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STUDY PROJECT

SHOULD WE FEAR MINE WARFARE?

BY

COLONEL GERARD GAMBIEZ

30 MARCH 1989

U.S. ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013-5050

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Mines are weapons. Thanks to the improvements allowed by electronics they become more and more efficient and cost effective. On land as well as at sea, they would be widely used at theater level by all belligerents in all types of conflicts. Unfortunately improvements in mine countermeasures are more difficult to realize and to use on the field. The nations of the free world should increase their efforts do in the domain of those countermeasure systems, or they risk to be the first victims of the

increasing advance taken by mines and mine delivery systems. The problem is as difficult as urgent.

USAWC MILITARY STUDIES PROGRAM PAPER

SHOULD WE FEAR MINE WARFARE?

AN INDIVIDUAL STUDY PROJECT

by

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Keywords: Land mines, Underwater Mines. (GC/AW)

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SHOULD WE FEAR MINE WARFARE?

CHAPTER I

INTRODUCTION

Mines are weapons. Every one that has ever met any on a land battlefield or at sea, knows that they are terribly effective. Sometimes they cause casualties, often they destroy equipment, most of the time, they cause an important waste of time, always they have a powerful psychological impact. They are an insidious threat.

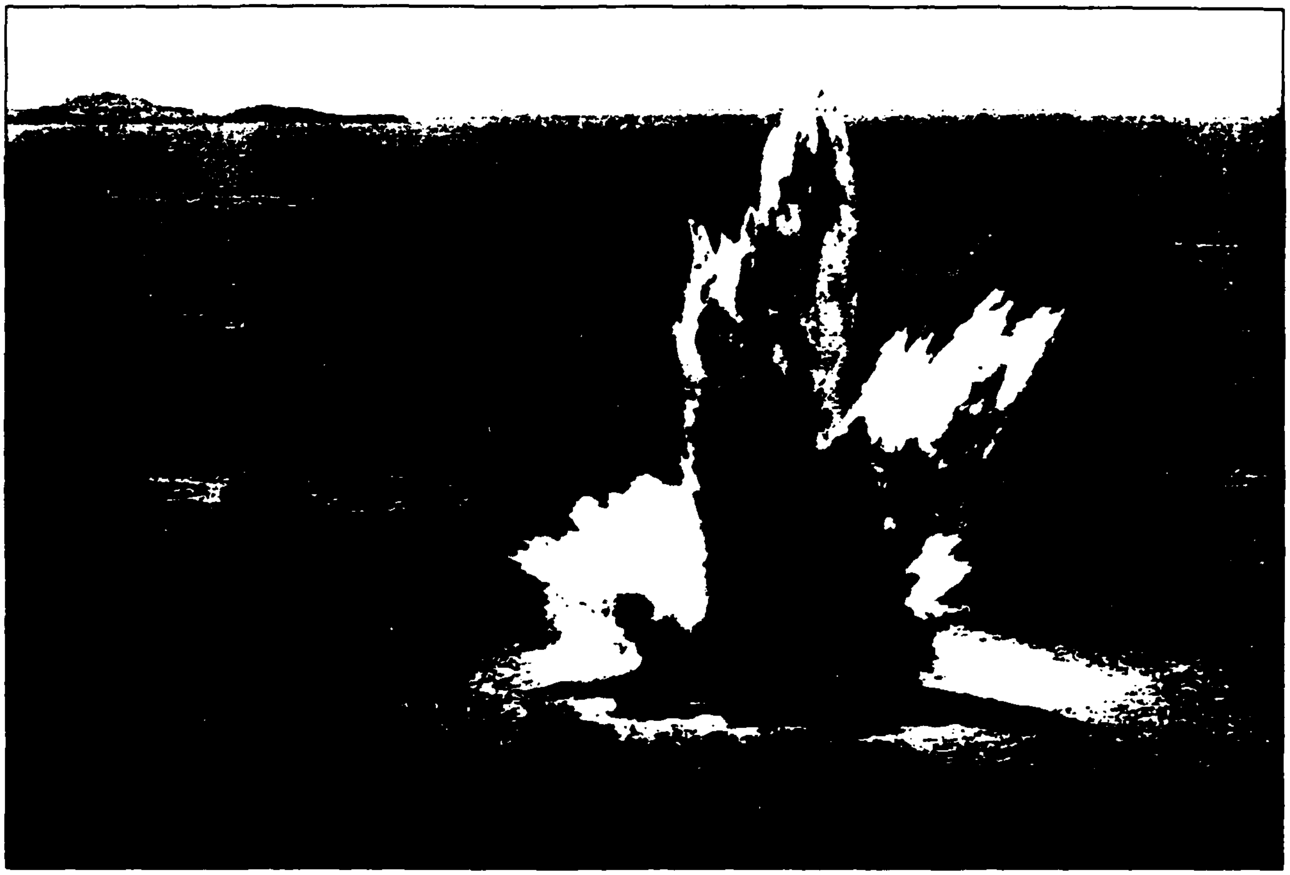
The threat should be more deeply considered, for mines are in the inventories of all national forces, ready for any type of conflict, wherever it occurs; all the more that something new happened a few years ago in the realm of mines. Electronics was introduced in the devices, and thanks to it, mines which have always been awfully lethal, have become devilishly more efficient, and also much more cost-effective (both in money and time), when they are in balance with the countermeasures which can be opposed to them.

All great countries conduct research and experiments with mines and mine-delivery systems. They conceive, experiment and field devices that are every day more efficient. The same countries also search and experiment countermeasures, but none has, up to now, found the safe sure quick and cheap method. The balance more and more falls by the side of mining systems.

This represents an important threat for each party, but most of all for the nations of the free world.

Land mines are not likely to be used, mainly in Europe, except if a major conflict takes place; sea mines on the contrary, can be laid very quickly, may be laid covertly, on sea lines of communications or in the approaches of ports and military harbors by "unfriendly" nations or organizations, even if no conflict is officially declared. And the nations of the free world have not the means to cope with that threat.

It is urgent to do something in the domain of mine countermeasure systems, mainly at sea.



A simple, inexpensive form of warfare that terrifies anyone who might cross the wrong path.

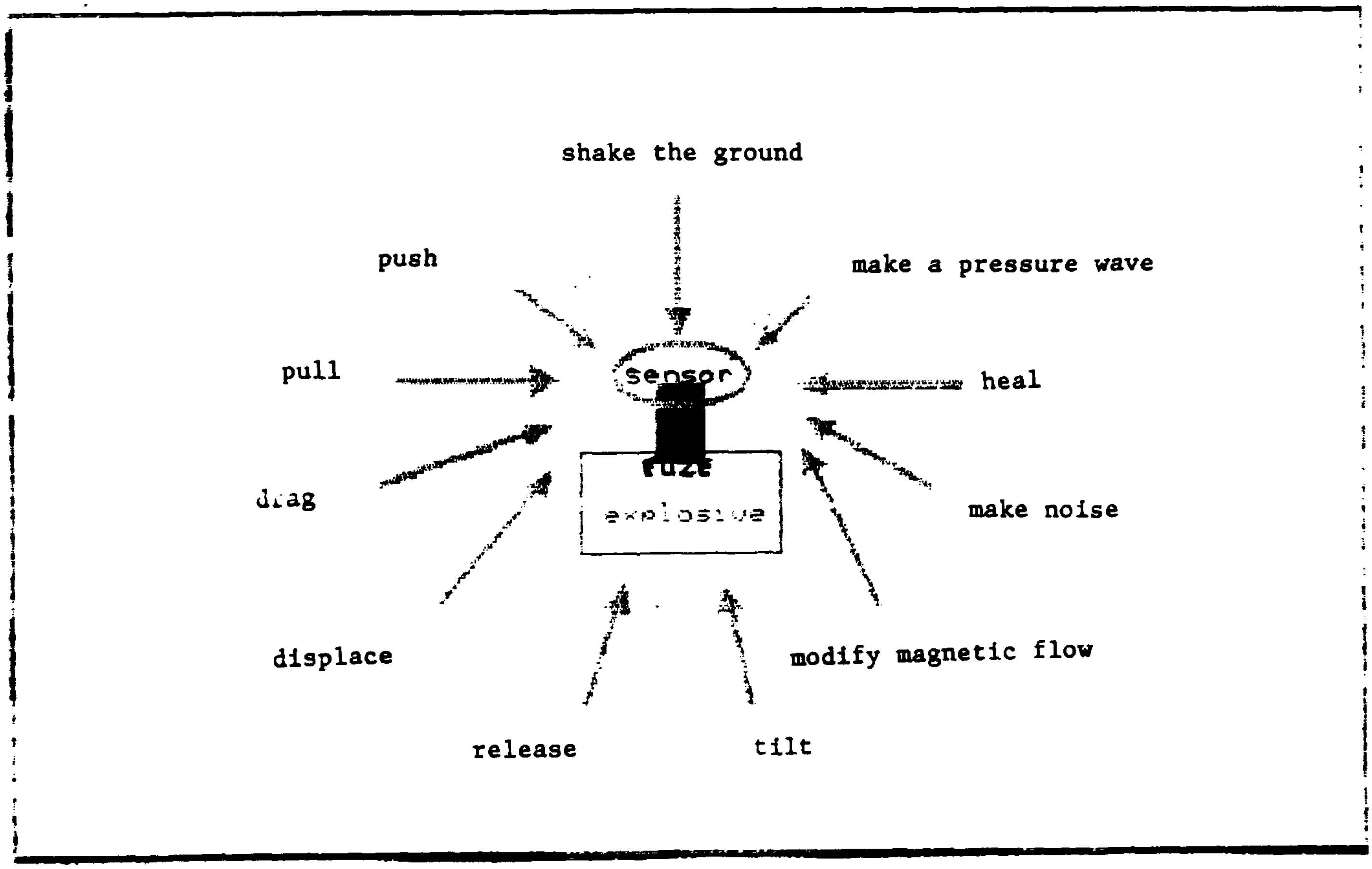
By Harry Manning

CHAPTER II

MINE DELIVERY SYSTEMS VERSUS COUNTERMEASURES

NATURE OF MINES. RECENT IMPROVEMENTS

A mine is an explosive device ignited by its victim. It is always composed of a destructive charge and of a system that enables it to explode when an (unvoluntary) action of the target (man or machine) modifies its structure or its environment.



Mines are efficient and thus widely used during wars. Let us not go back too far in history, when mines were only used to complement other weapons and tactics, but let us remember that they were extensively used for the first time at theater level during the Second World War. Thousands were laid by the

Soviets during the battle of Kursk, and greatly contributed to the failure of the Wehrmacht, thousands were placed by the Germans under Rommel as by the Allies under the command of Montgomery, in Northern Africa. In many cases they allowed belligerents to hold positions or delay enemy action much more than they both expected. Tens of thousands were hidden by the Germans all along the Atlantic Wall and on the Siegfried line. Each time they set big problems to combat troops and engineers.

At that time, explosives were only one-third as powerful as they are now, and the systems used for detonating them necessitated a mechanical action of the target: push, pull, touch, lift, drag. Mines were local action devices only, but they were efficient enough for the type of operations of that time. The mine delivery systems were also very simple. Most of the time, they only demanded most of all the intervention of many men, mainly on land where they were laid manually. No machine was used. But at that time, manpower was not so scarce as in modern armies, and operations were conducted at a speed much different from that now expected; time was available.[1] At sea, many operations were led to scatter mines along lines of communication and harbor entrances (as, for instance during the campaign of NORWAY).

Countermeasures were also very simple. The bayonet was about the only tool used by the land soldiers; visual tracking, and sweeping of the bottom of the sea were the only methods affordable for the sailors when they searched for mines. It was slow, unsafe and often inefficient.

▲ Manual clearing using detector and prodder: sure but slow.

During the war many improvements were made. Antipersonnel mines comprised area action mines; antitank mines became undetectable; anti-release systems were added. At sea, magnetic and acoustic sensors were built and implemented. And the losses and casualties grew dramatically. (For instance, armor casualties due to mines reached 25 percent of the total during the war on the European theater.)

Historical Mine Effectiveness

Allied Tank Losses to Mines as a Percentage of Losses to all Enemy Action

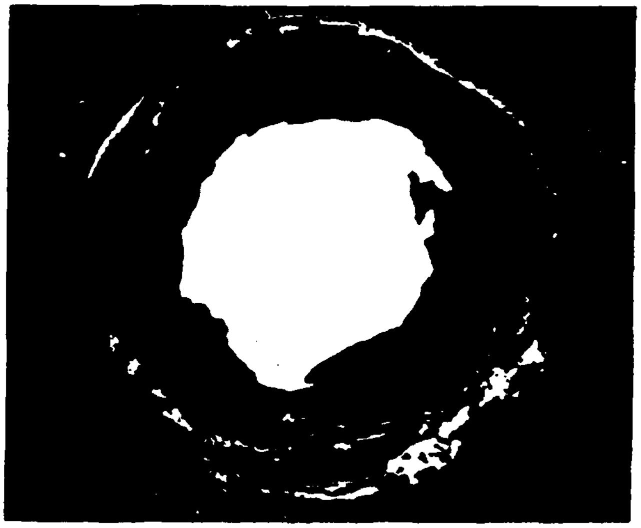
THEATER		PERCENT
North Africa	1942-1943	18%
Western Europe	1944-1954	23%
Italy	1943-1945	28%
Pacific	1944-1945	34%
Korea	1950-1951	56%
Vietnam	1967-1969	69%

Armor Casualties in World War II by Cause

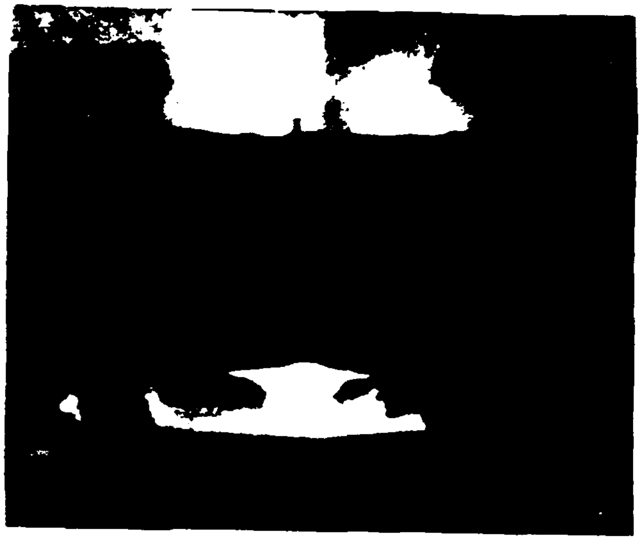
THEATER	PERCENT
Artillery and antitank weapons	58.8%
Mines	23.7%
Bazookas	17.0%
Miscellaneous	.5%
	100.0%

During World War II, land mines emplaced by the German Afrika Korps were highly effective, restricting British maneuverability and forcing units into kill zones. British attacks were repeatedly halted. Although outnumbered by the British Eighth Army throughout the campaign, the Germans were able to use mines as a combat multiplier to reduce the force ratio. Their mines were directly responsible for 18 percent of Allied tank losses in North Africa.

But it was -ot enough, and the main improvements, were done during the fifties only. Land mines could be made completely undetectable thanks to the plastics; their effects on tanks were tremendously increased through utilization of shaped charges (hollow and flat charges which can completely destroy a tank, not only stop it) their effects on men (physical and psychological) grew in the same way (directed effect antipersonnel mines more efficient than the former "jumping mines").



SMI 22/7C off-route anti-tank mine can penetrate 80 mm of steel at 50-metre range



Then came the electronic era. It was a new era for mines. Electronics which allows us to listen to the world, to transmit information at the speed of light, to calculate without error and to robotize industrial tools, also allows us to build mine sensors able to react within a distance or to a specific target. Sensors are sensitive to heat, or to sound, or to magnetic disturbance, to a pressure wave or to any other type of "signature," they can be remotely activated or deactivated. There seems to be no limit to the ingenuity of military engineers; so that mines now seem "intelligent."

Horizontal Action Anti-tank Mine Mle F1

DESCRIPTION
The Horizontal Action Anti-tank Mine (Mine Antichar à Action Horizontale: MIACAH F1) consists of a cylindrical drum pivot mounted on a circular frame. The drum, which has a carrying handle, contains a shaped charge which can penetrate 50 mm of armour at a range of 80 metres with an angle of impact of 0 degrees or at a range of 40 metres with a 30-degree angle of impact and can penetrate 70 mm of armour at a range of 40 metres, with an angle of impact of 0 degrees.

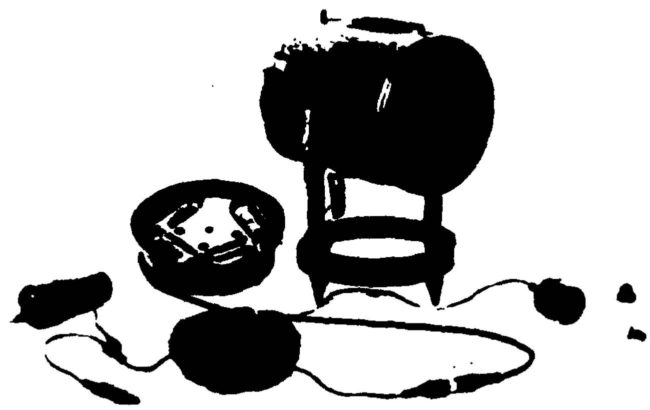
The mine is normally anchored to the ground, camouflaged and pointed across the tank's expected route. A wire is stretched out in line with the mine and when a tracked vehicle crosses this wire, the mine operates and the shaped charge penetrates the side armour of the tank.

One training model of the mine is available. It is called the MIACAH d'Exercice Mle F1 (MIACAH X F1) and has the shaped charge replaced by an Alsetex MMI 30699 *marking cartridge* which has an effective range of 50 metres. This is positioned in a similar manner to the real mine and when the tracked vehicle crosses the wire the

Horizontal Action Anti-tank Mine F1 with infra-red radiation sensor IRMAH Mle F1

DESCRIPTION
Now in production for the French Army this is a standard action anti-tank mine Mle F1 (MIACAH F1) fitted with an infra-red and acoustic sensor type IRMAH Mle F1 to improve the mine's performance in difficult terrain such as marsh, rocky ground and snow.

The sensor is attached to the main body of the mine and utilises the infra-red and acoustic emissions from the target vehicle to trigger the mine. It is capable of detecting targets up to 80 metres away when travelling at speeds of between 5 and 60 km per hour. A built-in programmer enables the mine to engage either the first, second or third target detected. It also has built-in immunity to counterm[illegible]sures.

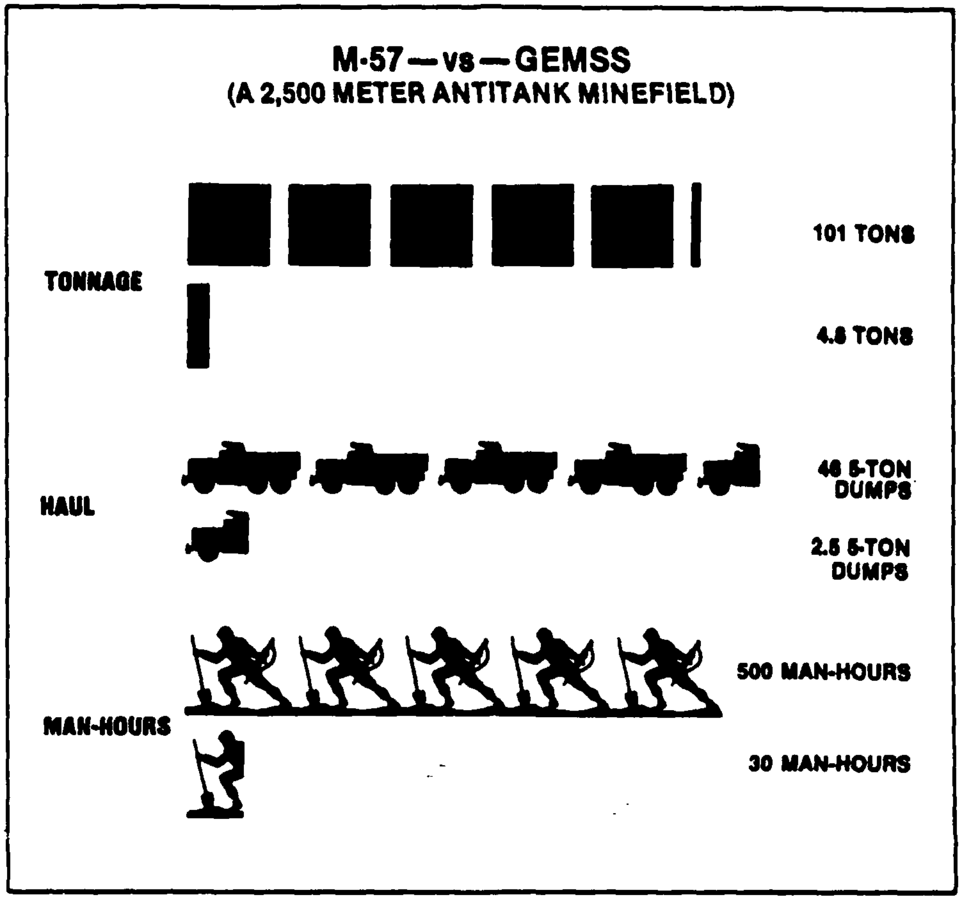


MIACAH F1 anti-tank mine showing the electronic fuse and control unit to the left rear

And electronic devices become every day less expensive. Thus, sensors can become as cheap as calculators, quartz clocks and radio sets (the prices of which have been divided by more than 50 in less than ten years).

Along with the progress made on mines, delivery systems were built and improved. The number of man-hours necessary to lay a minefield has been divided by 100, thanks to the adoption of machines able to bury mines automatically at a chosen pace, or to scatter them on the terrain. They also count them and set the sensors on.[2]

Even better, mines can also be delivered only when necessary, by artillery shells, by land mine dispensers, by helicopters or aircraft.[3] This facilitates the problem of logistics which seriously impacted on the use of



mines at theater level, since tons of ammunition, hundreds of men and long delays were required for laying minefields, which often proved useless. It made it necessary to seed this type of obstacle long before the arrival of he enemy, and sometimes, all these efforts were in vain, because of the effective route of that enemy.

Now, the efficiency of mines allows reducing by at least ten times the number of assets necessary to obtain a given effect. In addition to this, the efficiency of delivery systems allows mines not to be laid far in advance, thereby conserving this valuable ammunition. The planners of modern battlefields can rely on mines. They give them the possibility to secure or forbid vast zones of terrain, obliging the enemy either to modify his axes of effort or to slow down dramatically the rhythm of his progression, without even showing their intentions. This would be the case in Europe (as it has been in Africa during the attacks launched by Libya against Chad) or anywhere else.[4]

Because countermeasures do not improve at the same pace. Searching and eliminating mines on the battlefield remain very hazardous and time consuming

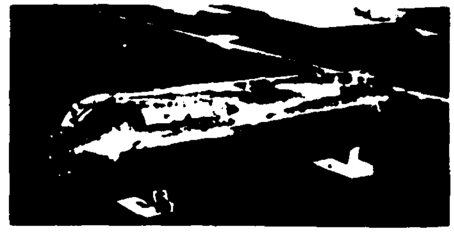
operations. Despite modern systems (aerial photos, electronic devices, gravity detectors, specially trained dogs, plow and roller tanks, rockets, fuel air explosives) no convenient and easy way has been found to realize quickly a breakthrough in a mined area. It remains difficult, dangerous and slow to search for land mines, and noisy, time consuming and ponderous to destroy or clear them. (A team of engineers can completely clear a path in a minefield but needs three to four hours for every hundred yards. The job can be done more quickly by special devices mounted on tanks, engineer equipment or trucks, but it is not so safe since only 90 to 95 percent of the mines are destroyed or neutralized, and it necessitates rare specialized equipment and/or great amounts of special ammunition.)[5]

Improvements do not appear as spectacular in sea warfare, but actually they have been, for the capabilities of sea mines have been enhanced in the same manner, thanks always to electronics. The sensors now mounted on modern

3826.441
THOMSON SINTRA SEA MINES
Thomson Sintra is responsible for the production of a variety of sea mines, both war types and for training purposes. The current operational models are as follows.

TSM 3510 (MCC 23)
This is an operational seabed mine designed to be deployed from submarines, and its shape and dimensions are appropriate to its discharge from submarine torpedo tubes (see *illustration*). Full details of the type of operation employed have not been revealed, but the TSM 3510 probably is of the multiple sensor variety relying upon magnetic, pressure, and acoustic sensors for detection of the target vessel. The sensitivity can be adjusted to suit the depth of the mine and the type of ship(s) intended as targets. The mine is maintained in a passive condition during storage by a locking bar, and is *armed prior to insertion into the torpedo tube by the* withdrawal of two safety pins.
CHARACTERISTICS
Length: 2368 mm
Diameter: 530 mm
Weight: 850 kg (loaded)

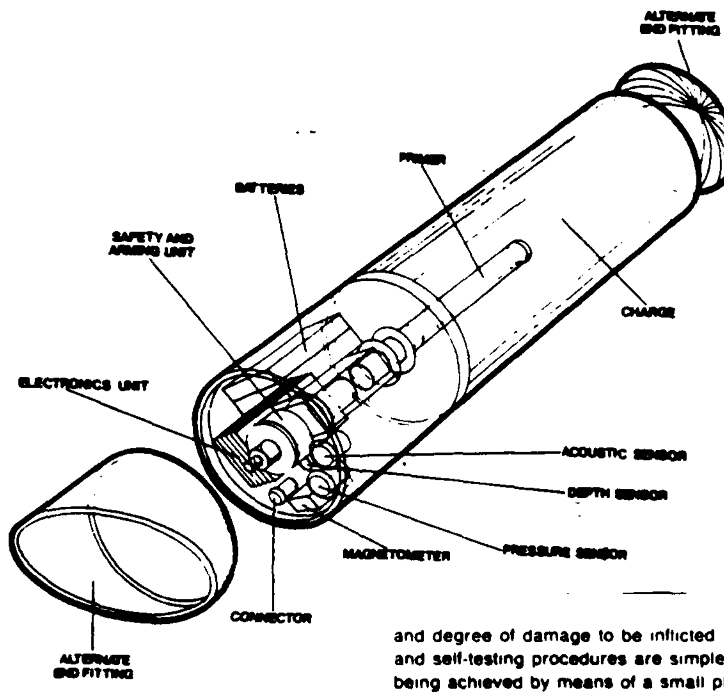
TSM 3530 (MCT 15)
This mine is a seabed defensive mine for deployment from surface ships. It is launched from rails and settles on *the bottom after a parachute-retarded* descent. The TSM 3530 is armed by clockwork activated time delay, the elapsed time between sowing and arming being preset.
CHARACTERISTICS
Length: 1100 mm
Diameter: 1200 mm
Weight: 1500 kg (loaded)


TSM 3510 (MCC 23) submarine-launched sea mine

STATUS
In service with the French and other navies.
CONTRACTOR
Thomson Sintra Activities Sous-Marins, Route de Sainte Anne de Portzic, 29601 Brest Cedex, France.

4482.441
SEA URCHIN MINE
Sea Urchin is a family of intelligent mines, which can be programmed to detonate on a range of influence characteristics, including the acoustic signature of a ship, a ship's magnetic influence, or a change in water pressure from a ship's displacement. Its *advanced microprocessor control ensures that detonation occurs at the closest approach point of the target* within the damage radius of the mine.

Flexibility of warhead charge weight (sizes from 350 to 1200 kg can easily be assembled) enables Sea Urchin to be configured to suit a range of operational requirements in terms of laying depths, target size,

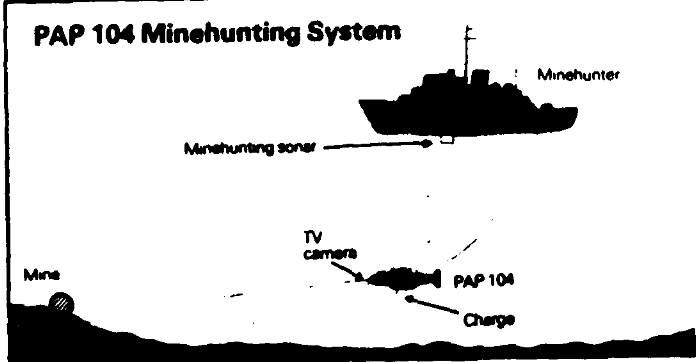


and degree of damage to be inflicted. Mine setting and self-testing procedures are simple and secure, being achieved by means of a small plug-in setting box weighing less than 5 kg.

In its ground mine version, Sea Urchin can be deployed in water depths from 5 to 200 metres.

mines allow them to pass a preselected number of targets before bursting, or to choose their preassigned target among many others. In addition to that, the time during which they remain active has been greatly expanded (modern electronic devices need very little energy). Sea mines equipped with those sensors can be laid by many types of surface ships (military or not), submarines, aircraft, helicopters or by frogmen. They can stay in mid-deep water or on the bottom of the sea, or be buried, waiting for their objective. Some of them can stay like that quite indefinitely, until they are remotely activated. The maximum depth was usually about 50 fathoms, it is now more than 100. This is enough since it is that of the continental plateau, but it can easily be increased if necessary; and unfortunately for the defenders, it is the limit of present surface mine hunting systems and beyond that of divers; and it represents a spread of surface very difficult to scan and sweep in a short time (mine sweepers and mine hunters work slowly; a few knots when they scan, less when they have to eliminate what they have found and identified (using a "PAP" or divers). This is all the more dangerous that the means available are scarce.

PAP 104 Minehunting System



The French PAP-104 system. Following detection by sonar the submersible is guided to the mine using remote control from the mine-hunter. A demolition charge is then placed beside the mine and detonated. A TV camera is in the nose of the submersible.

PAP Minehunter

The French Circé class of the early 1970s broke new ground in being fitted with two "selfpropelled fish" (PAP), which were subsequently adopted by a number of other NATO countries for use on their own minehunters. The PAP is an unmanned, retrievable vehicle equipped with a TV camera. Once the mine has been located and classified by the ship's sonar the PAP is lowered to the spot and deposits a charge which is then detonated, with the ship being at a safe distance.

An alternative system of mine destruction is the German Troika system, in which a trio of small unmanned vessels fitted with a variety of sweep gear is controlled by a mother-ship.

Western navies build many submarines, aircraft carriers and surface combatants, but the proportion of mine sweepers and mine hunters in their fleet is very low. Despite the fact that mine sweepers and mine hunters are up to now the only effective means of dealing with mines, the United States has no hunters and only a score of sweepers, 18 of them in reserve. None had been launched between 1958 and 1988.[6] The total number of mine hunters in line in European countries is less than 100 (for 68,000 km of coastlines and more than 50 main harbors).[7]

Of course it is more expensive to build ships and sophisticated devices than mines,[8] as it is more difficult and expensive to build countermeasure equipment than land mines; but let us remember that the Soviets build both systems, and that the Warsaw Pact has more than 450 minehunters/sweepers (for less than 45,000 km of coastlines, including the Pacific, and less than 20 important harbors, none of them absolutely vital. And they have all types of mines, including nuclear ones.[9] We know that, "The Soviet Union has a vast inventory of air-surface and submarine launched mines, using mechanical (contact), accoustic, magnetic, and possibly, pressure fusing."

ENDNOTES

1. See Annex 1: Former mine delivery systems.

2. See Annex 2: Modern mine delivery systems.

3. *Ibid*.

4. See Annex 3: FASCAM employment.

5. See Annex 4: Mine clearing systems.

6. See Annex 4: Balance of mine warfare assets.

7. See Annex 5: Harbors in the world.

8. See Annex 6: American mine warfare program.

9. See Annex 7/1-7/2: Soviet mines.

CHAPTER III

WHAT ABOUT THE USE OF MINES AT THEATER LEVEL?

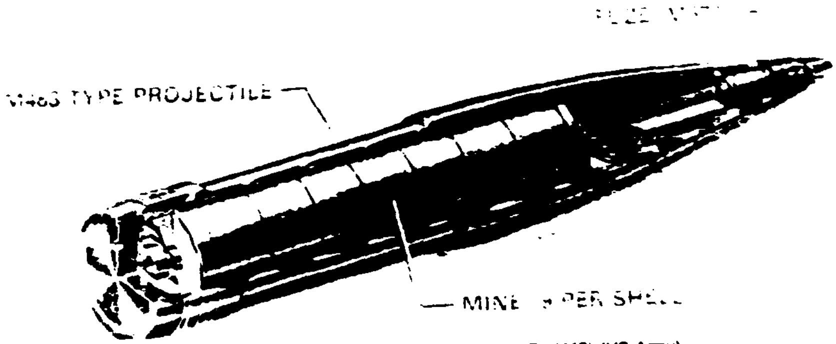
This being said, let us also remember that the competition is not that of one mine against one countermeasure system, or between one delivery system against one clearing device, but between the use of all, at theater level. Would there be an advantage for an aggressor to employ mines at this level? Unfortunately yes, both at tactical, operational and political levels, on land and most of all at sea.

On Land.

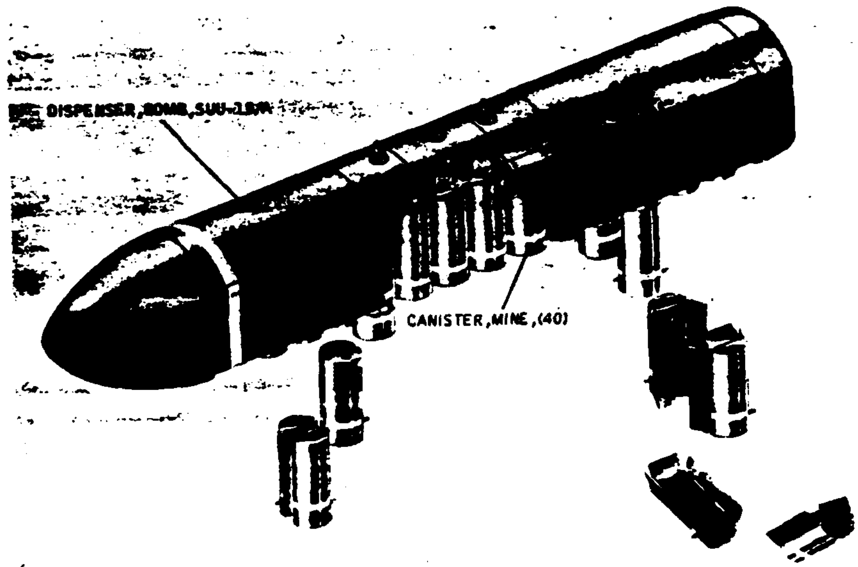
Let us be honest: the open use of mines as a means of deterrence is not threatening for peace. Both NATO and Warsaw Pact would, for instance, lay mines all along their borders; it would reinforce deterrence. Since no one can deal with such obstacles at a speed sufficient to warrant surprise, surprise attacks would no longer be feared by either side. This is even more obvious when one considers the possibility of laying other obstacles of the same type later, on short notice, in the rear, using modern delivery means to block a breakthrough if it occurs. In this type of situation the mine has become an instrument of peace. Unfortunately it is not the only possible use of some modern mines.

The Soviets have more than 450,000 mines in their inventory, many of them "modern," they also have great numbers of mine delivery systems. Some of them (but with the Soviets "some" means "many") are able to deliver mines far away in our rear areas. Using them at the beginning of an attack would create for NATO a very difficult situation. All the movements necessary for the deployment of Allied units would be highly disturbed or delayed; all the flow of logistics would be upset by mines suddenly dispersed along the axes of approach or lines of communications. The same mines would have a terrible effect on troops but also on civilians and would suddenly create traffic and psychological problems very difficult to solve. In the case of the Soviets, their equipment could pass unimpaired in Soviet mined areas since electronics allow mine sensors to recognize friends and foes as easily as IFF systems do for airplanes and helicopters.

Of course, the Allies could do the same on the other side of the borders. But the delivery means would not be available in sufficient numbers, even if the stocks of mines were at the necessary levels.



Projectile, 155 mm, Anti-tank, M718/M741 (RAAMS) (US Army)



SUU-13/A dispenser

Unluckily also, what is true about mines in a conventional attack, is equally true in another type of conflict, the unconventional one, which occurs more often. In that case, modern "intelligent" mines can be easily used with incredible efficiency, not in minefields laid over wide areas for denial, or to bar a breakthrough, but on axes (since they can stay off routes), and in localities where they are as easy to hide, as impossible to find. (Let us think of the situation in the Lebanese towns.) Mines can be the main weapons of unconventional warfare. With them, movements can be impaired or forbidden ovet an entire area for a brief period or for a long time. An intolerable pressure can be put on a population by specially trained "opponents" using mines: it can create a situation facilitating the overthrow of the legal power, presented by propaganda as unable to solve the problem of the safety of civilian populations in their own country, (conventional mines, not even chemical or nuclear ones which exist or will soon exist in inventories, and thus sooner or later will be in the hands of terrorists).

At Sea.

Now, what about employment of sea mines? A glimpse at a world map shows that seas are linked by many straits.[1] A blockade of some of them would bring a lot of trouble for many. It has already occurred. Let us remember the problems posed by the blockade of the Suez Canal, or more recently the threat represented by the war between Iran and Iraq, when one of the belligerents could any day close the Strait of Hormuz, and where mine sweepers and mine hunters are still at work, now that the war has come to an end. What is true in the Middle East region is also true in Asia. The only convenient passages between the Pacific and the Indian Ocean (which means between Far East and Middle East) are named Malaca, Timor, Lombok, Selat, Bali.

Other critical bottlenecks exist, including Panama and Gibraltar.2

With a minimum of modern sea mines, it would be easy to block those straights of shallow waters, or to make them very dangerous to cross. Thanks to modern devices their use could be denied to certain ships and not to others. The military advantage of such an action would be great for the party which should initiate it. The political gain could be very important, too, under conditions of appropriate exploitation through the media (an art in which the Soviets are very clever).

Let us not think about the threat that could pose some extremist group, disposing of a few appropriate mines, procurred by supporting states, and which could use them as a means of blackmail against free nations; let us better consider other types of places where the use of modern mines would be effective. There are three: the "military" straits, the approaches of harbors, and the continental plateau. The first are those denying to the Soviets a free access to blue waters. They are situated in Europe (the Bosphorus/Dardanelles, and the Skagerak/Kategat) but also in the Far East (Sakhalin, and La Perouse-Soya). The European ones are so important for NATO that their defense has for long been prepared and is constantly improved. They are under control of NATO and do not constitute a threat, at least for us.

The Far Eastern bottlenecks are not as famous but they could be used for the same purpose, giving to the free world a real advantage in case of crisis. This time the advantage seems to be for Western democracies. But it is only a "case," for none of them wants to use this possibility in order to initiate hostilities. The Soviets, on the contrary, can very easily close the strait of Bab el mandeb, since they are already well settled in its neighborhood (bases or facilities of Dalak, Aden, Soccotra) or any other bottleneck important for Western lines of communications (Cuba, Nicaragua). It is not sure they will always have the same scruples.

> ***"The Soviet navy would probably lay clusters of mines not only at the entrances to Western ports, but in the entire North Sea, the western approaches to the English Channel and strategic choke points worldwide, such as the Florida Straits, using more than a dozen types of mines."***

Harbors, military or not, and their accesses are the most effective places where mines could be laid. They are carefully watched and regularly swept, even in peace time; but it would be very easy and fast to block them with modern mines. It would give to the Soviets an important advantage at the very beginning of a conflict. And the Soviets have the ability to do it.

Maybe NATO could do the same (just like the United States forces blocked the harbor of Haiphong) but the means available are once more much too insufficient. Is it necessary to remind the reader that NATO as well as most of western countries absolutely need their harbors, the case being very different for the WARSAW PACT?

Last but not least, the continental plateau,[3] with its depths usually less than 50 fathoms, offers the same possibilities. Western countries could use it to complete the blockade of Soviet fleets, but they do not have at all the capabilities which would be necessary. On the contrary, Soviet forces can use it for preventing timely reinforcement of NATO or, and it is more important, for denying to western fleets the possibility to operate close to Europe, especially around the United Kingdom. They can, for they have the means and likely would have the will if it was their interest.

ENDNOTES

1. See Annex 8: Choke points.

2. *Ibid.*

3. See Annex 9: European continental plateau.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Mines are efficient weapons. They exist in great numbers in the inventories of all the nations. They are more and more easy to use. There exists a disequilibrium between East and West. Most of all, there is a growing gap between the efficiency of mine systems and countermeasures. All this represents a threat for Western countries, mainly at sea. It does not mean that the situation is hopeless; it is possible to do something; but it is urgent to do it. It is possible to work in two directions: deterrence and efficiency of countermeasures.

Deterrence.

Deterrence is possible in the domain of mines as long as the risk of retaliation is felt by a possible enemy as so important that it would be imprudent or too costly for him to use his assets. In order to achieve this goal, it is necessary to go on with the improvements which are possible thanks to technology. This is the case in western countries.

They should prepare more specialized mines, more simple and robust delivery systems, and lighter assets.

They should also go back to other types of mines such as the chemical and the nuclear. (The Soviets have nuclear sea mines and used mustard ground mines in Afghanistan). The first ones are not necessarily lethal, they can have effects on engines, optics, or any sensible part of weapons systems. It is possible.

The second must become as easy to use as "classical" or "modern" mines, and look like them so as to enforce their psychological effect. That is also possible. Only a few number of each must be built and fielded in order to insure deterrence. Their existence, known by the enemy, is in itself a deterrence. And this deterrence would work as it worked with the gas during World War Two.

Countermeasures.

Deterrence is not enough. It is efficient only with people who think and act in a reasonable way. It is not a good insurance against fanatics, desperados or fools. And there are many around the world. It is thus necessary to prepare the countermeasures which would quickly match them if they used mines.

A great effort must be done in research and development of efficient countermeasures. Electronics is a possibility; other technologies must also be tested. There are many unexplored domains to research and exploit. It needs some times a certain amount of money, a few clever brains and a political will. Western countries can afford all of that. It is the future.

Other possibilities exist. The first is that of building and fielding more numerous countermeasure systems. Even if they are not as convenient as they could and should be, they would represent a valuable insurance. They would cost money. But it is urgent to realize that some less aircraft tanks or surface combatants would make less difference in case of conflict or crisis than more countermeasure systems, which are indispensable to the freedom of movement of all the forces. This can be tomorrow.

Training.

The last way is that of a more intense and serious training of specialists (and rank and file) in our forces. This needs no great amount of money, not much time but certainly greater attention of the leaders. It demands most of all good information about the nature of the threat, then the will to match it through training. It is as necessary as possible. It can begin today. Let us take good insurances:

- FEAR MINE WARFARE,
- THINK ABOUT IT,
- GET PREPARED.

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ANNEX 1

FORMER MINE DELIVERY SYSTEMS

▲ Soviet soldiers with a TM-46 anti-tank mine.

Astrolite, liquid mine

United States

Dimensions	Liquid
Weight	Not known
Charge	HE
Method of laying	Pouring or spraying
Actuation	Remote or with pressure device
Effect	No precise information available
Safety	Inoperative after 4 days in ground
Detection	Not susceptible to any known detector
Manufacturer	Explosives Corporation of America

Astrolite is a recent development, and very little information has been released to date. However, it is understood that it is a liquid HE which can be sprayed from vehicles or aircraft, as well as being poured manually. Astrolite soaks into the first few cms of soil and, as far as is known, is entirely undetectable except, possibly, by dogs. Initiation can be achieved remotely, or by a pressure-type detonator. Unlike conventional minefields which eventually have to be cleared, Astrolite becomes inoperative after 4 days in the ground.

Not yet in service.

MIACAH F1 anti-tank mine

France

Dimensions	Length 26·5 cm Diameter 19 cm
Weight	12 kg
Body material	Metal
Charge	6·5 kg shaped HE
Method of laying	Manual
Actuation	Remote or by breaking a tripwire
Effect	Penetrates 70 mm of armour plate at 30 m or 50 mm at 80 m
Safety	Electrical
Environment	Pan climatic
Detection	Visual
Packing	Two mines in a special moulded container
Manufacturer	Groupement Industriel des Armements Terrestres

The MIACAH F1 owes its existence to some on-the-spot improvisations during World War II when allied troops made tank traps using rocket launchers. A loaded launcher was fixed in a hidden position across the axis of an enemy vehicle's advance and a line was attached to the firing mechanism. The operator then retired to a safe distance and waited. By pulling the line at the right moment he could kill the tank at relatively little risk to himself. Some troops became quite adept and devised a number of ingenious triggering devices from materials available to hand. The MIACAH F1 is a rationalisation of the idea, and was adopted by the French Army in 1968.

This mine consists of three basic assemblies—a pedestal-type mount equipped with lockable trunnion brackets on to which the mine is attached, the mine itself, which is composed of a spun-steel casing, with a sight, containing the electronic fuse and explosive charge and, lastly, the accessories which include the devices required for setting up, sighting and triggering the mine, either remotely or directly. The mine works by projecting a copper-plated hexalite hollow charge capable of penetrating 70 mm of armour plate or more.

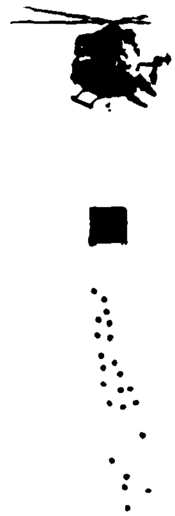
The mine is triggered by the actuation of the electronic fuse which can be done in two ways. 60 m of tripwire with a breaking strain of only 0·4 kg is connected to a cable. When this wire has been broken by a vehicle, an electrical circuit is completed and the electronic fuse, which is powered by four conventional torch batteries, is actuated. The other method of triggering is by remote control. A control box with a 50 m separation cable is connected to the electronic fuse, and a soldier can trigger the mine by pressing a button. In addition, the control box can be used to check the mine, or to neutralise it, to allow passage of friendly troops. When the mine is to be trip-triggered a special jump lead is provided for the same purpose.

In service with the French forces.

MIACAH F1 assembled (left) and two mines packed for transit (right)

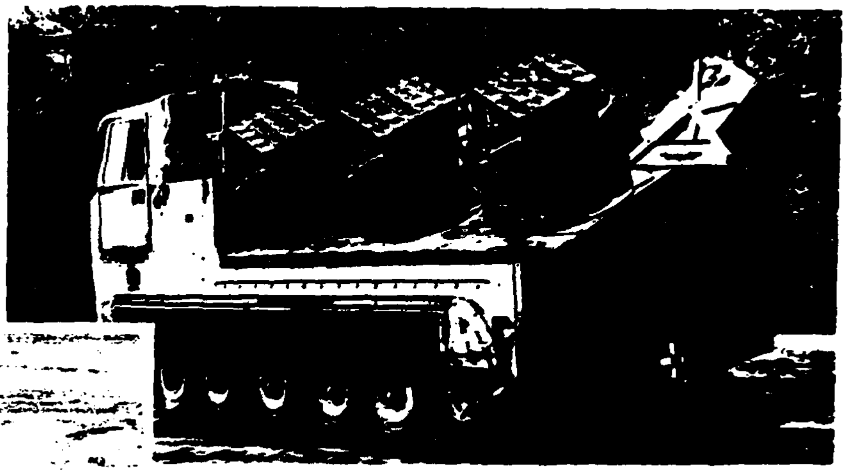
ANNEX 3

MODERN MINE DELIVERY SYSTEMS

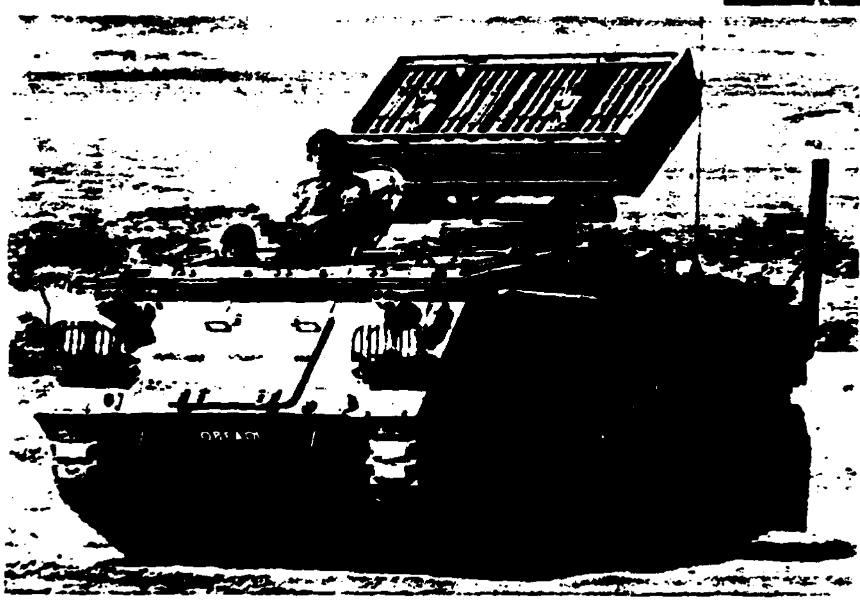


Technovar DAT scatter-dropping mine system in use slung under Lynx helicopter

JP233 full load release from Tornado GR1 aircraft

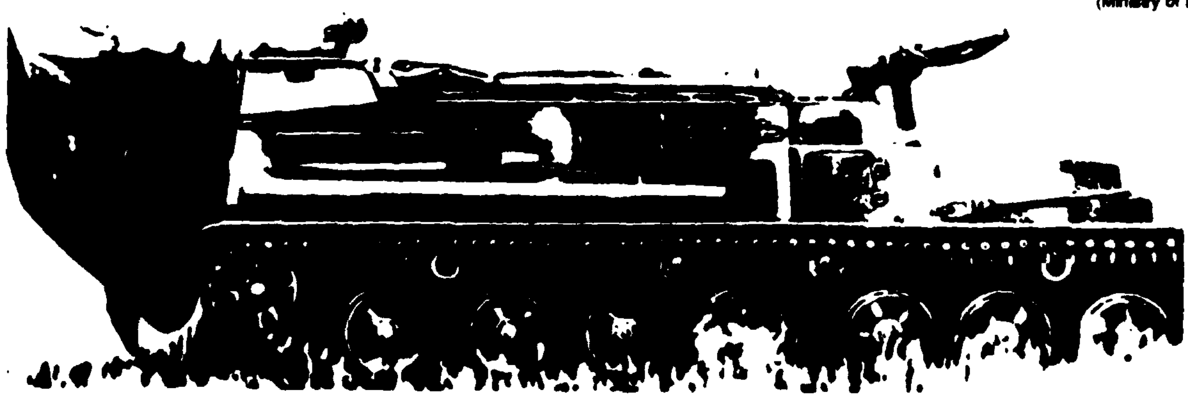


M548GA1 Skorpion fitted with MiWS



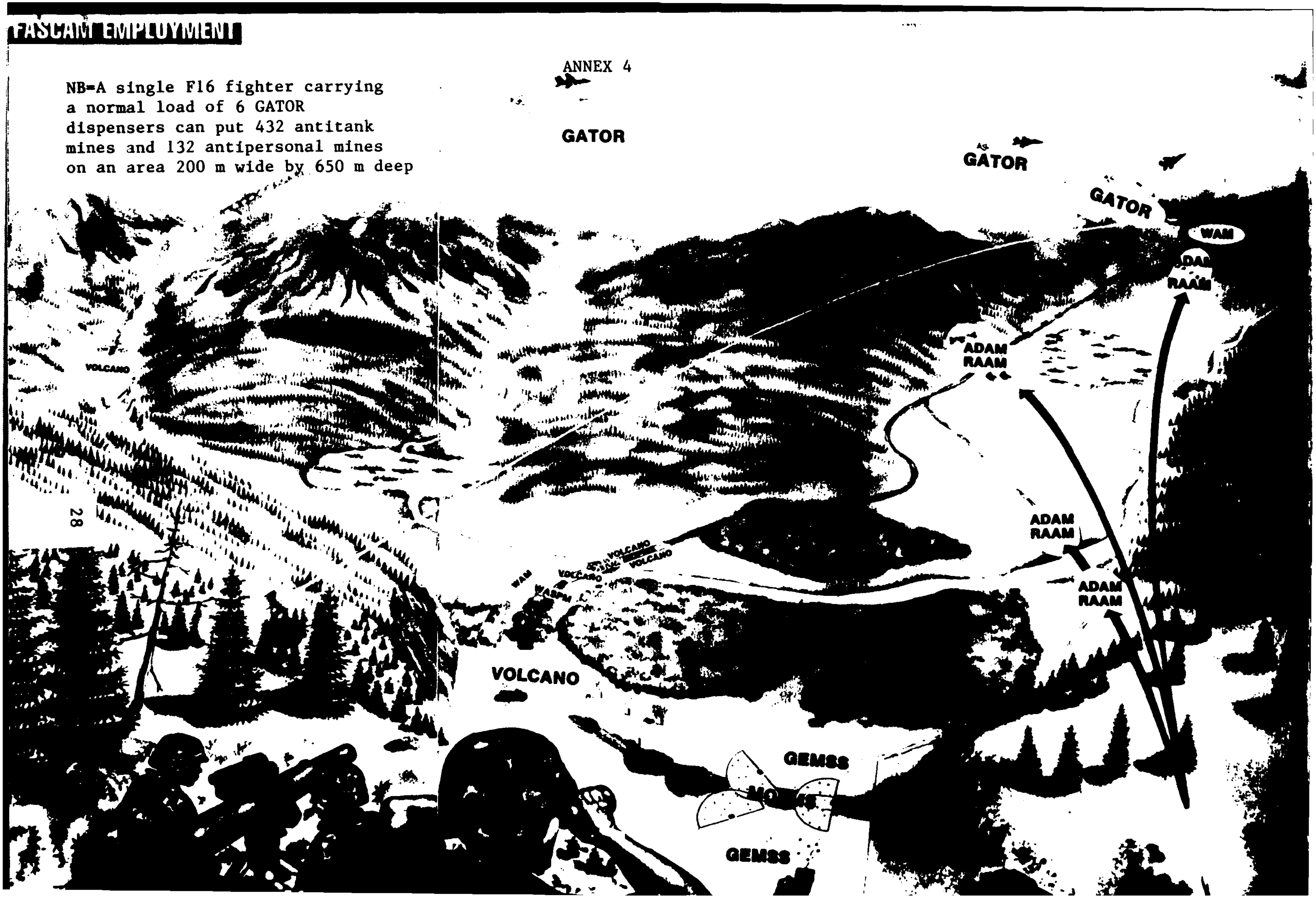
THORN EMI [illegible]

FV432 towing Bar minelayer being loaded with cardboard exercise mines (Ministry of Defence)



ANNEX 4

NB=A single F16 fighter carrying a normal load of 6 GATOR dispensers can put 432 antitank mines and 132 antipersonal mines on an area 200 m wide by 650 m deep

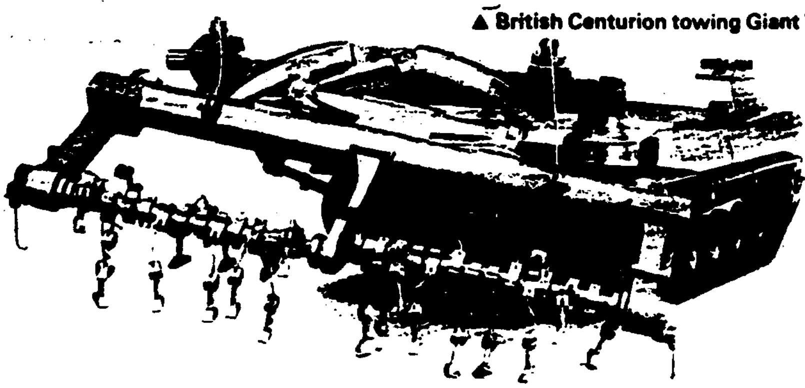


ANNEX 5

MINE CLEARING SYSTEMS (LAND)

face-Launched Unit, Fuel-Air Explosive, ***based*** *on modified FMC M548 tracked carrier, launching rocket with* ***FAE warhead*** (US Army)

▲ British Centurion towing Giant Viper mine clearance equipment.



Merkava with a mine-clearing device.

Above: Centurion tank equipped with plough for minefield breaching (Y. Turgovnik, IDF).

ANNEX 6

AMERICAN MINE WARFARE PROGRAMS

3342.441

AMERICAN MINE WARFARE PROGRAMMES

The American mine warfare programme comprises two main elements, mines and mine-countermeasures. The application of mines in weapons against submarines and surface ships has the objective of denying access to and use of ports and to provide offensive and defensive barriers. The current stock of sea mines consists of the Mks 52, 55, 56 and 57 types.

CHARACTERISTICS

Type: Mk 52, aircraft laid bottom mine
Length: 2.25 m
Diameter: 844 mm
Weight: Mod 1, 542 kg; Mod 2, 567 kg; Mod 3, 572 kg; Mod 5, 570 kg; Mod 6, 563 kg
Charge: 270 kg HBX-1
Max depth: 45.7 m (Mod 2, 183 m)
Actuation: Mod 1 acoustic; Mod 2 magnetic; Mod 3 pressure/magnetic; Mod 5 acoustic/magnetic; Mod 6 pressure/acoustic/magnetic

Type: Mk 55, aircraft laid bottom mine
Length: 2.89 m
Diameter: 1.03 m
Weight: Mod 2, 580 kg; Mod 3, 992 kg; Mod 5, 992 kg; Mod 6, 996 kg; Mod 7, 995 kg
Charge: 576 kg HBX-1
Max depth: 45.7 m (Mods 2/7, 183 m)
Actuation: Mod 2 magnetic; Mod 3 pressure/magnetic; Mod 5 acoustic/magnetic; Mod 6 pressure/acoustic/magnetic; Mod 7 dual channel magnetic

Type: Mk 56 Mod 0, aircraft laid moored mine
Length: 3.5 m
Diameter: 1.06 m
Weight: 1010 kg
Charge: 159 kg HBX-3
Max depth: 366 m
Actuation: Total field, magnetic dual channel

Type: Mk 57 Mod 0, submarine or ship laid moored mine
Length: 3 m
Diameter: 510 mm
Weight: 934 kg
Charge: 154 kg HBX-3
Max depth: 350 m
Actuation: total field, magnetic dual channel

Also employed by the USN is a range of air deployed munitions based on modified general purpose low drag bombs and which can be released without requiring a parachute. The modification involves the use of a Mk 75 Mod 0 Destructor Modification Kit which can be added to 500 lb, 1000 lb and 2000 lb Mk 80 series bombs to form the Service Destructors (DST) Mks 36, 40 and 41, respectively. These are mostly intended for use in shallow waters such as estuaries etc. against typical coastal targets.

There is also the DST 115A, which can be employed with either aircraft or surface craft for use against surface targets.

CHARACTERISTICS

Type: Mk 36, aircraft laid bottom mine
Length: 2.25 m
Diameter: 400 mm
Weight: 240 kg (with fixed conical fin) 261 kg (with tail retarding device)
Charge: 87 kg H-6
Max depth: 91.4 m
Actuation: Mods 0/3 magnetometer; Mods 4/5 magnetic/seismic

Type: Mk 40, aircraft laid bottom mine
Length: 2.86 m
Diameter: 570 mm
Weight: 447 kg (with fixed conical fin) 481 kg (with tail retarding device)
Charge: 204 kg H-6
Max depth: 91.4 m
Actuation: Mods 0/3 magnetometer; Mod 4/5 magnetic/seismic

Type: Mk 41, aircraft laid bottom mine
Length: 3.83 m
Diameter: 630 mm
Weight: Mods 0/3, 926 kg; Mods 4/5, 921 kg
Charge: H-6
Actuation: Mods 0/3, magnetometer; Mods 4/5, magnetic/seismic

Type: 115A, aircraft laid surface mine
Length: 0.45 m
Diameter: 620 mm
Weight: 61 kg
Charge: 24 kg HBX-3
Actuation: Magnetic/seismic

Quickstrike

The Quickstrike bottom mine development programme embraced a family of mines using different size cases but with common target detection and classification mechanisms. The four members of the Quickstrike family are the Mks 62, 63, 64 and 65. The last of these (Mk 65 Mod 0) is in the 2000 lb (900 kg) class and is in full production by Aerojet Tech Systems in Sacramento, California. The Mk 64 will probably be the next to enter production and this also is in the 2000 lb (900 kg) class, based on a Mk 84 2000 lb bomb and measuring 3.8 m long and 633 mm diameter.

Quickstrike mines are for shallow water deployment (to approximately 100 m) and targets will have to approach to within a few hundred feet for it to act. It will use existing Mk 80 series GP bomb cases as well as a new mine case. Quickstrike mines are deployed by aircraft, surface ships, or submarines, but principally from the former.

This family of mines is based primarily on conversion of existing ordnance (bombs and torpedoes). An exception is the Mk 65 mine which is not a bomb conversion. It has a thinner case than the equivalent bomb and contains the effective underwater PBX explosive. It is 3.25 m long and 533 mm in diameter. The Mk 65 has now been deployed with the US Navy and is being evaluated by the Italian Navy.

Captor

Captor is a deep anti-submarine mine (Mk 60) intended for use in barriers against enemy strategic submarines. It can be emplaced by submarines, surface ships and aircraft. The kill mechanism consists of a Mk 46 Mod 4 homing torpedo (2822.441) which is released by a fire control system contained within the detection and control unit of the main Captor unit. Further details of Captor will be found in 2541.441, above.

SLMM

The submarine-launched mobile mine (SLMM) Mk 67 is intended to provide the US fleet with a capability for planting mines in shallow water (to approximately 100 m) by submarine, using a self-propelled mine to reach water inaccessible to other vehicles. It is also meant for use in locations where covert mining would be particularly desirable from a tactical standpoint. It measures 4.09 m long × 485 mm diameter and weighs 754 kg.

The Mk 67 SLMM consists essentially of a modified Mk 37 torpedo (2818.441); alterations involved include some reworking of the Mk 37 torpedo bodies and replacement of the torpedo warhead with the applicable mine components. Tooling and other plant facilities were installed in fiscal year 1978 for production of Mk 67 sub-launched mobile mines in 1979.

Procurement plans for the Mk 67 SLMM for 1987 was 273 but it appears that this has now been cancelled.

Mine Countermeasures

In 1983 construction began of the first in a new class of mine countermeasures ships, the MCM-1 Avenger. Ships of this class are intended to match increasing Soviet mine warfare capabilities and to enhance US minesweeping facilities. Five of these ships have been authorised to 1988 and two have been commissioned. It is planned to authorise the building of nine more ships of this class. A second new class of mine countermeasure ship, the MSH-1 will augment the MCM class ships. The MSH-1 minehunters will be equipped with advanced combat systems similar to those in the MCM-1 ships, but will be smaller and less costly. Congress authorised the lead ship of the class in 1984. To complete the 17-ship programme, the five-year building plan contains another 16 vessels. More detailed information is given in *Jane's Fighting Ships*.

ANNEX 7

WORLD HARBORS

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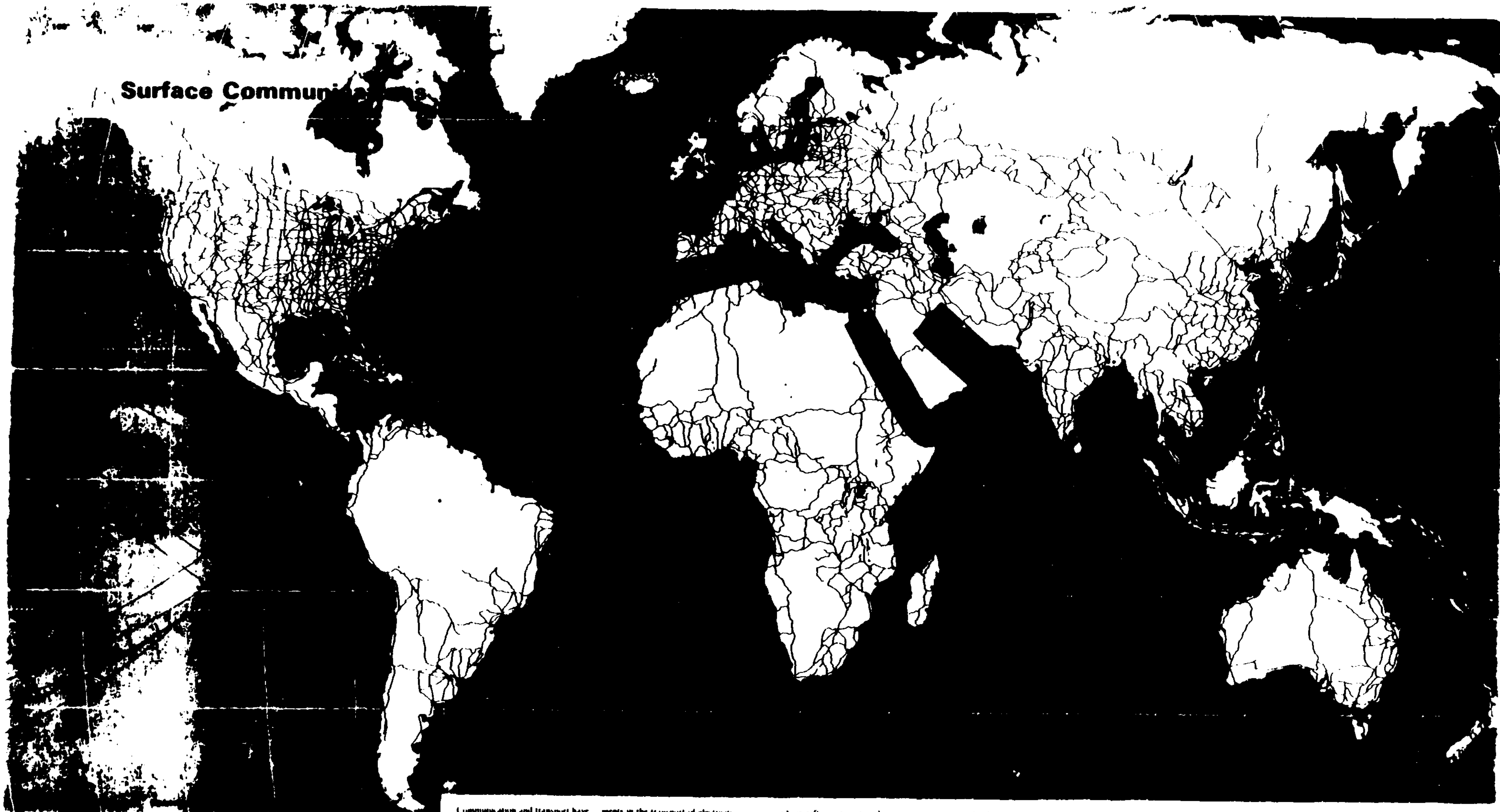


Surface communications 11

Roads

Shipping

Communication and transport have become synonymous as terms for expressing the interaction between people and places. This interaction between *resources, production and distribution* in developed and developing industrial economies demands efficient means of conveying people and materials between countries and continents. Efficiency in this field is gauged by the time, effort and cost involved.
The desire to increase efficiency has led to technological improvements, particularly in the transport of raw materials, which are complicating the problem of defining communications. For example, crude oil, gasoline and natural gas are transported thousands of miles in pipelines, one of the longest of which extends 1,800 miles from the Urals to Eastern Europe. Also improvements in the transport of electricity via national and international grid systems have greatly decreased the quantity of coal transported to *small, localized generating stations.*
Despite the increasing complexity of communications networks certain principles and patterns may still be discerned both on a national and *on a world scale.*
On an international level the main forms of transport are low-cost, time-consuming shipping, particularly suited to carrying bulk freight, and relatively high-cost, time-saving air services, which are particularly suited to carrying passengers and freight with a high *value–weight ratio. Shipping routes, air control and terminal procedures* have been standardized by international agreement. Problems of traffic control [illegible] and aircraft in international waters or air space are discussed by the countries involved, for example the decision to ease congestion in the *English Channel by instituting one-way shipping lanes.*
The main concern of these two forms of transport is to improve efficiency, in particular the cutting *of running costs, by technological* improvements which increase carrying capacity (supertankers and jumbo-jets), which further mechanize terminal procedures (containerization and automated cargo terminals) and which cut travelling time (supersonic jets).
On a national rather than on an *international level the problems facing both freight and passenger* transport systems vary considerably from country to country and even [illegible] priorities in development between states, regions and provinces may vary as much as between nations.
In the developing countries of Asia, *Africa and South America the new* and expanding industries take priority over passenger requirements when transport systems are planned. The primary aim is to provide a *basic network to link resources with* industry and distribution points. This leaves vast areas still relying on primitive methods of transport.
In the highly developed industrial *conurbations of North America,* Western Europe and more recently, Japan the means of surface transport have evolved into highly complex systems of road, rail, sea and air communications, each interacting and competing with the others in transporting both freight [illegible]
In contrast to developing nations the initial network connecting resources, production centres and distribution areas has already been *established and the problem being* faced now is to keep the system operating under increased pressure from the growth and redistribution of industry, urban expansion, *increasing ownership of private cars* and the changing pattern of work and leisure activity.
These last two factors are particularly important as the provision of *adequate road services,* particularly in urban areas, is one of the greatest problems facing road transport planners. In 1890 an average American travelled 300 miles a year away from his home community; now the average is 4,000 miles a year. [illegible] of these by [illegible] are built so more people are drawn to use them and thus congestion begins, leading to new plans to provide for this increased usage. It is this *circle which transport planners are* finding increasingly difficult to break.
The benefit to users in the increased efficiency of jet air services, interstate highways, motorways and express train services will be lost unless more viable solutions can be found to channel both passengers and freight through the urban terminal centres. Japan sees the solu*tion in overhead trans-city motor*ways whereas the U.S.S.R. is looking ahead to high-speed underground railways. Monorail systems and helicopter services have also *been the object of experimentation* in an attempt to by-pass traditional trans-city road and rail network. In [illegible] land area has already been given over to road systems yet congestion still remains.
The use of road systems depends *to a great extent on individual.* This makes road traffic control more difficult than, for example, air traffic control where flights are scheduled and planned to connect *with other flights both on a national* and on an international basis. Control of road traffic is further complicated by the nature of road networks which are so closely tied to *other transport networks,* acting as feeder routes to and from air, sea and rail terminals. The dependence of one transport system upon another creates a communication system which, in order to operate effectively, must respond as a unit to the changing demands and pre[illegible]


Surface Communications
Surface communications I
Predominant cargoes
Railways

ANNEX 8

BALANCE OF SEA MINE WARFARE ASSETS

WARSAW PACT	Mine layers	Mine countermeasure	Mine countermeasure	Mine layers	NATO
USSR	3	370	30	0	USA
Bulgaria	0	33	0	0	Canada
GDR	0	24	28	0	Belgium
Poland	0	30	55	2	FRG
Romania	2	38	29	0	France
			14	2	Greece
			22	0	Italy
			24	0	NL
			8	2	Norway
			12	0	Spain
			22	7	Turkey
			42	0	UK
Total	5	495	286	13	

NB: Most Warsaw Pact ships have a minelaying capability. | Some NATO ships have a minelaying capability.

▲Soviet subs can carry up to 50 mines

NB=The Figure of mine countermeasure assets do not include several dozens of non self-propelled mine countermeasures craft.

◆ several dozen non-self-propelled mine countermeasures c

Towed mine countermeasures craft

ANNEX 9-1

SOVIET LAND MINES

Type	Structure	Role	Weight (kg)	Dimensions (cm)*	Charge	Force (kg)	Blast radius
YaM-5	wood	AT	7.7	47.5 l × 18.5 w × 8.5 h	3.6-5kg	136	
TM-57	steel	AT	9.5	29.9 d × 7.4 h	7kg	200-700	
TMN-46	steel	AT	8.7	31 d × 7.4 h	5.3kg	180	
KhF-2	metal	gas (mustard)	15	18.5 d × 28 h	4.5 l		
OMZ-3	metal	AP (bounding)	3	6 d × 13.5 h	75g	-	25m
POMZ-2	metal	AP (frag)	2	6 d × 13.5 h	75g	0.5-1.3	4m
PDM-6	-	river bottom	47.5	100 d × 55 h	28kg	-	
PMD-6	wood	AP (blast)	0.4	20 l × 9 w × 6.5 h	0.2kg	6-28	-
PDM-2	-	river bottom	100 +	140h	15kg	4--50	
YaM-10	wood	AT	11.8	62 l × 21.6 w × 19.6 h	10kg	130	
TMD-B	wood	AT	7.7	32 l × 28 w × 14 h	5-6.8kg	200	
TMK-2	metal	AT	12.5	30 d × 35 h	6.5kg	HEAT	
PDM-1M		river bottom	29	100 h	10kg	40-50	
PDM-2		river bottom	100 +	140h	15kg	40-50	
TM-62P	plastic	AT	9.5	32 d × 11.7 h	7.5kg	200-500	
TMB-2	cardboard	AT	7	27.4 d × 15.5 h	5kg	200	
PMD-7	wood	AP (blast)	0.3	15 l × 17.5 w × 6.5 h	75g		
PMN	plastic	AP (blast)	0.5	10 d × 55 h		1-1.4	
PFM-1	plastic	blast (surface)	0.074			5	-
MON-50	plastic	claymore	-		1kg		
MON-100	-	directional (frag)	5.0	22 d	2kg	-	100m
MON-200	-	directional (frag)	25.0	52 d	12 kg	-	100m
MON-500	-	directional (frag)	-	-		-	100m
PGMDM	plastic	AT (rocket or air-delivered)	1.4-2	6.5 d × 30 h	-	-	-
OTK-10	plastic	AP	-	15 d × 10 h	0.25kg	-	10m

All mines are normally pressure-activated, but can also be command or pull-activated. The gas mine normally uses mustard gas. Force shows the pressure in kilogrammes that must be exerted to detonate the mine. * l = long, w = wide, h = high, d = diameter. Other mines include TM-72 plastic AT, PPM-2 plastic AP, PMP-71 plastic bounding AP.

ANNEX 9-2

SOVIET SEA MINES

Soviet sea mines in current use fall into four major categories: moored, seabed, floating, and nuclear, and brief notes on each category appear in the following paragraphs. It is estimated that some 350,000 sea mines, mostly of the latest types, have been stockpiled by the USSR.

Defensive moored mines: The main type is the basic contact moored mine that uses an inertia-type firing mechanism which can either be galvano-contact, moored mine have apparently been exported to Soviet client states and the Warsaw Pact nations.

Offensive bottom mines: There are two basic types of conventional ground influence mines used by the USSR the AMD-500 and AMD-1000 series. The number refers to their weight in kilograms. The AMD-1000 is reported to be the only one capable of laying by submarine, whereas both the AMD-1000 and AMD-500 can be laid by ship and aircraft. In the last case the designation is reported by Middle Eastern sources to change to KMD-1000 and KMD-500, respectively. The two series are produced in four variants:

(1) magnetic influence that relies on either the intensity of the horizontal or vertical component of the target's magnetic field or the rate of change of the target's field

(2) acoustic influence using either or both low frequency and high frequency noise generated by the target

(3) pressure influence in which the passage of the target over or near the mine causes a reduction in pressure within the water column adjacent to the mine

(4) combination influence in which two or all three of the above influences are combined in a single sensor unit.

For greatest selectivity in target and to maximise sweeping difficulties the combination systems most likely to be used are magnetic-pressure and acoustic-pressure; although the presence of mines with all three influences would be logical for specialist targets such as NATO MCMV forces.

contact-mechanical or contact-electrical. The mines come in three sizes: small, medium and large according to the explosive charge carried. The two smallest mines are designated YaRM and YaM. The former has an explosive charge of 3 kg and is used in rivers and lakes; the latter has an explosive charge of 20 kg and is used in lakes and shallow coastal areas. Both have the conventional spherical shape with horns and small sinker units. The medium-sized moored contact mine is believed to be confined to the large stocks of the elderly M08/39 series used for

Normal laying depth would be between 4 and 70 m, although the larger AMD-1000 would be effective against submarines down to 200 m. It is assumed that both types can be fitted with ship counter units, anti-handling devices and self-timed neutralisation devices. Both types have been exported widely to Soviet client states and the Warsaw Pact countries. However the pressure influence variants are likely to be restricted to the Soviet Navy and Pact states that are considered trustworthy.

Offensive moored ASW mines: There are three basic types, two of which for delivery by submarine, ship or aircraft are classed as rising mines and the third assessed for delivery by submarine or ship is known as the underwater electrical potential (UEP) mine. All three have their origins as strategic ASW barrier mine types for use in areas adjacent to NATO submarine bases. The rising mines can also be expected to be encountered on transit and choke point zones frequented by NATO submarine and surface units, as they have a secondary anti-ship capability. Of the two rising mine types one is designed for use on the continental shelf (believed to have the NATO code-name Cluster Bay) and the other is an improved version for use on the deeper continental ledge region (believed to be code-named Cluster Gulf). Both are thought to be tethered torpedo-shaped devices fitted with a rocket propulsion unit and an active/passive acoustic sensor device. The target is initially detected by the passive component of the detection system and located by transmissions from the active part. If the target is confirmed as being within the vertical attack zone, the tether is cut and the rocket

coastal defence barriers. This also is spherical with horns and sinker unit but has an explosive charge of about 120 kg. The largest moored contact mine types are cylindrical with explosive charges in excess of 200 kg. These mines are matched by large stocks of an antenna mine variant for defensive ASW barriers and an acoustic influence activated variant for use in areas of strong tidal or current action. The antenna mine is believed to have a 30 m antenna above and below the mine casing and the acoustic mine has a 30 m target location distance. All three types of ignited. The very fast upward speed will allow very little time for the target to evade the device if its launch has been detected. Nothing much is known about the UEP mine other than that it relies on the target's electrical field for detection. It is the presence of these three mines in the Soviet Navy inventory that has prompted the RN to introduce the deep sweeping capability into its MCMV forces to protect the UK's submarine bases.

Nuclear mines: The Soviet Union is believed to have a small stockpile of nuclear mines with yields varying between 5 and 20 kilotons for use against high value surface units, and base targets. Laying of these mines is almost certainly assigned to specially selected SSK/SSN units.

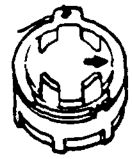
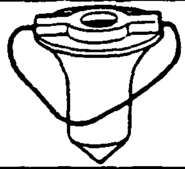
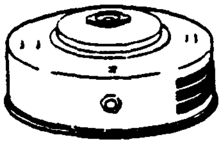
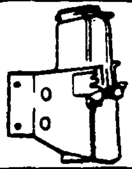
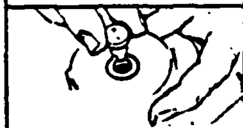
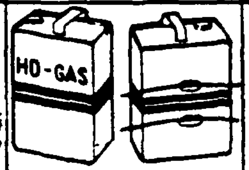
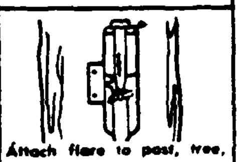
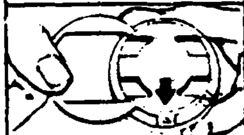
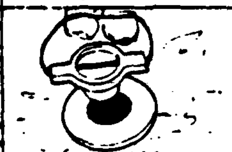
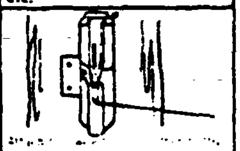
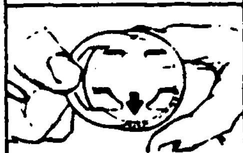
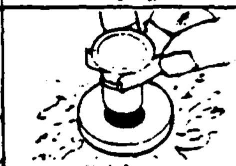
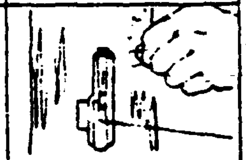
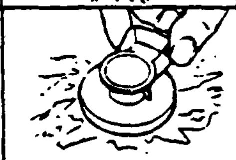
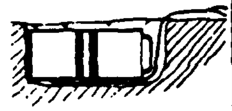
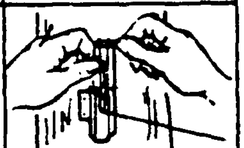
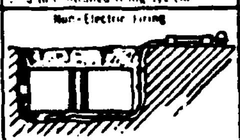
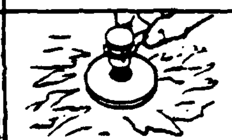
The primary Soviet offensive minelaying platform is the 'Foxtrot', 'Whiskey', 'Tango' and 'Kilo' SSK force because of their covert laying capability. Offensive ASW and ground influence mines would be laid by these boats round European NATO bases and at choke points, while overseas bases, SLOCs and deep water choke points would be assigned to the SSN force. Reactive minelaying and renewal of the fields once laid could be accomplished by the Soviet Naval Air Force with Badger A/G, Blinder A and Backfire B aircraft. Defensive minelaying and selective offensive laying in areas contiguous to the Soviet homeland would be undertaken by the surface fleet and the maritime patrol aircraft.

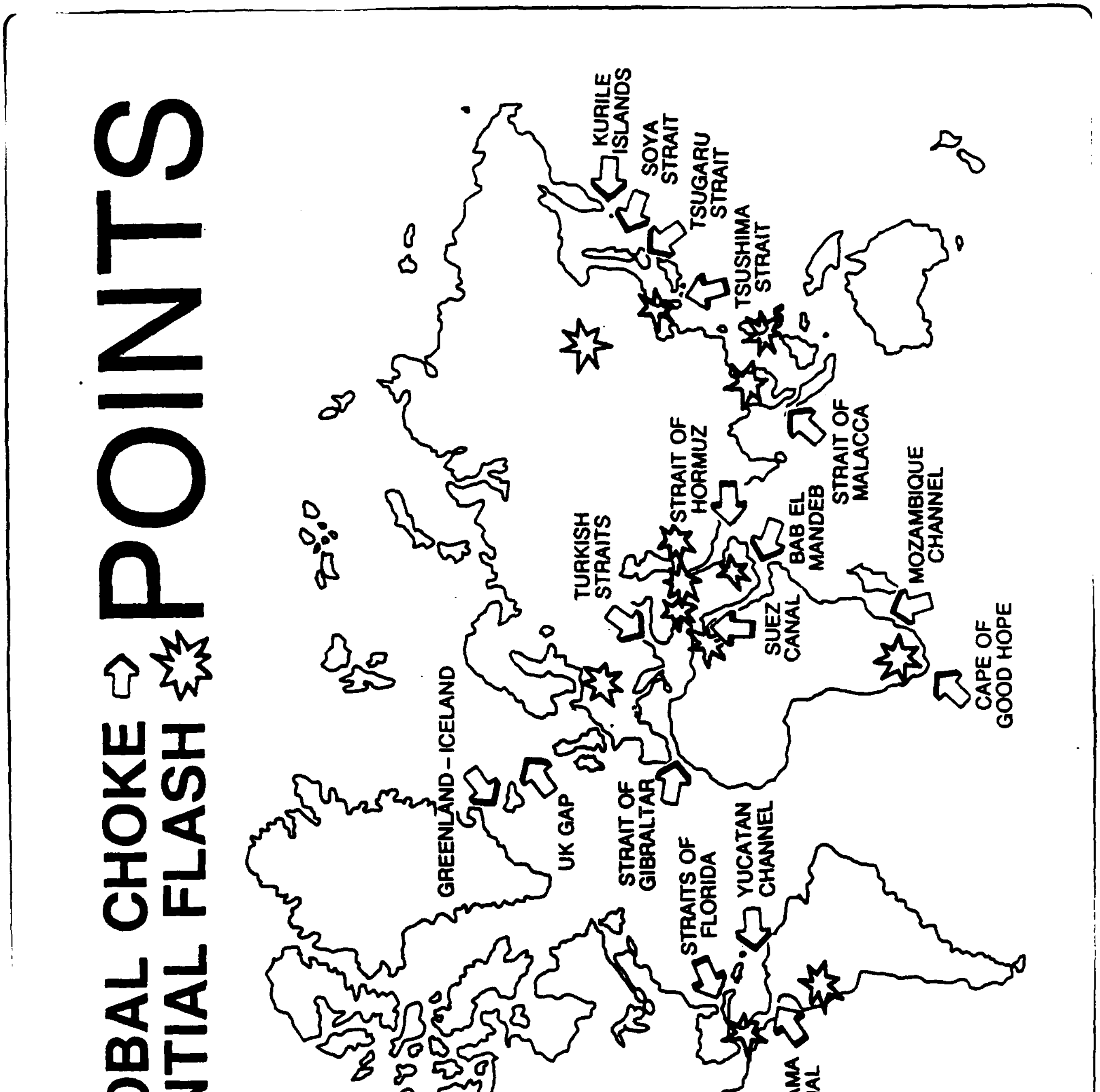
Designation	Type	Firing Mechanism	Case Depth (m)	Bottom Depth (m)	Explosive (kg)	Layer	Minimum spacing (m)
M 08	Moored	Contact	6.1	110	115	Ship	36
M 12	Moored	Contact	6.1	147	115	Ship	30 5
M 16	Moored	Contact	6.1	366	115	Ship	36
M 26	Moored	Contact	6.1	139	240	Ship	55
M 31	Moored	Contact	6 1	—	200	Ship	—
MKB	Moored	Contact	9 1	272	230	Ship	41
MKB3	Moored	Contact	9 1	272	200	Ship	35
MAG	Moored	Contact	79.3	457	230	Ship	35
AMAG	Moored	Contact	8.5	100	259	Aircraft	44
PLT	Moored	Contact	9.1	137	230	Submarine	80
PLT 3	Moored	Contact	9.1	128	100	Submarine	30 5
R	Moored	Contact	1 8	35	10	Ship	15
R1	Moored	Contact	1 6	35	40	Ship	20
MYaM	Moored	Contact	2.7	51	20	Ship	20
MIRAB	Bottom	Influence	9 1	—	65	Ship	61
KRAB	Moored	Influence	18.3	272	230	Ship	41
MKD	Bottom	Influence	54.9	—	784	Ship/sub	137
AMD 500	Bottom	Influence	24 4	—	300	Aircraft	69
AMD 1000	Bottom	Influence	54.9	—	699	Ship/sub	137
Rising Mine	Moored	Acoustic	609.6	226	227	Submarine	—
Sectionalised	Moored	Influence	488.7	—	227	Submarine	—
BPM 2	Limpet	—	—	—	3 1	Swimmer	—
MZ 26	Moored	Contact	34	46	1.3	Ship	—

ANNEX 10

". . . chemical mines, which exist or will soon exist in inventories:

TABLE 7
CHARACTERISTICS OF MINES

M14 BLAST ANTIPERSONNEL MINE	M25 BLAST ANTIPERSONNEL MINE (ELSIE)	M23 AND M1. 1 GALLON CHEMICAL LANDMINES	M49A1 TRIP FLARE
			
Wt 3⅓ oz Expl 1 oz TETRYL Fuze Integral with Belleville Spring Functioning 20 to 35 lb	Wt 3½ oz Expl ⅓ oz shaped charge Fuze Integral, with ball release Functioning 17 to 22 lb press	When armed for pressure detonation, emplace in same manner as the M15 antitank mine	Has 55 to 70 sec surface burning period and an illumination radius of approximately 330 yds. Initiates by taut or loose trip wire
 Unscrew shipping plug from bottom of mine. Turn pressure plate to ARMED position with arming [illegible]	 Push mine into ground. Keep dust cap in place. If ground is hard dig hole with bayonet.		 Attach flare to post, tree, etc.
 [illegible]	 [illegible]	Wt. 11 lb. loaded; has an 4-ft. length of detonating cord for burster charge. May be armed for electric or trip wire actuation.	 [illegible]
 Replace safety clip.	 Insert charge	[illegible]  Attach burster charge — 4 ft. length of detonating cord — to side of mine.	 To Arm remove safety clip
 Screw detonator into detonator well	 Remove safety clip	 Bury mine 4 in. and attach detonating cord to installed firing system	 To Disarm: Insert safety pin
 Bury mine & remove safety clip	The M25 can penetrate a soldier's boot and foot or puncture a 17 ply tire and tube	Non-Electric Firing  Bury mine as above and attach non-electric detonator to burster	 Check both ends of trip wire, then cut near trigger.
To Bury: Pressure plate should be slightly above ground level. To Disarm: Insert safety clip and remove detonator. Caution: Repeated turning of arming dial may cause excessive wear.	 To Disarm: Replace safety clip and lift charge container from mine	Warning: SOLDIERS PREPARING LAYING and REMOVING CHEMICAL LAND MINES MUST WEAR PROTECTIVE MASK and PROTECTIVE CLOTHING	Warning: NEVER LOOK DIRECTLY AT BURNING FLARE. Note: For loose trip wire initiation, attach trip wire to eye of safety pin.


GLOBAL CHOKE
& POTENTIAL FLASH POINTS
KURILE ISLANDS
SOYA STRAIT
TSUGARU STRAIT
TSUSHIMA STRAIT
STRAIT OF HORMUZ
STRAIT OF MALACCA
TURKISH STRAITS
BAB EL MANDEB
MOZAMBIQUE CHANNEL
SUEZ CANAL
CAPE OF GOOD HOPE
GREENLAND - ICELAND
UK GAP
STRAIT OF GIBRALTAR
STRAITS OF FLORIDA
YUCATAN CHANNEL
PANAMA CANAL

ANNEX 12

CONTINENTAL PLATEAU