doesn't jibe, that things don't seem to be accurate. There are five possibilities.

- **Your pace count is wrong.** Double check it.
- **Your azimuth is wrong.** Double check it, both on the ground and on the map. And have someone else check your work.
- **The points weren't accurately placed.** You'll have to recheck *everything*.
- **Your map is wrong.** It may be, but you'll have to be very sure that it is before you discard it or alter it based on this possibility.
- **You have done your math incorrectly.** Check the figures again and make sure you fed the calculator the right numbers.

Once you have checked these five possibilities, you should be able to eliminate any errors on your course.

In sum, setting up and checking a good map course requires some time and effort, but they are hours well spent, and they will pay high dividends.

If you are going to train your soldiers to the same high standards you hold for yourself, you must make every effort to see that they have the tools they need—precisely accurate courses and good instruction.

Then the errors they make will be their own. You can work with them, find what they are doing wrong, and correct them. But the successes they achieve, the confidence they build, the skills they develop will be their own, unsullied by faulty tools. And they deserve no less. They're *your* soldiers.

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Hasty River Crossings

LIEUTENANT COLONEL STEPHEN E. RUNALS

Since 1982, the AirLand Battle concept has described the U.S. Army's doctrinal approach to generating and focusing combat power for operational and tactical planning and for field operations. Resting as it does on the four basic tenets of initiative, agility, depth, and synchronization, the concept offers the Army an opportunity to fight outnumbered and win. While all four of these tenets are essential to battlefield success, a quick look at just one aspect of Soviet tactical doctrine, river crossing operations, reveals that the U.S. Army is not alone in the importance it places on initiative.

Both the Soviet Union and the U.S. believe that the fluid nature of future warfare will require tactical forces that are organized, trained, and equipped to move rapidly over extended distances and strike at the enemy's vulnerabilities. However, Soviet studies have found that on a European battlefield, combat forces can expect to encounter water obstacles up to 100 meters wide every 35 to 60 kilometers, between 100 and 300 meters wide every 100 to 150 kilometers, and greater than 300 meters wide every 250 to 300 kilometers. To be successful in maintaining the initiative and the tempo of operations that is required on such a battlefield, therefore, U.S. and Soviet forces must be able to breach these numerous water obstacles quickly. The assault or hasty river crossing is one solution both armies have identified to meet this requirement.

HIGH TEMPO

The Soviets view a tactical river crossing as either an assault crossing from the march or a deliberate crossing. In keepng with their view that success on the battlefield can be achieved only if they maintain a high tempo of operations, Soviet doctrine, in reality, places little emphasis on the deliberate crossing. Soviet tactical literature insists that even wide rivers defended by well-organized forces can be assaulted and crossed from the march. Assault crossings are characterized by forces moving toward a river on a broad front in normal march formation while maintaining a high rate of advance. The doctrine therefore emphasizes prior planning and the use of specially organized forward detachments.

A decision to cross a water barrier from the march is made as early as possible to allow enough time for organizing and positioning forces and equipment for the anticipated crossing. The Soviets use their available intelligence information to identify only those possible crossing sites that best conform to their operational requirements. Naturally, potential crossing sites are selected in areas where the banks and approach routes require a minimum of engineer preparation. Once those possible sites have been identified, engineer reconnaissance patrols are sent out to identify the actual crossing locations. Forward detachments, operating two to three hours ahead of the main body, are then directed to advance to the selected crossing sites, bypassing enemy forces as

and direction between any *two* points must be along the hypotenuse of a right triangle (Figure 2).

There is a simple mathematical formula for determining the length (distance) of the hypotenuse of a right triangle: the square of the hypotenuse is equal to the sums of the squares of the other two sides. If there were a simple, easy way to determine the distance represented by those two sides, we might have something here—and there is.

Look at Figure 3. Since we read maps right and up, an eight-digit coordinate is measured from a "major" gridline. If it's four digits, we can measure the distance to the nearest thousand meters; if it's six, to the nearest hundred meters; and, if it's eight, to the nearest ten meters. Point A on Figure 3 is at 82412115 and Point B is at 84712115. B is on the same plane as A, due east, 90 degrees. What is the distance between the two?

We can find out by subtracting the grid coordinates. Since this is an east-west measurement, we are interested only in the first four numbers of each coordinate—the "right" part of the "right and up." Subtracting 8241 from 8471, we get 230. Since eight-digit coordinates measure to the nearest 10 meters, add a zero (multiplying by 10) to get the exact distance, in this case 2,300 meters.

The same method works for north-south distances. Point B is still at 84712115. Point C is at 84712265. This time we're interested only in the last four digits—the north-south numbers—2115 and 2265, the "up" of "right and up." Subtract 2115 from 2265; the result is 150. Add a zero and our answer is 1,500 meters.

This will work for any distance, obviously. It doesn't matter which number is the larger for subtraction, but it must be done consistently for north-south or east-west. You can't take the first four digits of one coordinate and the second four of the other and get a useful answer.

We now have the distances for two sides of a right triangle: From Point A to Point B and from Point B to Point C. But what is the distance from C to A?

We determined that the distance from A to B was 2,300 meters and the distance from B to C was 1,500 meters. The distance from C to A (or A to C) is the hypotenuse. Using a pocket calculator, multiply 2300 times itself (2300 x 2300 equals 5290000) and write it down. Now multiply 1500 times itself (1500 x 1500 equals 2250000). We have now squared the lengths of the two sides of the right triangle.

Add the 5290000 you got for the first side to the 2250000 still showing on your calculator, and you should get 7540000. Hit the square root on the keypad, and you should see 2745.906044. This is the hypotenuse; the distance from Point C to Point A is 2745.906044 meters. For practical work, round it to either 2745 or 2750 meters. (Don't let the size of the numbers scare you; it is not that difficult once you understand the principle and have done it once or twice for practice.)

Obviously, this is not a method you can use for every situation. Although it's not difficult, it does take a few moments. You probably couldn't use it on the fly, except as an approximation, and it would be difficult to use in a track bouncing across rugged terrain, or while running an orienteering course.

Its advantage, however, is extreme accuracy. You can use this method when you need to know the precise distance between two points, such as when you're checking your answers on a map test, when you're doing some detailed planning, or when you're setting up your own map course, which is how we began this discussion.

Once you've established the distance between the points on the map course, place your points on the ground. Now walk the course—every point. When the troops argue about a point, you have to be able to tell them honestly, "I have personally walked every point, and I verify that they are all there and that they are where they are supposed to be." And you know they'll argue; you always did, didn't you? That's why, time-consuming as it is, you must walk it yourself.

Suppose, as part of your final check of the map course, you find that the course

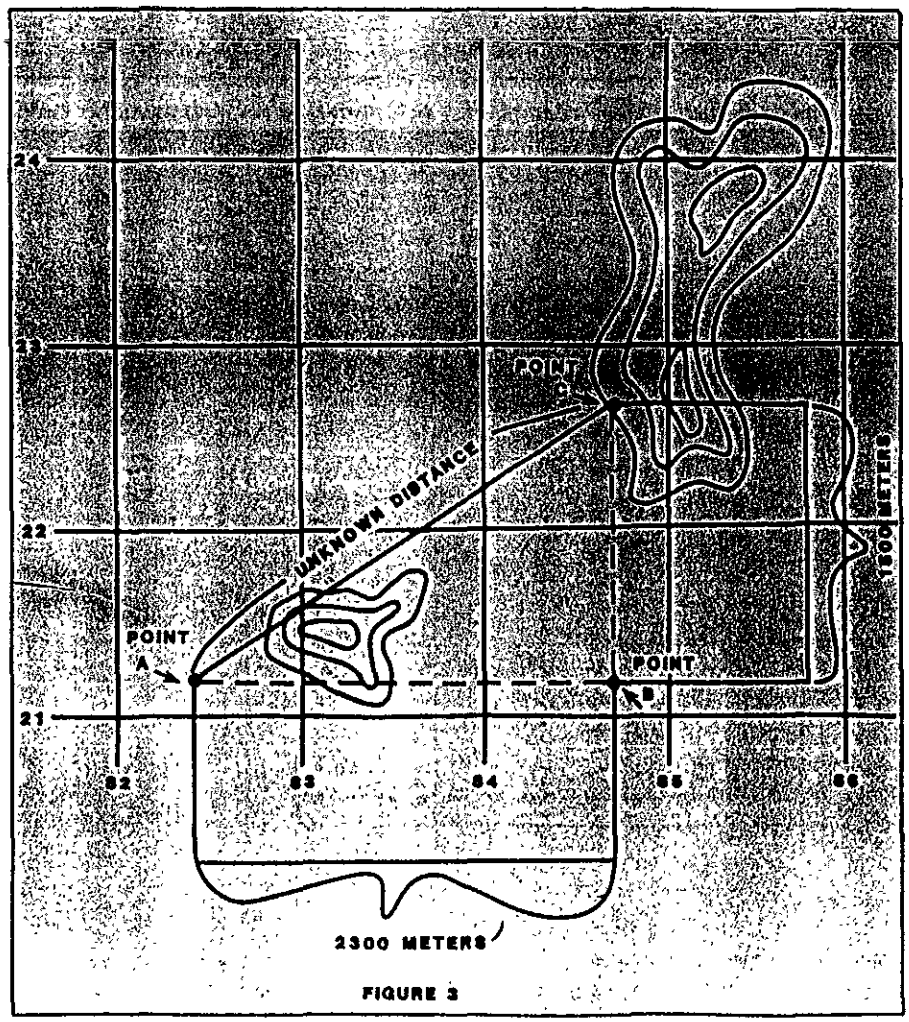
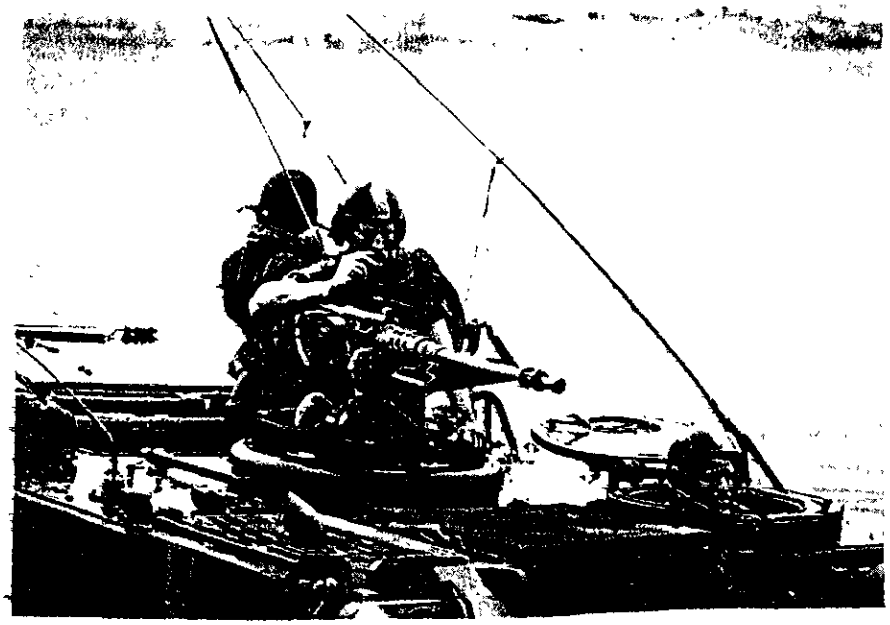


FIGURE 3



U.S. troops during a river-crossing exercise in Korea.

required, to secure near-shore crossing sites and attempt an assault crossing to seize a bridgehead. (These detachments are normally made up of a motorized rifle battalion reinforced with a tank company, an artillery battalion, ferry and tracked amphibians, and such subunits as air defense, antitank, and chemical, ranging from squad to company size.)

To save time during each crossing and to reduce the size of potential targets as the main body moves into position to cross the river, Soviet doctrine emphasizes the need for strong air cover and air defense throughout the entire crossing operation. Additionally, crossings are conducted over a broad front. A typical regiment uses two or three crossing sites on a 10-kilometer front while a division conducts crossings with one, two, or three regiments in the first echelon in a zone 20 to 30 kilometers wide.

The Soviets further maintain speed by attaching division, army, and front-level engineering assets to the already extensive crossing capabilities of the assaulting forces. The expected time for the motorized forward detachment to conduct a crossing varies from 45 minutes to 90 minutes. The combat elements of a forward division are expected to be able to cross a 200-meter obstacle in five to six hours using only their organic engineer equipment. If they are given additional engineer assets, they can save even more time.

Speed, then, is the most important factor in a Soviet or Warsaw Pact officer's solution to operational problems or planning requirements. The Soviets see assault crossings as one key element in their ability to maintain a high tempo of operations, and make every effort to set the terms of battle to retain the initiative and maintain the tempo of operations.

U.S. doctrine also recognizes the need to be able to cross the numerous water obstacles of a European battlefield quickly. But the U.S. solution addresses the problem and its solutions with a different degree of detail and emphasis.

While the Soviets break river crossings down into two types of operations with the primary emphasis on assault crossings from the march, U.S. doctrine identifies two categories of crossings—offensive and retrograde. Offensive operations are further defined as either hasty or deliberate. This doctrine states that hasty crossings are preferred but places its primary written emphasis on the planning, organization, and execution of deliberate crossings and, to a lesser degree, retrograde crossings.

Hasty crossings are described as the crossing of water obstacles using organic, existing, or expedient means. Although "hasty," these operations are preplanned and conducted as a continuation of a tactical maneuver already in progress. Detailed planning is conducted to ensure that fire support and engineer assets will be in position when they are needed to support the crossing.

The forces should be organized to conduct crossings with little or no loss of momentum. To maintain momentum, they are expected to cross an obstacle on a broad front under decentralized control. Whenever possible, crossing sites are to be seized intact and in advance of the leading elements.

Although U.S. doctrine repeats many of the same principles found in the Soviet doctrine for assault crossings, a U.S. hasty river crossing occurs only if the conditions necessary for such a crossing exist when the combat forces arrive at a crossing site. Little emphasis is placed on creating opportunity.

Also absent from U.S. doctrine is a requirement to push engineer assets down to the assaulting forces. U.S. doctrine calls for the use of organic equipment in hasty crossings while the Soviets emphasize pushing assets from all levels down to the units making the assault. These assets include not only engineer equipment but air cover and air assault or airborne forces. Soviet doctrine further emphasizes the need for coordinated air support and air defense throughout the entire crossing. A discussion on the use of these same types of forces is noticeably absent from the limited doctrinal discussion of U.S. hasty river crossings.

Two final points are necessary in any comparison of the U.S. and Soviet doctrinal approaches to hasty river crossings. First, Soviet doctrine assumes that smoke will normally be included as part of

assault crossing support, while U.S. doctrine indicates that smoke may be incorporated as part of the operaton but provides little further guidance or direction for its use.

The second point is more fundamental. Soviet doctrine is designed to take advantage of a high degree of amphibious mobility. All Soviet armored fighting vehicles are amphibious, as are selected artillery and air defense weapons. Soviet medium tanks are capable of crossing water obstacles using snorkels or, unmanned and sealed, of being pulled across underwater. The capability of amphibious operations has been engineered into a high percentage of Soviet equipment and is organic to all Soviet regiments, and this provides a flexibility that is only partially available to U.S. commanders.

If the U.S. Army is to achieve the operational success that its AirLand Battle concept offers, the tenets of that doctrine must become more than just theoretical concepts discussed within our military school system and during officer professional development classes. They must become the underlying principles for tactical employment and must be fully incorporated into all of the doctrinal publications that support it.

A well-thought-out hasty river crossing doctrine will prove essential to both the attacker and the defender on battlefields of the future. Although both Soviet and U.S. doctrine recognize this requirement, only in Soviet tactical doctrine do we find the emphasis and direction necessary to create and maintain the initiative and momentum of attack that is anticipated for success in modern mobile warfare.

Having an effective river crossing doctrine does not in itself guarantee an army the ability to execute that doctrine on the battlefield. But it does provide a sound foundation upon which an army can base the design and procurement of its warfighting equipment and the tactical training necessary to meet the requirements of that battlefield. The success of the Soviet trained and equipped Egyptian forces on the Suez in October 1973 provides adequate evidence that sound Soviet doctrine is matched with an equally effective ability to carry it out.

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Improved Mortar Vehicle

SERGEANT GILBERT F. WARNER

The fast, violent combat expected on today's battlefield requires that mortars be able to keep up with the units they are supporting. And mortar vehicles must be able to fire rapidly under all weather conditions, at any time of day, and still survive.

The present version of the M106 mortar vehicle (the M106A2) has several shortcomings in these areas: It is slow, both in moving cross country and in setting up for firing; its accuracy is severely affected by bad weather, bad visibility, and simple darkness; and it could stand some improvements in survivability. Although budget constraints may make an entirely new family of vehicles impossible, it may be possible to upgrade the M106A2 at a fairly low cost per unit.

At the present time, the vehicle's raw speed (that is, acceleration from 0 to 30 miles per hour), its top end speed, and the like can be changed only if the power-to-weight ratio is improved or if the power pack is changed. This would be expensive. But there are far less expensive ways of upgrading the vehicle.

TIME

Presently, for example, it takes two minutes to lay the base gun and 30 seconds to lay each additional gun in the section. Breaking the guns down for travel requires another 30 seconds, including the recovery of the aiming poles. Thus, for a section to stop, set up, and break down, not counting any fire missions, takes about three-and-one-half minutes—the same time it takes the section to travel a little over one kilometer at the present cross-country speed of 20 kilometers per hour.

If the vehicle could stop, shoot, and move out in 15 to 30 seconds, however, its cross country speed would be doubled, assuming it made one-kilometer bounds. A two-kilometer move of the section would take six-and-one-half minutes instead of the present 10, and that would be a fairly substantial increase in speed. The time lost in transit could be made up by the reduced set-up and break-down time.

As for accuracy, it can be no better than the accuracy of locating the target, correcting for weather, and determining the section's location. There is not much a mortar section can do about the first two items, except adjust, but it can improve upon the third.