has designed and manufactured these means and which branch arm they are in. For example, in a number of cases, after the obstacle is negotiated by amphibious tanks, as well as after conventional tanks cross on tracked self-propelled ferries or under water, it will be possible, rather than deploying pontoon bridge sets to assemble ferries, to set about laying bridges immediately. Motorized rifle subunits and artillery in this case will be able, as they come to the water obstacle, to carry out a crossing on amphibious armored personnel carriers and self-propelled amphibious means. The slight decrease in the rate of advance, which might take place in the first hours after the beginning of the crossing, will be compensated for by the subsequent accelerated troop crossing over the bridges which have been laid.

When bridges are laid soon after the division arrives at the water obstacle, the higher traffic capacity of the bridges can ensure that the division crosses within a short time. Until recently, floating bridges could be built at best within three hours from the moment the forward units arrived at the water obstacle. This circumstance compelled the utilization of pontoon bridge means initially for ferry crossings, since it was known beforehand that the capacity of the latter would not permit adequate forces to be rapidly concentrated on the opposite shore for the immediate organization of the offensive. As a result of this, in a number of cases it was necessary to secure small bridgeheads even when the enemy forces in the sector of the assault crossing were insignificant.

In disengaging the pontoon means deployed to lay floating bridges, as rapidly as possible, the construction of bridges on narrow water obstacles, as well as trestles or submerged bridges on fixed supports on medium-width and wide rivers, will play an important role. The construction of the latter should begin at the same time as the laying of floating bridges. A trestle of any length built at such a distance from the bridge that it cannot be destroyed at the same time as the bridge with one burst of a medium-yield nuclear warhead, will be a sort of reserve for bridge crossing means already deployed on the water.

Under all conditions a submerged bridge will have greater survivability against the effect of nuclear strikes than a low-level bridge. However, in the initial period of a war it is not likely that there will be a large number of component parts for the construction of such bridges among the troops. Apparently, in this situation in order to construct bridges on narrow rivers and trestles on medium-width and wide rivers, it will be necessary to utilize in full measure treadway bridge layers of the vehicle-mounted treadway bridge and the vehicle-mounted heavy bridge models, as well as non-bulky organic means enabling submerged bridges to be erected quickly. At the present time, the speed with which such bridges can be constructed is still one fourth to one fifth that with which low-level bridges are built.

We must also take into consideration the fact that in the initial period of a war the employment of missile/nuclear weapons and swift actions both by specially allocated forward detachments when the troops approach the water obstacles and by airborne landing forces dropped in advance, will enable, to a greater extent than in the last war, bridge crossings to be seized before they are destroyed. In this case, purposeful actions by engineer troops to clear, as rapidly as possible, mines from the bridges which have been seized will be very important.

We can safely say that the successive negotiation of a series of water obstacles will not affect the rate of advance if crossing means are correctly distributed in the army to the large units, and in the large units to the units, and most important, if they are maneuvered at the proper time. This acquires especially important, decisive significance in the planned support of the negotiation of water obstacles under all conditions of the situation.

The maneuvering of crossing means depends on the skilful leadership of the engineer troops equipped with these means, and will be complicated by the absence of a continuous and straight front line. In order to ensure high speeds for a troop crossing on the main axes, it is necessary in conducting a maneuver to concentrate other bridging means, in addition to the means moved up to the troops in advance, from those sectors where a crossing was unsuccessful, as well as means from the second echelons and reserves of the army and, in a number of cases, from the front. Military transport aviation has a great future in the maneuvering of crossing means.

At the present time it is in order to examine the following ways of maneuvering crossing means: from the depth to the water obstacle, along the water obstacle, by leap-frogging or shifting the crossing means during the successive negotiation of a series of water obstacles, and finally, from the water obstacle into the depth. In connection with this, problems of maneuvering crossing means, not only on a division and army scale but also within a front, using ground transport and especially military transport aviation, as well as problems of controlling engineer troops when negotiating a series of water obstacles at high speeds, should be worked out carefully and in advance. In developing means for the integrated mechanization and automation of troop control, we must also take into consideration the need of the engineer troops for these means in order to carry out control and maneuvering while supporting an offensive which includes the negotiation of a series of water obstacles at a high speed.

We should also take into consideration the circumstance that the enemy, utilizing water obstacles to conduct combat operations, will strive to hamper the deployment of crossing means on the water, to exert maximum influence on them with his nuclear and conventional weapons and aviation before and after they are put into operation, and prevent the maneuvering of crossing means. It is sufficient to note that the crossings and bridges on a water obstacle within a radius of 1.5 kilometers from ground zero of a burst can be destroyed by a low-yield nuclear warhead. And, when nuclear ground bursts are employed, zones of radioactive contamination many kilometers in area and having high levels of radiation will be created on the approaches to the water obstacle and at the crossings.

The vulnerability of crossing means to such strikes requires that engineer chiefs take part in organizing surface-to-air missile and air cover for the crossing areas, coordinate actions by the engineer troops with actions by tanks and ground artillery, as well as take effective measures to directly ensure the survivability of the crossings.

From the engineer point of view, the survivability of crossings can be ensured by distributing crossing means along a broad front, by building dummy crossings and especially bridges, by rapidly changing over from bridge to ferry crossings and back, by systematically transferring floating and composite bridge crossings to new places (an anti-nuclear maneuver), as well as by freeing crossing means in a timely manner, especially pontoon bridge sets, and replacing them with submerged and low-level bridges on fixed supports.

In conjunction with the problem of the survivability of crossings, there arises the urgent necessity of maintaining all crossing means in a state of readiness to support the negotiation of water obstacles by the troops at any time of day and in any sector, including those with unsuitable approaches. In connection with this, all crossing means should be equipped beforehand with all that is necessary for laying crossings or utilizing them at night.

The width of the present-day offensive zone of large units and formations has changed significantly in comparison with the past war. Combined with the post-war development of crossing equipment, which in its tactical characteristics and specifications cannot be compared to previous means in any way, this width also has strongly influenced the organization of the negotiation of water obstacles and, in particular, the increase in the length of the assault crossing sectors of divisions and the assault crossing zones of armies. Thus, in 1943 six armies of the Steppe Front advanced across the Dnepr River in the Kremenchug-Dneprodzerzhinsk sector, while during the operational-strategic exercise in the autumn of 1956 (?), the water obstacle in this same sector was negotiated from the march by two armies, in support of which a significantly larger number of the best quality crossing means were utilized than were possessed by the entire Steppe Front.

When an army is advancing in a zone 100 to 150 kilometers wide, its divisions will actually be advancing on separate axes with gaps between them reaching 20 to 30 kilometers at times. In this case the army will approach the water obstacle along a broad front, and to negotiate the obstacle, divisions could obtain a sector up to 20 to 30 kilometers wide. For the successful negotiation of a water obstacle along a broad front by all the first-echelon divisions of an army, it is necessary to reinforce them beforehand with amphibious and pontoon bridge means.

It is known that in the past war the delay of mechanized troops on swampy sectors of river floodplains was caused, as a rule, by the slow building of treadway road surfaces. Thus, when the troops of the 36th Army of the Transbaykal Front were negotiating the swampy floodplain of the Argun river in August 1945, the rate at which work proceeded on the laying of plank wheel tracks on each of the approaches to this river was dependent on the speed at which the vehicles hauling the wooden wheel tracks moved over the floodplain.

Now it is completely realistic to count on the utilization of helicopters for the transport and laying of wheel treadways, along which the troops will be able to advance to the crossings, in sectors with routes which have a low load carrying capacity. The employment of helicopters to carry out such tasks is desirable, since a helicopter is capable of flying in a straight line at a speed of 200 kilometers per hour even above sectors of terrain which are inaccessible to vehicle transport, while a truck can move no faster than 40 to 50 kilometers per hour.

The exercises conducted in 1959 in the Baltic Military District showed that by using helicopters it is possible to quickly select places for crossing the swampy sectors of river floodplains which would require the minimum artificial increase in the load carrying capacity, and to transport by air and lay road surfaces of plank wheel tracks and duralumin in these places within a very short time without decreasing the rate of approach by the troops to the water obstacle.

In our opinion, we should continue to work out theoretically and experiment widely in troop exercises with ways to rapidly reconnoiter passages across swampy sectors of terrain and methods to increase the load carrying capacity of river floodplain sectors.

However, even a substantial acceleration in the completion of engineer operations by utilizing helicopters will not be able to fully solve the problem of ensuring the timely approach of the troops to water obstacles across wide swampy floodplains along impassable roads, especially during the flood season and rainy periods. In connection with this, we must raise a question concerning the significant increase in the cross-country capability of the combat and transport vehicles of all the branch arms, as well as the vehicle chassis for engineer equipment allotted to support an offensive at high speeds which includes the negotiation of water obstacles. Moving crossing means, and the troops and cargo to be put across, to the water obstacle without using the roads already in existence or those laid in the course of the offensive will enable crossings to be set up in sectors to which access is difficult, and the location of crossings to be easily shifted on the water obstacle, thus ensuring the greatest safety for crossings from strikes by enemy nuclear weapons.

However, even if the problem of sharply increasing the cross-country capability of ground transport is solved, engineer support for the movement of troops to a water obstacle will remain, as before, one of the most difficult measures directly affecting the achievement of high rates of advance. This support will consist primarily of reconnoitering routes and eliminating enemy obstacles which it is disadvantageous or impossible to bypass. To achieve high rates of advance there are movement support detachments on each of the routes of the first-echelon regiments and within forward detachments on the routes of the battalions. Also, engineer units within the march columns must lay short sections of column routes, clear the roads of tree barriers and combat equipment which has been abandoned, damaged, or burned, and eliminate damage to the road beds in an extremely short time.

The movement support detachments should always be supplied with engineer equipment mounted on tank chassis, which would enable the above operations to be carried out in zones of radioactive contamination having radiation levels of up to 50 roentgens. But when such engineer equipment is available the radiation dose received by the crews will be one tenth of that received by personnel during exposed movement and work on contaminated terrain.

At the present time it is becoming vitally necessary for engineer units to have equipment that would protect the personnel working in it against radioactive contamination when the level of radiation is from 150 to 200 roentgens. The placing of a special protective layer (liner) in the cabs of existing engineer vehicles using tank and heavy artillery prime mover chassis is entirely practicable. There is no doubt that the time has come to supply the engineer troops with remote-controlled equipment for operations in zones having high levels of radiation which are either impossible or inadvisable to bypass.

Turning to engineer equipment which directly supports a crossing, we should say that the PMP model pontoon bridge set which was adopted into service at the beginning of 1960 possesses the best indices in comparison with earlier pontoon bridge sets. This set permits high rates of advance to be ensured while negotiating water obstacles. Bridges built from the PMP pontoon bridge set are laid not within 1.5 to two hours, as is the case with bridges made from TPP heavy pontoon bridge sets, but within 20 to 30 minutes; that is, three to four times faster. The speed which is permitted on them is two times greater (20 to 25 kilometers per hour), and the number of vehicles required to transport the bridge assembly and personnel needed to lay the bridge is one half as many. However, the inadequate cross-country capability of the transporting vehicles of the PMP pontoon bridge set off the roads necessitates further improvement of the design with the goal of developing self-propelled bridge sets.

The reduced time used by crews in laying the bridges and the increased speed of troop movement over such bridges are very important in the event of high levels of radioactive contamination at the water obstacle. It would only be necessary to relieve the personnel maintaining the bridges more frequently.

Since the PMP pontoon bridge set possesses such good indices, there arises the urgent necessity to equip the troops with these sets as rapidly as possible. The presence in an army pontoon bridge regiment of two PMP sets would enable divisions to be reinforced while negotiating water obstacles of medium width and, under the conditions of the Western European theaters of military operations, allow such water obstacles to be negotiated by an army within 10 to 12 hours, without reinforcement with the crossing means of the front.

Returning to the question of the utilization of helicopters, we should point out that at the present time there is not one task for the engineer support of a troop offensive which includes the negotiation of a series of water obstacles, in the accomplishment of which helicopters could not play a great role. The capability of landing engineer subunits with obstacle clearing means in order to negotiate obstacles and areas of destruction on the approaches to water obstacles will assist tank groupings in quickly approaching them. Unfortunately, in exercises the decision to utilize helicopters for this purpose, which for some reason is considered a passive task for them, is often not approved. On the other hand, at times the totally unjustified setting down of landing forces by helicopters on the opposite shore in areas which were subjected to nuclear strikes and where the tasks of these landing forces certainly were not always active, has become almost commonplace.

Helicopters can also be widely utilized for the carrying out of a whole series of other important military-engineer operations. Let us mention that the helicopter is not only a transport means, but also an ideal hoisting means, in which the engineer troops are very interested. Using helicopters, one- and two-span bridges can be assembled in a very short time across small obstacles on the approach routes to the main water obstacles. Thus, the MI-1 helicopter is capable of airlifting structural components for bridges weighing up to 1,150 kilograms at speeds of up to 100 kilometers per hour and erecting them at the obstacle.

In connection with this, the demand for the development of basic means of engineer equipment, primarily crossing means, which could be transported by air, is fully justified. They should have higher technical specifications than the existing models.

In relation to the organization of engineer reconnaissance, it should be emphasized above all that the engineer reconnaissance subunits in the divisions must be prepared to find axes for the laying of routes to the water obstacle, as well as to reconnoiter places for tank crossings along the bottom, and for amphibious, ferry, and bridge crossings, and to detect obstacles within the water obstacle. As the experience of a series of exercises shows, engineer reconnaissance subunits acting jointly with regimental reconnaissance 20 to 25 kilometers in front of the forward detachments were able to reconnoiter and mark approach routes and places for crossings, as well as sectors on the shore and in the water which had been mined, by the time the forward detachments approached the water obstacle.

In all circumstances, before a decision can be made to negotiate water obstacles, data about the water obstacles gathered from maps and military-geographical descriptions, and obtained by agent reconnaissance and from other sources, will have to be refined on the basis of an interpretation of aerial photographs of the sectors of the water obstacles in the offensive zone of army (front) troops. Using aerial photographs it is now possible to determine: the width (with an accuracy of plus or minus four meters) and the depth of water obstacles, the speed of the current, the presence of obstacles in the water and on the shores, the steepness of descents and ascents (with accuracy within one or two degrees), the nature of the bottom, the condition of the approaches to the water obstacle and the exits onto the opposite shore, and the height of the banks (with an accuracy of plus or minus a half meter).

In addition to this, the methods for obtaining aerial photographs of objects in the water obstacle and on the approaches to it must be improved by using television systems installed on helicopters and aircraft. Technically, it is already possible to transmit an image of the terrain from an altitude of ten kilometers and for a distance of 250 to 300 kilometers, and at the reception point the objects in which we are interested (bridges, approaches to the water obstacle, hydraulic engineering works, and others) can be photographed from the television screen.

For the conduct of engineer reconnaissance it is very important to develop technical means which would enable the initial data necessary to immediately organize a troop crossing of a water obstacle to be determined in a most rapid manner. It has become necessary to equip engineer reconnaissance subunits with special vehicles having a cross-country capability in order for these subunits to rapidly and directly reconnoiter water obstacles, especially the contour and quality of the bottom, and the approaches to them. Such vehicles should ensure the selection and marking of deep fords and routes for the negotiation of water obstacles along the bottom by tanks. It is possible that one of the vehicles will swim at various depths and move along the bottom of the water obstacle to gather the necessary data.

The increased importance of seizing bridge crossings in the course of a high-speed offensive brings up the need to equip engineer reconnaissance subunits with improved instruments enabling the mining of bridges to be detected, and with means for the removal of mixed minefields which have been detected.

While approaching a water obstacle the troops should be dispersed in order to decrease losses from enemy nuclear strikes, since the rate of the troop crossing in a number of cases might be less than their rate of march. In connection with this, operational camouflage acquires an important role: the basic measures of this camouflage, when preparing for an offensive with the negotiation of water obstacles, must be worked out in peacetime. These measures should have a dynamic nature corresponding to the rapid actions of the troops when negotiating a water obstacle. We should note that while we have enormous experience in displaying dummy stationary targets, the simulation of moving targets (marches, crossings, mobile operations) still requires a large number of forces and means. This problem urgently needs to be worked out further.

In order to reduce losses from nuclear weapons and to negotiate water obstacles at high speeds and in a well organized manner, the provost and traffic control service organized by the combined-arms staffs on the approaches to the water obstacle and at the crossings will have enormous importance. It is advisable to assign engineer troops to perform the provost and traffic control service only at the crossings themselves and on the closest approaches to them. In each specific case, depending on the contours of the terrain on the close approaches to the water obstacle and on the nature of the floodplain, a boundary line between the posts of the provost and traffic control service of the engineer troops and those of the combined-arms provost and traffic control service should be set up in advance.

As the experience of exercises shows, it is advisable to organize the provost and traffic control service at the crossings after the forward detachments have come to the water obstacle. Under these conditions, as forward subunits cross, the commandants of the crossings will be able to have their own assistants, provost and traffic control posts and rescue teams on the opposite shore. Officers and engineer subunits assigned to perform provost and traffic control service at the crossings will be able to fulfil their duties in a timely manner only if they move with the leading battalions of the forward detachments.

From all that has been said, this conclusion can be drawn: for the engineer support of high rates of advance including the negotiation of water obstacles, it is necessary to equip the engineer troops with improved means for the reconnaissance of water obstacles, with modern water crossing means, and with means for the erection of submerged bridges.

At the present time, the most complex problem in organizing engineer support for the negotiation of water obstacles very likely is not so much to immediately move the troops across, as to ensure their rapid and organized approach to the water obstacle along a broad front on separate axes, and the continuous development of the offensive on the opposite shore. In our opinion, this is linked to the slight lag in the development of the road-building vehicles and bridge-building means in service with the engineer troops, as well as to the low cross-country capability of organic combat and transport vehicles. However, it would be incorrect to attribute all the shortcomings to equipment alone. Further improvement in the organization of the utilization of the existing road network, its restoration, development and maintenance, and control of troop movement along it, will affect the solution of this problem considerably. The development of a new type of operational support, that is, road support, apparently would also eliminate such shortcomings.

In our opinion, such are the urgent problems of engineer support for the negotiation of water obstacles which, in the interests of such support, require solution as quickly as possible.

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