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SECTION I

AIR

1. FRAGMENTATION BOMBS

Certain characteristics of fragmentation bombs are described in the following article, reprinted from issue No. 12 of AFGIB (Air Forces General Information Bulletin). Included in the summary is a reference to a few types of Axis bombs in this category, particularly those of a "combination" character.

* * *

In the category of "fragmentation" bombs are included certain bombs of small size designed for destructive effect on personnel, animals, and light materiel targets such as motor transport, and aircraft on the ground or in flight. Bombs of this class are generally less than 100 pounds in total weight, and are often termed antipersonnel bombs.

Whereas general-purpose demolition bombs depend for destructive effect primarily on their violence of detonation, with fragmentation a secondary consideration, fragmentation bombs depend primarily on the projection at high velocity of bomb-body fragments. The design of the bomb-body, and the charge/weight ratio, are determined with this end in view. Thus, with our demolition bombs the high explosive charge may approximate 50% of the total bomb weight; where with fragmentation bombs it may approximate only 15%.

Bodies of fragmentation bombs show a considerable variation in type. They include simple steel cases; bodies built up by winding on a steel shell a helix of strip or bar steel, or assembling on a steel shell a series of rings; and bodies consisting of concentric steel cylinders, a smaller within a larger one, with the intervening space filled with concrete containing steel fragments. The general effort is to devise bodies which will shatter into the maximum number of effective fragments neither too large nor too small in size.

Fragmentation bombs may be dropped singly or in clusters, bound or held together during a portion of their fall and then released, or in containers which operate in a similar manner. The purpose of dropping in clusters or containers is to ensure a closer concentration of bombs dropped from high levels, since bombs dropped singly would tend to disperse considerably during their fall. Such clusters or containers are generally provided with either an explosive cartridge or a spring-loaded mechanical device, which functions after a predetermined period to break open the cluster or container and free the bombs.

Fragmentation bombs produce their maximum effect when detonated at, or slightly above, ground level. A flat cone of fragments sweeping outward is highly desirable. Any ground penetration by the bomb prior to exploding narrows this cone of fragment-sweep, since many fragments expend their force in the ground, and the remaining ones take higher trajectory.

The normal fuzing is, therefore, with instantaneous impact-type nose fuze. However, time (delay) fuzing may be necessary if the bombs are to be dropped from low level, in order that the aircraft may be beyond the danger space when the bomb explodes.

In dropping from low level, the disadvantage of time fuzing is somewhat counterbalanced by the fact that the bomb is more apt to ricochet and come to rest on the ground surface, and less liable to bury itself, than if dropped from higher levels. However, low-level drop with instantaneous fuzing has been made feasible by the provision of a chute attachment for the bomb. This greatly retards the flight of the bomb, allowing the aircraft to get beyond the danger zone before the bomb reaches the ground and detonates. Release of this bomb is possible at 100 feet, and lower if tactically required.

In addition to normal types of fragmentation bombs, the Axis nations have employed some which are unusual in design, or of a "combination" character. A few of these are noted below.

The German SD* 2-kilogram "butterfly" bomb differs markedly in appearance from ordinary types. The small drum-shaped body is enclosed in a hinged shell of thin metal which opens in flight and acts as a metal braking drogue similar to a parachute attachment. The usual fuze allows either instantaneous burst or time delayed action of 3 to 5 seconds. It is thought that in some cases a disturbance-operated (antihandling) fuze may be fitted, of a type such that bombs which have come to rest on the ground are thereafter exploded by the least jar or movement.

The Italian 4 A.R.**(thermos) bomb is normally equipped with an antidisturbance fuze which functions if the bomb is moved or jarred after coming to rest on the ground. This bomb resembles a thermos bottle in general size and shape, and may attract the curious to pick it up, kick it, or otherwise disturb it -- to their extreme misfortune. It partakes of the nature of a booby trap, though it is distributed by airplanes.

It may be pointed out that antipersonnel bombs equipped with these antihandling fuzes are not only fatal to the unwary -- they are annoying and difficult to dispose of even when their nature is thoroughly understood. Thus they serve to hamper operations on ground where they have been dropped.

The Japanese 50-kilogram phosphorous pellet bomb is a dual-purpose bomb combining antipersonnel and incendiary effects. On detonation, the steel bomb-body fragments are projected at high velocity in a flat cone, and numerous phosphorous-impregnated pellets are scattered. This bomb is described as being quite effective for antipersonnel uses.

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*[SD is the designation for a bomb with a thick casing, which achieves its effect chiefly by fragmentation.]
** [Armamento Ritardato - delayed action.]

The German 2.2-kilogram I.B.E.N. (incendiary bomb with explosive nose) similarly combines incendiary and antipersonnel effect; but this bomb is primarily an incendiary, with the high-explosive and antipersonnel component added to hamper and delay fire fighters. The antipersonnel component may break off and come to rest at a distance from the incendiary portion of the bomb, yet function nevertheless. It explodes from 1 to 7 minutes (approximate time) after the incendiary portion has functioned. The delay is unpredictable, and varies with individual bombs.

During the Japanese raid on Rangoon, 23 December 1941, some ten or a dozen antipersonnel bombs fell in an open space of about 150 by 250 yards, which was laced with slit trenches. But the people were on top of the trenches and even ran out of them, with the result that 250 were killed on the spot in a few minutes. The wounds were generally terrible leg and stomach injuries. The most fatal zone was within 50 to 60 yards of the burst, but some individuals were killed up to 300 yards away.

Had these people remained in the trenches, even without overhead cover, the casualties would have been neglibile by comparison. The slit trench or fox hole provides excellent protection against small fragmentation bombs. Wherever they may be expected, a little "digging in" will pay dividends.

Corresponding destruction has been achieved on aircraft or motor transport caught undispersed in the open.

While the SD 2 "butterfly" bomb and the 4 A.R. "thermos" bomb are especially to be avoided, unexploded specimens of any fragmentation bomb should be given a wide berth. Failure of the fuze to function normally on impact may nevertheless leave the bomb in a highly sensitive condition; and the disposal of such "duds" can be safely undertaken only by specially trained personnel.

2. JAPANESE CAMOUFLAGE AND DECEPTION METHODS ON AIRFIELDS

Little use of camouflage by the Japanese has been found thus far on existing airfields or newly-constructed strips, and no extensive schemes for their concealment. What little means of concealment have been noticed may be classified as follows; (a) use of natural foliage (branches of trees, etc.) to cover objects; (b) use of nets or similar material to obscure outline; (c) use of covered "hangarettes," etc., to conceal aircraft, and (d) concealment by dispersion in woods and scrub.

Disruptive painting of buildings has been noticed infrequently. On the roof of one service hangar was noticed a disruptive camouflage, but no attempt was made to break up its sharp outline, and it was plainly visible against the light-toned background of the area upon which it was situated.

Branches and foliage were used to disguise fighter aircraft on one airfield and were found to effectively conceal details, but the aircraft had not been dispersed in the adjacent scrub and were easily detected.

The most extensive use of nets has been in the form of individual nets to disguise the outlines of aircraft. This is sometimes done merely by draping a large net over an aircraft, and at other times, by laying nets over a rough framework of long poles. Both methods achieve the desired result of making the exact study of the aircraft's form and measurements difficult; they do not mask the presence of aircraft.

Lightly built movable "hangarettes" are used by the Japanese on airfields in China, Thailand, and Burma. Sometimes these "hangarettes" stand by themselves; at other times they are placed inside the blast walls of aircraft shelters. These "hangarettes" are built of wood or of light bamboo framework covered with openwork matting. They vary in form from inverted V-section tents to inverted U-shaped structures like Nissen huts, and house-like structures with straight walls and pitched roof. They are not extensively used by the Japanese, there being only about an average of 50 on the Burma airfields photographed in the last 6 months, as against a total of over 1,000 aircraft shelters in Burma. Frequently they do not afford complete concealment and the outlines of the aircraft can be seen through the "matting." No covered aircraft shelters affording complete concealment are used by the Japanese in Burma.

Occasionally the Japanese have made use of gaps in hedges, and have dispersed fighter aircraft in these gaps so that they are very inconspicuous. This is a common practice in German-occupied airfields in Europe. There has been a recent tendency on Japanese airfields to disperse the aircraft at greater distances and with greater care, hiding them among scrub and bushes on the outskirts of the area. The sequence in disposal of aircraft in enemy-occupied Burma is interesting. During the Japanese advance in May-June 1942, aircraft were parked along runways with no attempt at concealment. This was followed by the very extensive construction, not far from the runways, of blast shelters, sometimes with internal "hangarettes." The latest practice according to photographs is, as has been stated above, toward deliberate concealment in far more widely dispersed areas.

The use of dummy aircraft and other indications to give a false impression of the presence or availability of landing grounds has been noted on several occasions. In one instance, unserviceable aircraft were lined up on the main airfield and the satellite landing strips to suggest that these were in use, when other indications showed that they were most likely to be unusable. A recent study of another airfield has shown 8 unserviceable aircraft used as dummies since the beginning of December 1942. Near another there was an arrangement of rough 2-dimensional dummies representing fighter aircraft, with dummy corner-markings adjacent, which may have been intended to constitute a decoy site for the actual airfield. A single dummy aircraft, partly 3-dimensional and partly flat, was constructed in open country near still another airfield.

3. NEW ULTRA-HIGH-VELOCITY GERMAN "88"

a. General

The well-known German 88-mm dual-purpose Flak 36 has, according to a recent British report, now been greatly improved upon in the new dual-purpose 88-mm Flak 41, which develops, without choked boring, the remarkable estimated velocity of 3,400 fs. The 36 was considered a high-velocity gun with a muzzle velocity of only 2,690 fs. As an antiaircraft weapon, the new gun is believed to have a maximum ceiling of 45,000 feet, and an effective ceiling of from 36,000 to 38,500 feet as compared to 32,500 maximum and 26,250 effective, for the older gun. This excellent performance is not the result of firing a lighter projectile. In fact, the new shell weighs 22.4 pounds against 21 pounds for the 36. The propelling charge has been stepped up from 5.34 pounds to 11.9 pounds, more than half the weight of the shell.

b. The Gun

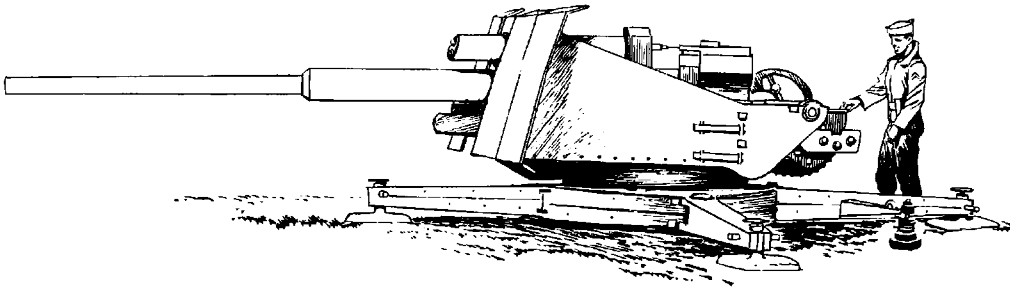
As indicated in the accompanying sketches, the new gun can be recognized by the thick sleeve that projects about a yard in front of the shield and by the longer barrel--about 3 feet more than that of the 36. In spite of its increased power, the gun is reported to be lighter than the old 88, due to a better and lighter design of the carriage. The shield has been built up on the sides, an improvement on the 36, and the gun is equipped for electric firing. According to report, the recoil mechanism is quite similar to the Flak 36, but strengthened. It is probable that some of these guns have been provided with self-propelled mounts, thus enabling them to be used for antitank as well as antiaircraft purposes. Such weapons would be a formidable answer to our own tank-destroyer with the long 155. The armor penetration at long antitank range is practically 6 inches, and the trajectory is obviously quite flat.

Against homogenous armor the performance with the APCBC* shell, as compared with the Model 36, is as follows:

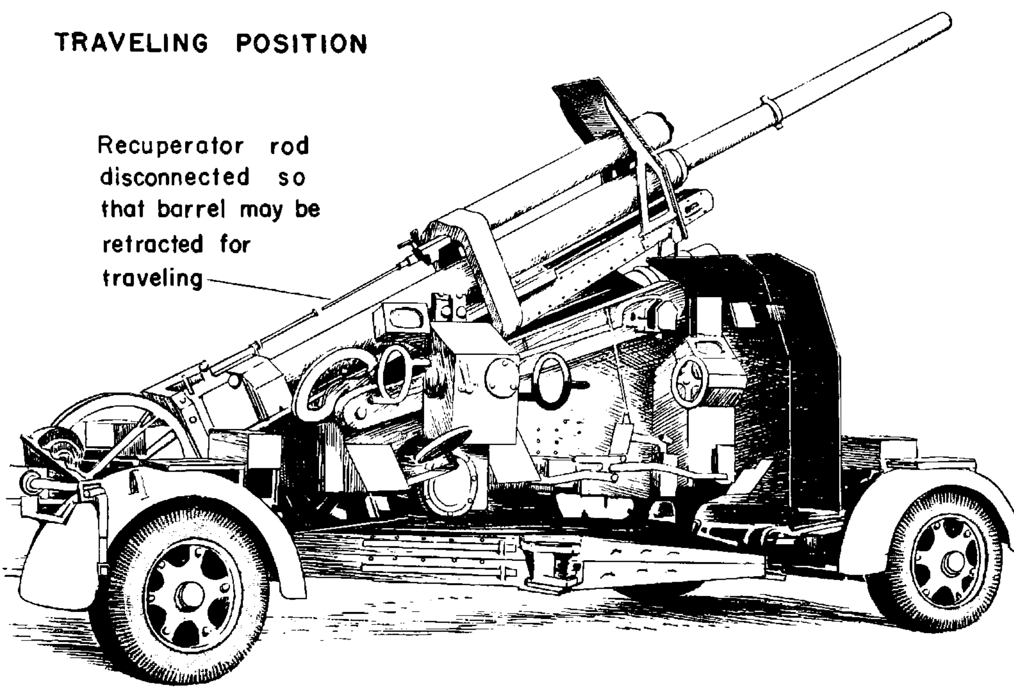
Range yards	Normal		30 Deg.	
	Flak 41	Flak 36	Flak 41	Flak 36
Point Blank	7.76 in	---	6.65 in	---
500	7.28 in	5.08 in	6.26 in	4.33 in
1,000	6.85 in	4.69 in	5.87 in	3.97 in
1,500	6.42 in	4.33 in	5.47 in	3.58 in
2,000	5.98 in	3.94 in	5.12 in	3.23 in
2,500	5.59 in	---	4.76 in	---

*Armor-piercing capped with ballistic cap (British abbreviation)

FIRING POSITION



TRAVELING POSITION



GERMAN 8.8-CM FLAK 41

c. The AP Ammunition

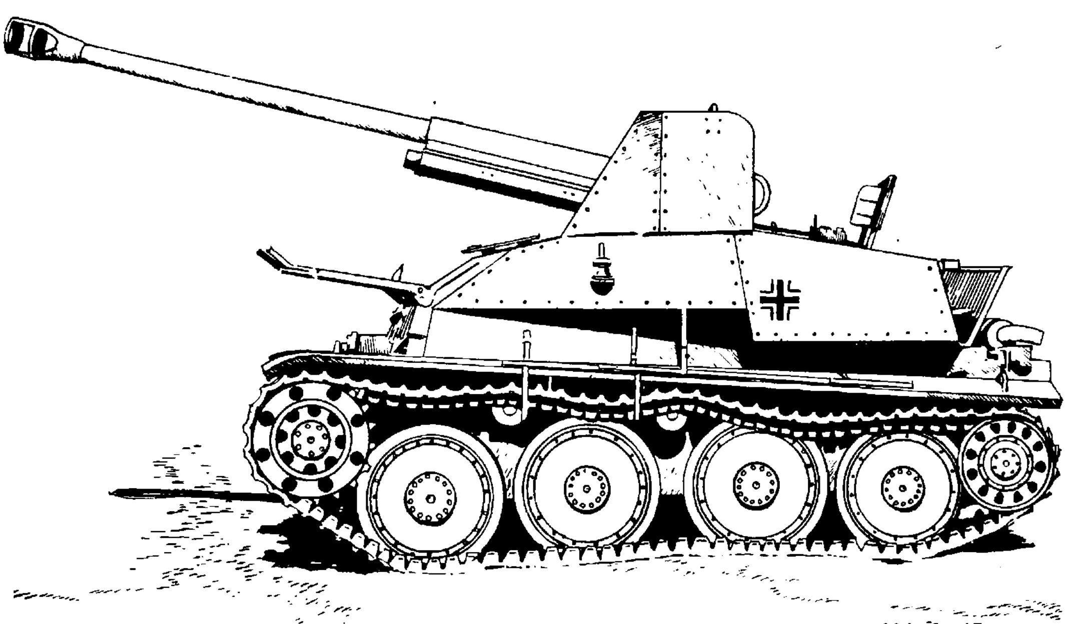
The APCBC projectile, as stated, weighs 22.4 pounds, with the remarkably small bursting charge of 2.12 ounces of HE--scarcely more than the load of some hand grenades. The decrease in the HE capacity from 1.6 percent in the Flak 36, 21-pound shell to only 0.59 percent in the 41 is in line with the German policy of decreasing the HE capacity while increasing the weight of the APCBC shell. The complete round is 45.5 inches long against 34.2 for the Flak 36. The propellant charge of 11.9 pounds is of the flashless type. While hitherto only the heavier antiaircraft guns have been electrically fired, this ammunition is fitted with an electric-type primer instead of a percussion primer. The projectile is reported to have a black-and-white tip. From documentary sources, a similar type of shell is known to exist for ordinary 88's. The rounds are stated to be packed separately in metal cylinders.

ANTITANK

4. GERMAN 76.2-MM SELF-PROPELLED GUN

Further information has been reported from official sources about this weapon, previously referred to in Tactical and Technical Trends, No. 21, p. 6.

It appears that to date the only 76.2-mm piece reported mounted on the 38 light (t)* tank chassis is a long-chambered version of the Russian field piece 76.2-mm FK (Feldkanone, field piece 36 (r).*



GERMAN 76.2-MM SELF-PROPELLED GUN

*The letter t stands for Czech; r for Russian.

The long-chambered piece and the Russian light field piece are identical except for the following differences:

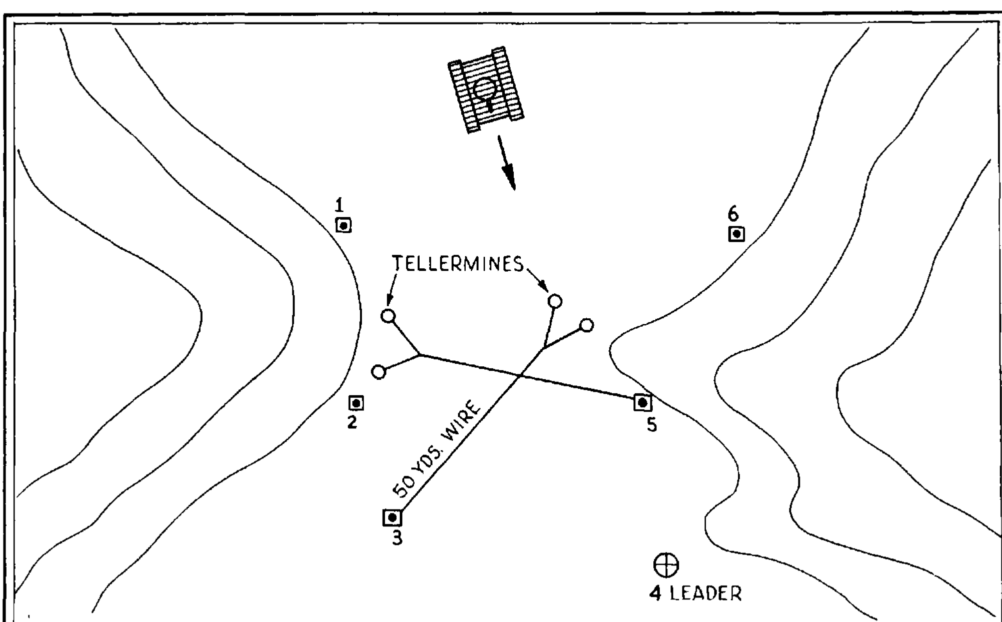
	76.2-mm as mounted on 38 (t) tank	76.2-mm FK 36 (r)
Muzzle brake	Yes	No
Length of chamber (approx)	28 in	15 in
Chamber volume (approx)	3,600 cc	1,780 cc
Maximum range (estimated)	15,000 yds	8,000 yds

Both pieces have Russian markings; however, the only known long cartridge case ammunition is of German manufacture.

It is also of interest to note that the same cartridge case is used in the 75-mm Pak 40 (antitank) as is used in the long-chambered 76.2 mm.

5. GERMAN "TANK HUNTING" TACTICS

The following information on the employment of magnetic mines by German infantry antitank squads has come from a credible German source. Six men are assigned as an antitank team, generally for night operations in positions



offering possible avenues of tank approach. The team is deployed in the form of a U at intervals of approximately 50 yards, adapting itself to the terrain for observation and field of fire.

All men are armed with machine pistols and antitank, magnetic hollow-charges. The team leader, No. 4, carries a pyrotechnic pistol. In addition, four Tellermines are carried for placing in the probable path of the tank and are controlled by a 50-yard length of wire by which they can be pulled under the approaching tank.

When a tank comes on, the team leader fires a pyrotechnic charge directly at the turret of the tank and momentarily blinds the crew. At the same time Nos. 3 and 5 pull Tellermines into its path, and No. 2 rushes forward to place the magnetic charge on the side armor plate of the tank. Meanwhile, No. 4 covers the turret-hatch to prevent the escape of the crew; Nos. 1 and 6 cover the ground behind the tank for possible infantry accompanying it. Each man is interchangeable with the others of the team and his duties are determined by the terrain.

ARMORED FORCE

6. ARMOR ARRANGEMENT ON GERMAN TANKS

The accompanying sketches show the armor arrangement on current models of the PzKw 2, 3, 4, and 6. These sketches are believed to be accurate and up-to-date. Armor thicknesses (circled figures) are given in millimeters; their equivalent in inches may be found in the article beginning on page 30. A question mark following some of these figures indicates that definite information is not available. Where two small figures appear in parentheses, it indicates that there are 2 plates at this point; in only 2 instances, namely on the PzKw 3, are the 2 plates separated to form so-called spaced armor.

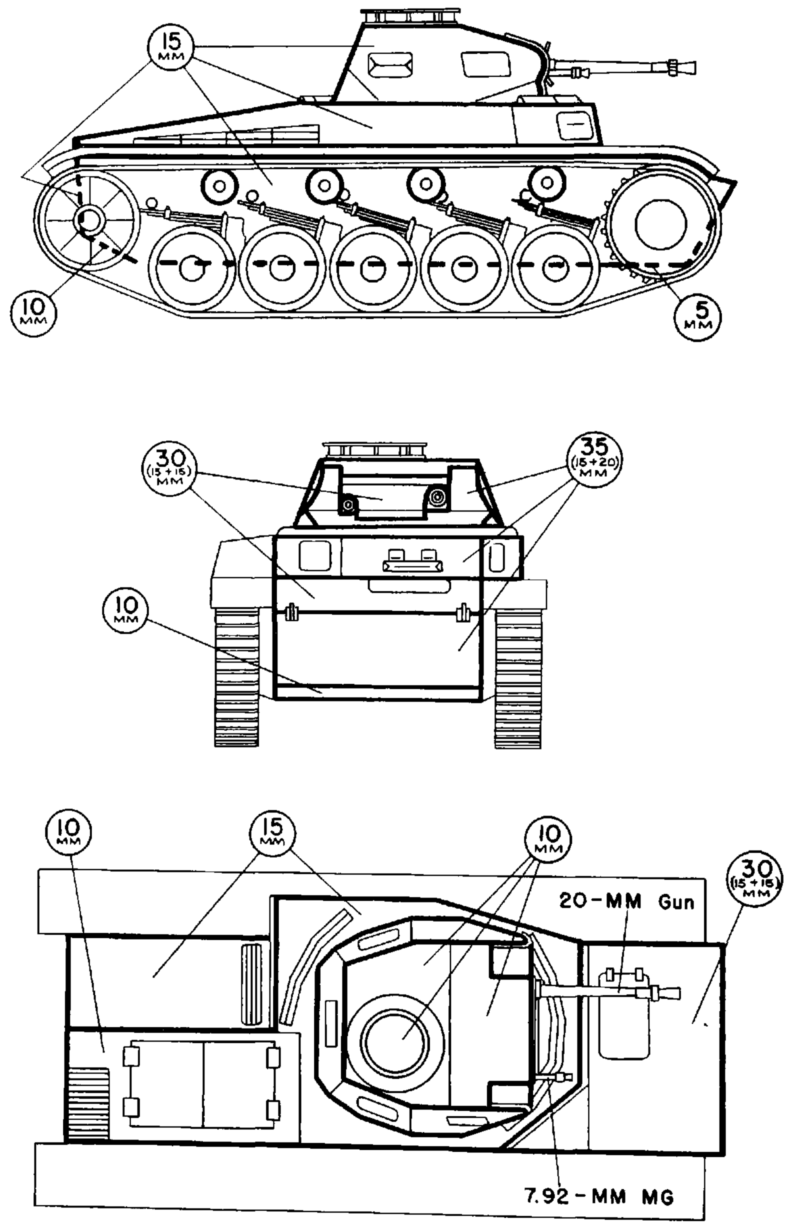
The armament of these tanks is also shown.

ARTILLERY

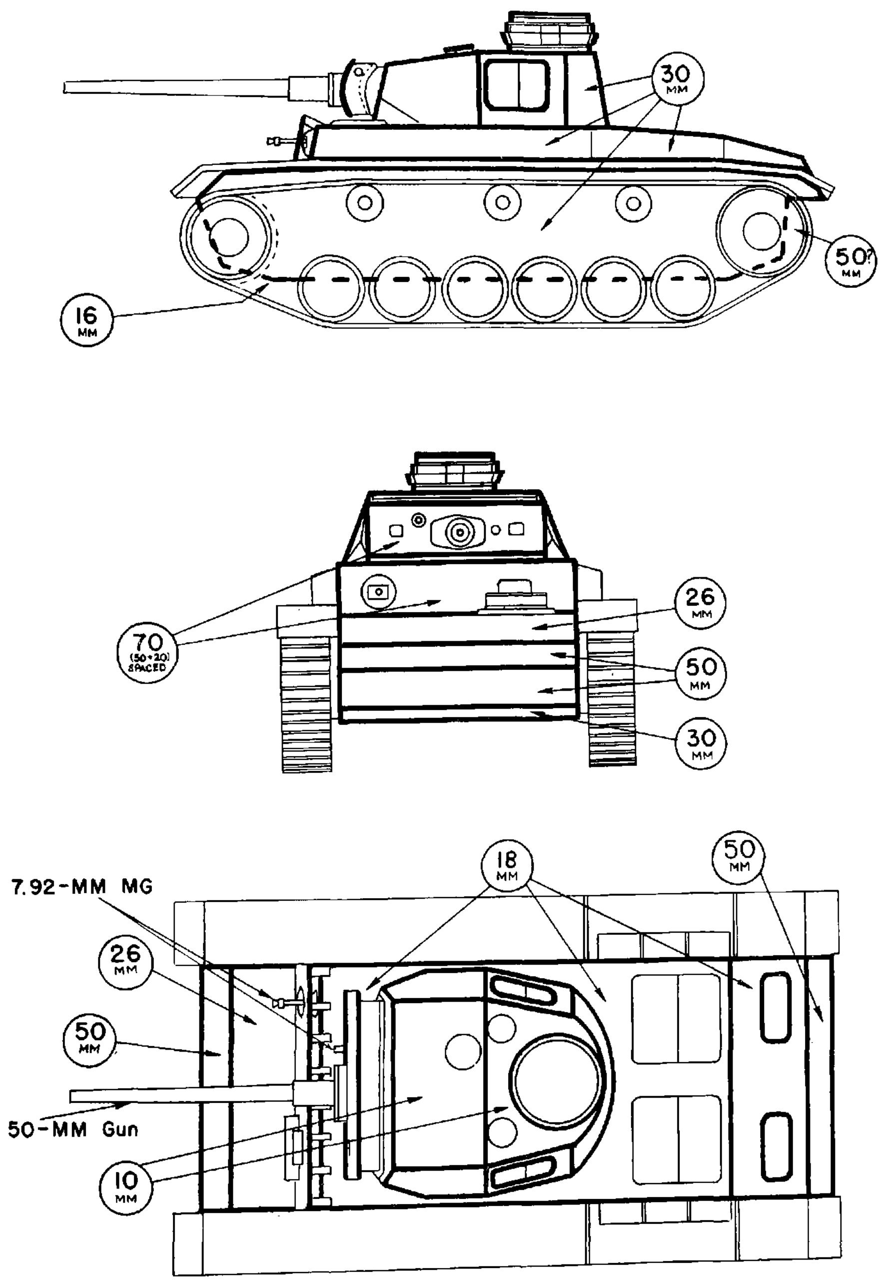
7. ARTILLERY COMMAND IN THE GERMAN ARMY

In the German Army all artillery apart from the relatively small divisional allotment belongs to the GHQ pool (Heerestruppen). Units are allotted from this pool to army groups or armies according to the estimated needs. They may be sub-allotted to corps or divisions. The commander of the divisional artillery regiment, Artillerieführer or Arfü, commands the divisional artillery when it is not reinforced from the GHQ pool.

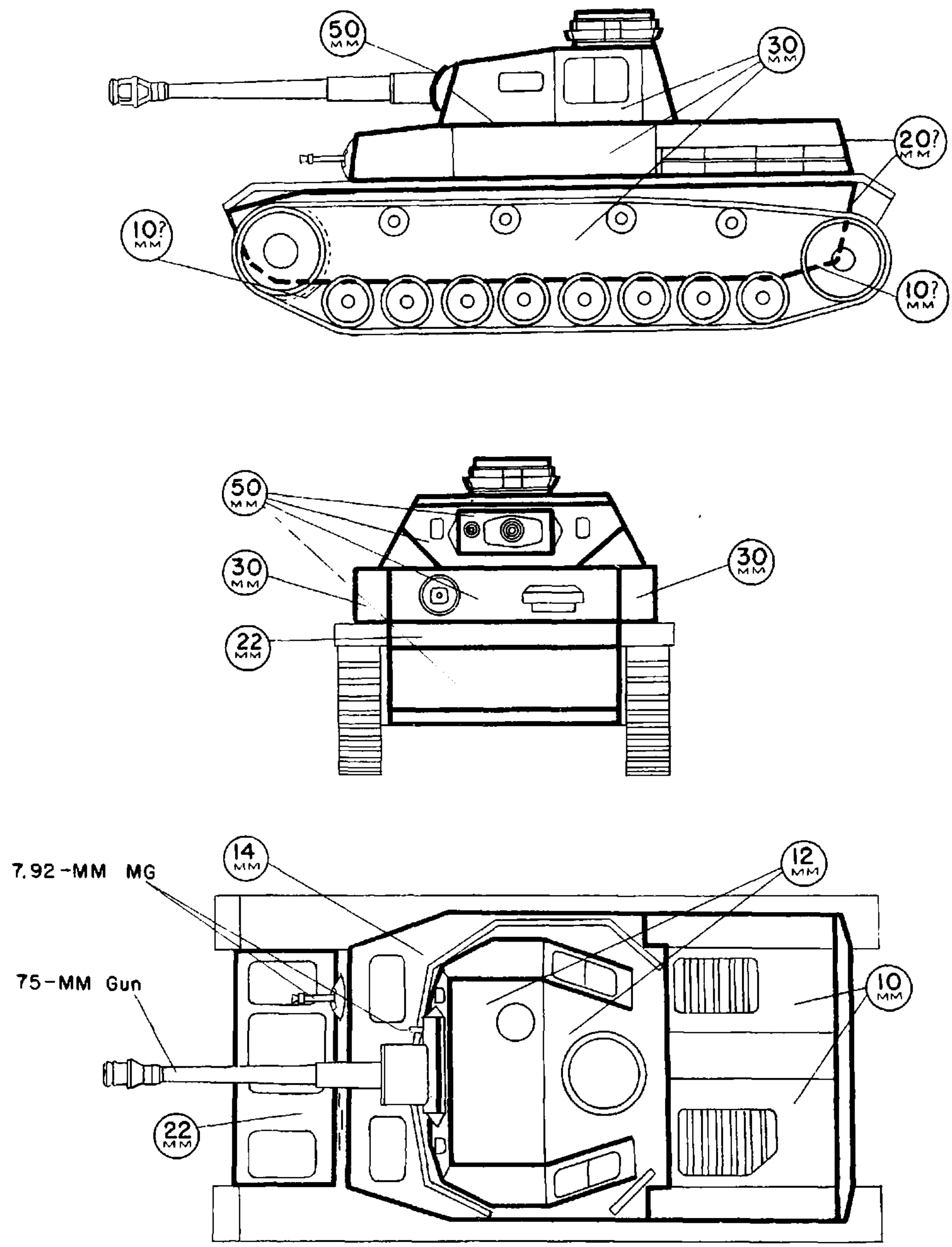
When GHQ artillery units are attached to the division, the Arfü is usually subordinated to an Artillery Commander, Artilleriekommandeur, abbreviated Arko, who with his staff is likewise from GHQ. An Arko may also be assigned to command an allotment of GHQ artillery to a corps. When no GHQ artillery has been assigned to an army group or army, an Artillery General Stabsoffizier der


15 MM
10 MM
5 MM
30 (15 + 15) MM
35 (15 + 20) MM
10 MM
10 MM
15 MM
10 MM
30 (15 + 15) MM
20-MM Gun
7.92-MM MG

Pz. Kw. 2

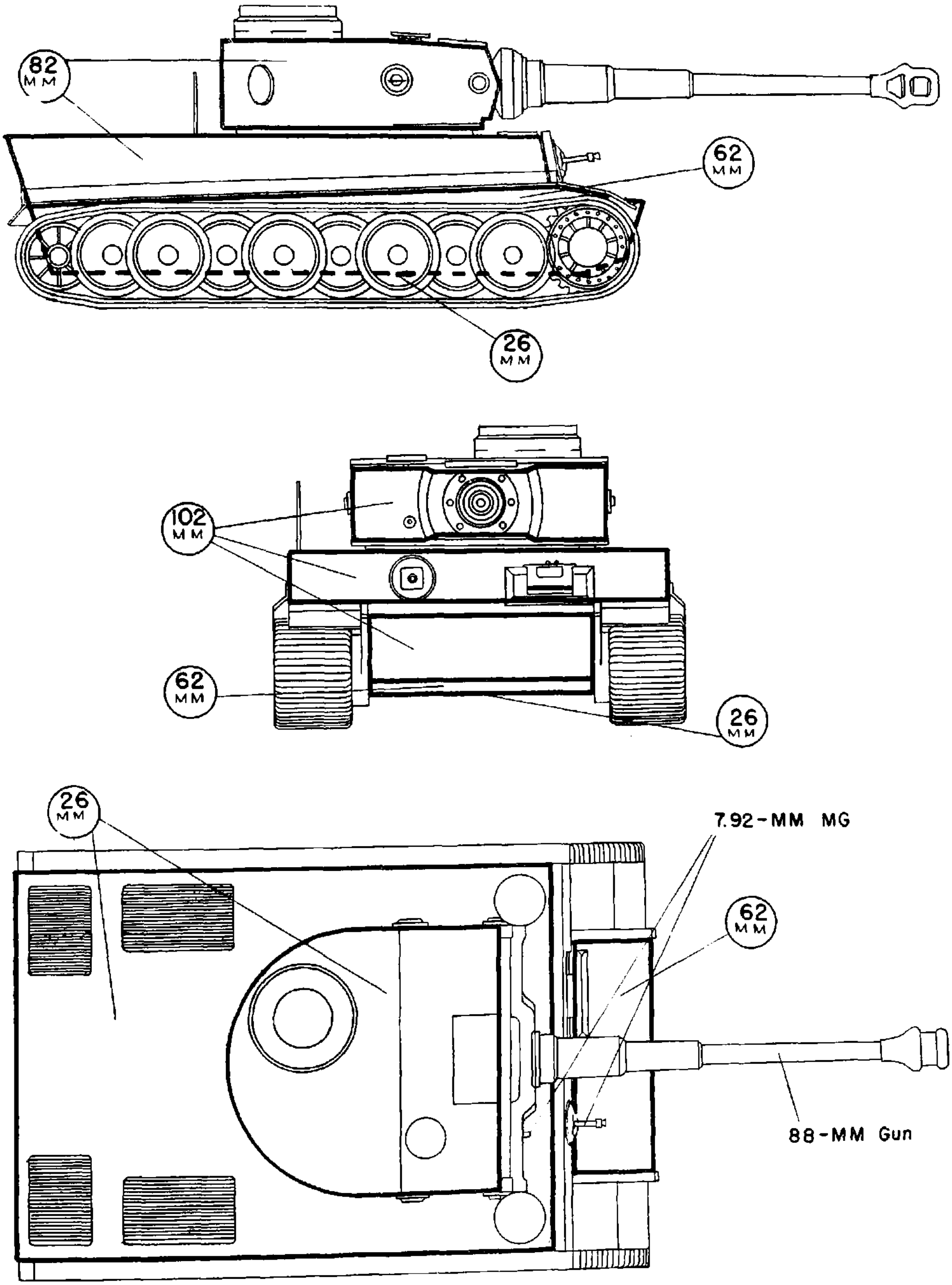

30 MM
50? MM
16 MM
26 MM
70 (50+20) SPACED
50 MM
30 MM
18 MM
50 MM
7.92-MM MG
26 MM
50 MM
50-MM Gun
10 MM

Pz. Kw. 3



50 MM
30 MM
20? MM
10? MM
10? MM
50 MM
30 MM
30 MM
22 MM
14 MM
12 MM
7.92-MM MG
75-MM Gun
10 MM
22 MM

Pz. Kw. 4



Pz. Kw. 6

Artillerie, abbreviated Stoart, advises the army group or army commander on artillery matters. When GHQ artillery units have been attached to an army, a Higher Artillery Commander, Höherer Artilleriekommandeur, abbreviated Höh, Arko, is assigned to the army. A recent report from British sources gives some interesting details as to the powers and duties of a Higher Artillery Commander of an army, and of an Artillery Commander.

a. Powers and Duties of a Higher Artillery Commander of an Army

The Higher Artillery Commander of an army is directly responsible to the army commander. He is at the disposal of the army commander for the supervision of the employment of artillery, for ground reconnaissance, and for any special tasks. He supervises artillery training within the army command and keeps an eye on the state of repair of artillery equipment. He is the commander of all army artillery directly under command of the army, as well as any of the army artillery units placed at the disposal of the Army High Command or the Army Group.

He has the right to attach himself to any unit within the army area, in which case he informs the appropriate headquarters. If he is not at army headquarters or in the immediate vicinity, an officer on his staff must be detached as liaison officer to the army headquarters. In any case, there is always close cooperation between the operational section of army headquarters and the staff of the Higher Artillery Commander.

The duties of the Higher Artillery Commander may be summarized as falling into 2 categories, namely, duties within the army area and duties within the army command. As regards all artillery within the army area his individual duties include:

(1) Organization of the employment of all methods for artillery reconnaissance, meteorological services, etc., in cooperation with neighboring armies;

(2) Control of artillery cooperation with the Air Force and with mapping and plotting units;

(3) The supervision of artillery training;

(4) Constant watch on the state of repair of artillery equipment;

(5) Participation in the delivery and return of guns;

(6) Submitting reports to the army high command as to experiences with artillery equipment;

As to army artillery within the army command his duties include:

(1) Assignment of officer personnel;

(2) Requests for, and distribution of, reinforcements;

(3) The control of supplies of weapons and equipment, clothing, motor transport, and tires.

b. Powers and Duties of an Artillery Commander

The Artillery Commander belongs to GHQ troops. He is assigned to a division or directly to a corps. He retains the right to attach himself to any artillery unit in agreement with the appropriate division headquarters. He maintains close cooperation with the higher artillery command of the army, and as regards signal matters has the cooperation of both divisions and corps signal battalions.

When under command of a division, he assumes the role of the Artillery Commander of the division. The division artillery is tactically under his command, but this need not alter its allocation to units.

As commander of corps artillery, or artillery group, he commands all artillery placed under command of the corps in accordance with the corps commander's orders. His duties include:

(1) Preparation for the employment of support artillery;

(2) Organization and use of support artillery;

(3) Fire-control of individual artillery groups;

(4) Cooperation of corps artillery with ground and air reconnaissance;

(5) Formation of an artillery signal net;

(6) Ammunition supplies.

In the corps area he is responsible for giving advice on all artillery matters, and for supervising artillery methods and training in the corps area. His duties include suggestions as to:

(1) Distribution of support artillery to divisions;

(2) Battle orders outside the division battle sectors;

(3) Tasks of artillery immediately under command of corps;

(4) Limits for counterbattery and harassing fire;

(5) Division artillery reconnaissance tasks outside the battle sectors;

(6) Regulation of artillery air services and reconnaissance;

(7) Regulation of artillery signal communications with the divisions;

(8) Provision of uniform plotting boards and range tables;

(9) Use of AA for protection of artillery;

(10) Ammunition supply.

CHEMICAL WARFARE

8. GERMAN AND ITALIAN INDIVIDUAL ANTIGAS EQUIPMENT

The following information briefly outlines the antigas equipment carried by the individual German and Italian soldier; it is based on the most recent information available.

a. German Army

(1) Gas Mask

The gas mask is always on the soldier's person, both in active theaters of war and elsewhere. German regulations give clear instructions to this effect. There has been some evidence that German soldiers in occupied countries only carry them when on duty. Recent information, however, indicates that German soldiers in Paris always carry gas masks.

(2) Personal Decontaminant

This consists of a box containing 10 tablets of Losantin carried by every soldier in the pocket of his uniform.

Losantin tablets are stabilized bleach, with an available chlorine content of 39.8 percent. They are used for treating skin contaminated with a vesicant. A tablet is made into paste with water or saliva which is then applied to the affected part; after 10 minutes it is washed or wiped off. The example of the incautious experimenter who ate several tablets under the impression that he was eating "Nazi food tablets" should NOT be followed.

(3) Antigas Sheet

The so-called antigas sheet it is carried in all operational theaters by every soldier in a satchel slung on the chest. These sheets, about 6 by 4 feet, are made of a rubberized fabric. They are designed primarily for protection of the person in surprise attacks with liquid vesicants.

b. Italian Army

(1) Gas Mask

The gas mask is always carried on the man.

(2) Personal Decontaminant

An "antivesicant packet" is carried by every soldier. It contains absorbent pads which are saturated with carbon tetrachloride from an ampoule which has to be broken. The contamination is then dabbed off with the moistened pad.

(3) Antigas Sheet

There has been no reference in any Italian manuals or orders to the existence of an antigas sheet, and none have been reported as having been captured. It is presumed that none have been introduced.

ENGINEERS

9. CONSTRUCTION OF SUBMERGED BRIDGE

The following description of the construction of a submerged bridge is a condensation of an article originally appearing in the Soviet "Red Star."

It was pointed out in this article that bridges built above the water are easily observed from the air and on aerial photographs, whereas bridges built below the surface of the water cannot be detected from altitudes greater than 900 feet and will not show up on aerial photographs.

Satisfactory conditions for use of submerged bridges are (1) that the enemy has not previously photographed the area of the crossing, or that the approaches to the crossing do not reveal the location -- either by the fact that existing roads are used or new ones constructed along the bank above and below crossing points; and (2) that there are no sharp changes in water level. It is sometimes more advisable to construct a submerged bridge within 2 kilometers of an already existing bridge above water. In such cases the enemy may bomb the latter, not knowing the submerged bridge is there.

The changes in water level cannot vary more than 10 inches. Any greater change will either cause the bridge to become impassable or be exposed.

The construction of submerged bridges is somewhat more complicated than the other types. Working under water increases the time necessary, and at times divers are needed; this requires special personnel, although well-trained troops can usually do the job without divers.

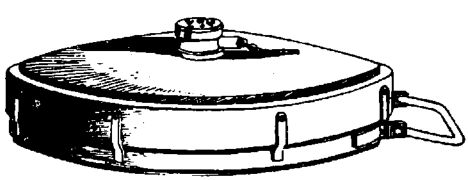
The actual construction of this type of bridge does not differ greatly from that of other bridges except perhaps in that prepared lumber is always necessary.

Care must be taken to have firm approaches; otherwise the disturbance of the water by crossing vehicles causes the approaches to wash away. This can be prevented, however, by constructing retaining walls and filling in with rock or gravel.

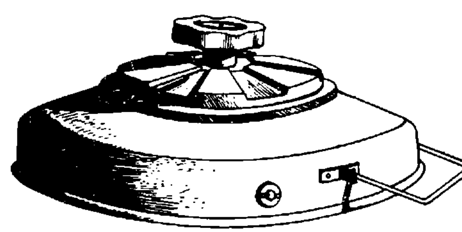
It is estimated that a 40-meter (130-foot) bridge with a 60-ton capacity requires 8 men 24 hours to prepare (but not drive in) the piles. Remarks: Our Military Attache in Moscow, commenting upon this type of construction, remarks as follows: "It was noted several days ago in the Soviet press that such bridges had been used by the Red Army, and in view of the recent creation of the medal 'Distinguished Pontoneer' it is possible that the use of such bridges has been successful."

10. GERMAN TELLERMINES

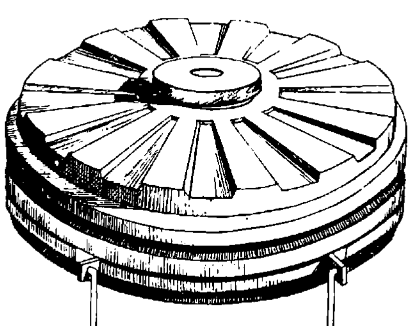
In the last issue of Tactical and Technical Trends (No. 28, p. 15), the four known German Tellermines (antitank mines), known as Tellermine Nos.



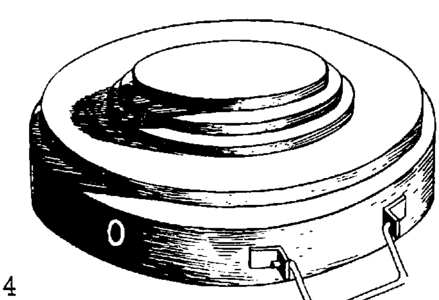
No. 1



No. 2



No. 3



No. 4

1, 2, 3, and 4, were described in some detail. An exterior view of Tellermine No. 4 is now available, and for purposes of comparison and identification the exterior views of all four mines are published herewith (see accompanying sketches). The mines are all of about the same dimensions, being approximately

12 inches in diameter and from 3 1/2 to 4 inches in over-all height. The relative scale of the 4 mines is only approximate in the sketches.

It should be noted that the pressure plates on Tellermine No. 1 and No. 3 extend over the entire top of the mines, but the pressure plates on Tellermines No. 2 and No. 4 cover only the center portion of the mine. Accordingly a tank might pass over the edge or rim of Tellermines No. 2 or No. 4 without detonating the mines, whereas the same load passing over the edge or rim of Tellermines No. 1 or No. 3 would detonate the mine. It is possible for a spread-out load of fairly low intensity covering the whole top of Tellermines No. 1 or No. 3 to detonate them, while a more heavy, concentrated load is necessary to detonate Tellermines No. 2 and No. 4.

The pressure plates on Tellermines No. 2 and No. 3 are fluted or grooved, but the pressure plates on Tellermines No. 1 and No. 4 are smooth.

INFANTRY

11. GERMAN DEFENSE OF LINES OF COMMUNICATION IN RUSSIA

An eye-witness recently returned from Russia gives the following information as to how the Germans protect their lines of communication. There are three lines of defense on either side of the road or railway to be defended, viz:

The First Line--This is situated approximately 10 miles from the road or railway and consists of wire with occasional machine-gun posts, and is only intended to give warning and delay infantry.

The Second Line--The defense areas in this line, which is about 2 miles behind the wire, are dzots or timber-reenforced, dug-in earthworks, containing heavy machine guns, mortars and light artillery and antitank guns. They are invariably arranged for all-around defense. These dzots are normally sited on road forks, cross roads, or in farm yards.

The Third Line--This, too, is based on dzots and is normally found about two miles from the road or railway to be protected. Here there are two or three rows of dzots centered on a village and inter-connected by shallow trenches. They are in radio or wire communication with each other and have, within the perimeter, artillery and a mobile force of light tanks and infantry, carrying automatic rifles. Tanks that have been knocked out are also dug in to turret level to form strongpoints.

Between the second and third lines, the terrain is mined and antitank obstacles are constructed. These, where possible, are covered by antitank guns.

Comment: Defense of lines of communication assumes added importance when it is realized that there is no well-defined line, in Russia, and parties from both sides operate as far as 20 miles behind each other's forward positions.

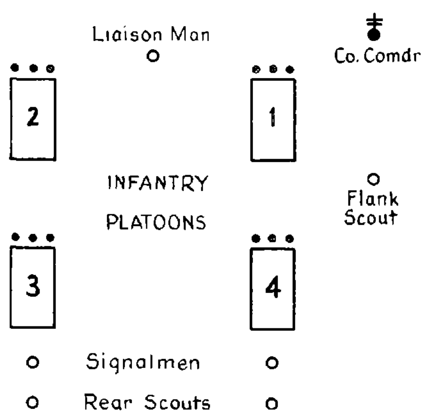
12. JAPANESE NOTES ON JUNGLE WARFARE

In planning their training for jungle warfare, the Japanese have been conscious of the great varieties of the jungle country of East Asia and the southwest Pacific area. The following points on jungle warfare taken from Japanese sources emphasize certain methods of jungle warfare apparently tested by Japanese experience.

* * *

a. The Advance

Leave some distance between the leading unit and the main body, and distribute liaison men between units; although it is best to relieve the unit each day, the officer commanding the leading unit should not be changed.



The above diagram reporduced from a Japanese diary had the caption, "Suggested Formation for a Company Advancing through Jungle."

It is essential for the leading unit to include in the regular reports to the commanding officer in the rear, the condition of the trail and the type of country.

As there are clearings in the jungle, the commanding officer must advance his units by bounds and rushes from one area to another. Camouflage of each man and each gun must be complete. When crossing a grassy plain, cover everything with grass. If enemy planes appear while you are in a clearing, lie still. Generally, riflemen must support the heavy weapons. The minimum is one rifle platoon for a machine-gun company and one for the battalion gun platoon.

When bivouacking in the jungle, cooking should be done in several places, well away from the bivouac area. All fires should be extinguished immediately after cooking. During the advance, communication will be by telephone and runner. Radio will not be used. The rate of advance will be regulated by that of the heavy weapons. The distance covered in a day will usually be between 3 to 5 miles.

b. The Attack

When selecting assembly areas for the attack, try to disperse units, and choose places which are naturally camouflaged. The concentration of the main force at the assembly point for the attack, must be made at night. If enemy artillery fire is encountered, it is important that this be neutralized before units take up their positions. Attacking units will move to the edge of the forest during darkness, crawling if necessary. On signal, they will rush the enemy positions. As it is best for each flank unit to make a rush at the same time, the time of the attack should be coordinated.

13. GERMAN VIEWS ON SNIPING

A German source reports the following notes dealing with snipers and the use of rifles with telescopic sights.

*   *   *

(1) Rifles with telescopic sights must be given to the best marksmen irrespective of rank. This should be looked upon as an honor, and changes should be avoided as far as possible;

(2) Continuous fire should be kept up when on the defensive in order to harass the enemy;

(3) During the attack the sniper should concentrate on the particularly dangerous targets and flanking movements. He should be situated some distance away from his squad and so be used for observation. Combination with mortar and rifle grenades is particularly effective, as the enemy can then be sniped at when he has been forced out from his cover.

When considering the telescopic sight it must be realized that the greater the magnification, the smaller the field of vision. A telescopic sight with wide field of vision and high magnification is not available for general service because of its size and its sensitivity. Further experiments in this respect are, however, being carried out. A telescopic sight of the sporting type is not suitable for military purposes and cannot be manufactured within a short period in sufficient quantities for issue in large numbers. The intention is to issue as many serviceable telescopic sights as possible, and not to develop just a few high-grade optical instruments.

The present telescopic sight has a low magnification but has been confirmed by experimental units as practical and rugged. When properly handled, it is effective in the field.

Sights must be tested before issue and, if necessary, corrected. This is nearly always the case when the sights have been transported for long periods.

For good results a fork rest is sometimes advisable. The range may have to be determined by using tracer; the actual sniping should be done from another position as the tracer will have given away the original position.

It is intended to issue one telescopic sight to each company and platoon HQ, and to each rifle squad. A special sniper's badge is under consideration.

Comment: This is evidence of increased German interest in sniping on a large scale. It is known that the Germans have been much impressed by Russian sniping methods.

14. GERMAN REARGUARD ACTION ON BRITISH EIGHTH ARMY FRONT

An example of the skillful maneuvers of the German rearguard action, on the British Eighth Army Front (January 1943) emphasizes the Germans' practical use of natural cover and natural tank obstacles.

The foundation of the German rearguard positions was always the 88-mm gun with 50-mm AT guns concentrated within the position. For support, reliance was placed on artillery (105's and 210's, and 75's on self-propelled mounts), tanks, engineers, and infantry well equipped with machine guns and mortars.

The German rearguard screen or protection in the initial stages (open desert) was at first deployed over a wide front. Artillery was here used (including the 88's) at extreme range to hold up the British advance and cause deployment. For this same purpose, mines were effectively used, including dummy minefields.

The Germans moved their tanks to engage the attention of British tanks and OPs while concentrating their antitank guns on the British line of advance, and then withdrew their tanks to hull-down positions.

No attempt was made to withdraw the antitank guns until dusk--in some cases after dark--when the German tanks invariably moved forward to cover their withdrawal.

Except in close country where natural cover and concealment afforded protection, the 50-mm guns were always placed in defiladed position.

A covered route of withdrawal was always provided for the antitank guns. Infantry were placed to protect the antitank guns against infantry attack; the protection was achieved by machine guns and mortar fire from the flanks and not by men in front of the guns.

The Germans made good use of both natural cover and natural tank obstacles in the siting of their guns; however, the damage inflicted was negligible, since it was preferred to hold up the British by firing at extreme range, rather than wait until there was certainty of making a "kill."

MEDICAL

15. SOME NOTES ON HEALTH PRECAUTIONS

Certain elementary precautions for use in tropical warfare are contained in the following notes taken from British sources.

*   *   *

Reports of the operations in New Guinea emphasize the necessity of a high standard of physical fitness; all troops must arrive in the area fit and hard. In order to maintain this high standard, close attention to unit and personal hygiene is at all times essential. In the jungle, troops often bivouac in small detachments, and it must be their personal responsibility to ensure that the precautions that they have been taught are faithfully observed. Strict adherence to malaria discipline is particularly important; otherwise, a force may suffer more casualties from malaria than through enemy action.

Clothing and boots are continually wet in the damp climate of most tropical countries, and full use must be made of every opportunity of drying them. In particular, boots should be removed at least once a day and the feet dried by vigorous rubbing. Neglect of this precaution may lead to personnel becoming ineffective through a form of trench foot. Arms and legs must be kept covered as protection against insects and infection from the undergrowth, and troops must be prepared to wear slacks instead of shorts in spite of the discomfort.

The provision of hot meals or hot drink is as important in the jungle as elsewhere, but when in close contact with the enemy, the necessity for concealment makes any form of cooking difficult. Troops should be capable of doing their own cooking, but experience has shown that supervision is necessary to ensure that mess equipment is properly cleaned after use in order to avoid dysentery.

Although what follows is not perhaps immediately related to this general subject, nevertheless it is not wholly out of place here. Many casualties have been caused among troops who have gone to the aid of wounded men during their advance. Troops must not be deflected from the operation in hand, and must realize that they will be of more assistance to the wounded by pushing on to their objectives and thus enabling medical personnel to come forward. The Japanese often fire along lanes in the jungle and, when possible, casualties should try to crawl to a flank where they can be aided in greater safety.

ORDNANCE

16. TWO GERMAN 100-MM SMOKE/HE MORTARS

In Tactical and Technical Trends, No. 24, p. 24 was published an account, based on the best sources then available, of a German 100-mm mortar. A more recent report indicates that there are not one, but two such weapons, and the original account was inaccurate in many details because of incomplete source data. More information on these mortars has now come in.

a. The 100-mm (4-inch) German Smoke Mortar (10-cm Nebelwerfer 35)

This mortar, the standard smoke-CW weapon of the German Army, is actually 105 mm in caliber. HE ammunition, however, is also fired, and the

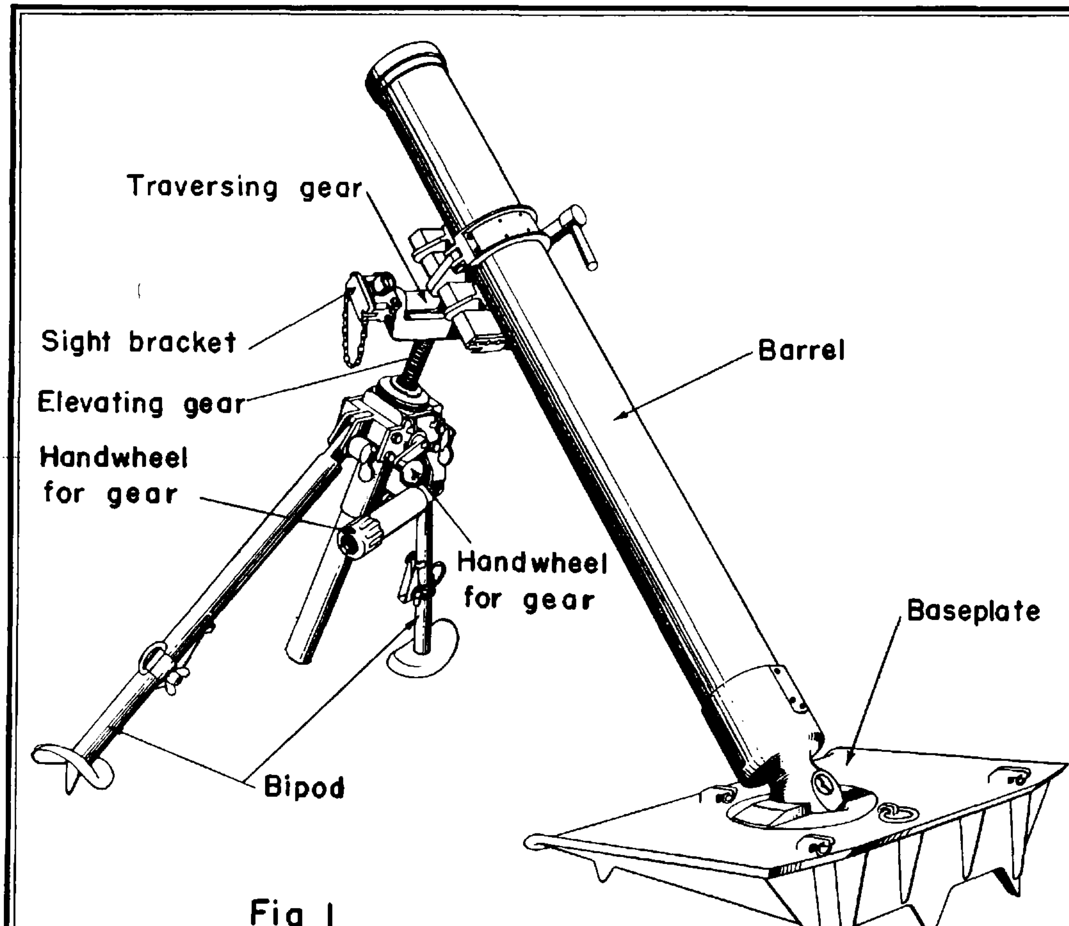


Fig I

mortar is used to some extent by airborne troops. It consists of a barrel, bipod, ·d baseplate constructed on the familiar German lines--a scaled-up version of the German 81-mm mortar with the exception of the traversing gear. In this case, the traversing screw is housed in a sleeve by the two ends of a bow-shaped yoke, secured to the top of the elevating screw (see figure 1).

The particulars of the mortar follow:

Weight in action	231 lbs	Weight of bomb	16 lbs
Weight in barrel	72 lbs	Maximum range	3,300 yds
Weight of bipod	73 lbs	Rate of fire	12-15 rpm
Weight of baseplate	85 lbs	Crew	5 men

Transport, two-wheeled handcart

The details of the HE bomb are:

Weight	16 lbs	Color	greenish gray
Weight of filling	3 lbs 12 ozs	Length over-all	17.12 in
Filling	TNT	Maximum diameter	4.09 in
Fuze	Nose -percuss <u>Type</u> <u>WgrZ</u>*<u>38</u>	No of charges	primary plus four augmenting
Weight of primary charge	262 grains	Weight of augmenting charge, each	324 grains
Booster	Standard mortar bomb booster, type <u>Zdlg</u>**<u>c/98</u> <u>Np</u> with small smoke box	Packing	Singly in container; weight with bomb, about 20 pounds.

*Werfergranatzünder - mortar shell fuze
**Zündladung - detonation charge

b. <u>100-mm (4-inch) Smoke Mortar 40 (10-cm Nebelwerfer 40)</u>

While full details are not yet at hand, it will be seen from figure 2 that the mortar is fired from a two-wheeled, rubber-tired carriage, provided with a rectangular baseplate. It is, in addition, known to be breech loading, an unusual feature in mortars, and has a rather long, smooth-bore barrel of 5.64 feet which presumably forced the adoption of breech loading. It would be interesting to learn how the breech mechanism operates.

Under the barrel will be noted in the illustration a tube that looks quite like a recoil mechanism, presumably to take up some of the stresses. The weapon throws a 19-pound bomb, either HE or smoke, from a 550-yard minimum, to the very respectable maximum range of 6,780 yards, nearly 4 miles, at a rate of from 8 to 10 rounds per minute. The elevation is from 44.8 to 84.6 degrees, and the traverse 7 degrees, right or left. Three charges can be used; charge I, 2.08 ounces, giving a muzzle velocity of 427 foot seconds; II, 4.76 ounces, 755 foot seconds, and III, with 8.78 ounces, which develops a velocity of 1,017 foot seconds. Altogether, this rather odd weapon presents a curious combination of a mobile, smooth-bore, gun-howitzer of considerable power on a light, handy mount, with extremely interesting tactical possibilities.

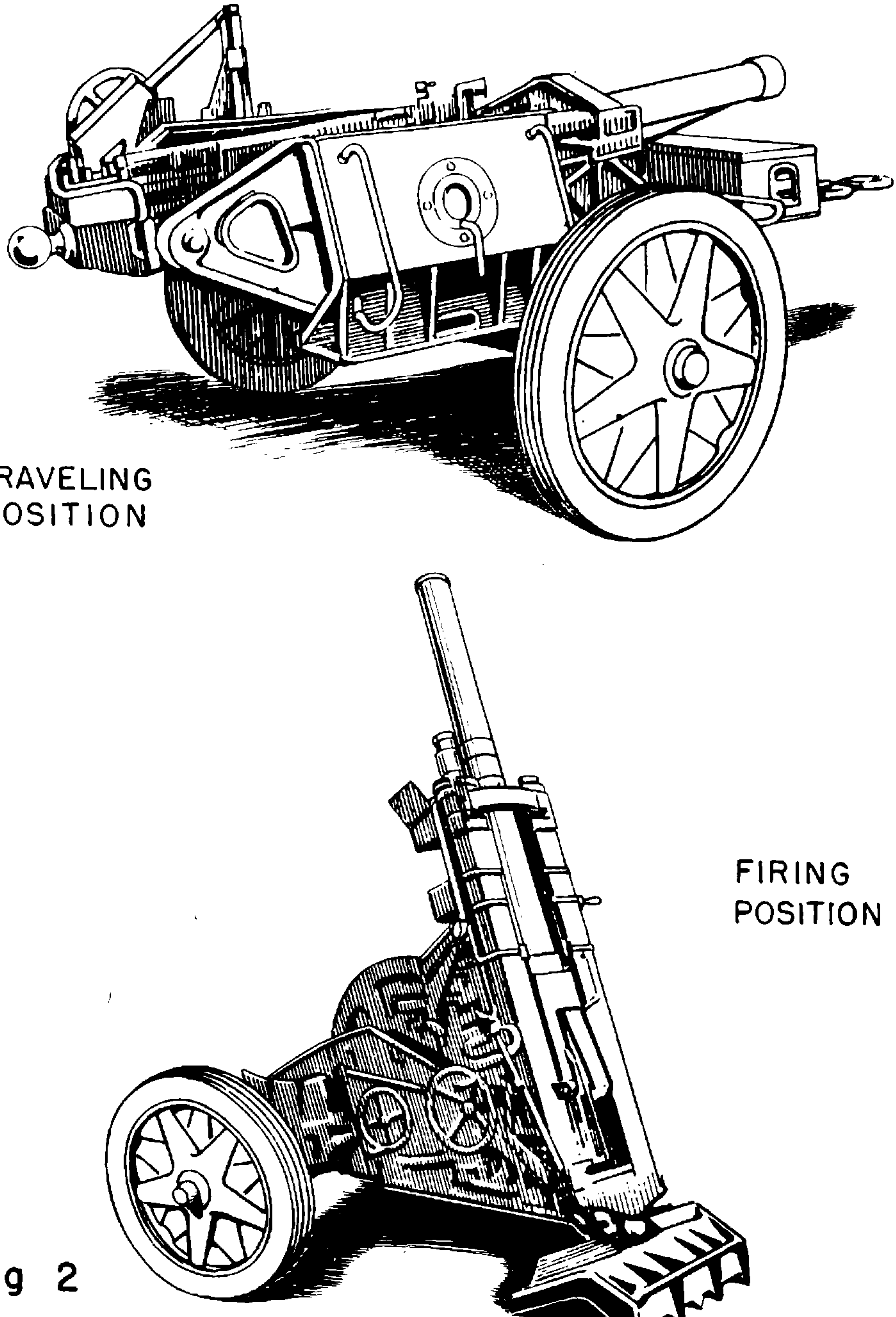


Fig 2

17. GERMAN N C 50 SMOKE BOMB

This bomb is designed to be dropped from aircraft. It is reported to produce large quantities of greenish-black smoke for about 20 minutes. An authoritative German military writer states that in cooperation with friendly ground forces, aircraft may drop smoke bombs to cover or screen hostile troops for a short time in limited areas. Presumably aerial smoke bombs would only be used for this purpose where, for one reason or another, more economical means than the airplane are either unsuitable or not available. Conceivably aerial smoke bombs might also be used to screen the dropping of parachute troops or to designate a target to bombers.

a. Description

This bomb is similar in appearance to the normal 50-kilogram (110-pound) HE bomb. The marking "N C 50" painted on the bomb is probably an abbreviation for "Nebel Cylinder 50 (kilograms)," that is "Smoke Cylinder 50 (kilograms)." The nose is painted white for 4 1/2 inches from the tip; from that point 4 white bands, 1 inch wide, run back to the shoulder where the nose is welded to the bomb body.

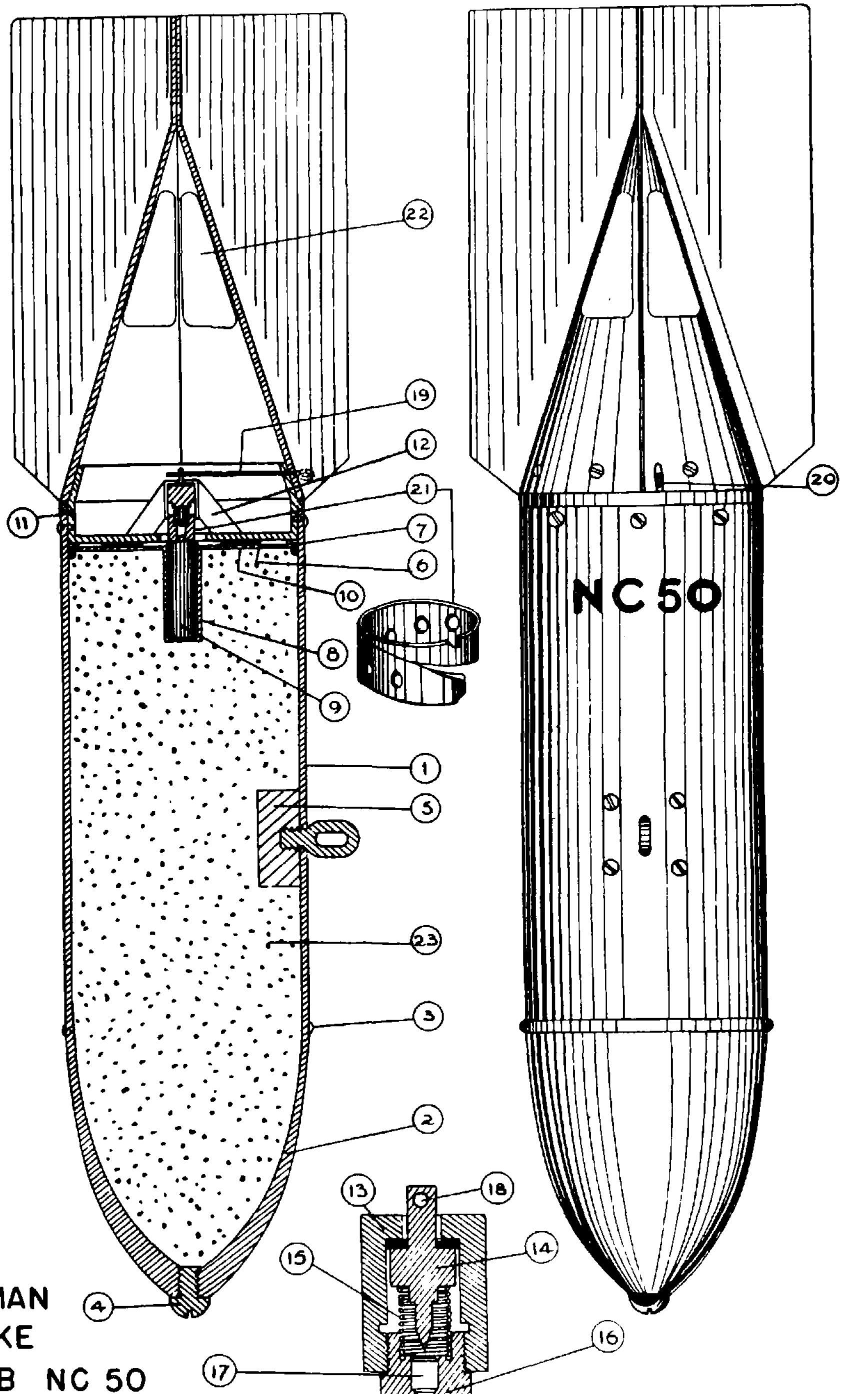
The over-all length of the bomb and tail is 3 feet 7.3 inches, the bomb itself being 2 feet 2.5 inches long with a diameter of 8 inches. The thickness of the casing is 1/8 inch. The smoke-producing filling consists of:

Hexachlorethane	91.1%
Aluminum powder	8.5%
Probably iron oxide and silica	0.4%

The bomb is made up in two parts (see accompanying sketch), the cylindrical portion (1) being welded to the nose (2) along the circumference at (3). In the nose is a screw plug (4) which can be removed to accommodate a lug for vertical suspension. The lug for horizontal suspension screws into a block (5) which is secured to the inside of the bomb casing. The closing plate (6) at the rear end of the bomb is made of sheet steel. The edge of this plate is pressed inwards, and then turned over so as to form a recess in which a rubber ring (7) is placed to seal the filling. To the plate is welded the igniter pocket (8) which contains the igniter (9). The latter consists of a steel tube 3 inches long and 1 inch in diameter. It is closed at its lower end by an aluminum disk, and at its upper end has an igniter cap pressed in.

The plate (6) has four equally spaced holes (10) which are covered by aluminum disks soldered in the position shown in the sketch.

Above the plate (6) and resting on it is the steel casting (11) which is secured to the bomb by eight screws. The base of this casting is perforated by 4 holes to correspond with those in the plate below it. At the center of the casting are 4 webs (12) supporting the fuze body (13).



GERMAN
SMOKE
BOMB NC 50

The fuze is simple in construction and consists of a striker (14) supported on a creep spring (15). Into the base of the body is screwed the cap holder (16). The cap (17) is housed in the recess in this holder and secured by burring over the top edge of the recess. The hole (18) takes the safety pin (19), which projects through a hole in the casting (11) and a slot (20) in the tail cone. Between the fuze and the igniter is a perforated coiled spacer (21).

The tail is similar in general appearance to that of a 50-kilogram HE bomb. It is made of sheet steel and is in 4 pieces. Each piece has a flat area to form the fin and a portion shaped to form the cone of the tail. The 4 pieces are welded together to form the complete tail. In the upper portion of the tail cone, 4 holes (22) are cut to provide suitable outlets for the smoke when the bomb functions. The tail is attached to the face of the casting (11) by 8 screws.

b. Functioning

On release of the bomb from the aircraft the safety pin (19) is withdrawn and the fuze is then armed. On impact the striker (14) compresses the creep spring below it and fires the cap (17). This in turn fires the igniter cap in the head of the igniter (9). This igniter contains a thermite mixture consisting of magnetic oxide of iron, magnesium, and aluminum powders. The weight of this mixture is 2.6 ounces.

The thermite on ignition melts the solder on the disks (10) and provides an exit for the smoke. The main filling is ignited when the aluminum closing disk in the base of the igniter burns through.

c. To Render Safe

If the safety pin (19) is not in place, the bomb may be rendered safe by first unscrewing the 8 screws securing the tail to the bomb, and removing the tail; a cotter pin or nail should then be inserted into the hole (18) and in the striker (14). If the safety pin is not in place, jolting the bomb before rendering it safe may cause it to function.

GENERAL

18. INCH EQUIVALENTS OF MILLIMETER MEASUREMENTS

In reading European specifications expressed in metric terms, Americans often have difficulty in translating them into English equivalents. The following table may be helpful:

MM	Inch	MM	Inch
1	.039	19	.758
2	.079	20	.787
3	.118	25	.984
4	.157	30	1.181
5	.197	35	1.378
6	.236	40	1.575
7	.276	45	1.772
8	.315	50	1.969
9	.354	55	2.165
10	.394	60	2.362
11	.433	65	2.559
12	.472	70	2.756
13	.512	75	2.953
14	.551	80	3.150
15	.591	85	3.346
16	.630	90	3.543
17	.669	95	3.740
18	.709	100	3.937
		105	4.134

Approximate armor thickness usually met with on German Tanks:

MM	Inch	MM	Inch
5	.20	22	.87
10	.39	26	1.02
12	.47	30	1.18
14	.55	50	1.97
15	.59	62	2.44
18	.71	82	3.23
20	.79	102	4.02

Land-gun calibers--(G) for German, (J) for Japanese, (I) for Italian, (F) for French (captured), and (R) for Russian (captured). Designations of countries not necessarily exclusive.

MM		Inch	MM		Inch
6.5	(I-J)	.256	76.2	(R)	3.000
7.5	(F)	.295	81	(G-J-F)	3.189
7.62	(R)	.300	88	(G)	3.465
7.7	(J-I)	.303	100	(G)	3.937
7.92	(G)	.312	105	(G-J)	4.134
8.0	(J-I-F)	.315	122	(R)	4.799
9.0	(G-I)	.354	150	(G)	5.906
12.7	(I-J)	.500	152	(R)	5.985
13	(J)	.512	155	(F-J)	6.102
15	(G)	.591	170	(G)	6.693
20	(G-I-J)	.787	200	(J)	7.874
25	(F)	.984	203	(R)	7.992
28	(G)	1.102	210	(G)	8.268
30	(G)	1.181	240	(G-J)	9.449
37	(G-J-I)	1.457	280	(G-R)	11.024
46	(G)	1.811	300	(G)	11.811
47	(I)	1.850	305	(G)	12.007
50	(G-J-R)	1.969	350	(G)	13.779
70	(J)	2.756	380	(G)	14.961
75	(F-G-I)	2.953	610	(G)	24.016

NOTE: According to the metric system, the meter is split up into tenths, hundredths, thousandths. Latin prefixes are used:

deci	=	1/100
centi	=	1/100
milli	=	1/1000

For larger measures, Greek prefixes are used:

Deka	=	10
Hecto		100
Kilo	=	1000

Thus we have the following measurement basis:

10 millimeters (mm)	=	1 centimeter (cm)
10 cm	=	1 decimeter (dm)
10 dm	=	1 meter (m)
10 m	=	1 Dekameter (Dm)
10 Dm	=	1 Hectometer (Hm)
10 Hm	=	1 Kilometer (Km)
1 inch	=	2.5 cm (approx)
5 miles	=	8 Km
1 Km	=	.621 mile (approx 5/8)

19. SECURITY IN THE BRITISH INDIAN ARMY

The following instructions in military security come from British sources and are intended for the guidance of the "Unit Security Officer" of the British forces operating in India. Especially charged with the problems of security are the "Field Security Sections" and the "Unit Security Officers," discussed below.

* * *

a. General

Security is the name given to our countermeasures against the enemy's secret attack by espionage, sabotage, propaganda, and Fifth Column activities. The enemy espionage service is trying to obtain information about all military matters. Enemy saboteurs are holding up our war effort by damaging war materials, derailing trains, and tampering with gasoline supplies. The enemy propaganda aims at undermining morale.

Security measures will neutralize such attempts. Security is only possible if it becomes the personal daily concern of every member of the forces, from the Commander-in-Chief to the private, and of every civilian.

b. Field Security Sections

In all activated corps and divisions there are Field Security Sections on the scale of one per corps and one per division, and such sections as the situation demands at Army Corps HQ, GHQ, on lines of communication, base areas and ports. Part of the personnel are linguists, and all are specially trained in security work.

(1) Composition

There are three types of sections, all-Indian, composite (Indian and British) and all-British. [The all-British would probably be met with an all-British division, and a composite or all-Indian in the Indian divisions or special organizations.] The all-Indian sections consist of a lieutenant [probably native], two "Viceroy's commissioned officers" [corresponding to our warrant officer, and of two grades], two sergeants, four corporals, six lance-corporals, and two privates. The composite sections consist of a lieutenant, one warrant officer, a sergeant, two corporals, two lance-corporals, all British; a native sergeant, two native corporals, two native lance-corporals and a native private. The all-British sections include one officer--captain or lieutenant, two warrant officers, two sergeants, four corporals, six lance-corporals, and a private. In each of the above groups, the privates are orderlies or chauffers. All sections have a 1 1/2-ton truck and are completely mobile and self-contained.

(2) Duties

The duties of the Field Security Section are to advise and instruct in all security matters, to provide specialists for putting security measures into operation and to conduct security investigations, and to cooperate with civil police in counter-espionage. The sections work under the direction of the Intelligence Staffs of the units to which they are attached.

Field Security personnel are not concerned with the discipline of troops. They are concerned with the maintenance of good security. All ranks should be encouraged to look on them as friends and advisers, whose criticism, when made, is intended to be constructive only. They are NOT police or spies. There are at ports, in addition, specialized Security Sections who work under the local Military Port Security Officer. These are directed by Military Intelligence Directorate of GHQ and are mainly concerned with counter-espionage control. NOTE: All-British Field Security Sections raised and trained in the United Kingdom are part of the Intelligence Corps.

When the Indian Intelligence Corps becomes fully organized, all Field Service personnel will be accordingly transferred to it. Members of Field Security Sections raised and trained in India are mainly drawn from the units to which they will eventually be assigned.

c. Unit Security Officers

In every unit or installation, one officer will be appointed as "unit security officer." His duties, as such, are in addition to his other duties. His role is an important one for he is charged with the training of the individual, which is the foundation of good security.

It is his duty to ensure that security measures are properly applied within his own unit. His responsibility as far as concerns civilians, other than those employed in his own unit, is limited to close liaison with the civil authorities. He will also act as an intelligent observer and reliable reporter of suspicious incidents.

He must at all times maintain close relations with the Field Security Personnel in his unit or area. He must now, however, carry out any investigation work except under express instruction from the higher command. It is possible that this particular case is already under investigation, and that independent investigation will only cause confusion.

d. Military Security

(1) Security of Information

Surprise is a most potent factor in war. It is of supreme importance that we deny the enemy information from which he may judge of our condition or guess our intentions.

This can be done by using common sense and imagination to prevent military information of any kind coming to the knowledge of unauthorized persons and so, eventually, to the enemy. It is the rule of the closed office and the closed mouth--in a word, security discipline.

Every soldier should be made to understand that a breach of security is not merely an offense against an arbitrary military code, but a crime against his comrades and his country's life.

The knowledge of an enemy's armed forces, dispositions, and intentions is usually gained by the piecing together of many disjointed and often apparently quite valueless scraps of information. No piece of information can, therefore, be regarded so trivial as not to require safeguarding.

Information which is of particular interest to the enemy includes the following:

Our intentions and plans for the conduct of the war by land, sea and air.

Means whereby any enemy operations have been frustrated.

The order of battle, movements, locations, and morale of our forces. The names, characteristics, and particulars of our commanders and their staffs.

Developments in all forms of armament, equipment, and training.

Administrative arrangements, such as locations of bases, supply depots, distribution centers, and key industrial plants. Details regarding sources and systems of supply of all kinds.

Any reference to spies or suspicious persons in our hands, whether awaiting trial or already disposed of.

Sailing dates, routes, and destinations of all types of shipping.

Losses in men and materiel.

Details of enemy attacks, whether by sea or air.

The situation in regard to manpower, recruiting, economic resources, and civilian morale.

Local subversive political movements.

Our information regarding the enemy.

The main sources of leakage of information may be summarized as:

Insufficient precautions to prevent unauthorized persons from obtaining access to offices, HQ, and other military establishments. All persons, whether in uniform or not, and of whatever rank, must be made to establish their identity unless personally known to the guard. Over-caution is excusable, lack of caution is criminal.

Carelessness in classification and safeguarding of documents, marked maps, ciphers, codes, etc. Omission to burn drafts, carbons, unnecessary copies of orders, etc. Omission to carry out a systematic search of all vacated premises, including officers' quarters, when moving. Omission to collect daily and burn under supervision all secret waste paper. Carelessness in carrying secret documents on the person in trains or in cars at all times and particularly when in contact with the enemy. Disclosure of the existence of secret documents. Even laundry tickets and theater stubs or old letters may sometimes give valuable information to the enemy.

Disclosing official information of future operations, moves, etc., to anyone not directly concerned with such information.

Capture by the enemy, and loss, of personal diaries. All personnel must realize that these are documents which are certain to contain matters of interest to the enemy, and must be safeguarded.

A fruitful source of information to an enemy intelligence staff is the examination of our prisoners of war. All personnel must, therefore, be thoroughly instructed as to their conduct if they have the misfortune to be captured. A prisoner must give his correct name, rank, and serial number and nothing else. The most difficult man to interrogate is the one who is determined to maintain a polite but strictly military attitude towards the interrogator, viz., "You are a soldier. I am a soldier. I have my orders and I must obey them."

Reticence under interrogation must be followed by reticence among fellow prisoners; it is certain that there will be "stool pigeons" dressed in British and Indian uniforms to overhear conversation. Microphones may also be used. It is absolutely forbidden for prisoners to broadcast. Unless incapacitated by wounds, it is the duty of a soldier taken prisoner to attempt to escape. The first 24 hours after capture usually present the most favorable opportunities.

(2) Security of Materiel

As far as military security is concerned, this is mainly a question of providing physical safeguards, and of siting dumps, vehicle parks, etc.,with an eye to protection against sabotage. The dispersal of dumped materiel into small lots to limit the effects of enemy air attack frequently makes physical safeguarding difficult, but such dispersal also localizes the effects of an act of sabotage. The only time at which a potential saboteur is likely to come into the open is when he is making his reconnaissance. For this reason the strictest security of identity papers, both of civilians and members of the uniformed services, is absolutely necessary wherever antisabotage guards are mounted. No person of whatever rank should be allowed to approach the materiel or the point being guarded unless it is necessary for him to do so in the course of his duty and then only after identification. It is also the duty of Unit Security Officers to advise, on track discipline, vehicle concealment and camouflage affecting safety from air observation and attack.

(3) Security of Personnel

Lying propaganda, rumors, doubt and treason are weeds that flourish in rank soil, but cannot take root in a healthy one. The cultivation of resolute cheerfulness, sane thinking, and high morale is an invincible defense. Rumor must be traced and the persons who start and pass on rumor must be punished. Listening to enemy radio propaganda should be ridiculed and discouraged. It should be impressed upon all ranks that it is their duty at all times to discourage and counteract unfounded gossip or statements likely to cause alarm or despondency, whether made by members of the armed forces or civilians, in public or in private. Security officers are reminded that troops going on leave and off duty are their best propagandists if properly trained and instructed.

(4) Security of Operations and Training

This is the particular application of all security measures to ensure the secrecy of particular operations or training. These are frequently coupled with active measures to deceive and mislead the enemy which are usually the subject of special instructions from the higher command. The responsibility of unit security officers is to see that these are carried out to the smallest detail.

SECTION II

UNDERGROUND MINING OPERATIONS IN WARFARE

UNDERGROUND MINING OPERATIONS IN WARFARE

Mining operations--not to be confused with the laying of ground mines--are a rather unusual but at times a vitally important phase of warfare, which may be called for when the "Fortress of Europe" is invaded. Its origin is ancient. In Roman days, if not earlier, mines were dug under city walls, and the props that held up the walls during the digging operations were then burned out, causing sections of the wall to collapse. In the First World War, mine warfare was carried on extensively in Flanders, culminating in actions at Messines and Wytschaete Ridges, where on 7 June 1917, the British troops, in preparation for their offensive of June 1917, blew out the large German position together with much of the crests of the ridges. On 13 March 1918, the greatest single blast in military history was effected by Austrian mining engineers against the Italian position on Mt. Pasubio, on the Adige about 40 miles north of Verona. It blew off the whole top of the mountain and turned it into something very like a volcano in full eruption.

The following pages have been selected from an article in the Pioneers' Quarterly (Vierteljahreshefte für Pioniere). Its author is reported to be a former engineer officer of the Austro-Hungarian Army and "one of the most experienced men in mine warfare." The article is dated May 1939.

a. The Surface Effects of a Mine

(1) General Considerations

Mine warfare is a part of tactics on the combat front; it differs from other tactical methods in the place of combat, underground, and therefore the method of conducting the combat is different. The proper weapon in mine combat is the mine, that is, the concentrated explosive charge completely enclosed in the earth.

The range of effect of this weapon is limited; 10 meters' range requires as much as 4,400 to 6,600 pounds of modern explosives, while a range of 20 meters requires as much as one and a half to two carloads.

The mine attack is for the purpose of destroying both personnel and materiel of the enemy by its effect at the surface. The operations that follow the blast are not our concern. For the mining engineer officer, the decisive element is the mine crater itself.

(2) Craters

(a) Craters in Earth

By the effect of a single explosive charge sunk in the earth, the mass of earth lying above it is thrown out (see Fig. 1). In figure 1, M--M 1 is the sur-

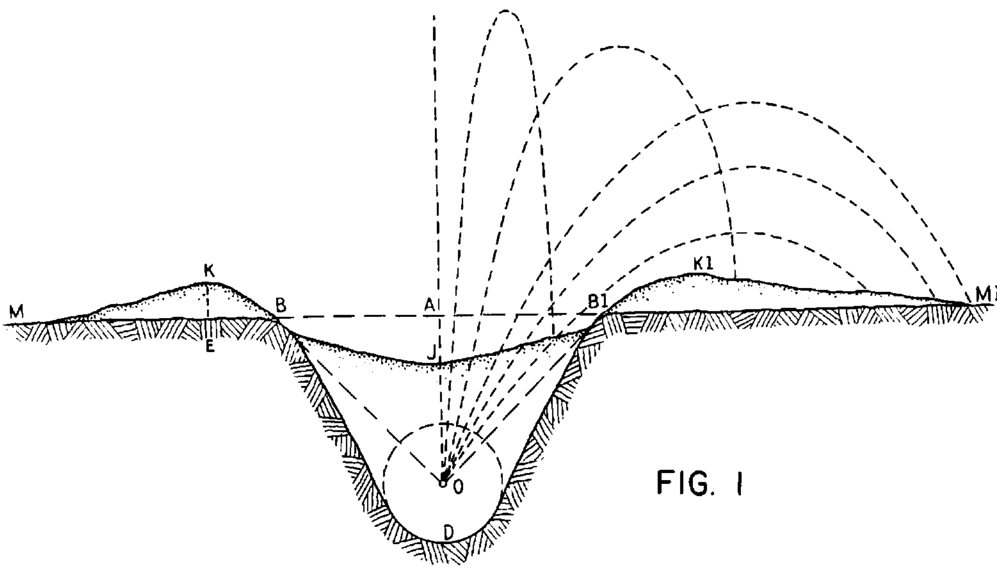


FIG. I

face of the earth; B and B 1, the edge of the crater; B--D--B 1, the crater initially blasted; and B--J--B 1 the crater actually resulting. The crater radius is B--A or A--B 1. K and K 1 are the crater crown, A--J the depth, and A--O the depth of the charge to the center of the charge (O), which is the shortest line of resistance. The dislodged earth-core can only be a cone, and in its place there remains in the earth a crater of equivalent size. This cone of earth is hurled vertically by the explosive charge and breaks up in the air; then almost all of it falls back into the crater. For an excellent illustration of a typical blast, see figure 2. The crater is refilled in large part to approximately two thirds of its depth, while the remainder of the erupted earth drops within a short radius on the edges of the crater and forms the crater crown. A small portion of the earth in the air, the "crater cone," is more widely scattered, and is called the "crater spread."

The magnitude of the crater effect can quite generally, as a rule of thumb, be determined by the following method:

The radius of the presumed circular crater cavity is normally equal to the depth at which the charge was placed. Whenever, therefore, the charge lies at a depth of 33 feet,* then the crater diameter is also 33 feet and the diameter

*All data are translations of metric terms except as stated otherwise.

of the crater cavity 65 feet. (This would be the effect of a charge of about 4,400 to 6,600 pounds of demolition explosive.) The ultimate crater depth is, as mentioned, one-third of this magnitude; with a crater radius of 33 feet, therefore, a crater depth of 9 to 10 feet measured from the surface of the earth. The height of the crater crown is fixed at about one-third of the crater depth; in our example, accordingly, 3 to 4 feet.

Figure 2 illustrates the beehive shape of the "crater cone" or earth hurled up by the blast of a standard mine containing 771 pounds of HE in alluvial gravel. At the top of the cone, corresponding to the cubical shape of the charge, extend the 4 "peaks." The cones of overcharged mines open at the top in a form of a bouquet, while weakly charged mines produce cones ranging in appearance from a cake down to a simple oval skullcap. In this way, from the shape of the "crater cone" alone, conclusions can be drawn as to the strength of the charge, the type of mine, and even the ground conditions. The crater cone of dispersion, that is, the height to which the earth is propelled, is usually twice the depth of charge. With a charge depth of 33 feet, therefore, the crater cone would rise to 66 feet.

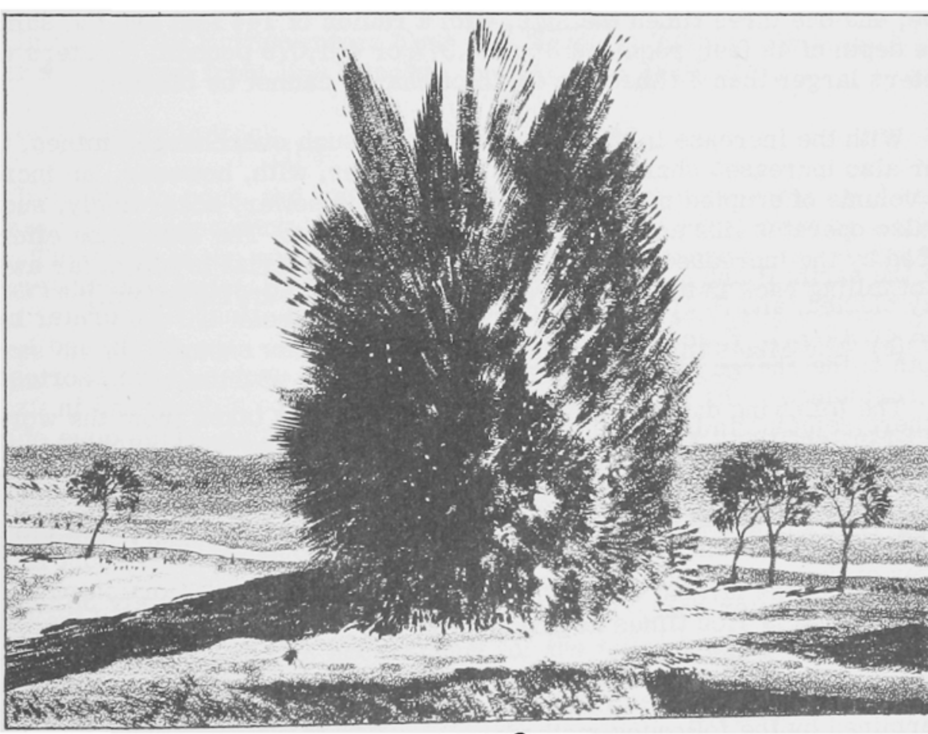


FIG. 2

The crater scatter usually reaches the same dimensions as the crater cone. The limits of the crater scatter are difficult to determine conclusively. A lethal effect outside the area stated, however, is not to be assumed in any case. Occasional accidents due to stones, etc., cannot be given any consideration as risks in war. Precaution should be practiced however; in peacetime training maintain a cleared zone of 1,000 feet on all sides.

The crater, plus the scatter, represents the actual zone of destruction on the earth's surface; in our example, therefore, with 66 feet of scatter plus 66 feet of crater plus 66 feet of scatter, we have a total of 198 feet. This--and here is the point to emphasize--is the absolute limit of the external effect. Within such a zone living men as well as the material will be destroyed or buried. Outside these limits the mine has almost no real effect.

Naturally, the attacker will apply himself to the accomplishment of this final result of his exertions and combat by making the external destruction as comprehensive as possible. To a certain degree, this can be achieved by heavier charging of the mine--overcharging. However, overcharging involves a serious disadvantage,--an enormous increase in consumption of explosive. Today this has even greater weight, since mine galleries, because of the effect of artillery, must lie at least 39 feet and if possible even deeper, below the earth's surface. The size of the charge, however, increases as the cube of the crater radius. If a crater 49 feet in radius with a charge depth of 49 feet requires about 14,887 pounds of ammunition, a crater twice the size, with a radius of 98 feet and the same depth of charge, requires 2^3 x 14,887, or 119,016 pounds of demolition explosive; and one three times the size, with a radius of 144 feet and the same charge depth of 49 feet, requires 3^3 x 14,877, or 401,679 pounds. Craters with diameters larger than 3 times the depth of charge cannot be blasted.

With the increase in the crater radius of such overcharged mines, the scatter also increases sharply--by the third power, with, however, an increase in the volume of erupted matter by only the second power; accordingly, such a mine also operates like an ordinary land mine. (Note: The land-mine effect is produced by the increased scatter, as the erupted material is blown far away instead of falling back in the vicinity of the crater with burying effect.)

(b) The Mines in the Wytschaete Bend

The following data relating to mine craters was taken from the work by Major Kranz entitled "Mine Combat and Military Geology in the Wytschaete Bend" (Minierkampf und Kriegsgeologie im Wytschaetebogen) appearing in No. 3 (1935) of The Pioneer Quarterly. At Wytschaete and Messines Ridges on 7 June 1917, the British set off 19 mines in the watery clay of the Flanders flat-lands.

Some of the largest craters, with a charge of approximately 35 tons of ammonal, which is 1.05 times as powerful as TNT, at a charge depth of 97.8 feet had the following dimensions:

Diameter	265 ft
Width of crater crown	60 ft
Height of crater crown	17 ft
Depth of crater	51 ft

The largest single charge used by the British in the Wytschaete Bend amounted to 95,573 pounds of ammonal, which with a charge depth of 125 feet produced a crater of 165 feet in diameter and 17 feet in depth.

If we average the 19 mines used on 7 June 1917 in the Wytschaete Bend, all of them gigantic mines with a total outlay of 913,315 pounds of demolition explosives, we obtain:

Crater diameter	182 ft
Width of crater crown	62.5 ft
Depth of crater	26 ft

Let us assume that each mine is placed in the most unfavorable position for the defender, i.e., perpendicularly below the combat position.* We then see that the position under attack is disturbed by one mine for a width running across the entire crater and the two outside crater crowns, that is 182 + (2 x 62.5), or 307 feet, and in the depth of the position by the half crater + one crater crown, that is 91 + 62.5, or 153.5 feet.

This is the absolute total effect of one such mine on the earth's surface.

In all, the 19 British mines blew up a length of 2,000 yards in the 10.6 miles of the German front line attacked, or about one-tenth of it.

(c) Craters in Rock

In mountain rock, the mine effect is fundamentally the same as in soil. The charges, corresponding to the greater resistance of rock, must be made larger. The form of the surface effect is strongly influenced by the conformation of the terrain; this must, of course, be given due consideration in the plan of attack and in placing the mine. Here too, in fact, we also see quite regular craters, like those on Mt. Cimone and the Col di Lana where the flat and almost uniform conformation of the surface of impact permitted such a result.

On the other hand, however, we note mines with quite peculiar external effects, sometimes intended, sometimes unintended. Such, for example, was the case of Mt. Pasubio, where by the blasting of two lateral craters, the rock mass supporting the enemy emplacement was brought to collapse (see Figs. 3 & 3a)-

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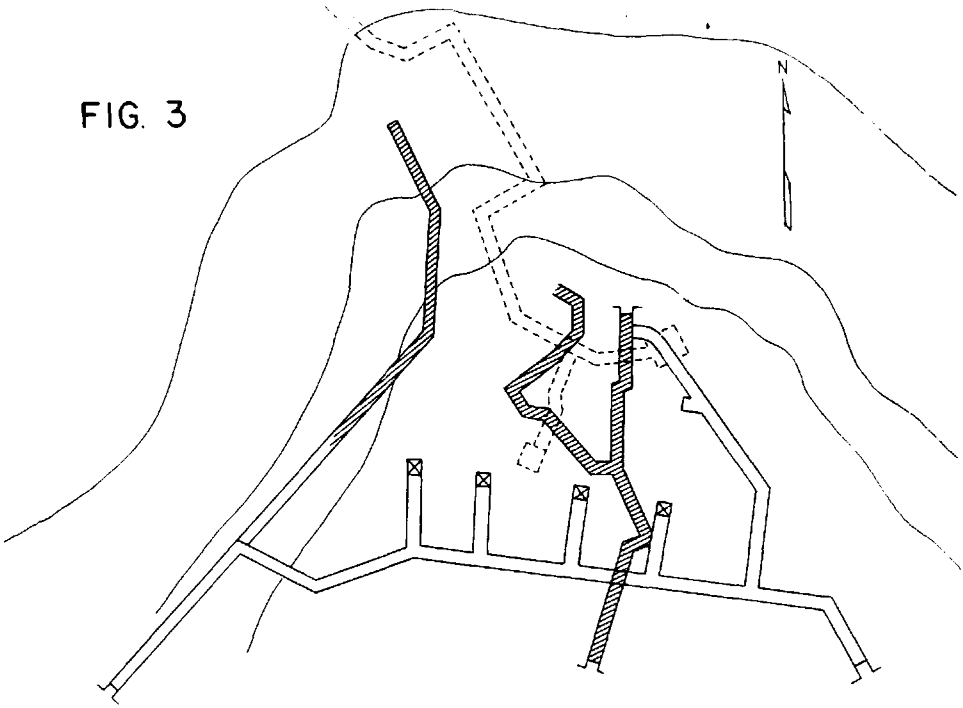
*In practice, however, this is not frequent for the following reasons:

1. The attacker, in using the mine, will try to demolish the obstacle placed in front of the position.
2. The long work directly below the feet of the enemy is in no sense a comfortable matter. The placing of the mine itself (construction of the mine chamber, charging, attaching fuse connections, and tamping with truckloads of sand bags, concrete and steel, or wooden beams) takes a week or even longer. For this reason one is satisfied in most cases to have the blasting effect merely reach the enemy position.

Both sketches are schematic only and not to scale. Figure 3 is the plan for the final blast on 18 March 1918, and 3 a, the approximate position of the Italian and Austrian mine galleries. It would appear that the Austrian galleries were driven below those of the Italians.

FIG. 3



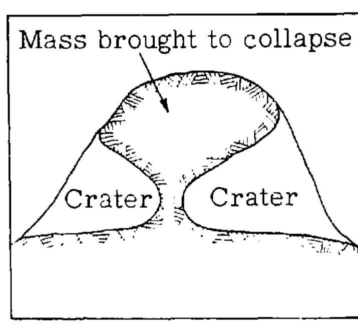


FIG. 3A

b. The Subterranean Effect of the Mine

(1) General

The effect of the explosive with which the mine is charged, on its explosion is an impact generated in a fraction of a second. This impact operates with equal force in all directions, therefore in a spherical form. This is the start of the effect of every mine, quite independent of how this effect is later transmitted.

The impact is propagated in the earth, so long as it has sufficient force

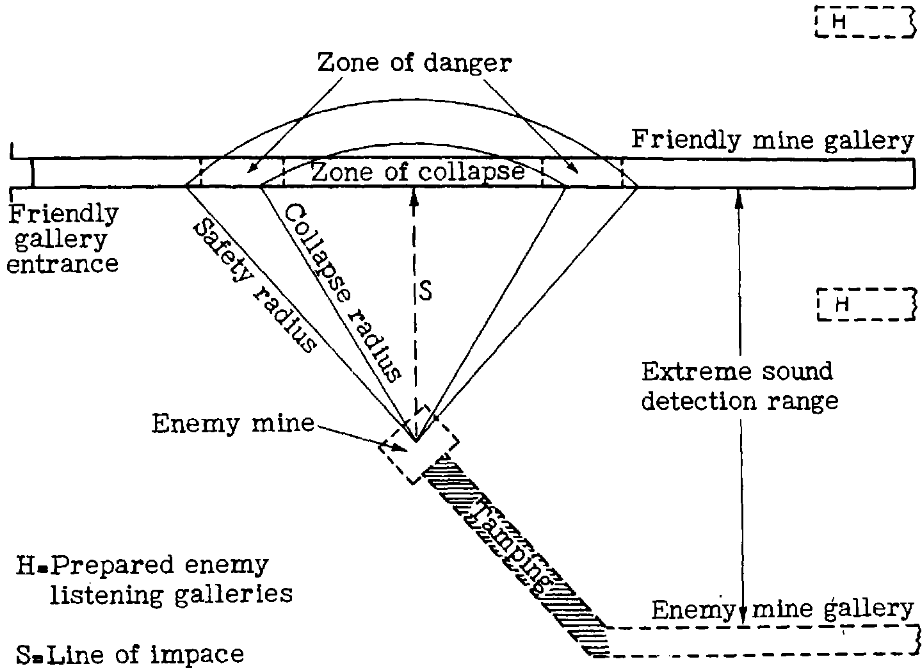


FIG. 4

to overcome the quite considerable resistance of the soil and rock. It is finally dissipated if the mine lies deep enough in the earth, or reaches a point somewhere at which the resistance is weaker and gives way completely. The impact then behaves as a thrust and hurls the portion of the earth which still offers resistance into the air; the mine comes into the open and produces the crater.

(2) <u>The Camouflet, or Completely Subterranean Mine</u>

In the first case of the dissipation of the wave of concussion, there can be only a subterranean effect, and the mine therefore acts only underground; it is then called a "camouflet" (figs. 4 & 5), a crushing or damped mine. It is easy to see that the camouflet can utilize in subterranean effect the force it economizes in comparison with the crater mine.

A distinction is therefore n le between the crater mine with both surface (external) <u>and</u> underground effect, and the camouflet with a somewhat greater destructive effect, but entirely underground.

The officer in charge should recognize that the crater mines primarily of interest to him have not only a surface effect due to excavation of crater, lateral burying effect, and scatter, but have their subterranean effect as well against one's own dugouts, shelters, etc., below the earth's surface. This underground effect reaches approximately the same magnitude as the surface effect, but in a spherical form in all directions around the mine.

One more point should also be mentioned here: that the camouflet is of primary interest to the miner for his own combat. This form of mine is his weapon, in fact his weapon exclusively. The crater mine is only the final objective of his work. Until he reaches this objective, in the course of mine combat he will have to apply many camouflets, for it is with them that miners fight in subterranean combat, defenders work to ward off the subterranean enemy, and the attacker strives to cut his way through the subterranean defense installations. To make use of the crater mine before reaching the final objective is always an error on the part of the defender, and is an error in most cases on the part of the attacker, if either does not by so doing promote some other major purpose.

(3) The Gas Effect of the Mine

We know that the explosive effect occurs as the result of the transformation of the explosive into a tremendous volume of gas under intense pressure and at a high temperature, with the volume and quantity of gas persisting for some time after the blasting. These effects then are dissipated in the vicinity of the mine with cooling of the gases and loss of pressure.

FIG. 5

These gases, or more properly, this gas composite, are a compound of various gases and vapors, of which carbon monoxide only, because of its dangerous properties and the quantity that is produced in blasting, is of interest to our discussion. Carbon monoxide is colorless and extremely poisonous. There is no warning of it. Inhaled in even slight quantities, it has a fatal effect. Mixed with atmospheric air, it burns, and with a certain ratio of mixture it becomes highly explosive. The gas masks used in the last war provided no protection whatever against it, and only the inhalator equipment generating breathable air itself could give protection against the poisonous effect.

This gas production, a secondary result of the mine, can often become the major consequence. It is equally dangerous for friend and foe. Frequently, along with the poisonous effect, the entire volume of gas will ignite, produce explosions in various places, and, by setting fire to structural material or stores, cause stubborn fires in the emplacements. Some examples from the history of war will explain and illustrate the point; while from earlier wars many examples are on record of serious catastrophes due to the gas effects of mines, we shall confine ourselves to those from the last war. In the Italian mine blasting on the Castelletto, the blast gases made the mine galleries, which had to be designed to serve tactical purposes as well, unusable for 2 days after the shot. The attack-column, dashing forward from the gallery immediately after the blast, was overcome immediately by the gas and suffered extremely heavy losses in gassed and dead. We read in the descriptions of the mines in the Wytschaete Bend on 7 June 1917 of the blazing sea of blue flames in the bottom of the gigantic craters. On the Lagazuoi in the Dolomites in 1917, a persistent fire was reported in the craters produced by the Austro-Hungarian blasting of 22 May which made any approach to the crater impossible because of the heat it generated. Finally, on Mt. Pasubio, as a result of the peculiarity of the mountain structure, the gas effect played a part in each of the 11 blastings done in the course of the mine combat and led to serious losses among the Austro-Hungarian troops. Thus, on 2 October 1917, when Austro-Hungarian miner and assault patrols hurried into the quite open and absolutely undamaged galleries following the Italian blasting, they suddenly dropped as if struck by lightning. In the final Austro-Hungarian blast on 13 March 1918, absolutely the greatest blasting of military history, the entire mass of Mt. Pasubio was enveloped in flames, and jets shot out from the Italian gallery exits for a distance of 100 feet during a period of hours.

This phenomenon in mine combat, which results in far greater casualties than the purely mechanical effect of the mine, should be given much more attention than was given it in the war of 1914-1918.

c. The Mine in Combat against Modern Fixed Fortifications

For obvious reasons, within the scope of this article we shall attempt to speak only quite generally on the topic of mine combat against fixed fortifications. Here the important point is the absolutely static position of one party, the defender. From this fact arises all the peculiarities of the situation from the operational, tactical, and also the mining viewpoints. The battle for fixed fortifications must be fought out on the spot. While in field warfare a local withdrawal from the vicinity of a known mine can usually be made without great tactical loss, such a retreat often can not be made from a fortified position without endangering the whole front. The possibility of underground combat against such fortifications must be regarded as ever present.

Because the forward area of permanent fortifications is prepared and completely dominated by the defender, greater underground distances will also have to be overcome at the start of the attacker's subterranean activity. In attack on permanent fortifications the opportunity for a short mine combat with a surprise effect on the enemy will scarcely ever arise. A second determining factor in the situation stems from the consideration that the attacker will always meet an enemy prepared for underground warfare. The attacking miner is faced with a difficult battle with an enemy who has reconnoitered the details of a possible mine attack in advance, on the basis of his defensive system built up in time of peace. He now lies in wait like a spider in this thoroughly planned system and can operate effectively against the attacker everywhere and almost without danger to himself. The attacker will have to consider giving the underground attack a more prompt and systematic development by increased provision of personnel and equipment. For this reason numerous organizations capable of conducting such work will have to be in readiness, and in addition, units trained in mine combat and organized solely for this purpose, as well as columns and stores of machines, tools, and material.

From the standpoint of mine tactics, the attacker has the advantage that he is subject to only the one limitation--that in any case, the attack objective must be reached. The final objective of the underground attack against fixed fortifications is never, or only rarely, the mine effect on the earth's surface, but rather the fortified installations of the enemy, positions that cannot be reached by artillery fire, such as the substructures of gun and machine-gun turrets. The matter is therefore one of purely demolition mines, quite similar in placement to the crater mine, with their depth depending upon the effect to be obtained against those targets.

d. Underground Combat

(1) General

Without a knowledge of its tactical method of employment, it is impossible to understand the use of any weapon. The following sections will outline, principles which every commander should know on the subject of underground combat. These suggestions are not intended to be a complete guide to independent leadership of underground warfare, but rather an explanation of methods which should be generally understood by members of the land forces.

(2) Reconnaissance

The greatest attention must be paid to reconnaissance. As has been apparent from the history of warfare, especially from the accounts of the last war, no complete surprise of the enemy has been achieved in any mine operation. On the other hand, rumors and warnings at the front often led to the starting of countermine operations against a suspected subterranean attack in places where the enemy had, in fact, not the least intention of mining, and often where circumstances excluded any real mine danger.

But the object of reconnaissance is not merely to recognize enemy subterranean activities; it is to effect this speedily enough to gain time and take countermeasures. For evaluating the results of reconnaissance, fundamental mine training experience is indispensable. Hasty or incorrect conclusions have unfailingly led to underground combat, whether desired or not, for it must be assumed that all mining operations will côme to the knowledge of the enemy and force him, in turn, to take his own countermeasures. The miner has no means of reconnoitering underground with any assurance of success other than by digging tunnels and shafts. The enemy becomes aware only of this excavation; its purpose remains unknown. In order to protect himself he must then do the same, and by reason of the short distance that separates the two forces, this operation necessarily leads to combat, and to combat which can end only by the evacuation of the underground region by one side or the other. Such was the case in all mine battles of World War I, in the Wytschaete Bend as well as on the Dolzok in Bessarabia, on Mt. Sief as well as on the Lagazuoi in the Dolomites.

(a) Reports

The treatment given to intelligence reports, especially those based on statements of prisoners, is the same as that given to all other reports in time of war. Only mining experts should be brought in for the examination and questioning of prisoners on the subject of mine operations. Otherwise, because the subject is equally foreign both to the prisoners and the ordinary examiner, the most unbelievable kind of reports will appear. Moreover, even reliable reports must be accepted with reservation. In the late autumn of 1917, for example, the report came to Mt. Pasubio from foreign sources, that in northern Italy a few special detachments of professional miners, and tunnel and quarry workers, were being formed and sent into the Pasubio region. While the statement was entirely correct, these detachments were, in fact, assembled for extensive highway construction with curved tunnels and galleries on the Pasubio massif, and had nothing to do with mine warfare.

(b) Observation

Observation can yield data which, when assembled, give a basis for estimating any underground activity of the enemy. Many conclusions can be drawn from the nature of the earth spoil. Here, geological observations are of special value. With continuity in observation which may disclose the scope of enemy work and its position in depth, miners need not without urgent reason be withdrawn from work that has been started, and thoroughly trained units need never be left behind underground should a sudden evacuation of the works become necessary.

Snowfall facilitates the recognition of large quantities of excavated material. Aerial reconnaissance should be carried out for the study of enemy diggings, as well as to locate the entrances to his mines, always carefully concealed from ground observation. In spite of the inadequacy of the reports, air reconnaissance in mine attack against permanent fortifications and mine systems prepared as a part of the fortifications is the only means of getting information in the first phases of combat. Clear and positive results, however, can consistently be expected only through subterranean reconnaissance.

(c) Subterranean Reconnaissance*

i. General

Reconnaissance underground is done by ear. To completely reconnoiter the combat terrain, every means should be used to extend the sense of hearing in both vertical and horizontal directions. In the horizontal direction galleries are employed, and in the vertical direction, shafts. Listening apparatus must be installed to give the ear increased range, and arrangements made for organizing and coordinating the listening service.

ii. Listening Service

The listening service is furnished by individual listening posts in the galleries, and the men who man them must be thoroughly trained in sound detection. The work of the sound-detection miner is difficult. To lie for hours in a dark, wet hole underground, with your ear pressed to the ground, in constant uncertainty about your own fate, your head crammed full of imagined suspicious whispers and-what is of great importance--without the possibility of any comparison with the results at other listening posts--all this imposes severe demands on the listener.

The mine listener should be at home in any terrain, in any type of earth. He must know how the different types of soil transmit sound and how far they propagate them, and in order to understand all that can happen in mine warfare and so connect certain noises with particular phases of underground activities, he must be a military miner himself. The trained miner well knows how to distinguish sounds of engines, and whether a two-hammer or single-hammer unit is working. He knows the number of points where work is going on, and the number of drills (which, incidentally, are recognized as a sharper tap and never as a dull thud in rock). He must know whether the enemy is working in a gallery, in a mine chamber, or in a trench. Many times he can determine from the sound itself that most important moment in mine combat, namely, when the enemy is about to blast. In the mine combat on the Colbricon, a porphyry horn just beside the Rolle Pass (see fig. 6), the entire endangered region was evacuated, on the basis of what had been heard, 2 hours before the Italian blast. The regrouping for the occupation of the crater was then organized--in this case, of course, only a reoccupation of the expected debris-zone. All this was done without difficulty and not a man of the garrison was lost; the position was immediately reoccupied and a few minutes after the blasting it was as ready for combat as it had been before.

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*The author has had no experience whatever with the new geophysical soil investigations and their applicability in the field of mine warfare.

iii. Sound-Detection Pauses

For the carrying out of the sound-detection service, sound-detection pauses in the entire listening area must be ordered by the commander. In these pauses every noise and all speech in the emplacement are to be discontinued, even on the surface. Such pauses are to be made at irregular time intervals according to the directions of the mine officer. What mistakes can occur is well illustrated in the following instance: On 24 January 1917 under Mt. Pasubio, clear voices and the sound of rolling equipment could be heard in the midst of the Austrian gallery. According to the sounds, the enemy seemed to be already under the Austrian position. A committee met, listened and came to the same conclusion; then, a short time later, the voices were recognized as Tyrolean.

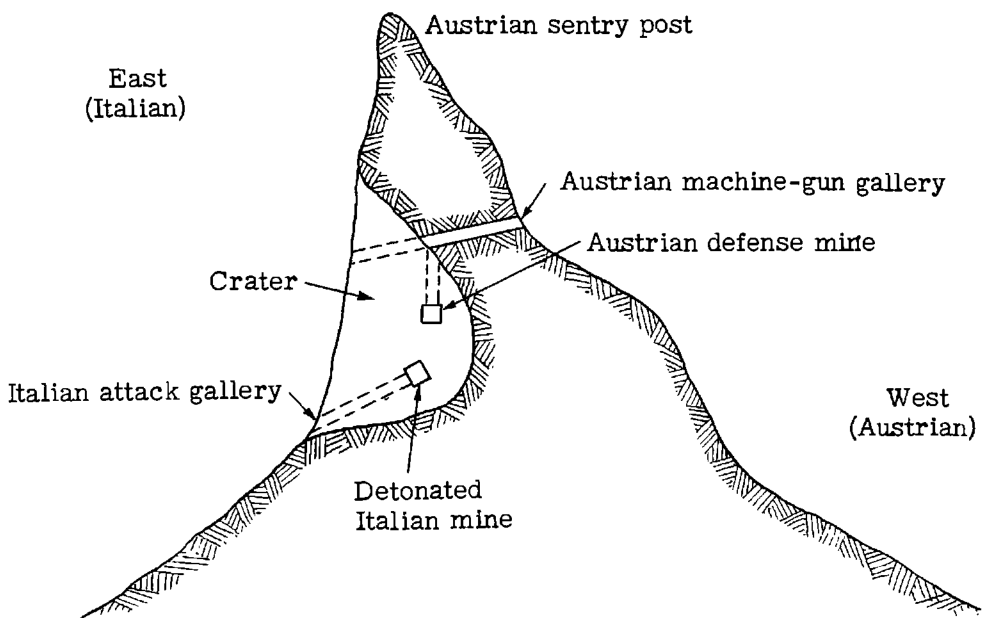

FIG. 6

In one of our own dugouts they had been paying no attention to the sound-detection pauses!

The sound-detection service has been given greater space here intentionally, for it is of absolutely vital importance in mine combats. Everything depends on its reliable operation.

(3) The Underground Advance (Extension of Mine Construction)

(a) General

The distinction between offense and defense underground is difficult to maintain. The objective of the miner under all circumstances must be that of attacking the enemy's combat emplacements without involving his own. This is his duty, assigned exclusively to him; and his comrades in the surface fortifications must be able to rely on him. Therefore, the immediate mission of the subterranean defenders, whenever they learn of the intention and direction of the attacker, is to counterattack as far to the front as possible.

(b) Galleries and Shafts

The underground advance proceeds by way of galleries and shafts. Just as the troop-columns, whenever possible, utilize good, straight roads with shelters, supply, and other facilities, the same is true in the underground advance. The advance must be started with large galleries, for these passages must provide a clear roadway for the miners, with their loads of tools, respirator apparatus, and other material. The galleries must allow space for assembly areas and room for the storage of tools and tamping, blasting, and detonating materiel; for such transport arrangements as pushcart tracks and cable transport; for ventilation equipment with pipes a foot in diameter and drainage conduits, and often, also, for high and low tension cables, which must be kept at a distance from each other (fig. 7). Above on the right are the 12-inch ventilation tubes; on the side wall beneath are the low tension conduits for the sound-detection apparatus, as well as for the alarm and gas-alarm system. On the left is the practically noiseless suspension cableway, and at the extreme left, the high tension cable for the gallery lighting plant.

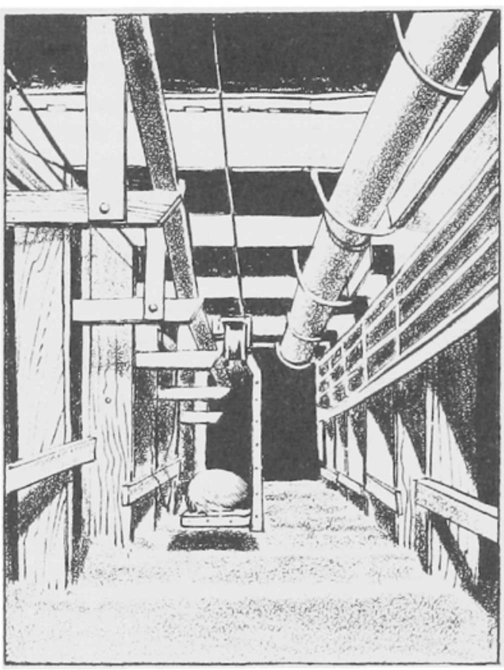

FIG. 7

After work has begun, any enlargement of the passageways can be done only in galleries cut in solid rock. (Note: This is due to the difficulty of side-bracing in earth.) Because of the effect of artillery fire, all structures must be built at least 60 feet underground, and any subsequent enlargement can be carried out only under great difficulty and with temporary loss of utility. To start with a cross section of small diameter, because of haste and urgency, has been shown in almost every case to be a mistake. As the galleries become longer, branch passages become necessary, imposing greater demands on transportation, traffic, and the bringing in of equipment.

For the beginning of the mine construction, beyond contact with the underground enemy, a gallery profile 4.5 feet high and 3.9 feet wide in the upper third, or 3.9 feet in diameter, will be the minimum dimension.* With further training and practice, under certain circumstances smaller dimensions can later be applied, with a smaller amount of labor and cubic volume of material to transport.

(c) Miners Should be Left to Their Own Work

At this point another war experience should be mentioned. This is the requirement of complete separation of mine construction from other tactical installations; otherwise the miner is seriously impaired in the performance of his duty of protecting the troops against the effects of underground events. Moreover, the maintenance of the secrecy of underground work is also made difficult. For example, in addition to the information from prisoners and deserters on this subject, we read in the reports from the Bessarabian front how, before each listening pause, a few mortar bombs were fired against the suspected enemy gallery entrances, whereupon in our galleries there could immediately be heard the sound of the running feet of the enemy garrison in their own mine galleries, and from this valuable inferences as to distances, etc., could be drawn. In close relationship to the requirement of secrecy, is that even more urgent need of exclusive subordination of mine work and miners to leaders of their own arms of the service, or under the higher HQ command, in order to be independent of the junior front-line commanders. Miners then will not be constantly used for other work which may seem more desirable to the local garrison. Otherwise, when the enemy has done his blasting, we will wonder why no precautions, or too few, had been taken on our own side. For experienced miners, historical military examples need not be quoted; they are not hard to find.

(d) Time Estimates

The efficiency of the miners' effort depends on a great many circumstances, but for the most part on the degree of their training. Within broad limits, the following time allowances may apply.

1. In Earth (with a high degree of training and normal conditions, such as good lighting and ventilation, previously prepared shoring material, etc.):

Shafts (per linear meter). . . . . . . 5 hours min., 9 1/2 hours max.

Galleries (per linear meter) . . . . . 4 hours min., 9 hours max.

In loam and clayey soil, a minimum of 1 hour and a maximum of 2 hours

*Note: This is a literal translation of the German. The types of cross section implied in the statement are not clear, and no illustrations are given in the original.

per linear meter, according to the length of the gallery, were required for hand removal at a distance from the enemy. In proximity to the enemy the rate dropped to 1.50 meters per day.

ii. In Rock. The achievements reported in the last war are absolutely undependable. They suggest, for a passage cross-section of 32 to 40 inches, an advance of 30 to 32 inches per hour with machinery, and 8 to 12 inches by hand. According to experience, however, the figures of 12 inches by hand and about 40 inches with the mechanical drill were the approximate daily, not hourly, work-accomplishment with our untrained soldiers. On Mt. Pasubio the Italians calculated, for their certainly well-trained stone workers, 80 inches of gallery advance per day.

e. Summary

(1) The weapon of mine combat, the mine itself, is almost absolutely certain of its objective in view of the small sphere of effect and the all-around uniform effect in every direction. The size of the mine is to be determined on the basis of its purpose, and can therefore always be accurately adapted to the nature and resistance of the objective. With the possibility of an unlimited increase in charges, the effect can also be practically unlimited in its concentration at one point. As regards casualties, the blasting effect can also be increased at will be means of the gas effect.

(2) The great moral effect of mine combat, from the beginning of suspicion that it is underway up to the detonation of the mine itself, has been repeatedly shown by military history. It is extremely difficult to counteract. Because subterranean attack can be made almost anywhere, the threat of its use is liable to be widely felt.

(3) The underground conduct of battle can be opposed only underground. It must be reconnoitered underground, with a very great outlay in time, work, and material. Combatting it on and above the surface is possible only to a limited extent, and under no circumstances with lasting success.

(4) Underground resistance to mine attack by means of mine defense, corresponding to the information disclosed by thorough reconnaissance, always can be a laborious process, involves many times the quantity of supplies and personnel as required by the attacker. In most cases only the installation of a complete and organized underground defense system will have any prospect of success.

(5) Because the site of combat is in the earth, and because of the extensive and difficult work required, the underground mode of battle is a very slow one and requires a great outlay of special troops and equipment. Its employment is therefore justified only against the most profitable objectives.

(6) The site of combat underground, where only one human sense, hearing, is capable of giving warning, stamps the underground mode of combat with the

mark of something unknown, something uncertain, which often forces both sides to take up underground combat unwillingly, and thereby to lose the advantage that rests with aggressive mining operations. This uncertainty also makes it difficult to evaluate the plan and the intention of the enemy, the phases of the battle, and the prospects of success.

(7) The abandonment of the combat area, which is one way of meeting a threatened mining attack, implies a locally limited failure in the campaign. However, it is an absolute defeat in the combat for permanent fortifications, confined to a limited locality, with their system of mutually supporting defenses. For this reason permanent fortifications have always been a proper field for mine combat.

(8) Uncertainty always makes mine combat an expensive, tedious method of battle, seeming to the non-expert more of a hidden game of chance than an open combat. It can be met only by a firm will based on one's own knowledge of mine operations.

(9) Lack of technical knowledge is apt to arouse the belief that luck alone is the controlling factor in mine combat. Luck certainly belongs there, but no more than in any other form of combat.