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.

Lieutenant Colonel Stephen E. Runals commands the 2d Battalion, 28th Infantry at Fort Jackson. He was previously a brigade S-3 and division G-3 plans officer in the 101st Airborne Division and a battalion S-3 and a brigade operations officer in the 193d Infantry Brigade. He is a 1971 ROTC graduate of Norwich University.

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.

A highly trained section leader who is skilled in map reading must make sure the location is correct to an eight-digit grid. Few things are as discouraging to a mortar gunner as watching a pair of platoon sergeants argue about where in a particular area they are. Too often, a mortar location is known to within only a few hundred meters.

Darkness presents a whole range of problems. To adjust the range on a 4.2-inch mortar round, for instance, the propellant charges must be cut properly, and this is difficult to do in the dark. An ammunition bearer who is trying to count, by touch, charge 3s may get charge 5s instead. Darkness also slows down the preparation of rounds. (Trying to keep the rounds dry in rain or snow further compounds the problem.)

Light discipline at night is also a real problem. Gun positions are often visible because of the flashlights the ammunition bearers use in trying to set fuses and charges. In addition, there are lights on the aiming posts, the aiming circle, and the M-53 sight.

Other items that affect survivability are the lack of a fire suppression system, the location of the fuel tank, and the stowage of ammunition. A hit on the left rear of the vehicle can burst the tank and send burning fuel over the interior of the track. In addition, most of the 88 rounds of ammunition are in open horizontal racks, and a good shock can knock them out.

Because the amount of vertical stowage is limited, the 88-round basic load may contain no more than 25 white phosphorus rounds. Assuming two adjusting rounds and a three-round fire for effect, this allows the equivalent of about 17 fire missions. More realistically, 29 three-round immediate suppression missions can be carried out, that being the most common mission called for in armor and cavalry operations. Any increase in this number would help.

I believe the inside of the M106 could be improved upon to solve some of these problems. The present layout of the vehicle is shown in Figure 1, and my proposed arrangement is shown in Figure 2.

The first change should be to remove the internal fuel tank and add external tanks. External fuel tanks, to be mounted on the rear fenders, are currently in the technical manual. The removal of the fuel from the inside of the vehicle would reduce the fire hazard and provide room for more ammunition and equipment.

Then, the present ammunition racks, the radios, and the batteries should be removed. (At this point, a spall liner could be installed.) A flexible kevlar curtain with a baffled pass port should be installed to divide the mortar area from the center of the vehicle. The result would be a light, tight area for the ammunition handler so he can see what he is doing. Bins should be provided for waste and extra charges.

Vertical ammunition racks with doors and a fire detection-suppression system should be installed where the fuel tank,

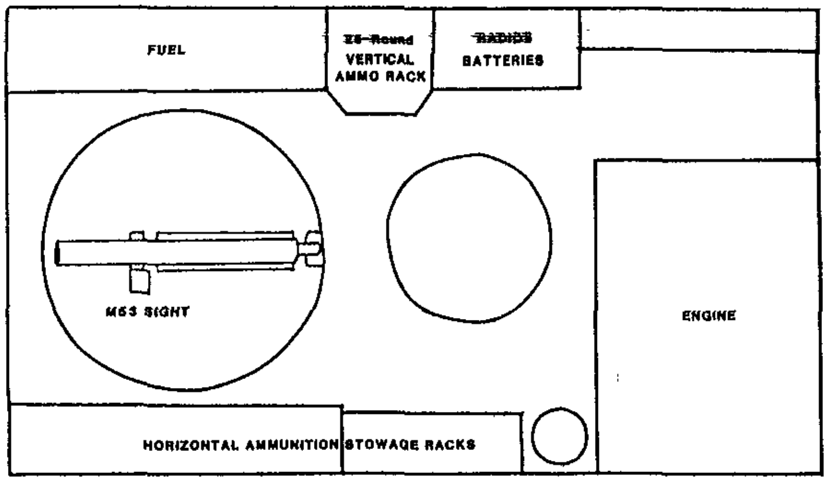

Figure 1. Present layout of mortar vehicle.

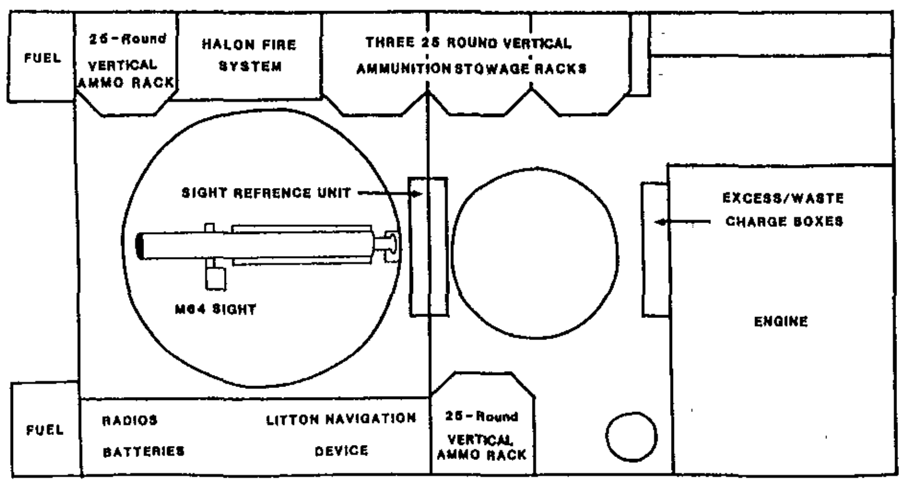

Figure 2. Proposed rearrangement of vehicle.

the batteries, and the radios were. Racks should also be installed on the righthand side forward of the mortar compartment. Total stowage would then be 125 rounds, or enough for about 41 immediate suppression missions.

To further reduce the light coming from the vehicle, the M-64 self-illuminated sight should be substituted for the present M-53. Aiming posts should be replaced by a hooded reference bar fixed just ahead of the mortar compartment. This reference bar would save the time normally used emplacing and recovering aiming posts, and it would remove an external light source.

More active measures should also be used to ensure survivability. First, the current M-2 .50 caliber heavy machinegun does not have enough penetration against armored vehicles; its rate of fire is too low against infantry; and the gun mounting suffers from too much vibration when the gun is fired.

The present cupola should be replaced by the M60/Dragon/90mm recoilless rifle cupola from the old M113 scout vehicle. The M60 would be better to use against infantry, and more rounds could be carried. The Dragon or the 90mm would be better against light armor than the old M-2, and the 90mm with beehive would be great against an RPG gunner. In addition, pintle mounts for the M249 machinegun (squad automatic weapon) should be welded or bolted on.

The largest and most important of the proposed changes would be the least noticeable from outside the vehicle. The batteries and radios removed along with the ammunition rack should be put in the right rear corner, next to the gunner. Intercom boxes could then be added so that all of the crewmen—not just the track commander and the driver—could communicate.

Co-located with the electronics would be a new box containing a device (made by Litton) that is capable of tracking the location of the vehicle to an eight-digit grid with an accuracy of plus or minus .05 percent of the distance traveled. With this device, the heading of the mortar carrier could be accurately displayed to within one degree or 17.7 mils. It would provide displays for both the driver and the track commander.

An important feature of the tracker is that if a second location is entered into it, the direction and distance to that second point are also shown. Thus, the track is pivoted to the back azimuth, the gun is centered and leveled, the charge and drift are taken from the firing table, and the gun is up and a round on the way within seconds after the vehicle stops. At the maximum range of 6,600 meters, the total error would be less than 120 meters. Set-up and break-down time would be reduced, which would give the section a faster effective speed.

The vehicle could then operate by itself; it would not require a fire direction center for all missions. The section could then be dispersed over a wider area, with a lower signature and greater flexibility. And because the frequency of rearming would be reduced, logistics would be easier.

The total cost should be much less than that for a totally new mortar vehicle. In fact, many of the parts for the proposed changes are in the technical manual, and all of them are "off the shelf." The price of the Litton device was once quoted as under $15,000. Adding up the costs of the rest from the M113 family, the total price of the modifications should be well under $40,000 per vehicle. Much of the work could be done by a conversion team visiting the units.

I believe that this would be a cost effective way to upgrade the M106 mortar vehicle and thereby prolong its useful life.

Sergeant Gilbert F. Warner is assigned to the 329th Transportation Company at Fort Eustis, Virginia. He has served as computer or chief computer in infantry, armor, and cavalry battalions.