PERMANENT FORTIFICATION

FOR THE

IMPERIAL MILITARY TRAINING ESTABLISHMENTS

AND FOR THE

INSTRUCTION OF OFFICERS OF ALL ARMS OF THE AUSTRO-HUNGARIAN ARMY.

By MORITZ RITTER VON BRUNNER, Major, Engineer Staff, Austro-Hungarian Army.

(*WITH ONE MAP AND NUMEROUS DIAGRAMS.*)

7th Edition completely revised.

TRANSLATED FOR THE GENERAL STAFF.

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NOTE.

Most of the information and data given in this Book apply to European systems only.

The Section on Coast Defences has been considerably abbreviated and a few additions have been made by the translator.

1911.

AUTHOR'S PREFACE.

THIS edition is a complete revision of the previous issue which appeared in 1901. The newest improvements and latest war experience have been included, and the subject matter has been rearranged.

An analytical consideration of the subject has taken the place of the synthetical method formerly adopted and it is treated in greater detail. Further, those parts dealing with fundamental principles have been separated from those dealing with tactical problems. It is thought that this will help the reader to obtain a quicker grip of the subject, and will make it easier for both principles and details to be understood.

At the same time the author has tried to arrange that all the fortification drawings and designs comply with actual war conditions.

Important new matter has been introduced, including an example (with plans) of a modern fortress. The letterpress is fully annotated with explanatory notes.

A fresh feature in the present edition is that, owing to the present importance of "Barrier" forts for mountainous country and of Coast Defences, these subjects have been treated from first principles, with many illustrative examples. Information concerning warships and the effect of their gun fire, as well as that of the coast batteries, will be found in Chapter IV.

In the chapter entitled "Improvised or Auxiliary Fortifications" an endeavour has been made to show briefly that, as weapons become more perfect, this type of fortification tends to lose its importance.

An entirely new chapter on the use of permanent fortification, illustrated by examples from mid-Europe, has been added to the book. It is thought it will meet a want.

The instructors at the Technical Military Academy and the Artillery and Engineering Cadet Schools will, of course, find many opportunities for amplifying the contents of this book.

MORITZ RITTER VON BRUNNER.

VIENNA,
June, 1909.

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The MAP will be found in the pocket.

CHAPTER I.—INTRODUCTION.

1. General Considerations.—In any given theatre of war there are places which it is absolutely necessary for one side to occupy for the safety of its army or fleet both at the opening of and throughout the campaign. Such places are for the same reasons of importance to the other side. Examples of these are :—Important river crossings close to the frontier, passes in hilly country, naval ports, etc.

For the defence of places of such special military importance, permanent fortifications are far more efficient than field defences. In order to retain possession of such places without the aid of permanent fortifications it would be necessary to employ a large number of troops, and the prolonged resistance entailed could hardly be obtained without weakening the field army to an inadmissible extent. Permanent fortifications enable an inferior force to hold out for a considerable time against one greatly superior. The defender of a permanently fortified position always fights over ground which is very well known to him, and is not obliged to be always adapting his defence to suit changing conditions, as he is during the course of field operations. For this reason it is possible to employ less highly trained troops (*e.g.*, The Landsturm) as part of the garrison.

2. General form of Permanent Fortification.—If the places to be defended are to fulfil their main object, they must be prepared for war as thoroughly as possible in time of peace. The work must be carried on year by year with the aid of the highest technical skill available. The period between the beginning of the war and actual hostilities (which is the period of mobilization) must be employed to complete whatever has not been made ready in time of peace, whether from financial or other reasons.

Special points which arise are as follows :—

First and foremost the fighting positions must be chosen according to correct tactical principles. The separate "points d'appui" of the fighting positions (called works or forts) will have been already built in peace time. They should not only be arranged so as to get the maximum fire effect from their own armament, but they should also be provided with such protection as will make them secure against the heaviest kind of fire which may be expected. Further, they must be protected from assault by strong and well-enfiladed obstacles.

Then again, those portions of the defensive line lying between the "points d'appui," which are of less tactical importance, must also be strengthened by the addition of infantry cover, gun batteries, screens, obstacles, etc. This work will be carried out partly in time of peace and partly during the mobilization period.

That part of the work carried out during the mobilization period will be similar in character to that of field defences. The field of fire in front of the defensive position must be cleared, obstacles (such as mines) laid down, roads and bridges destroyed, etc. Behind the position the necessary communications and telegraphic connections must be made and shelters for the troops and magazines must be constructed. Most of this latter work should be carried out in time of peace.

Lastly, every provision must be made to enable the garrison to make a prolonged resistance if necessary. This includes the provision of ammunition, supplies, sanitary arrangements, technical stores, etc.

3. General Remarks on the Attack.—If the defender has created and equipped his fortified position in a thorough manner, and if he makes full use of the tactical advantages that this gives, the enemy will be compelled to carry out a long and tedious attack which is called a "Siege." Not only must he employ a force considerably in excess of the defender's, but he must also bring up special means of attack, such as heavy guns. Further, during the lengthy investment he will be forced to provide himself with a large amount of artificial cover. The loss of time and strength involved in these operations is detrimental to his operations elsewhere.

If, however, the fortress is ill-equipped and but feebly defended, the enemy will achieve success far quicker. When the artillery bombardment can be carried through with only a few guns and in a short time, or when it is possible to reduce the amount of infantry cover to be provided (which adds so greatly to the length of an attack), we have the conditions for an "*Attack in force.*"

A sudden attack under cover of darkness is termed a "*Coup-de-main*" or "*Surprise attack.*"

4. From the foregoing remarks it is evident that the length of time for which permanent fortifications can be "held" varies considerably. Above all the "nature of the conduct of the defence" is the deciding factor, for even fortifications of an inferior character may be held for many months if defended with caution and bravery. On the other hand it is obvious that, under similar conditions, suitably designed and constructed fortifications might be held with a smaller garrison and for a longer time than others less well-equipped. It is self-evident that a garrison cannot hold out after the munitions for war (especially food) have come to an end. If food fails, the attacker can attain his object by starving out the garrison instead of making an attack.

Historical Examples.—In 1761 the Prussian fortress of Schweidnitz was captured by the Austrians in one night. One year later this fortress, which had been strengthened in the meantime, was only recaptured after a two months' siege.

Similarly in 1807, the Russian fortress of Danzig was taken by the French in two months, while in 1813 an eleven months' siege was required to retake it. The Prussian fortress of Kolberg (1807) and the French fortress of Belfort (1870–71) only fell into the hands of the enemy, one after a three and a-half months' siege and the other upon the conclusion of peace.

The eleven months' defence of Sebastopol by the Russians (1854–55) is celebrated, while the siege of Port Arthur, lasting seven months, is equally well known. The defence of the coast fortress of Charleston for twenty months in the American Civil War (1863–65) is less well-known.

As examples of sudden attacks we have the two attempts to capture by surprise the Turkish fortress of Kars. The first in 1855 was unsuccessful, but the second in 1877 resulted in the fall of the fortress.

The war of 1870–71 is especially rich in lessons, amongst which are the captures by "starvation"—Paris after 132 days' siege and Metz after 69 days. In the case of Belfort (already mentioned) the attacking force was far too small. The out-of-date fortress of Strasbourg was captured after a 45 days' siege. On the other hand numerous small fortresses, also quite out of date, were reduced by several days' heavy artillery bombardment alone, while some offered no resistance at all.

5. The Nature of Permanent Fortification.

(a) Land fortifications.

Modern land fortifications are of two kinds—"fortresses" consisting of a girdle of detached works (Gurtelfestungen), and "barrier" forts (Sperren). Fortresses are used chiefly as bridge defences, and in their main features resemble the double bridge heads of field fortification. Besides this, fortresses are always sited to block important railways or roads, especially when the place to be defended lies on the banks of a large river. Lastly, fortresses can be advantageously used as reserve centres for all kinds of war stores.

The distinctive feature of the "fortress" as compared to the "barrier" fort is that its works of defence are in the form of a girdle (Rundbefestigungen).

These works are sited and designed so as to be capable of keeping off attacks from any direction; they are not necessarily distributed equally along the girdle.

This all-round attack is likely to occur in flat or hilly country or at the junctions of important valleys in mountainous country.

"Barrier" forts serve the same purpose as a post blocking a line of communication in field fortification, and are similar to them in details.

In contradistinction to a fortress they are designed to meet attacks in force delivered over a limited area and from a fixed direction only. This direction coincides more or less with that of the line of communications which has to be blocked. They consist, therefore, of only one group of works or even of only one fort.

"Barrier" forts are mainly employed in mountainous country, for in such places all movement of large bodies of troops and transport columns is confined to the main roads owing to the difficulty of traversing the country lying between them.

As similar conditions are to be found in tracts where swamps and lakes are numerous (West Russia or East Prussia), barrier forts are then also applicable.

In exceptional cases barrier forts are used in open country such as

the French frontier with Belgium and Germany. The forts thus situated must be very near together so as to confine attacks to the front or rear. This either entails a large number of forts, or the allotment to the defence of a considerable force in addition to the forts themselves. Both of these alternatives have disadvantages.

(*b*) *Coast Defences.*

The chief use of coast fortresses is in the defence of those ports which serve as strategical bases for the fleet and for its refit. If these ports are open to attack from the land side they are provided with land defences, and in such cases resemble land fortresses.

It may also be necessary to defend mercantile ports and anchorages in order to close them to the enemy or to secure their use as ports of refuge at any time for one's own fleet.

Coast defences are often required to close river mouths or sea canals, to prevent landings on particular parts of the coast or to protect bases for torpedo craft, coaling stations and the like.

CHAPTER II.—THE EMPLOYMENT OF PERMANENT FORTIFICATION.*

(Illustrated by Examples from Mid-Europe.)

Strategical and political considerations determine what places require to be protected by permanent fortifications.

In the following paragraphs an attempt is made to give with the simplest possible explanation the most important instances in recent times in which permanent fortifications have been employed, and from the facts set forth, to draw such conclusions as seem justifiable.

(*a*) Fortifications on the Western Frontiers of Germany.

Of the fortified places shown in Sketch 1† only the fortresses on the banks of the Rhine, Germersheim, Mainz, Coblentz and Cologne belonged to Germany before the Franco-German war, since the frontier then ran north of the line Diedenhofen-Bitsch-Weissenburg. In order to estimate the influence on warlike operations which these fortresses might have exerted by reason of their position, we must first of all consider the circumstances of the period before 1860. It was thought at that time that in the event of a war with France the German armies would necessarily deploy behind the line of the Rhine. It was evident in the first place that this great obstacle, the most important passages of which were guarded by the above-mentioned fortresses, would be a great protection to a deployment in case of an unexpected attack; and secondly, that the fortresses themselves would, in their capacity of bridgeheads, protect a crossing in the face of the enemy at the outset of the campaign; and again, although they would have fulfilled their chief function as soon as the invasion had been accomplished, they would still have great value as protected reserve centres and points of support; and lastly, if the invaders were repulsed they would materially assist their retreat over the Rhine and would later on have enabled the offensive to be resumed.

After 1860 Germany was satisfied that her mobilisation arrangements, including her network of railways, had been sufficiently improved to enable her to contemplate a deployment in front of the line of the Rhine. In these circumstances the fortresses were likely

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* The chief object of this chapter is to give the student a few definite ideas. For an exhaustive study the following works dealing principally with the Franco-German war are recommended :—

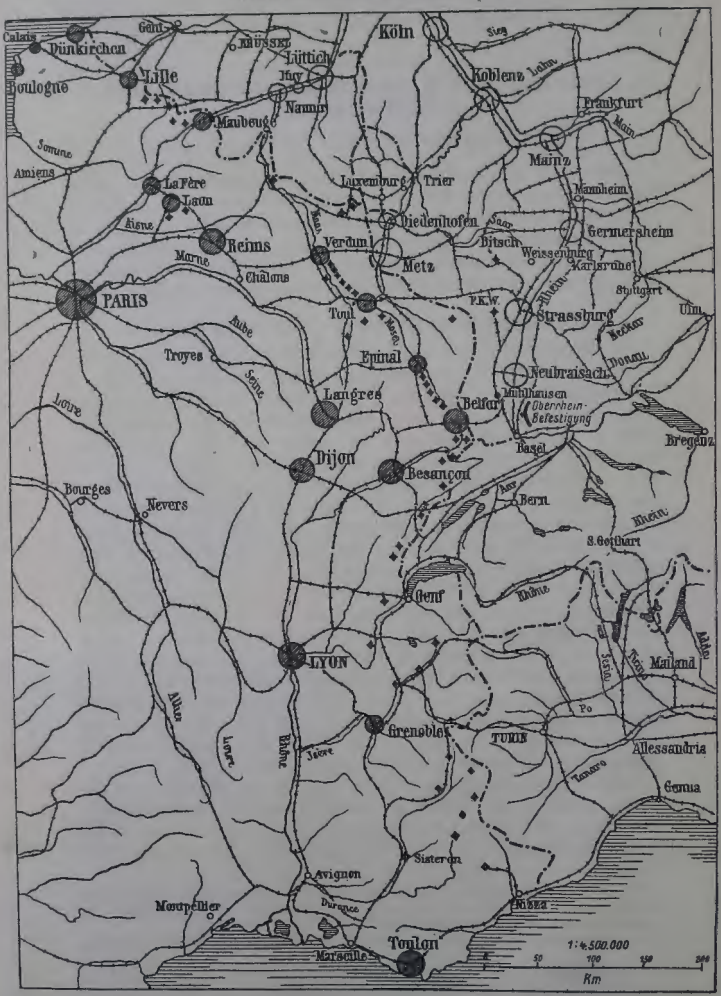
Frobenius.—"Examples of fortress warfare in the Franco-German war, 1870–71."

Schroeter.—"The meaning of fortresses in the great wars, based on Moltke's schemes of operations."

Gundelach.—"The fortress and the field army in the war of 1870–71."

† This sketch was made for use with a plan in the book, "The fortress in modern warfare," by Von Schroeter, Lt.-Col. in the Prussian Army.

Sketch 1.—Scale, 1/4,500,000.



to be called upon to fulfil the last-mentioned purposes only. They were, in fact, merely of use as a reserve, while the deployment area was left unprotected.

Modern conditions, however, are quite different. As France is now in a better state of preparation, Germany can no longer reckon on being able to effect a deployment or to assume the offensive as easily as was the case in 1870.

For this reason Metz, which was acquired from the French, and, on a smaller scale, Diedenhof, have been converted into modern fortresses.

These two bridgeheads connect up the shortest and most important lines of operation leading towards the front of the deployment area. In contrast to 1870 this is now partly protected by fortifications, which make the passage of the Mosel easier.

The line of the Rhine has also been strengthened by the reconstruction of the fortresses at Strasbourg, which was formerly French, and at Neubrisach (a smaller adapted fortress). This newly acquired stretch of the Rhine is specially important because it lies near the frontier, and because it is open to attack in spite of the Vosges mountains which overlook it and which can only be crossed in a few places. The fortifications of the old Rhine frontier have also been brought up to date, but they have lost most of their importance and are only of value in case the German offensive fails. If the Rhine fortresses had not already existed, it is open to question whether they would all have been reconstructed; as this has been carried out they have, no doubt, made the flanks of the deployment area more secure.

Lastly, mention must be made of two existing German forts which guard the railways, namely, the fort* (Feste) Bitsch, which was formerly French, and the new fort* Kaiser Wilhelm II, an advanced work of the fortress of Strasbourg. There are also defences at Oberrhein which act as a barrier fort in the Rhine Valley north of Basle.

The above examples show that the relative importance of the fortresses in a fortified line is liable to vary within a comparatively short period of time. This is caused by changes in political affairs and alterations in the strategical plans. These points must therefore be very carefully weighed when any scheme of fortification is under consideration, so that costly forts may not be built which do not fulfil the object for which they were intended.

Germany also has fortifications on her eastern frontier, since she has to be prepared for war on both frontiers.

In the interior there are no fortified areas which could possibly be compared to the fortifications of the Rhine line, except a few isolated and antiquated places such as Magdeburg, Spandau, Kustrin, Ulm, Ingolstadt.

(*b*) Fortifications on the North and East Frontiers of France.

Though France possessed several fortresses at the time of the outbreak of the Franco-German war, the majority of them were out of date. She hoped to have been able at once to carry the offensive

* By "Feste" is meant an extra large barrier fort.

into German territory and to remain in occupation. Consequently she had almost entirely neglected both to carry out the necessary work of reconstruction and to make preparations for mobilisation, the supply of her garrisons, etc. Yet in spite of this neglect, and in spite of the surprising and brilliant victories of the German army,* France was able to compel the victorious German invader to lie before her fortifications for months exposed to the attacks of fresh armies† which had assembled under cover of the fortresses.

The existence of these fortresses, although enabling France to hold out for a far longer time than was anticipated, did not exert any apparent influence upon the final result of the war. We learn at least one important lesson from the operations round these fortresses. France has shown that she possesses immense latent powers of resistance.‡ How different might her fate have been had she been better prepared!

After the Franco-German war France at once began with great energy to reconstruct her Fortifications. Some of the result of her efforts are shown in Sketch 1.

The northern and eastern frontiers of France are divided into two regions fundamentally distinct in nature and military importance. From the Pas de Calais up to and including Belfort—the frontier with Belgium and Germany—plains and low hills predominate. From Belfort to the Mediterranean—the frontier with Switzerland and Italy—the country is mainly mountainous.

1. *The French Frontier with Belgium and Germany.*

(See Sketch 1.)

In this area the defence of the French frontier is carried out by single fortresses, between which are arranged chains of blocking forts (Sperrfortketten).§ Behind these, forming a second line, there are fortress groups (Festungs-gruppen), two to every three fortresses; and finally, as a third line, lies the huge fortress of Paris.

The object of the first line is clear. It is not an impenetrable barrier, and yet affords protection against a strategical deployment and makes it possible to fight a defensive and delaying action. This may be necessary when a purely defensive attitude is taken up or in order to hold some portions of the frontier with relatively weak forces, so that the offensive may be assumed elsewhere with all the stronger force. This line naturally acts also as a support should the offensive fail.

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* August 1st, 1870: Start of the German offensive. August 20th: Surrounding of Bazaine's Army in Metz. September 1st: Capitulation of Macmahon's Army at Sedan. Yet it was not until January 28th, 1871, that the armistice was agreed to which preceded the peace, and during the interval Germany had been compelled to attack two large and 22 smaller fortresses.

† First and second Armies of the Loire, the Northern Army and Bourbaki's Army.

‡ As a result France, in spite of her defeat, could not for one moment be set on one side as a "quantite negligeable." Her credit scarcely suffered, and she was able to pay off the enormous war indemnity in an astonishingly short time.

§ Cf. p. 3, bottom paragraph.

The second line (the fortress groups) only comes into play when the first line has been broken through, after which it may be employed in various ways according to circumstances.

Supposing a defeated army was retiring upon one of the fortress groups it would have one of its flanks secured. Such protection is a great advantage.

In the case of a retreat in the gap between any two of the groups this advantage would be lost, but the two groups would threaten the enemy's communications as he advanced between them, especially as they have the power of harassing his supports.* The enemy would thus be compelled to " contain " one of the groups or else to attack it : in either case his main body would be weakened.

To turn to Paris : even in 1870–71 she only fell when her provisions ran out. Though her defences were incomplete and her equipment and stores deficient she was, contrary to all expectation, able to hold out for 132 days. The German army of investment was in a somewhat precarious position. Insufficiently provided with means of attack and inferior in numbers to the defence, it was not in a position to carry out an overwhelming attack. Detachments had continually to be sent to oppose the threatened attacks of the newly formed corps in the north-west and east of France.

If the army which was investing Metz had not been set free by the fall of that fortress, the siege of Paris would not have succeeded.

The modern fortress of Paris is incomparably better prepared for war than it was in 1870–71, and a besieger would now have a far more difficult task than at the former siege.

Though France has obviously taken precautions to complete her land defences in the most thorough way possible, it must not be forgotton that to construct, equip and maintain so many fortresses and barrier forts involves an enormous expenditure and moreover very large numbers of men are required for their defence. If it be borne in mind that the main objective of a powerful State should be the enemy's territory, it is an open question whether such a complete and extensive system of fortification as that existing in France is really necessary.

A State which has determined to assume the immediate offensive in the event of war, but which is forced to consider economy, will undoubtedly get the best value by a thorough preparation of its field army. But since no State can make certain of a successful offensive from the very start it is not justified in dispensing entirely with fortifications. Fortifications are necessary, if only to afford protection to a strategical deployment and to ensure that initial defeat does not spell disaster.

There are two conditions under which a State is justified in developing a system of fortifications as elaborate as that of France. Firstly, it must have sufficient means to provide for her field army as well as her land defences; and secondly, it must have the moral and financial strength to carry on the defensive to the bitter end.

If, after admitting that France fulfils these conditions, we still consider her fortifications too elaborate, we must not forget that

* Either by the garrison itself or as in 1870–71 by fresh troops assembled under cover of the fortress.

her boundary with Belgium and Germany lacks any naturally strong obstacle such as is formed by the River Rhine. To meet this weakness she has adopted a deep zone of barrier forts, and at the same time she has probably abandoned certain places whose defence would have entailed a complete new system of fortifications.

2. *The French Frontiers with Switzerland and Italy (Alps and the Jura Mountains).*

The fortifications hitherto under consideration have been situated in districts which, by reason of their geographical features, must constitute the main theatre of operations for a field army.

Military history teaches us that the so-called "Frontier zone" (Durchszugsland), though ill-adapted to major operations, frequently becomes the locale of subsidiary movements. The object of such minor operations may be the seizure of the areas concerned or they may be merely auxiliary to the occupation of the main theatre of war.

In this connection we have only to recall the part which was played by the Tyrol in the wars of Napoleon.

The Alps and their outlying spurs—the Jura Mountains—form the frontier zone between France, Switzerland and Italy. The defences here consist of barrier forts which connect up the most important lines of communication. There are in addition the fortresses of Besançon* for the Jura, Grenoble and Lyons for the Cottian Alps, the small place Sisteron for the Maritime Alps; these all lie along the line of railway behind this frontier, and are of value when the advanced forts have fallen.

This system of fortification permits of the defence of this frontier with a relatively small force to the benefit of the main army operating in the north. For political reasons this is especially necessary in the case of France.

Besides liberating troops for use elsewhere these defences may so delay a part of the enemy's forces as to prevent their co-operation in the main theatre of war.

For these reasons permanent fortifications are of great value in such "frontier zones." Their expense is not prohibitive, since barrier forts are far less costly than fortresses. Even the less wealthy States might with advantage make use of this type of land fortification.

The French frontier with Spain consists broadly of the Pyrenees. Barrier forts defend the eastern and western ends, while the fortresses of Perpignan and Bayonne act as supporting points. (The centre portion of the frontier in the Pyrenees cannot be considered to be a "frontier zone.")

The examples which now follow can only be referred to briefly owing to lack of space.

(c) Fortifications in West Russia.

The frontier here is entirely free of obstacles and the country is very open.

* Besancon belongs to the Southern group of fortresses already mentioned, but at the same time acts as a central position for the defence of the Jura Mountains.

A system of fortresses with chains of barrier forts in the intervals would not be a very valuable asset in this country, and moreover, on account of the expense, could not be even considered.

Russia has therefore been compelled to site her fortresses along the rivers which run near to her frontiers.

Ivangorod, Warschau and Novogeorgiewsk lie on the Vistula; adjoining the Narew and Bohr there is a row of smaller fortresses, the last and most important being Osowiec.

The fortress of Brest-Litowski lying on the Bug is also important, being situated at a railway junction and at the head of a vast stretch of marsh land. The area enclosed by these fortresses is not one in which an army could conveniently assemble with a view to taking the offensive or simply acting on the defensive.

The fortified line of the Niemen closes in, this defended zone on the north; while in the south-east the way into the frontier zone across the Pripet's morass near Kowno is blocked by several forts.

The great disadvantage of this system is that a strategical deployment anywhere in front of the line of the Vistula in Russian Poland would be entirely unprotected by fortifications.

(*d*) Fortifications in North Italy.

1. *The fortified Quadrilateral.*

The fortified quadrilateral Verona-Peschiera-Mantua-Legnago will only be referred to in so far as it affected the campaigns of 1848 and 1866. These fortresses were able to exercise a decisive influence on the final result of two campaigns, they took part in the opening of the campaigns, and they further acted as a protection throughout the operations. This example is classic, and details will be found in all military histories. These fortresses now hold an entirely different position and are of comparatively minor importance.

2. *Fortifications on the Alps Frontier.*

The main theatre of war for Italy has always been the valley of the Po. It is only possible to carry out extensive operations here from east to west or from west to east. In order to make these operations secure upon their north flank the only thing to do is to block the passes across the Alps by " barrier " forts.

(*e*) The Defence of small States by Fortifications.

The lesser powers must endeavour to prevent any breach of their neutrality, or if they are not neutral they must try to keep at bay the superior force till such a time as help may be received from one of the great powers by diplomatic or armed intervention. They can only accomplish these ends when their small armies are supported by fortified positions.

In the fortified line of the Meuse (Luttich-Huy-Namur), *Belgium* holds a position from which her army can very effectually harass any attempt on the part of a German or French force to march through her territory between the Meuse and the Mosel.

In conjunction with the centre point—Antwerp—these fortresses

make it possible for her army to hold out until the stronger power intervenes.

The fortified line of the Sereth (Fokchani-Nemoloassa-Galatz) with the centre point Bukarest, serves an exactly similar purpose for *Rumania* in the case of a war with Russia.

Switzerland, by an extended line of "barrier" forts, has protected the important pass over the St. Gotthard, which prevents any attempt to march through her territory from north to south.

(*f*) The Coast Defences of Germany.

Germany possesses two first-class naval harbours, Wilhelmshafen on the North Sea and Kiel on the Baltic, which are the main mobilisation centres for her fleet. All the more important river estuaries (Weser, Elbe, Oder, Vistula), as well as the Kurische and Frische Haff, are also defended for purposes which have already been mentioned in Chapter I, paragraph 5 *b*.

It may be generally stated that coast defences are necessary under all conditions, whether the fleet is small or large, whether its *rôle* is to be defensive or offensive, and particularly for the following reasons :—

(*a*) The mobilisation of a fleet can be molested on the very first day that war is declared (cf. the attack of the torpedo-boat destroyers at Port Arthur).

(*b*) It is rarely known what course the operations at sea will take, and even the strongest fleet may be compelled at times to seek protection in her harbours.

(*c*) Even the most powerful ships have only a limited radius of action, *i.e.*, they are only provided with water, coal and ammunition for a certain length of time. They may therefore be compelled during lengthy engagements to renew their supplies or carry out repairs at protected bases.

Many tasks may therefore fall to the lot of permanent fortifications, and taking into consideration the varying conditions under which they are used, it is clearly almost impossible to lay down any definite rules for their employment.

CHAPTER III.—LAND FORTIFICATIONS.

THE FORTRESS* (GÜRTELFESTUNG).

(A) General Considerations.

(See the Map.)

Main Features.

6. The main features of a fortress are its fighting positions. The principal line of defence surrounds the place to be fortified in the form of a ring or girdle at a distance of several miles. This is called the line of detached forts (Gürtelstellung).

The majority of fortresses have also a second defensive line, which is much nearer to the place to be fortified; this is called the "Enceinte" (Kernbefestigung). Its object is to check an enemy who has forced his way through the first line at some point between the forts, and also to assist the reserve which has been hastily assembled to drive him back again.

Some fortresses have still another line of defence, an inner belt between the main belt of forts and the Enceinte. This inner belt is frequently found in old fortresses, where a new belt of larger circumference has been constructed. The construction of a new inner belt of works, which is recommended by many authors, would generally be prohibitive on account of the cost—it might sometimes take the place of the Enceinte.

The belt of forts as well as the "Enceinte" comprise extensive positions, which must be divided into sections,† each under a single commander. Rivers form the section boundaries, or failing these any other well-defined lines except roads or railways. Each section is further divided into "groups," the boundaries of which are also determined by the special nature of the ground.

See on the map, Sections I and II of the Belt, with groups I (*a*), (*b*), (*c*); II (*a*), (*b*), (*c*); and Section V of the Enceinte. The Sections III and IV of the Belt and Section VI of the Enceinte are supposed to lie on the other bank of the Elbe.

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* The example of an imaginary fortress at Koniggratz, which has been chosen, is especially full of lessons on account of the nature of the ground in the vicinity.

In the work "Fortress Warfare," by Jas. Macalik and Alb. Langer, Vienna, 1904, which is especially recommended for the study of details, a Fortress Koniggratz has also been selected. In this book, however, for special reasons, the use of a particularly narrow girdle only has been discussed.

† Previously the term "Defence district" was used, but this has now been replaced by the term "Section" in order to conform to the terms in use in the Regulations on Tactics.

Means of Attack.

8. Disregarding for the moment the question of artillery defences the great advantage which the "belt of forts" as well as the "enceinte" have over the majority of positions defended on field lines is that they compel the enemy to employ a frontal attack. This attack, however, will never be directed against the whole circumference of the fortress, for this would require too many troops and is unnecessary. The objective is rather to capture a few miles of the girdle, and to achieve this the attacker will completely invest the place with troops while directing the decisive attack against one only, or, if in great superiority, against two points of the belt of forts. He will endeavour to conceal his intentions by demonstrations along the whole front.

The attacker has attained his main object when one section of the belt of forts has been captured and finally occupied; for, if the adjoining forts still hold out he can subdue them by attacking them in rear, while the enceinte is unlikely to offer more than a feeble resistance. This latter is due to the fact that a stubborn defence of the belt of forts will compel the defender to use up most of his reserve strength.

The defender must therefore keep his reserves in hand as long as possible, as they are of extreme importance should a surprise attack succeed at some weakly defended "internal position." The presence of the enceinte checks the attack, averts a panic and gains sufficient time for the defender to bring up his reserves. At this stage the whole strength of the fortress comes into action. The attacker will be in a precarious position and his retreat is likely to be fraught with great danger.

9. Two other characteristics of siege warfare are the lengthy artillery preparation and the provision of artificial cover to aid the infantry attack.

The light and heavy guns of the field army* are not sufficient in number or weight for siege warfare. Special siege artillery† must be assembled by ship or rail. Positions must be prepared for the guns and light railways, teams of horses, or mechanical means of some nature must be provided to bring them up into position. The construction of the batteries and emplacements must be carried out with care, bearing in mind the direction of the intended main attack. All this work takes a long time and is open to interruption from the defender.

It is necessary to provide extensive and continuous artificial cover (saps or approach trenches) for the infantry attack, and to remove or destroy all obstacles at the points where the assault is to be made. Entrenching tools, explosives and all other appliances required for an assault must be collected together in the "siege park."

The attack of a thoroughly equipped and well-defended fortress is a very lengthy operation.

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* In the German Army the heavy howitzers of a Division belong to the Field Army, in other states they are classed as siege artillery.

† 200 to 400 pieces are required with their detachments, including howitzers of at least 10½" calibre, 4" to 6" howitzers, and 4" to 7·5" guns. See the books on "Armament" and "Fortress Warfare" for further details.

purpose (calibres of 4-inch and upwards, range 9,000 to 11,000 yards or more); they must cover the lines of advance and communication and be used to bombard cantonments, camps, parks, etc.

The hostile field and heavy artillery, which comes into action at the first stages of the siege, must also be engaged. *Howitzers* (calibre 6-inch to 7·5-inch, range at least 6,600 yards) appear to be most suitable for this purpose, for they can bring fire to bear on all kinds of cover and can search hidden folds in the ground.

In the map the batteries sited outside the works are indicated (*see* para. 24).

The mobile (horsed) gun reserve (40 to 80 pieces) is primarily intended for the rapid reinforcement of those long range batteries which are for the moment exposed to the heaviest hostile fire.

When quick changes in position are necessary field howitzers are preferable to heavy ones.

Light mortars (calibre 3½-inch to 4-inch) can also be allotted to the mobile reserve, and may be used when the attacker has reached a position within the range of the small guns. At this short range only mortars can obtain the steep angle of descent necessary. One of these light mortars can be moved by two or three men.

When the attacker is finally prepared to bring up his siege artillery the defender must call up his **heavy artillery reserve** (unhorsed). All unhorsed howitzers and any other heavy guns which are still available will be allotted to this reserve.

It takes a far longer time to bring up the unhorsed guns than it does to bring up the mobile gun reserve. In most cases, however, this time will be available, for the direction of the main attack will be readily recognised on account of the extensive preparations required for the siting of the siege artillery.

(B) Choice of Fighting Positions.

(See the map.)

Tactical Requirements.

13. The best tactical positions are, as a rule, good defensive positions. When selecting the line for the belt of forts and the enceinte every endeavour must be made to meet as far as possible all the tactical requirements of the case.

There must be an extensive field of view which can be well covered with a grazing fire, favourable artillery positions, concealed points of assembly for reserves, etc., and where possible it is of great importance that the foreground should be commanded at artillery ranges.

In the choice of the defensive positions the following points have also to be considered :—

Choice of the Girdle Line.

14. In the majority of instances fortresses resemble the double bridge head. As a rule, therefore, the girdle line of detached forts must be chosen with a view to the protection of an area containing both ends of the bridge which lies in the path of the main lines of communication. Both ends must be held in order that an army may

be able to effect a crossing and advance* in the face of an opponent who is in position in front of the fortress, or in order to ensure the safety of a retreat.

The bridge must first of all be fully protected from bombardment. In addition to this the town which is usually situated close to the bridge as well as any important military establishments in the vicinity must, as far as possible, be included in the scheme of defence (*e.g.*, the camps, commissariat and sanitary establishments, the artillery park, etc.).

When the line of detached forts is at a considerable distance from the object to be defended there will be no danger from bombardment, and at the same time an army marching through the fortress will be able to deploy after it has passed the precincts of the town without being exposed to hostile fire.

A theoretical calculation of the necessary distance can be made by subtracting from the extreme range of the attacking artillery the distance from the belt of the forts at which it can take up a position.

Assuming the extreme range of the enemy's guns to be $6\frac{1}{4}$ miles and the latter distance to be at least $1\frac{3}{4}$ miles, the distance between the belt of forts and the object to be defended should be $4\frac{1}{2}$ miles. A bombardment at such a long range, however, is not likely to cause serious damage, and since tactical considerations are of primary importance it will rarely be possible to adhere strictly to the distance obtained by this method of calculation.

Supposing for example that there were two positions possible, one of which was tactically more suitable than the other for a belt of forts but lay a mile or two within the theoretical minimum distance, this one would, as a rule, be chosen without further consideration. A short belt of forts has also the advantage that a smaller garrison is required and the distance to be traversed by the reserves is less.

Cases in which a greater distance than the theoretical occur are :—

(1) When there is no suitable position any nearer.
(2) When it is required to protect specially costly objects such as warships in naval ports.
(3) When it is required to defend the important towns of a State.

In these cases a more distant girdle is desirable in order to increase the difficulties of a bombardment.

Finally, when selecting the position for the belt of forts it must be borne in mind that the opponent will not bring up his long range artillery against all the fronts of the fortress, and so a distance much shorter than the theoretical is permissible at those parts of the line where no attack is to be expected (*e.g.*, the south-east front of Königgrätz No. III Defence Section, is an example of such front, but it is not shown on the map.)

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* This for example will occur when an army which has deployed behind a river wishes to assume the offensive against an opponent already drawn up facing the river ; or else when it is desired to attack an enemy in rear who is on the point of crossing the river at a point outside the limits of the fortress, and at the same time to maintain the defence of the river.

The Example on the Map.

In the imaginary fortress Königgrätz there are two defensive lines in the north-west. The position on the heights of Horenoves-Swiebwald is the more suitable because it affords an extensive view over all the foreground. The position, on the heights north of the Niedelist and near Chlum, is overlooked in front by the first-mentioned position and is also rather too near.

There are again two possible defensive positions in the south-west, the most advanced one on the heights south-east of Nechanic is not suitable from a tactical point of view, and therefore the retired position along the heights Problus-Prim-Techlowitz has been chosen.

In this example the belt of forts is $2\frac{1}{2}$ to 3 miles from the place to be protected, and $2\frac{3}{4}$ to $4\frac{1}{2}$ miles from a selected centre point. The belt is about 34 miles* in circumference.

Choice of the Inner Defensive Position.

(The Enceinte.)

15. When selecting this defensive position we must abandon all ideas of protecting the precincts of the town or the bridges against a bombardment from any of the works which have been captured by the enemy. The enceinte presents a new difficulty. On the one hand it must not hamper the building developments of the town. On the other hand it must not be too far out, for this would involve great expense and a large garrison, and does not comply with the tactical requirements of a second line position. These latter must receive the first consideration.

The choice of the line shown on the plan does not therefore need any further confirmation, even if other arguments could be brought forward in its favour.

It may be mentioned that the former fortress Königgrätz lay altogether within the present enceinte except at the least important section of the defence No. III, where it coincided with this position.

(C) The Main Fortification Features of the Girdle Position.

16. The defensive features of the belt of forts must be such that they can deal with any attack to which it may be exposed by reason of its importance or its power of resistance. The special features of fortress warfare have been shortly dealt with in paragraphs 8 to 12, and will only be repeated here in so far as they are necessary to make this point clear.‡

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* All the large European fortresses seldom have a belt of forts less than 28 miles long, and it is rarely situated at a distance less than $3\frac{1}{2}$ to 4 miles from the town. Bucharest has a belt of 47 miles in circumference, Paris 120 miles ($10\frac{1}{2}$ to $15\frac{1}{2}$ miles diameter), Belfort, Thun, Verdun 25 to $25\frac{1}{2}$ miles, Langres $32\frac{1}{2}$ miles, Lyons $42\frac{1}{2}$ miles. At Antwerp the forts are $5\frac{1}{2}$ to $9\frac{1}{2}$ miles distant. The new Forts of Metz are $6\frac{1}{2}$ miles distant from the centre point of the town.

† In some of the old German fortresses the town walls which acted as the enceinte have had to be demolished on account of the growth of the town. In most cases the laying out of a new enceinte has been left undone for the sake of economy, and this neglect has been attacked by some of the leading military authorities.

‡ This is dealt with at greater length in the book on "Fortress Warfare."

phases in fortress warfare
and the preliminary operations,

conducted at long range, but in
the problems of a close range

it is necessary to secure the best
foreground.

selected for this position has obviously
field of fire is not seriously curtailed.
adjoining country.

distant firing line will be used in the *long range*
possible field of view and a good command over
foreground are required for the former, and concealed
positions for the latter. Positions for the long range fight will there-
fore be selected partly on and partly behind the peaks or ridges
of the main ground.

As a rule, the siting of the works for the close range and
the long range fights is done separately and depends on local
circumstances. This will be discussed later with the aid of the map
and sketch 2 on page 20.

The siting of the works for the long range fight must be carried out
with a view to obtaining the tactical support of the close range posi-
tions. A further advantage in the separation of these positions
is that they cannot be both attacked simultaneously.

and long range—must be divided
since no defensive position can
value over all its circumference.
is of less importance than a line of heights,
to be subdivided
on the map. It is evident,
with the
line on heights
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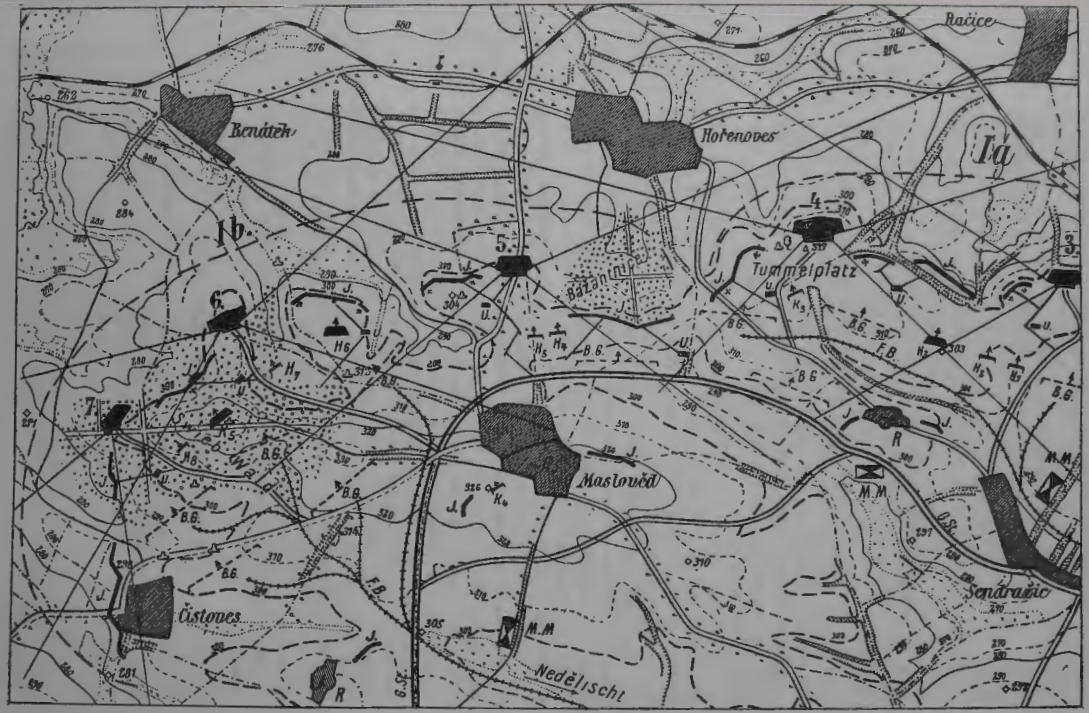
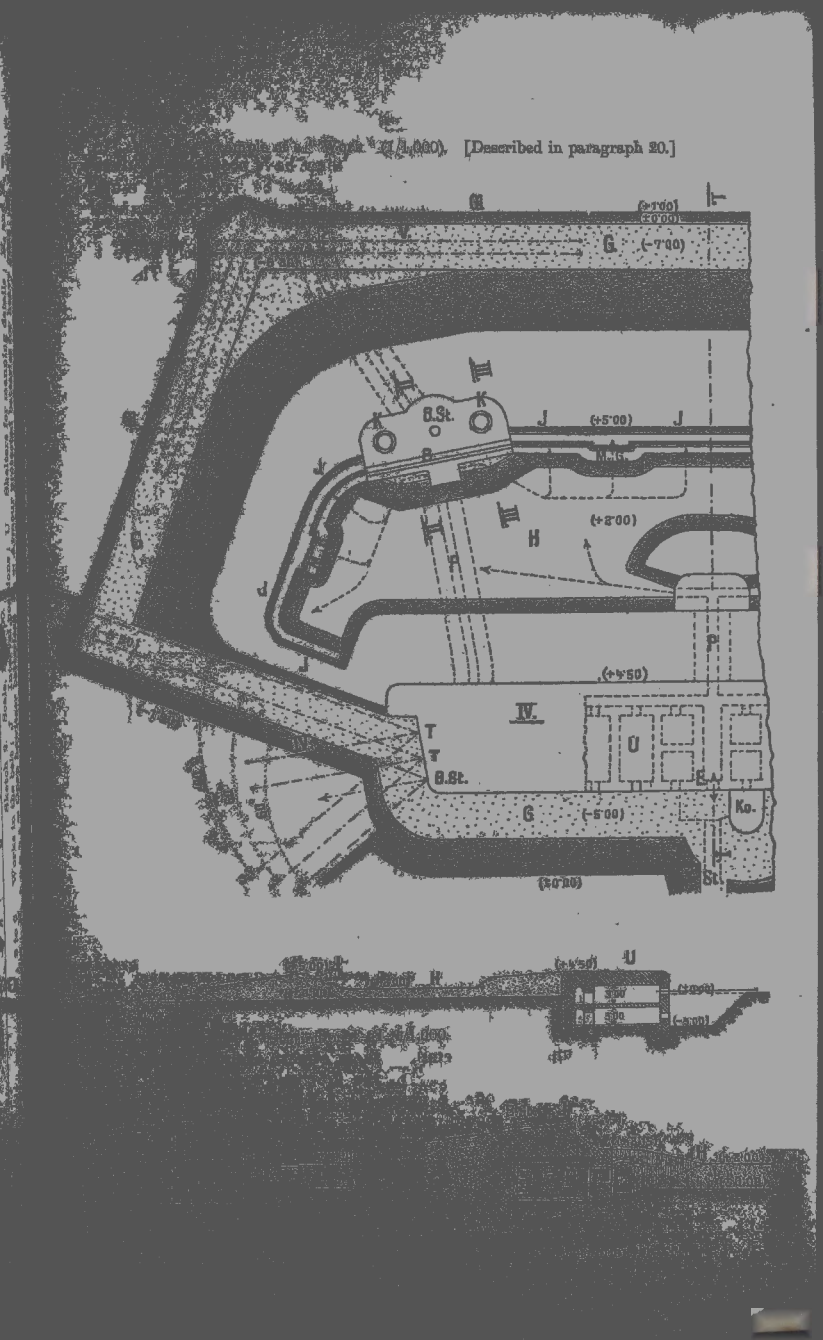
which will play a
the group



Sketch 2.—Scale, 1/25,000.

References.—1a and 1b = The groups; 3 to 6 = Works in the belt; J = Interval positions; U = Shelters for manning details; H_2 and H_6 = Armour protected howitzer batteries; $H_{1\ 3\ 4\ 5\ 7\ 8}$ = Open howitzer batteries; K_5 = Armour protected batteries for heavy guns; $K_{3\ 4}$ = Open batteries for heavy guns; R, G = Positions for reserve gun batteries; F. B. = Light railway; G. St. = Communication road

[Described in paragraph 20.]

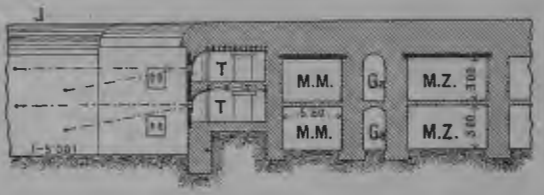


of fire to the front and on the flanks, and must have protection against the most powerful shell. Strong obstacles must be erected. It must also be possible to cover the ground in front of the interval positions with fire from the works.

The works by themselves only hinder and cannot entirely prevent the enemy breaking through the intervals between them. The intervals must in addition have fire positions for infantry, machine-guns and short range quick-firing guns, but they need only be comparatively weakly defended.

These positions are not likely to be bombarded by heavy guns, for

Section IV—IV.



Section V—V.

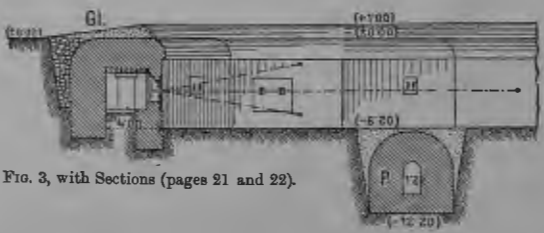


FIG. 3, with Sections (pages 21 and 22).

References.—B = Manning details shelters; B. St. = Observation Post; E = Entrance; F = Ditch flanking galleries; Ga = Passage; G = Ditch; J = Infantry parapet; K = Revolving cupola for a Q.F. gun; Ko = Gorge caponier; Gl = Glacis; H = Terreplein; L = Ladder up to the observation post; M.G = Platform for machine guns; M.M = Magazines; M.Z = Men's accommodation; P = Underground communication passage; T = Traditor position (quick firing guns); U = Shelters or casemates.

the attacker can only bring up his most powerful guns in comparatively small numbers; will employ them almost exclusively against the works. Then, too, "cover" in the intervals can be made very inconspicuous, and will offer a much less favourable target than that in the forts. Lastly, should an attack on an "interval position" succeed, everything is not irretrievably lost, for if the forts themselves have not been captured their flank and reverse fire make the enemy's position in the interval untenable.

For these reasons, therefore, field defences are used in the intervals, and they are for the most part only constructed on mobilisation, so that they do not become known during time of peace.

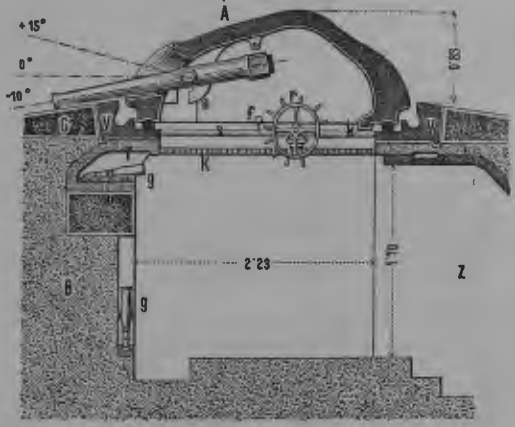
When the fortresses are not situated immediately on the frontier, some weeks will be available to complete the defences of these positions. They can therefore be constructed more carefully and substantially than those of the usual field type, and in some cases it will be possible to use stone and iron for building materials as well as earth and wood.

Works.*

See Figures 3, 4, 5, and 6.

20. A simple example is shown in FIG. 3 with its Sections. The position for the infantry (half a company) and the machine-

FIG. 4.—Revolving armoured cupola for a 3·2-inch Q.F. Gun. Scale, 1/50. (Described in paragraph 49.)



guns is an ordinary earth parapet (Section I—I), which, as a rule, is not occupied until the enemy's artillery has ceased firing at the work and he is ready to carry out the assault. Up till then a portion of the infantry and the machine-guns are held in readiness in masonry bomb-proof shelters "B" (Section II—II), the remainder are in reserve in the casemates "U" (Section I—I).

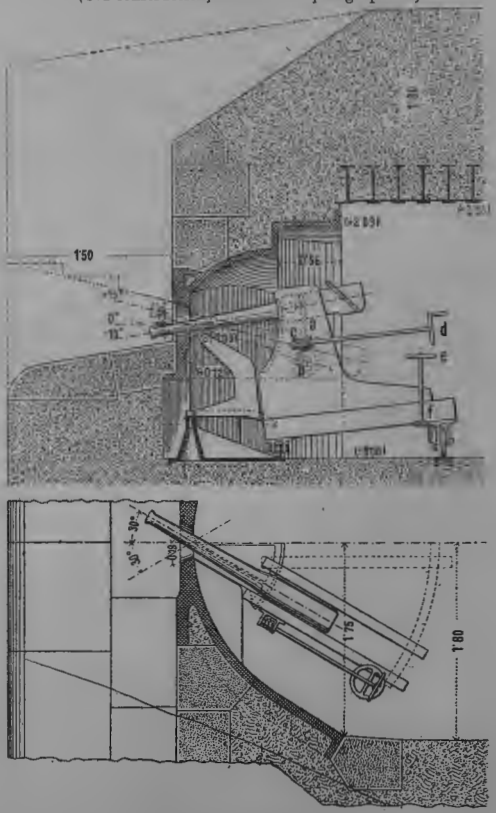
The light quick-firing guns are mounted in revolving armoured cupolas "K" (Section III—III) [details similar to FIG. 4], which are bomb-proof and have an all-round traverse. They can therefore be fired during the artillery bombardment.

Other guns are mounted behind steel shields in the so-called traditor casemates "T" (Section IV—IV); these are set apart

* Details will be given later in Section "D," page 31.

especially for purposes of flanking fire. In detail they resemble that shown in FIG. 5. They are placed in retired positions on the flanks of the casemates "U" and are completely hidden from the

FIG. 5.—Traditor casemates for a 3·2-inch gun with a minimum size gunport. Scale, 1/50.
(Old construction, described in paragraph 54.)



References.—d = Hand wheel with worm and toothed wheel gearing, *b*, *c* working on a rack "*a*" to obtain elevation; e = Hand wheel with bevel wheel gearing "*f*" for traversing.

view and the direct fire of the enemy. These guns only require an arc of fire of from 40 to 80 degrees.

The bomb-proof casemates "U" already mentioned contain

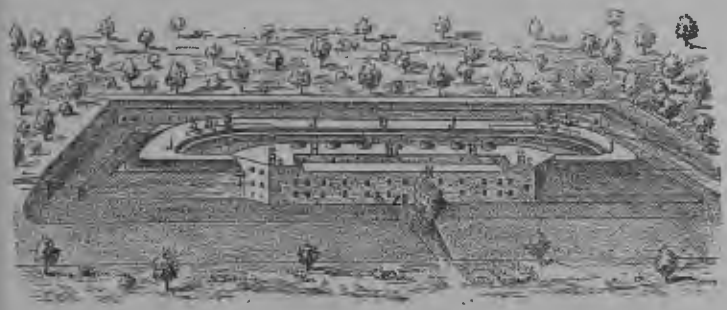
living-rooms for the officers and men, magazines for ammunition and supplies, kitchens, wells and cisterns, latrine and all other necessary accommodation.

The obstacle consists of a deep wide ditch " G " (Section I—I), which can be enfiladed throughout its length by case shot fire from the guns in the flanking galleries " F " (Section V—V). All parts of the work are connected together by underground passages called " poterne."

A work of this nature is always fully prepared for war.

FIG. 6 shows an isometric view of a fort, which also contains armoured cupolas " H " for long range guns.

FIG. 6.—Isometric view of a Fort.



References.—J = Infantry parapet; S = Q.F. guns in cupolas; H = 6 in. Howitzers in revolving cupolas; B_1, B_2, B_3 = Observation posts; T = Traditor position; K = Gorge caponier; U = Shelters for first reliefs; Z = Gate defence (Zwinger).

Intervals between the Works.

21. Where the country is flat or only slightly undulating, works may be sited at more or less equal intervals. They must be able to support one another, and this factor determines the distance apart at which they are sited. This distance will about equal the most effective range of shrapnel fire (about 2,200 yards).

Fortresses are not often found in this kind of " terrain." The country is usually flat and interspersed with hills or mountains and the works cannot be equally distributed, but are arranged in groups as already described in paragraph 18. The distance apart of the works within the groups depends on the nature of the ground.

Care must be taken to leave no large areas of dead ground. Experience shows that a suitable distance lies between 1,000 and 2,200 yards (see on the map the works 2 to 16).

The number of works must be kept as low as possible in all cases, for they are the most costly parts of the fortress.

With a further view to keeping down the expense improvised points d'appui are sometimes constructed at the less important points within the groups instead of permanent works. These bear some resemblance to the points d'appui of field fortification (see Group Ic, IIb, IIc on the map).

Permanent works are only found outside the groups in isolated cases (see the infantry works 1 to 16). In most cases improvised points d'appui will suffice.

22. The *positions in the intervals* consist of simple earthworks for infantry, machine-guns and light guns, with the necessary traverses, communication trenches, shelters, etc., and the usual obstacles.

Sketch 2, page 20, shows the features of the arrangements in the interval at one part of No. 1 Defence Section. The explanation is given in the references.

Light guns and machine-guns are sited at all points at which it is most desirable to reinforce the infantry fire. They are also mounted at points where the enemy can approach under cover, or at any place where enfilade fire can be brought to bear on him, especially when making a flanking attack upon the works. In Sketch 2 these points are indicated by the conventional sign for a gun.

The Position for the Long Range Fight.

23. In this position arrangements must be made for the long range protective batteries (Sicherheitsarmierung) and for the mobile reserve armament, and in certain cases too for the heavy artillery reserve which will be required along the front selected for attack.

24. The *long range batteries* are mostly constructed during peace time as permanent works, the remainder are erected during the mobilisation period on improvised lines.

The gun must have an arc of fire of from 60 to 90 degrees. The batteries are sited at points in or near the belt from which a good view of the front can be obtained. They must be able to support one another by cross fire and to bring enfilade fire to bear on the important lines of approach (see batteries K1 to K14 on the map).

The Howitzers must have an arc of fire of from 45 to 60 degrees, and usually are sited in batteries opposite the most important hostile positions and therefore generally within the "groups." The larger the mobile gun reserve the fewer will be the number of these howitzers. From three to six batteries to a group, on the whole, are sufficient (see batteries H1 to H6 on the map).

25. It is, of course, desirable that the guns in these batteries should be protected by armour, as well as those in the "Works." Financial considerations render this impossible except in the case of one or two of the more important batteries. The remainder, called "open batteries," are constructed as simple earth works and should be concealed.

In the Group Ib (Sketch 2) the highest peak of the Swiedwald is specially suitable as a site for an armoured gun battery K5.*

In the Group Ia, Point 317, is the most suitable spot. Since, however, work No. 4 lies immediately in front of this peak the armour protected guns are themselves in this exceptional case placed in the work itself. The drawback to this, however, is that the battery will be liable to suffer damage during the bombardment of the work.

In each of the two groups it has been possible to arrange for one direct firing armour-protected battery (H3 and H6). The other batteries of both groups are of the open type and are concealed. The gun batteries are sited immediately behind the ridge. The howitzer batteries are as far down the slope as possible, being just able to fire over the edge of the hill. Several less exposed "open" batteries for guns (cf. K1, K6 to K8) might employ direct fire, for they are not likely to be a special mark for the enemy's fire.

Further details of the construction of batteries in the defence protective armament (Sicherheitsarmierung) will be found in Section (E), page 58.

26. It is not, of course, possible to provide cover everywhere for *the mobile (horsed) gun reserve* (some 40 to 80 pieces), for it may be needed at different points in the belt, and will have to change its position repeatedly.

These reserve guns must therefore be brought up under cover into sheltered positions, situated at some place in the intervals between the batteries of the protective armament. The only fortification work necessary is to make approach roads.

27. *The heavy (unhorsed) gun reserve* comprises some 100 to 200 pieces, and will be required to remain in action for long periods. It must be sited in a fixed position on the "Front" selected for attack. As soon as this front is known, cover must be put up as speedily as possible.

These open batteries will be as simple in construction as possible and similar to those that are made for the siege guns of the attack.† Since the heavy reserve guns are not horsed they must be brought up from the park to their positions along field railway lines, which will also serve for the supply of ammunition.

Room for this reserve of heavy guns will be found by placing it in a second line behind the protective armament.

In Sketch 2 the intermediate positions BG, which might be suitable for sheltered batteries of the heavy gun reserve, are shown dotted.

For the sake of simplicity the battery groups are shown instead of single batteries. These groups are tactical units, each under one commander, and as a rule consist of four batteries of from four to six pieces each.

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* An opponent coming from the N. or N.W. would probably detrain his siege artillery at Horits (*see* Map) and bring it up into position against the N.W. front of the fortress, by means of a light railway. It is of special importance, therefore, to command the foreground upon this front, and this can best be accomplished from the peak mentioned.

† Instead of batteries, single gun emplacements, spaced at intervals at about 20 paces might be desirable. The guns would be less liable to be struck by the hostile fire if sited in this way, but the restricted space available for this reserve will seldom permit such an arrangement.

Magazines for shell and cartridges will be sited behind the long range position outside the fire zone and hidden in the folds of the ground.

Cartridge stores should be bomb-proof (Sketch 2 MM), but shell stores may be lighter in construction.

"*Keep*" *Works* (*Rückhaltspunkte*).*

28. During a lengthy siege the enemy is never successful simultaneously along the whole line. He first of all gains a footing at a few isolated points in the intervals.

The defender must endeavour to render these partial successes nugatory. For this purpose "Keep" works—as in field fortifications—are sited at the most important tactical points behind the main position (see the "point d'appui" marked "R" on Sketch 2).

These "points d'appui" will prevent an enemy who has captured part of the main position from advancing any further or from seizing the heights upon which they are situated.

They will protect the reserves who may be assembling on their flank, and will act as a support to any attempt which may be made to drive out the intruder, and, lastly, will act as rallying points for troops which have been driven back from the first line.

In our example (see especially No. I defence section) the ridge which lies directly behind the main fighting position is a very suitable site for a "Keep" work.

On the other hand, if the ground behind the belt of forts falls away at once towards the rear, it would be difficult to site "Keep" works which would serve any very useful purpose.

29. There are great advantages in being able to construct "Keep" works on permanent lines. The expense, however, is prohibitive† (see paragraph 6). Improvised "points d'appui" or fortified villages will have to suffice for this purpose.

Other additional Defence Measures.

30. *Measures to be taken in the Foreground of the Belt of Forts.*—It is of the first importance that the foreground should be cleared over the whole circumference. The way in which this should be carried out has been dealt with previously under Field Fortification.

There is usually plenty of time for this work, and extensive clearance of woods, demolition of villages and levelling of the ground should be carried out. In the example it would be necessary to clear a large area of wooded country. This will supply the material for making extensive "abattis."

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* The siege of Port Arthur affords us a modern example of a "Keep" work. The capture of the two Pan Lung redoubts led to no decisive results on account of the retired position of the Chinese wall.

† In Lt.-Col. Schroeter's well known work "The fortress in modern warfare," field defences at distances of from 550 to 1,100 yards behind the belt are shown as "Keep" works. In addition about 1,100 yards further to the rear he places a permanent inner line of works which takes the place of the enceinte.

All bridges which might be of use to the enemy must be prepared for demolition.

Lastly, waterways can be dammed up wherever possible for the purpose of flooding the adjoining land and rendering it impassable.

All this work can naturally be carried out only during the mobilisation period.

31. *Masking devices.*—In order to screen the defensive positions from the enemy's view, trees and shrubs will be planted during peace time in front of the permanent works, batteries and communicating roads, as well as the sites of future defensive works which are to be constructed on mobilisation.

The trees should be planted in clumps rather than in avenues and at varying distances from the points which it is intended to screen. Wherever possible, use should be made of evergreen bushes and trees.

32. *Observation Arrangements.*—Where possible each defence section will have one or two captive balloons for purposes of general observation. Arrangements must be made behind the main line of defences for housing them, for filling them and for sending them up.

The balloons must constantly change their positions in order to avoid the hostile fire zone. For this purpose they can be moved about when filled.

Telescopes will also be used for observation, and suitable posts with an extensive view, will also be chosen. In cases of necessity field observatories will be erected.

Similar arrangements will be made separately for the artillery observation posts, which are used to locate hostile works, and for the identification of targets and observation of fire.

33. *Illumination of the Foreground.*—At least one 3-feet searchlight with a range of 3,300 yards is required with every group of works for distant illumination. Besides this, star shell are provided for the howitzers and mortars. For illumination at close ranges each group of works requires a number of 14-inch searchlights with a range of 1,100 yards. As a substitute for the latter acetylene searchlights are used but are of less value. Besides this, "light" pistols (*Leuchtpistole*) are distributed during the early stages to the troops in the works and later also to the troops allotted for the defence of the intervals.

The searchlights are operated from previously prepared emplacements, which are generally in the close range position. The engine plant and accumulators are sited under cover to one flank or immediately in rear.

34. *Communications and means of Transport.*—The existing network of roads must be completed during time of peace by a circular road behind the line of detached forts. This connecting road will, if possible, be under cover (see the map). The necessary radial roads must also be constructed. During the mobilisation period the few remaining roads will be made in the form of cart tracks.

The question of field railways has already been referred to in paragraph 27.

Lack of forage limits the number of horses which can be kept within the fortress; this renders the use of mechanical transport

necessary. Armoured motor-cars with machine guns and light guns may be of use to accompany sorties.

A navigable river flowing through a fortress should be commanded by armoured gunboats (monitors). They can prevent the enemy building bridges and also co-operate in any engagement, especially in sorties.

Protection against the attack of hostile ships is afforded by the batteries, and also by mines and by rows of stakes (stockades) or anchored baulks blocking the waterway.

Such obstructions also protect the bridges themselves from destruction by floating objects.

35. *Telephonic and Telegraphic Communications* will be mainly laid out during time of peace. They will include the telephonic lines from the fortress commander (in the town) to the section commanders. These latter are also connected to the local reserves and to all the works.

All other commanders, officials, establishments—including the supply depôts, artillery park, ammunition magazines, etc—and the observation stations will also be linked up with this system.

The artillery will have their own separate telephonic system for fire control purposes.

On the outbreak of war all the other necessary connections, such as those to the outposts, will be at once put in hand.

Visual signal stations act as a reserve. Wireless telegraphy and carrier pigeons will be employed to connect the fortress with the outside world.

36. *Shelter Accommodation.*—The local reserves (see GR on the map) will be accommodated in cantonments, either in villages concealed in folds of the ground or, failing these, in barracks. It is highly probable that these quarters will suffer from the searching fire of the enemy, and shelters must be constructed which will at least afford protection from field howitzer fire and which can be occupied in case of need.*

The section reserves will generally find suitable billets in the villages; barracks used in peace time will also be available.

The general reserve will require to change its position according as the probable direction of the attack becomes known. They will be accommodated in cantonments or camps near the Enceinte.

37. *Fortress Establishments.*—These include the sanitary establishments, the supply depôts (with arrangements for rapid pickling, smoking and meat freezing), the artillery park and laboratory and the engineer park for tools, explosives, etc. There should be some well-organised means for dealing with an outbreak of fire within the fortress.

38. *Areas within which Building is Prohibited.*—The erection of buildings and any alterations to the conformation of ground should

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* A good shelter can be obtained by digging out holes or caves in the mountain slopes, and if the thickness of earth is sufficient, protection can be had even from heavy howitzer fire. These holes, called by the French "logements-cavernes," must not be excavated in loose ground or in woody country (see the article "Underground caves as shell proof shelters" by 1st Lieut. Ritter v. Brunner, Streffleur 1895). This was carried out in the case of ammunition magazines at Olmutz 1866, and frequently by the Boers in 1899–1900 in their besieged towns.

be prohibited in the foreground of a fortress. If any buildings are permitted they should be constructed of materials which can be easily demolished. The areas upon which building is prohibited by law are called "rayons." Usually the foreground is divided into two "rayons." The nearer rayon at a distance of 660 yards from the fortress within which no building at all is permitted, and the more distant rayon, 1,320 yards from the fortress, within which the number of buildings other than military is strictly limited.

(D) Details of the Detached Work.

(*a*) Preliminary Remarks on the Effects of Shell Fire.

39. Each work of a fortress has its distinctive rôle. When this is determined on the factor which exerts the greatest influence on its details is the amount and character of the hostile fire to be expected. The building materials, the choice of armament, the mounting of the guns, are also all dependent upon the effect of this fire. In order, therefore, that the subsequent arrangement of the details may not be compromised by paying too much attention to the methods of construction and the materials used, only the most important points concerning the effect of shell fire will be mentioned.

A modern work must afford protection against the heaviest kind of fire from mortars (12-inch) and direct-firing guns (9·2-inch).

The materials available are earth, stone, concrete and iron.

40. Experience shows that the *parapet of an earthwork* must be from 25 to 32 feet thick at the top, with escarp slopes of less than 40 degrees. They will naturally lose some of their shape after a lengthy bombardment, but if given the above dimensions they will still be able to afford the necessary protection for the infantry and machine guns.

During the artillery bombardment this portion of the garrison cannot take any part in the engagement, but must remain in bomb-proof shelters. They will only take up their fire positions when the enemy is compelled to stop his artillery fire owing to the advance of his own troops.

41. Stone and Concrete Buildings.—The majority of casemates are protected from gun fire in the following way (*see* Fig. 7) :—

The front or escarp wall "M" although several feet thick would soon be destroyed by continuous direct fire if left bare. It is therefore protected by a bank of earth "E," which absorbs most of the striking energy of the shell (see Trajectory 1).

Shell with low trajectory which strike the crest of the earth parapet or the masonry roof of the casemate glance off and do no damage (see Trajectory 2).

A "mortar" shell compared to one from a gun of the same calibre has a smaller striking energy but a far greater bursting charge.

The damage caused by a shell hitting the roof "D" of the casemate is due, firstly, to its striking velocity, and secondly, to the bursting of the charge immediately after the impact (see Trajectory 3); 6½ to 10 feet of concrete* is sufficient to withstand the shock of even

* Concrete is a mixture of broken stone, sand and cement which sets after it is made up with water and becomes as strong and hard as natural stone.

two hits at the same spot. The roof is supported by arches or prefer ably by steel girders (see also FIG. 5).

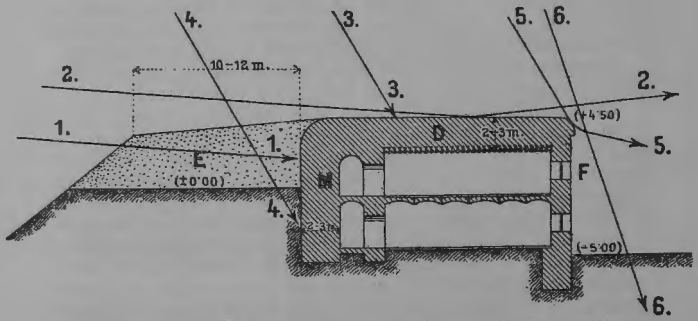
As regards those shell which strike the front (see Trajectory 4) and side walls, it is only their bursting effect which need be considered, for the angle of descent is so steep that their striking energy, is almost entirely absorbed by the earth in front. In this case, however, the bursting effect is greater than that produced by a shell which strikes the bare concrete, for the explosion takes place under tamped conditions.

The walls liable to be damaged by these explosions must be at least 5 to 9 feet thick.

Shell which graze the edge of the roof and then explode in the air (see Trajectory 5) are dangerous to the windows at "F," owing to splinters and gas pressures. These windows must, therefore, be protected with strong steel shutters.

Shell which explode in the air behind the building (see Trajec-

FIG. 7.—Diagram illustrating shell effect. Scale, 1/400.
(Explained in paragraph 41.)



tory 6) may cause damage to the foundations of the rear walls by gas pressures transmitted through the soil. These foundations must therefore be made deep and strong.

42. Armour Protection.—In order that a work may be able to reply to the enemy's heavy guns during a bombardment, its guns must be well protected. Brickwork is quite insufficient, and armour plate of the best steel must be used* (see paragraph 20 and FIG. 4).

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* Armour plate must be very hard to resist the penetration of the shell and yet at the same time it must not be brittle, for it would then crack with the concussion due to the blow or the bursting of the shell and might possibly break up into pieces.

Hardness and toughness, the two qualities required, cannot easily be obtained in one and the same material. The hardest steel which has a high percentage of carbon is too brittle, while the tougher steels which have a low percentage of carbon are not sufficiently hard. Toughness is the more important quality since a defect in the hardness can be remedied by using thicker plates. Tough steel is therefore used and the plates are hardened on the surface during manufacture by the addition of nickel and chromium. In this process no injury is done to the toughness of the steel.

Armour protection can also be employed for machine guns, but there is not much to be gained by doing this, as it would cost little more to provide similar protection for quickfiring guns.

Armour-protected positions for the infantry cannot be considered, on account of the expense.*

43. Stone or concrete buildings and armoured cupolas, which afford protection against bursting shell from heavy howitzers, are said to be "bomb proof."

"Works" of minor importance or those in the enceinte need only have protection against medium howitzer fire (6-inch calibre). Such buildings are said to be shell proof and are only about half as strong as those which are bomb-proof.

No protection weaker than this is permissible in the permanent works of a fortress. Splinter-proof protection against field howitzers is used in the interval positions and long range works, as these are only semi-permanent or of field type. It is not generally possible to construct any better protection, as the materials available will be only earth, wood and stones.

(*b*) Description of the various Parts of the Work.

44. The many objects for which works are laid out, the different formations of the ground upon which they are sited, and the amount of money available for their construction, all tend to produce great variations in design, so that no two works are exactly alike. There are, however, certain details which, though they may be arranged and grouped differently in each case, are always to be found in every permanent work.

These component parts are :—

The fighting position for the guns and infantry.
The casemates and shelters for the gun detachments.
The accessory buildings.
The obstacles and the arrangements for covering them with fire.

These components will now be discussed in detail. They will be illustrated from the same example (FIG. 3), but other figures will be referred to in each case.

1. *The Infantry and Machine Gun Position.*

45. The infantry garrison of a work usually consists of from one-half to one company, but a larger garrison is occasionally allotted to an exceptionally elaborate work. Owing to the small number of men forming the garrison, machine guns are provided, as they help to increase the rate and amount of the fire. They are mounted on parapet carriages and are usually from four to eight in number.

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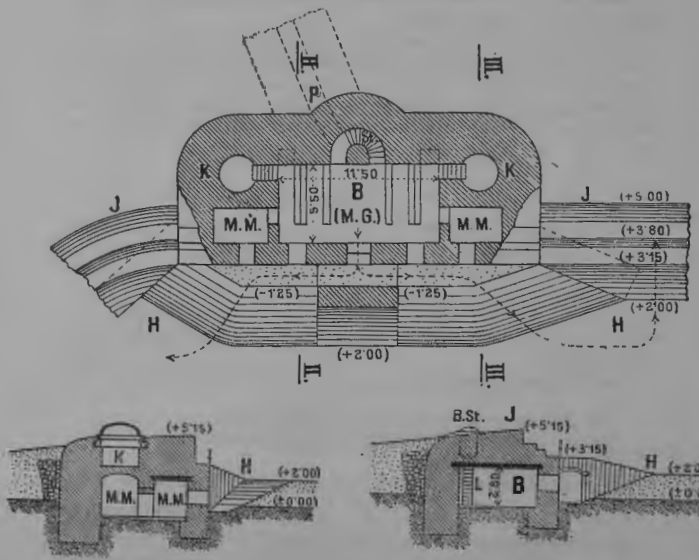
* Neverthless the Russian Engineer Lieutenant von Schwarz includes proposals for this armour protection in his schemes but omits all reference to cupola guns.

The earth parapet already mentioned forms the most suitable fire position. In plan it resembles the crest line of a redoubt so that from it fire can be directed to the front, flanks and rear (FIG. 3 " J"). The breastwork, the banquette and a covered way leading to the terreplein " H " are shown in profile (Section I). A broader banquette must be provided for the machine guns " MG."

At places where the parapet is interrupted by the buildings (for

FIG. 8. Details of FIG. 3.—A battery for Q.F. guns with men's shelters (Komplex). Scale, 1/400.
(Described in paragraphs 46 and 53.)



Section III—III (FIG. 8.)

Section II—II (FIG. 8).

References —B = Shelter for reliefs (also for the machine guns M.G.); K = Revolving cupola for a Q.F. gun; B.St = Observation post with ladder L (in the ground plan it lies between the two cupolas); J = Infantry fire parapet; M.M = Ammunition magazines; H = The terreplein; P = Undergound communications (Poterne); St = Steps leading up from P.

example, at the two angles) the infantry position must be carried over the roof (FIG. 8, Section II).

As splinters are a source of danger at these points steel shields* affording head cover may be provided as additional protection. They are usually kept behind the banquette and should only be placed on the parapet when required.

* These were first proposed by the late F. M. L. von Brunnen in 1873. Since then they have been introduced into nearly all armies.

[illegible] emplacements, and shields [illegible] artillery fire; but the expense [illegible] against shrapnel bullets and [illegible] the parapet might be pro- [illegible] would be completely destroyed [illegible] bombardment [illegible] often lasts for many weeks.

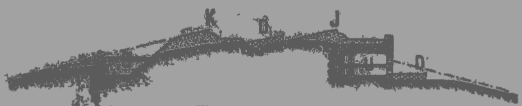
[illegible] a second position can be constructed from which [illegible] be brought to bear on the enemy after he has captured the [illegible] fire position. Such fire would assist a counter attack [illegible] the intruder (see Fig. 9, J). If the second fire position is constructed for frontal fire only it is called a "Retrenchment"; [illegible] it is known as a "Keep."

2. Infantry Shelters.

[illegible] In order that the infantry may make every possible use of the short interval of time between the last stages of the bombardment and the assault, bomb-proof shelters must be constructed close to the fire positions (see B, Figs. 3 and 8, Section II).

The infantry will be held in readiness in these shelters fully equipped

Fig. 9.—Inner fire position. Scale, 1/2000.



References.—K = [illegible] fire position; J = Inner fire position; C = [illegible]; D = Wire entanglements; C = Men's shelter.

and with [illegible] waiting for the hostile fire to cease [illegible]

[illegible] limited time (say [illegible] only a portion of the garrison can be kept [illegible] the remainder—the "Reserve" (Objects [illegible] already mentioned or will [illegible]

[illegible] will at once hasten to the support of [illegible] will [illegible] in shelters near [illegible]

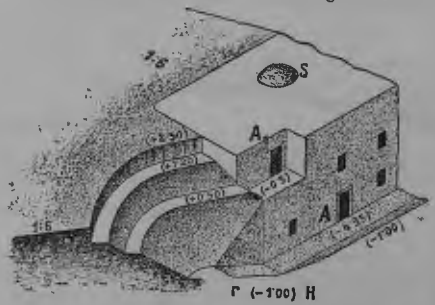
the assault. These guns should also be able to come into action at longer ranges whenever an opportunity occurs. Great rapidity of fire is thus required, and a shell with a fair sized bursting charge. These guns must also be able to remain in action during the artillery bombardment. The armour-protected Q.F. guns of field gun calibres are best suited to meet all these requirements.

Guns of smaller calibre are frequently employed in foreign countries. They can fire with greater rapidity, but each individual shell is far less effective and observation of fire is difficult.

The infantry making the assault are compelled to use artificial cover while the heavy fire of the fortress lasts. This consideration suggests the use of Q.F. howitzers in place of Q.F. guns, since the former can be used far more effectively against concealed targets.

Field howitzers are intended for both high angle and direct fire, and would appear therefore to satisfy all the necessary conditions, but unfortunately they have a lower rate of fire than the Q.F. guns. This is a most serious disadvantage, and as the chief object of

Fig. 10.—Isometric view of exit arrangements.



References.—A and A = The exits ; r = Ramp ; H = Terreplein ; Schn. K = Q.F. gun in revolving cupola.

these pieces is to repel the assault, Q.F. guns are usually preferred.

48. Armour Protection for Q.F. Guns.—There are so many different types of armoured protection for guns that it will only be possible to give a single example to illustrate the fundamental principles underlying their design. The construction of the most modern types is also kept secret in the majority of countries, so that examples of these cannot be given.

The armoured structure must occupy the smallest possible space because of the initial cost and because it will be less likely to be hit. The mounting of the gun must also, for reasons of economy, be made as small as possible.

49. *A revolving armour-protected gun carriage for a 3·2-inch Q.F. gun*

* In the figure only the most important construction details are included.

is shown in FIG. 4.* The cupola acts as a carriage for the gun, and revolves with it through the whole 360 degrees. A device is included for taking up the recoil, and this helps to increase the rate of fire. Castings (a) in which the trunnions of the gun are held and can revolve, are fixed to the bomb-proof cupola A.

The cupola revolves upon a ball race in the base V, the latter being carried by an iron baseplate T. A hand wheel "r" is firmly fixed to the base plate; through a bevel gear this operates a toothed wheel which engages in a circular rack K fixed to the base. When the wheel "r" is turned the cupola is made to rotate rapidly, and a pointer "f" moving over the circular scale "s" indicates the angular position of the cupola. About 80 rounds of ammunition are stored in a recess in the base plate and in a circular nitch B in the concrete wall.

The steps "Z" leading up into the cupola are covered in with an armoured concrete roof.

The cupola is surrounded by a ring of granite blocks "G."

The detachment consists of four men, including the ammunition reserve numbers. The rate of fire is about ten aimed shots a minute. The means for rapid traverse make it possible to obtain an almost instantaneous combination of fire from all the guns against a moving target. It is also possible to change rapidly from one target to another.

Hostile shell, especially those with a low trajectory, will, as a rule, glance off the rounded cupola. They can rarely develop the full force of their striking energy.

The same construction is suitable for the *4-inch Q.F. howitzer* but its shorter barrel will not project so far out of the gunport.

The construction just described affords complete protection, except against a shell which chances to pass through the gunport. During pauses in the fire precautions may be taken even against this unlikely chance by revolving the gunport away from the enemy.

The arrangements for revolving the cupola may be seriously damaged by shell splinters penetrating through the slit between the cupola and its base. The projecting portion of the barrel is also liable to be struck. This type of mounting is not, therefore, entirely exempt from damage, and may not be in perfect working order at the moment of assault when it is most needed.

50. The damage which was liable to this type of cupola led to the design of the "**Sunken cupola.**" The foreign example described in this paragraph is constructed for a 2·5-inch gun (see FIG. 11**.)

In this type the gun can be drawn back into the cupola. The whole structure is then lowered until the roof (a) rests firmly on the base (Vorpanzer). This is effected by raising the counterweight G.g, which draws down the pillar "Z." In the lowered position the cupola is a most unfavourable target for the hostile artillery and is only likely to be hit by howitzer fire. In the fighting position, however, (as illustrated in the figure), it is more exposed than the previous type, and is liable to be damaged even by field artillery fire.

It follows, therefore, that this type of gun mounting ought only to be used to repel the assault; but, on the other hand, we can be

---

** The drawing shows only a shell-proof structure.

certain that it will be available for use at the critical moment. This type of cupola can be traversed through a complete circle round the pillar "Z" (s = seat for the layer).

Fig. 11.—Sunken cupola for a 2·5 inch gun. Scale, 1/50.
(Described in paragraph 50.)

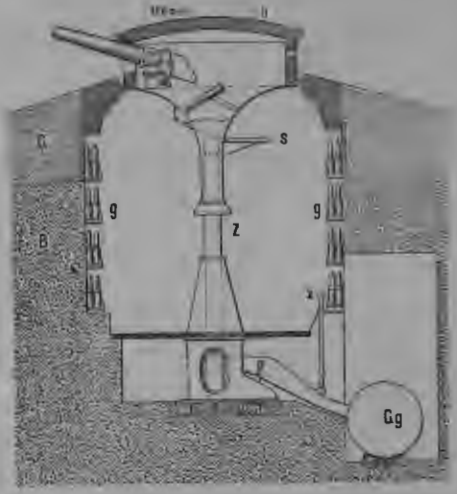
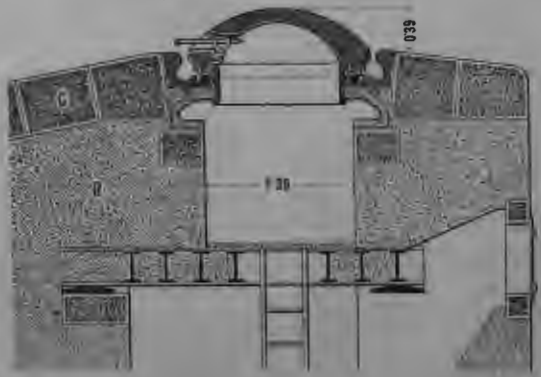


Fig. 12.—Revolving armoured observation post. Scale, 1/50.
(Described in paragraph 51.)



51. Armoured Observation Posts.—In order to obtain accurate firing it is of the first importance that the foreground should be under constant observation. See B.St. in Fig. 3 and Section II, Fig. 8, for

two such posts, which are provided with telescopes. One type of post is shown in FIG. 12, constructed on the same principles as a cupola.

There is a scale in the observation post graduated from 0 to 180 degrees which corresponds to a similar scale in the cupola, the lines of their divisions being parallel. When a target has been picked up in the observation post the reading on the scale is communicated to the cupola, which is then traversed round until the same reading is obtained upon its own scale. When this is done the gun is correctly laid.

Some observation posts are constructed which do not revolve. These have several peep-holes, and observations are taken with telescopes and binoculars. They have an advantage over the revolving type, as there is no delicate traversing mechanism.

52. Open (Unarmoured) Emplacements for Close Range Guns.—In less important works field guns are occasionally fought from behind ordinary earth parapets. These guns, like the infantry and machine guns, must be kept in covered shelters near their positions during the hostile bombardment. When the assault is about to develop they are brought up into action, but time is lost in doing this, especially if the ramps and emplacements have been destroyed. This arrangement is not, therefore, recommended.

53. The Arrangement of the Batteries in the Works.—In this work, (see FIG. 3) two Q.F. gun cupolas are placed at each angle of the work, together with the necessary observation posts and ammunition magazines. Two other Q.F. guns might also be sited in the middle of the infantry parapet. The details are shown in FIG. 8.

(4) *The Positions for the Flank (Traditor) Guns.*

54. Guns which are intended for frontal fire when mounted in the angles of the work can also cover the ground in front of the interval positions. They could, however, only be used for this purpose when the work itself is not being attacked. In the event of a simultaneous attack upon the work and the intervals, additional guns must be set apart for the necessary flanking fire. These guns will only require a small angle of traverse, about 60 degrees (see Sketch 2), and can therefore be mounted in armoured casemates instead of in the costly and delicate cupolas.

FIG. 5 illustrates a somewhat antiquated type of armoured casemate; the dotted line shows the outline of the casemate and embrasure if constructed of stone and concrete only.

In FIGS. 3 and 13 these casemates (T) are shown behind the gorge of the work. Placed here they are out of sight of the enemy and are only liable to slight damage from indirect fire. In order to bring direct fire to bear upon them the enemy would require to bring up his guns close in front of the adjacent works to within a range of 1,600 yards,* and this could only be possible in the last stages of the siege.

Even in this case direct fire is not possible, as the front wall of the

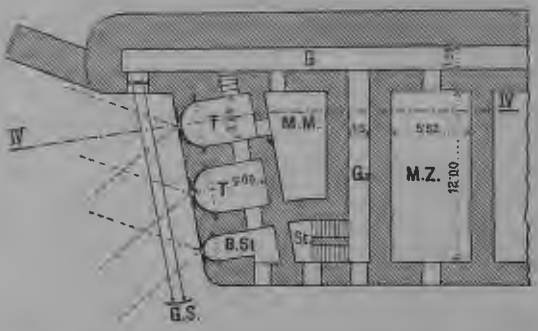
* The gun port must be aimed at and a hit is only likely after the expenditure of a vast quantity of ammunition.

casemate inclines inwards here. Flanking guns mounted in this position are, therefore, almost invulnerable, and are certain to be available when the critical moment arrives.

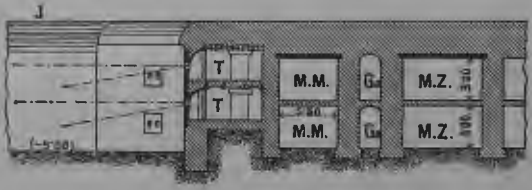
These flanking guns are also known as "*Traditor*" guns (the word is derived from the Italian word meaning "traitor").

55. Traditor guns are intended for close range fighting, and should therefore be quick-firing and of 3.2-inch or 4-inch calibres. The same arguments as are given in paragraph 47 might be urged in favour of Q.F. howitzers, but since their first object is to develop enfilade fire those pieces which have the larger danger zone are preferable.

FIG. 13.—Details of FIG. 3. Traditor position. Scale, 1/400.
(Described in paragraph 54.)



Section IV—IV of FIG. 13. Scale, 1/400.



References.—T = Traditor casemate; M.M = Magazines; Ga = Passage; B.St. = Observation post; M.Z = Barrack rooms; G.S. = Loophole fire.

When the field of fire is particularly "deep" 4-inch and 4.7-inch guns are occasionally used. One would be justified in mounting guns of these calibres on the right flank of Work 2 and on the left flank of Work 8.

Traditor casemates are, as a rule, placed on both flanks of a work, except when the intervals between the works are very small.

Each traditor casemate mounts from two to six guns according to the size of the work and the distance between them. These are mounted on recoil carriages and can fire through a very small gun-

…; and in two tiers so that …t as short as possible, which …

… through the interval he will … itter casemates (see Sketch 2). … gun's own troops fighting in … is made upon the gun platform to indicate … traverse that can safely be used at night or in …

… of Long Range Guns in Exceptional Cases.

… cases—for instance, when there are no suitable positions outside—it may be necessary or even advantageous to mount heavy guns and howitzers in the work itself. Armour protection would be required for them. (Compare paragraph 25.)

There are so many concealed sites available for howitzers in the example given that it is not possible to select any particular work in which they might be mounted.

27. Heavy guns can be mounted either in revolving cupolas or in casemates with an armoured front protection. The former cost little more for *heavy howitzers* than for short range guns. A typical example is shewn in Fig. 14.

In this design elevation and depression are obtained by sliding the trunnions of the gun in a segmental groove (a), while the gun pivots about the trunnion.† In other respects the mounting resembles that illustrated in Fig. 4.

Fig. 15 illustrates a bomb-proof casemate for a howitzer. This possesses the advantage of having no delicate mechanism such as is necessary for the revolving cupola, but the arc of fire is limited to about 30 degrees.‡ The internal space necessary in armoured turrets for heavy guns adds considerably to the expense of their construction. … the guns are usually mounted in pairs.

… the chief features of a turret for a 4.7-inch gun. … underframe, "U." The latter … of the gun, the carriage and … on the roller bearings Kg. … is the …

FIG. 14.—Armoured cupola for a 6-inch howitzer. Scale, 1/50.
(Described in paragraph 57.)

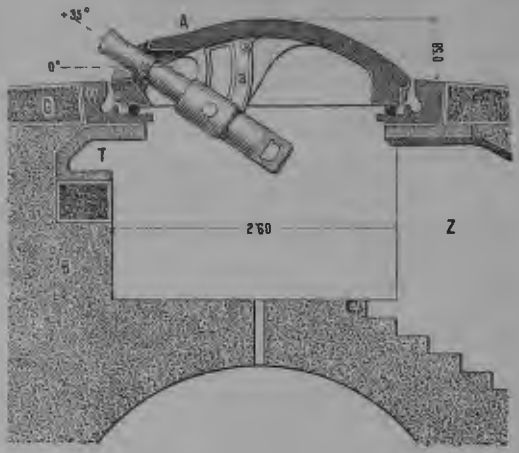
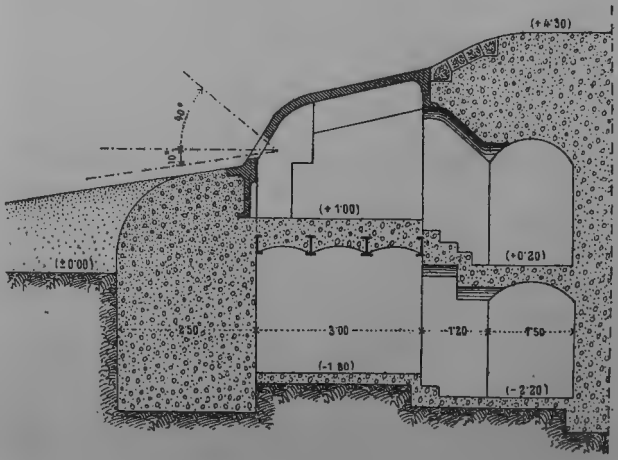


FIG. 15.—Armoured casement for a howitzer. Scale, 1/100.
(Described in paragraph 57.)



6. *Accessory Buildings.*

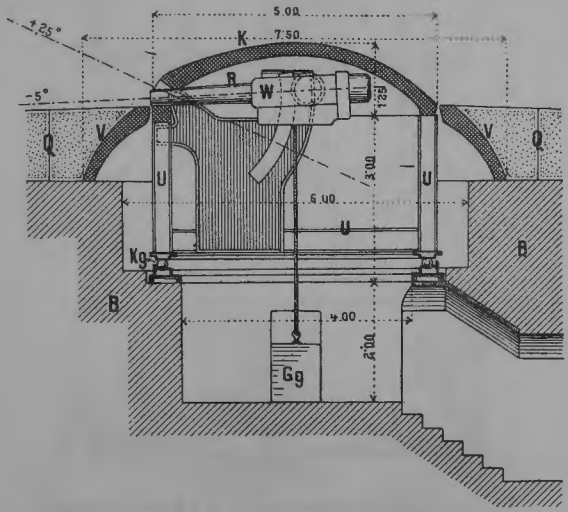
58. It has already been mentioned that the infantry first reliefs (one-third to one-half of the whole garrison) are held in readiness close by their fire position. This is the case also with the artillery manning details.

Special casemates are provided containing plank beds and straw mattresses in which the remainder (Objektreserve) rest.

Accommodation is required also for the fort commander and other officers.

The following rooms, stores, etc., must be provided:—A medical dressing-room, cook-houses, provision stores, telephone room with

FIG. 16.—Armoured turret for a 12 cm. gun. Scale, 1/100.
(Described in paragraph 57.)



apparatus for visual signalling, guard-room at the entrance, wells and cisterns, ablution rooms and several latrines; also magazines for storing the greater part of the gun and rifle ammunition (the remainder is kept with the guns or in the shelters).

The casemates contain the necessary stairways and passages leading to the upper stories and connecting up the various rooms.

In brief:—The garrison of a fort must be provided with everything that is necessary to enable it to hold out for a long time without any outside support or hope of relief.*

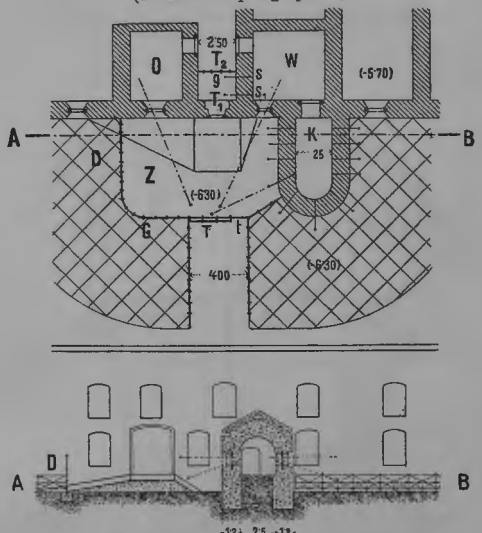
* An enforced confinement in one work for any length of time leads to all kinds of inconvenience. It is desirable therefore occasionally to relieve a garrison, but as the ground in rear of the works is also under fire it is not always possible to carry this out in safety.

All the various kinds of accommodation required can, as a rule, be found in the casemates in the gorge. The positions for the traditor guns are on either flank; the battery for heavy guns may, if necessary, be sited in front (paragraph 57).

The gorge buildings are connected with the other parts of the work by bomb-proof passages P. (Poterne). In FIG. 3 the direction from the shelters and casemates on to the terreplein (Hof) is marked by an arrow.

59. The *entrance* is closed by two gates T1 and T2. Immediately

Fig. 17.—Entrance to a fort. Scale, 1/400.
(Described in paragraph 59.)



References.—D = Wire entanglement; G = Fence with Gate T and wicket gate t; Z = Gate protection (Zwinger); K = Gorge caponier; T_1, T_2 = Entrance gates; S, S_1 = Rifle loopholes; O = Officers' room; W = Guard room.

outside these there is an open space (Z) surrounded by a fence G. This is intended to prevent the enemy from making a sudden dash on the gates. Arrangements should be made to cover this area with a cross fire.

In the example shown the gorge caponier "K," which has loopholes for rifles and machine guns, provides this cross fire and also enfilades the rear of the buildings.

The obstacle gates should not all be open at the same time. After a patrol or individual has been let in through the outside gate it should be shut before the inner one is opened.

60. There are various ways of making *loopholes* in the walls.

FIG. 18 shows a vertical loophole in the form of a slit for one rifle; FIG. 19 a loophole for two rifles; FIG. 20 for a machine gun.

FIG. 18.—Loophole in the form of a vertical slit for 1 rifle (Schlitzscharte). Scale 1/100.

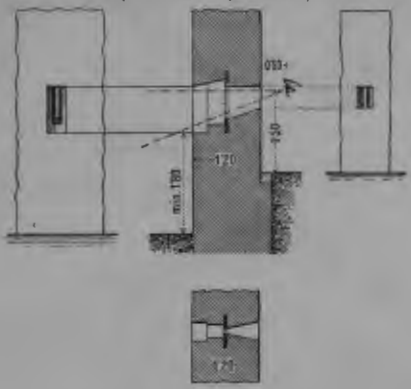


FIG. 19.—Loophole for 2 rifles. Scale 1/100.

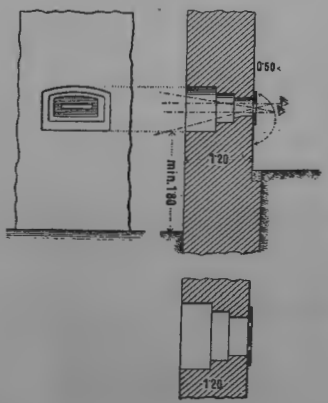
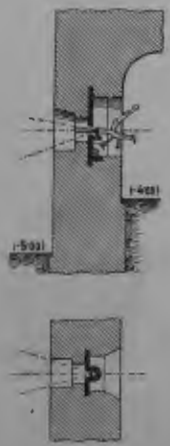
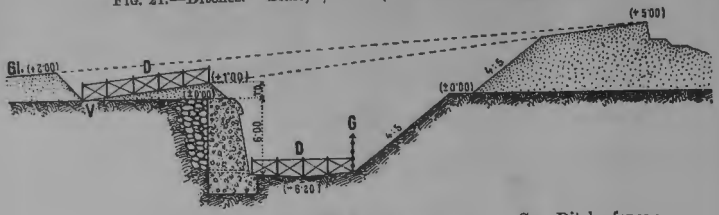


FIG. 20.—Loop for machine-gun. Scale 1/100.



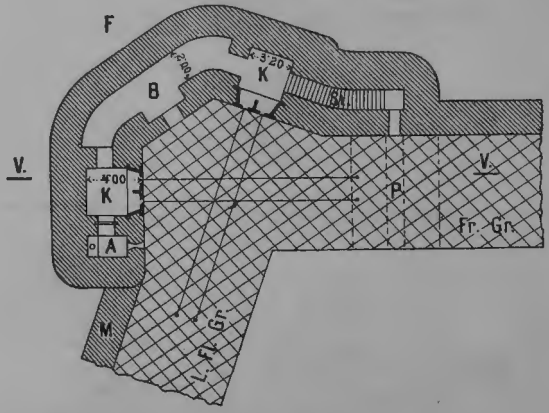
Small loopholes are also made in the iron shutters for the casemate windows. In this way the infantry fire position is also made continuous along the gorge of the work (see FIG. 3).

FIG. 21.—Ditches. Scale, 1/400. (Described in paragraph 62.)

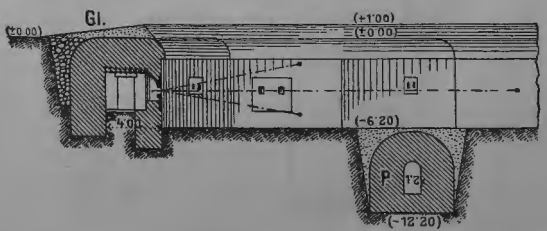


References.—Gl = Glacis; D = Wire entanglement; G = Ditch fence; V = Glacis ditch (Vorgraben.)

FIG. 22.—Details of FIG. 3. Scale, 1/400. Flanking gallery. (Described in paragraph 62.)



Section V—V of FIG. 22. Scale, 1/400.



References.—K = Casemate for two 2·4-in. guns for enfilading the ditch; B = 1st Relief accommodation with ammunition recesses; A = Latrines; St = Steps; P = Underground communications (Poterne); L Fl G = Left flank ditch; Fr Gr = Main front ditch.

7. The Obstacle and the means taken to defend it.

61. The obstacle is intended to check the attacker at a place where he will come under the most effective fire from the work he is assaulting.

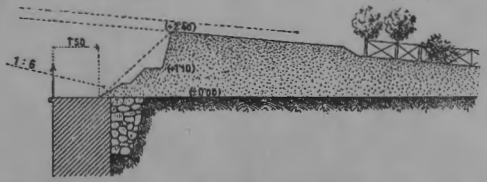
It prevents the attacker rushing the work after the guns of the fort have been put out of action, and should delay his advance until the infantry, who may have been caught napping or have had to keep under cover while the artillery bombardment lasted, shall have occupied the parapet.

The obstacle therefore and the caponiers, etc., defending it, must be protected from long range artillery fire, and should be so constructed as to demand the exhaustion of every technical device of the engineer before they can be destroyed.

62. Ditches (Fig. 21 and Section I, Fig. 3) must be from 20 to 28 feet deep and at least 50 feet wide across the top. They must be flanked from end to end by fire. The counterscarp wall nearest the enemy is formed by a bomb-proof wall.* The escarp wall facing the enemy, which is exposed to his artillery fire, is an earth slope.

As an additional obstacle a wire entanglement (D) or several wire fences can be erected in a ditch on the glacis (Vorgraben) and

Fig. 23.—Covered way. Scale 1/200. (Described in paragraph 62.)



also at the bottom of the main ditch. Lastly, fences are fixed on the counterscarp wall and at the foot of the escarp slope (G in Fig. 21), which latter can also be planted with thorn bushes. The gently sloped parapet beyond the obstacle is called the Glacis (Gl).

As the ditch is in plan a polygon (usually in the form of a trapezium or triangle) there must be several positions from which to enfilade it. In the example shown in Fig. 3 the ditches in front and on the left flank are covered by the flanking gallery "F," while that on the right flank is covered by a flanking gallery in the right half of the work. Each gallery has two guns. The gorge ditch is covered by rifle fire from the caponier KO. The flanking galleries are situated in the counterscarp, and therefore, being unseen from the positions of the attacker, can only be reached by howitzer fire. They are nevertheless protected by armour plating and bomb-proof roofs like the traditor casemates.

For other details Fig. 22 may be studied.

Small calibre Q.F. guns firing case shot are sufficient to enfilade the main ditch. In case of the less important ditches, or when it is desired to keep down the cost, machine guns or even rifles mounted in rifle stands or carriages may be used.

* For the sake of economy the counterscarp on the flanks of the work is often an earth slope.

FIG. 24.—Section of an old type of ditch. Scale, 1/400.
(Paragraph 63.)

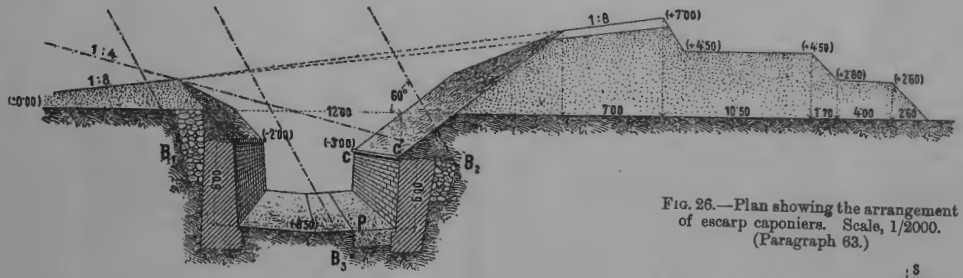
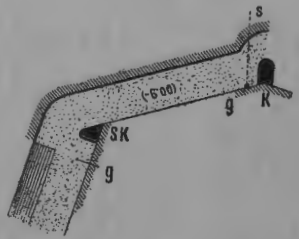


FIG. 25.—Profile of an old ditch. Scale, 1/400.
(Paragraph 63.)

FIG. 26.—Plan showing the arrangement of escarp caponiers. Scale, 1/2000.
(Paragraph 63.)



References.—K = Caponier; Sk = Angle Caponier; g = Rifle gallery; S = Direction of hostile rifle fire.

The ditches are lit up by acetylene and sometimes electric light projectors of about 10 inches diameter (see FIG. 31).

In many works there is a so-called "Covered way" along the top of the counterscarp wall, prepared for infantry defence (FIG. 23). It is so constructed as to be open to fire from the main parapet of

FIG. 27.—Isometric view of caponier.
(Described in paragraph 63.)

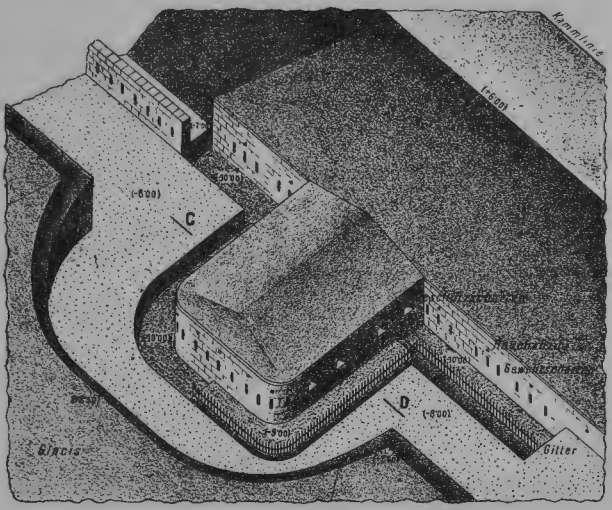
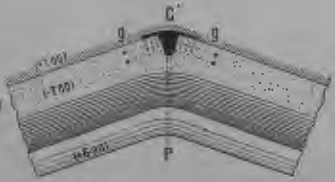


FIG. 28.—Counterscarp caponier.
Scale 1/2000. (Described in paragraph 63.)

Section C—D. FIG. 27. Scale 1/400.



the work, in case it should at any time be occupied by the enemy. This main parapet is only occupied when the covered way has to be evacuated owing to the hostile fire. Observation posts are formed along this covered way from which the glacis can be watched.

63. Ditches in Old Works.—In old works the escarp is frequently formed by a wall as well as the counterscarp (FIGS. 24 and 25).

It is more difficult to cross this type of ditch than the one just described. Ladders or, if the ditches are not too wide, a light portable bridge specially constructed for the purpose will have to be used. Since the escarp wall faces the attacker it is possible for him to destroy the top part or possibly all of it by howitzer fire. This type of ditch is therefore seldom used in new works, and for the same reason the practice of siting caponiers in the escarp so common in old works has also been abolished. The general arrangement of the caponiers is shown in FIG. 26, and the details in FIG. 27.

A caponier in the counterscarp is shown in FIG. 28.

Ditches of the type shown in FIG. 25 were covered not only by enfilade fire from caponiers, but also by rifle fire from a counterscarp gallery and a circular covered way "r" at the base of the escarp. This type of work consequently required a very large garrison.

64. Ditches with no Enfilade Defence.—In less important works

FIG. 29.—Ditch covered by frontal fire. Scale 1/400.
(Described in paragraph 64.)

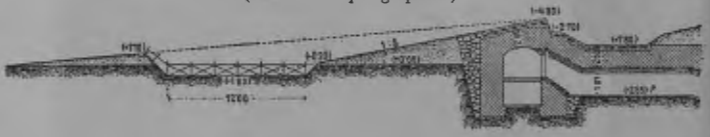


FIG. 30.—Moat. Scale 1/400. (Described in paragraph 65.)

the costly walls and flanking galleries are replaced by shallow ditches and wire entanglements, which are covered by frontal fire from the parapet. Such an obstacle is, of course, less effective.

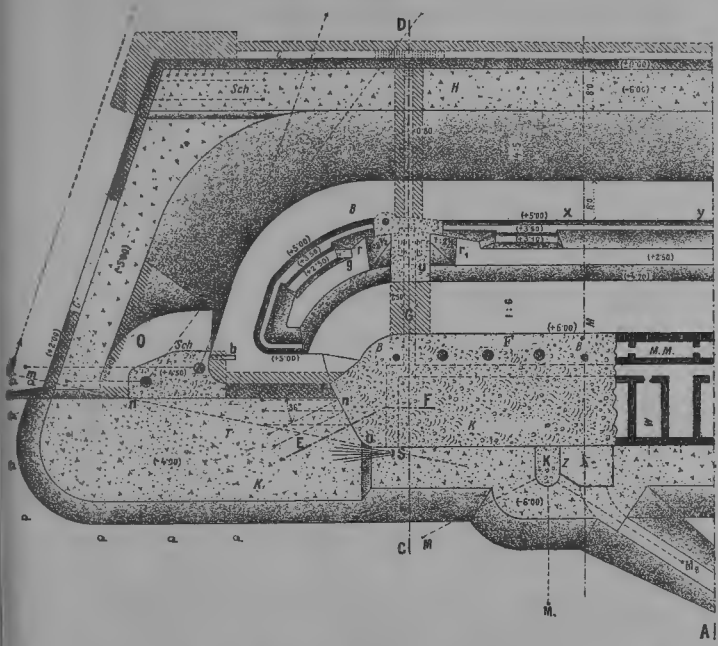
65. Moats form good obstacles when not frozen over. As there is no means of obviating such a contingency a wire entanglement should be added to the moat.

66. The usual forms of **Field obstacles** such as crows-feet, fougasses, land mines, make an effective addition to the obstacles described above. They can be laid out after mobilisation begins, if time and materials are available.

67. Mines.—On the glacis and even in the immediate foreground fougasses and land mines may be employed with advantage.

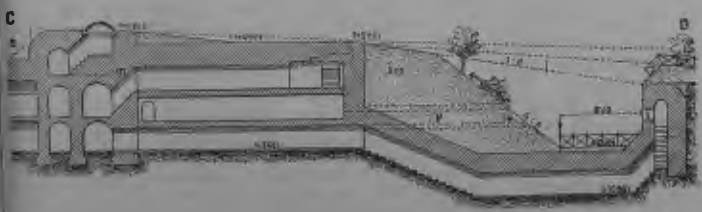
There are at the present time many serious technical difficulties to be overcome in laying out a system of mines on account of the heavy high angle fire of the enemy. Several authors propose the use of "Bore mines" (Röhrenminen) radiating out from the flanking galleries.

FIG. 31.—Example of a self-contained (Einheits) Fort. Scale 1/1000.
(Described in paragraph 68.)



Section A—B. FIG. 31. Scale 1/1000.

Section C—D. FIG. 31. Scale 1/500.



They consist of borings which are made in the ground and filled with high explosives. They are intended to prevent the enemy driving countermines against the galleries and caponiers with a view to blowing them up.

(*c*) Further Examples of Forts.*

68. Example of a Self-Contained (Einheits) Fort.—FIG. 31 shows a fort in which the close range guns are mounted on the flanks of the long range battery and are able to cover the ground in rear of the work with their fire.

The garrison and armament consist of half a company of infantry, eight machine guns on parapet mountings, twelve traditor guns in casemates and two guns for the galleries in the ditch.

There are two fighting positions—the front parapet for close range and the position behind it for long range fighting.

The **front parapet** (*Nahkampfwall*) is prepared for infantry defence, x, y (Section A—B). It has four positions (*g*) for eight machine guns, and two "wing" positions "O" (ear-shaped) for light quick-firing cupola guns.

The positions for the machine guns occupy a front six times as broad as would normally be required for their emplacements, which enables them to find cover when the parapet is destroyed at several points. A wide berm runs along the inner edge of the machine gun positions, sheltered behind the crest line and 6 feet below it. The machine guns are first of all brought up out of the shelters by their detachments, over the ramps, r and r_1, on to this berm, and from here they are hoisted straight up on to the higher level. The shoulders of the men serving these machine guns will be above the crest line. It will therefore be necessary to provide them with bullet-proof shields.

In the **rear position** (*Fernkampfwall*) 6-inch howitzers are mounted in cupolas in the top storey of the casemates (Sections A—B and C—D).

In order to offer as small a target as possible to the enemy this position is only 3 feet above the front parapet. It cannot therefore assist in the close range fight, which is a great disadvantage.

The howitzers could be mounted in cupolas in the close range parapet, but this again would interfere with the infantry defence. **Observing stations** are provided as follows:—One, usually in the centre of the gorge casemates, for observation of the distant foreground; one for each howitzer battery of three pieces on the flanks of the building; and two in the front parapet for the light guns.

The traditor casemates† are situated on the flanks of the barrack casemates (Section E—F) in two-storied buildings. The extreme arc of fire from these casemates covers the ground for 300 or 400 yards in front of the adjoining work.

The face of this casemate (n′ o) is hidden from view by the gorge wall n n′ anywhere outside the line o.m. produced.

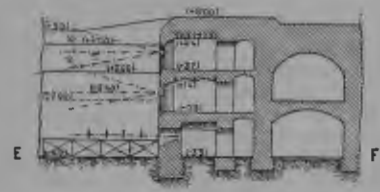
* The forts described in the following paragraphs have never been constructed. They were designed by the late Feldmarshall Leutnant v. Brunner. As regards some of the constructive details they do not entirely fulfil latest requirements, but such details are of small importance in a book of this nature.

† Traditor casemates were introduced in 1887 by F.M.L. v. Brunner and took the place of the usual open or casemated flanks.

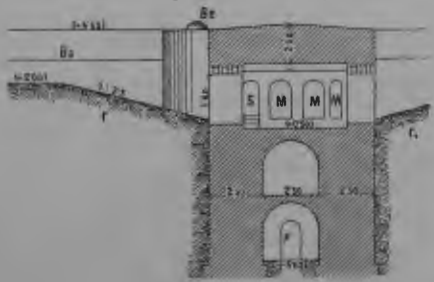
Shelters for the First Reliefs.—The first infantry reliefs are sheltered in the two passages G which lead from the gorge casemates up to the front parapet. The men can sit in these passages in two rows on benches with their rifles in their hands. As soon as they receive the order to occupy the fire position they will march up in close order through the two exits r and r_1 (Section r—r_1), to the foot of the parapet, and on receiving further orders will take up their position along the crest line. The machine guns will be held in readiness near the exits; they are shown in FIG. 31.

Accommodation is given for two-thirds of the garrison in the two-storied casemates in the gorge. In the example before us one "Zug" (one-third company) of the infantry garrison is allotted to

Section E—F. FIG. 31. Scale 1/400.



Section r—r_1. FIG. 31. Scale 1/250.



the right half of the fort and another to the left half. One-third of these forms the first relief and is held in readiness in the passages "G" as already mentioned. One "Zug" also provides the guard for the entrance gate and is quartered in the gorge caponier. The other "Zug" occupies the counterscarp rifle gallery which flanks the ditches.

Clear instructions and many rehearsals with the whole garrison are necessary to ensure that when the alarm is raised the separate detachments shall all reach their correct positions as quickly as possible.

The work is made "**storm-proof**" by including a ditch with counterscarp wall in front and on the flanks, a wire fence at the foot of the escarp, and a wire entanglement with crows'-feet

at the bottom of the ditch. Bushes between which wire is stretched may be planted or other obstacles erected on the glacis and escarp and also in a glacis ditch (Vorgraben) (see Sections A—B and C—D).

The ditch is defended by flanking galleries in the counterscarp. The main front ditch is covered by two guns and the flank ditches by rifle fire. The right and left flanking galleries are connected together by a counterscarp gallery which is prepared for musketry defence. Two covered passages branch out from this latter and lead into the fort (Section C—D). The gorge ditch is swept by fire from the gorge caponier (K), and also from the lowest storey of the traditor casemate (Section E—F).

In the upper storey of the gorge caponier are mounted three machine guns to cover the ground in rear of the fort and the road leading up to it.

The commanding officer is in communication with the guard-room, the central observing station and the flanking galleries by means of **speaking tubes or telephones.** All the observing stations are connected up to each other and to the various batteries in the same way.

It is advisable to construct an underground passage for about 120 yards to the rear as a safe means of communication under hostile fire for carrying out reliefs, inspection of the garrison, removal of the wounded, etc.

Some works may have no separate close range position, and in this case the parapet slope would run into the bottom of the ditch at a point "a," shown in Section A—B.

FIG. 31a gives an *isometric view* from the left side of this same fort, with a few minor variations. The arrangement of the searchlights is shown in this figure.

It should be observed that the part of traditor casemate beyond the line Dt t_1 t_2 will be hidden from the enemy; 0 is a window for visual signalling to the next fort. A similar arrangement might be made at the corner of the gorge caponier for signalling to the local reserve.

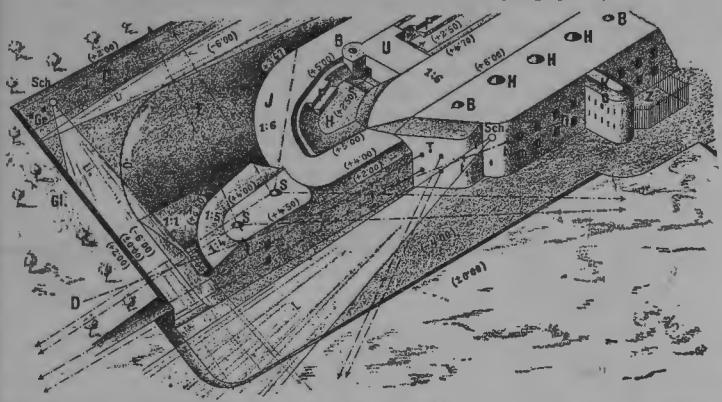
69. A Close Range Work of simple Type (FIG. 32 and Section I—II). —This work is triangular in plan has only one flanking gallery. After the detailed description of the fort given in the previous paragraph the references give sufficient explanation of this smaller work.

It is shown in FIG. 33, Section A—B, that the machine guns and infantry are each provided with separate exits through which they can reach the fire positions and so avoid collision during this movement; a and a′ are the exits for the machine guns, l and l_1 are the exits for the infantry, who sit waiting in the shelters Be. The infantry banquette adjoins the machine gun position; t and t_1 are iron doors, n and n_1 ammunition recesses.

70. Additional Remarks.—It is obvious that various types of construction can be used in the works of a fortress. In order that the fort commander may speedily become conversant with all the defensive measures in his work and be able to direct the personnel and carry out the defence in the best possible way, a complete book of instructions is published for each fort.

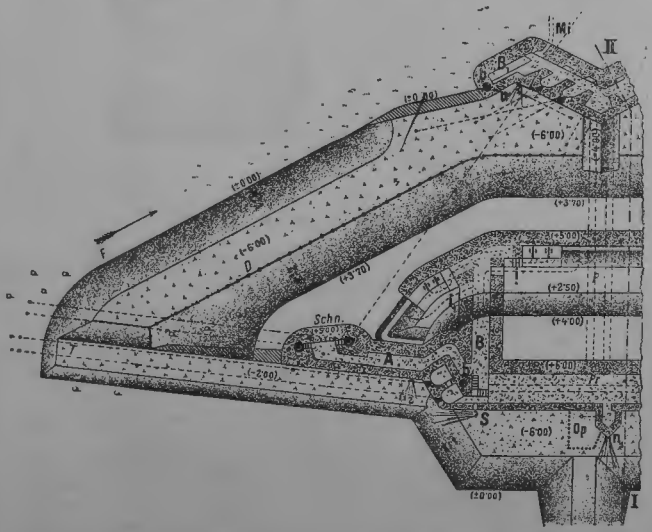
In the less important works certain simplifications can be introduced without detracting from their value.

FIG. 31a.—Isometric view of FIG. 31. (Described in paragraph 68.)



References.—B = Observing station ; C = Counterscarp wall ; E = Escarp slope ; Gl = Glacis ; Gr = Ditch ; H = Howitzer cupola ; J = Infantry position ; K = Gorge caponier ; L = Searchlight beams ; P = Platform for machine guns ; S = Cupola for Q.F. guns ; Sch. = Searchlight projector ; T = Traditor casemate ; Z = Entrance gate defence (Zwinger).

FIG. 32.—Example of a simple work. Scale 1/1000. (Described in paragraph 69.)

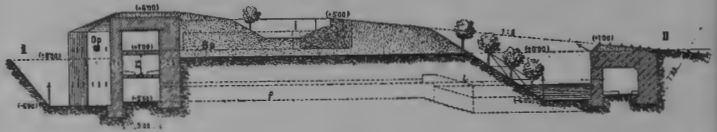


References.—Schn = Q.F. gun in cupola ; A = Shelter for R.A. manning details ; Pr = Plank beds ; D = Wire fence ; Op = Visual signalling post ; T = Direction of Traditor gun fire ; F = Direction of fire from interval positions ; b = Observing station ; B = Infantry war shelters ; P = Underground passage ; S, n_1, n_2, n_3 = Searchlight projectors.

The deep ditch may be replaced by a wire entanglement in a shallow ditch, covered by frontal fire (see Fig. 29). Armour-protected guns for frontal fire may be dispensed with in some cases. Some forts may even be without an infantry garrison and depend upon their guns. Occasionally the traditor casemates may be omitted but this is not recommended.

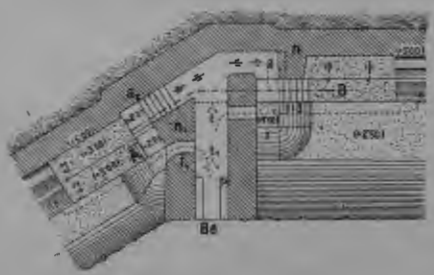
71. Old Types of Fort.—Before the introduction of the armour-protected gun about 1880, forts were constructed with embrasured

Section I—II. Fig. 32.



References.—Be = Infantry war shelters; i = Exit for war shelters; P = Underground communications; L = Air shaft; o/s = Visual signalling post.

Fig. 33.—Details of Fig. 32. Scale 1/500.

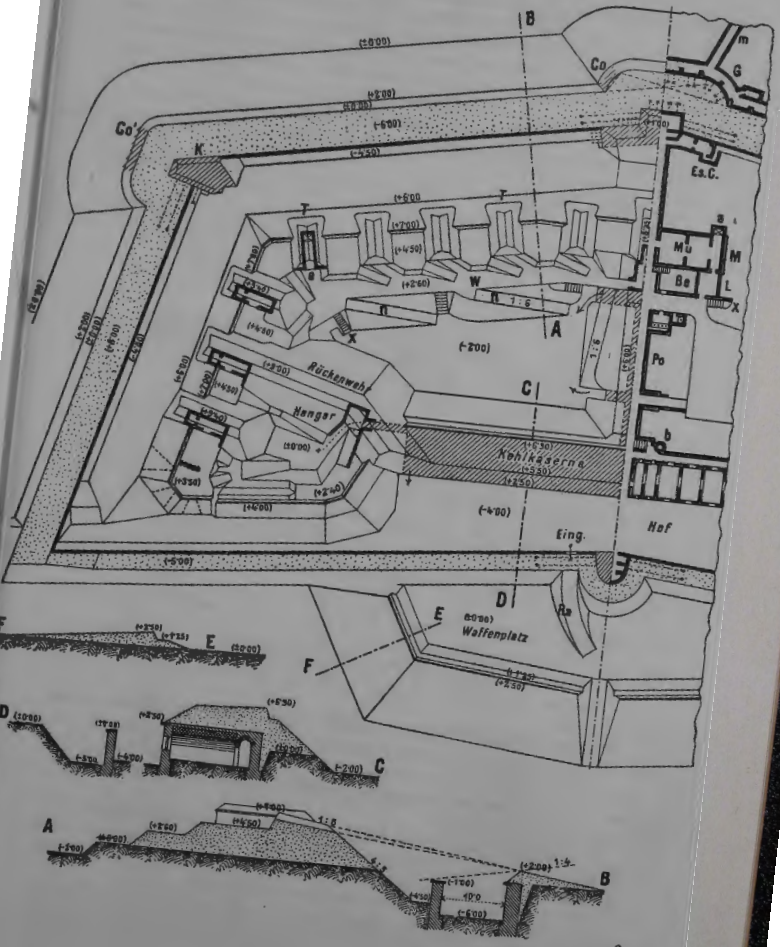


Section A—B. Fig. 33. Scale 1/2500.

parapets, and examples of these, more or less unaltered, exist to-day in all countries.

This type of work was known as an "Artillery Fort" (see Figs. 34 and 35). In nearly every case the front and flanks were defended with heavy guns (4·7-inch to 6-inch). The arrangement for mounting them is shown in Fig. 35. A hollow traverse (T) between each pair of guns served as a store for the ammunition and as a shelter for the detachments during a lull in the firing.

FIG. 34 with Sections A—B, C—D, E—F.—Example of an old fort. Scale 1/1600. (Scale of Sections 1/800.) (Described in paragraph 71.)



Light guns were mounted at the corners of the gorge. All guns were kept under cover in so-called "Hangars" (sheds) until required. Accommodation was provided for the infantry in the gorge and in the so-called "Place d'armes."

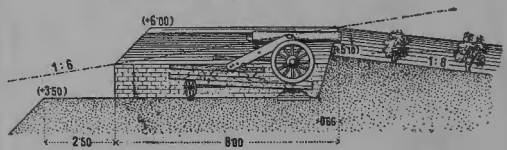
The gorge barrack was connected with the parapet and the ditch by underground passages. The obstacles used in these forts have already been described in paragraph 63. Works of this type existed on the south front of Paris during the siege in 1870. They were then proved to be inefficient, their fire being silenced in a surprisingly short time, while the guns mounted outside the works, which offered a much smaller target, were attacked with little success.

It was a considerable time, however, before correct deductions were drawn from this experience and before armour came to be applied to fortification.*

The High Parapet Fort.—Fig. 36 shows a somewhat improved type of fort known as a high parapet fort.

Since infantry and light guns are better adapted for the close range fight than the slow firing long range guns, a so-called "low parapet"

Fig. 35. Details of Fig. 34. Scale 1/200.



was provided for this part of the defence. Behind this was placed a "high parapet" for the long range fight (Section A—B). Light guns were mounted at the corners and the shelters were built under the high parapet.

(E) Details of the Long Range Batteries of the Protective Armament.

72. There are two kinds of batteries—the armour-protected and the open types (see paragraph 25).

Armoured casemates (see Fig. 15) might take the place of cupolas, but they are not much cheaper and restrict the angle of traverse of the gun.

73. The Armour-Protected Battery for 4-inch to 6-inch Guns is similar in every way to the howitzer battery (Fig. 37), except that the very costly cupolas (Fig. 16) are replaced by armoured casemates. These latter are constructed on similar lines to the howitzer casemates but are larger.

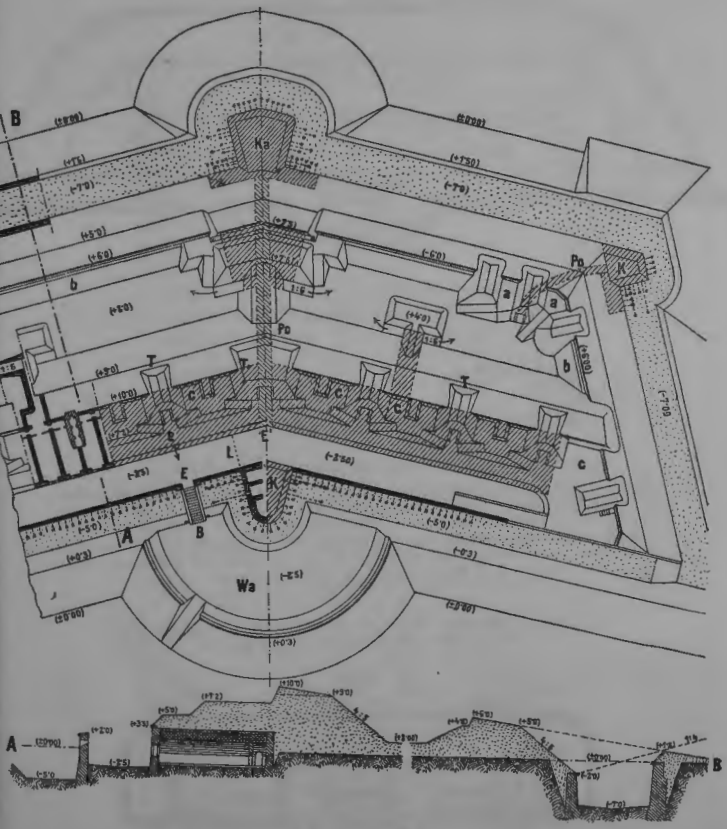
74. An Open Battery for Long Range Guns or howitzers is shown in Fig. 38. It has permanent shell-proof traverses, which contain the men's shelters and the expense magazine (Fig. 38). The details of a gun platform and traverse are shown in Fig. 39.

Those batteries which are only built during the mobilisation period cannot have masonry traverses. In their case field howitzer shelters

* There are no armour-protected guns in Russia even now.

(Fig. 40) must suffice. These semi-permanent batteries have one shelter for each gun, while in the permanent type one shelter is provided for every two guns.

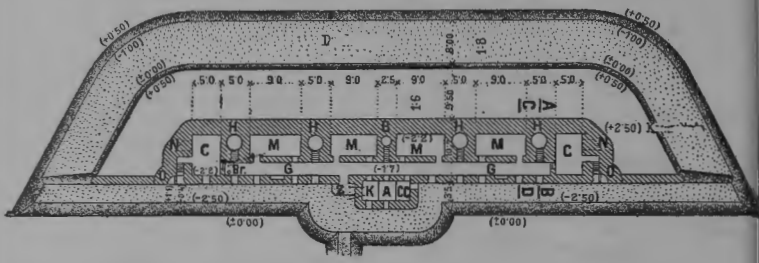
Fig. 36 with Section A—B.—Example of an old fort. Scale 1/1600. (Section scale 1/800.) (Described in paragraph 71.)



In neither case are the guns very well protected. Wooden bullet-proof screens (S in Fig. 39) can be used which will at least afford protection against shrapnel bullets (Füllkugeln) and small splinters.

Splinter-proof observing stations are placed outside the battery because they must have a clear view, while the battery is generally sited in a concealed position.

FIG. 37.—Example of an armour-protected battery of 6-inch howitzers in revolving cupolas. Scale 1/1000.
(Described in paragraph 72.)

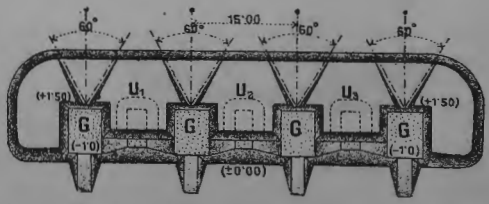


Sections A—B and C—D. FIG. 37. Scale 1/500.

Battery for 6-inch howitzer cupola (FIG. 37).

References.—H = Cupola (similar to FIG. 14); B = Armoured observing station (see FIG. 12); O = Open observing station (the approach is similar to A_1 in FIG. 10); M = Magazine for 800 rounds per gun; N = Recess for stores; C = Casemates (reliefs take place every 24 hours); CC = Commandant's room; G = Passage and shelter; K = Cookhouse and telephone room; A = Latrine; B = Water supply; Z = Gate defence.

FIG. 38.—Example of an open battery for long range guns.
Scale 1/800. (Described in paragraph 74.)

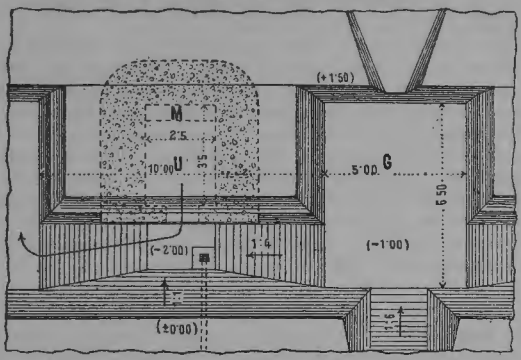


References.—G = Gun platform; U_1, U_3 = Shelters for personnel and the expense magazines; U_2 = Shelter for battery commander, with telephone room.

(F) Fortification Features of the Enceinte.

75. The enceinte serves a double purpose. First, it is intended to check a surprise attack which has penetrated the line of detached forts, and secondly, it is required to offer a fresh resistance, though less effective, after part of the belt of forts has been permanently occupied by the enemy.

Fig. 39.—Details of Fig. 38. Scale 1/200.



Section of Fig. 39. Scale 1/200.

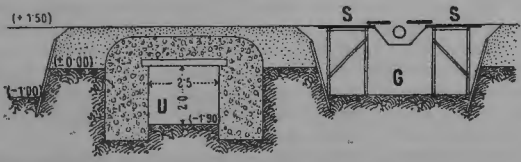
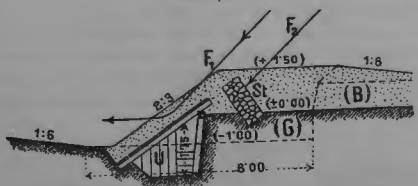


Fig. 40.—Shelter proof against field howitzer fire. Scale 1/200.



References.—F_1 and F_2 = Flight of shell; U = Shelter; B = Breastwork; St = Stone packing; G = Gun platform.

From the nature of the case the enemy cannot carry out a preliminary artillery bombardment, and therefore the enceinte must primarily be constructed to deal with a close range attack.

This entails the erection of suitable fire positions for infantry and Q.F. guns and of a strong obstacle in front, to give effective

protection against an assault. The position should consist of single "sturmfrei" works with obstacles such as wire entanglement, abattis, etc., placed between them. It is also desirable to have positions for infantry and machine guns behind the obstacles to cover them with frontal fire.

In the second place the enceinte will have to meet a bombardment from guns mounted in that part of the belt of forts which the enemy has captured. The light and medium hostile guns which are more easily removed will be the first to open fire.

The enceinte, owing to its comparatively short length, will only be able to mount a small number of guns. It is desirable, however, to construct a few long range batteries. It will often be possible to save some guns from the captured forts and mount them also.

The works in the enceinte can be on less expensive lines than those in the belt of forts. It will be sufficient to provide protection from shell fire. The simplifications mentioned in paragraph 70 may be made, except that the traditor casemates must not be omitted. These latter can on no account be dispensed with, since the works cannot always be fully occupied, and every possible weapon of defence which can bring enfilade fire to bear must be retained.

(G) Special Remarks.

76. The system of fortifications described in the previous paragraphs is based upon the principles of construction evolved during the last decade. There are still those who say that the modern forts with their active means of defence crowded close together form a very good target for the enemy, in spite of their small dimensions. They contend that the small width of the target lends itself to concentrated fire and that the various positions, the flanking galleries, close range parapet, gorge buildings and the long range position, lying as they do one behind the other, all come within the danger zone of heavy howitzer and mortar fire.

Thus if the fire is directed at the cupolas of the long range position, shots which fall short are likely to damage the flanking galleries, while shots which are over the target may injure the gorge buildings.

Several proposals to overcome this difficulty have been made. Some advocate the dispersion of all the component parts of the fort, others would replace the fort by several batteries of armour-protected Q.F. and long range guns. The first arrangement may be described as a system of "Dispersed points d'appui" and the second as a system of "armoured fronts."

Dispersed points d'appui.

77. *The advantages of this system are—*

(1) The dispersion of the targets.
(2) It is easy to conform to the lie of the ground.
(3) Less dead foreground.

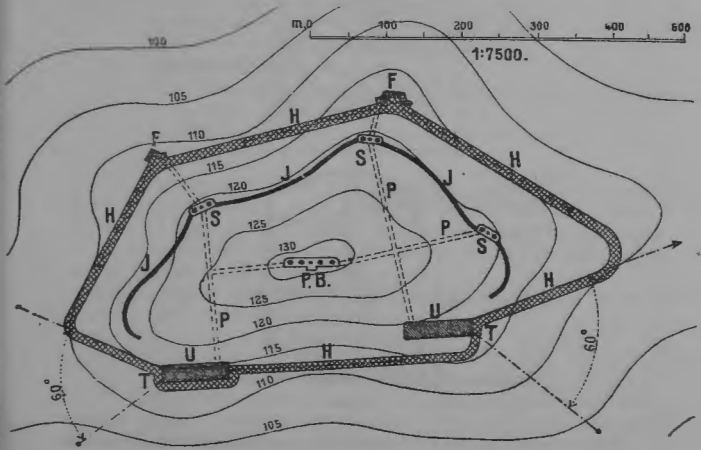
The disadvantages are—

(1) The difficulty of obtaining unity of command.
(2) Liability to assault owing to the impossibility of surrounding the whole position with a deep ditch.

(3) Difficulty in choosing the necessary enfilade fire positions.
(4) The communications cannot be fully protected; for the cost of constructing the necessary lengths of bomb-proof passages would be prohibitive.
(5) The cost is from 50 to 80 per cent. more than that of the ordinary modern fortress.

When considering the advisability of using this system we must remember the increased effect of artillery fire. Some of the disadvantages might, of course, be overcome by employing a picked garrison.

FIG. 41.—A dispersed ("Zerlegter") Point d'appui. Scale 1/7500. (Described in paragraph 77.)



References.—S = Battery (Komplex) for 2 Q.F. guns or Q.F. howitzers—the details are the same as in FIG. 8; T = Traditor position for 4 to 6 Q.F. guns in armoured casemates, similar to FIG. 13; P = Armoured batteries for the long range pieces, similar to FIG. 37; U = Men's shelters; J = The intermediate fire position, an earth parapet for infantry and machine guns—the first relief shelters are in the batteries S; D = Wire entanglement in a ditch of varying depth without a wall, open to enfilade fire from the gallery F, similar to FIG. 22; P = Shell-proof underground communication.

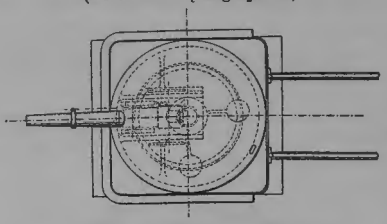
Armoured Fronts.

78. This system is in use on the line of the Sereth (Chapter II, Section (*e*)). It is based on the use of mobile armoured cupolas (see FIG. 42).

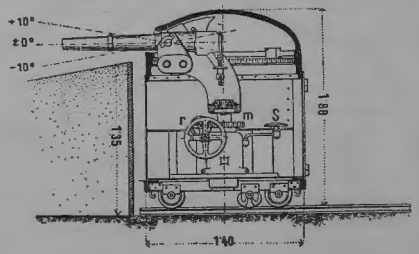
These are the mobile carriages which mount a 2½-inch Q.F. gun and are provided with armour protection against rifle and field gun fire. They are brought up into position along field railway lines, and if provided with large wheels can be moved along good roads by two horses.

The steel under-structure is fixed and bullet-proof. The armoured top with the gun can be traversed about a central pivot "m" by means of a wheel "r," and rack worked by a man from the seat S. The ammunition is passed up by hand. The gun is served by two men, and the rest of the detachment is housed in shell-proof shelters outside the work until such time as an attack is expected.

*Fig. 42.—Mobile armoured cupola for a 53 mm. gun.
Scale 1/50.
(Described in paragraph 78.)



Section of Fig. 42. Scale 1/50.



These mobile cupolas are intended for use behind an earth mound or a concrete parapet. They only project 1 foot 4 inches above the parapet. They should be suitably painted or screened with branches of trees. Dummy parapets and bushes will be used to deceive the enemy, so that at distances over 2,200 yards this small target should be unrecognisable.

These guns are only intended to repel infantry attacks, and are supplied with 152 rounds of case and shrapnel.

An "armoured front" consists of three lines. In the first line, batteries of three to five mobile pieces are installed behind a low parapet and secured against surprise attacks by wire entanglements. Single batteries must not be separated from each other by more than

* The cupola illustrated was made at the Skoda works. These mobile cupolas were first made at the Gruson works at Magdeburg where several hundred pieces were turned out for various states—Calibres 1½-inch, 2-inch and 2½-inch—capable of firing 30 rounds a minute. The Gruson works (now Krupp) also make 5-inch Q.F. howitzer turrets which can be taken to pieces and re-erected within a few hours and are to this extent mobile.

550 yards. A second line, 100 yards behind, consists of similar batteries sited behind the gaps in the first line; 1,100 yards behind the first line there are batteries of 4·7-inch Q.F. howitzers and 6-inch mortars. On the fronts to be attacked there is a third line of fixed armament mounted in ordinary batteries.

No provision is made for infantry cover as the whole of the infantry act as a mobile reserve. To repel an attack entire reliance is placed upon the tremendous hail of fire from this large number of Q.F. guns in all the three lines (as the gunners are all under armour protection the guns in rear can safely fire over the batteries in front).

The advantages of this system are :—

(1) The targets are both small and dispersed.
(2) Fewer men are required for the defence.
(3) The cost of such a fortress is comparatively small.

The disadvantages are :—

(1) Difficulty of supervision and command.
(2) Liability to surprise attacks.
(3) If the enemy penetrates the line at one place there is a chance of the whole defence being "rolled up."
(4) The delicate mechanism of the armoured carriage is easily damaged.

The disadvantages of this system clearly outweigh the advantages, and consequently only one example of it is to be found—the line of the Sereth, previously mentioned. It was originally put forward by Lieutenant-Colonel Schumann, an engineer in the Prussian Army, and by Captain Meyer of the Swiss Army.

Mobile cupolas are, however, held in readiness in some countries for use in the "Interval" positions.

BARRIER FORTS.

The barrier forts described in the following paragraphs are those situated in mountainous country. Other types are dealt with briefly at the end of the Chapter.

(A) General Remarks.

The Object and Nature of Barrier Forts.

79. The main object of a barrier fort in mountainous country is to block all the practicable ways by which troops and transport can penetrate into a neighbouring territory. They are usually roads or railways, which follow the main valleys or cross from one valley to another over passes and ridges.

It is not necessary to block bridle paths or cart tracks. They are unsuitable for the lines of communication of any considerable force.

The less important roads which do not require to be blocked may be rendered impassable by demolition at several places. When mines are used they should be laid out in time of peace, otherwise field methods are used.

80. Barrier forts are occasionally required for more than purely defensive purposes. For example, when a force is advancing

through a defile a barrier fort may act in the same way as a bridge-head, by protecting the passage through the defile and then covering a deployment as soon as the troops emerge at the further end.

81. All kinds of barrier forts, but especially those for offensive purposes, are sited as near the frontier as possible. Occasionally when a barrier fort has to be sited at the junction of two or more lines of communication crossing a range of mountains on the frontier, it may be in a more retired position.

Means of Attack and Defence.

82. In a mountainous region there are few lines of communication available for large operations; moreover, the country lying between these lines is usually impassable or very difficult. The country is also, as a rule, very barren, and the hostile force will be entirely dependent upon its own supplies. It is clear, therefore, that the difficulties due to the nature of the country will be enormously enhanced by the presence of barrier forts, and that an enemy will be forced to capture them with all possible speed if an advance is contemplated.

83. A greatly superior force is necessary in order to subdue the barrier forts in as short a time as possible. On the other hand, the difficult nature of the ground will often prevent the deployment of large numbers of troops, and the attack may be limited by the lie of the country to certain special points, all of which will be well-known to the defender.

This applies especially to heavy artillery, for its positions cannot be very far off the road. In some cases detachments of infantry with machine guns will be able to reach the flanks and rear of the fort, but they will have some difficulty in getting up their supplies.

The difficulty of attack will be much increased if the defender has mobile troops and field guns.

84. The defenders labour under certain disadvantages also. It will be impossible for them to obtain a view over all the foreground owing to the mountainous nature of the terrain. The attacking artillery will often be entirely hidden from the fort, and many places, of great use to the enemy for the close attack, will be screened from the defenders' fire. Fogs, so frequent in mountainous country, will also increase the chance of a surprise attack.

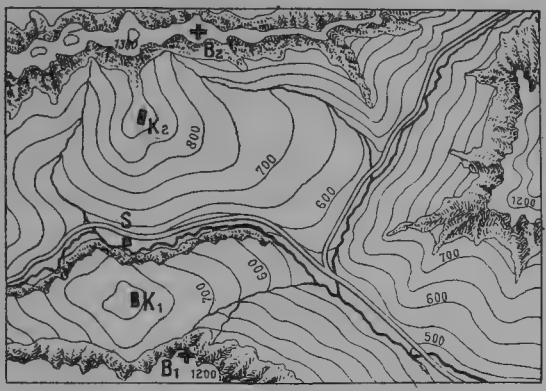
In an extensive mountainous country it will not be possible for mobile troops to reinforce all the barrier forts at the beginning of operations. Some of them will therefore be entirely, or at least for a considerable time, dependent upon their own fire. These isolated garrisons are far less favourably situated than those of fortresses.

(*b*) Main Fortification Features.

The Barrier Fort for Passive Defence.

85. It is first of all necessary to block the main lines of communication so that nothing can pass along them unobserved even at night or in a fog. For this purpose one work is usually sited close beside the road or railway and covers it with gun fire (see 'S' in Figs. 43 and 44).

FIG. 43.—Example of a fort blocking a valley. Scale 1/50,000.
(Described in paragraghs 85 to 89.)



References.—S = Work blocking the road ; B_1, B_2 = Observation stations or blockhouses ; K_1, K_2 = Works (Kampfwerke).

FIG. 44.—Example of a fort blocking a pass.
(Described in paragraphs 85 to 89.)

1:50.000.

References.—S = Work blocking the road ; K = Works.
B = Blockhouse } Used as
H = Alpine hut } observing stations.

86. Such a work being sited low, seldom has a good view over the foreground. It would not be able to fire over the slopes which are "passable," and therefore other works must be sited on these slopes.

These latter works must bear the brunt of the artillery fight, since the co-operation of any troops and guns outside cannot be relied upon. They are known as "*fighting works*" (Kampfwerke) (see K_1, K_2, FIG. 43, K in FIG. 44).

87. Even these "fighting works" will not necessarily command all the possible positions for hostile artillery, and therefore fortified *observation posts* must be constructed from which certain specified points can be seen (see B_1, B_2 in FIG. 43, also B and H in FIG. 44).

Besides serving the purposes of general look-out or fire observation posts, they will often serve to block footpaths or mule tracks, hence their name "Blockhouses."

88. In the case of an important fort or when there is sufficient room available for manœuvring, mobile forces may be expected to co-operate, and positions must be prepared for them adjoining or even in advance of the "fighting works."* These positions will comprise the usual fire trenches, gun emplacements, obstacles, etc., and they may be left partly incomplete.

Occasionally one work will be necessary in order to safeguard some lateral communication in rear.

89. The sketches of barrier forts in FIGS. 43 and 44 are given as examples only and must not be regarded as types. No single type can exist; the works will vary in nature and in number according to the local conditions. For instance, it is frequently possible to omit a barrier fort on the road if its duties can be carried out by one of the "fighting works." Again, in valleys with precipitous sides or in defiles there may only be room for one work to block the road.

90. As in the case of a fortress, the following defensive measures are to be found:—Means for lighting up the foreground, obstacles, mines, screens, communicating trenches, telephone connections, shelters for mobile troops, etc.

In mountainous districts the preparation for demolition of bridges and portions of the road is specially important, since the enemy is confined to the roads or railway. The construction of roads between the forts and leading up to the positions, for the use of the mobile guns is also important.

Owing to the amount of dead ground, the lighting up of the foreground at night is very necessary. Star shell are used for long range work, while for short ranges pistols throwing lights (Leuchtpistolen) and small searchlights are required. Balloons are not required, as high sites are always available for observation purposes.

Features of a Barrier Fort for Active Defence.

91. These forts are usually found in localities which are only partially mountainous or hilly, such as high plateau land or on the lower outlying spurs of mountain ranges.

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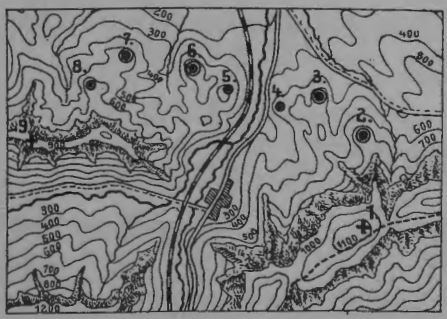
* The advanced positions, as a rule found in Italy, are occupied in order to delay the enemy as long as possible from reaching suitable artillery positions.

Since one of the functions of an *offensive barrier fort* is to protect the deployment of a large force it resembles a fortress in many of its features. This is seen from the example in FIG. 45. It consists of a number of works and close range points d'appui which surround the area to be protected in the form of an arc (see Works 2 to 8, FIG. 45).

If the main line of communication upon which a work lies is in a deep valley, additional works will be required on it. There will usually be several high sites on which to erect observation posts (see Works 1 to 9 in FIG. 48), and interval positions will occasionally be required for the mobile troops.

FIG. 45.—Example of an offensive barrier fort.
Scale 1/200,000.
(Described in paragraph 91.)



References.—2, 3, 6, 7 = Works; 4, 5, 8 = Close range points d'appui; 1, 9 = Blockhouses—observing stations.

(C) THE FEATURES OF THE BARRIER FORT.

(*a*) The Works.

92. There are many important differences between the barrier fort and the fortress, of which the following are the chief:—

(1) In the first place the works themselves come under the effect of long range fire and must mount armour-protected long range guns. This arrangement is rarely found in the works of a fortress.

(2) The unprotected infantry fire positions found in the works of a fortress have frequently to be omitted in barrier forts. The latter are often overlooked by ground close to them, which, though difficult of access, may afford concealed positions from which small detachments of infantry may pour in enfilade or reverse fire. For this reason the close range fight can only be conducted with guns and machine guns which have armour protection.

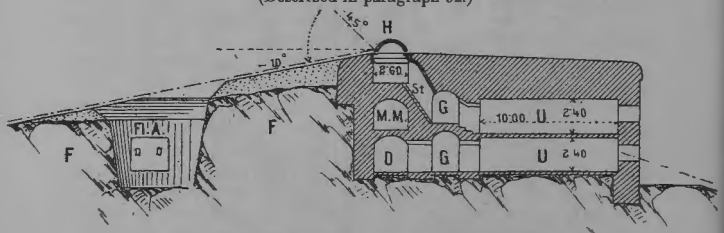
In the example shown in FIG. 46 the cupola guns "H" are intended for both the long range and the close range actions. In FIG. 47, Section I—I, the machine guns in armoured casemates are for close range fire, while the long range fight is carried on by the cupola guns.

This latter arrangement is very necessary where the foreground slopes down at about 15 degrees or more, for the construction of cupolas does not admit of such a steep angle of depression for the guns.*

(3) The absence of any definite type for a barrier fort has been already noted.

(4) The limited space available for a barrier fort, which is often situated on a narrow ridge, leads to a crowding together of the redoubts, batteries and shelters, which is a great advantage to the enemy and will make his fire more effective. On the other hand, the irregular nature of the ground compels a wide dispersion of the individual "works" in order to have as little dead ground as possible (see FIG. 48).

FIG. 46.—Section through a fighting work. Scale 1/400.
(Described in paragraph 92.)



References.—H = Cupolaf or a 4-inch howitzer (for close and long range fire); St = Steps; G = Passage; U = Casemates; M = Magazine; D = Store; Fl. A = Flanking galleries in ditch; F = Rock.

Choice of Armament.

93. Medium and heavy guns (4·7-inch to 6-inch) are often useless in mountainous country owing to the impossibility of long range fire. When such guns are mounted they are placed in armoured casemates (see FIG. 15) or in turrets (see FIG. 16). 4·7-inch guns are usually heavy enough.

To reduce the expenditure on armour, the guns are sometimes mounted in concealed batteries outside the works. They are then exposed to surprise attacks unless infantry detachments are posted outside the works for their protection.

For the close range fight Q.F. guns in cupolas, somewhat similar to that shown in FIG. 4, are sometimes used. Since it is scarcely ever possible to mount enough armour-protected guns in the confined space available it is preferable to employ 4-inch cupola howitzers which can be used at both long and short ranges. If the arc of fire on the flanks is not too restricted, light Q.F. guns in traditor casemates can be used, similarly to those in the works of a fortress (see T in FIG. 47).

* In such cases light howitzers are valuable for it is possible by using small charges to cover this steep foreground.

94. The howitzers bear the brunt of the enemy's artillery fire. Those that are required for both short and long range fighting as well should be of 4-inch calibre. For long range action only the 6-inch might be used; but, taking into consideration the inferior cover available to the enemy and the probable distance at which he will come into action, 4-inch cupola howitzers will generally suffice in all cases (as in FIGS. 4 and 14).

Howitzers which are allotted for long range fighting only use elevations above 45 degrees. Any attempt to use the same howitzers at close ranges results in too great an enlargement of the gun port.

95. Mortars.—6-inch mortars have not the range of the 6-inch howitzer, and are therefore no longer employed, especially as howitzers are capable of high angle fire of over 45° elevation. Light mortars, however (3·75-inch to 4-inch), may be of use in reaching any concealed ground near the works, for the necessary angle of descent could not be obtained at such short ranges with howitzers.

96. Machine guns take the place of infantry in the close range fight. Two types of armoured protection are provided for them according to the angle of traverse required—the cheaper armoured casemate (see Section I—I, FIG. 47) and the cupola (see Section A—B, FIG. 48). The details of the latter are similar to those shown in FIG. 4.

Other Details (Illustrated by Examples).

97. The Example in FIG. 47 shows a work sited in a similar position to the work K_2 in FIG. 43, but with a restricted arc of fire on the left flank. In this case the most important field of fire lies in front and on the right flank and is covered by six machine guns (M.G.), four cupola howitzers (H) and two traditor guns (T). On the left flank rifle fire will be sufficient. For this purpose infantry will be stationed in the passages (G) on the ground floor and in the first storey (Section III—III).

Observing Stations.—These are at B_1, B_2 for the machine gun batteries (see Section II—II), at B_3 and B_4 (revolving posts) for the howitzer battery (FIG. 12), and at B_5 for the traditor battery.

Shelters for the machine gun detachments are provided in the passage G, for the howitzer battery in the passage G_2, for the traditor battery in the rooms B and R behind it, and for the infantry in the passages G on the ground and first floors.

The Ammunition Magazines.—M_1 to M_5 are for the howitzers, and M_6 for the traditor battery and the machine guns.

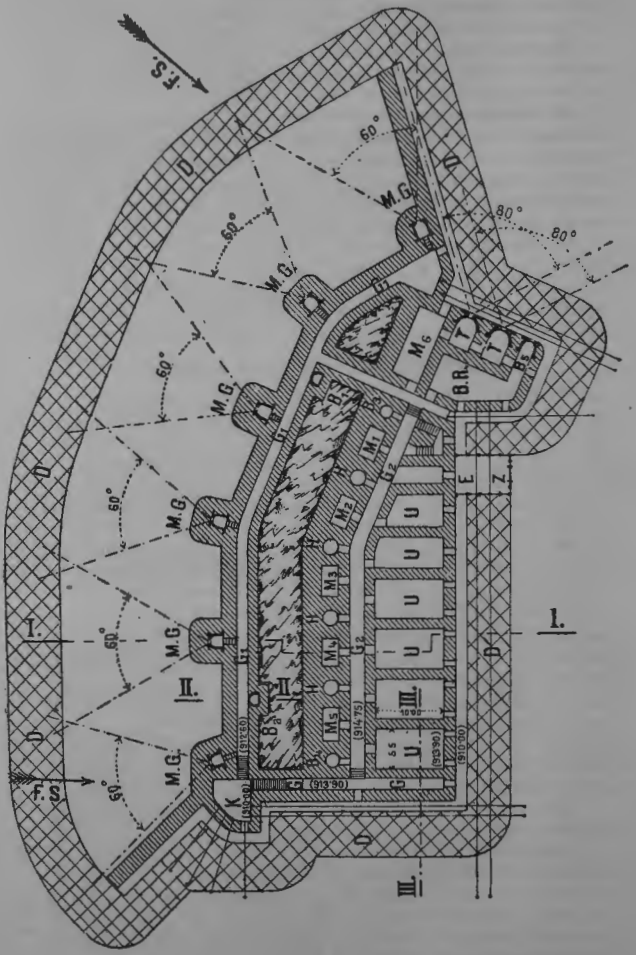
The Barrack Rooms and Accessory Accommodation, including officers' rooms, telephone room, cookhouse, dressing station, stores, etc., are provided in the two-storied casemates U in the gorge.

The Guard Room with gate protection Z is next the entrance E and cannot be seen in the figure.

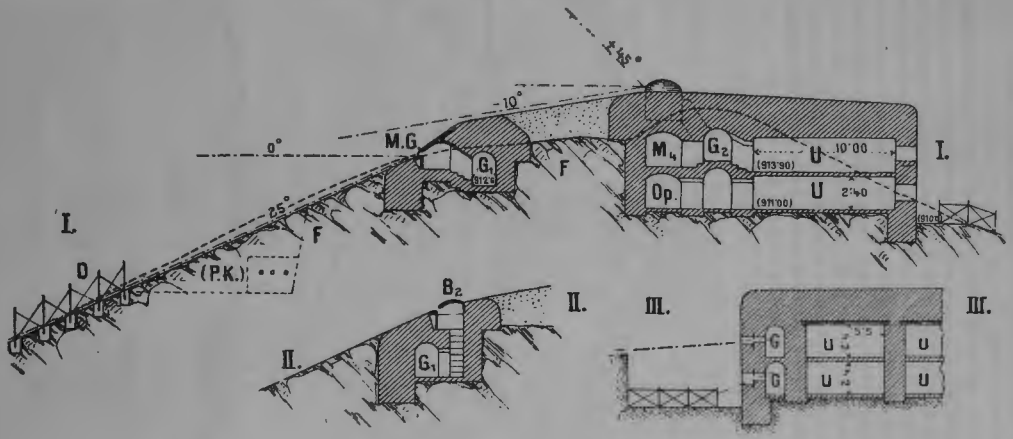
The Obstacle in front and on the right flank consists of several wire fences (D) which are enfiladed by the machine guns (Section I—I).

In this case a ditch, as is shown in FIG. 46, cannot be included owing to the steep fall of the foreground, which would necessitate a huge excavation in the rock in order to obtain the required depth and width. It might be possible to make a cut in the side of the hill (shown dotted in Section I—I), which could be enfiladed from the flanking galleries P.K., also shown dotted. This arrangement is not recommended, since the flanking galleries

Fig. 47.—Example of a work on a confined position. Scale 1/800.
(Described in paragraph 97.)



Section I—I to III—III of Fig. 47. Scale 1/400.



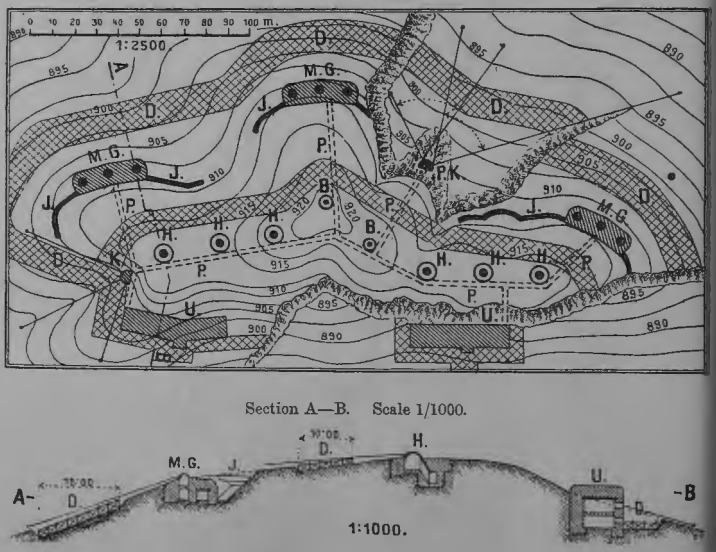
are exposed to direct gun fire and, in the event of their destruction, this cutting would form a sheltered place in which the enemy could collect for an assault.

On the left flank (Section III—III) a wire entanglement is erected in front of the casemate wall; it is enfiladed from the caponier (K). Another wire entanglement is placed behind the gorge casemates. This is enfiladed from the projecting portion of the traditor casemate.

Howitzer star shell are used to light up the distant foreground, for the near foreground "light" pistols would be fired from the observing stations B_1, B_2 (Sections II—II). The left flank of the gorge is lit by acetylene searchlights shining through ports in the flanking galleries.

In this FIG. 47 F.S. indicates the assumed direction of the enemy's artillery fire, and F. indicates rocky ground.

FIG. 48.—Example of a work with dispersed component parts. Scale 1/2500. (Described in paragraph 98.)



Section A—B. Scale 1/1000.

98. The Example in Fig. 48 (Section A—B) shows a work similar to the "Point d'appui" described in paragraph 77. The formation of the ground in this case necessitates a dispersion of the component parts (see paragraph 92 (3)).

For the *close range fight* there are three batteries of three machine guns each (M.G.), which are sited wherever it is required to cover the ground at point blank range. On account of the large horizontal arc of fire necessary they must be mounted in revolving cupolas (FIG. 4). Their fire can be supplemented from the *infantry positions* "J."

The long range pieces (H), with their observing station B, are sited on tops of the hills where the best view over the foreground can be obtained. Long intervals are left between the batteries, so as to make it more difficult for the enemy's fire to take effect.

An *armour-protected emplacement* for two machine guns is sited to cover the ravine in front of the right half of the work.

The ground in front of the gorge is covered by rifle fire or by *machine guns from casemates* (U in Section A—B) behind the hill crest. Traditor guns, if required, can either be mounted on the outer flanks of the casemates or in detached positions.

Obstacle ditches cannot as a rule be made for these extended positions. Wire entanglements and fences must suffice and should be enfiladed in the usual way.

A "Reduit" can be formed by erecting a wire entanglement in front of the long range guns.

Underground Passages (P) connect together the separate portions of the work.

The advantages and disadvantages of this type of work are set out in paragraph 77. Their use in mountainous country is often necessitated by the ground, but they are rarely found in flat or hilly country.

The advantages of a distributed target in mountainous country are more pronounced than elsewhere, owing to the great difficulty or even impossibility of obtaining satisfactory observing stations.

(*b*) Works Blocking a Line of Communication.

99. These are usually small works. Their armament consists of Q.F. guns or machine guns, according to the range required. They should enfilade as great a length of the road or railway as possible. As only a small arc of traverse for the guns is required armoured casemates will do.

Rifle fire, and in some cases machine gun fire, will be sufficient on the flanks and from the gorge of the work.

Unprotected fire positions are of course out of the question, since these works are always overlooked by higher ground.

(*c*) Observation Posts.

100. These are even simpler in construction. Owing to their small size they are less likely to be hit, and being on high sites they are only exposed to the fire of field or mountain guns.

For these reasons they need not be so heavily protected as the other works of the barrier fort. Two or more machine guns are necessary to augment the rifle fire or to cover any bridle path or mule track. A few infantry will be stationed at the loopholes.

The construction of these works is similar to that of a blockhouse (see paragraph 103).

(D) Barrier Forts in Flat or Hilly Country.

101. Compared to other barrier forts these require relatively stronger garrisons and more armour-protected guns, for they may be called upon to hold out for long periods against superior numbers.

SPECIAL FORMS OF PERMANENT LAND FORTIFICATIONS.

(A) General Considerations.

102. The fortifications dealt with so far are those designed to resist the attack of organised troops, which are superior in numbers to the defence, and are provided with special means for the attack of permanent works.

It is necessary at times to protect certain points against the attacks of Irregulars and Insurgents. These points will require a far less expensive form of fortification than a fortress or barrier fort. Occasions may even arise where points have to be held which are little or not at all exposed to any systematic artillery attack.

The blockhouse and defensive shelters described in the next few paragraphs are types of this special form of fortification.

(B) Blockhouses.

103. Blockhouses are small fortified posts usually constructed at both ends of important bridges or tunnels to protect them against minor attacks. They are built of stone or other material, and both house the garrison and act as fighting positions (see Figs. 49 and 50). The garrison consists of from one to three sections of infantry with two to four machine guns if necessary. The fire is from loopholes in the outer wall or in the bullet-proof window shutters and from a breastwork on the roof.

A courtyard (Hof) is frequently found inside the building so that the garrison may remain out in the open when threatened with attack. It is impossible for the garrison to remain continuously at the loopholes in expectation of a sudden attack. For this reason the building is provided with small caponiers (K, K_1), from which a few men may defend it by enfilade fire, until the rest of the garrison can reach their positions.

The entrance must be well protected. The door is bullet-proof and in front is the protected area (Zwinger), which in Fig. 49 is formed by the parade ground.

Small turrets on the flat roof of the blockhouse make the best positions for the sentries. The building is surrounded by a wire entanglement and contains separate rooms for the officers and men, also cookhouses, latrines, wells and tanks. Since the attacker is not expected to possess guns, the walls are as a rule only made bullet-proof.

104. Blockhouses can be erected as observation posts. When they are intended to block bridle paths they are made with thicker walls so as to withstand the fire of mountain artillery.

105. Occasionally open or lightly armoured Q.F. batteries may be sited to some purpose on both sides of the blockhouse and within the obstacle.

The Turkish "Kula" (see Fig. 52, with Section A—B) is another type of blockhouse.

Fig. 49.—Plan of a blockhouse. Scale 1/800. (Described in paragraph 103.)

Fig. 51.—Blockhouse with supporting batteries. (Described in paragraph 105.)

Fig. 50.—View of a blockhouse.

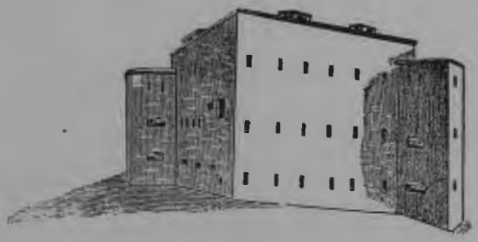


Fig. 52.—Turkish "Kula" scale 1/800, with section A—B, scale 1/400. (Described in paragraph 105.)

Fig. 53.—Plan of a defended barracks. Scale 1/800. (Described in paragraph 106).

(C) Defensive Quarters.

106. These are erected in rebellious districts so that sentry duties may be carried out with as few men as possible. A so-called "Defensive barrack" for one-half to two companies is shown in Fig. 53. They are constructed on the same lines as a blockhouse but are much larger in size.

Fortified camps are laid out for larger garrisons of from one to three battalions. The different buildings in these camps, such as officer's quarters, men's quarters, hospital, magazines, stables, &c., are connected together by defensive walls, the whole forming an enclosed area which is often square-shaped. Projections are left in the perimeter for the purposes of enfilade fire. The defensive garrison can, in this way be reduced to a minimum when the rest of the troops are being employed outside the camp.

CHAPTER IV.—COAST DEFENCES.

107. The rôle of coast defences has already been dealt with in the Introduction (paragraph 5 (*b*)). Their main object is to attack hostile warships, and they must also be capable of warding off the attacks of landing parties.

(A) PRELIMINARY REMARKS ON WARSHIPS.

108. Warships are divided broadly into three classes—battleships, cruisers, torpedo craft. All these types are built and armed primarily for naval fighting; they are comparatively little suited for the attack of coast defences.

(*a*) Battleships (Figs. 54 and 55).

109. Battleships are the most powerful fighting units. They combine the greatest power of offence with extensive protection against hostile fire, and the highest speed with a capacity for the most far-reaching operations.*

110. The chief weapon of battleships is the gun. They are also provided with means for firing torpedoes. The armament of a battleship consists of heavy guns (11-inch to 13·5-inch), and of anti-torpedo craft guns, 6-inch to 4-inch.

Lighter armament is used to assist at landings.

Guns are grouped on board ship according to their range and rate of fire.

Length of range depends on the weight of the charge, the shape of the projectile head, and the length of the gun.

The *rate of fire* on the type of mounting, the method of ammunition supply (hydraulic or electrical power), the training of the crews and the use of range-finders. Night firing is assisted by searchlights.

111. Protection against hostile fire is obtained to a very large extent by the use of armour-plating.

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* That distance which a warship can travel at an average speed (about 12 sea miles an hour) without having to renew her coal supply is called the "Radius of Action." This is about 6,000 to 7,000 sea miles for battleships and double that distance for cruisers.

FIG. 54.—View showing design of a pre-Dreadnought battleship, with horizontal section A—A and B—B. Scale 1/1000.

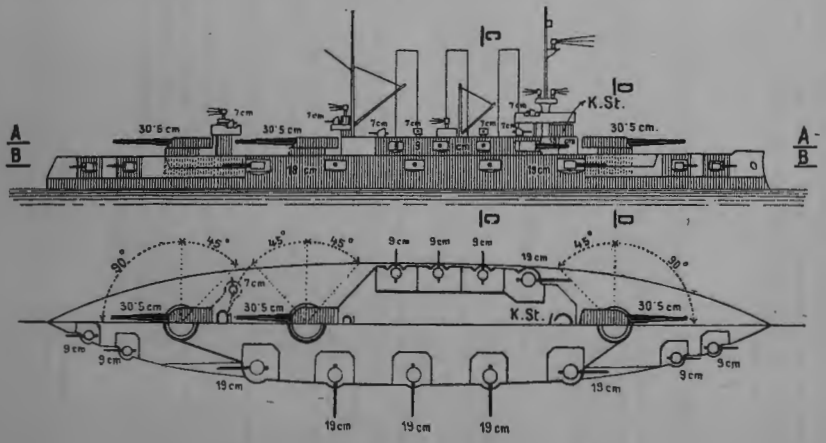
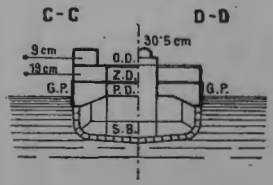


FIG. 55.—Sections C—C and D—D of FIG. 54. Scale 1/1000. (Described in paragraph 111.)



This is provided for the guns and the vital parts of the hull and the fighting posts (see the hatched-in portions in FIGS. 54 and 55).

The less important parts of the ship are left unarmoured, as their destruction does not affect the flotation of the vessel.

It is not possible to protect everything with armour plate or to use absolutely shot-proof armour, for the cost would be prohibitive and a heavy, slow type of ship would be the result. The "displacement," corresponding to the volume of the submerged part of the ship (the maximum weight of water displaced to date is about 20,000 tons) is to a great extent taken up by the guns and ammunition and by the engines, together with their coal supply. In order, therefore, to obtain the necessary correct relation between the displacement and the total weight of the ship adjustments must be made in the thickness of the armouring.

The heavy guns (see FIGS. 54 and 55) are generally mounted in pairs in armoured turrets capable of large angles of traverse (up to 270 degrees). The light guns are either mounted in casemates or on the open deck or in the masts.

The armour belt for the protection of the vital parts of the ship, such as the engines, boilers, magazine, etc., reaches down 3½ feet to 7 feet below the water line (G.P., FIG. 55). Besides this there is the slightly curved armoured deck (P.D. in FIG. 55), which acts chiefly as a protection against the high angle fire of coast batteries; it is known as the middle deck.

The upper deck (O.D.) and main deck (Z.D.) shown in the plan are unarmoured.

(*b*) CRUISERS.

112. Cruisers act as scouts and must therefore possess a greater speed and radius of action than the battleship. Similar guns to those of the battleship must be mounted, for they, too, will have to take their part in the naval fight and be prepared to engage the coast batteries.

(*c*) TORPEDO CRAFT.

113. Torpedo craft* are small vessels which can move at an exceptionally high rate of speed. Their weapon of attack is the torpedo.

Besides this they are provided with a light armour protection and some small guns for use against hostile torpedo craft.

114. The maximum range of a torpedo is at present about 4,000 yards. In practice, however, half this distance is the utmost range at which they are likely to hit the mark. A lucky hit by a torpedo may sink a ship, but the experience of the Russo-Japanese war is that many will have to be fired before any result is obtained. A new torpedo is now under trial which has a range of 7,000 yards.

115. When at rest or moving slowly ships are able to protect themselves to some extent from torpedoes by suspending nets over the side. This is not possible during an action, for torpedo nets would prevent the ship from manœuvring at her maximum speed.

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* The different types—torpedo boat destroyers, sea-going torpedo craft, and torpedo boats—are merely differentiated from each other according to size, radius of action, speed and strength of armouring.

116. Special mention must be made of the submarines and submersibles which are able to approach a ship under the water without being seen, except at the occasional moments when they come up to the surface to determine their correct course.*

(B) THE EFFECT OF COAST DEFENCE AND SHIPS' GUNS AGAINST WARSHIPS.

(*a*) General Considerations.

118. The **coast defence gun** has a distinct advantage over the ships' gun, for it is mounted on a fixed and stable platform, while the ships' gun has for a foundation the vibrating and rolling deck, which very considerably affects the accuracy of its fire.

The accuracy of fire from a ship is still further diminished, because she must be kept going at full speed during the action.

When engaging coast batteries it is even more important for the ship to keep on the move, for she offers such an excellent target when at rest. The coast batteries offer a far less favourable target.

It is therefore apparent that ships' guns are far less accurate than the coast defence guns, and the former can only partly make up for this disadvantage by being greatly superior in numbers. But here again, in order to save weight, only a few rounds (about 80) of ammunition are provided for each gun, and this number is only sufficient for the short-lived naval fight.

119. Howitzers may be used in coast batteries but never on board ship. In Europe 11-inch howitzers are mostly in use; there are also some of 9·4-inch calibre. In the future we shall be obliged to construct 12-inch howitzers, so as to take advantage of the increased effect of one single shot.

Howitzers or mortars less than 9·2-inch are not able to pierce modern armoured decks, but they can be effectively used against the unarmoured parts of a ship.

(*b*) The Effect of Shell Hits.

120. As regards the target we must discuss separately side armour whether for a turret, casemate or in the belt; the armoured decks; and the unarmoured portions of the battleship and armoured cruiser; and finally, the light armour of torpedo craft.

121. Side armour must be attacked by armour piercing (A.P.) shell, which are specially constructed for this object, and form part of the heavy armament of ships and coast batteries.

When the shell has pierced the armour the comparatively small charge explodes (maximum about 14 lbs.). The effect of this explosion is sufficient to dismount guns. Serious damage, too, will be caused in the engine rooms and magazines; and lastly, hits near the water line will cause serious leaks.

---

* The range of vision under water is very limited (maximum 28 yards). Prism telescopes (Periscope) which reach up from the submarine to the surface of the water can only be used in a calm sea.

Compared with the extreme range (22,000) of the heavy coast defence gun, A.P. shell are only effective up to a limited distance, which varies according to the calibre of the shell and thickness of the armour plate between 8,000 and 1,000 yards.

For example :—

Nature of Gun.	Effective Distance with Armour Plate of Thickness—		Remarks.
	11·8-inch.	9·8-inch.	
	Yards.	Yards.	
12-inch ...	5,830	7,800	This is for the best armour plate made. The impact being assumed to be normal.
11-inch ...	4,400	6,380	
9·5-inch ...	1,200	3,300	

This table shows clearly the marked superiority of the large calibre guns.

122. The armoured decks of battleships and armoured cruisers can, as a rule, only be pierced by shell from the heavy howitzers. After penetration the powerful bursting charge (33 to 68 lbs.) explodes, and may sometimes produce disastrous results.

This high angle fire is, however, less accurate than direct fire, and, in addition, the impact of the projectiles is generally oblique.* Most shell will explode above the armoured deck, and the effect is similar to that described in the next paragraph.

The distance at which these shell are effective against armoured decks varies also according to their calibre; it lies between 11,000 and 5,500 yards, with armour plate of from 3 to 4 inches.

The small chance of hitting must be counteracted by mounting a large number of high angle firing guns and howitzers.

123. Common and high explosive shell are used against the **unarmoured portions of ships.** These shell are not made to pierce armour plate, and therefore can take a far larger bursting charge, viz., up to 85 lbs., for the heavy guns and 22·5 lbs. for the medium ones.

The bursting effect of a shell is not dependent on the range, but more hits are naturally obtained at the short ranges.

Heavy shell have the advantage that they are effective at a far greater range than the A.P. shell mentioned in paragraphs 121 and 122. Medium guns have, it is true, a shorter range (up to 16,500 yards), and the effect of a single shot is less; but to make up for this they can fire far more rapidly than the heavy guns.

The effect of this fire on the unarmoured parts of the ship cannot really influence the mobility or buoyancy of a ship, but it may set it on fire. Moreover, the splinters and gas pressures will damage the armament to an extent which must not be underated, and will have a demoralising effect on the personnel (*cf.* the battle of Tsushima). Damage to funnels and ventilators lessens the speed.

* A further condition comes into play here, namely, that the shell may be deflected by the upper and main decks.

124. Light guns are used **against torpedo craft,** for they possess the necessary rapidity of fire, and the effect of their shell is sufficient to cause material damage. Medium armament can also be used against torpedo craft.

125. Finally, coast guns as well as ships' guns, must be direct-firing. The indirect method is too complicated for rapidly moving targets. This also applies to howitzers, although numerous indirect firing howitzer batteries have been constructed by some Powers.

(C) THE GENERAL ARRANGEMENT OF COAST DEFENCES.

(*a*) Naval Ports.

(1) Their Function and Features.

126. Naval harbours are the centres at which a fleet is equipped and assembled, and they must afford protection for it against unexpected attacks.

A good naval harbour will have natural protection from the wind and weather, and a deep fairway. The entrance must not be too broad, and may with advantage be studded with islands.

In most naval harbours (Figs. 56 and 57) the inner waters (J) and the roads (R) are distinct. The fleet will be manned and equipped inside the harbour, and when war is imminent it will lie in the roads ready to sail at any moment.

127. The defences of a naval harbour consist of the *works on shore* and the *obstacles* blocking the fair way. Friendly channels are left between these latter for the use of the Home fleet.

Coast batteries are armed with heavy, medium and light guns, as referred to in Section B. Machine guns and a few infantry are only required in the works themselves to ward off the attacks of landing parties.

There are also "*Torpedo*" *batteries* which can fire ordinary torpedoes.

Harbour obstacles are of three kinds:—(1) Mines to prevent the entry of large warships; (2) Booms consisting of wire ropes and baulks stretched across the channel to guard against the attack of torpedo craft; (3) Nets to keep out torpedoes. It is also important to have a large number of electric searchlights.

128. Some form of *land defence* is necessary to protect the coast works from attacks upon their land side.

(2) Nature of the Attack.

129. The three principal methods of attack open to a hostile fleet are first, a "*Blockade*"; secondly, a "*Bombardment,*" which consists in a long range attack upon the ships in the harbour from positions beyond the range of the coast batteries; and thirdly, an "*Attack from the sea,*" which consists in bombarding and silencing the guns of the coast batteries, removing booms and mines, and then

attacking the fleet lying within the harbour. Other methods are attacks by landing parties or surprise night attacks by torpedo craft upon the fleet.

(3) Nature of the Defences.

130. The heavy guns carry on the long range fight at distances up to 12½ miles and the howitzers up to 7½ miles. This long range fire compels the hostile fleet to keep a long distance off the entrances, and hinders it from getting into battle formation to meet any sortie; it also makes a reconnaissance of the coast defences a matter of some difficulty.

Fig. 56.—Example of a naval harbour (no islands).

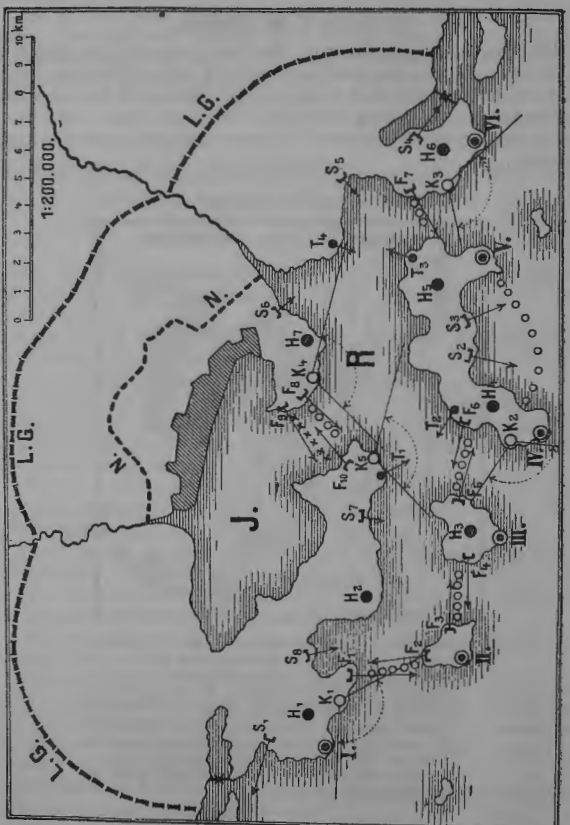
References.—J = The inner harbour; R = The roads; I to V = Coast forts with heavy guns (9·2-inch to 12-inch); H_1 to H_7 = Coast batteries for heavy howitzers (9-inch to 12-inch); K_1 to K_5 = Coast batteries for medium guns (6-inch to 7·5-inch); L.G. = Outer land defence line; N = The enceinte. The small circles indicate the outer and inner line of mines. The small crosses indicated the boom. The shore and flanking batteries of light guns are not included in the plan.

In order to bring an effective fire to bear upon the coast batteries the hostile fleet must approach within short ranges (4,500 to 6,600 yards). At these ranges the heavy guns and howitzers of the batteries will attack the ships with armour-piercing shell and the medium guns will use common shell.

The light and medium guns are intended especially for use against torpedo craft in their attempts to clear the harbour of obstacles. They are also for use against "landings" and torpedo attacks.

The torpedo batteries come into play when the hostile fleet has forced an entrance into the harbour.

FIG. 57.—Example of a naval harbour (with islands across its mouth).



References.—J = The inner harbour; R = The roads; 1 to 6 = Coast forts with heavy guns; H_1 to H_7 = Coast batteries for heavy howitzers; K_1 to K_5 = Coast batteries for medium guns; F_1 to F_{10} = Flanking batteries for light guns; S_1 to S_3 = Shore batteries for light guns; T_1 to T_4 = Torpedo batteries; L.G. = Outer defence line; N = The enceinte. The small circles indicate the outer and inner lines of mines. The small crosses indicate the boom.

Since any fleet can commence hostilities almost immediately after the declaration of war, all coast defences must be thoroughly prepared for war in time of peace.

(4) Grouping of the Armament.

131. The heavy guns are of primary importance owing to the accuracy and effect of their fire. They are mounted in twos or fours in *coast forts* at the most important points. Sites are chosen on both sides of the entrances or on the flanks of a sea front or even at intermediate points which command an extensive arc of view (see coast forts 1 to 6, FIG. 57 ; and 1 to 5, FIG. 56).

The 12-inch gun has a decided advantage over those of smaller calibre (9·2-inch and 11-inch), but for financial reasons the latter must suffice the less important sites.

132. Howitzers and medium guns are mounted in *coast batteries* which are arranged in groups with the coast forts (see howitzer batteries H_1 to H_2 and gun batteries K_1 to K_5, FIG. 56).* The howitzers are required to take part in the long range fight, and an extensive view must therefore be obtained from their batteries. The medium guns must command the water in front of the obstacles.

133. Some light guns are mounted in the coast forts and more important coast batteries to protect them against infantry attack. The remainder are mounted in the *shore and flanking batteries* primarily to enfilade the line of obstacles but also to repel boat landings (see flanking batteries F_1 to F_{10} and shore batteries S_1 to S_8, FIG. 57).

A gun of 2·75-inch calibre is at present in use, but guns of from 3·5-inch to 4·7-inch calibre will be introduced in the near future.

134. The best sites for the *Torpedo batteries* are behind the line of obstacles (see torpedo batteries T_1 to T_4, FIG. 57).

135. Searchlights are sited on both flanks of the coast forts and the more important batteries to light up the obstacles.

136. Infantry and machine gun fire is important for the protection of the coast line and for warding off landings.

(*b*) OTHER COAST FORTIFICATIONS.

137. At commercial ports it is as a rule sufficient to close the entrance by a line of obstacles flanked on both sides by coast batteries. It is desirable to have batteries with heavy armament (possibly howitzers only) to oppose a bombardment. Land defences are usually omitted.

Defended commercial harbours may serve as war anchorages for divisions of the fleet. Arms of the sea, river mouths and canals can also be used, but their entrances must be blocked, and it is desirable to mount some heavy guns.

Torpedo boat bases and coaling stations are similarly protected. Coast forts with howitzers and light or even medium guns may be sited at important points to deal with landing parties, but as a rule mobile detachments in conjunction with coast reconnaissance parties are sufficient.

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* Batteries K_4 and K_5 which defend the entrance to the inner harbour are, however, provided with heavy instead of medium guns.

(D) DETAILS.

(*a*) The Works.

(1) Protection and Disposition of the Armament.

138. General Remarks.—Coast works are only exposed to direct fire from warships, and this fire loses some of its effect as the forts are always sited higher than a ship's guns.

When coast guns are sited 330, 150 or 75 feet above sea level a battleship must stand off 3, 2½ or 2 miles respectively if she wishes to make effective shooting.

At any nearer range the shot would still be rising and would fly over the crest line or be deflected still further upwards by the superior slope of the parapet. A ship is unlikely to hit a coast battery at distances over 4,400 yards. A simple parapet is therefore sufficient protection for a coast gun sited about 150 feet above mean sea level.*

Guns sited lower than this must, as a rule, be protected by armour. Batteries of light guns are the exception, as they afford a very small and unfavourable target and are usually sited in retired positions.

High sites for coast batteries are therefore desirable from the point of view of their protection, but each position must be chosen to suit the various duties of the battery concerned.

Most *heavy guns* can only fire with a depression of about 5 degrees, and if sited too high they will be unable to cover a large area of water near the coast. It is not usual to choose a site for these guns over 150 feet high, in which case the dead water extends only for a distance of 620 yards. *Medium guns*, which generally have a maximum depression of 10 degrees, can be sited much higher, but it is not usual to exceed 330 feet even in their case.

Light guns should, under almost all conditions, be sited low down, so as to be able to attack torpedo craft with a grazing fire.

The more important high sites will be allotted to howitzer batteries.

139. Various Kinds of Cover.—Parapets must be constructed of earth 37 to 46 feet thick, backed by a concrete wall, which will afford sufficient protection against direct hits from the heaviest ships' guns.

The guns fire *en barbette* and over an arc of at least 120 degrees. Howitzers can even fire to the rear, if the position of the battery is sufficiently isolated.

The gun mountings are mostly central pivot and are firmly anchored down in massive beds of concrete.

Splinter-proof shields are occasionally used and form part of the gun carriage. Sometimes the gun is completely surrounded by armouring which protects the detachment as well as the gun. (Fig. 59 and Section A—B show an emplacement "K" for a 6-inch gun, the gun on central pivot mounting with its shield, the parapet and concrete bed.)

140. Turrets are usually constructed to mount two guns (see Fig. 58, turret for one 12-inch gun). The armoured hood is shaped

* It is desirable, however, to use armour protection even in this case, especially if the work is exposed to an attack from the land side.

to deflect the shots, and is not nearly as thick as would be required if normal impact was to be expected.

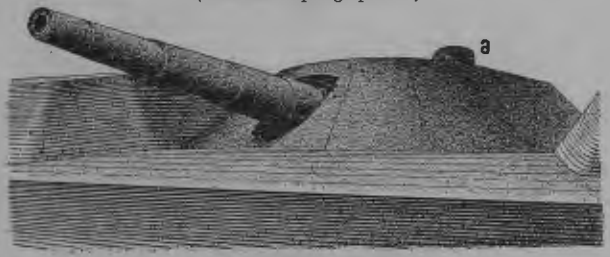
The barrel is very long, and although it projects out of the gun-port for the greater part of its length the inside diameter of the turret must be as much as 33 feet. Hydraulic or electrical power is used for traversing the turret and for elevating, depressing, loading and firing. The cost of the 12-inch gun with its turret armouring is about £85,000.

Cupolas for guns of smaller calibre are similar but more simple in construction.

The medium guns are rarely, if ever, mounted in cupolas; howitzers never, since they can be mounted in elevated positions without any disadvantages being incurred.

Armoured casemates, so common in land fortifications, are not suited to coast fortifications, in which large arcs of horizontal traverse are required.

FIG. 58.—Sketch of a 12-inch gun turret.
(Described in paragraph 140.)



Reference.—a = Armoured observation post for the turret commander.

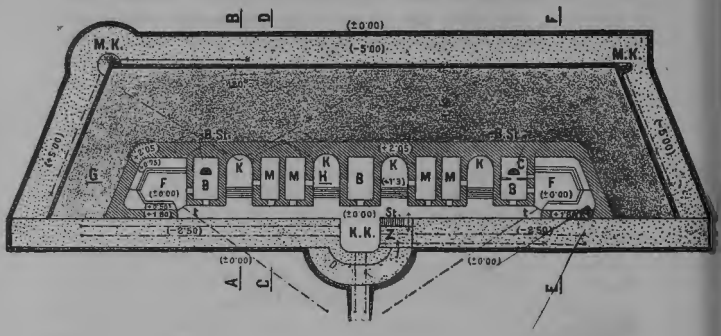
141. Shelters (Hangars).—Light guns and machine guns are kept in masonry shelters, and when required are run out on light rails to their positions behind ordinary parapets, which are usually thrown up on the flanks of the works (see FIG. 59 and Sections G—H and E—F, flank position F and adjoining shelters B for the machine guns).

142. Accommodation for First Reliefs.—The manning details for the guns when not in action are accommodated partly in their own shelters and partly in the "Hangars" (see in FIG. 59, the shelters "B" for the men and "C" for the battery commander).

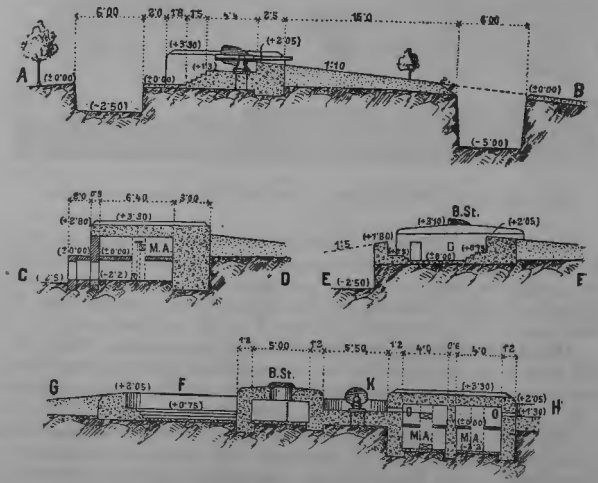
143. Observing stations are most important both for the guns and searchlights in order to deal effectively with a fast moving warship. Both kinds of posts are of the same size and are invariably armoured. The former are provided with very accurate and rapid working position finders.* The latter have arrangements to control the searchlights

* When a work is situated at least 60 feet above the means sea level and the rise and fall of the tide is small, position finders with vertical bases are used in preference to those with horizontal. These instruments can be dispensed with for light guns.

FIG. 59.—Example of a coast battery for 15 cm. guns L/40.
Scale 1/1000.
(Described in paragraphs 139, 141 to 146.)



Section of FIG. 59. Scale 1/500.



References.—K = Emplacement for a 6-inch gun; B.St. = Observation post and D.R.F. pillar; F = Infantry and machine gun parapet with doors in rear "t"; M = Ammunition magazine with handing out hatch O and lift M.A.; B = Shelter for gun detachments; C = Officers' shelter; M.K. = Machine gun caponier; K.K. = Gorge caponier; Z = Gate defence; St. = Steps.

which are in positions outside the works. The guns and the lights are connected up by telephone and speaking tubes. (Two observation posts B.St., are shown in FIG. 59, they are reached from the shelters below by iron ladders).

144. Ammunition Supply.—Expense magazines must be provided close by the guns for the ammunition required at the beginning of the fight.

The remainder of the ammunition is stored in magazines connected to the above by light railway lines or ammunition hoists and lifts. FIG. 59 shows four expense magazines M, and in the sections GH and CD the other magazines are seen below; M.A. are the ammunition lifts, O the hatches through which the truck-loads of shell are delivered; from here they are run up behind the guns along light rails.

(2) Accessory Buildings.

145. Casemates similar to those in use for land defence works are constructed for the relief parties. Cookhouses, stores and latrines must also be included.

Since warships do not employ high angle fire, these accessories may be ordinary two-storied buildings, sited outside the works and in folds of the ground, so as to be hidden from the hostile ships and out of reach of their direct fire.

Allowance has been made for such an arrangement in FIG. 59, as only the bare necessities for war are provided in the battery itself.

Coast works with heavy guns or searchlights require a central electric generating station to provide power for working the guns and searchlights and for lighting the batteries.

(3) Protection from Assault.

146. Some forts and batteries are exposed to the attacks of landing parties. In such a case a ditch, flanked by caponiers, is constructed as an obstacle. FIG. 59, Section A—B, shows the ditch, the machine gun caponiers M.K., and the gorge caponier or guardroom K.K, with gate defence Z. The approaches to the battery can also be covered by machine guns firing through loopholes in the iron doors (t) of the infantry position on the flanks. A wire entanglement in front is sufficient for less exposed batteries.

(*b*) PASSIVE OBSTRUCTIONS.

147. General Remarks.—Obstacles are intended to prevent hostile ships entering a harbour by surprise or after a successful action. It is very difficult to lay out the obstacles so that they are covered by the fire of the flanking batteries.

FIGS. 56 and 57 show the more usual arrangement of two distinct lines of obstacles—an outer line guarding the anchorage and an inner line guarding the inner harbour.

148. Mines.—Mines are used to protect harbour entrances against ships of great draught. They are floating steel cases filled with from

110 to 600 lbs. of guncotton, and are either exploded by the impact of the ship or fired electrically from an observation post on shore.

Both types of mines are anchored to the bottom of the sea, each mine by a separate mooring. Contact mines are placed from 10 to 13 feet under the surface so as to be struck by the unarmoured parts of the ship's bottom. Observation* mines are moored at such a depth below the surface that ships can pass over them, or else they rest on the bottom of the sea. "Friendly channels" must be left through a minefield by which the home fleet can enter. With contact mines it is sometimes necessary to have an elaborate arrangement raising and lowering them from the shore. In spite of this disadvantage contact mines are better than observation mines, for the latter depend entirely for their success upon the accuracy of the observation arrangements and the careful attention of the observer himself. The mines are laid out in several rows chequerwise, so that a ship steering a moderately straight course is certain to come upon one mine. They can be used to block any width of channel.

149. Booms and other Obstructions.—Booms assist the defence of harbours against torpedo craft, torpedoes and submarine boats. The same arrangement cannot serve all three purposes, and consequently an ordinary boom consists of three parts.

(*a*) *Protection against Torpedo Craft.—Wire ropes* are stretched across the entrance and kept on the surface by baulks of wood. The whole is held fast by heavy moorings to give it additional strength against the charges of the torpedo craft.

(*b*) *Protection against Torpedoes.—Narrow mesh nets* reaching to a depth corresponding to the draught of the largest ships—torpedoes fired at greater depths are obviously ineffective.

(*c*) *Protection against Submarine Boats.—The nets* in this case have a 7-foot mesh and extend from a depth of 13 feet to the sea bottom. They are intended to foul the screws, steering rudders and periscopes of these boats, and so put them out of action.

Large "cuts" must be made in all these booms for for the passage of one's own ships, or else means must be provided for swinging back a portion of them when required.

Booms of great length are difficult to construct and also offer a great resistance to the flow of the tide. They are therefore only used to guard "inner waters" (see FIG. 57).

150. Other types of booms are "*fixed*" *booms* and *submarine causeways*.

Fixed booms consist of rows of piles connected together by baulks and chains. They are used to block shallow entrances and bays in which landings might be effected.

Submarine causeways are heaps of stones just reaching to the surface. They are an excellent substitute for mines and booms, as they afford protection against every kind of craft. The entrances left for one's own ships are blocked by swinging booms. The construction of these causeways is very expensive.

* Observation mines are not always buoyant. They may be cylindrical cases filled with guncotton which sink to the bottom of the sea by their own weight. These "ground" mines cannot be used in very deep water.

(*c*) Other Details.

151. Observing Stations.—In order to detect the approach of hostile ships as soon as possible observing stations are erected on high sites outside the works. In clear atmosphere smoke from a battleship can often be detected at a distance of 30 miles.

152. Wireless telegraphy stations connect up the various rendezvous of the fleet with the squadrons operating in home or distant waters.

153. Telephone and telegraphic communications are similar to those in use for land works. Submarine cables connect up the works sited on islands. Visual means of communication are also arranged for.

154. Impeding the Enemy's Navigation.—In war time all navigation marks will be removed. Mobile searchlights will be used to deceive an enemy who has become acquainted with the positions of the fixed searchlights.

155. Naval establishments are similar to the usual fortress establishments, but with the addition of naval arsenals and repairing docks.

CHAPTER V.—IMPROVISED FORTIFICATIONS.

(A) GENERAL CONSIDERATIONS.

156. Improvised fortifications are constructed at places where, for financial or other reasons, permanent works must be dispensed with. They may also be used to supplement any permanent defences which are in an incomplete state.

157. The time available for the construction of these fortifications is limited. The work is only commenced on mobilisation, and they must be completed before there is any possibility of an attack. The interval of time between these events can only be roughly estimated and depends upon the distance of the place from the frontier. It may be reckoned at anything from four to ten weeks.*

All the building material must be obtained locally except what has been collected at the spot in time of peace.

On this account, and owing to the short time available, brick and concrete work must be sparingly used.

The use of armour protection for the guns cannot be considered.

If any extensive work is to be carried out and made sufficiently strong in the short time available, large working parties and quantities of tools and special means of transport must be provided. The question of organisation will be a very difficult matter.

All these difficulties are increased by unfavourable weather. Taking everything into consideration it is scarcely possible to construct improvised fortifications which have as great an intrinsic power of resistance as permanent fortifications. It will only be possible at best to construct overhead cover proof against heavy field artillery fire.

As artillery fire becomes more and more efficient the construction of satisfactory improvised fortifications becomes increasingly difficult, and it is inevitable that in the course of time all preparations for defences on these lines will have to be carried out in time of peace.

158. Cases of Employment.—In the main line of defence there are often single or double bridgeheads which become important only when the operations take an unfavourable turn. If no permanent works have been constructed at such points then improvised fortifications may be employed.

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* In the Franco-German war the Germans appeared before the frontier fortress of Strasburg twenty-six days after the first day of mobilisation. They reached Metz in four weeks and found the improvised work St. Privat still unfinished. When Paris itself was invested, after nine weeks the improvised works Moulin-la-tour, Sèvres, Brimborion and Montretout had not been finished, and when subsequently surrendered they were still incomplete.

As an additional peace precaution, it is quite possible that improvised works might be erected at important points within the deployment area.

Barrier forts and coast defences which are liable to immediate attack after the declaration of war can, of course, only be improvised in cases where there is time for their construction before the mobilisation period begins. This often occurs where the political relations become strained some time before the outbreak of war.

Semi-permanent defences or even hasty entrenchments must suffice at points where the construction of improvised fortifications is impracticable.

(B) THE MAIN FEATURES OF IMPROVISED FORTIFICATIONS.

An improvised bridgehead is a very helpful example and is described below. It closely resembles a fortress in its general arrangement.

(*a*) The Belt of Detached Works.

159. The **belt of detached works** extends along one or both banks of the river according as it is to be used as a single or double bridgehead. Tactical considerations demand that this "belt" should be kept as narrow as possible so as to reduce the amount of construction work to a minimum. This is not a very great drawback, because the place to be defended has little importance and the enemy can only employ the field army artillery, the guns of which are usually lighter than siege guns.

The distance of the "belt" from the bridge or other point requiring protection is generally from 4 to 6 miles, provided that there is a position between those limits which is suitable from a tactical point of view. Suppose Königgrätz had to be fortified provisionally, the line chosen for the detached forts in No. 1 Section would probably be the nearer one (page 13, paragraph 6), that is, the heights north of Nedelist and near to Chlum; while in No. 2 Section the line shown in the plan must be adopted since there is no nearer position which is suitable.

This latter position is most unfavourable and is too far away for improvised defences, but owing to the nature of ground there is no choice.

The division into sections and groups and the details for close and long range fighting positions are on the same lines as in the fortress (see paragraphs 7 and 17).

160. Improvised "points d'appui" are constructed at the most important tactical points of the *close range fire position*, and are connected together by "interval" positions for infantry, machine guns and light guns. A specially difficult obstacle is erected in front of this fighting position, and the shelters and the communication trenches are placed behind it.

161. Howitzers and guns are mounted in the *long range position*, but they are in smaller numbers than in a fortress. Roads are also constructed along which the mobile reserve armament can be quickly brought up into position. It is unnecessary to make provision for a reserve of heavy guns, since there is no question of an action with large numbers of siege guns (*cf.* page 16).

162. "Keep" Works (*cf.* paragraph 28) will take the form of hasty entrenchments, for lack of time and labour prevent more than this being done.

163. Any **additional defensive measures** required will not differ materially from those provided in a fortress (paragraph 30 and 37). They will, of course, be on a smaller scale, and in most cases they will not be carried out until the actual hostilities have begun. They will include clearing of the foreground, the erection of screens and observation posts, illumination of the foreground, communications, telephones, the construction of shelters and stores, and the formation of depôts.

(*b*) The Enceinte.

164. An enceinte is in all cases desirable, but in order to complete the preparations in time the circumference must be as small as possible. It will consist merely of hasty entrenchments with fire trenches and obstacles in the intervals.

In the case of single bridgeheads the enceinte must include both sides of the river. There must be at least one work on the unprotected bank near the bridge as a protection against "Coups de main" attacks.

(C) DETAILS OF IMPROVISED FORTIFICATIONS.

(*a*) The Works.

165. From the foregoing remarks the following differences between improvised "points d'appui" and permanent works may now be summarised:—

(1) Since it is necessary to dispense with armour protection it becomes extremely difficult to arrange for short range gun fire as well as that of the infantry and machine guns. Guns intended for frontal fire should only be very occasionally used, and they must be given shelters (*cf.* paragraph 52). Formerly, when there was no question of having to change position, traditor guns used to be mounted in casemates.

(2) The number of underground buildings, shelters, casemates, magazines, etc., must be reduced to a minimum, and even then can only be made proof against 6-inch shell.

(3) Wire entanglements replace the ditches with their counter-scarp walls and flanking galleries.

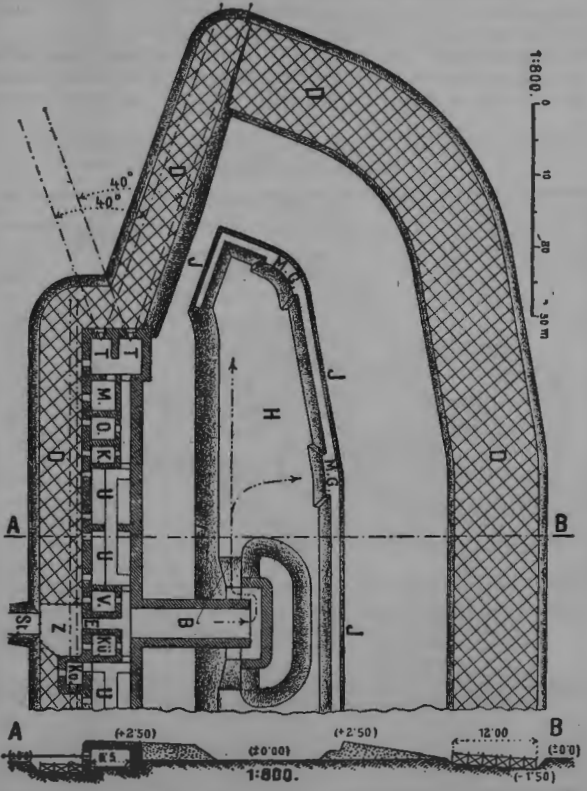
From the above it is evident that the fire from and the power of resistance of improvised defences is greatly inferior to that of a permanent work, and, moreover, they are far more liable to assault.

Fig. 60 shows an improvised work for a half company and four machine guns, and also four field guns in traditor casemates. The description is given in the references. This type of work is also known as a "semi-permanent" work.

166. It is difficult to construct even such works in any large numbers, as the time available is so short. They must therefore be confined to the most important points. At other places "points d'appui" must suffice whose value in defence lies not in the strength of their accessory buildings but in the fact that they are widely dispersed.

Such a work is illustrated in FIG. 61. The position (J) indicated is far more extensive than would really be necessary for its garrison of one and a-half companies and four machine guns.

FIG. 60.—Example of an improvised work.
(Described in paragraph 165.)



References.—J = Infantry parapet ; M.G = Machine guns ; B = Shelter for infantry detachments ; H = Terreplein (Hof.) ; T = Traditor casemate for one field gun ; M = Magazine ; O = Officers' shelter ; K = Commandant's room ; U = Accommodation for rank and file ; V = Dressing station ; Ku = Cookhouse (latrine and telephone room are on the other flank) ; Z and E = Defended entrance gate ; Ko = Caponier ; St. = Approach road ; D = Wire entanglements under enfilade fire.

Inside this extended fighting position there are four shelters for one-third of the garrison, which are made of wood, earth and stone, and are proof against field howitzer fire. Each one accommodates

one section, and they are connected together and also to the fire positions by communication trenches (V).

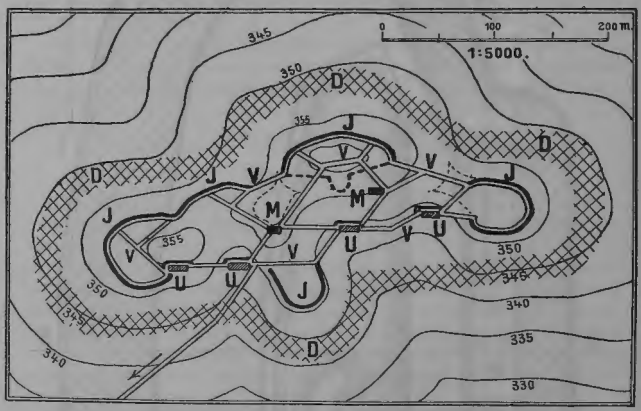
The rest of the garrison is supposed to be accommodated in a splinter-proof shelter outside the work, situated some 220 yards to the flank and in rear of the position.

Only the machine guns with their ammunition and detachments are provided with masonry shell-proof shelters (M).

The object of these arrangements is as follows :—

The extended "point d'appui" can be more easily adapted to the ground than the one illustrated in FIG. 60. This fact alone may greatly diminish the effect of the enemy's fire, not taking into account

FIG. 61.—Example of a simple "Point d'appui."
(Described in paragraph 166.)



References.—J = Splinter-proof shelter trench ; V = Communication trenches ; M = Masonry shell-proof shelters ; U = Shelters, proof against field howitzer fire, with sloping timber roof for about half a Zug of infantry ; D = Wire entanglement.

N.B.—The remainder of the garrison (1 company) is accommodated in splinter-proof shelters to a flank and in rear of the position.

that it must be distributed over a greater area. The small shelters "U" can only be hit by a chance shot and even then comparatively few men can be affected.

The shelter trenches for the rest of the garrison, sited outside the work, are not within the zone of the enemy's searching fire, and consequently are only liable to be struck by a chance shot. It is not, therefore, to be expected that the enemy's fire will cause very severe losses.

This type of "point d'appui" does little more than afford an opportunity for obtaining information about the enemy. It cannot be reckoned to be secure from attack under all circumstances, for,

firstly, it is difficult to secure the co-operation of detachments accommodated in such scattered shelters; and secondly, that portion of the garrison situated outside the work comes under the enemy's fire for several hundred yards before reaching its position.

A specially deep wire entanglement D must be erected in order to delay the attack while the fire positions are being occupied. Other details of FIG. 61 appear in the references.

Owing to the scattered nature of the defences the construction of some kind of "reduit" is to be recommended which will afford the defender a chance of recapturing his outer defence line.

(*b*) THE INTERVAL POSITIONS.

167. The stronger forms of field fortification will be adopted for the intervals between the "points d'appui."

(*c*) BATTERIES FOR LONG RANGE GUNS.

168. The type of battery illustrated in FIG. 38 with bomb-proof shelters is the most desirable, but more often one must be content with that illustrated in FIG. 40, which affords protection against howitzer fire. If there is sufficient room it is better to use single emplacements connected by trenches instead of batteries. Armoured batteries are, of course, out of the question.

(D) PRECAUTIONS TO BE TAKEN IN TIME OF PEACE.

169. If the more elaborate improvised fortifications are to be completed in the short time available all details of the work must be worked out in time of peace and steps must be taken towards their actual construction. These will include the allotment of a supervising staff and working parties, collection of transport and building materials, etc. If building materials, stores and tools cannot be obtained upon the spot or brought in from the surrounding country, their supply must be guaranteed in some other way. Further, wherever it is possible the earth works for the "point d'appui" should be executed in time of peace. Natural screens should also be planted and obstacle stakes erected.

In difficult country it is occasionally necessary during time of peace to construct the approach roads to the different "points d'appui" and to prepare and store near by the required bridging materials.

The nearer to the frontier the position to be fortified and the less abundant the local resources, the more elaborate must be the precautions which are taken in time of peace.

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