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THE DEFENCE OF METZ BY ARMOURED FRONTS.

AN ABRIDGED TRANSLATION

BY

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PAPER III.

THE DEFENCE OF METZ BY ARMOURED FRONTS.

[*An Abridged Translation by Captain W. W. Baker, R.E., from the German of Captain J. Meyer.*]

CHAPTER I.

The Historical Development of the Fortress of Metz.

General Description of the Terrain.

The plateau of Lorraine extends west of the Vosges to the Maas, and is intersected by various watercourses, which run mostly from south to north.

The most important of these rivers is the Moselle, which rises in the Ballon d'Alsace, the highest point of the Vosges, and flows thence to Toul in a north-westerly direction, and afterwards to the Rhine in a north-easterly direction.

The town of Metz lies approximately in the middle of its course, in a deep valley where a tributary, the Seille, joins the Moselle on its right bank.

The valley of the river there widens out to a breadth of from 2 to 4 kilomètres. The crest of the hills, which rise up from the edges of the valley on both banks, attain a height of 220 mètres at the highest place above the surface of the water (163 mètres). The

Moselle has there a width of 150 mètres, but 2½ kilomètres above the town it divides itself into two main branches, which unite 6 kilomètres below, and include three islands of different sizes. They are called—proceeding from the south—St. Symphorien, Saulcy, and Chambiere.

A part of the fortress lies on the last named, but the greater part is on the right bank of the river, in the triangle between the Moselle and the Seille.

Historical Events up to 1870.

The name of the town occurs in ancient history, for it was the Diverdurum of the Gauls and the Medromatrix of the Romans. This name was contracted into Metae, or Metis, which became afterwards Metz.

After the town had been destroyed in the 5th century by the Huns under Attila, it came into the hands of the French, and in 843, by the treaty of Verdun, it passed to the Germans, under whom it rose to be an Imperial free town.

In 1552 a new turn in its affairs took place which we must notice in more detail, because from thence dates the construction of part of the present defences.

Through the political ambition of the Elector Moritz of Saxony, and through his double treachery—first against the German princes connected with him, in favour of Charles V., for the purpose of securing Saxony for himself; then against the Emperor, in favour of the protestant rulers he had formerly deserted, with the object of retaining and enlarging his power—Metz fell into the hands of the French.

After Moritz of Saxony had, in return for the war services rendered by him to the Emperor, received the electorate and territory of his cousin, John Frederick, he besieged the fortress of Magdeburg on behalf of the empire from the 4th October, 1550. This town, however, was well provided with arms and provisions, and was bravely defended by its citizens and their mercenaries. The cunning Moritz saw that there was not much glory to be got out of these operations, and as a rebellion of his subjects, owing to his betrayal of the protestant cause, also threatened to become dangerous, he resolved to secede from the Emperor, and to commence negociations with his opponents.

These led to the capitulation of Magdeburg on 30th November, 1551, and in 1552 to a secret treaty with the French, who were to

support him in his expedition to South Germany against the Emperor by attacking Alsace and the Upper Rhine.

As a return for this assistance to the protestant princes, Moritz of Saxony gave Henry II., King of France, the right of garrisoning Metz, Toul, and Verdun.

On the 10th April, 1552, the French entered through the open gates of the town that their king was to rule as a prince of the German empire, but they had no intention of acting as catspaw for the Elector Moritz, and hence attempted to lay hold of the fortress for their own ends.

The citizens of Metz soon saw that they had made a mistake in separating themselves from the German Empire and in throwing themselves into the arms of the French, and were, therefore, glad when Charles V. shortly after appeared before the place to re-capture it. The siege began on October 19th, the Emperor watching its progress from the east knoll of Mount St. Quentin, where Fort Prince Frederick Charles now stands.

The fortress was energetically defended by the French under Duke Frank of Guize. The Imperial army was soon decimated by the siege, by frost, sickness and want, losing 35,000 men, and, therefore, on the 23rd December, 1552, it relinquished the undertaking, and withdrew to the Netherlands.

By the peace of Westphalia in 1648, France was confirmed in the possession of Metz and of Alsace and Lorraine.

For a considerable time after this the place played no important part in military history; it was watched, and for a short time blockaded, but never seriously besieged.

Neither was it of any particular use as a support of the field armies, for in the wars of the French Republic against Germany (Austria) the main lines of operations led through the present Belgium and Luxemburg (often very near to Metz by way of Thionville to Verdun, and *vice versa*) to the Lower and Middle Rhine, while on the other side they led to Switzerland and Upper Italy. Metz first came into play again in 1814. Then the fortress was blockaded from the 13th January till Napoleon abdicated, first by the Prussians, next by the Russians, and finally by the Hessians, but, as formerly, without result, it not being taken.

The value of this place would have been far greater if the Emperor Napoleon had, at the end of March, fully carried out his design of placing himself outside the circle of the Allies.

Having placed himself, by his march from Arcis to St. Dizier, and

This close ring of forts, which approximates in principle to Montalembert German system, would have been more apparent had the curtains of the bridgeheads been omitted, leaving the bastions as detached redoubts.

Thus stood Metz when the battle of Sadowa, in 1866, made it clear to the French that the military equilibrium of Europe was being disturbed to their disadvantage.

The Position of the Art of Fortification at the Introduction of Rifled Guns.

At this date only Paris and Lyons had received a more distant girdle of forts than the above, while all the other fortresses, *e.g.*, Strasburg, Verdun, Toul, etc., were provided, as a rule, with hardly any advanced works, and hence were far behind Metz.

The extended ring resulted from the first experiences of rifled armament, when the necessity of pushing further forward the detached forts, in order to give the town enclosed in the enceinte better protection from bombardment, was recognized.

The long range of firearms made it possible to separate the works by greater distances than before, but the opposite extreme was gone into in this matter, and the distances were made too great.

The strength of the close fortified ring lay in the self-dependence of its outworks, and in the fact that a system of support was embodied in its two lines of defence. When the forts were attacked, the main wall, which was close behind them, came into action as well, sweeping with its fire the intervals between and the flanks of the works in front, and finally dominating the works themselves should they be threatened with capture.

This was a good system, the best up to that date. Its main principle springs from Montalembert, who must be considered to have been the greatest fortress engineer of the old school. He stands far higher than Vauban, for he invented a self-reliant system that was ahead of the times, and that required a novel system of tactics corresponding to the tactical use of columns and skirmishers in the field.

Had it been desired that the new enlarged ring of forts should gain something of this advantage, it would have been necessary to construct it in the form of a double circle of small works. The difference between the close and the widened rings would then have been that the works of the latter would have been separated by wider intervals, and that the second front would no longer have

been a closed line like the enceinte used to be. The necessary room for deploying the reserves would thus also have been gained.

The first line would have consisted mainly of well-covered forts armed with high-angle-fire pieces, and so traced as to defend, with the help of powerful gorge caponiers, their own ditches.

The Appendix and Table VI. of my paper "Attack and Defence of Modern Armoured Fortifications" shows the plan and section of such a fort.

Immediately behind these howitzer works (which should be considered as consisting of three separate parts enclosed by one ditch) moveable armament would have found, the front being secure against assault, effective application.

The intervals between the howitzer forts would have been, according to the ground, from 1,000 mètres to a maximum of 2,000 mètres.

As second line, small forts, armed with guns, would have been placed about 1,000 mètres behind the intervals, to fire over the line in front, in order to support the howitzers during the artillery fight, while in case of assault their fire would have commanded both the intervals and the howitzer works.

Clearly for these second line forts the highest sites would have been chosen, and these would have been reserved for them when the project was being worked out, especially as covered howitzer batteries can get just as good results from lower sites as from higher.

For this new ring of forts works of any design would have been of approximately equal use if they had been tactically disposed, as explained above. At the root of the whole matter lies the duplication of the line of defence, in order to embody the self-dependence of the separate parts with a system of support, which latter would come into play at once when, through the loss of one of the parts, reinforcements became necessary.

Let us see how the engineers have carried out these tactical requirements at Metz.

The Foreground at Metz.

On the German, that is to say, the east, side, on the right banks of the Seille and Moselle, three radial hills, dying out in the direction of Metz, stretch their spurs towards its enceinte, passing successively into terraces.

From the fortress, beginning on the right, Fort Gizors (185 mètres) is on the northern spur of the terrace (225 mètres), which lies south-east of Queuleu, between the Seille and the Cheneau. The central

hill between the Cheneau and the Vallieres also extends to close on to the Seille. The water-level of the Moselle is roughly 163 mètres above the sea, and the terrace on which the bridgehead fort Belle Croix was built has a level of 205 mètres. Thence the ground rises gently to a level of 215 mètres at les Bordes, and 230 mètres at Belle Croix farm. North-east of the town, between the Vallieres and the Moselle, the terrace of St. Julien lies at a height of 260 mètres. Here also the slope, the spur of which it is, continues towards the enemy, but while the first-mentioned slopes unite at Mercy with a maximum height of 250 mètres, this one rises to a height, at St. Barbe, of 313 mètres, its breadth being 8 kilomètres.

On the south front, between the Moselle and the Seille, the country (190 mètres), 6 kilomètres wide, is fairly level from the citadel to the foot of the isolated hill of St. Blaise, which rises to a maximum height of 364 mètres.

On the left bank of the Moselle there stretches, in gentle undulations, a plateau, deeply cleft by a stream, with its eastern edge falling, as a rule, steeply into the valley.

There are on this side no terraces such as those on the other, but, on the other hand, the high sides of the valley withdraw below Metz from this river, thus leaving to the north of the town a flat plain some 4 kilomètres wide.

From the plateau a hill (360 mètres), sharply separated from it by watercourses, is very prominent due west of the town. This is Mount St. Quentin, the key of the fortress.

North of this lies the terrace (345 mètres) near Plappeville, the east side of which falls steeply. This, like that of St. Quentin, is a southerly spur of a deeply-divided highland that reaches its highest point (380 mètres) near Plesnois.

The Construction of the More Distant Ring of Forts by the French.

The carrying out of the plans for the revision of the place, which had been considered in 1867, was commenced in the spring of 1868. The heights on both banks that surround the town were chosen as the line of defence, and it was considered sufficient to push forward the new works 2,000 to 4,000 mètres, a distance which, it must be allowed, fully met the then conditions.

The east front was strengthened in front of both flanks of the bridgehead Belle Croix by two very large works. That on the right was Fort Queuleu (225 mètres), 2,500 mètres distant from the

Moselle gate and fronting towards Mercy le Haut. That on the left was Fort St. Julien (260 mètres), 2,500 mètres from the left bank of the bridgehead, and fronting towards St. Barbe.

In the centre, between these two, the fort of Les Bordes (215 mètres), 2,000 mètres from the bridgehead and fronting towards Flanville over Belle Croix farm, was to have closed the interval.

The west front was also strengthened with two works.

The one, St. Quentin (360 mètres), was placed on the eastern corner of the hill of that name. It is 2,500 mètres in advance of the left flank of Fort la Moselle, and fronts towards the plateau of Rozerieulles. The other, on its right, called Fort Plappeville, is 3,500 mètres from Fort la Moselle, and fronts towards the long plateau of Saulny.

To close the north front between St. Julien and Plappeville, a fort, Fort St. Eloy, 170 mètres, was proposed in the valley. It was sited 2,000 mètres from the right flank of the bridgehead fronting towards Haucancourt.

On the south front Fort St. Privat (195 mètres) was sited 4,000 mètres from the enceinte, in order to protect the railway station. It fronted towards Augny, and thus had in front of it, up to the foot of the hill, 2,000 mètres of level country.

In order to avoid misapprehension, it should be pointed out here that the other two works, Manstein and Kameke, were only projected after 1870.

The circumference of the place, as marked out by these seven forts—Queuleu, Bordes, St. Julien, St. Eloy, Plappeville, St. Quentin, St. Privat—has a length of 26 kilomètres. Now it is considered that its length, for a place of this class, should be double that, or about 50 to 60 kilomètres; thus the Strasburg defences have a circumference of 47 kilomètres.

The average interval between the forts was $3\frac{1}{2}$ kilomètres, which was rather too much, nor were they all now built at this time, for les Bordes, St. Eloy, and St. Privat remained in the project stage.

Queuleu and St. Julien were constructed as bastioned works with five fronts, St. Quentin and Plappeville as the same with four.

In France, at that time, forts were designed on two different types.

1. The proposed work had bastioned fronts, four or five in number, according to its size, and, as a rule, the gorge was bastioned. The escarps and counterscarps were built in masonry up to the ground level, and were well defiladed from sight from a distance.

On the other hand, the high parapet, that had a great command

over the glacis, was naturally very conspicuous, and hence this masonry was not secure against indirect fire.

The flanks of the bastions contained casemates, and in the gorge of the work were the living rooms and magazines in counter-arched casemates.

Inside the work was a cavalier, serving both as an inner fort and as a reduit. The main lines of its trace ran parallel to those of the work, and hence its form became a lunette. It also contained casemates in that side which was turned away from the enemy.

This cavalier, which was very strong in section, rose higher than the parapet in front, and its armament was intended to especially undertake the artillery fight. The bastioned fronts lying in front helped in this fight with their guns, but their principal duty was to sweep the ditches with their fire should an assault take place, and hence they did the work of the caponiers of the German system.

2. The work had bastioned fronts as above, but contained no cavalier. The main parapet was provided instead with casemates, and heavy guns to undertake the artillery fight were placed on it. Thus the main parapet had the pre-eminence that was held by the cavalier in the first system. In this latter case the work was surrounded by an envelope, which was a second lower parapet, thrown forward for the purposes both of affording better cover to the escarp wall, and of compelling the enemy, should he try an assault, to force two lines at whatever point he might attack.

The first system was applied to the forts at Metz, the second partially to those at Langres. The first system is undoubtedly the better of the two, for the envelope of the second forms a shell trap, catching all the projectiles striking the main rampart and its escarp.

In the first system the bastioned fronts form, it is true, a lower rampart with respect to the cavalier, but they are much further from it than the envelope could possibly be from the parapet rising behind it.

Another system, the German, will now be described, because it was subsequently applied at Metz at Forts Manstein, Kameke, St. Eloy and Zastrow.

In this the parapet of the fort is traced in the shape of a lunette with blunted angles, and is provided with casemates and hollow traverses. The gorge is of bastioned trace, but this does not matter in this case, as the flanking guns do not fire from on the parapet, but from out of casemates, which are not liable to be hit, as they do not face the enemy. The inside of the work is divided into two

by a large traverse, or into three by two of them. Caponiers at the salient and shoulders flank the ditches, or, what is better, the counterscarp is given in for this purpose a bastioned trace with counter-arched casemates. Caponiers that are attached to an outwork, protecting them from fire, and enclosed by the main ditch, also provide flanking fire.

This method of construction has been treated of in the Appendix and in Table VI. of my paper "The Attack and Defence of Modern Armoured Fortifications."

These lunettes have the advantage that their method of defending the ditches secures them more certainly from the dangers of an assault than does the French bastion system.

The French would never allow this, for they swore by the works of their headmaster Vauban, but the power of facts must be great, for after 1870 we see them imitating the German system, which, strictly speaking, is founded on the principles of the general of dragoons Montalembert.

Had some such a system been selected, and had small self-contained forts been formed from the numerous bastions and curtains on the lines stated on pp. 6 and 7, then for the same outlay a ring of 24 to 32 forts could have been created.

Imagine only the cavalier left on the site of Fort Queuleu, with the five bastions separated from each other and distributed over the terrace. We should then have here six works, and an equal number could be got by breaking up Fort St. Julien. These divided into two lines would make it possible to utilize the ground to better advantage, while the greater number of separate targets would sensibly reduce the effect of an enemy's fire. Plappeville would give five works—two in the first, three in the second line.

Of the four bastions of Fort St. Quentin, one would become an advanced work on the west edge of the hill (where Manstein was afterwards built), two would go further back, and to the flanks of this one on to the upper edges of the north and south descents, while the fourth would go as reduit to the east corner of the knoll.

In a similar way would be treated the north and south fronts, and the eastern section by the Vallieres.

The four above-named large works were the only ones built at Metz when the War of 1870 broke out, and they were not fully equipped. A fifth fort, St. Privat, was begun in haste, under special orders from the Government, in May, and was first erected as an earthwork without covered chambers.

The others, les Bottes and St. Eloy, were added as intermediate works during the war, and were built more after the style of provisional batteries than of forts.

On the other hand, instead of the work in the middle of the east front, a strong cavalier, on the lines of those in the forts, was given to the bridgehead Belle Croix, within it and behind its left flank, while a strong lunette was erected towards the Vallieres, outside the bridgehead, but commanded by its cavalier. Fort la Moselle in the same way was given a strong casemated battery on its right flank, facing northward, which was intended to make up to some extent for the omission of the work at St. Eloy.

The part the Fortress of Metz played in the War of 1870–71.

According to the plan of the Emperor, the French forces were to have been concentrated into three armies, with the right wing at Strasburg, the main body round Metz, and a small reserve army in the camp of Chalons. As soon as the troops had been collected at these points, Napoleon intended to unite the armies of Metz and Strasburg, and to take the offensive with them, while the reserve army would have been brought from the camp at Chalons to Metz, in order to cover the rear of the main body. Metz was thus to have become a point of support for offensive operations, and was destined to give up its stores of provisions, ammunition and war *matériel*, to the field army as it required them.

But already the inadequacy of the communications with the interior of the country forced itself into notice, the shortest line to the great French camp, namely, the railway from Metz, through Verdun to Chalons, not yet having been made.

Hence the offensive was given up when the mobilization showed that the French corps were not ready to carry it out, and it was decided to cover the fortress of Strasburg with one army in Lower Alsace, near Woerth, and the fortress of Metz with another on the Saar, near Calenbronn.

Actually, on the 5th of August, the right wing (1st, 5th, and 7th Corps), under MacMahon, stood with the 1st Corps on the Sauer at Woerth, with the 7th at Belfort and partly entrained on their way to Woerth, and with the 5th at Bitsch under orders to march on Reichshofen. The left wing (2nd, 3rd, and 4th Corps), under Bazaine, stood with the 2nd Corps at Spicheren (north of the Calenbronn position), with the 3rd Corps at St. Avold, and with the 4th in Bonzonville.

The Emperor, ready to advance to St. Avold, was behind at Metz with the Guard, and there the divisions of the 6th Corps (from Chalons) joined him one after the other.

The change of plan entirely altered the *rôle* this place had to play.

In the first case it was to have formed a support for the field army, which was to have advanced on the offensive, by becoming a great depôt, from which everything required could be sent forward to the troops, while at the same time it became, in case of defeat, a rallying point.

Naturally in this case the fortress would have been behind the offensive army.

After it had been decided to await the German attack, the army ought to have been withdrawn to behind the fortresses, if the latter were to take part in the operations, for, on the defensive, it is their task to draw part of the hostile army on to themselves and to cover the flanks of their own troops, and thus to induce a weakening of the attack and a strengthening of the defence.

Metz would have carried out this duty if the French army had concentrated southwards of the place, behind the Moselle, in the neighbourhood of Pont-a-Mousson, in which case it would have covered the left, and Toul the right flank.

But the opposite was done, the field army was made use of to cover two fortresses, Metz and Strasburg, and thus all the sensible rules of the art of war were broken. It is not the fault of a fortress if it becomes a drag on the army, it is the fault of him who does not know how to make use of it to better advantage.

It will be seen that the events of the war were such that this fortress had a still more disastrous influence on the course of the operations.

After the battles of Woerth and Spicheren, Bazaine collected the 2nd, 3rd, 4th, 6th, and Guard Corps at Metz, and took up his position under the shelter of the guns of the eastern group of forts, while the fragments of MacMahon's Corps, with the 5th Corps, retreated by Nancy upon Chalons.

Bazaine, too, ought to have withdrawn his army to that place, while the division of Laveaucoupet (detached from the 2nd Corps) might have been left behind to form the nucleus of the garrison.

Meanwhile Bazaine delayed his march. He began it leisurely on the morning of the 14th August, and that afternoon the 3rd French Corps was attacked at Borny by portions of the 1st German Army. Severe fighting ensued, in which the 4th Corps, which was already

commencing its march, took part, and which resulted in the postponement of Bazaine's march on Verdun till the 15th.

Meanwhile the 2nd German Army had seized the Moselle crossings between Fronard and Corny, had crossed the river, and were pressing northwards against the road from Metz to Verdun.

On the 16th August fighting took place between Bazaine's army, which had not got beyond the line Vionville-Gravelotte, and the left wing of the 2nd German Army.

Both sides maintained their positions and claimed the victory, and truly the French had, owing to their numerical superiority, the better right to consider themselves as tactically the victors, but the Germans gained the strategical victory. Their object was to halt the retreating army, and in this they had succeeded, for without a fresh victorious battle the French Army of the Rhine could not carry out its march.

Hence, on the morning of the 17th, Bazaine retreated on Metz, where his troops occupied the plateau of Rozerieulles and the heights of Montigny-St. Privat-Roncourt. The great battle of the 18th August lost him, after long and bloody fighting, this position, and on the 19th the French withdrew to behind the detached western forts.

Then began the siege of Metz. The French army, exhausted by the three battles round Metz, was shut in; it was held fast by an army only a little stronger than itself, and without an artillery fight or a formal siege of the works it was compelled by hunger to capitulate. Bazaine certainly undertook, on the 31st August and 1st September, a great sortie against the plateau of St. Barbe, but it was unsuccessful. From then he only made weak attempts to break through the blockade, and at last commenced political negociations with the Germans, who made use of them to spin out the time till his provisions had come to an end.

On the 27th October he had to capitulate; a Prussian corps occupied the town, and the German flag flew on the walls of the forts.

Metz as a fortress had not been an advantage to France, but the reverse. As a support to offensive action it could do nothing, for the offensive came to nothing; but still, it favourably influenced the time of mobilization and the march of the army by supplying the 2nd, 3rd, and 4th Corps from its stores.

As a support of the defence it did not have the influence it should have had, because Bazaine allowed himself to be stopped and finally

shut in there. It would not, however, have been able to withstand a siege of several months, for there were many gaps in the ring of forts, while those works that were commenced were not in a proper state to make a good defence.

For all that, the fortress could have rendered good service, and, even granting the final capture of the forts, the strength of the heart of the place, namely, the enceinte with the two large bridgeheads, was not to be despised; it had at any rate greater power of resistance than the indifferently laid out wall of Strasburg.

Matters did not go on the same lines as at Strasburg, because the presence of large bodies of troops made it possible to close the interval between the forts with army corps, and because the Germans could count on hunger forcing a capitulation. Their plan was not to make use of their artillery, and not to disturb the army of the Rhine in their comfortable rest, for the bombardment of the hostile camps would have entailed great losses on the French, which would have compelled them to undertake strong sorties, whereby the safety of the besieger's enclosing ring might have been endangered.

This siege, the circumstances that led up to it, and the way it was carried through, are unique in military history. We see here about 170,000 French shut in by about 180,000 Germans, and they could not, that is to say, they did not seriously try to, break through the blockade. We must not, however, forget that the three battles round Metz must have exercised a demoralizing influence on the French, and an exhilarating one on the Germans, and, taking this into account, it would be fair to consider the besiegers as double as strong as the besieged.

The Completion of the Works by the Germans.

The first care of the Germans was to improve the existing works, to complete the improvised ones, and to close the gaps in the ring of forts.

Forts St. Quentin, Plappeville, Queuleu, and St. Julien came under the first heading, while under the second St. Privat, les Bordes, and St. Eloy were revised and completed, and under the third a new work was inserted at the west edge of the St. Quentin plateau, and another similar one between Woippy and Lorry.

All these advanced works were re-named. Formerly they were called after the names of the places near to which they had been built, but now they received the names of the army chiefs and generals in command whose corps had fought near them.

Thus Fort St. Quentin was re-named Prince Frederick Charles,

Fort Plappeville, Alversleben ; Fort St. Eloy, Stiehle, after the chief of the staff of the 2nd Army ; Fort Woippy, Kameke ; the fort on the west edge of St. Quentin, Manstein ; Fort la Moselle, Voigts-Rhetz ; Fort St. Privat, Prince Augustus of Wurtemberg ; Fort Queuleu, Goeben ; Fort les Bordes, Zastrow ; Fort St. Julien, Manteuffel ; Fort Belle Croix, Steinmetz.

The new forts were built by the Germans, as usual in the shape of lunettes, and no new ideas were, to start with, embodied in them.

Numerous intermediate batteries, that were given as permanent a character as possible, were afterwards constructed in order to further strengthen the defences.

The fortress was thus arranged when the introduction, in 1885–6, of high-explosive shells called into question the value of the old style of construction.

One of the two following lines of action was then open for adoption :—

1. To strengthen the old system of defence by increasing, with concrete or granite, the protection given to the stores, casemates, etc., as well as providing armoured protection for some of the guns in the forts.

2. To introduce a new system designed to regain, through tactical rather than through material means, the lost advantages, by utilizing mobile cupolas for the defensive ring.

Metz was strengthened by the first method, that is to say, directly. The hollow traverses, shell and cartridge stores, magazines, mine galleries, caponiers and gorge casemates were made bombproof with thick masses of concrete and granite.

The armaments of several of the forts were protected with heavy armour, and, above all, the intervals between the forts were closed with small intermediate works, forming supporting points for infantry and protected storage room for the artillery. These now exist in considerable numbers between all the forts.

In this way the fortress grew, as far as was possible on the principles of the old school, to have a mighty power of defence ; but it still retains, with all the advantages given by the revision which has been carried out, the one great drawback of too small a radius.

A radius of 4 kilomètres to 5 kilomètres, a circumference of 24 kilomètres to 30 kilomètres, does not suffice when dealing with modern artillery.

The contours of the ground may, it is true, justify so small a radius, but it must be remembered that once such a position has been broken into in war, all chance of profitably continuing the defence would be done away with.

CHAPTER II.

The Principles of Armoured Fronts.

A General View of the Design of New Fortifications.

The destructive power of the means employed in fighting controls the formations of troops, their tactical movements, and their method of using their weapons in battle.

This applies both to attack and defence, to field army and fortress.

For that system of fighting only can be held to be correct that takes advantage of every kind of weapon, and primarily of those means of defence which form points of support for the troops engaged.

The word fortress can only mean a well-prepared defensive position, and, in peace time, the less it imposes fixed conditions on the future, the better it will fulfil its object. For however excellent these conditions may have been at the time, yet, when the place later comes into action, their advantages may be nullified by some new method of using his weapons employed by the enemy. Hence the more a fortress permits of movement and change of formation among its component parts, the better it is.

Only in the case where the means of fighting show no change in their effect has tactics no need to desert its old lines.

But this case does not occur, for since the middle of the sixties firearms have been in a perpetual state of change. Hardly has one reform been carried out than another one is mooted.

Artillery changes especially have seriously affected fortifications, with the result that we must consider the former methods of construction to be superannuated and ineffective.

The novelties that we are mainly thinking of are rifled breech-loaders, high-explosive shell, smokeless powder, and quick-firing guns.

Rifling and breech-loading increased the range, and especially the accuracy, of artillery to an extent formerly not considered possible. Now, obviously, accuracy of shooting is advantageous to anyone in proportion as his opponent presents him with targets on which it is easy to lay the guns, and to observe the effects of the fire. In other words, the sharply-defined, conspicuous fort is far more liable to be hit than the inconspicuous, almost invisible batteries of the besieger. The accuracy of rifled armaments is thus an advantage to the attack, a disadvantage to the defence. And yet for all this those later Metz forts were built as a means of defence against long-range breech-loaders.

High explosives, and their application as charges for shells, brought about another change in the state of affairs, which we consider to have had the most important effect of all on artillery matters.

It is more important than the transition from smooth bores to rifles, for hits with explosive shells would do more harm than the increased number of hits with ordinary shell obtained by greater accuracy of shooting. The power of destruction of a shell has been increased tenfold to what it used to be, and the effect of its explosion approaches that of dynamite.

This effect has been largely increased by the introduction of steel instead of iron shell, and by the adoption of a fuze that gives a delay of $\frac{1}{4}$ to $\frac{1}{3}$ of a second after striking, and that thus allows a shell that hits an earthwork to penetrate deep enough to secure its full explosive effect.

Reverting to the example we considered above, it is again evident that the masonry of the forts will suffer terribly from the destructive power of the enemy's high-explosive shells, which, owing to the size of the target, cannot miss.

Hence, before long, the retaining walls of the escarp and counter-scarp would be broken down, the ditch would be filled in with fallen masses of earth, and an assault would become possible.

The similar fire of the forts against the siege batteries would not be so effective, for, as they are hidden in the ground, it would be difficult to lay on them, and to observe the effect of one's fire on them. Also, as they are scattered instead of being crowded together, the effect of the defender's fire would be dispersed. His individual hits would, no doubt, do as much damage as would those of the attack, but he would not get as many hits.

Smokeless powder in the cartridges completely seals the fate of the forts. It does not benefit the fort guns much to be free from

betrayal by their smoke, for their positions are otherwise clearly enough shown by the sharp outlines of their parapets and traverses. It is, however, an incalculable advantage for the siege batteries, which, being hidden in the ground, will, when using smokeless powder, and provided no parapets are thrown up, give the enemy no indication whatever of their positions.

Quick-firing guns increase the intensity of fire, and make it possible to pour, at a given moment, projectiles as thick as hail on an enemy. During an assault they are of special advantage to the defence, during the artillery fight not less so to the attack. Were a large number of 12-cm. quick-firing howitzers to pour their concentrated fire of high-explosive shells on a fort it would not be possible to stir outside its casemates, while the *morale* of the troops sheltering inside them would be shattered by the constantly exploding shells.

On the other hand, the guns of the fort could not simultaneously engage the scattered siege batteries.

A comparison between a fort and a battery of the attack has been purposely drawn, for it is essential for us, in considering the maxims that follow, to know whether a fort can serve any longer as a point of support. I know very well, and have alluded to the fact in former pages, that the Germans propose to undertake the artillery fight mainly from intermediate batteries (where the task will be facilitated by the accommodation for guns already constructed), not from the forts.

From the above considerations it follows that a fortress should gain for itself the same advantages that the batteries of the attack possess. This it can do with the greater effect, since the invention and practical application of cupolas gives a means of largely increasing the power of resistance of individual guns, and of warding off an attack in superior force with fewer means of defence.

But before we consider these matters, let us lay down as a guide the following

Fundamental Principles of the Art of Fortification

as they stand at present.

I.—Strategical Principles.

1. The object of a fortress is fulfilled if it can maintain itself, with the garrison allotted for its defence, for some time against an enemy in superior strength.

2. The situation of a fortress should be chosen so as to favour both offensive and defensive action along a certain length of frontier. By being placed on large rivers and on mountain passes, ensuring the possession of convenient crossing places, and commanding important lines of rail and road junction, fortresses become, in a defensive war, supports of the army operating in the field. For they allow it to avoid a battle till their weakening and hampering influence on the attack has reduced its power to below that of the defence.

The same places would become, in an offensive war, great depôts of provisions, ammunition, and war *matériel*, whence the field army could easily draw the stores it required.

The power of attraction that a fortress has for an enemy, and hence the influence that it would probably exert on the course of the war, is increased by placing it on the most important strategic point, and thus enhancing its value by making it a great depôt of stores.

3. Changing the site of a fortress is not barred, even though it has the above-named advantages with unchanged site, for it may turn out that they may be more fully attained from sites other than that first selected. This is an argument in favour of the use of works which can, in the main, be moved so as to be re-used either for the purpose of an attack on an enemy's fortress, or to form fortified positions in the enemy's country.

For the strategic value of a place is not constant. It might happen, through political changes, that a whole frontier, on which many defences had been constructed, would become secured by an ally. At the same time the opposite frontier might urgently require strengthening, and it would thus become advisable to send some of the moveable defences to the threatened side, so as to have them, when war broke out, at the spot where they would be most required.

II.—Tactical Principles.

1. The radius of a fortress depends on the nature of the country round it, but the range of modern artillery make it necessary that the distance from the outer line of defence to the centre of a medium-sized town should lie between 5 and 10 kilomètres, which gives a circumference of 30 to 60 kilomètres.

2. The works of a defensive front should be arranged on the same tactical principles as are troops in the field. These works form

a framework, which is filled in with open batteries containing artillery of position (moveable armament).

Neither the linear arrangement of the old town wall, nor the columnar tactics of the forts, are in accordance with the fighting methods of troops, for the former allows for no support in rear, while the latter provides conspicuous targets for the enemy.

3. The rear lines of works in a tactically arranged system support the front ones. This system also leads to a fundamental separation of the artillery and infantry into separate works, and ensures that both come into action in their proper places, for under it the guns that have to undertake the artillery fight are advanced to the crests of the hills, while the infantry, that only come into action when an assault takes place, and which must be kept intact till that time, are retired on to the slopes that are turned away from the enemy.

4. The system of support secures us in the possession of the defensive front, even if some of the individual works be captured, by providing beforehand for making good any losses in the front line. The supporting line is comparable to the reduit in the old forts, except that its retired position, which withdraws it from the enemy's fire, keeps it intact till the last stage of the siege.

5. By judiciously grouping the guns for close and for distant fire, the self-dependence of the parts is secured; this entails nearness of the works to each other, so that they may help each other in their common task. It can only be maintained by providing each single part with an obstacle against assault, which must be so arranged as not to impede offensive action. In order to secure these obstacles under all conditions they should be under a twofold fire. The armament of the work that they surround provides the one fire that covers them, the fire from the supporting battery detailed to it provides the other.

6. Offensive action over the front covered should neither be cramped nor should it have too free play allowed it. The old town walls failed in this respect, for sorties had to issue through defiles, *i.e.*, the gates. In the present rings of forts, especially in the cases of armoured forts with few intermediate batteries, the fullest scope for offensive action is allowed. Entire deployed divisions can break out without hindrance, but the enemy can also penetrate in a similar formation. Numerous intervals, a few hundred mètres wide each, will allow the troops making a sortie to move freely, while the numerous individual works will secure their retreat, should the undertaking fail.

III.—Technical Principles.

1. The fire of the defence must be capable of being given its fullest effect. The enemy is fought with guns and ammunition, not with lifeless works, but still, in order to keep the guns fit for action, it is necessary to give them some protection. Steel protection, properly used, tends to give to the besieged, as he is first on the spot and has already cover for guns and ammunition, the advantage over the attacker even though the latter may have a great superiority in artillery.

Both moveable armament and steel protected armament are required, the former filling in the framework formed by the latter. The steel protected pieces must, however, also have in some degree the power of movement, as it may be necessary to shift their positions. It is essential to use these in fortifications because they only can endure the fire of an enemy for any length of time without being put out of action.

The steel-protected armament (*i.e.*, pieces in cupolas) consists of medium artillery (12-cm. quick-firing howitzers), to commence the artillery battle, and of light artillery (6-cm. quick-firing guns) to repulse an assault. The heavy artillery of position (mainly 15-cm. howitzers) will undertake the brunt of the artillery battle, which will in the future form the most important event in a siege. The light guns will also at times have to take part in this in order to raise the intensity of fire of the defence to a sufficient height to crush that of the attack.

The introduction of high-explosive shells has increased the importance of high-angle fire, for the steep angle of descent of the projectiles nullifies the advantage of overhead cover, while the high-explosive bursting charges give the shell splinters a velocity far exceeding the final velocity of the shell.

The accuracy of high-angle fire is, owing to the height of the trajectory, greater against horizontal targets at the decisive ranges than that of fire with flat trajectories, for its rectangle is shorter. The range of rifled howitzers is so little less than that of rifled guns that the difference may be neglected for practical purposes.

A high-angle-fire piece is more mobile than a direct-fire gun of the same calibre, for while the latter has a length of at least 24 calibres, the former has one of only 13 calibres. Hence the weight of piece and mounting is so reduced in the case of howitzers that a 12-cm. howitzer with mounting only weighs $\frac{2}{3}$ of what a gun and mounting

of that calibre weighs. Thus for equal weights the howitzer permits the use of larger shell, in other words, heavier bursting charges, and hence a greater effect on the enemy with equal power of movement.

A 12-cm. howitzer could well be substituted for a 9-cm. gun, or a 15-cm. howitzer for a 12-cm. gun, but the storage room required for ammunition would be doubled.

The high-angle-fire piece can fire over objects screening the target, and hence can defilade itself from the sight of the enemy by making use of natural features of the ground. No loss of effect is entailed by thus doing, for its commander can observe its fire just as well from some distance as from the battery itself, while indirect laying is more reliable than direct laying by excited gunners.

Finally, the gun detachment, seeing little, does not know what is going on elsewhere, and consequently the men retain their steadiness better.

A high-angle-fire battery thus treated is more difficult to detect, and far more difficult to see than a gun battery, and hence, as it would suffer far less than the gun battery, it would be able, even though it had fewer pieces, to do far more than it.

Owing to their being able, by the use of different charges, to do the work both of guns and mortars, howitzers have lately come to the front in the armaments of fortresses.

Artillery fire, except that of the light guns, being thus told off for long range, the infantry fire becomes available for the short ranges. It is then possible, when siting the infantry points of support, to defilade them from the enemy's sight, so as to guard their garrisons from losses in the early stages of the attack, and thus to preserve them intact for their work, namely, the repulse of an assault.

2. Protection is provided in order to reduce the effect of the enemy's fire on our troops and war *matériel*, and to keep our strength unimpaired for the decisive moment, and thus increase our effective power as against that of the enemy. But protection, to carry out this duty, must be in proper proportion to the sum total of the available means ; its use is profitable so long as only sufficient security is given to the means used in fighting, and to the men serving them.

High-explosive shells decided this question also, for they destroy everything they hit. A few shells, with their great splinter effect, can destroy the whole of a detachment occupying an open battery, while a large number of such shells bursting within the strongest possible work would have the effect of making its garrison unfit for action.

Thus on the one hand shelter is required to ward off splinters and individual hits, but on the other hand it is useless to attempt to provide a shelter that will stand intact against the blows of high-explosive shells.

Protection alone will not do, but the means used in fighting must be tactically arranged by separating their individual portions, so as to minimize the results gained by the enemy by dispersing them over a wide area.

Shelter is required for the detachments under fire, and for the troops that are resting. It is obtained either by artificial means or by utilizing the features of the ground to defilade our troops from view. This latter method is the most efficient, and the fortress should be designed to make full use of it.

The gunners in the foremost fighting line are protected by steel cupolas of medium thickness, the resting troops by shelters on sites defiladed from view, the heavy artillery, as far as it consists of howitzers, by being sited behind the crests.

Such crests exist in every sort of country. Sometimes close, sometimes far away, and at all sorts of levels, they can be made use of in all sorts of ways.

Heavy protection gives the work to which it is applied a certain solidity (*e.g.*, in the case of armoured forts), which often leads to the erroneous impression that it has an extraordinary power of resistance, while on the contrary the stiffly upstanding work becomes merely an anvil on which the enemy tries the power of his shell.

Medium protection has the advantage that more points can be protected for the same expenditure, and that it can be to some extent moved (*e.g.*, the cupola front), so as to avoid the enemy's fire or to assist the fighting elsewhere should it be necessary.

High-explosive shell have settled the fact that it is better to have medium and moveable protection than to have it heavy and fixed.

The fixed solidity of the armoured fort is certainly worth something, but the moveable solidity of the cupola front is worth more.

3. The object of obstacles is to impede the enemy's approach on a defensive position, and to delay him, so as to give a surprised garrison time to come into action. They ought to be able to withstand the enemy's fire for a good time, and to be easily repairable where destroyed. They must not obstruct the view from the infantry and artillery positions they surround, nor must they mark out their sites.

They must be swept by the fire of the lines behind them, for they

are never absolutely impassable, and only serve to lengthen, at the most favourable range, the time that the attack is kept under the fire of the defence.

Of all artificial obstacles a wire entanglement of great width but small height fulfils these requirements the best. This is only equalled as an obstacle by a marsh, a sheet of water, or a broad and deep ravine.

An artificial ditch is not as good as it, for the great destructive power of 21-cm. and 15-cm. high-explosive shells makes it useless to revet the sides, especially the escarp, for the masonry would not stand long under fire. The revetted counterscarp would also have its top cut down, and even if this did not happen it would not take long, as experiments have shown, to pass such an obstacle with the new storming gear.

An entanglement formed of wires crossing each other, and having a breadth of 20 to 30 mètres, and a height of ½ to 1 mètre, is impassable without special appliances. It must be bridged, which, owing to the way it gives when anything is laid on it, is very difficult to do, becoming almost impossible after the enemy's fire has thrown the wires into confusion and twisted them together.

Any gaps made in it are easily repaired, while masonry once destroyed can only be made good after the siege is over.

There is no form of obstacle that can absolutely withstand high-explosive shells, and they will no doubt do great damage to such an entanglement.

This has, however, the great advantage over other obstacles that it can be easily repaired, while the craters made by the shells increase the difficulty of crossing it. Provided it be effectively swept by the defender's fire, it assures him of all necessary freedom from assault.

The Application of the Principles.

As here laid down, they lead us to the adoption of cupola fronts, which, with their arrangement in different lines, their system of support and the self-dependence of their parts, correspond to the modern method of fighting in the field. Forts, on the other hand, correspond to fighting in column, intermediate batteries to fighting in line, and hence neither of these are now tactically correct. It has been already pointed out that fortification must seek to regain under the altered conditions the advantages of the close ring of forts that it possessed in the days of smooth bores.

The fort and the rampart that gave the guns command were good in those days, for in spite of their visibility the artillery of that time could not hit them from a distance, nor could it do them much damage if it did hit. The command of the ramparts gave their defenders a good view, while the concentration of the troops in a closed work enabled them to be kept in hand till the decisive moment arrived.

The front of defence was arranged in lines.

The forts, 500 to 1,000 mètres apart from each other, formed the first line. In shape they were, as a rule, closed lunettes with caponiers in the ditches for flanking purposes. Their faces were designed to take the guns, and a double parapet was often given to them Behind the front and lower parapet were placed light guns or infantry, while the main one could be armed with howitzers, or might be provided with banquettes for infantry. Flanks were provided on either side of the fort to command the intervals between the forts.

In the gorge behind was a redoubt provided with numerous defensive casemates. This ensured the self-dependence of the work, and in its bombproof living casemates lay the reserve, who thus lived close to its post, and was ready at any moment to come into action.

The closed main wall lay 500 to 1,000 mètres behind these works. It formed the supporting position, and from it a captured fort could be bombarded and re-taken.

Owing to the short distances of the main wall from the advanced works, and of these works from each other, they naturally supported one another, thus making it necessary for the attack to take several works in order to succeed. This excellent system lost its value when rifled guns were introduced, for the visibility of the rampart ensured its destruction by the enemy, the reduit became a shell trap, and the huge mass became the grave of its garrison. It appeared possible at first to use some strong and tough material that would keep out the shell striking it, and the majority of engineers started working on this hypothesis.

It was soon, however, apparent that this idea was incorrect. The building material used for the fortress was certainly much stronger than the freshly-thrown-up parapets of the batteries of the attack, but for all that the fire of the defence could not cope with that of the attack. The reasons for this failure did not lie in the materials used, but in the visibility and size of the defensive works compared with those of the enemy, and in the fact that the fort guns were

crowded together, while the batteries of the attack were widely scattered. The problem could only be solved by giving more room, *i.e.*, tactically. This led to the guns of the forts being employed in the intervals, the fort being retained as a supporting point.

But what a difference there still was between the attack and the defence. It was clearly essential that the works of the defence should not be visible to the attack, and yet there now stand at the ends of the lines of defence conspicuous forts, assisting the aim of the attack, and showing approximately the positions of the batteries of the defence.

At times, too, the defender did not apply his moveable guns at the right spot, and was, therefore, often too late to make good resistance when the main attack was made in an unexpected direction.

These drawbacks have the more weight the further from the enceinte and from each other the forts are.

The opinion that the advanced ring of forts could not withstand an attack, and that more than simple intermediate batteries were necessary to enable them to do so, grew continually, till finally artillery and infantry shelters (which though not directly defensible, form supporting points) were provided.

Meanwhile another school had attempted, by using heavy armour, to make works capable of withstanding artillery, but the introduction of high-explosive shells frustrated this attempt, and demanded the final abolition of such large targets.

What is the good of armour or masonry if the garrison is so shaken by the bombardment, and overcome by the pressure of air and the gases generated by the exploding shells, that it cannot stand to the guns?

There is only one solution. The guns and shelters must be separated, scattered, and concealed from the enemy by proper use of the ground. The main idea in all fortification works in the future must be to see without being seen oneself.

It is difficult to understand how there can still be so many engineers that do not comprehend this, but their number diminishes every year. Experiments with high-explosive shells prove conclusively that fortification must give up a method of fighting that has already been abandoned by troops in the open. The field army has had to give up columnar tactics, as they find that shell after shell hits the large target offered, and why should a different law apply to fortifications?

If the attacker in the next war deals in the proper way with the

armoured forts, *i.e.*, if he brings some 100 heavy howitzers against two or three works, with the same number, hidden by the ground, to deal with the intervals, and provides them with 100 rounds per gun, if he then overwhelms the forts and intervals with the concentrated rapid fire of all his pieces, the defensive works will be put out of action within 12 hours.

The fire of the forts may be ignored, as its effect would be very small—six clearly visible armoured guns in the forts could do little against 100 hidden howitzers, and no one really imagines they could.

Even allowing, as an extreme case, that the guns, knowing the ground, could put half the howitzers out of action, the other half would meanwhile have settled them.

There would then be nothing left to oppose an assault, which would have to take place before the defender could bring up reinforcements from the reserve.

It is true the fire of the attack would not have destroyed the armour and other protection in the forts, but their garrisons would have become useless. The gunners would have been mostly killed by the splinters and air pressure, caused by the exploding high explosives, those left would have fled utterly demoralized into the casemates. But they would find no rest there, for the continual explosions shaking the work would prevent their stirring, and would make them prisoners in their places of refuge.

It is claimed that closed works ensure the retention of fire control, and of the personal influence of the commanding officer. This they do in peace manœuvres, but in war these much vaunted advantages are swept away. The acceptance of the idea of armoured forts is due simply to the fact that the destructive power of high-explosive shells is not sufficiently realized.

It must be pointed out that the above applies only to flat and hilly country, not to the Swiss mountains, where the attack would meet with great difficulties.

The experimental defences at Bucharest, Namur, etc., would have been able to withstand the fire to which they were subjected had they not been so conspicuous and so crowded together, for the majority of the shot would have been misses. The saving made in masonry would have enabled 30 cupolas to have been allotted to 4 kilomètres instead of only 6.

The result of this would have been that the defender's fire would have overmastered that of the attacker, and would have compelled him to confine himself to a blockade.

In peace fire control would be much more difficult, and the direct influence of the commander would be much less, but both fire control and direct influence would be retained over the troops told off for the battle, and they would have that advantage that the skirmishing line has over the column, namely, that they would suffer less from the enemy's fire, and hence would remain fit for action.

The Cupola Front Applied Alone to the Defence of a Fortress.

Plate I., *Fig.* 1, gives a type plan for this, the map of Metz gives its application to actual ground. A complete separation of the cupolas, artillery of position (moveable armament in open batteries), and shelters would appear to be the best way of minimizing the effect of the enemy's fire, but difficulties of command make this impossible.

A certain amount of concentration is hence necessary, and, indeed, is not harmful as long as all the means for fighting in each work are individualized.

The framework of the artillery defence is formed of 12-cm. rapid-firing howitzers, in cupolas, that can be taken to pieces, and of 5·7-cm. rapid-firing guns, also in cupolas. These cupolas are moveable, and can be grouped as desired when need arises. Their use enables us to deceive the enemy by making alterations at the last minute in works already constructed.

Where 5·3-cm. guns exist they can be substituted for the 5·7-cm. guns. It is to be observed that the same cupola takes either of these guns.

Shelters in improvised, or casemates in permanent, defences would be constructed in large numbers, and would be as scattered as possible. They would be small, never large enough to hold even a company, plentifully provided with means of exit, and would extend parallel to the lines of defence rather than at right angles to them.

The attached plans show in plan only casemates for permanent defences, but the sections show also shelters that would be used in improvised works.

In former writings I separated the shelters and cupolas more strictly than in this, but then I assumed that twice the number of guns now allowed for would be provided.

Now let us consider the components of the cupola front.

The whole scheme depends on the central cupola batteries Nos. 2, 4, 6, 8, etc.

They would be, normally, 1,500 mètres apart (in the Metz project they are from 1,000 to 2,000 mètres apart).

Their armament consists of three moveable cupola guns for use in an assault, and two cupola howitzers for the artillery battle. They also contain five shelters for the garrison of 18 men, and are surrounded by broad belts of wire entanglement.

The infantry positions closing the intervals are a little behind their line, and hold a garrison of 250 men (a company) each. The central batteries being on the crests, the infantry works would be behind them, and thus withdrawn from the artillery fire of the enemy.

The men in these are arranged as if they were a company in the open field that did not know from which side the attack was coming.

As all the ground can seldom be seen from the main position, light flanking batteries are provided in front of it. Each of these holds two moveable cupolas, and assists in barring the intervals.

A supporting cupola battery, *e.g.*, 2 R, 4 R, 6 R, is told off to each central battery, and is sited behind it. These hold one 12-cm. howitzer and two 5·7-cm. guns each. They take part in the artillery battle, and support their central battery if it be assaulted.

The artillery of position (moveable armament), which for the sake of simplicity is not shown, fills in this framework. Its positions would be mainly on the heights on which are the supporting batteries, but it would often have to go forward on to the main position, and, exceptionally, to the line of the flanking batteries. About eight of such guns would be allotted to each group of cupolas.

Behind all this is the infantry reserve, either in buildings or in shelters. On an alarm they would advance to the line of the supporting batteries, where shelter trenches would be provided for them. Thence, if feasible, they can be advanced into one of the infantry positions.

Taking a 3-kilomètre length of front, we find we have in it, instead of a single fort (or part of one, for they are often 4 to 6 kilomètres, apart)—

2 central batteries, with 4 12-cm. howitzers for the artillery battle, and 6 5·7-cm. guns for an assault.

2 flanking batteries, with 4 5·7-cm. guns for an assault.

2 supporting batteries, with 4 5·7-cm. howitzers for the artillery battle, and 4 5·7-cm. guns for the assault.

4 batteries of position, with 16 15-cm. howitzers for the artillery battle.

This gives a total of 22 howitzers for the artillery battle, and 14 guns for use against assault.

In addition we have two infantry positions with a company in each, and two companies in reserve.

The garrison of this 3 kilomètres of front is—

1. Gunners for 20 cupolas	210	men.
2. Gunners for 16 heavy guns of position ...	300	„
3. Infantry (garrisons and reserve)	1000	„
4. Share of staff and departmental troops ...	290	„
Total...	1800	men.

Of these men about $\frac{1}{3}$ are under fire, and are divided between 12 works instead of being penned up in one closed fort.

As the cupolas are 100 mètres apart they form 20 separate works; each infantry position forms three more, and the four batteries of position make up the number of scattered targets to 30 divided into 12 groups.

This cupola front complies with the principles laid down.

The place to be defended lies in the centre of the defended area, which has a radius of $7\frac{1}{2}$ kilomètres, a circumference of 45 kilomètres.

In the case of Metz the circumference is increased to 55—60 kilomètres.

There are three lines of defence, and the main position is supported by the supporting batteries behind it.

The self-dependence of the parts is ensured by the complete separation of the artillery and infantry, of the pieces in cupolas, and the pieces of position.

The offensive is neither cramped nor given too much room, for the 400-mètre intervals, while allowing enough room for the advance, are small enough to enable an attacker to be repulsed should he try to press through them.

The fire effect is very great, owing to the dispersion of the batteries, and the fire can be directed on to any point of the foreground.

The numerous rapid-firing cupola pieces increase this effect.

Cover is obtained either by making use of the ground for the howitzers and shelters, or by the provision of cupolas. Wire entanglements, well swept by fire, form the obstacles.

In *Plate* I., *Fig.* 2, a similar system closing the intervals in a ring of forts is shown. These intervals are taken as of 3 kilomètres each, should they be greater a larger number of batteries would be required. The figure shows clearly the distribution in depth of the works.

The right wing contains two cupola positions, two supporting batteries, and one work for infantry. In front of these are three flanking batteries, one before each front, one in the centre.

This arrangement could often not be carried out, as a stream, ravine, etc., may run down the centre of the interval; hence on the left wing are shown two infantry positions close together, which would in this case hold the edges of such a ravine.

This direct strengthening would only be used if there were no favourable positions to the front of the forts, or if the line of defence could not be extended. In most cases the cupola front would be advanced, as is shown in the case of Metz.

If means are limited we can make do with less, but two lines must always be retained.

Plate VI. of my pamphlet "Attack and Defence of Modern Armoured Defences" gives a sketch of defences strengthened without cupolas. In that the front line consists of covered howitzer emplacements, the second of open batteries supporting, and, if necessary, firing into them.

Now let us consider the component parts of the cupola front more in detail.

Fig. 3 of *Plate* II. shows the type plan of a *central cupola battery* on a plain. The guns are placed in front of the howitzers; they act as look-out stations for them during the artillery battle, and also in an assault they protect them from being fired at at short ranges.

On a plain parapets of a height of 2 mètres are required, the front one to give command to the guns, the rear one to cover the howitzers, while both cover shelters. On actual ground these parapets would be done away with, especially if the defences were improvised.

Sections 4, 7, 8, 9 show the method of permanent, 10, 11, 12 of improvised construction.

The moveable cupolas are advanced to the crest, the howitzers are behind them at a little distance if the ground be flat (*Fig.* 13), nearer, in order not to get too low, if the ground be hilly (*Fig.* 14).

The shape of the ground, too, influences the arrangement of the

pieces. If formed of small rounded knolls, the flank guns may have to be withdrawn to the level of the howitzers (*Fig.* 15), if it consists of terraces the centre gun may have to be retired (*Fig.* 16).

The whole battery is surrounded by a *wire entanglement* about 20 mètres broad, unless this has been already provided some hundreds of mètres to the front.

Plate III., *Figs.* 48, 49, 50, give sections showing forms of this obstacle.

The armament and garrison of this main work would be—

1 officer commanding under the section commander,
2 non-commissioned officers,
3 commanders of the howitzer cupolas,
4 men for the two howitzer cupolas,
6 men for the three gun cupolas,
3 men reserve,

or a total of 1 officer, 2 non-commissioned officers, 15 men, with two howitzers in cupolas and three guns in cupolas.

Three reliefs must be provided, and hence the battery would absorb 54 officers and men.

The fire of the *supporting cupola battery* (*Fig.* 20) behind commands the main work. The adoption of this deep distribution of the armament minimizes the effect of the enemy's fire, and makes it possible for us to draw him closer to our main position by opening the artillery battle with fire from our back lines. In an assault it enables us to sweep with our fire our foremost positions, and thus to defeat any attempt of the enemy to penetrate them.

An open battery would not carry out this task in a satisfactory manner. Only a piece in a cupola, owing to the excellent method of laying possible with it, can make certain of hitting its target at night and during fogs.

A supporting battery mounts for the artillery battle one 12-cm. howitzer, and for close defence two moveable cupolas. The profile is similar to that of the other batteries, and different methods of arranging the armament are shown in *Figs.* 21, 22.

The garrison would be—

1 officer,
1 non-commissioned officer,
1 commander of the howitzers,
2 men for howitzer cupolas,
4 men for the two gun cupolas,
1 man reserve,

or a total of 1 officer, 1 non-commissioned officer, 8 men, thus, allowing for three reliefs, 30 officers and men would be required.

The *flanking cupola battery* (*Fig.* 17) helps in closing the intervals. It should see that part of the foreground that is not fully seen from the main position, should arrest the undue advance of the enemy's batteries, and should give notice of and delay an assault. It mounts on either flank a 5·7-cm. quick-firing gun in a cupola, and contains a shelter between or behind these guns. Sections 7, 9 show the method of permanent, sections 10, 12 of improvised construction, and *Figs.* 18, 19 show different methods of arranging the work.

The garrison consists of—

1 non-commissioned officer,
4 men for 2 guns in cupolas,
2 men reserve,

giving a total of 1 non-commissioned officer and 6 men. Three reliefs thus necessitates 21 non-commissioned officers and men.

The Infantry Position.

A fortification engineer can scarcely design an infantry post that will satisfy everyone, for one school demands a closed redoubt with deep ditches, and a garrison of a battalion, while another wishes for little more than shelter trenches, garrisoned by a company.

Plate III., *Fig.* 23, proposes a middle course between those two schools.

The work shown may be divided into three parts.

Its front parapet corresponds to the faces of a redoubt, the outer flanks of the two parapets behind to the flanks, and their inner flanks to the reduit.

The garrison is a company of infantry 258 strong. The first section occupies parapet No. 1, the second the face and outer flank of No. 2, the third the face and outer flank of No. 3.

The reserve, formed of the fourth section if there is one, or if not of 20 men from each of the other sections, is concentrated at the gorge.

The separation of infantry and artillery allows their fullest development to be given to both. Nor is there any possibility of confusion as regards command, for artillery officers command the cupola works, captains of companies the infantry works.

The size of the work is fixed by the space required for the garrison of 258 men. It could be reduced by arranging the casemates so as

to stretch from front to rear, instead of from flank to flank, but to do this would be inadvisable, for such casemates, having their long sides parallel to the enemy's fire, the rectangle of which is longer than it is broad, would be more liable to be hit. Were also the entrance to such a casemate to be destroyed, the space behind would generally be unusable.

On the other hand, should a line of shallow casemates, at right angles to the direction of fire, have one portion destroyed, the remaining portions would remain fit for use. Iron girders supporting the roofs form a capital method of construction here, for they prevent a breach in the roofs extending more than a mètre or two, and the hole made forms a new entrance.

More than 20 men are never put into one casemate.

In order to completely destroy such an infantry position, it is necessary to breach 19 separate shelters. These do not lie on one level, and a separate bombardment, made very difficult by the sheltered position of the work behind the crest, is needed for each of the nine lines of shelters.

This form of work corresponds to the mode of fighting of the infantry, as, to be of any use, any form must do, for it is not the works, but the troops in them, that do the fighting.

A section is extended in front, two more somewhat retired on the flanks, one on each, while the fourth in the centre forms the reserve. This arrangement suffices for a company in the open, for they can change their front in order to meet a flank attack.

Works cannot do this, and hence they must be arranged so as to meet this difficulty. In *Fig.* 23 three lines of parapets face the front, namely, the centre portions of 1, 2, and 3, three face to the right, namely, the right flanks of these, while the three left flanks face to the left. The inner flanks of 1 and 2 would form the reserve position should the work be broken into.

This arrangement ensures that even the loss of one of the component parts of the position would not destroy entirely its power of resistance.

The entrance is covered by the fire from the guard casemates in the outer flanks of 1 and 2, and also by the fire from the piece of parapet across it.

2 and 3 face slightly outwards to prevent their occupants firing into No. 1, in case of a frontal attack at night. Red lanterns on its flanks would also be used to mark out the position of the foremost parapet.

Each of these parapets is 120 mètres long, *i.e.*, the length a section occupies in skirmishing order. The whole position provides 300 to 400 mètres of parapet, which gives sufficient room for two supporting companies coming up from the rear to occupy it, the men being in closed order.

This amount of room is, however, necessary, in order to allow the garrisoning company full freedom of movement, for all the 2nd section, for instance, may have to occupy the outer flank of No. 2 work only, in order to meet a flank attack frontally.

The 20-mètre wide wire entanglement ensures delay in storming the position, and this delay, at a distance most favourable for the effect of the fire of the 240 rifles in the work, will result in the storming columns being beaten off.

The arrival of supporting companies would certainly give much assistance, but their help is not essential.

One such company is reckoned for each work, but they would be kept together in groups of two to four, so that most of the positions would have to defend themselves with their garrisons only.

The above arrangement allows this to be done, for each work fires in three directions, and thus they support each other.

Fig. 23 shows the type plan.

Figs. 24 to 27 elevations.

Figs. 28 and 29 sections of different profiles, *Fig.* 28 being shown enlarged in *Fig.* 30, *Fig.* 29 in *Fig.* 33.

Figs. 30 to 39 show various positions suited for both level (*Figs.* 30 to 34) and hilly ground, and for permanent, provisional or improvised defences.

Permanent fortifications are such as can be made in peace time. A permanent cupola front would have its cupola positions, its casemates for the gunners, and its infantry positions of this class.

Provisional fortifications are such as would be made when war threatened. The cupola front will play a great part in these, for now that the old ideas—high walls and deep ditches—have died out, it will enable selected positions to be fortified at the most rapid rate possible.

Improvised fortifications are such as would be made when the time available was a minimum.

They would be required for the defence of positions unexpectedly requiring it, either in our own country or in that of the enemy.

Where the necessary stores and materials are to hand the cupola defence could be completed in a few days.

The defender would always have an advantage in point of time over the attacker, who would have to improvise everything, and that mostly under fire.

The infantry position has been gone into more fully than were the cupola batteries, because the latter have already been dealt with in my former paper—"Attack and Defence of Modern Armoured Defences."

* * * *

N.B.—A detailed explanation of the various figures given on *Plate* III. is here omitted.

* * * *

Artillery of position (moveable armament) is essential for carrying out the artillery fight. It includes the heavy ordnance, especially 15-cm. howitzers, and covers itself by making use of the ground.

Cupolas are not provided for it, for they would be too expensive, nor could they be taken to pieces and moved. Its mobility is retained if it be left unfettered, and then it can be used to strengthen that section on which the main attack is taking place by inserting it between the supporting cupola batteries, thus making the threatened front impenetrable.

The reserve infantry is camped or quartered to the rear; at times it may be necessary to provide shelters for it.

It is not on the spot to join in the fight at its commencement, but is near enough to get to it in time to assist when it is required.

The Distribution of Duties.

We now know where and in what strength our troops are to be found.

The artillery is on duty in the cupolas with three reliefs, and in the batteries of position with two reliefs. As a rule, they are on duty for 24 hours at a time, but during that time most of them are in the shelters, only a few look-outs being left on the watch.

An officer with four subordinates commands each central battery, another with two subordinates each supporting battery, non-commissioned officers the flanking batteries.

The first two of these classes of works are connected to each other and to the section commander by telephone. After the fight has well begun this connection will be of no use, and recourse must be had to orderlies or dogs. If all means of communicating orders

fails, there remains always the officer in the work to act on his own responsibility.

The second and third artillery reliefs are camped behind, and are occupied in preparing stores and ammunition.

The infantry detailed as garrisons will remain, as a rule, in their works for the whole of the siege. Should a work suffer much from fire, or should epidemic disease break out among its garrison, it would be abandoned, and its place taken by an improvised work built near it.

The company, after spending the night in its work, would be marched, when it was broad daylight, towards the interior of the fortress, leaving a guard of 20 men behind. They would not go further than 2 kilomètres, so that there would be time to recall them should the enemy advance.

Sufficient notice would be given, for the fully-manned cupola batteries lie nearer to the enemy than do the infantry positions.

In foggy weather the company would remain in its position.

Whatever happens during an attack a garrison never leaves its work, even though it is not attacked and sees a chance of helping some other hard-pressed work. Any help necessary must be given by the reserve companies. These spend the night in their quarters, and the day in exercising or on working parties.

Hence no cooking is, as a rule, done in the positions for the infantry. They eat their dinners, at any rate in fine weather, in the open, behind the supporting line.

The cavalry are camped inside the fortress. Their work is mainly to provide patrols, orderlies, etc.

The engineers carry out their multifarious duties, with the assistance of civil workmen and of infantry working parties.

The medical department enrols women of the place as nurses.

The commissariat, guarded and led by cavalry, collect provisions from the neighbourhood. They draw on the artillery trains to complete the number of their wagons.

The Defence of the Cupola Front.

In fortress warfare the artillery plays the chief part. It conducts the artillery battle, and is the most important factor when an assault takes place. The infantry plays the minor part of supporting the artillery. Their patrols watch the ground in front, and they assist in opposing an assault. During a sortie, however, their

importance becomes much greater. The cavalry during the artillery battle provides orderlies, and should an assault take place they become the reserve of the third line. But during a sortie they play the important part that they do with a field army.

The engineers during the artillery battle attend to the field railways, which bring up ammunition, and to the telegraphic communications. During an assault they serve the mines and the electric lights.

We will now examine in more detail the proceedings of the two most important bodies—artillery and infantry.

The Artillery Battle.—When the place has been shut in, the back line of supporting batteries comes especially into play. Its fire has to disturb the attacker while he is entrenching himself, to deceive him as to the position of the inconspicuous cupola front, and to entice him nearer to the main works.

As soon as matters become a bit clear the main position comes into action, backed up by the fire from the supporting line and batteries of position. The method to be used is the massed fire of the guns on to portions of the country.

Every gun that can effectively bear on the target takes part, not omitting the light guns. It would be foolish to reserve these latter strictly for repelling an assault which may never take place, and hence they are sited on the crests. Rapid fire, never slow, is used for them, with the same expenditure of ammunition ; the pauses for laying the guns can be made longer.

This firing in mass is intended to overwhelm the attacker.

It is not accurately known where he is, but it is known that, for instance, he has brought numerous howitzers during the night behind the western slopes of Gravelotte. The only way of getting any result, if his batteries cannot be seen, is to cover the slopes with a hail of rapidly-fired projectiles from, say, 100 guns. It would only last a minute, but the effect would be great. The batteries would be silent, for the men in them would be annihilated.

True, the attacker would adopt the same tactics in order to make it impossible to hold the cupolas for any length of time, but he would be under the disadvantage that his shell splinters could not penetrate the cupolas, and that his ammunition supply would not be as effective as that of the besieged, who have their ammunition under the cupolas. For in the cupola front everything was provided for when it was armed, and it can quietly await whatever may turn up.

The defenders of an advanced line of forts do not know at which

of the open intervals their reserve will have to be employed ; those of the cupola front have not this uncertainty to dread. For in this system there is no pushing forward of reserves during the artillery battle, nor, indeed, till it is clearly seen where the main attack will fall. Then the besieged, fighting still on his original line, strengthens the hard-pressed sections by bringing to their help half the moveable cupolas and artillery of position from the sections that are not seriously threatened. He thus doubles his fire at the vital points, and multiplies his chances of beating off the attack.

If the defence is successful, the attacker can bring up reinforcements till finally he has destroyed so many cupolas and shelters that the foremost lines of the defence are untenable. The besieger then clears out of them, leaving only the immoveable howitzer cupolas behind. With the remainder of the armament he forms a new front where his reserve batteries were, and behind it his infantry construct a new supporting line.

From this new front he fights the attack again on ground known to him, unknown to it. If he does not succeed in beating the attacking artillery from here, nothing remains but to retire to the enceinte, and next to the other bank of the river, whence he would begin the fight over again as he did formerly from the citadel.

The attack, however, would require enormous resources to get such a result in face of the massed fire of the fortress artillery, and if the defender properly understands how to use the resources given him by the scheme put forward, he will beat off the artillery attack on the day it commences.

To do this guns are essential. Concrete and armour are only means of warding off blows, and their use is only justified so far as is absolutely necessary for the protection of guns and carriages, men and ammunition.

The Assault.—Directly the advanced flanking batteries remark the enemy approaching, they give the alarm and open fire on the assaulting columns. The cupola and infantry positions of the main line pass the alarm on, and stand to their arms. The cupola guns fire on to the intervals where they see a dark mass. The cupola howitzers, if ordered by the commanding officer (who only gives the order if he is certain that the assault is being made on his work), throw their shell to the front.

This is the first stage, and, if the assault be detected early, it would be beaten off generally then.

Were the defences surprised, many of the advanced batteries would

be lost, and the main line would give the first alarm. The attacker would then press on to the cupola positions, and would try to penetrate the intervals between them. But once he has crossed the ridge he finds himself under the fire of the infantry from their works.

He would try and take them, but he would be brought up by the wire entanglement, and the heavy fire under which he would be would frustrate his turning movement.

Meanwhile others of his columns might have penetrated through the shattered obstacles into an artillery position, and would be attempting to take the cupolas. They would be driven out by the splinters of high-explosive shell bursting over them, and fused to act as shrapnel. These shell would come from the supporting battery detailed to that artillery position. That would be the second check the attacker would meet with in attempting to gain his object.

Supposing, however, that he succeeded in penetrating some front that had been much damaged by his artillery fire, and that he captured some of the infantry and artillery positions.

This would not decide the fight, for the supporting batteries and the advancing fresh infantry and cavalry of the defence would still oppose him. The fire from the batteries of position, and the explosions of land mines, would support this resistance.

Thus the apparently victorious attack would meet with a third check, and the slightest wavering now would cost him his dearly-bought successes.

But even if he succeeds in sweeping away this opposition, he has not yet assured himself of success. He has, it is true, made a gap through the ring of forts, but this gap is swept by deadly cross-fire from the works at its sides, and unless he succeeds in rolling up the whole front, he will be driven from the ground he has captured.

There are thus four phases of the assault, four moments at which the enemy's advance is checked, and at which he sustains enormous losses. Owing to the depth of the defence there are considerable spaces of time between them, during which the attack is under the fire of the defence.

No other system of defence puts such tremendous obstacles in the way of the attacker, or compels him to take three lines, one after the other, before he can even maintain himself in the one first line.

Such are the general lines of the artillery battle and of the assault as they were discussed in detail in "The Attack and Defence of Modern Armoured Defences."

So far no criticism has been able to gainsay them.

CHAPTER III.

The Application of the Detached Cupola Front to Metz.

The radius of the fortress must be increased to 8 to 10 kilomètres, so that its centre, containing the town, the large store magazine and the camp of the reserve, may be protected from bombardment, and also in order that further resistance may be made should one front be destroyed or captured.

The fact that the battlefields of the 14th, 18th, and 31st August, 1870, and the ground connecting them, form a very strong position, tends to reconcile us to the increase.

This extension also makes a siege more difficult, for the enemy's lines will have to be about 80 kilomètres long, instead of the 50 kilomètres they would have to be at present.

The new ring of defences is divided into three great sections:—

1. The west front, on the left bank of the Moselle.
2. The south front, between the Moselle and the Seille.
3. The east front, from the right bank of the Seille and that of the Moselle.

In the map, in order to be able to make proper use of the positions for permament or provisional (prepared beforehand) defences, the woods on the heights are shown as cut down, and hence the map does not show the actual state of the country. With improvised defences, when such a preparation of the ground could not be made, other fronts would have to be chosen closer to the present forts, and then only single groups of cupolas could be pushed forward here and there on to the positions shown in the map. The size of a fortress thus defended will be further considered in the next chapter.

The West Front.

This includes the heights of Saulny and Rozerieulles. It stretches from the ferry at Malroy to the bridge at Ars, and has a length, measured along the curve, of 26 kilomètres.

There are told off for its defence—

17 central batteries, with 34 howitzers in cupolas, and 51 guns in cupolas.

17 supporting batteries, with 17 howitzers in cupolas, and 34 guns in cupolas.

22 flanking batteries, with 50 guns in cupolas (see below, S.W. section).

34 batteries of position, with 136 pieces in open batteries altogether.

Altogether, 51 12-cm. howitzers, 135 5·7-guns, and 136 15-cm. pieces; also 20 infantry positions, with 20 companies garrisoning them, and 24 companies in reserve.

That is to say, the armament and garrison consists of 90 batteries with 330 pieces, and 20 infantry positions with 11 battalions.

The grouping of the artillery and infantry positions is not as regular as is shown on the type (*Plate* I.).

In some places the flanking batteries are directly in front of the main works, in others between them. Often two of the artillery or infantry positions are next to each other. Here and there a supporting battery is found on the same height as the main work next it, or, in a few cases, with an infantry position behind it. These arrangements are necessitated by the features of the ground.

In order to simplify command, the front is divided into sections, and the latter into groups that comprise single battery and infantry positions.

The west front is split up into the north-west section (from the Moselle up to and including the Metz-Saulny-St. Privat road) the west section (from south of the St. Privat road to north of the Gravelotte road), and the south-west section (from the Gravelotte road to the Moselle).

Infantry positions and supporting batteries tie these sections together so that they are not clearly defined on the plan. The subdivision of the front is, however, essential for purposes of command.

The North-West Section comprises cupola positions Nos. 2, 4, 6, 8, 10, 12, with the similarly numbered supporting batteries, and six advanced posts, also infantry positions Nos. 1, 3, 5, 7, 9, 11, and the seven companies of the reserve belonging to them.

The plain of the Moselle has no main artillery positions allotted to it. It forms a gap watched by a few moveable cupolas and some infantry. This was so arranged designedly, for battery No. 2 is 20 mètres, No. 4 40 mètres, No. 6 80 mètres above the plain, which is

also commanded by the high positions on the right bank of the river. Hence an attack at this point would at once be beaten back, and is out of the question. This enables us the more to strengthen the heights of Feves and Saulny, in order to co-operate with the west section against the St. Privat road.

For this reason the majority of the supporting batteries are pushed to the left on to the all-commanding heights near Plesnois (380 mètres). The supporting line there has all the advantages of a main position.

The sub-division of the sections into groups has been mentioned above.

This sub-division is not so distinct as is that of the fortress into fronts separated by rivers, nor have the group commanders their batteries so entirely at their own disposal as have the commanders of fronts. For the grouping of the parts for the artillery battle may be different from that required when an assault has to be met.

It is all very well in a type plan (*Plate* I., *Fig.* 1) to have permanent groupings, but they break down when applied to actual ground. In this case works that are close together necessarily come under the same command. Thus the batteries 8 R, 10 R, 14 R, 16 R are in a position to fire, as a rule, on the same objective, and hence though they do not even belong to the same section, they would be put for the artillery battle under a superior officer. During an assault, however, they would fire towards the main batteries with similar numbers, and in this case their fire would be divergent.

It might be said that it would be better to transfer 14 R and 16 R, or to alter the boundaries of the sections, but there is no reason to do this, for this temporary placing of batteries belonging to different sections under a single command would not stand in the way of the section commanders in carrying out their duties. They would know beforehand what guns, during the different phases of the attack, would be under their orders.

If Nos. 14 and 16 batteries were given to the north-west section, the west section would not be able to use them against an attack from the direction of Verneville, and hence its power of resistance, which should be as great as possible against such an attack, would be reduced.

Batteries Nos. 2 and 4, as also Nos. 8 and 10, are grouped together, while No. 6 would be told off to one or the other of these groups according to circumstances. Similarly No. 12 would belong

sometimes to the Nos. 8 and 10 group, sometimes to the Nos. 14 and 16 group.

Of the infantry positions, 1 and 3, with the two companies in reserve for them, would be under their battalion commander, No. 5, with its company in reserve, would make up a half-battalion. Nos. 7 and 9, with two companies in reserve, would also make up a full battalion, while No. 11, with two companies, would again make up a small battalion.

The regimental commander is not, however, precluded from dealing otherwise with the companies of his four battalions that are in reserve.

A more detailed description seems unnecessary, as the map explains itself.

It is willingly admitted that different arrangements from the above might well be made, but care must be taken that the chosen arrangements will enable this front to solve its battle problem.

The West Section comprises the cupola positions Nos. 14, 16, 18, 20, 22, 24, the supporting batteries similarly numbered, and six advanced posts; also the infantry positions 13, 15, 17, 19, 21, 23, and nine companies in reserve.

The type plan in *Plate* I., *Fig.* 1, is closely adhered to, at any rate as far as it concerns the lines of cupola batteries, but the companies in reserve are more to the front than in the type. These could not be placed in line with the supporting batteries, and if retired behind them they would be too far from their fighting line. Hence they are advanced, and the ground, which furnishes good cover for them, favours this being done.

The excellent lie of the ground behind this section—the Plappeville plateau—gives it great strength. For on the plateau there is abundant room for the artillery of position to deploy in positions that mostly command the ground in front.

The deep valley of the Montveau furnishes capital sites on its hidden slopes for the shelters of the left wing. The whole west front of Metz is particularly favourable to the defence in this respect.

For the artillery battle the works Nos. 14 and 16, 18 and 20, 22 and 24 are grouped together, and these groups support each other.

As regards the infantry positions Nos. 13 and 13 R, 15 and 15 R, 17 and 17 R, each contain a battalion of three companies, No. 19 has one reserve company, No. 21 has no reserve, but it, with Nos. 23 and 23 R, contains a battalion.

The companies in reserve for Nos. 15, 17, and 19 could also be massed together if desired.

The companies in reserve on this section are, as a rule, accommodated in shelters, as there are few houses. If the main attack is made here, the Chatel St. Germain would become useless for shelter purposes, and the companies in reserve there would move to the sheltered slope north of Lessy.

The cupola front has the advantage of mobility over every other system of fortification. Should an alteration of the site of a work appear desirable during the fighting, it can be carried out. New foundations are required for the moveable cupolas, and as soon as these are provided they can be put on them, and are then ready to fight. The guns of position are, it is true, more easy to move about, but then they have not armour protection. When they are moved the platforms must be shifted. This can easily be done, as the battery takes position behind the crest instead of on it, as do the moveable cupolas.

The infantry, too, can be moved, though they cannot take their concrete shelters with them. Instead of these, they construct for themselves improvised shelters with shelter trenches close by.

The howitzers in cupolas alone of all the components of the cupola front cannot be moved while fighting is going on, for under fire they cannot be dismounted, moved about, and set up again. Their sitting can, however, be altered before or after the artillery battle, should such re-sitting for any reason be desirable.

None of these alterations can be carried out in the case of an armoured fort.

The South-West Section behind the ravine of the Mance comprises cupola positions Nos. 26, 28, 30, 32, 34, the supporting batteries attached to them, and nine separate flanking batteries; also infantry positions Nos. 25, 27, 29, 31, 33, 35, 37, 39, and eight companies in reserve.

The type of a cupola front is not adhered to in this section, for here infantry positions are pushed, in opposition to the principles on which the type was designed, into the front line.

The Mance ravine necessitates this exceptional treatment, for it is, as it were, a fort ditch naturally provided for the Rozerieulles plateau, and as such it requires independent defence. This plateau, like Mont St. Quentin for the existing defences, is one of the most important features in the proposed cupola front. On the whole west front the height of Plesnois (380 mètres) alone equals it in impor-

tance, and hence the old school of engineers would have guarded these two points with groups of forts, and would have neglected as subsidiary all the intermediate ground. This would not be correct, for a commanding point is only properly fortified when its foreground, its flanks, and its communications to the rear are made thoroughly secure.

The western slopes of the Mance ravine must be made into a counterscarp. They should be made impassable, for sorties will not take place here, but at other points better fitted naturally for the purpose. All the trees on these slopes would be cut down, leaving on their lower portions stumps a few feet high, and an impenetrable obstacle about 50 paces wide would be made along the stream with the help of wire entanglements. For its defence are told off four infantry positions, a company in reserve, and 20 moveable cupolas. These latter lie along the length of the obstacle, and in places are within the infantry positions. This is against the principle of radically separating infantry and artillery, but it must be remembered that in this case both have the same task to fulfil, namely, only to oppose an assault.

The Mance ravine garrison will suffer but little from hostile fire. Behind them are four cupola batteries which have a command of some 20 mètres over the enemy's position. The broad plateau, too, in contradistinction to the narrow St. Quentin plateau, to which we likened it above, has the great advantage of favouring the deployment of the artillery.

But, some may say, what is the good of all this if the plateau lies exposed to assault should the Mance ravine be stormed? Well, that matter may be left to the cupola batteries. Should the Mance ravine, in spite of the difficulties in the way, be captured, why then the assault would have to begin afresh. The works on the heights have their own obstacles, the fire from their own guns, and are backed by their supporting batteries. They will in their own strength beat off the attack. That done, their howitzers will drive the enemy out of the ravine, and will enable it to be re-occupied by the reserve.

It is again freely admitted that the plateau could be otherwise defended. Thus, for instance, the ravine could be neglected, and a broad impassable obstacle constructed 300 to 400 mètres in front of the main works, thus enabling one battalion and 20 moveable cupolas to be reduced. The enemy's descent into the ravine would still be difficult, because his line of approach from the heights of

Gravelotte would be seen, and at night would be lit up by the defence.

The first-mentioned method of defence is preferred.

Something else should be noted in this south-west section, namely, the detached post on the Gorgimont plateau which forms the bridge-head of Ars. This battery (No. 34) is well connected with the main front, as it merely fills in a re-entering angle corner. Weak though this may appear, yet an attack on No. 34 would benefit the besieged a great deal, both by using up the attacker's ammunition, and by causing him to suffer great losses, when he assaults, from the cross-fire of the lines behind.

Even if captured, no harm could be done, as the enemy could not maintain himself there any length of time under the fire of batteries Nos. 28, 30, 32, 36, 38, 40. For the artillery battle works Nos. 26, 28, 26 R, 28 R, and also Nos. 30, 32, 30 R, 32 R, with their intermediate batteries (batteries of position) are put under one command, while work No. 34 is independent.

Work No. 25, with three companies and reserve, makes up a battalion, No. 27, with two, another. Works Nos. 29 and 31, with two companies in reserve between them, make up a third battalion, and works Nos. 33, 35, 37, 39, with only one reserve company, make up a fourth.

The South Front.

This includes the heights of St. Blaise, and, stretching from Iony-aux-Arches to Haut Rive, on the Seille, has a length, on the curve, of seven kilomètres.

There are told off for its defence—

6 central batteries, with 12 howitzers and 18 guns, all in cupolas.
6 supporting batteries, with 6 howitzers and 12 guns, all in cupolas.
5 flanking batteries, with 10 guns in cupolas.
12 batteries of position, with 48 pieces.

Altogether—18 12-cm. howitzers, 40 5·7-cm. guns, and 48 15 cm. pieces.

Also six infantry positions, with six garrisoning companies, and six more in reserve, that is to say, the armament and garrison consists of 29 batteries with 106 pieces, and six infantry positions with three battalions.

Owing to its short length, it is not necessary to divide this front up into sections, but the works are grouped together as in the western sections.

Of these groups the cupola positions Nos. 38, 40, 42, 40 R, 42 R form one, supported on the right by the group formed from Nos. 36, 36 R, 38 R, and on the left by groups 44, 46. A reduit, to meet the case of a successful assault on the heights, is formed by the supporting batteries 34 R, 44 R, 46 R.

The infantry consists of three normal battalions, of which one garrisons positions Nos. 41 and 43, with two companies in reserve that could support No. 45; another garrisons Nos. 45, 47, 49, 51; while the third remains in the wood of Orly as a general reserve.

The south front is about 10 kilomètres from the cathedral, and 5 from Fort Prinz August von Wurtemberg. This is rather far, but cannot be helped, for the St. Blaise heights, on which the only good southern position can be made, must be held, and must be included in the cupola front, if only to cover the left flank of the plateau of Rozerieulles. They provide the attack on the present forts with a menacing position, from whence the interior of the fortress can be clearly seen. This front, too, differs considerably from the type in *Plate* I., *Fig.* 1.

The infantry positions in the centre are well retired, even to behind the supporting batteries, while on the right the cupolas and infantry are massed together. This is necessary, for, should an assault succeed, the northern knoll of the St. Blaise heights would form the final position whence the capture of the whole front could be prevented, and the re-capture of the lost portions facilitated. Hence the general reserve for the front is placed there. The left wing may be weaker held, as it is supported by the front in rear.

It may be noticed by someone that the batteries Nos. 38, 40, 42 are not on the knolls, but use them only as traverses against enfilading fire. That is so arranged because it is considered that in the great majority of cases, when a small isolated knoll has to be defended, its defence will be best undertaken from the side slopes, the knoll itself being used as a look-out place.

Some groups of sham cupolas placed on the highest spots would draw a lot of the enemy's fire, and thus reduce his available ammunition for the attack on the real works.

The East Front.

This includes the neighbourhood of the plateau of St. Barbe. It has, from Pouilly on the Seille to Malroy on the Moselle, a length

on the curve (not counting the projection towards St. Barbe) of 22 kilomètres.

There are told off for its defence (including the advanced position of St. Barbe)—

20 central batteries, with 40 howitzers and 60 guns, all in cupolas.

21 supporting batteries, with 21 howitzers and 42 guns, all in cupolas.

34 batteries of position, with 136 pieces.

Altogether—61 12-cm. howitzers, 145 5·7-cm. guns, and 136 15-cm. pieces.

Also 18 infantry positions garrisoned by 18 companies, with 22 companies in reserve, that is to say, the armament and garrison consists of 94 batteries with 342 pieces, and 18 infantry positions with 10 battalions.

The east front is divided into the south-east section (from the Seille up to and including the Courcelles-Metz road), the east section (northwards of the Ars-Laquenexy up to and including Noineville), the north-east section (from Servigny to Malroy on the Moselle, and the detached position of St. Barbe, with its front on the line Cheuby-Avancy).

The South-East Section contains the cupola positions Nos. 48, 50, 52, 54, 56, 58, 60, 62, the similarly numbered supporting batteries, and 10 advanced posts; also infantry positions Nos. 53, 55, 57, 59, 61, 63, 65, with six companies in reserve.

It forms, as do other sections, the advanced fighting front of the fort (in this case Goeben) that lies behind it. But what a difference there is between the tactical efficiency of the column-shaped fort and the batteries arranged like troops fighting in the open.

The foremost lines might be destroyed by the enemy's fire, so that they could not be directly held by the defence, and yet the section would not be broken through. For the supporting line still stands, and from it the attacker would be opposed when trying to take possession of the lines his guns have silenced. Should he succeed in overcoming this resistance, he would find that the defence had utilized the delay to form, with the help of his moveable armament and his infantry, another supporting line further back.

In this section this line would be sited as follows. On the right wing to support Nos. 48 R and 50 R on the hill marked 186; to support Nos. 52 R and 54 R, on the particularly suitable line Magny-Bevoye that would already be being made use of by the moveable armament. The south side of Magny village would be

made into a supporting point by the infantry. The fort would serve as second line for Nos. 56 R and 58 R, and Borny wood for No. 62 R. Grigy village would be made defensible by the infantry, who would remain, as also those at Magny wood, in shelters outside the village, but ready to take post in their fighting positions.

With the old system of forts and intermediate batteries, if one fort with its subsidiary works were destroyed, then a hole would have been punched through the defence—a hole, too, that could not be stopped up as quickly as it could be if it were made in a cupola front. For this latter, through its supporting batteries, provides beforehand for the loss of one of its members.

Were this section defended on Brialmont's system, two armoured forts would be constructed in it. One of these would be on Haut Guenot (219 mètres), the other on the Mercy height (251 mètres), and they would form two targets for the attack to concentrate its fire on.

The intermediate batteries are not taken into account, for provision is also made for them, under the name of batteries for artillery of position (moveable armament), in the cupola front.

On the other hand, with this section defended with a cupola front, the cupola batteries would form 26 targets, and the infantry (counting each collection of companies in reserve as one target) would form nine more.

The fire of the attack would be dispersed over all these small targets instead of being concentrated on two large ones—much to the advantage of the cupola-front system.

To facilitate command in this section, groups would be formed of batteries Nos. 48 and 50, of Nos. 52 and 54, of Nos. 56 and 58, and of Nos. 60 and 62, and included in each group would be the supporting batteries and advanced batteries told off to its component parts.

The East Section contains cupola batteries Nos. 64, 66, 68, 70, 72, the similarly numbered supporting batteries, and three advanced posts; also infantry positions Nos. 67, 69, 71, 73, 75, with eight companies in reserve.

The ground in this section is very different from that already investigated. Up till now the positions chosen commanded their foregrounds, but here the reverse is the case, the ground rising steadily towards the enemy for 5 kilomètres. This, as we shall see hereafter, has led to the placing of a special detached group of defences at the highest point of the plateau, near St. Barbe. On examining the matter more in detail, however, we see that the

disadvantages to the defence are not as great as they appear at first sight.

We should be badly off indeed if we held a position that was separated by a valley from a higher one, say 2 kilomètres away, whence we could be looked into. But here it is not so. The foreground of the eastern section is not intersected by valleys parallel to our front, the slopes of which, that would be turned away from us, would give first-rate cover to the attack. On the contrary, the valleys are perpendicular to the front of defence, and can be seen into by the batteries. The ground also does not rise steeply, but gently, say 1 mètre (or often only $\frac{1}{2}$ mètre) in 100 mètres. That is to say it is not a line of hills, but a gradually ascending plain that rises up before us, and this is only intersected with cross valleys 4 to 6 mètres away in the neighbourhood of Glattigny Sellers-Colligny.

It is hence easier for the defender to see the attacker, when he approaches within two or three kilomètres of the defences, than for the latter to see the groups of cupolas which have been sunk into the ground beforehand. Besides, there are great difficulties in concealing works on ground falling to the front, for there is no reverse slope down which to throw the excavated earth, while, if it be utilized for parapets, these will serve to clearly define the works from the country on which they stand.

The east section has also a capital position for infantry defence on the Vallieres river, with a good reserve line on its left bank, as well as a strong position on Belle-Croix hill for the artillery of position.

For the artillery battle batteries Nos. 64 and 66 are grouped together, also Nos. 70 and 72, and again Nos. 64 R, 66 R, 68 R, and 70 R. No. 68 connects the front groups, and 72 R links this section with the one next it.

The north-east section includes cupola positions Nos. 74, 76, 78, 80, with the similarly-numbered supporting batteries, and three advanced posts on the left wing. Also infantry positions Nos. 77, 79, 81, with three companies in reserve.

Should the St. Barbe advanced position be captured, or not be occupied, it would be necessary to strengthen the right wing also with some flanking batteries.

A division into two groups suffices here for the artillery battle, and these would obviously be formed one by the higher batteries Nos. 74, 76, 74 R, 76 R, the other by the lower ones, Nos. 78, 80, 78 R, 80 R.

The ridge near No. 76 R, and Grimont wood, with Fort Manteuffel,

form a strong position within this north-east section. On the right it is well connected with the east section, and its left rests on the Moselle. Here the edge of the valley commands the other bank throughout (by 30 mètres at 80 R). Hence it was judicious to treat the valley of the Moselle here as an open interval, it being swept by the fire from Nos. 80, 80 R, 2, 2 R, 4, 4 R, 6, 6 R.

The infantry of this section consists of two 3-company battalions, one of which garrisons the three infantry positions, the other forming the reserve.

It must be remarked here that the garrison is not intended to be divided into battalions containing a varying number of companies.

The total line of defence, nearly 60 kilomètres long, takes 24 normal battalions, but the importance of all the sections, or of all the groups therein, is not equal, hence more garrison and reserve companies are required at one spot than at another. This could not be adjusted by detailing whole battalions to one place and several to others, for the battalions would be all used up before we had completed the round of the defensive line.

Hence our garrisons are told off by companies, not by battalions.

As section reserves we give as many companies as appear necessary, and, where possible, as we have shown repeatedly in the distribution already detailed, the battalion remains under the command of its chief. The number of different groups of the reserve could certainly have been reduced till they tallied with the number of battalions available, but then someone would have come forward to demand that regiments should be grouped together.

Let us see what the infantry of the reserve has to do. When fighting in the open field they are united, so that they can be used to strike an offensive blow in a definite direction. But on a prepared line of defence they are required to ward off an assault on some unknown point or points along a line of say 60 kilomètres. Hence the defence must have at least a small reserve ready and close to every point. Strong reserves are very good if the assault happens to take place near where they are, but if they have a long way to go to get to the point attacked they are useless. Thus having a concentrated regimental reserve would not do, for then there would be only one such in every 12 kilomètres. A battalion reserve is what has been aimed at, but when this was not found possible for want of troops, three, two, or even one company has been made to do. The map shows clearly their camping places and fighting posts near the supporting batteries. Arrows show towards what works the battalion com-

mander would lead his companies should he think it necessary, but it is not held that they could always get into the works indicated, for, on account of the distance, they would often find they had no time to do so.

Hence even the infantry positions that are sheltered have been given a closed obstacle right round them, so that they can, if necessary, make do with only the company garrisoning them ; they must, however, be prepared with the room if required for the reserve.

Where a 3-company battalion is mentioned it is to be understood hat the fourth company has been detached either independently to garrison a position, or as a fifth company for some neighbouring battalion.

In the south-east and east sections 3-company battalions are formed, one of the companies in positions Nos. 53, 55, 57, one of the reserve companies at Magny, and a third of these at Grigy.

Four-company battalions are formed one in positions Nos. 59, 61, 63, 65, one of the reserves in Colombey wood, and one of those at Vantoux.

One 5-company battalion is formed from the companies in works Nos. 67, 69, 71, 73, 75.

The Detached Front of St. Barbe includes cupola positions Nos. 82, 84, 86, their similarly numbered supporting batteries, also No. 88 R and five flanking batteries. Infantry positions Nos. 83, 85, 87, with five companies in reserve, are also included in it.

Measuring from battery No. 84, it lies 12 kilomètres from the Cathedral, 5 kilomètres from the cupola front. It is on the highest point of the plateau, and sees northwards and southwards into the lines of the attack. There is something to be said both for and against such advanced posts. They prevent the attack from proceeding at once against the main front, give the fortress a desirable extension and a view of the enemy's positions, while they also stop him from overlooking the defence. But, on the other hand, they entail splitting up the power of the defence, they are, as they can be surrounded, difficult to defend, and may easily be captured, their loss then having a demoralizing effect on the garrison of the fortress. Still, a detached front here is recommended. Battery No. 34 (west front) is such, but under conditions that preclude the worst evil that can befall it, viz., being surrounded by the enemy, from occurring.

A single battery at St. Barbe would be no good, for it would be in the air, and on the enemy's first appearance it, as would also an isolated armoured fort, would be cut off from the fortress. Hence a

strong front is shown here, consisting of the three cupola positions Nos. 82, 84, 86, and their intermediate works, with supporting works in rear, and very favourably placed wings connecting it with the main front. Without these wings, that make the width of the position 4 kilomètres, there would be no secure connection with Fort Manteuffel.

But the defence of the front behind has not been neglected because of this. Should the St. Barbe batteries be lost, cupola positions Nos. 74, 76, directly in their rear, will have to be dealt with. A concentrated attack on the detached position will also be much impeded by the fire of the batteries that flank it, Nos. 70 and 72 on the right, Nos. 78, 80 on the left.

The three central batteries, with the works supporting them, will be placed under one command for the purposes of the artillery battle, and the wing batteries work independently.

The infantry consists of two battalions, that garrison three positions and retain five companies in reserve close to, but outside them.

In case of an assault, the infantry positions Nos. 83 and 87 would thus each be defended by three companies, and No. 85 by two companies.

General View of the Whole Line of Defence.

The cupola front of Metz runs from Malroy on the Moselle to the heights of Fèves and Saulny, crosses the Montveau valley, south of Amanweiler, and includes the plateau of Rozerieulles and the Moselle crossings at Ars. Thence it climbs the heights of St. Blaize, then descends to Cuvry on the Seille, and proceeds, utilizing the folds of the ground at Magny and Peltre, to Mercy-le-Haut. Thence it runs across the Vallière to Villers l'Orme, and then, while stretching feelers well forward towards the St. Barbe plateau, it bends backwards, and regains the Moselle at Malroy.

Its length is 55 kilomètres, or, including the detached position at St. Barbe, 60 kilomètres.

The artillery told off for its defence is—

1. West front, 51 howitzers, and 135 guns in cupolas, with 136 pieces in open batteries.

2. South front, 18 howitzers and 40 guns in cupolas, with 48 pieces in open batteries.

3. East front, 61 howitzers and 145 guns in cupolas, with 136 pieces in open batteries.

Giving a total of 130 howitzers and 320 guns in cupolas, and 320 pieces (artillery of position) in open batteries.

These 770 pieces are mounted in 43 central batteries containing five cupolas each, 44 supporting batteries containing three each, 48 flanking batteries containing two each, and some 80 batteries of position mounting about four pieces each.

The infantry told off is—

1. West front, 20 positions with 11 battalions.
2. South front, 6 positions with 3 battalions.
3. East front, 18 positions with 10 battalions.

Altogether—44 positions with 24 battalions—11 of which garrison the works, the other 13 being in reserve.

In Chapter II. we have seen that a central battery with three reliefs requires 54 men. Hence 43 requires 2,322. One supporting battery requires 30 men, hence 44 requires 1,320. A flanking battery requires 21 men, hence 48 requires 1,008. That is to say, 4,650 gunners are required, or, with staff, etc., say 5,000.

Each piece of position may be taken to require five men and a commander, or with two reliefs, 12 men. Hence 3,840 gunners are required for them. Allowing 640 more in reserve, and 520 for the staff of the batteries, regiments and brigades, the total rank and file required for the artillery of position (moveable armament) is brought up to 5,000.

About $\frac{1}{6}$ of the total number of men must be added for cavalry, pioneers, departmental troops, etc., as I have shown in my former pamphlet.

The 60 kilomètre cupola front thus defended by—

130 rapidly-firing howitzers in cupolas that can be taken to pieces.

320 rapidly-firing guns in moveable cupolas.

320 heavy pieces of position (moveable armament), with 30,000 rifles held by the infantry, the second and third artillery reliefs, and the pioneers.

The garrison required is—

1. General staff	200	rank and file.
2. Artillery in cupolas ...	5,000	,,
3. Moveable armament ...	5,000	,,
4. Infantry	24,000	,,
5. Pioneers	2,000	,,
6. Cavalry	2,400	,,
7. Medical Department ...	1,000	,,
8. Commissariat, etc.	400	,,
Total...	40,000	,,

To garrison the forts, about 6,000 gunners, forming the artillery reliefs not on duty, can be told off, and also three of the battalions in reserve, but this latter entails reducing the 52 companies shown on the plan as in reserve by 12.

A fortress as important as Metz requires for this length of fighting front, which is double that at present existing, a further whole division with field guns as general reserve, which, supported by the reserves in the sections, would take the offensive—that means increasing the troops of the defence to over 50,000 men, or to nearly one man per mètre of the line to be defended.

But even if 40,000 have to suffice, the foundation of a main reserve to carry out sorties is laid. For at least 12 battalions of the section reserves, together with the lightest of the moveable armament, can be taken for this purpose. That would leave facing the enemy in the defensive front: in the 135 cupola batteries 1,600 men (a quite sufficient number), in the 44 infantry positions 11,000 men, while 200 pieces of position, with 1,400 men, would, in addition to the supporting batteries, form the reserve.

That makes altogether 14,000 men, or say $\frac{1}{3}$ of the garrison. Of the remaining $\frac{2}{3}$ (26,000 men) 5,000 would go to garrison the forts, 4,000 to watch the city, and 2,000 may be taken as non-combatants, leaving 15,000 men of the infantry, cavalry, and field artillery available for the offensive.

Further the garrison cannot be reduced, for 40,000 men gives only one fighting man to each $1\frac{1}{2}$ mètre of the line to be defended.

Still, this one man to each $1\frac{1}{2}$ mètre is less than any other system of fortification requires. If we give the present Metz one man to each $1\frac{1}{2}$ mètres, the garrison of its 26 kilomètres would be only 18,000 men, though it certainly requires at least 24,000 men. Now we will quit the interior of the cupola ring and look at

The Choice of the Front of Attack.

The main features of every fortress will be known to the attacker before he begins the artillery battle. Even where the defences have been improvised his reconnaissances will have shown him at any rate as much as is given in the above general view. Hence he will know three things that will influence the choice of the front of attack:—

1. The approximate defensive line taken up.
2. The character of the cupola front, with some idea of the probable positions of the batteries.
3. The lie of the country in front and rear of the defences.

This last point would be ascertained by an examination of the plans available, and it would make it clear whether the lines of defence were in the nature of an indirect strengthening, or whether they were intended to stand alone.

The Region West of the Moselle.

Bearing the above in mind, if we examine the west front from the point of view of the attack, it will be seen at once that there are exceptional difficulties in the way of any attempt to capture it. The heights of Fèves, Plesnois, and Saulny in the centre, command the attacker's position, while from the Plappeville plateau back to the line of forts successive reserve positions can be occupied against an attack along the Amanweiler and St. Privat roads. The right flank, near the Moselle, is covered by the high-lying works near Semécourt, the left by the Rozérieulles plateau, with the unassaultable Mance ravine before it. The former flank bars the roads towards the north, the latter those to Gravelotte, Verdun, and Pont à Mousson.

The artillery attack here would be beaten off the day it was commenced, and even if it were re-commenced with the help of stores drawn from the neighbouring fortresses of Mezières, Verdun and Toul, and if it should finally succeed in piercing the lines of defence, yet it would then have to overcome the forts and their intermediate works in rear. This it would be unable to do.

It may be asked what the use of pushing defences forward on the west front is if the forts are so strong. It is that the forts might not be strong enough to repulse the attack unless it has first been weakened by the enormous loss of men and stores incurred when previously breaking through the cupola front.

The Region between the Moselle and Seille.

The attack on the south front, for which front the three knolls of the St. Blaize heights form rallying points, is just as difficult. True, once the line of defence is pierced, Fort St. Privat does not give as much help as do the forts on the west front under similar circumstances, but, on the other hand, the flanking fire of the batteries near Vaux and Queuleu would then come into play, while St. Quentin, fronting south, with the Moselle before it, forms an unapproachable point of support.

This front is not as favourable for the defence as are the others. Hence it will probably be the one attacked, and, therefore, it has been given as much artillery as possible. The railway from Epinal, Toul, and Nancy, through Mœrchingen to Remilly and Courcelles, and the one coming from the north through St. Avold to Metz, facilitates the bringing up of the siege stores.

As a rule, too, the attacker's positions on the gently falling western slopes of the St. Barbe plateau command those of the defenders. From Cuvry to Ars-Laquenexy only this is not the case, at least, not for the nearer positions. Hence here the cupola front has been sited only 7½ kilomètres from the Cathedral, while on the south and west fronts it is some 10 kilomètres from it. Had the radius been kept at the latter figure all round, the commanding ground at Orny would be 2 kilomètres from the front, while, as arranged, it is too far away to harm the defence.

Towards the north-east matters are far less favourable, and hence an attempt has been made to better them there by providing the detached St. Barbe position. Even granting this position is after a time captured, it will have made it clear that the main attack is being carried out on that side, it will have delayed that attack, and will have enabled the defence to strengthen the lines in rear before the real attack against them commences. Quite possibly, too, the attacker when attempting to surround the St. Barbe position would suffer so greatly from the fire of the flanking works that his further operations against the closed main lines would be much crippled.

But, anyhow, the west and south fronts are much more difficult to pierce than the east front, and hence the main attack should be directed against this east front.

Supposing that the whole east front is broken through, and that its forts are captured. This would involve the evacuation of the south front, but the west front, with the Moselle as its obstacle on the east, would still remain an independent fortress stronger than Metz as it now is.

The town in this case would, of course, be completely lost, but the key of the fortress would still be in the hands of the defence, for he who holds Mont St. Quentin holds Metz.

The throwing forward of the west front advocated and shown on the map is justified by the necessity of ensuring the retention of this key in the hands of the defence.

CHAPTER IV.

The Preparation of the Fortress for War.

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Details Regarding the Cupola Park.

N.B.—The necessary transport, etc., is here omitted.

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Arming the Cupola Front.

The Style of Construction.—It is evident that so large a fortress as is shown in the map should not depend for its defences on improvised works.

For one thing, its position near the frontier forbids it, for should the enemy appear unexpectedly before the place directly, or even before, war was declared, it would then be too late to construct such defences on the sites shown. Further, large tracts of woodlands have to be cleared in order to allow the works to be constructed, for in no system of defence is it permissible to site works in or close to woods. Though, however, we are compelled to make many preparations during peace, it does not follow that all the works should be constructed then.

The fortress will do better service if it be constructed half in permanent, half in improvised style, for then, at any rate, some of the works will not be known of by the enemy.

The permanent defences would be the central batteries, their flanking batteries and half the infantry positions.

The improvised defences, which would be commenced at the outbreak of war, would be the supporting batteries, the rest of the infantry positions and the batteries of position.

The following would be the improvised infantry positions, viz.:—Nos. 1, 3, 5, 9, 13, 15, 19, 23, 27, 29, 31, 41, 45, 49, 53, 55, 59, 61, 65, 69, 73, 77, 79, 85, *i.e.*, 24. The other 20 would be built in permanent style.

Not till the attack developes itself is it necessary to make further improvised works in order to strengthen particular portions of the line.

Should the main attack take place against the St. Barbe plateau, a considerable number of moveable cupolas would be drawn from the main and supporting batteries on the west front in order to secure the threatened point.

All works necessary then would be in improvised style.

Estimates of Cost.—The cost of the defence in permanent style would be 25 millions of marks; that of the defence half in permanent, half in improvised style would be 21 millions of marks (see abridged Appendices); 450 cupolas are provided in each case, and the cost of the defence thus comes to

56,000 marks per cupola in permanent defence.
47,000 „ „ „ in the mixed defence.

The average cost of the old system comes to 75,000 marks for each gun on the ramparts, or 34 millions for 450. These 450, if divided among 15 forts, would never be as effective as if divided as proposed, for, on the old system, there would be intervals of 4 kilomètres. If, instead of these 15 forts, 15 armoured forts were built, mounting 150 armoured pieces of all sizes, the cost would be 45 millions, or about double that of the scheme proposed.

Working Parties, Time, etc.

It has been stated above that 40,000 men of all arms would be required for the defence. Of these 25,000 men should be the permanent peace garrison. These would not form part of the field army, but would be available as a siege corps should successful offensive action be taken by that army.

Two-thirds of this number, say 16,000 men, would be available for working parties, to which must be added 12,000 civilians.

* * * *

N.B.—Details of the daily tasks, etc., are here omitted; the time to complete all the works (some half as above having been done in

peace time) is eight days, the main and flanking batteries being ready for action on the evening of the first day.

* * * *

The Application of the Stores for the Defence of Metz to an Improvised Cupola Front.

If there be no question of a siege, owing to the transfer of the theatre of war into the enemy's country, or should a relieving army cause the siege to be raised, then the moveable cupolas provide an excellent means of securing the success gained, for with them excellent supporting points for detached corps can be formed. In 1870–71 Orleans and Dijon would have been such points.

Such points would never be as large as Metz. Two hundred cupolas, which would suffice for a circumference of 30 kilomètres, would be about the number detailed for such a point. The old method of fortification could do nothing in this way, and fortresses improvised according to it were hardly ever completed, as deep ditches and raised gun platforms were required.

The cupolas, on the other hand, contain everything required except obstacles to the front, and shelters for the infantry and reliefs in rear. Once they are put into their places the main defensive works are ready.

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FINAL REMARKS.

Captain Meyer here details the concession he has made in this project to the critics of his former writings, and also the points objected to, to which he still adheres.

APPENDICES.

In these Captain Meyer gives estimates both in money and time for the various types of works proposed by him.

The following are the outlines of his estimates :—

Permanent Central Battery (Figs. 7, 8, 9, 48*) (Concrete Casemates).*

Earthwork	9,500	marks.
Masonry and concrete	23,980	,,
2 12-cm. howitzers in cupolas ...	88,000	,,
3 5·7-cm. guns ,, ...	42,000	,,
Wire entanglement	32,400	,,
Contingencies	4,120	,,
Total	200,000	marks.

Time—4,500 men days.

Improvised Central Battery (Figs. 10, 11, 32, 33, 50*) (Corrugated Iron and Girders used for Shelters).*

Earthwork	*Nil* (working parties).	
Shelters	6,640	marks.
Armament (as above)...	13,000	,,
Wire entanglement	28,800	,,
Contingencies	4,560	,,
Total	170,000	marks.

Time—2,000 men days.

Permanent Supporting Battery (Figs. 7, 8, 9, 48*) (Concrete Casemates).*

Earthwork	3,160	marks.
Masonry and concrete	12,440	,,
1 12-cm. howitzer in cupola	44,000	,,
2 5·7-cm. guns in cupolas	28,000	,,
Wire entanglement	9,000	,,
Contingencies	3,400	,,
Total	100,000	marks.

Time—2,000 men days.

Improvised Supporting Battery (Figs. 10, 11, 12, 33, 50 *(Corrugated Iron used for Shelters).*

Earthwork	*Nil* (working parties).	
Shelters	2,616	marks.
Armament (as before)	72,000	,,
Entanglement	7,200	,,
Contingencies	3,184	,,
Total	85,000	marks.

Time—800 men days.

Permanent Flanking Battery (Figs. 7, 9, 48*) (Concrete Casemates).*

Earthwork	2,940	marks.
Masonry and concrete	5,200	,,
2 5·7-cm. guns in cupolas	28,000	,,
Entanglement	10,800	,,
Contingencies	3,060	,,
Total	50,000	marks.

Time—1,400 men days.

Improvised Flanking Battery (Figs. 10, 12, 38, 50*) (Corrugated Iron used for Shelters).*

Earthwork	*Nil.*	
Shelters	1,104	marks.
Armament (as above)	28,000	,,
Entanglement	9,000	,,
Contingencies	1,896	,,
Total	40,000	marks.

Time—600 men days.

Permanent Infantry Work (Figs. 28, 30, 35, 45*) (Concrete Casemates).*

Earthwork	17,900	marks.
Masonry and concrete	140,000	,,
Entanglement	36,000	,,
Contingencies	6,100	,,
Total	200,000	marks.

Time—10,000 men days.

Improvised Infantry Work (Figs. 33, 38, 50*) (Corrugated Iron used for Shelters).*

Earthwork	*Nil.*	
Shelters	27,000	marks.
Entanglement	28,800	,,
Contingencies	4,200	,,
Total	60,000	marks.

Time—2,000 men days.

Improvised Infantry Work (Figs. 34, 39, 50*) (Wood used for Shelters).*

Earthwork	*Nil.*	
Shelters	18,000	marks.
Entanglement	28,800	,,
Contingencies	3,200	,,
Total	50,000	marks.

Time—2,400 men days.

Thus the Metz cupola front, 60 kilomètres long, will cost :—

(a). Built in Permanent Style.

43 central batteries	8,600,000	marks.
44 supporting ,, ...	4,400,000	,,
48 flanking ,, ...	2,400,000	,,
44 infantry works	8,800,000	,,
100-kilomètres field railway, with 1,200 trucks	800,000	,,
Total	25,000,000	marks.

(b). Built in Mixed Style.

43 permanent central batteries ...	8,600,000	marks.
44 improvised supporting ,, ...	3,740,000	,,
48 permanent flanking ,, ...	2,400,000	,,
20 ,, infantry works ...	4,000,000	,,
24 improvised ,, ,, ...	1,440,000	,,
100-kilomètre railway, and trucks ...	800,000	,,
Total	20,980,000	marks.

The cost of a supporting point 30 kilomètres in circumference, 200 cupolas, would be (see above estimates) :—

20 improvised central batteries ...	3,400,000	marks.
20 ,, supporting ,, ...	1,700,000	,,
20 ,, flanking ,, ...	800,000	,,
20 ,, infantry works ...	1,200,000	,,
100-kilomètre railway, 1,200 trucks...	800,000	,,
Total	7,900,000	marks.

The cupolas, stores, etc., would be drawn from Metz or some other large cupola-fronted fortress that was free from the chance of being besieged. Their price is included in the estimate.

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PLATE I.

Metz defended by
Armoured Forts.
a proposal by
Captain J. Meyer.