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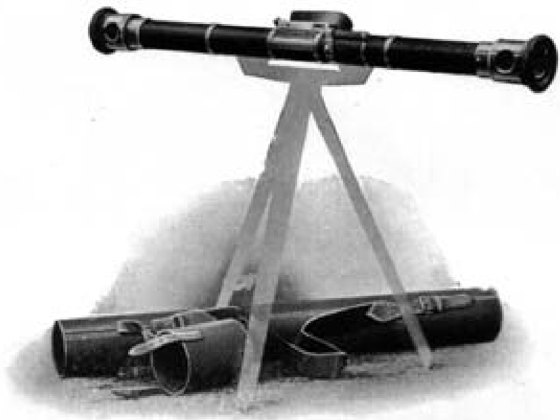

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FOR USE WITH INFANTRY, CAVALRY, AND MACHINE GUNS.

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The tripod shown in the illustration is not supplied with the instrument, as the Rangefinder is so constructed that it can be used with ease without a stand.

Approximate uncertainty of observation:—

5 yards at 1,000 yards.
40 yards at 3,000 yards.
170 yards at 6,000 yards.

Barr & Stroud Rangefinder

THE DEFENCE OF A POSITION UPON OPEN GROUND,

AS INFLUENCED BY THE Q.F. ARTILLERY FIRE OF THE ATTACK.

By CAPT. E. D. SWINTON, D.S.O., R.E.

IN 1903 a pamphlet, entitled *Conséquences tactiques des progrès de l'armement : Etude sur le terrain*, was written by General Langlois of the French Army. The author is a member of the "Conseil Supérieur de la Guerre," and a well-known writer upon matters military.

This essay was written with the definite object of combating what the author describes as a pernicious theory, enunciated in France in 1868 much to the detriment of that country, which re-appears at every step made in the improvement of weapons and which was also revived by the Boer War, namely, that the power of modern weapons has rendered the Attack more difficult, while it has conferred considerable and unexpected benefits upon the Defence.

With this general thesis it is not proposed to deal here. The subject was ably argued out, and produced replies from other French military writers. These were dealt with in a further edition of the work in 1905.*

To illustrate his arguments, General Langlois worked out on the map an actual case of two armies manœuvring, the one (Southern) according to the principles supported by him, the other (Eastern) according to the principles he wished to refute. The approach of the two armies acting upon these lines is followed out in detail, and finally ends in an attack by the Southern army upon the Eastern on ground near Troyes.

The portion of the Eastern army's position chosen for the decisive attack was an open plateau—almost in the centre of the position. The attack was successful and, as explained by the General, the success was mainly due to the ease with which the Southern army—acting according to his views—could concentrate, and the difficulty which the Eastern force, owing to its dispersion in separate divisions over a wide area, had in so doing.

For the logical working out of this imaginary scheme to its end, the defensive dispositions of the Eastern army were assumed. The

* Published by Henri Charles-Lavauzelle, 10 Rue Danton, Boulevard Saint-Germain 118.

open plateau of Nuisement, between Vendeuvre and the Bois de Bossican, was the terrain upon which the final attack was delivered. The slopes of the hills in this area are stated to be convex, and in the case as imagined it is explained that the defences were on this account forced to take up a firing line position some 300 or 400 yards in front of the "covering crest"* in order to obtain a good enough field of fire over the immediate foreground. Even so, the field of fire was hardly 400 yards in range for men firing standing; and it is pointed out that on such terrains one is reduced to a very short field of fire if trenches of low command are employed, while parapets of high command would be very conspicuous, and in neither case are the defenders invisible when they are firing. Attention is also drawn to the fact that the defenders had a dense firing line in this advanced position, and that the hillside for 400 m. behind it right up to the Nuisement ridge was exposed to the attacker's projectiles, so that no movement to reinforce could have been made without great loss.

The defenders' artillery was in no better plight for it had to advance in front of the covering crest to see, and thus was forced to present itself "*en espalier*" to the attackers' guns, besides suffering from the impossibility of ammunition supply and of reinforcement.

The objectives of the attacking artillery (55 batteries concentrated) are clearly laid down; a portion was to fire upon the defenders' guns, another portion upon any counter-attack that should be attempted, a third portion was to cover the infantry advance by firing on the defence trenches to keep the defenders down in them and to shell all the ground from the firing line to the ridge behind.

From the position taken up by the defenders, it is suggested by the author that, exposed as they were to a crushing artillery fire, threatened by a close attack, and having in case of retreat to cross 300 or 400 yards of open ground, there must have been many of them who would have preferred to find themselves in the ranks of the attackers!

This remark cannot be gainsaid, for, apart from other considerations, the luckless defenders, under the dispositions imagined for them upon the terrain chosen, are spread out upon the hillside like washing put out to dry. Unless the author is misinterpreted, whilst the attacking infantry are approaching, protected by the curve of the hillside, the defending infantry are in full view *without head-cover or overhead cover* and exposed to a shower of shrapnel which would prevent them using their rifles with effect. Any reinforcements or a retreat must be made across the shell-swept hillside. Their artillery is somewhat similarly circumstanced.

Apart from the more important matters, such as the author's dispositions of the Army and Army Corps—which form the main subject of the brochure and, carried out according to the author's

* See Note at end.

ideas, are the chief reasons for the success of the Southern army,—it seems to the reader that, in the matter of the tactical defensive occupation of the bare plateau actually chosen for the assault, the Eastern army was more than a little "kind" to the Southern. This was brought to notice in 1904 by another French officer, Colonel L. Piarron de Mondésir, in his *Essai sur l'emploi tactique de la fortification de campagne.** In this book the author explains in detail his views on the tactical employment of field fortification, and puts forward one possible solution of the complex problem of the organization of the defence against Q.F. artillery. Throughout the book the action of the Q.F. artillery of the attack is treated as the decisive factor. Finally (in Part III.), as an illustration of his views, the same case of the assault on the plateau of Nuisement is taken. It is considered from the side of the Defence, which is carried out according to the author's views in contradistinction to the plan adopted by the Eastern army in General Langlois' example. This is not done to disprove the possibility of the decisive attack, which is always recognized, but to show that the defence has now, as formerly (*i.e.* before the introduction of Q.F. guns), some chance of meeting it with success. In other words, it is implied that, in the case imagined by General Langlois, the defenders did not make the best possible arrangements.

The brochure is divided into three parts :—

Part I.—Hasty Field Fortification, or battlefield fortification.

Part II.—Deliberate Field Fortification.

Part III.—Application to a concrete case.

Parts I. and II. can be best considered together because the same principles apply ; the only difference is one of degree as to time and strength of works possible.

Purely passive defence is condemned, and great stress is laid on the tactical employment of field fortification, *i.e.* the correct relation between the firing line and the mobile force. The defence position is not taken as a line in the "geometric sense," but is arranged for depth in échelon of firing lines (†advanced caponnière positions for flanking, fighting outposts, main firing line) and of the mobile force (†supports, reserves, general reserve). The whole defence should be organized for the intervention (counter-attack) of the mobile force, which should be kept well covered till the "moment of intervention." Every liberty of movement should be allowed to the defence generally.

The mobile force, ready to meet the attack or to assume the offensive, should, as well as the firing line, be provided with artificial cover where the ground does not afford it naturally ; great stress is

* Published by Berger-Levrault & Co., 5 Rue des Beaux Arts, Paris.

† See later.

laid upon the difference between the protection given to the firing line (which allows of the use of the rifle) and the protection given to the mobile force (which must be abandoned before the rifle can be used).

The firing line or "defence" is not continuous, but is divided up into groups of trenches forming "supporting points" or "centres of resistance," each with its own garrison and local reserves. The whole question of the arrangement of these centres of resistance with intervals, so as to be mutually supporting, allow of counter-attacks, and permit of the fire of the defence artillery over them (see later), is gone into with much detail. The area is divided up into sectors, and all points of the necessary organization, command, and design and execution of works, etc., are also entered into.

In the author's opinion, the power of modern artillery is such that, in those cases where protection has to be arranged in an open position for both firing line and mobile force, *the guiding factor in taking up such a position is the necessity for nullifying its neutralising effect.** The question of the extent of the field of fire to be provided for the firing line takes second place. Owing to the power of Q.F. artillery, it is impossible to imagine reinforcements being made across the open under its shell squalls. Accordingly, the main firing line of the position *can no longer be on the military crest*† *of a slope facing the (superior) artillery fire of the attack*, but must be sheltered from its neutralising effect. It should be out of the direct observation of fire; *and may therefore be, according to the nature of the ground, on a secondary crest, on an edge of the plateau or even on the reverse slope, provided that it has a clear field of fire of from 250 yards to 300 yards and searches the crest at which the attack will arrive.*

This is in accordance with the author's contention that *immunity from the attacking artillery fire* is the chief point to be considered in determining the position of the main firing line. The limited field of rifle fire mentioned (250–300 yards) is stated to be sufficient with the present rapid fire, and has the advantage that the main firing line will have a better chance of withstanding the "prolongation" of the attackers' artillery fire than if it were further back from the military crest. (It was laid down in the French Regulations that the covering fire of the artillery of the attack should be continued upon the enemy's position until it became dangerous for the assaulting infantry, when the range should be increased by 500 m.—the "prolongation"—in order to catch the defence supports and reserves advancing).

The exposed slopes of the plateau (the position has all along been taken to be a plateau) are not entirely given up to the undisturbed

* By neutralising is meant a fire which forces the defenders to remain under cover without using their rifles.

† See Note at end.

use of the enemy; for though the military crest is not occupied by the main firing line, it is occupied by little entrenched groups—"fighting outposts"—of which the supports, if any, would have to be placed in cover trenches alongside the firing trenches, for reinforcement over the beaten zone would be impossible. These little entrenched groups do not form the main firing line and, owing to their weakness, the forward slopes of the position would not be swept to any great extent by frontal fire; but this is provided for by the long range flanking fire of certain strongly entrenched advanced posts—called caponnière trenches—placed where the ground admits.

The *rôle* of the "fighting outposts" is to watch the front slopes; to fire on the enemy as long as possible; and then, at the last minute, to retire to the main position along the top of the plateau which is defiladed both from the attacking artillery and from the assaulting infantry. This would be the signal to the defence artillery that the assault had arrived at the military crest, of which they have the range.

It is not stated whether these "fighting outposts" are provided with overhead cover. Presumably this is intended, for without it they would be no better able to withstand the *neutralising artillery fire* of the attack than would the main firing line.

The dispositions proposed for the defence artillery are that a few guns should, for the flanking of the front slopes, be placed in the advanced caponnière positions, where they will be (presumably) strongly entrenched. Of the main artillery force, a portion will take up preliminary forward positions, whence it will be able to fire on the batteries of the attack as the latter come into position. From these points it will (being presupposed much inferior to the attacking artillery) retire to its final position, where the bulk of the artillery will have been from the first, *i.e.* at suitable places away to the rear. Here it will be defiladed from the sight and fire of the attacking guns. Its *rôle* will be to await the moment of arrival of the infantry attack upon the military crest of the position, which would be indicated by the retirement of the "fighting outposts." It will be able to fire upon the crest and upon the ground in front of the main firing line over the intervals in the main defensive position.

The actual course of the decisive attack against such a position is foreshadowed thus:—

The attacking artillery, after having gained the superiority over the defence artillery, tries to *neutralise* the defence by firing on the defence position, in order to allow of the approach of its own infantry. The defence position in this case is, as far as the attackers know, the line of "fighting outposts" on the military crest. The attacking infantry gradually advances under cover of this artillery fire. It finally reaches an assaulting position. The psychological moment arrives. Its fire intensifies, and the infantry prepares to cross, with one last rush, the space which separates it from the military crest—*that outline of the hill as seen by it from down below*, and which the "fighting outposts" alone occupy. The "fighting outposts" quickly fall back. The attackers' artillery fire is prolonged. (From this prolongation the troops retiring would suffer). The attack arrives at the crest. The men are blown. It is henceforward deprived of the support of its own artillery. This then is the *decisive moment* for the defence. It can now employ the neutralising fire of its own artillery upon the attackers; use infantry fire from its main line; and make offensive returns and perhaps unloose the counter-attack, so that "*the moment when the enemy appears over the crest is for the defence the beginning of the fun, instead of being the end of it.*"

There is much more in the two quoted works of General Langlois and Colonel Piarron de Mondésir than is brought out in this brief *résumé*, which only touches upon certain points applicable to this article. A sufficient epitome has been given, however, to show that, when describing the imaginary organisation of a defensive position on a bare hill or plateau, one well-known writer places the defence main line well forward on the exposed slope of the hill in order to gain a field of fire. He at the same time points out how disadvantageous such a position is for the defence, and shows how useless it would be under the concentrated fire of the attack artillery, and how impossible to reinforce or to retreat from. The main factor in rendering this position not defensible is the *attacking artillery fire*, though this point is not specially laboured.

The other writer frankly maintains that the artillery fire of the concentrated Q.F. guns of the attack is the "clou" of the whole question, and that the principal thing to be done in organising the defence is to protect the main firing line from its effect, which is characterised as "neutralising." This he arranges to do by placing the main firing line in a retired position out of view of the attacking artillery. The consideration of the infantry field of fire is relegated to a second place. (Nevertheless, in the case under consideration, owing to the curve of the hill, the actual field of fire, though short, appears nearly as good as if the main line had gone forward).

No mention is made in either case of providing head cover or overhead cover for the firing line trenches, so that these might be exposed on the front slope to the hostile shrapnel and yet allow of the defenders using their rifles at the same time. Each writer assumes as a matter of course that a main firing line so exposed would be useless.

In the first case the defence is *perforce* practically passive until the main line is captured, and even then any counter stroke would be exposed to the attacking artillery. In the second case, the defence is *designedly* almost passive until the attack reaches the crest of the forward slope and drives in the "fighting outposts." At this moment the *rôles* change, and the attacking infantry (which only disposes of small-arm and unaimed artillery fire) is subjected to rifle fire at decisive range, aimed artillery fire at known ranges, and then the counter strokes. The essential idea appears to be that the enemy are knowingly and of set purposes to be allowed to advance to a certain point practically unmolested. They are then fallen upon suddenly when at a great disadvantage. It is open to question whether the foreknowledge that it is done with a set purpose will counteract the adverse moral effects upon the defenders of allowing the attack to approach so close. Troops of very good quality would be necessary to do this. No mention is made of the probability of the attack massing large numbers under cover of darkness on the slope of the hill, and rushing the position. Possibly it is thought that the forward flanking positions would be sufficient in most cases to prevent this.

It is an old problem whether, in taking up a defensive battle position upon a bare hill, the main firing line should be placed on the "military crest" (or in front of it), so as to sweep the front slopes of the hill up which the infantry attack must advance; or whether it should be further back with a reduced field of fire, so as to catch the advancing enemy when he has climbed the slope and arrived at the military crest, as was so often done by Wellington [generally with well-seasoned troops]. This point has been much discussed, as also has the cognate question, whether it is better to place the firing line of a defensive position near the top or at the bottom of the front slope of a hill, when the ground to be held offers the choice.

Frequently there is no choice, but positions that do offer the alternative are sufficiently often found to make a consideration of the problem profitable, and it is to such a case that the two articles quoted refer.

This is one of the many subjects about which it can be said that, "since it depends entirely upon the ground, each case can therefore be best settled upon the ground"; a statement which is undeniable, but does not necessarily mean that the study of possible conditions beforehand will in any way impair the power of the man who so studies to settle on the spot the questions which may arise.

In Mayne's *Infantry Fire Tactics*, Chapter XI., the best site for fire trenches is most exhaustively discussed. The arguments for placing the main line of a position on the forward crest of a hill, or some way back, are given impartially and in great detail, though the author explains that he personally favours the forward position as a general rule. All through the discussion the matter is chiefly considered with an eye to the probable results of the rifle fire of the attack and defence as affected by the positions taken up, and to how the zones of fire directed upon the firing lines might incidentally, owing to the slopes of the ground, include within their beaten areas the supports and reserves on either side. Historic examples of the employment of the retired position are given. The moral aspects of each system are also analysed. One consideration, which now seems very important in the bearing it has upon the question, though touched upon is not much taken into account, and that is how far *the position of the main defensive firing line is affected by the attacking artillery fire.* Since this book was published, however, field artillery has undergone great changes, and the nature of the concentrated fire which can be brought to bear upon any visible target, such as a section of a defensive position, is far different from what it was at the date of writing (1888). [In the Franco-German war common shell was chiefly used.] An additional and powerful argument has thereby been brought forward upon the side of those who favoured the adoption of a retired position.

According to report, in some cases during the Russo-Japanese War, the covering fire from the Japanese guns apparently succeeded in so subduing the rifle fire from the Russian defence entrenchments that the attacking infantry was able to get right into the trenches whilst their own artillery were firing. In fact, to such a degree was this carried that the attacking infantry suffered loss from the fire of their own guns. The advantage of so continuing the fire was considered to outweigh the possible loss.

That the attacking artillery should cover the advance of its own infantry by a concentration of fire upon the points of the position to be attacked has always been laid down as a principle. It was often attempted in the South African War, but, owing to various causes—especially to the nature of the usual Boer positions, rock and scrub which generally enabled the defence trenches to be so absolutely hidden that it was impossible to locate them within closer limits than the whole side of a kopje,—it can hardly be considered to have been successfully accomplished. The case generally admitted to be the best example of the co-operation of artillery with attacking infantry was Pieter's Hill.

It is only in the Russo-Japanese War that the procedure has been carried out to its logical end,—by the Japanese,—and carried out with surprising results for the attack. In considering this example, however, it must be borne in mind that the Japanese guns were not Q.F. and the effect of their concentrated artillery fire was nothing like what must now be expected, for all nations will in the future have Q.F. artillery. The change to be looked for does not, therefore, lie in what the attacking artillery will attempt, but in what it will accomplish.

Colonel Mayne draws attention in his book to the fact that, at the time of writing, the French were the chief exponents of the idea of taking up the retired position, and mentions two works written by a French officer, Commandant E. Paquié, in support of this. From the examples quoted the French still appear to be strong supporters of this principle. This seems natural, for they have led the way in the adoption of Q.F. field artillery and in thinking out its proper employment and the results to be expected. These expected results, according to some of the military writers, form one of the strongest arguments for the system advocated.

It may be contended that the expected results, arguing from the statistics of the Russo-Japanese War, will not be very great; for these statistics show that the proportion of casualties from gun fire was small. If, however, the Japanese artillery succeeded in making the Russian defending infantry keep under cover without using their rifles during the advance of the attacking infantry, it effected its object. It is not a question of how many men were actually hit by the artillery fire, but of what this fire prevented them from doing.

The other arguments for or against taking up a firing line upon the forward slope of an open defensive position remain as they were. The new aspect of the factor appears to be whether the increased smothering effect of modern Q.F. artillery will not render the forward position impossible. It seems certain that the commander of an attacking force, by the time he has decided what point is to be assaulted, will be able to concentrate the fire of a large number of guns upon it; also that these guns will be Q.F. guns. This fire will be kept up during the infantry assault up to the very last moment; and if anticipations of its effect are fulfilled, it will prevent the defenders from putting up their heads and using their rifles, or in other words it will "neutralise" the defence. This will be so, unless

(*a*) The ground is of a nature to permit of the firing trenches being so well concealed that the attacking artillery cannot range on them. (This would be the case with rocky, scrubby, or heath country).

(*b*) The firing-line trenches are provided with overhead cover or good head-cover, so that the defenders can use their rifles at the time that they are being shelled by the attacking artillery.

(*c*) The defenders have the superiority in guns at the spot, which is unlikely, or have the longer ranging gun, which is a chance.

From the conditions of the case under consideration—one of open ground—(*a*) is precluded; for though it is possible, even on ordinary open ground, to so conceal trenches and mislead by dummy trenches, etc., that the attackers may not be able to detect the actual position when at some distance, this is not possible, except by the construction of an immense number of bogus works, when the attackers have faced the position for a sufficient length of time to have fixed upon the exact point for the assault. It seems that alternative (*b*) must be adopted, viz., that the trenches should have head cover or over-head cover of a nature to allow the defenders to use their rifles whilst they are under artillery fire.

The provision of good head cover implies that some time will be required for the preparation of the position, also that a certain amount of material besides earth will be necessary for the loopholes. Over-head cover requires even more time and a large amount of material, such as brushwood, corrugated iron, or other stuff suitable for roofing.

It follows that in such positions, when considering whether a forward or retired line should be taken up, it should be borne in mind that, apart from other considerations, the forward position will require more time and more material to prepare than the retired one, which would be out of sight and therefore not under the direct fire of the attacking artillery. For this reason, therefore, when time or material or both are short, it may be better to construct inferior trenches, which will suffice against rifle fire only, in a retired position, than to construct similar trenches on the front slopes, where they will be exposed to the full force of the concentrated artillery fire, against which they will not protect men who are shooting and so will be useless for their purpose even if they afford cover to men not shooting.

The idea has been sometimes expressed that, provided trenches give shelter against artillery fire to the men who are *taking cover*, these men will, the moment the attacking artillery fire has to cease owing to the propinquity of the assaulting infantry, be able to man the parapet and use their rifles against the attacking infantry in time to drive them back. This might be true if the covering artillery fire ceased when the assaulting infantry are still 300 to 400 yards away; but in future it is possible that the assaulting infantry will reach the defenders' position at the same moment as their supporting artillery fire ceases. It will be then too late for the defenders to commence using their rifles.

Finally, the question which has yet to be answered is—In open and exposed portions of a defensive position will the concentrated Q.F. artillery covering fire of the attack upon good open trenches really neutralise them in the future?

If it will, then head or over-head cover will be necessary in cases where the main firing line is exposed to this fire, *i.e.* if the trenches *are to be of any use*. If time and material for this are not available, it may in such cases be better to place the firing line retired, as advocated by Colonel Piarron de Mondésir, and to reserve the counter-blow of the defence.

Should a retired position in such a case be decided upon for the main firing line, it does not follow that the front slopes need necessarily be quite undefended, for they can, as suggested in Colonel Piarron de Mondésir's essay, be flanked from advanced portions of the position; some chance of doing this will usually exist.

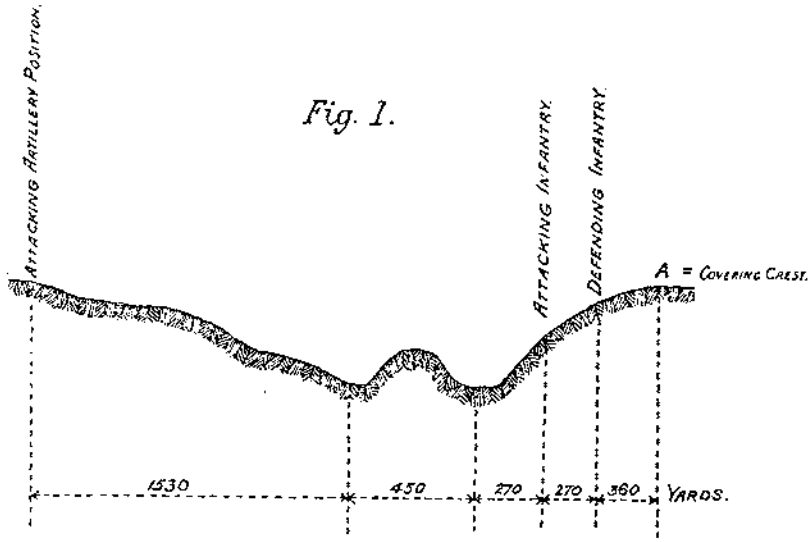
NOTE.

By the term "covering crest" employed by General Langlois is understood the line on the convex top of the plateau behind which the defenders would be defiladed from the view of the attacking artillery. It is, in other words, the "skyline" as seen from the attacking artillery positions. The exact situation of this depends of course upon where the attackers' artillery positions are, and varies accordingly.

It seems worth while to refer to this because the expression "the skyline" is often used in a loose way, oblivious of the fact that on convex hills there is a different position of the skyline for every point of vision down below.

Fig. 1 gives a section of the ground between one of the artillery positions of the attack and the top of the Nuisement plateau held by the Eastern Army, showing the position as described by General Langlois.

Fig. 1.

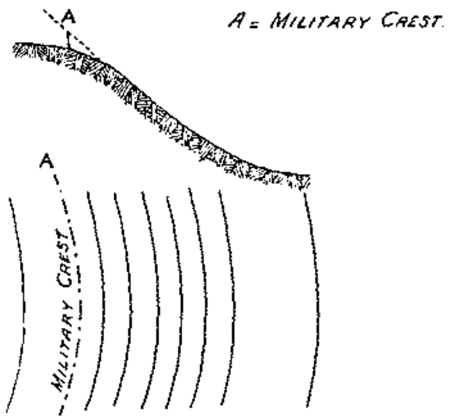


Vertical to Horizontal Scale 7/1

The "military crest" alluded to by Colonel Piarron de Mondésir is another matter. This term, though used almost as an English expression, is of French origin.

It is, according to a French military text book—the *Manuel de Fortification*—the line joining those points on a plateau or hill from which a good view is obtained over the slopes in front, thus providing a good field of fire (see *Fig.* 2).

Fig. 2.



It is obvious that, where the position is a convex hill, several lines might be chosen as "military crests," all having much the same value as regards view and field of fire. It follows also that any "military crest" would invariably be in front of and below the "covering crest" as defined above.

THE CANADIAN BACKWOODSMAN:

With Some Notes on Dam and Bridge Construction.

By Capt. E. N. Mozley, R.E.

We used to be taught in our school geographies to estimate the comparative strength of nations by current statistics. Their populations, manufactures, exports, and imports were committed to our unwilling memories, while the possibilities of the interior and the coastline for farmer, miner, and fisherman were outlined with a vague splendour. But, although such great stress was laid on the materials at the disposal of the national engine, the character and possibilities of the men themselves were usually, sometimes of politeness, left unrecorded.

The omission was for ourselves doubly unfortunate. Not only is it impossible without such knowledge to forecast the future course of the world's history, but in our own case a vista of dull figures has taken the place of the great appeal to the patriotic imagination which might have been made. The British Confederacy, if we studied aright its various races and their history, would reassure us as to its own future. Our statesmen would realize that one of the great tasks before them was to appreciate the individual powers of our fellow citizens and to co-ordinate them both in peace and in war. But through ignorance and listlessness this has not been done.

For the soldier the Intelligence Department supplies his geography book and atlas; and that able office is executing its task with great assiduity. We have been told by an American officer that after the International Expedition to Pekin no doubt was entertained as to the superiority of the British Intelligence to that furnished by any other nation. But while we are so well supplied with publications containing minute details of foreign armies, and with the best maps available, little attention is called to the great military possibilities in the peoples of the British Empire. That is left to us to find out by experience or through the traditions of the service.

Nowadays, however, the British army no longer garrisons the whole Empire; its range of occupation is being gradually confined to Home and the East: and we soldiers are in danger of losing touch with the sentiment and practice of the men whose courage in subduing nature has never yet been equalled and whose fellowship is perhaps our greatest inheritance.

In the front rank of these pioneers stands the shantyman of the backwoods of Canada. The product of two nations, the descendants of those colonists who carved their home out of the inhospitable North, these men retain all the endurance and supreme technical skill handed down for three centuries. Especially is this the case with the French Canadian. Nowhere perhaps in the civilized world will be found men who adhere so closely to the manners of their forefathers. The Quebec village presents to-day many of those features which France uprooted when she tore down the Bastille and installed the Reign of Terror. The *habitant* still farms his 'arpent' of land, 3 miles long and 60 yards wide, which his ancestor was allotted 200 years ago; and still as ever the more intrepid youth of Lower Canada seek every autumn a livelihood in the Northern forests.

The English-speaking shantyman, fine workman as he is, is an adventurer at the game; his French competitor is the professional backwoodsman. Both are men who can fell a 30-inch pine tree in 5 minutes; who, singlehanded, can run up a log hut, 20 foot square and 10 feet high, in 2 days; who know by instinct every *tour de force* which the laws of mechanics can give them; and who can find a meal and shelter in the wilderness where many an old campaigner would die of hunger and cold.

These men are specialists among professionals; as sappers every man would be placed on the first rate; as soldiers and riflemen they would generally be far ahead of anything a European army could put into the field. And those who are best qualified to know will tell you that 98 per cent. will take up arms for Canada, if her freedom is ever threatened. Can we not see in these men a source of strength for the future?

Such are the reflections aroused by a few days' life in the timber limits of Northern Ontario.

The moose season (October 16th to November 15th) had just begun and the chance of ten days' leave was not to be missed. Quitting the main line of the Canadian Pacific Railway at North Bay, a station near the north-east corner of Georgia Bay, a journey of 100 miles northwards along the Temiskaming and Northern Ontario Railway brought the writer to his destination, the siding of Messrs. Gillies, one of the great Canadian lumber firms. Sport was unfortunately poor. Every day until snow fell (curiously enough not afterwards) tracks of moose and bear were common, but no opportunity for a shot at them was obtained, though partridges were fairly plentiful. A better chance would have been procured by keeping away from the sections where the shanty men were at work. But the longer odds were taken in order to see a little of the backwoodsman's life.

The great characteristic of the Canadian forest is its silence. On a still morning, when the trees are at rest, the feeling of solitude is profound. Everywhere traces of animal life are seen; but their authors are scarcely ever heard. The hunter, as he moves along the trail, hears only his own footsteps, and seeing the frequent tracks he might well imagine that he is watched by a thousand eyes. An occasional squirrel at work in the trees aloft may disturb his thoughts, or a raven may startle him with its harsh and mocking cry; but the sounds soon die away, and the mysterious silence closes in once more.

Close to Gillies' siding runs the Montreal River. This rapid stream falls into Lake Temiskaming, and its waters eventually swell the great Ottawa River which drains that lake. Here we started down stream in a canoe. After passing a few small rapids we reached, soon after sunset, our night's shelter; this was a log hut six miles down the river, close to where the Montreal leaps down the beautiful Houndshoot falls. Woe betide the unhappy canoe which is carried past that landing!

We had arrived at a transfer station, the half-way house for forwarding provisions and stores from the depôt on the railway to the lumber camps further on. Our host was accustomed to calls on his hospitality at any hour, and gave us a substantial supper of pork, beans, and 'flapjacks' (a very determined-looking pancake).

Tea is the universal drink in the backwoods. Whiskey is not allowed on the limits and, contrary to the general experience in 'prohibited' areas, is not often met with. Here too we saw our last of butter and eggs. We parted with the latter without regret; of a dozen which were opened for our entertainment next morning only three were up to standard requirements. We slept between a couple of blankets on the floor of a very warm hut.

Next day we struck the trail to our destination, six miles further on. We looked in on the way at one or two other camps, paying a visit to the cook in every case. Feeding on trail in the timber limits is as irregular as it is frequent. Excellent pie can always be procured, and the cooking is generally very good.

We passed the stump of a pine tree which had long ago been bitten through by a beaver for dam purposes, and after crossing a floating bridge (a description of which is given below) we reached our halting place. The camp consisted of half-a-dozen log huts, all substantially built on the sealed pattern from which there is never any departure. The various huts comprised the dining camp, sleeping camps, handy-man's shop, stable, grain store, and office. Everything possible is made of wood and of course on the spot. Any man can in a very short time cut off good level boards from the log to supply the materials for his hut's furniture. The fastenings are mostly wedges and trenails; wire is little used, all that is available being the bands of the hay trusses; nails are expensive and rarely to hand.

The huts themselves are all built as shown in Part V. of *Instruction in Military Engineering* (*Plate* VII., *Figs.* 8 and 9), but the corner uprights are omitted. The joint where logs meet is also different from that shown in our text book. There are two general patterns of this joint. In the simpler one, called the *coup platte* (*Fig.* 1), each log has a semi-circular recess cut in its lower surface (as far as the axis of the log) to fit on the log below it, which lies at right angles. In the other pattern, the 'saddle' joint (*Fig.* 2), which, though more complicated, is said to be stronger and certainly prevents all movement, the under-side of one log is cut to a wedge shape and fits on to a corresponding triangular recess in the upper side of the log below; thus each log has two cuts in it at the same point but on opposite sides of the log and at right angles to each other. The roofs are composed of light spars, laid side by side at a slope of perhaps 20 degrees, one wall being higher than the other to give this slope. A long stout log acts as purlin; this is very necessary as the roof is heavily loaded in winter.

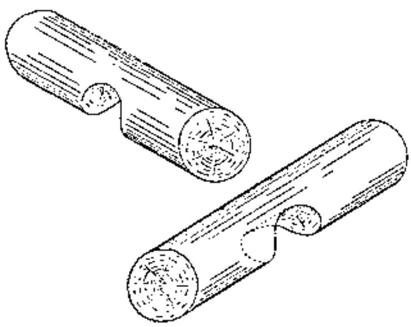


Fig. 1.

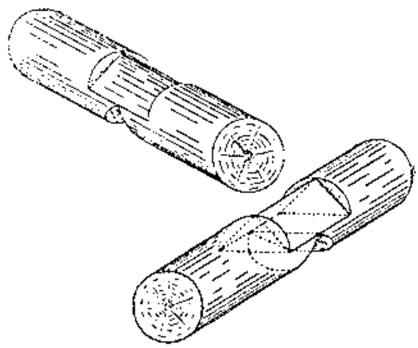


Fig. 2.

These huts are often run up single-handed, the upper logs being rolled up inclined poles into position. The chinks between the logs are filled up with birch bark and moss, secured by wedges which are prevented from moving by wooden pins. After the doors and window frames have been put in there only remain the hinges, locks, and glass, which must be imported.

There is a certain sameness about the shantyman's diet. Each meal consists of pork (sometimes beef), beans and potatoes, bread, prunes and baked apples, and cheese. The food is always good. Meals (they hardly deserve separate titles) are at 5.30 a.m., 11.30 a.m., and 5.30 p.m. Gangs that are working far away take their dinner out with them.

There will be perhaps 80 men in the average camp. They are divided into woodcutters, hewers, skidders, loading and unloading parties, teamsters, and road cutters.

The 'general idea' being to convey the felled tree from the forest to Quebec for shipment to Europe, the 'special idea' is more or less as follows:—The foreman allots to the various gangs their area of operations and gives them instructions as to the trees to be cut down. These are felled, and then cut into logs of 16-foot lengths. If the logs are to be squared, which saves labour in portaging and also detects bad logs, this is done by 'hewers,' whose axe work is so perfect that they will divide a chalk line the length of the log, and level the faces with the precisions of a plane. If the lumber is to be left in log, a pair of horses is brought up to draw the log to the 'rollways.' (This is known as skidding; rollways are piles of logs which can be loaded on to sleighs later on in the winter). A pair of tongs, similar to those used in lifting stone, is attached to the swingle-tree and fixed into the ends of the log; a length of chain is used if the ground requires it. The draught work of these horses is admirable: many times a 40″ log will fall in a bad place and may almost have to be lifted out of a hole; but the horses will spring together into the collar on the word, without a sign of jibbing. After a log has been brought up to the rollways a couple of men will roll it with their cant-hooks up inclined poles into its place on the pile. The rollways are placed on the lower side of a hillside road. In the winter a new sleigh road is made *below* the rollway, and the logs are taken down it to lake or river. The sleigh roads are regularly watered in winter to get a good ice surface. As much as 5 tons of logs have been taken down in one load by a pair of horses, who are given each 22 lbs. of oats and 20 lbs. of hay daily; they undoubtedly earn their keep.

All the year round new wagon trails are being constructed in the bush. Great use is made of the corduroy road over marshy ground. Small bridges on crib abutments cross the creeks. Their construction is quite simple; the spans are small, and all that is done is to lay logs close together across the creek and on them smaller spars to form the roadway; heavy logs are laid along the roadway as wheel guides, generally without being pinned down.

In the spring the 'drives' begin. Hewn timber is made up into rafts of enormous size, but built in sections in order that they may be split up to pass through the water slides. These slides are constructed at the river falls: the principal ones on the Ottawa river are at the Chaudière falls close to the capital. It has been decided by the Canadian Government, to whom the site of these slides belong, to cancel the lease owing to the great value of the river frontage which they take up; next year, therefore, will probably see the last of the rafts down the Ottawa. After that only round logs can be floated down.

The logs are marked with the firm's brand. In navigable rivers they have to be made up into booms (a mass of logs surrounded by a perimeter of logs chained together). They are then set adrift to find their own way down to Quebec. The loose logs sent down the river by the hundred thousand are the cause of the famous 'jams' which sometimes occur. A log jam in a river channel requires fine handling. Experienced men who can detect the 'key' logs have to get out on the jam and cut them away; after this has been done the jam may break at any moment, and many a man has lost his life through not being able to regain the shore before the torrent of logs is once more sweeping down the river.

It would be impossible to do justice to the skill of the backwoodsman with auger, axe, and lever. The accuracy of fit with so few tools and no working drawings is equalled only by the rapidity of execution. Their pay is not high as rates go on the other side of the Atlantic—28 to 35 dollars a month, with board. The life is very hard, especially in the rigorous Canadian winter; and amusements are few. After supper the men will wander into the office to inquire for their mail or to buy tobacco. Later on the sleep camp resounds with interminable French songs, the words of which are as mysterious as their tunes; but for all that the English shantyman may well envy the gaiety of the Frenchman.

Hitherto not much love has been lost between the two races. The rivalries between Ontario and Quebec, between Catholic and Protestant, are ever the weakness of the Dominion. In the towns such sentiments are usually confined to merely verbal expression. But in the backwoods tales of fierce encounters are common. It is possible that the present friendship between France and England may foster a similar feeling between the races in Canada. We could get all the volunteers we needed from the province of Quebec for a war in which France was our ally; that she may never again be our enemy should be the prayer of every Canadian who values the future of his country.

The writer's thanks are due to the firm of Messrs. Gillies, especially to Mr. A. Gillies, whose guest he was and who devoted much time in assisting him to obtain the information given in this article.

TIMBER DAMS.

It is often necessary to improve the water communications from the woods to the lakes and main waterways in order to save moving the logs by sleigh. Small lakes and streams are abundant, and the latter can easily be utilized by improvements such as shoots, while the former may be dammed at their outlet. Very ambitious schemes are often successfully carried out, and dams containing thirty or forty feet of water are not uncommon. They are said to be capable of lasting fifty years or more. Timber, sand, and stone are all the material necessary, and none of the accurate measurements or rigid precautions usual in waterworks are required. Indeed a level is hardly ever used!

The first dam which the writer saw was at the outlet of a lake a mile and a-half long and on a average a quarter of a mile across. The dimensions of the dam were approximately 320 feet length, 24 feet height, with an average thickness of 27 feet. It was built by 24 men in three weeks, excluding the parties employed in felling and bringing up the logs. The following is a rough description of it:—

The front and rear faces of the dam are built up of courses of horizontal logs, barked and flattened on two sides to get a close fit and laid so as to break joint. No foundations to the dam are excavated except for these two faces, and in their case only the pick and shovel are used to get a good seating for the logs which lie on the ground. It is not thought necessary to go down to rock if the soil is good; it is, however, important to remove all old stumps and roots, as these induce leakage under the foundations. *Fig.* 1 of *Plate* I. is an elevation of the lower courses of a face.

The two faces of the dam are connected by 'header' logs, notched (as shown in *Fig.* 2) into the 'stretcher' logs. No 'shoulders' are needed. The 'headers' are secured with ⅝" round spikes, 12" to 18" long and wedge-pointed: these lengths and thicknesses will drive in soft wood. Spikes are found to be cheaper than trenails, taking labour into consideration. When trenails are used it is customary to drive a square trenail into a circular hole, the diameter of the circle being equal to or a little larger than the side of the square.

The 'headers' are arranged in vertical tiers passing through every other joint in the 'stretcher' logs. These vertical tiers are built every 8′ to 12′ (depending on the height of the dam) along the length of the dam, which is thus divided up into compartments. The compartments next the gateway, and perhaps the two *next but one* to these, are filled with loose stone and sand, as is the compartment at each end of the dam; but the remainder of the dam is left empty. In loading these compartments the more stone used the better.

The front face of a dam is often built with a slight batter, offsets of an inch or two being given to each course of logs. Where the gateway of the dam is to be left for the exit of the logs floating in the lake above, the faces are discontinued. They terminate each side of the gateway in a vertical tier of headers.

The gate itself is very simple and ingenious (*Fig.* 3 is a plan, *Fig.* 6 a cross section, and *Fig.* 7 an elevation). Two recesses, or 'gains' as they are locally called (*pq* in *Fig.* 3), are cut as vertical grooves right down the tiers of headers which face the gateway, one on each side. These grooves are placed at a distance back from the front face of the dam equal to about the width of the gateway, which is generally 10 or 12 feet. In these grooves squared "stop logs" slide and form the gate. A groove as shown (*ab*) is also cut in each end of every stop log and a horizontal bolt (shown dotted) passes across the groove. The stop logs are raised as follows:—A long chain with a hook at the end is lowered down the groove *ab* with the point of the hook towards *b*. To assist the lowering of the hook a staple with a socket (cross-section as in *Fig.* 4) is fixed to the back of the hook. Into the socket a long thin pole can be inserted (*Fig.* 5), thus enabling the hook to be pushed down and worked from above. As soon as the hooks (of which there are of course two, one at each end of the stop log) catch under the bolts the stop log can be hauled up. Thus any given quantity of water can be let through the gate.

Hardwood planks are nailed to the 'gains,' as shown in *Fig.* 3, to allow the stop logs to slide evenly. If the stop logs jam so that the bolts pull out, they can be raised by means of a heavy pair of tongs similar to those used in lifting stone or ice. These tongs are attached to a chain and dropped over the jammed stop log, which they will catch and hold. The log can then be easily raised by the windlass above.

In many dams a large bank of sand is tipped in front of the fixed portion of the dam to give greater stability and to reduce leakage. There is also generally a small bank (3′ to 5′ high) tipped so as to lie in front of the bottom stop-logs of the gate; in such cases the stop logs are carried down to a foundation a few feet below the normal level of the surface of the lake. The idea is to enable every drop of water to be used and yet to save the pressure of water from underscouring the gate. When the water in the lake gets as low as the top of this sandbank it can still be utilized by lifting up one of the stop logs which lie behind the sandbank (FF in *Fig.* 6); The sand will then be swept away, and thus the level can be lowered a few more feet.

Leakage between the face logs of the dam is prevented in two ways. Firstly by packing the interstices, and secondly by building up a large sandbank in the water in front of the dam.

As the dam is built up, cedar bark (roughly twisted to give it compactness), manure, etc., are hammered tightly in between the face logs. In addition to this, when a sandbank is not built (and always in the case of the stop logs of the gate), bags of sand are tipped from the top of the dam into the water. As the sand falls to the bottom any leak between the logs gets plugged up, since the water sucks the falling sand into the leak. This action is facilitated by having offsets on the face, as these offsets catch the falling sand. Since the gate is only in use for a short time each year it is possible to keep it fairly watertight by this means, while the dam is closed.

A more efficient method of ensuring the water-tightness of the dam, and one that to a considerable extent relieves the pressure, consists of forming a big sandbag all along the front face (except where the gate is). The sand is carried along a tram line on the top of the dam and tipped, waggons being also used as required. The cross-section of such a dam is shown in *Fig.* 8.

Sand is nearly always tipped in front of the foot of a dam, as shown by the line *abc* in *Fig.* 8, as it is of great use if musk rats take to burrowing under the foundations; the sand in that case drops down into the holes and closes them.

In large dams, five or six hundred feet long, it is common to have three or more gates. In such cases, if either end of the dam shows signs of weakness, the gate at the opposite end is opened, and the pressure at the weak point is relieved while it is being strengthened. These dams are generally made a little higher at the ends than at the centre, in order that there may be no chance in case of flood of the ends being washed away.

Another type of dam, which the writer did not see, is known as a 'sheeted' dam (*Fig.* 9 is a cross-section). It is built up of alternate courses of header and stretcher logs, and the sloping front face is sheeted over with small timbers, the joints between which are plugged in the manner described for the previous dam. Straw and brushwood are often used for plugging. A sandbank is always added.

The gate, which is built more or less as described above, is placed at a distance in front of the rear face of the dam equal to about one-third the thickness of the dam. The sides of the gate-opening through the dam are lined with horizontal round logs spiked to each other and to the header course adjoining the gateway. The 'gains' are then cut in these horizontal logs as before, the sides and bottom of the gains being lined with hardwood planks, and all crevices filled with bark, etc., to prevent leakage.

In all these dams the stop logs of the gate are raised by means of a rough windlass (*Fig.* 10) placed on a platform above the gate. The chains which raise the stop logs are passed round the barrel of the windlass, which is revolved by handspikes passed through holes near each end of it.

In rocky bottoms holding-down bolts are often driven into the rock to secure the lowest tiers of logs. In soft ground scouring is prevented by driving a row of piles in front of the toe of the dam.

Fig. 11 shows another method of building up a sheeted dam.

A FLOATING BRIDGE.

A floating bridge to carry wagons across the Montreal River, where it is 180 yards wide with a current sometimes as great as 5 miles an hour, is of interest. It is practically a continuous log raft between two chains or booms which are anchored to each bank. The ease with which such a bridge can be built, when timber is close at hand, and its great durability serve to recommend it. The military necessity of permitting traffic to pass through can be met in the manner explained below.

Two booms are first stretched from bank to bank, about 10′ or 12′ apart, and anchored. They assume of course a curved form according to the current. Each boom consists of a series of spruce or pine logs 12″ or more in diameter, chained together end to end. The chain usually used is $\frac{5}{8}$″, and a length of 8′ or 9′ is required to connect two logs. It is passed through a 3″ auger hole, bored 12″ to 18″ from the ends of the logs. A clearance of at least 10″ is required between the ends of the logs to allow free movement. The two booms should break joint with each other; they are kept apart at a fixed distance throughout by means of cross-timbers fastened below them at intervals with chains (all lashings are made with chains).

The booms having been fixed, stout cedar logs are laid longitudinally between them, close together, over the whole length of the bridge. Cedar being light cannot easily slip out underneath the booms; the cross-pieces under the booms (which should be placed at intervals not exceeding the lengths of the cedars) entirely prevent this possibility. Where extra buoyancy is required big timbers are lashed crosswise under the booms.

Figs. 12 and 13, *Plate* II., are a cross-section and plan of a portion of the bridge. Across the cedars is laid a corduroy roadway of light spars, which are ribanded down by means of logs secured to the booms with long trenails. Occasional cross-pieces of the roadway are lashed to the booms.

Fig. 14 shows a method of allowing traffic to pass through such a bridge. For the 'cut' the wooden booms are entirely replaced by chains, which of course sink and are kept as low as possible, either by a kind of crib underneath the ends of the wooden booms (as shown on the left-hand side of *Fig.* 14) or by means of a strut (as on the right hand side) when necessary. The 'cut' is allowed to drop down stream in the usual way. The 'cut' portion of the bridge is made up into a special raft, the ends of which are made temporarily fast to the fixed portions. Occasionally the 'cut' portion consists merely of light poles carrying the roadway, the poles and roadway being removed when required.

Where the booms are broken for the cut they are usually double or even treble. In cases where the logs of treble booms meet they must be chained as shown in *Fig.* 15 to ensure equal play in each chain. *Fig.* 16 shows another method of chaining two treble booms together. In this case the pins *bbb*... must be examined occasionally to see that the chain is not cutting through them.

Fig. 17 shows a suggested alternative method of anchoring booms which have been interrupted for a cut. In this case the booms are entirely disconnected.

In this form of bridge it will be seen that two usual principles in military bridging are contravened—the floating portion is continuous, and the width of the roadway is nearly as great as that of the floating pier. But in so rapid a stream as the Montreal, and with far heavier (though not so crowded) traffic than would accompany an army, no failure or inconvenience has been experienced.

A PILE DRIVER.

A pile driver frequently used in the backwoods may be useful for military purposes. It consists (*Fig.* 18) of a double triangular frame, the three sides of the triangle being respectively the uprights between which the monkey slides (BC and B′C′), two back struts braced together (AC and A′C′), and two horizontal pieces (AB and A′B′), also braced together, connecting the feet of the struts with the feet of the uprights. The tops of the uprights are connected with a cap piece. The whole structure can be bolted together at A, A′, B, B′, C, C′, so as to be portable in three parts.

Dimensions may vary. A height of 12′, an equal length of horizontal (making the angles of the triangular frame 45°, 45°, and 90°), and a width varying with the size of monkey and scantling used would be suitable. The uprights might be 6″ by 6″ to 8″. The weight of a pile driver of this size would average 400 or 500 lbs.

The monkey is a block of a log, flattened to slide between the uprights, and is fitted with 4 guides (*Fig.* 19) which consist of wooden pins passing through holes bored in the block. The guides bear on the uprights. A pulley is suspended from the cap piece.

In using this pile driver from the head of a pile bridge under construction, two long stout spars (say 30′ by 10″ at centre) would be pushed out as cantilevers from the bridge head as far as required and lashed down. The pile driver would be slid out on these cantilevers until the monkey was over the required position of a new pile. The pile driver would then be lashed down to the cantilevers in four places (H, K, H′ and K′ in *Fig.* 18). A long plank, placed as DE, would allow a man to stand outside the pile driver on each side of the pile and to hold the latter in a vertical position with cant-hooks or lashed levers.

TRAVERSED FIRE TRENCHES.

Fig. 1 shows the usual method of placing traverses. *Fig.* 2 shows an arrangement proposed by Mr. W. H. Alexander, late Qr.-Mr.-Sergt. R.E.

This proposal has the advantage of considerably reducing the length of firing line lost by the construction of traverses. It appears to have no disadvantages.

Fig. 1. Ordinary Traversed and Recessed Fire Trench.

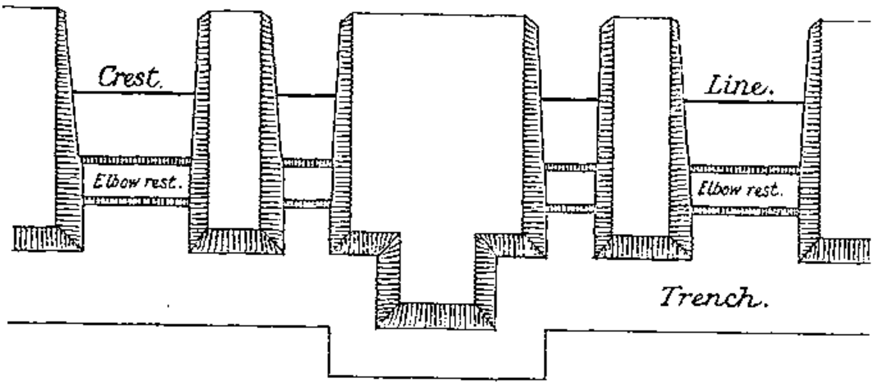
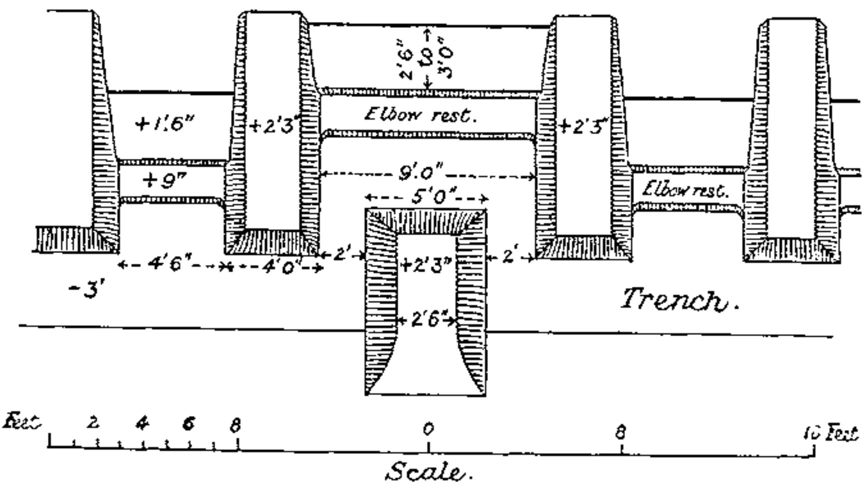


Fig. 2. Suggested Traversed and Recessed Fire Trench.



BUSINESS PRINCIPLES FOR R.E. OFFICERS.

By "C."

How to combine efficiency with economy in the organization, training, and administration of the British Army is a problem by no means yet completely solved, in spite of the labours of Commissions and the inspirations of successive War Ministers.

Economy is apt to degenerate into parsimony in time of peace, while the only real test of efficiency—war—has the awkward habit of throwing economy to the winds.

"Run the show on business lines," says the man in the street, "and there you are, don't you know." The truth is that a standing army is in itself essentially an unbusinesslike proposition. It is not easy to apply the ordinary rules of business to an aggregation of individuals, all of whom are, like Mr. Micawber, employed in waiting for something to turn up, and in the meantime are as drones in the hive, producing nothing, adding nothing to the wealth of the nation, and existing on the sufferance of the working bees. These latter, more merciful than Maeterlinck's protégés, provide the drones with the necessaries of life, only, however, on condition that they guard the hive and leave their busy fellows free to improve the shining hour in making—money. Now these same necessaries of life cost a pretty penny, and as business is concerned, among other things, in the spending of money to the best advantage, it is here that business lines may be pursued with considerable advantage.

Organization depends on the fad of the moment, training on the "lessons of the late war," but administration is business and independent of politics and parties.

What the man in the street does not appear to realise is that, to run the show on business lines, it is not merely necessary to disorganize the War Office, to call old things by new names, and to substitute new brooms of untried capacity for very serviceable articles of an older pattern. Reform in Pall Mall does not, in short, necessarily imply Army Reform.

The head of a business concern knows very well that the interest of the Firm may suffer through the neglect or incompetence of even a single employé in the humblest of situations, and he takes very good care to see that it does not.

Now the British Army is a very big concern indeed, and the business of feeding, clothing, and housing it cannot be economically and efficiently performed unless everybody concerned knows not only what to do but also how to do it.

The particulars recently elicited by the South African Stores Commission are sufficient proof that in such humdrum matters as contracts and sales at least a good many officers are mere babes in the wood, helpless victims of the wicked uncles as represented by the local contractors.

Their confidence in the integrity of human nature is beautiful and somewhat pathetic. One is almost persuaded to forget that it is considered in the bill to a pretty stiff figure.

But stone throwing is risky work for those who live in glass houses, and there are probably few officers of our own Corps who can proudly affirm that they have never been done over a business deal.

Such "regrettable incidents" tend to show that the education of officers, however thorough it may be in other respects, is decidedly deficient as regards the systematic inculcation of business principles. The man of business is not, like the poet, born, but made. Sometimes he is self-made, but more usually he is manufactured.

All business transactions are ultimately founded on a cash basis, and it therefore follows that a sound knowledge of accounts is the first and not the least important stage in the process.

Under ordinary conditions officers have little inducement to familiarise themselves with the principles and methods of accounting, and here it may be remarked that the term necessarily implies responsibility for *other people's money* and the duty of being able to *account* to them for its receipt and expenditure. Certifying bills for payment and recording the amounts in a ledger is not accounting, though frequently alluded to as if it were. Even if an officer may not be required in the usual course of duty to account for public funds, he will often be called upon to act as treasurer for regimental messes and clubs; and, if for no other reason, it is greatly to his advantage to be able to realise accurately and easily his own financial position. Yet it has been within my experience on more than one occasion to hand over accounts to officers who were obviously not only ignorant of but also entirely indifferent to the distinction between a cash balance and a balance sheet.

In war, any officer, and especially a R.E. officer, may find himself confronted with considerable financial responsibility, with no experienced clerk to relieve him of all labour save the exertion of signing his name. It is then that the inexperienced one will gladden the heart of the "honest merchant," who will promptly seize the golden opportunity of working off unpopular "lines" and derelict stocks at "war prices."

Let me not be misunderstood. There is no short cut to experience, which has to be bought and paid for like any other valuable commodity; but the price may, with common-sense precautions, be kept within reasonable limits.

Having mastered the intricacies of book-keeping—of cash-book, journal, ledger, balance-sheets, profit and loss accounts, stock accounts, and so forth—our tyro may be initiated into the higher mysteries of specifications, tenders, contracts, trade terms, prices and discounts, invoices, shipping and railway freights and rates, and all the other factors in commercial transactions. He will become acquainted with the forms and methods of business correspondence, and will learn to appreciate the subtle difference between addressing Mr. Jones as "Sir" or "Dear Sir." It will gradually be borne in upon him that a typewriter saves time; and that in a busy office the pounds are looked after by the General Manager while the office boy takes care of the pence.

I cannot do more than thus briefly indicate the principal items in a commercial education, and it seems superfluous to labour the necessity of including them in the professional training of officers of all arms. To R.E. officers they are of special importance; for officers of the Corps are brought into immediate and personal contact with the outside world of business, and to send them forth equipped with nothing but technical knowledge is a temptation both to Providence and the contractor. Providence *may* resist the temptation; the contractor will succumb without a struggle.

The remedy lies within our own hands. The young officer is already expected to be an Encyclopædia Britannica of information on most subjects from butcher's meat to the higher strategy. A chapter on business will not add much to the bulk of the volume, and it may render the remainder more readable.

Let accounting then be taught at Woolwich and Sandhurst, and let the more advanced subjects which I have mentioned figure at all events in the S.M.E. curriculum. I am loth to lay a final straw on a willing camel's back, but I would even add "business principles" to the subjects for promotion examinations. Lest a howl of execration greet this suggestion, let me hasten to remark that it is a wise subaltern that understandeth his own banking account, and that a contractor is harder to manage than a protractor.

TRANSCRIPTS.

THE PENETRATION OF SHELLS IN A SAND PARAPET BACKED WITH CONCRETE.*

The following is an extract from an account of some experiments which were carried out at the practice camp at Oldebroek, Holland, and were described in the official *Trials and Practice Report, 1904.*

"Two parapets were built as shown in *Figs.* 1 and 2, the front of each being revetted with deals.

A 15-centimètre gun, having a muzzle velocity of 460 m. (about 1,560 ft.), was placed at 80 m. (about 100 yards) range; and two shots were fired at each parapet. The average penetration into the one backed with concrete was 2·30 m. (about 8 ft.) and into the other 3 m. (about 10 ft.).

It was then decided to reduce the thickness of the sand to 2·50 m. (about 8 ft.); and three shots were fired under the same conditions as before. Again it was found that no damage was done to the concrete. The peculiar way in which the course of the shells has been influenced by the pressure of the sand is worth noting (*Fig.* 3).

A still further reduction was then made in the thickness of the parapet, which was built only 1·65 m. (about 5·6 ft.) thick. Three shots were fired at this under the same conditions as before. *Fig.* 4 shows clearly what happened, and the behaviour of the shells is again most remarkable.

From these experiments we gain a good deal of information as to the increased capability of resistance conferred on sand when backed by concrete. The results given ought to have some decided influence on the thickness of parapets of works, especially those which are allotted to coast defence."

The shells used were drill shells without bursting charges; they were fired point blank, and the front of the parapet was revetted.

These are not conditions from which many useful deductions can be made for experimenting in coast defence construction. Still the results of the trials have a general interest, and the illustrations show clearly the behaviour of an armour-piercing projectile or bullet in a parapet of sand slightly confined.

R. N. Harvey.

* This translation is published by the kind permission of the Dutch Minister of War.

FIG. 1.

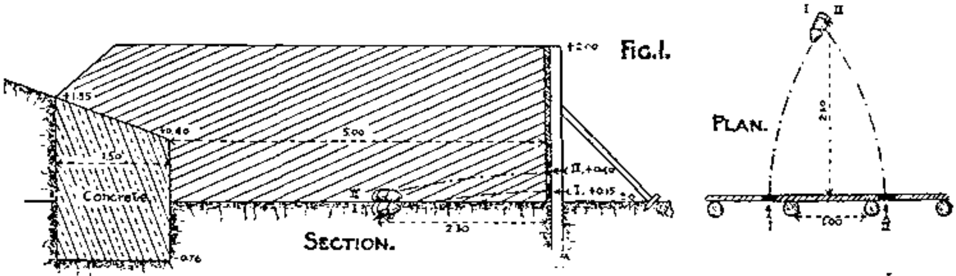


FIG. 2.

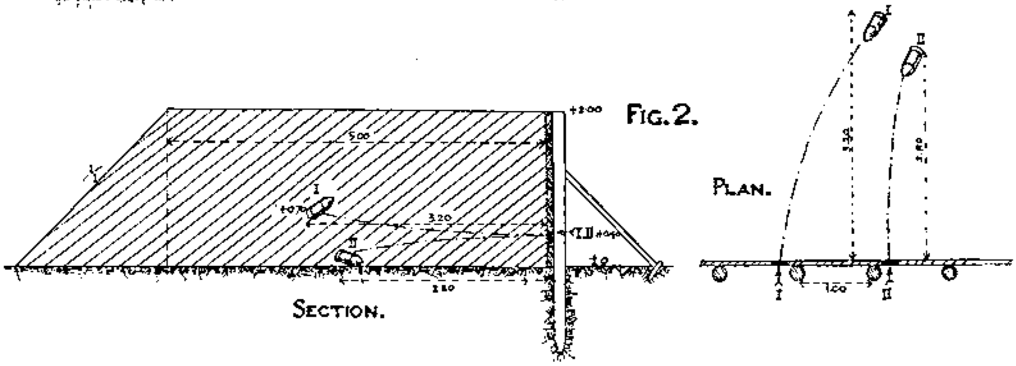


FIG. 3.

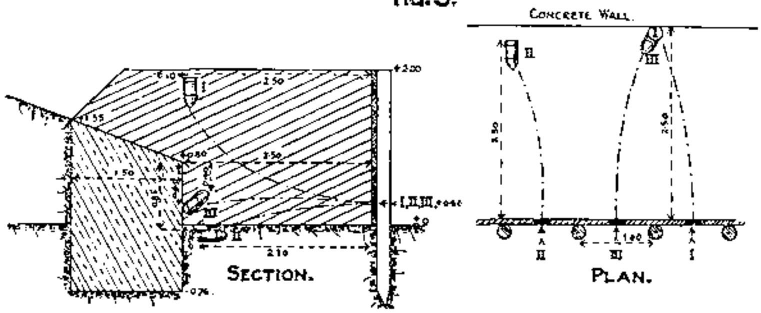
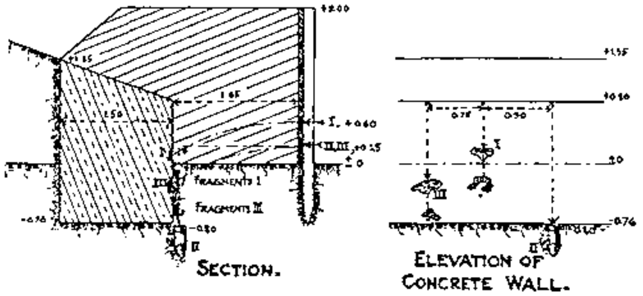


FIG. 4.



THE ORGANIZATION OF FORTIFICATION WORK IN FIELD WARFARE.*

UNDER the above heading the writer, recognising the very important lessons to be gathered from the field engineering experiences of the late war, contributes some opinions formed during a portion of the battle of Liao-Yang in August, 1905.

As a result of the long duration and obstinacy of modern battles the extreme fatigue of the men calls for careful consideration, and opportunities must be found for relieving the toil-worn and decimated battalions of the firing line by fresh troops from the reserve. But this is not always possible, and one cannot overlook the importance of field fortification as a partial means of relief.

In modern warfare every battle becomes a struggle for a fortified position. The protracted character of the fighting is itself both the result and the cause of the extensive use of fortification in modern battlefields. While the attack requires long preparation for breaking through the hostile lines and for developing its flank attacks, the defending troops are not slow to take full advantage of the delay of their opponents in order to strengthen the defensive portions of their position with a view to liberating a greater number of men for active defence and augmenting the reserve in the hands of the commander.

An error made by the Russians at Liao-Yang was the occupation of the defensive works on the left bank of the Tai-Tze by too strong a force. These works were in reality nothing more than a bridge head, and only played a secondary part in the engagement; yet they were occupied by two complete Corps, part of which might have been more usefully employed elsewhere. This error was due to an imperfect appreciation of the value of the effective fire of modern magazine rifles in combination with field defences, especially with such formidable works as those at Liao-Yang.

After the first series of failures in fights in the open a reaction set in, and the troops began to require a great deal more from the sappers than the small number attached to the divisions were able to carry out. The infantry expected the sappers to prepare for them in advance every position which they had to occupy, overlooking the fact that the sappers could not foresee every manœuvre of the armies; and they took to grumbling against the sappers and blaming them for their own want of success and heavy losses.

In order to take full advantage of field fortification and at the same time to leave themselves absolute freedom of action, infantry must learn

* Translated from articles by S. Petrof in the November and December, 1905, numbers of the *Enzhenernee Zhoornal.*

to make their own defences easily and quickly without the help of specialists. They must regulate their action by the movements of the enemy, and not tie themselves down to positions prepared for them some time in advance by their engineers. Examples are not wanting of the objections to this latter course, as for instance the strong lines of An-shan-chan, which the Russians were manœuvred out of without firing a shot.

As soon as the infantry learnt to appreciate the value of the spade and began to recognise the essential help they received from field defences, they began to lose their freedom of action and, unwilling to operate beyond the cover of their trenches, they began to suffer from "tactical paralysis." That the Japanese did not suffer from the same ignorance of the proper use of fortification and of the value of strong rifle and artillery fire, was proved by their capable performance on the principles taught them by their German instructors.

The problem set to modern military science is—What is the best means of counteracting the paralysing effect of the storm of fire of an attacking enemy and at the same time encouraging the *active* defence of a fortified position? In the solution of this question fortification and tactics must work hand in hand.

Three means are suggested for attaining this result. The first is the increase in the depth (front to rear) of fortifications, especially on flanks which are liable to enveloping attack. Notwithstanding the great improvement in modern artillery, the principal weapon in modern warfare is undoubtedly the magazine rifle in the hands of a well-trained man, and the first necessity of a defensive position is two or more lines of fire trenches. A large proportion of these trenches would be spare, for at the beginning of an engagement it would not always be possible to tell which trenches would be important and which only of secondary value; and only from this wide development of the system of trenches can be obtained the power of "manœuvring within entrenchments." Trenches thrown well forward in front of a position assist in discovering the intentions of the enemy and serve as a veil to conceal what is in rear of them, while those in rear of the main line form useful cover for the reserves.

The second means is a thorough system of concealed communications in rear of all the firing lines, leading by covered approaches to the concealed position road, and from that again still further to the rear.

At Liao-Yang, as soon as the enemy's fire began, it was found that communication between the various parts of the line became very difficult. The Japanese made a point of firing shrapnel at all individual horsemen in rear of the Russian lines; it was soon found that this means of communication was too dangerous, and orderlies had to make their way along the lines of defences and were consequently considerably delayed. At the time of preparing the position special attention was paid to masking the communications behind the high-standing millet; but on the first morning of the battle it was found that large gaps had been cut, exposing many of the works in the rear of the position and also portions of the road to observation from distant knolls on the Japanese side. The writer accuses the local Chinese of thus treacherously repaying the humanity of the Russians, which left them as far as possible undisturbed in their villages.

The third and last means of attaining success in a battle on a fortified position is the careful masking of all works and the concealment of all troops deployed in them. Defences not well concealed lose one-half of their value, especially in these days when there is no smoke to disclose the position of works otherwise well concealed. Everything must be thoroughly masked, not only completed works—redoubts, trenches, roads of communication, and river crossings—but also works in progress, by means of temporary screens erected in front of the workmen; and equally should all works of the enemy be carefully observed from hills or captive balloons.

By observing these conditions the service of communication in rear is rendered safe and free from interruption, and troops can be freely moved wherever the course of the battle renders concentration or reinforcement necessary.

Every defence should be arranged with a view to ultimately moving to the attack, and with this end in view every part of a position must be prepared for either active or passive defence.

For the former, wide passages for facilitating a general advance or for local counter-attacks must be left between the works. For protection these parts must depend mainly on effective fire, and they must be provided with a thorough development of roads of communication which will enable the reserves to be rapidly thrown into the fighting line.

In those portions of the position which are prepared for passive defence, the troops will be posted in weaker numbers and their weakness compensated for by formidable obstacles surrounding solidly-built works and trenches.

The points in a position which are most accessible to hostile attack are called "tactical keys" or "centres of resistance," and must be especially strongly fortified.

It sometimes occurs that a point especially vulnerable to hostile attack is also the most suitable for carrying out a counter-attack. Evidently this will be the scene of the most obstinate fighting and extra care should be taken with its defence.

It is plain that all this work cannot be carried out by the infantry alone, who have also to endure the excessive fatigue of the protracted battles of modern war. Neither can it be done by the parties of sappers attached to the divisions, although modern requirements will necessitate a large increase in their numbers. Wherever possible, hired labour under the supervision of engineer officers must be utilized.

In carrying out the fortification of a position everything depends on the skilful organisation of labour and superintendence; in order that there shall be no waste of labour every man must know what he has to do and must do that and nothing else.

Occasions occur when important lines in the theatre of war are prepared for defence some time before they are needed. Such lines should be built by sappers or civilian labour, but the infantry and sappers attached to the active divisions should not be told off for such work.

When troops occupy such a prepared position they must not rest satisfied that there is nothing more to be done to it; and it lies with their commanding officers to scrutinize everything and to carry out all modifications and alterations which may be required by any fresh conditions which have arisen. In this case the more simple work is done by the infantry while the divisional sappers are detailed for the more complicated services.

The organisation of work in the hasty defence of a fresh position, the "fortification of the battlefield," depends on the time at one's disposal, the object assigned to the force, its strength and composition, the character of the enemy's action, and on many other things. As to the question of time it should be noted that, owing to the difficulty of reconnaissance, to covering parties, and the great secrecy of action of both antagonists in modern war, the preparatory phases of modern battles cannot be hurried over and consequently there will usually be considerable time for carrying out the works. But it is necessary on such occasions to be able to decide what work is the most important, and so to construct the defences that at any moment effective resistance may be offered to hostile attack.

On such occasions the infantry would probably entrench the positions taken up by them in accordance with purely tactical requirements, and the sappers would be told off to strengthen the important points of support with such works and obstacles as they may have time and suitable materials at hand to erect.

With this view the infantry should be instructed in peace time in carrying out skilfully and expeditiously whatever work might fall to their lot in war. If they could be taught the construction not only of trenches but also of the works and obstacles required for points of support, they would release the sappers entirely for work in rear, such as organising concealed communication, making river crossings, constructing supporting works in rear and on the flanks, etc., duties to which it is undesirable to divert the infantry who are required in the firing line.

All efficiency in war depends on thorough instruction in peace time, and the lessons which are first learnt under the fire of the enemy are very costly.

As to artillery, its tactics have completely changed. Batteries cannot be placed in the open, but must be well masked or thoroughly concealed behind cover. In a defensive battle their most important duty is to oppose the enveloping and turning movements of the enemy. If the front of a fortified position is well supplied with rifle trenches it requires very few guns in that part, and guns so situated sacrifice to a great extent their valuable quality of mobility. But in opposing turning movements the long range and effectiveness of artillery fire gives it undisputed pre-eminence over rifle fire. Manœuvring freely on the flanks in conjunction with the mobile (*i.e.* not tied down to trenches) portions of the infantry, the guns can vary their position within wide limits depending on the fire of the enemy and the varying targets he presents to view.

The German method of massing guns remains essential in the attack. But in defence, so long as the energy of the enemy has not been worn out against the rifle fire and works of the position and the right moment for the counter-attack has not arrived, most of the guns should be kept with the mobile portions of the force.

By thus using the artillery in removing all fear of turning movements, and so inspiring confidence in the defence, the chances of "tactical paralysis" can be considerably reduced. For this purpose the artillery should be given great freedom of action and be independent of the infantry and of their lines of defence.

But a considerable change should be made in the organisation of the artillery. At present single crews for the guns are insufficient for carrying on their work, not to mention the fact that they often suffer heavy losses. The arrangement of infantry escorts is also unsatisfactory, and with the increase in the independent action of the guns will increase the difficulty to the infantry of the service of escort. At the same time the duties in connection with the guns themselves will become more numerous than the small gun crews can cope with. It is suggested that it would be incomparably better if permanent dismounted detachments were added to the strength of the batteries; besides acting as escort and being always ready to replace casualties among the gunners and drivers, such detachments could also man the drag ropes on hills or in marshy ground, excavate gun pits and roads of communication, arrange for rapid supply of ammunition, make observation stations and connect them with the guns by telephones, and perform all such special services as would enable the artillery to act without the assistance of other troops in whatever part of the position their independent actions might take them.

In this way the artillery, as well as the infantry, would be independent of the help of sappers, except on occasions when special technical work is required.

In preference to guns in the firing line the writer would recommend machine guns. Each machine gun sets free a number of rifles and bayonets, which can be used in the active parts of the defensive line; is more easily moved than a field gun; more easily concealed than its equivalent in riflemen; and more easily entrenched, and so saves a certain amount of digging. Machine guns also release the field artillery from the purely defensive parts of the position for more useful action elsewhere.

The two great principles to be aimed at in modern field fortification are:—

(1). To facilitate the *active* use of the troops, both by sheltering them behind works and by providing for their free manœuvring on the field of battle.

(2). By careful combination of labour to reduce the work of the troops as far as possible, so as to reserve their strength for the extreme tension of battle.

In posting a battery of artillery with a view to opposing the possible enfilade fire of the enemy, it should be placed with its flanks drawn back, so that, if the enemy suddenly appears on its flank, the fire of at least three guns can be brought to bear on him, whereas, if the guns were placed in a straight line, only one could be used.

A modern battle, owing to the large extent of front occupied by the opposing forces, is frequently broken up into a number of separate combats, and it is not easy for the troops in one part to tell what is going on in another. This enhances the importance of all kinds of signalling arrangements, whether balloons, telegraphs, telephones, heliographs, wireless telegraphy, or any other kind of day or night signalling. To connect the various staffs with each other and with the firing line should be the work of the sappers; but communication between the trenches and other works and their reserves and observation posts, etc., should be carried out by the troops themselves by means of visual signalling.

F. E. G. SKEY.

MODERN PERMANENT FORTIFICATION.*

THE desperate resistance which the brave defenders of Port Arthur made from their inadequately strengthened forts of Chinese construction, and from their hastily thrown up auxiliary works, against the artillery of the attack, which can hardly be described, from a modern point of view, as plentiful or of the latest pattern, makes it interesting to investigate how the works of large fortresses and barrier forts in European theatres of war are constructed and strengthened to resist the effect of high-explosive shell.

After the results of experiments made by all the great Powers from 1885 to 1890, which demonstrated the destructive effect of heavy mortar high-explosive shell against forts built according to the ideas of those days, the question arose as to whether anything could be gained by retaining and strengthening works dating from 1870 to 1885, or whether it would be better to give them up and replace them by new ones freely strengthened with concrete and armour.

France found the question most difficult to solve, owing to the fact that after 1870 she had constructed an elaborate system of barrier works and fortified localities at an enormous cost, while Germany had done little in the way of fortress construction. Other Powers, who had done little or nothing in the way of building defences, found themselves in the happy position of being able to benefit by their experiments and to make it worth their while to carry out schemes of modern fortress construction. A study of Army Estimates and military literature bearing on the subject shows that decisions were arrived at to strengthen and reconstruct existing works, and only to apply new principles to works in course of construction. Only a very few small and antiquated forts were converted, and others were retained as barrier forts or made to serve as the keeps of girdle fortresses. In future wars, in the attack of large fortresses many old works will have to be dealt with, which have been more or less modernised according to circumstances. At the same time we shall be confronted, with few exceptions, by well-fortified spaces between such works.

We must now see how this reconstruction of works has been carried out. In this connection, the suggestions made by prominent engineers after the results of the experiments give us very little positive information, but at the same time they have produced a number of ideas of which some have been found to be of value. In order to get a thorough grasp of the subject it is necessary to study deeply some of the more modern text-books on fortification and on the attack and defence of fortresses.†

* Translated by permission of the publishers from the *Kriegstechnische Zeitschrift*, No. 9, of 1905.

† E. Hennebert, "Fortifications," Paris, 1894. "Nouveau Manuel de Fortification Permanente," par un officier superieur du genie, Paris, 1895. "Instruction Générale du 4 fevrier 1899 sur la Guerre de Siège," Paris, 1899. "Instruction Provisoire sur le Service de l'Artillerie dans la Guerre de Siège," Paris, 1905.

As valuable adjuncts to these the following may be read, viz. :—*Le Monde Illustré*, 1904, S. 428–29, and *La Vie Illustrée*, 1904–05, S. 240–43. The reproductions of photographs of new fortifications which appeared in the *Illustrated London News* of the 28th January, 1905, though not quite accurate, are also useful.

The works of large fortresses and barrier forts, built before 1885, were constructed on high sites in order to obtain a wide field of view and to make the greatest use of the long range artillery mounted in them. Their conspicuousness was further emphasized by the roofs of the many-storied bomb-proof barracks built inside them. The ramparts were well found in traverses and hollow ways, and the works themselves presented an easy target to the hostile artillery. The profile of German and Russian forts was low in command, that of French, and of Belgian to some extent, very pronounced in every way; indeed the French forts, with their barracks and upper ramparts and numerous traverses, formed veritable shell traps.

When in 1880 the high-angle fire of heavy mortars and the shrapnel fire of long range large calibre guns developed in an unexpected way, some of the guns were placed in low-sited connected batteries and a few intermediate batteries were placed here and there. Some heavy guns were placed in revolving cupolas, visible from a long distance. In France two guns were placed in a cupola, the armour of the roof being 7·8″ thick and that of the sides 17″ thick. The action of revolving the cupola was intended to decrease the chances of hostile shell entering the embrasures.

The introduction of heavy mortar high-explosive shell in 1885 altered all ideas of the *rôle* which the outlying works of large fortresses were intended to play in the defence, and resulted in their reconstruction into works intended merely as supporting points to the main artillery positions and to be occupied by infantry and light guns. The high sites and commands of these works, which in many cases it has not been possible to remedy, are disadvantages which have to be reckoned with and which will be avoided in new works. Connected batteries in fortresses have had to be given up, but have been retained in barrier forts consisting of a system of works where the cupola is also in use.

The high-sited outlying works of fortresses have been used further for a few guns of large calibre, the *rôle* of which is to harass, at ranges of from 6 to 8 miles, the movements of the investing troops and the preparation of siege batteries. Where these guns are intended to fire at close ranges they have been left in armoured casemates or, as in France, in the old cupola, against which in experimental firing mortar shell had been found to glance off and do little or no damage.

In barrier forts, the open ramparts of which are still to be defended by guns for which no other use can be found, a resistance of only a few days can be expected. Only those forts have been strengthened which block important railways or which are capable of delaying attack on neighbouring works. In these cases, the strengthening has taken the form of a complete reconstruction, by which the garrison has been placed in bomb-proof covers and guns, both short and long range, mounted in armoured cupolas.

Fig. 1 shows a disappearing cupola in its raised position. A cupola 10 feet in diameter accommodates two Q.F. guns of small calibre: the one in *Fig.* 1, 17 feet in diameter, accommodates two heavy guns

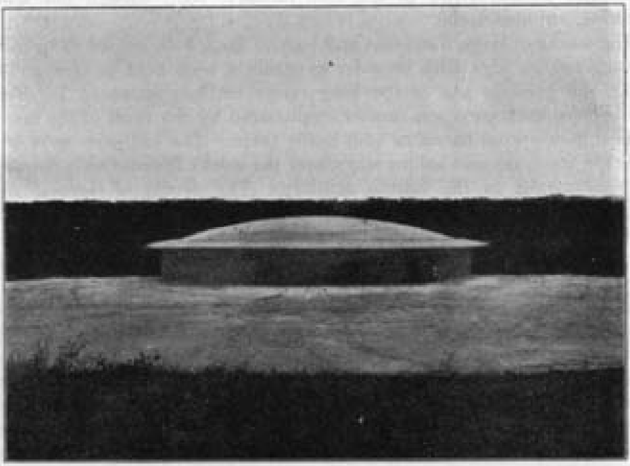


FIG 1

mounted as a pair, 3 feet apart. Their form of construction is that which was in vogue in France in 1892, namely the Galopin system. The cupola illustrated is armed with two long 15·5 c.m. (6") guns, which can be loaded and laid in the sunken position and fired by electricity in the raised position, resuming the loading position on discharge. The exposure is for 5 to 6 seconds, but the cupola can remain in the raised position and can be revolved. The thickness of the roof armour is 9·8" and of the side armour 17·7", the material being Schneider nickel steel. The cupola rests on the ends of two double-armed levers fitted with counter weights. An auxiliary weight works on a third lever, the sudden release of which gives the upward movement to the cupola. This motion is probably worked by electricity. The space between the concrete emplacement and the cupola is closed in the sunken position, by a gutta-percha projection from the roof of the cupola itself. Cupolas containing Q.F. guns of small calibre are used at the angles of barrier forts and out-lying works, in order to get as wide an angle of fire as possible. Their *rôle* is for the defence at close range, and the maximum thickness of the roof must be 9·8", the concrete emplacement being strengthened by armour if necessary. The great cost of these cupolas for heavy guns militates against their extensive use. The Creusot works have turned out a revolving cupola mounting two 15-c.m. (5·8") guns for Belgium. Cupolas for howitzers in concealed positions have also been supplied for that country as well as Germany. In France these found no favour on account of the general prejudice of artillery officers against armoured protection for guns. In Russia armoured protection for guns is considered dispensable and at Port Arthur many guns were mounted in the open on the high ramparts of the forts.

As it is impossible to observe fire from cupolas, armoured conning towers have been erected in reconstructed works. These (mostly fixed structures) are provided with narrow horizontal slits facing in different directions. They project about 1·9 ft. above the concrete emplacement, have a mushroom top about 1 yard in diameter, and present a strongly armoured and visible but small target. Similarly constructed conning towers of forged steel are provided for infantry observing stations. Disappearing conning towers have come into use in small numbers and are useful where search lights are employed.

Concrete, as well as armour, plays an important part in fortress construction.

In *Fig.* 2 a glance at an old strengthened mountain barrier fort in reverse shows how guns and garrison have been thus protected. On the

FIG 2

left are the gun casemates, each gun firing probably through an armoured embrasure vulnerable to mortar fire. Massive protection of this description (which is cheaper than entire armour) for guns intended to fire only in one direction, such as for the command of certain approaches, was thought to be indispensable. There are four concrete casemates écheloned from left to right. Roofs and sides are 7 feet thick. The armament consists probably of light or medium Q.F. guns. The casemates on the right look as if they were intended for infantry, as the entrances are so much smaller than the others. Under the parapet and casemates are concrete barracks, fitted with rifle loopholes on one face and gun embrasures on the other. There are four holes in the roof for ventilation, through which protrude small iron chimney pots.

In the reconstruction of outlying and intermediate works, particular stress is laid on the fact that the ground between them, where artillery positions and infantry shelter trenches would be, should be covered by their gun fire. Further the ground in front of neighbouring works should be flanked. For this reason the angle at the gorge is now made less obtuse, and concrete traverses are used to protect the infantry banquettes and gun emplacements from enfilade fire.

A better arrangement, which holds also against high-angle fire, is that of two adjoining gun casemates, back to back. Such a flanking battery may be placed at the gorge of a work, concealed from the front by the angle of the gorge, the 7 feet thick roofs being flat and covered with earth and indiscernible even from a balloon. These are called Bourges casemates and are armed with 7·5-c.m. (2·9″) Q.F. guns.

Such arrangements seem simpler than the proposals of Voorduin, Lausent, and Welitschko to have caponiers in rear of the centre of the work, as is done in Russian forts.

These works now assume the character of supporting points, owing to the fact that the profiles are arranged entirely for infantry defence and that the breastworks have been considerably strengthened against high-explosive shell fire. At one time the thickness of the parapet was only 22 to 26 feet of earth, now it is 39 feet and in many cases strengthened with a concrete revetment with a layer of stones or rock. Infantry banquettes and gun or machine-gun emplacements are very often made of concrete. The old shoulder traverses are carried to the height of the parapet, and the passages through these are revetted with concrete. Works which have been entirely reconstructed present, in their modified form, a far less target from a distance, especially where the high command has been reduced. It has rarely been found possible to merge the outlines of the works themselves into the features of the ground, as has very often been done in the construction of new works.

Endeavours have been made to give the reduced garrisons—say a company of infantry and some artillery personnel—immunity from high-explosive shell fire, and also to similarly protect the ammunition.

There are still a number of forts which have not had their parapets altered, but have been reconstructed internally with concrete, and have therefore the outward appearance of old works. The armament of these has not been changed, and they would be the first to attack. Such antiquated bomb-proof barracks, as still exist, are retained for use in time of peace. Some of these, however, have, as far as their foundations and abutments permitted, been strengthened with layers of concrete. These layers, from 3½ to 7 feet thick, have been in many cases separated from the old walls by a packing of sand, or a corridor, and secured against gun fire on exposed quarters by a packing of stone. Overhead earth cover has always been made 1 ft. 9 in. thick, in order to lessen the effect of high-explosive shell. Very often it has been omitted altogether.

Five or six large living rooms, of from 16 to 32 square feet, have been prepared for two-thirds of the garrison. In cases where old barracks had not been strengthened, new ones have been constructed of concrete or have been bored out of the rock, in many cases being located in the ditch of the gorge and lit and ventilated by portholes opening into it. The necessity for providing against shell splinters by closing the portholes with shutters of nickel steel has necessitated the use of artificial lighting and ventilation. It has been possible of recent years to modify the strength of massive concrete walls by the use of "beton armé," concrete applied to iron uprights of about a finger thickness. The construction of this form of concreting requires highly skilled labour.

Fig. 3 shows the interior of a modern fort fitted up with concrete barracks. The rounded roofs are intended to cause shell to glance off.

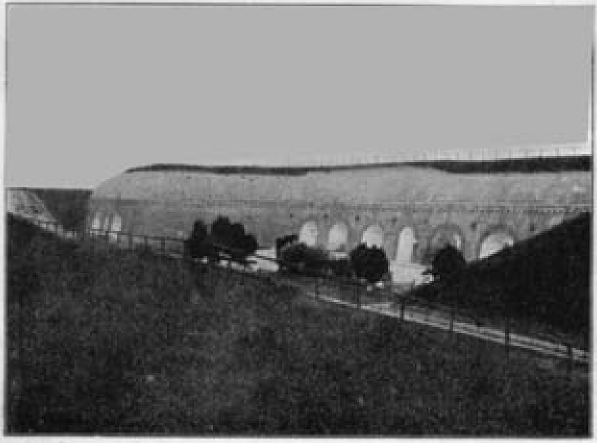


FIG 3

Fig. 4 shows some unprotected barracks inside a new fort provided with concrete-lined parapets. The portion of the building on the right has had its roof strengthened with concrete. An old covered way lies behind the top of the barracks.

In certain cases the living rooms of the garrison lie outside the work, and are connected with it by underground passages. This very often happens where barracks have to be excavated in rock. The minimum thickness of rock for the roof must be from 16 to 17 feet, and the floor must be at least 29 feet below the surface of the ground. The illustrations in *La Vie Illustrée* give an example of subterranean barracks with two entrances, about 45 feet apart, in the natural scarp of the fort; two cylindrical ventilating shafts, about 3 feet in diameter, show above the surface of the rock, about the same distance apart as the entrances. As these shafts have to be taken down on the outbreak of war in order not to give away the position of the barracks, it is doubtful whether the living rooms, 22 feet by 65 feet, would get sufficient ventilation by artificial means. There is no doubt that they would be quite safe from the effects of high-explosive shell, but it would be good neither for the health nor moral of the garrison to remain in them. A bomb-proof cover open to the rear lies outside the work.

Strengthened spaces in forts must be connected by passages lined with concrete. Access to works is now obtained through the ditch, not over a bridge, and in reconstructed forts entrances have had to be excavated.

The protection of the ammunition for the few remaining guns in modern works has not presented much difficulty. The ammunition for guns in cupolas lies beneath the concrete floor of the cupola emplacement; for other guns small magazines protected by concrete have had to be constructed. For fixed ammunition cellar spacing with little or no ventilation suffices, a much simpler state of affairs than heretofore. In barrier forts, where a greater amount of ammunition has to be protected, in addition to expense magazines, large main magazines are very often constructed outside the work and connected with it by underground passages.

Measures for improvement in fire effect from high parapets are closely associated with those for adding to immunity from assault. Alterations in the command of forts have necessitated reconstruction of the glacis, and very often the construction of a double glacis for the protection from hostile fire of wire entanglements placed on the glacis itself. These entanglements surround the works and have a depth of from 50 to 100 feet. They consist generally of strong iron posts, let into concrete sockets, from which the wire entanglement depends in all directions; the destruction of the obstacle by shell fire entails the expenditure of a vast amount of ammunition. Breaches made in the entanglement can easily be filled up by the defenders by throwing in loose rolls of wire. As high-explosive shell gain better effect on the work itself, the destruction of wire entanglement will in future be left to the engineers of the attacking force.

There has been some hesitation over the reconstruction of the ditch, in spite of the fact that splinters from high-explosive shell have great effect on masonry revetments and caponiers. Where the ditch is cut in the rock, the danger is less; the walls on either side are retained, and are probably strengthened in the upper portions, where the rock is less stable, by a concrete and stone revetment. This holds at any rate for the counterscarp wall, which would have to be breached to enable a storming party to obtain access to the ditch. If replaced entirely by a concrete revetment of from 10 to 14 feet thick, the height of the wall would be reduced to from 14 to 16 feet, and the berm thus made filled in with earth about 14 feet high, crowned by an 8-ft. iron paling. The use of a similar paling, about 11 feet high, to replace the escarp wall, if this were dispensed with and an earthen revetment used, would be quite in accordance with modern principles, which lay down that as little masonry work as possible should be exposed to direct fire. For this reason masonry revetments of the escarp of the gorge ditch are dispensed with and the counterscarp is revetted with earth.

The most important factor for the defence of forts against assault is the construction of indestructible auxiliary works for flanking the ditch. In forts exposed to attack, the caponiers, which were impossible to strengthen against high-explosive shell fire, have been replaced by concrete gun casemates built into the counterscarp at the angles of the ditch, and provided with embrasures from which the ditch can be flanked. These are called reverse caponiers. The embrasures are provided with iron screens (high-explosive shell curtains), which are intended to reduce the chance of their being destroyed. These flanking works are strengthened with concrete and stone from 8 to 10 feet thick, and countermine galleries are connected with them in order to be able to operate from them against the mining operations of the attack. In the siege of Port Arthur it was demonstrated that mining had to be resorted to in cases where fire effect did not attain the results hoped for.

Intermediate works have been constructed on the same principles as the above; but the lines adopted have been simpler, owing to the fact that the garrisons required are smaller than in large forts and heavy guns are not used. Deep ditches with flanking batteries have been dispensed with in this form of work; immunity from assault is provided for by a shallow ditch with wire entanglement, covered by the fire of Q.F. guns in disappearing cupolas and by the rifle fire of the garrison.

It may now be expected that most of the defences on the important frontiers of great military Powers, especially the more important barrier forts, will have been strengthened or reconstructed on the above principles. The lessons learnt from the recent war will no doubt give a spur to further strengthening of works, for the possibility of being able to resist modern methods of attack behind fortifications for an indefinite time has been well illustrated in the siege of Port Arthur. The period of resistance will depend more than ever on the moral of the garrison.

REVIEWS.

ACTIVE SERVICE POCKET BOOK.

By BERTRAND STEWART, 2nd Lieut., West Kent (Queen's Own) Imperial Yeomanry.—($5\frac{1}{2} \times 4$. 2s. 6d. Gale & Polden).

THE quantity of useful information and hints compressed into this little book—412 pages in the same compass as the 189 pages of *Combined Training*, weight 5 oz.—is astonishing. A large-minded War Office will doubtless refrain from prosecuting the author for masquerading it in the binding, colour, and "get-up" of the official training books of the day, when it recognizes its educational value.

Reading the book through from the Table of Contents to the well-arranged Index, it is difficult to find a superfluous sentence or to think of any subject of value to a minor leader in the field on which it does not furnish concise and complete information.

This is no cram book with boiled-down "tips" to enable the imperfectly educated officer to circumvent an examining board. It is an encyclopædia of information and a reference pocket book for constant use in the field. Many a regrettable incident on active service might have been avoided if the maxims set forth in it had been in the wallet or in the pocket, handy to refresh a memory jaded by the unceasing toil and strain of war.

The "Points to Note" in making reconnaissances and reports of all kinds are exhaustive and, if committed to memory and acted on, would tend to produce information of real value to commanders.

The chapter on Field Sketching is eminently practical; and the forty useful pages (with diagrams) on Finding Bearings by the aid of sun or star compasses and by the moon appear probably for the first time in any pocket book of this kind.

The part dealing with Field Engineering is rightly devoted chiefly to hasty demolitions, for the book is written mainly for the use of squadron officers and N.C.O.s of cavalry, mounted infantry, and yeomanry. At the same time much of it is equally valuable for infantry and other arms.

It is pleasant to see the acknowledgment in the preface of the assistance of two R.E. officers (Capt. C. W. Singer and Lieut. C. W. Biggs), who have enabled the author to make the information on Sketching and Field Engineering so complete and practical.

It is to be hoped that this little pocket book will have such a reception in the service as may induce the author to produce a companion volume for the infantry; the bulk of it would not require great alteration and much might be transferred *en bloc.*

G. H. SIM.

A WEEK AT WATERLOO IN 1815.—LADY DE LANCEY'S NARRATIVE.

Edited by MAJOR B. R. WARD, R.E.—(8 × 6. 6s. net. Murray).

Sir William De Lancey was Deputy Quartermaster General on Wellington's staff at Waterloo. The Duke told Lord Stanhope that "he was next De Lancey when he was struck; it was not by an actual wound, but by the wind of a cannon ball. This it was afterwards found had separated the ribs from the backbone. . . . He was thought to be dead, and reported as such in the first bulletin of the battle; however, the Duke had him carefully conveyed from the field in a blanket, and was afterwards told not only that he was alive but that he would certainly recover."

He lived rather more than a week. His wife, who had been married to him less than three months, was at Antwerp on the day of the battle, but joined him two or three days afterwards at Waterloo. Her narrative is a most touching record of those last days, unique in its simple realism. Sir Walter Scott said of it, "I never read anything which affected my own feelings more strongly," and the impression which it made on Dickens was even greater.

It was published for the first time in the *Century Magazine* last April, and now appears as a volume with an introduction and notes by Major Ward. Many people will be glad to have it in this form, though it is rather needlessly substantial.

E. M. LLOYD.

RULES FOR THE TRANSLITERATION OF PLACE-NAMES ON FOREIGN MAPS.

By ALEXANDER KNOX, B.A.—(6 × 4. 1s. Wyman).

The War Office has recently published this most useful little book, compiled in the Topographical Section of the General Staff by the Map Curator.

The 80 odd pages contain:—the Rules of the Royal Geographical Society; this Society's Alphabet in use for spelling Native Place-Names, and Letters and Combinations to be avoided; the methods of spelling adopted by the French, Belgian, Italian, Spanish, Portuguese, German, and Dutch authorities; and rules for transliterating the names on the maps published by these nations of their own foreign possessions, as well as names on Russian and Chinese maps. There are also Tables giving the "Wade" spelling corresponding to the French and German renderings of the Chinese word-elements.

The Rules contained in this book have been submitted to, and in the main approved by, the Foreign Office, the Colonial Office, the Admiralty, and the Royal Geographical Society.

A. T. MOORE.

NOTICES OF MAGAZINES.

Mitteilungen über Gegenstände des Artillerie-und Geniewesens.

July, 1906.

Sea Transport and Disembarkations.—A great deal has been written latterly in German military papers concerning the disembarkation of troops on a sea coast.

Blume estimates that on a moderately shelving beach 3 hours are required for the landing of 1 battalion, if the ships can anchor at about 1,200 yards from the shore; but if they cannot get closer than 2,500 yards, 5 to 6 hours are necessary.

For the landing of an army corps, assuming that the shore for a length of 12 miles offers the necessary facilities, about 48 hours are reckoned necessary, and to this must be added the time required to land the transport.

In 1881 experiments in embarkation and disembarkation were carried out at Neufahrwasser to ascertain to what extent merchant ships could be utilised as means of transport. Two three-masted ships were requisitioned, and within three days were fitted up with horse stalls, etc. On the 28th July 1 field battery of 175 men, 150 horses, and 18 vehicles, and also 125 infantry were embarked, the horses being hoisted on board partly by slings and partly in horse boxes. The next day the ships put to sea and disembarked the troops at another place without mishap.

In the Imperial Manœuvres in Mecklenburg, 1904, the fleet conveyed 1 infantry brigade, 1 troop of cavalry, 2 batteries, and 2 companies of pioneers, the total strength being 3,600 men, 170 horses, 8 guns, and 25 wagons. The personnel was carried on coast defence ships and cruisers, and the horses and wagons on six sea-going lighters.

The ships could not get nearer than 7 miles from the coast, and the boats themselves could not get closer than 1,200 yards; from this point the men had to wade ashore, carrying their boots on their rifles. The lighters were taken to a place where they could get within 200 yards of the shore.

During the disembarkation a pier 120 yards long was built by the engineers to facilitate re-embarkation in case of necessity.

Communication between the ships and troops was kept up by wireless telegraphy.

The English manœuvres on the coast of Essex in 1904 were followed with great interest in Germany, and in the official *Pocket Book for Pioneer Officers* a great deal of information on the subject of embarkations and disembarkations is to be found.

The transports consist of:—

(*a*). Passenger and freight steamers.
(*b*). Sea-going lighters.
(*c*). Steam tugs.

(*a*). The Pocket Book lays down that the *Passenger and Freight Steamers* must be specially adapted for the disembarkation of troops in such a way as to be independent of any extraneous assistance.

As the crew cannot be depended on for much assistance, a detachment of pioneers should always be on board; and two steam launches with relief crews should be provided for towing purposes.

Timber and ropes for the erection of piers and landing stages must also be included; derricks and cranes must be strengthened if necessary.

Gangways and rope ladders must be provided and, where horse transport is involved, ramps from one deck to another; and horse boxes must not be lost sight of.

Special care must be given to the provision of lighting apparatus for use at night and also to means of communication by signalling or telegraphy.

In arranging accommodation for personnel the provision of arm racks and stores for kits is important. Life belts must be provided on all the troop decks. Where the deck floors are of iron, they must be covered with matting to give the troops a firm foothold.

The Pocket Book gives detailed instructions concerning the accommodation of horses. The floors should be studded with cross strips to prevent slipping, and all posts, etc., padded with leather or canvas and straw. The horses should be placed at right angles to the longitudinal axis of the ship, in double rows facing one another, and with a passage 4 or 5 feet wide between them so that they can be easily fed and watered.

(*b*). *Sea-going Lighters.*—The German lighters are 100 to 180 feet long with a draught of 3 to 10 feet and a carrying capacity of 250 to 1,000 tons.

They can in very favourable weather be quickly adapted to carry troops, but as a rule are only used for heavy stores, etc., and occasionally for horses.

(*c*). The *Tugs* are for towing the lighters; and when this work is accomplished, they are used for communication purposes.

For landing both troops and stores the following are used:—

(1) Lighters.
(2) Steam launches.
(3) Shore boats.
(4) Ferry boats.
(5) Rafts.
(6) Piers.

(1). The *Lighters* with their flat bottoms can be run aground and then off loaded, or can be used to convey stores from the steamer to a landing pier erected in shallow water.

(2). The *Steam Launches* are used for towing the shore boats or barrel rafts, etc.

(3). *Shore Boats*, or the ship's boats, are of the following dimensions:—

Name.	Length.	Breadth.	Accommodation.	Draft.
Long boat...	30 to 40 ft.	9 to 11 ft.	80 men.	3 to 4 ft.
Pinnace	26 to 30 ft.	7 to 9 ft.	60 men.	3 to 3½ ft.
Cutter.........	24 to 30 ft.	6½ to 7½ ft.	35 men.	2½ to 3 ft.

(4). *Ferry Boats* in Germany consist of two large pontoons, coupled together and decked to form a raft. A strong rail is put round the deck and the sides are planked.

Such a raft is capable of carrying 12 horses or 3 vehicles at a time, and when loaded has a draught of 2 feet.

(5). The *Rafts* may be constructed of various material, such as barrels, timber, or waterproof bags.

(6). The *Landing Piers* are part of the special equipment of the transport ship and consist partly of trestles and partly of floating piers.

The roadway of the fixed portion of the pier must be at least 5 ft. above high water, and at the pier head a depth of 9 feet at low water is desirable.

The floating bridge-head rests on pontoons or lighters.

In disembarkations the pioneers, assisted by the crew of the transport, have the following duties to perform, as laid down in the Pocket Book:—

(i.). Working the cranes and derricks.
(ii.). Putting out the gangways and ladders.
(iii.). Lowering the boats.
(iv.). Building rafts.
(v.). Loading rafts with vehicles and horses.
(vi.). Attaching watertight sacks or barrels to vehicles and guns, to float them ashore.
(vii.). Preparations for swimming horses ashore.
(viii.). Construction of piers.

It will thus be seen that the German pioneers perform a large number of duties for which in English transports the crews are responsible.

C. OTLEY PLACE.

NATURE.

June and July, 1906.

THE STABILITY OF SUBMARINES.—By Sir W. H. White (*p.* 129).—In modern submarines of large size the operation of diving is performed when the vessels have headway. Horizontal rudders, controlled by skilled men, are employed as the active means of depressing the bow. The pressures on the upper surface of the vessel, resulting from the relative movement of the surrounding water, develop a vertical component acting downwards, which overcomes the small reserve of buoyancy and the vertical component of the pressures on the rudder. The submarine then moves obliquely downwards. When the desired depth below the surface has been reached, the steersman operates the horizontal rudders in such a manner that the vessel shall advance on a practically horizontal course, although it really is an undulating one. Watchfulness and skill are necessary to achieve this result, and there must be no movements of men or weights which would vary the position of the centre of gravity. If such movements become necessary, as when torpedoes are discharged, compensation must be arranged to take effect at once. Failures to comply with these conditions involve serious consequences and have caused submarines to dive to great depths; with trained and disciplined crews such accidents are rare. Plans for the automatic maintenance of any desired depth, similar to those used in locomotive torpedoes, have been tried, but for large submarines manual control has been found preferable. There has been a considerable increase in the speed of submarines. Our latest types have surface speeds of thirteen knots and a radius of action of 500 miles, while the underwater speed is nine knots and radius of action of 90 miles. The risk of diving to great depths increases greatly as speeds are raised, and they are now far from negligible.

THE ROYAL OBSERVATORY, GREENWICH (*p.* 136).—The measurement of the Greenwich photographic plates for the Astrographic Catalogue is now complete and the press copy has been prepared for the seven zones 80° to 86°. It is shown that the total number of the stars in this section will be about 178,380, whilst for the same region the Bonn Durchmusterung contains only 25,184 stars. For the different exposures given to the Greenwich plates the following numbers are shown:—

Exposure	20 seconds.	3 minutes.	6 minutes.	40 minutes.
Number of stars ...	12,019	56,921	58,393	170,180

Thus on the Greenwich plates with 40 minutes exposure there are 305 stars per square degree, or about 26 times as many stars as are given in the corresponding regions in the B.D.

AN INTERESTING MINOR PLANET (*p.* 210) recently discovered (T.G) proves to be of exceptional interest owing to its great mean distance being slightly greater than that of Jupiter, whilst its aphelion distance is nearly one unit beyond Jupiter's orbit. This discovery extends the limits of the asteroids so that they now include a distance of 1·1 (distance of sun from earth) the perihelion distance of Eros and one of 6·0 units, the aphelion distance of the newly discoyered (T.G.) asteroid.

CURVE DESCRIBED BY THE EARTH'S POLE (*p.* 237).—The possibility of a periodic shift of the earth's axis was foreseen by Euler, who calculated the time of revolution to be ten months, but this was not supported by observations, his calculation having been based on the supposition that the earth is an absolutely rigid body. Any yielding would increase the length of the period; in fact the earth must be more rigid than steel in order that the period should be as short as fourteen months, the period which Professor Chandler has demonstrated to be the case from existing observations. The pole describes a closed curve in about 14 months, but the displacement from its mean position is never more than about eight mètres. This shows how indirect information, on the physical properties of the earth, may be obtained sometimes in an unexpected manner; the periodic revolution of the pole leading to an estimate of the average rigidity of the interior of the earth.

SYMBIOSIS (*p.* 157).—The white ants in Ceylon cultivate nodular masses of fungus (entitled Termite truffles) in their nests. The nodules, about the size of pin's heads, are proved to be of fungus growth, and are introduced and cultivated by the termites for feeding the larvæ of the workers and soldiers and by the sexual forms at all ages, the adult soldiers and workers having, however, other food.

A crab in the Mauritius called "Melia Tesselata" is in the habit of holding sea-anemones in its two front claws, which it presents, with the tentacles fully expanded, to every intruder, in true "boxing attitude"; the stinging threads of the anemone are thus its active means of offence and defence, while the anemone benefits by its increased mobility in obtaining food.

"BRITISH INLAND NAVIGATION."—By A. Forbes (*p.* 169).—This book contains a considerable amount of information as to the rise, progress, and present condition of the inland waterways of the United Kingdom; the very extensive coast-line and numerous important tidal rivers are exceptionally well fitted for maritime trade; but the restricted area and small river basins, resulting in small rivers above their tidal limit, separated by high-water partings in proportion to the moderate distance between them, requiring to be surmounted by a canal, place this country at a serious disadvantage in regard to inland navigation, as compared with the Continent of Europe with its very extensive river basins draining into large rivers flowing for long distances over level plains, and capable, in some cases, of being joined, across their water parting, by a canal at a reasonable cost. Many of the French canals, however, have a traffic which could hardly pay their working expenses, as is the case with our Caledonian Canal; so it is evident that the purchase and improvement of the English canals as a whole would probably be a financial mistake; but the connection of Birmingham with a seaport by an adequate waterway and the development of some through routes might be effected with good prospects of satisfactory results.

TYPHOID BACILLUS (*p.* 280).—When exposed to the action of flowing lake water the longevity of the typhoid organisms ranged from eight to ten days; while exposed directly to the action of sewage bacteria it was reduced to three to five days!!

W. E. WARRAND.

REVUE DU GÉNIE MILITAIRE.

June, 1906.

TELEPHOTOGRAPHY FROM BALLOONS.—This is a continuation of the article which appeared in the May number. In order to be able to plot on a map the objects which are photographed, it is necessary to know the exact height of the optical centre of the camera. This is ascertained by photographing the balloon from the ground with another camera, placed at a fixed distance from it and inclined at a known angle. This photograph must be taken at the same instant as the plate in the telephoto apparatus is exposed.

At the conclusion of the article an account is given of experiments made during artillery practice in 1900 and 1905. In 1900 an attempt was made to locate the targets—various batteries and redoubts—by means of telephotographs taken from three different points, about 4,000 yards apart and 3¾ to 4¼ miles from the works. When the results were plotted it was found that some of the works had been located with absolute accuracy, and that the greatest error in the other cases was not more than thirty yards. The orientation of two of the batteries was very inaccurate. This was because they could only be photographed from one point.

In 1905, during the siege artillery practice, the targets were photographed from the besiegers' position, and *vice versâ*. From these photographs all the works were accurately plotted on the map, with the exception of two small shelters, where there was an error of 15 mètres. The range at which these photographs were taken and the relief of the objects photographed are not stated.

CONSTRUCTION OF REINFORCED CONCRETE WELLS.—A circular hole is excavated to a depth of about 3 feet, and its sides are lined with a meshwork of horizontal and vertical wires, the upper ends of the latter being bent back so as to form the skeleton of the concrete rim for the mouth of the well. Cement concrete is then worked into the meshes with a trowel, till a thickness of at least 2 inches is reached. Excavation is then continued, and a new section of the lining is constructed below the first, the vertical wires of the two sections being joined together.

If treacherous ground is reached, a reinforced concrete cylinder of smaller diameter than the upper lining is constructed. This is allowed to set, and is then lowered to the bottom of the well, and sunk by excavating under the lower edge. New sections are added to the top of the smaller cylinder till the required depth is reached.

PHOTOGRAPHS AND PLANS OF PORT ARTHUR.—Various plans and photographs of Port Arthur are given as an appendix to the account of the siege, published in a previous number. One is a contoured plan, captured from the Russians, showing their positions on 13th December, 1904. The other plans are small and of little value. There is a good photograph of the town and harbour taken from in front of 203-Mètre Hill, but the others are very small and indistinct.

July, 1906.

DIRIGIBLE BALLOONS.—This is a long and detailed discussion of the theoretical side of the subject. The following summary roughly indicates the contents of the article:—Velocity of the wind; recurrence of gusts at regular intervals; effect of the wind on the course of a dirigible balloon; pressure of the wind on various portions of a plane surface; resistance offered to the wind by different parts of a dirigible balloon; proportion that the length of a balloon should bear to its diameter; unsymmetrical balloons; tension on various parts of the envelope; construction of the envelope.

The article will be continued in the August number.

ARTESIAN WELLS IN PECHILI.—Various wells were bored in North China to supply the French barracks. The boring apparatus consisted of a hollow steel jumper attached to a series of bamboo rods. In one or two cases hollow bamboos were used instead of iron tubing for lining the finished well.

ELECTRIC LIGHTING OF MAILLY CAMP.—An estimate is given of the saving that will be effected by substituting electric lights for the existing paraffin lamps. The power is to be supplied partly by water turbines and partly by oil engines. It is interesting to note that an oil engine driving a dynamo is expected to consume 36½ per cent. less oil than paraffin lamps producing the same candle power.

J. E. E. CRASTER.

VOËNNYI SBÓRNIK.

July, 1906.

TELEGRAPHS AND TELEPHONES IN THE RUSSIAN ARMY.—At present each Army Corps is provided with only one Telegraph Company; each Company carries sufficient line for 53 miles, composed of air-line, cable, and rubber-covered wire, and has instruments and personnel for 12 telegraph and telephone stations and 6 helio, lamp, or flag stations. Some cavalry regiments possess their own private telegraph apparatus; and infantry regiments have a small quantity of rubber-covered wire and poor magneto-electric telephones, of which the only virtue is their simplicity.

The imperative needs of the army in the late war necessitated the despatch to the front, irrespective of their proper Corps, of Telegraph Battalions with 125 miles of line and a corresponding number of stations. No systematic reorganization of the Russian army telegraphs has however been undertaken.

In the writer's opinion the reorganization should be on the following lines. The system should be divided into five zones. In the first, the Cavalry zone, lightness and mobility should be the first consideration:

a light wire, covered with a lightened form of insulation, and telephones, instead of telegraph instruments, so as to follow readily all the movements of the cavalry screen. The second zone should be occupied by Infantry telegraphs, with a light form of telegraph apparatus, portable microtelephone stations, and a light cable. The third, the Corps zone, distinguished from the first two which are divisional zones, should consist of the present cable sections of the Telegraph Companies, and would serve to join the staffs of the Corps and Divisions. The fourth zone would be occupied by the present air-line sections of the telegraph companies, which would be provided with heavier and more complete apparatus than at present, even having letter-printing instruments, and would connect the staff of the Commander-in-Chief with the staffs of the different Army Corps. In the fifth zone would be the telegraphs joining the Commander-in-Chief with the government wires in the rear of the army; these latter lines would be built and equipped on a slightly more portable basis than the ordinary permanent civilian telegraphs.

In order to build up a body of trained officers and men for working the telegraphs in the first two zones, the writer suggests that one officer and two men from each infantry or cavalry division should be seconded for a one-year course at the Military Electro-technical School, and should then act as instructors in telegraphy to their own units. A certain proportion of these officers would undergo a further course of a year, making in all a two-year practical and technical course similar to that undergone by sapper officers; after this further course the officers so trained could undertake the organization of the divisional telegraphs. By thus passing all the officers who deal with telegraphs through one school, the diversity in procedure and practice, which at present hinders the smooth working of telegraphs, would be removed.

C. G. FULLER.

RECENT PUBLICATIONS.

Imperial Strategy, by the Military Correspondent of *The Times*. (9 × 6. 21s. Murray).

The Elements of Strategy, by the late Lieut.-Colonel Tovey, R.E., revised by T. Miller Maguire. 2nd edition. ($8\frac{1}{2} \times 5\frac{1}{2}$. 8s. 6d. Rees).

The Canadian War of 1812, by C. P. Lucas, C.B. ($9 \times 5\frac{1}{2}$. 12s. 6d. Frowde).

The Defenceless Islands, by L. Cope Cornford. ($7\frac{1}{2} \times 4\frac{1}{2}$. Richards).

The Invasion of 1910, by W. Le Queux; Naval Chapters by H. W. Wilson. Reprinted from the *Daily Mail*, with introductory letter, by F.M. Earl Roberts. (8 × 5. 6s. Nash).

Les Cerfs-Volants et leurs Applications Militaires, par Lieut. Th. Bois. (8vo. 3 fr. Berger-Levrault, Paris).

A Handbook on Reinforced Concrete, by F. D. Warren, Massachusetts Institute. ($8\frac{1}{2} \times 5\frac{1}{2}$. 10s. 6d. Crosby, Lockwood).

The Manufacture of Concrete Blocks and their Use in Building Construction, by H. H. Rice and W. M. Torrance. (8s. Constable).

The Electrical Nature of Matter and Radio-activity, by H. C. Jones. ($8\frac{1}{2} \times 5\frac{1}{2}$. 7s. 6d. Constable).

Rules for the Transliteration of Place-Names occurring on Foreign Maps, compiled in the Topographical Section, General Staff, by Alex. Knox, B.A., Map Curator. (6 × 4. 1s. Wyman).

The Dead Heart of Australia, by J. W. Gregory, F.R.S. (9 × 6. 16s. Murray).

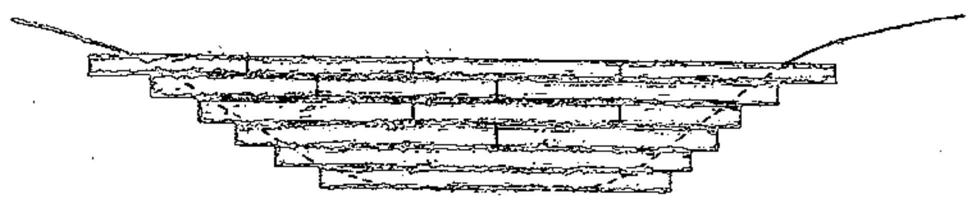
Le Canada: Les Deux Races, par André Siegfried. (4 frs. Colin, Paris).

Life and Experiences of Sir Henry E. Roscoe. (12s. Macmillan).

Plate I.

DETAILS OF DAMS.

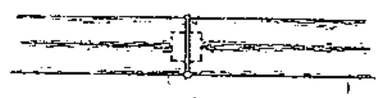
FIG. 1.—ELEVATION OF LOWER COURSES.



In rock the ends of the courses are scarved.

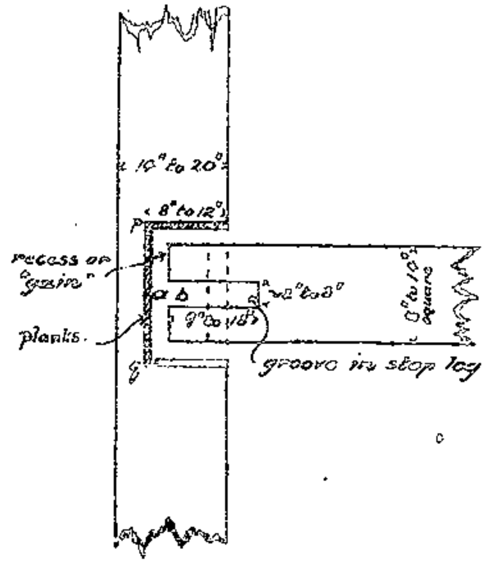
If the rock is some depth below the bed of the stream, piles are often driven (to a depth of at least 6 feet) for the bottom course to rest on.

FIG. 2.—ELEVATION OF JUNCTION OF HEADER WITH FACE.



If necessary the spike may be made long enough to go through three courses of logs.

FIG. 3.—PART PLAN OF GATE.



"ab" is the recess into which hook is lowered, the hook being towards "b" and the shaft or pole at "a."

The dotted lines are an iron bolt (1" to 1½"), through the recess in the stop log, for the hook to catch hold of; this bolt is placed horizontally about the middle of the groove, vertically a little below the centre of the stop log. Flat boards made of white birch are fixed on the inner surfaces of the recess.

FIG. 4. PLAN.

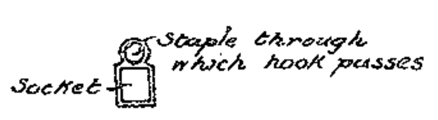
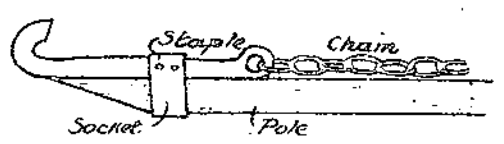


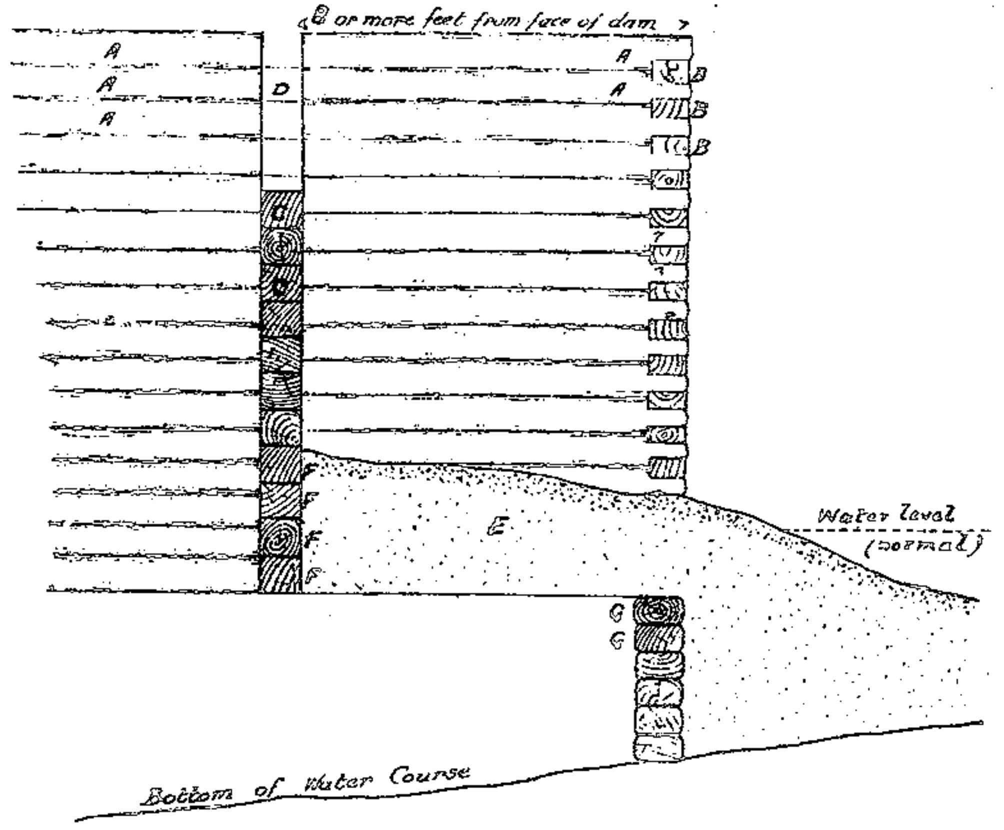
FIG. 5. SIDE VIEW.



DETAILS OF HOOK.

FIG. 6. CROSS SECTION OF GATE.

Stop logs CC fit loosely in the "gain" D.



AA "header" logs adjoining gate.
BB "stretcher" logs forming face of dam.
CC stop logs.
D "gain" in header logs.
E sand bank in front of bottom stop logs.
FF bottom stop logs, which are removed when water in lake gets low.
GG lowest tiers of face logs passing under the gate.

FIG. 7. FRONT ELEVATION OF GATE.

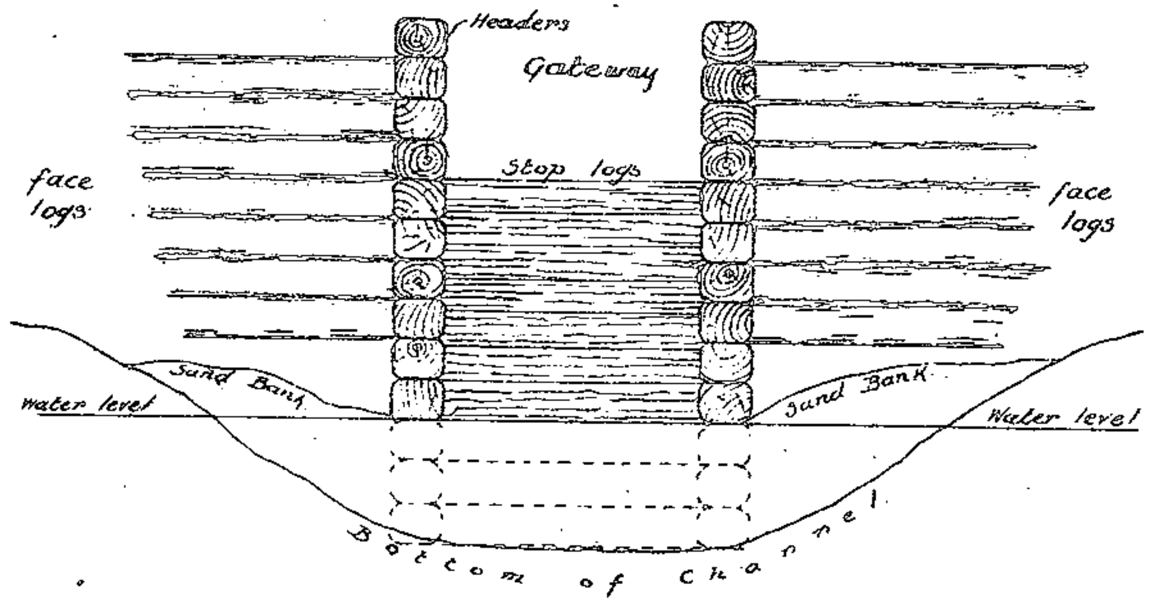
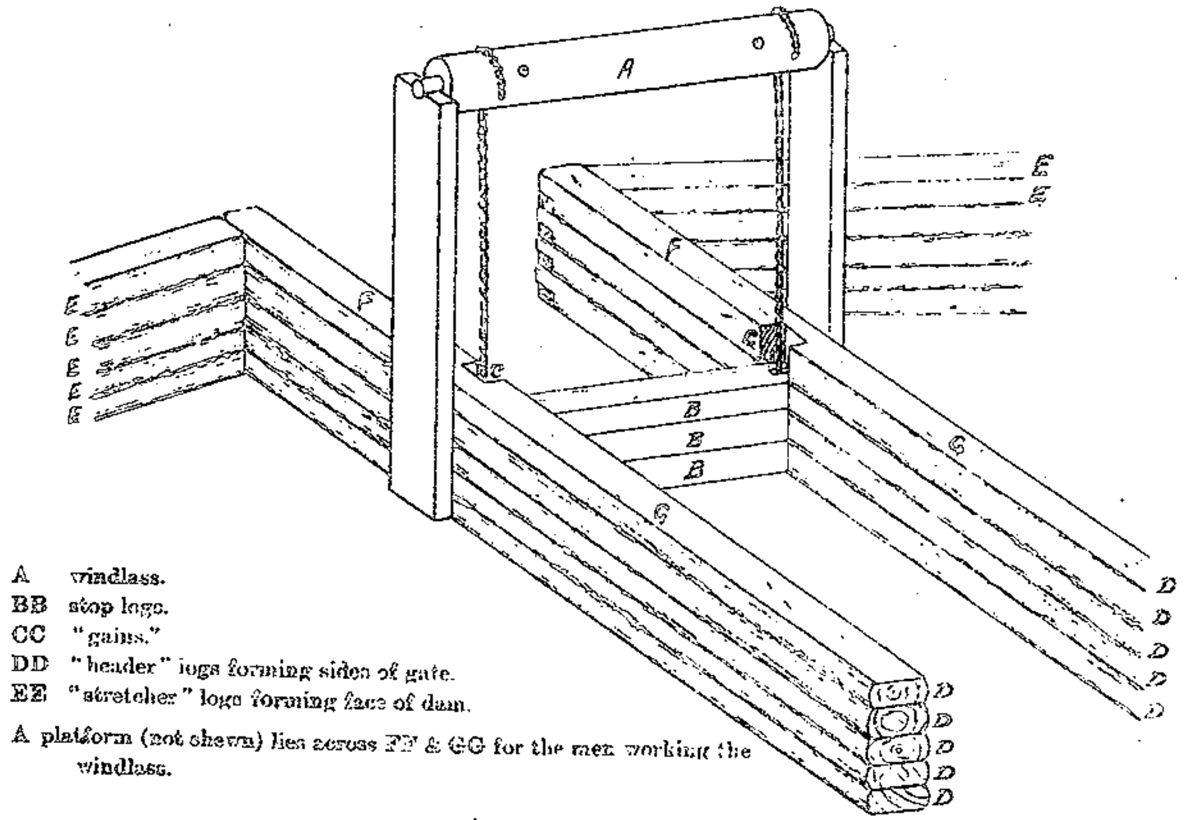


FIG. 10. WINDLASS FOR RAISING STOP-LOGS OF GATE.



A windlass.
BB stop logs.
CC "gains."
DD "header" logs forming sides of gate.
EE "stretcher" logs forming face of dam.

A platform (not shewn) lies across FF & GG for the men working the windlass.

Note. The "header" and "stretcher" logs in Figs. 7 and 10 should break joint, as shown in Fig. 6.

FIG. 8. CROSS SECTION OF ORDINARY DAM.

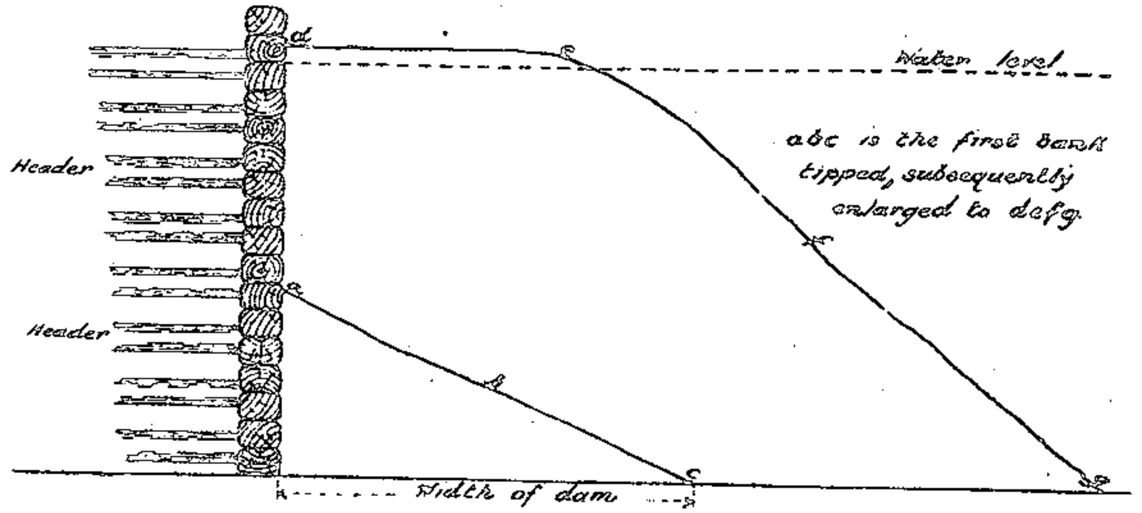
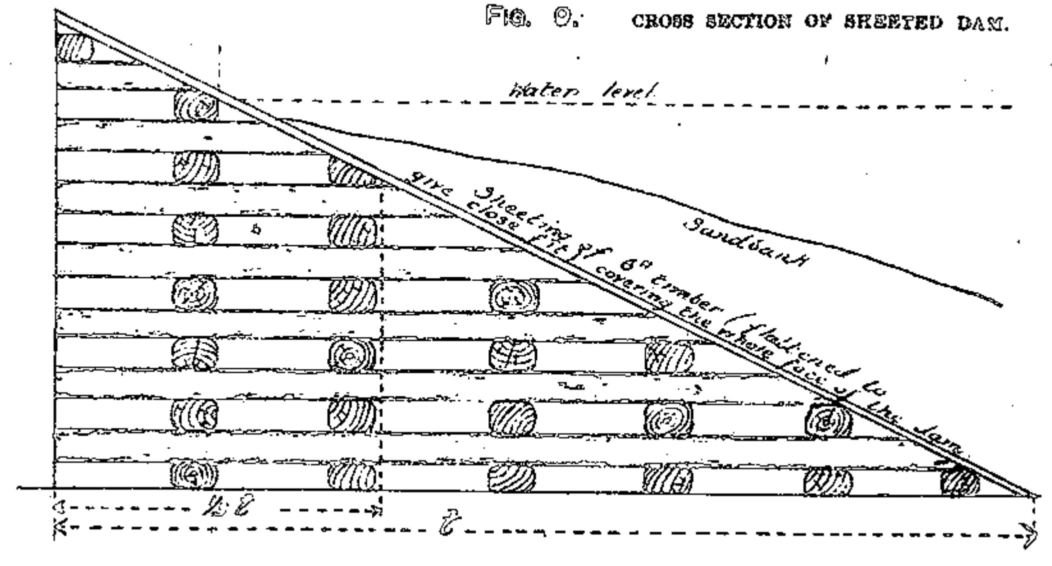
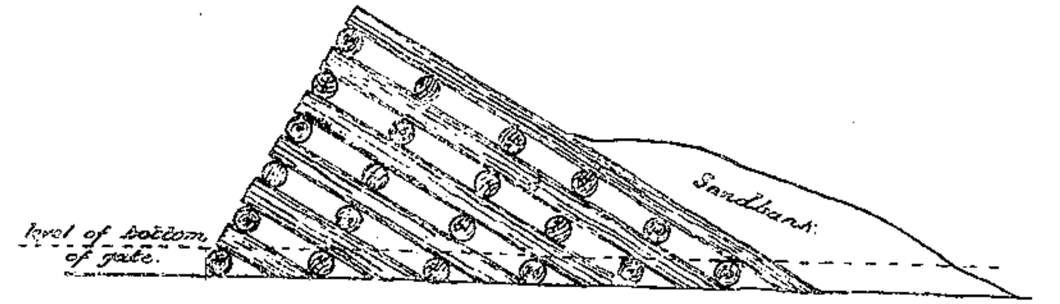


FIG. 9. CROSS SECTION OF SHEETED DAM.



Vertical dotted line shews position of gate.

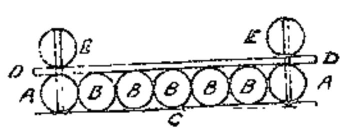
FIG. 11. CROSS SECTION OF SHEETED DAM.



WORK IN THE BACKWOODS OF CANADA.

FIG. 12.

CROSS SECTION.

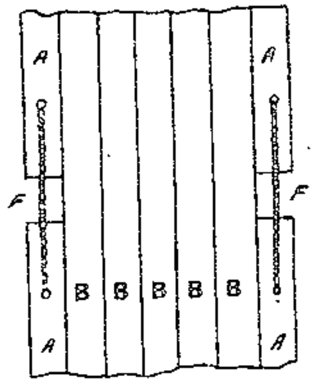


AA booms.
B longitudinal cedars
C crosspiece lashed to booms at XX.
DD crosspieces forming roadway (occasionally lashed to booms).
EE wheelguides pinned to booms with trenails.

FIG. 13.

PLAN.

omitting wheelguides & roadway.



FF connecting chains of booms.

FIG. 14

LONGITUDINAL ELEVATION.

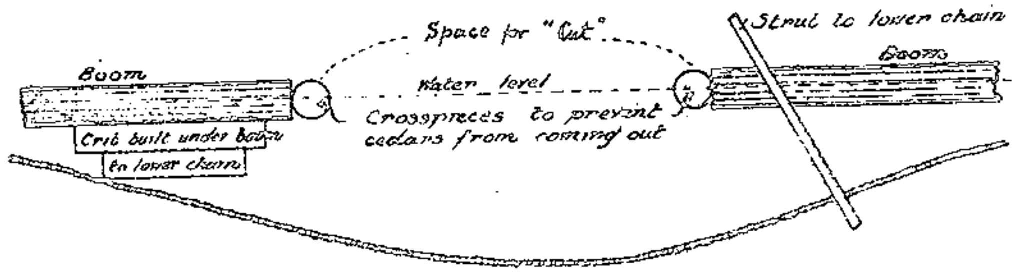
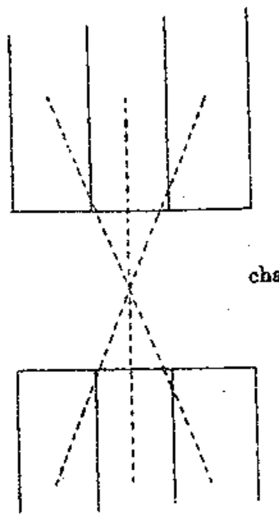


FIG. 15.

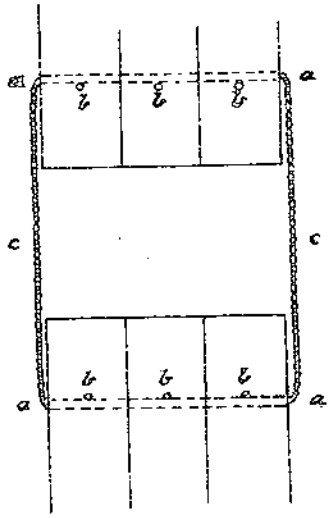
PLAN.



chains shewn dotted

FIG. 16.

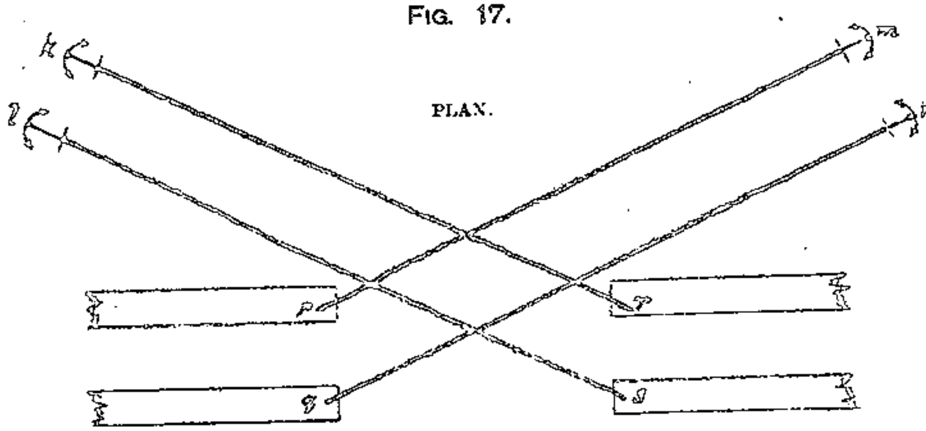
PLAN.



aa augur holes for chains.
bbb iron pins.
cc chains.

FIG. 17.

PLAN.

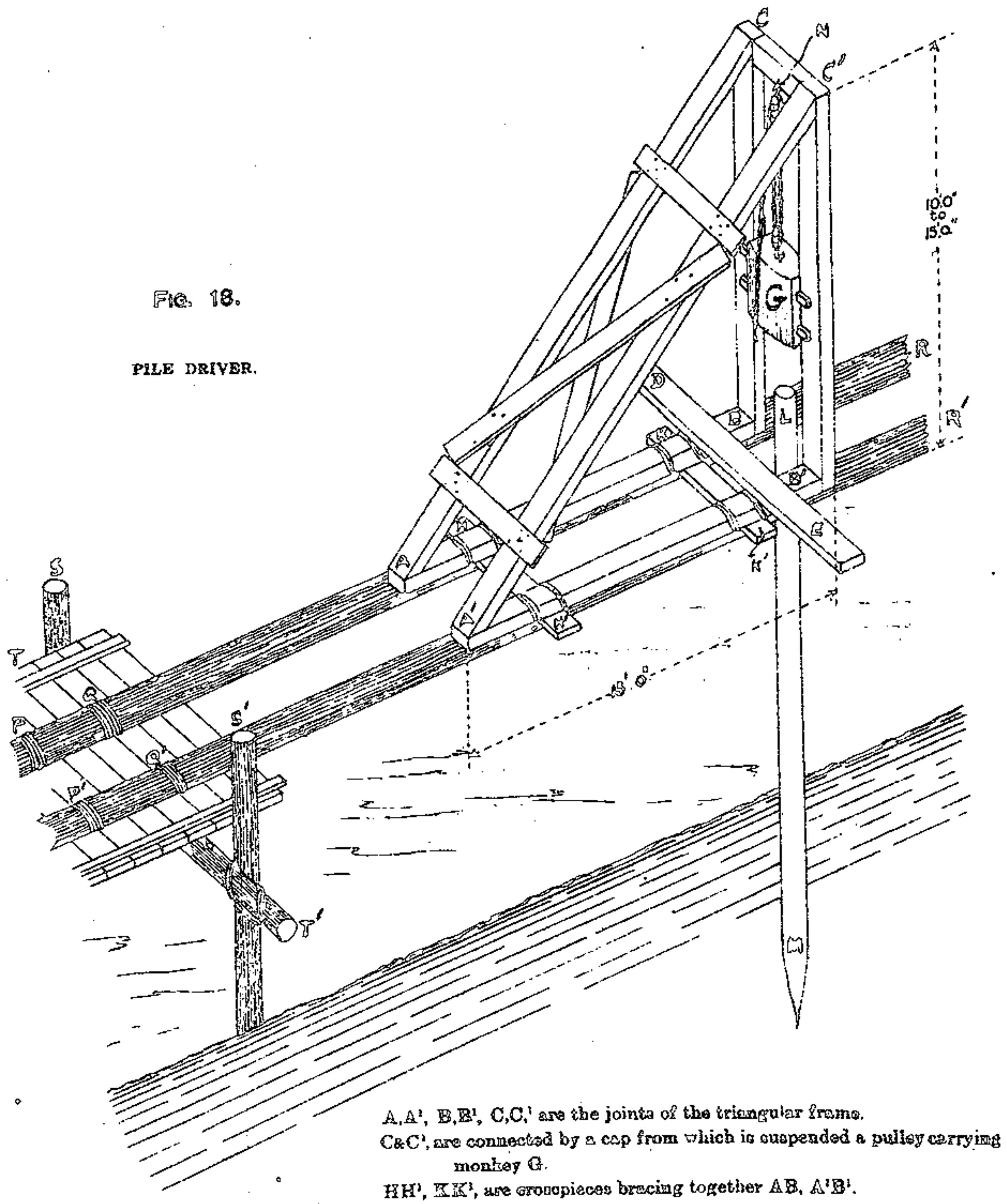


klmn anchors.
kr, ls, mp, nq chains to booms.

DETAILS OF FLOATING BRIDGES.

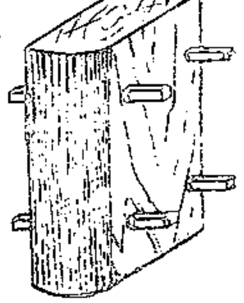
FIG. 18.

PILE DRIVER.



A,A', B,B', C,C,' are the joints of the triangular frame.
C&C', are connected by a cap from which is suspended a pulley carrying the monkey G.
HH', KK', are crosspieces bracing together AB, A'B'.
LM, the pile to be driven.
N, the pulley.
PQR, P'Q'R', the cantilevers carrying the piledriver lashed at P.Q.P'.Q'.
S,S', the tips of the legs of the preceding trestle.
T,T', tips of transom of the preceding trestle

FIG. 19.



MONKEY.

PILE DRIVER.