THE ROYAL ENGINEERS JOURNAL.

Vol. IV. No. 5. NOVEMBER, 1906.

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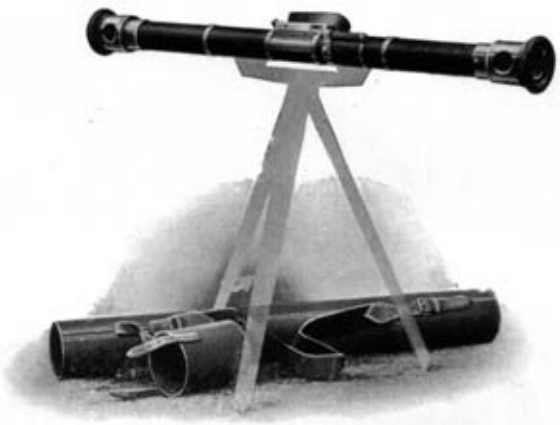


BARR AND STROUD RANGEFINDER, F.Q. TYPE, "INFANTRY," 1 METRE BASE.
FOR USE WITH INFANTRY, CAVALRY, AND MACHINE GUNS.

This Rangefinder is constructed largely of Aluminium and is covered externally with brown leather. It is fitted with pads on the ends to prevent damage by rough handling. It is supplied in a strong leather case, as shown, fitted with a shoulder-strap.

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

SOME LESSONS FROM PORT ARTHUR.

By Capt. J. C. Matheson, R.E.

The conduct of the siege of a permanently-fortified position had for many years to be discussed in the darkness of theory, illumined now and then by gleams from peace practice. The Russo-Japanese war has, however, given us the example of a modern siege; and it behoves us to profit as far as possible by the light thus shed by "the real thing." A long time must elapse, however, before final judgments can be arrived at; and the only excuse for thus bringing the subject forward, with incomplete data, is, that it is only by much discussion and many arguments that true deductions can be arrived at from the events which have taken place.

It may be argued by some that a siege, such as that of Port Arthur, is beyond the scope of our possible operations. About this however, there are two opinions; and at all events we possess official text-books for the carrying out of such a siege, from both an artillery and an engineer point of view, and it is self-evident that these books should be kept up to the times.

Argument from the particular to the general is always dangerous and it must be borne in mind that, as in all sieges, the siege of Port Arthur had peculiar features which probably may not again be repeated, at least not in the same proportion or relation.

To mention some of these. The assailants were an Oriental nation newly embued with Western ideas, only then "ranging themselves" as regards military affairs, and burning to take a place in the front rank. The fortress was a maritime one, sheltering a beaten fleet; it was in a peculiarly isolated position, and in an unfinished state. The expected advent of the Baltic Fleet added a disturbing influence, while that fundamental factor of the military art—the eternal variableness of the ground features—played its usual part.

As engineers we are more particularly interested in the "engineer attack," and it is here especially that light and guidance have been needed. Nothing seemed to be quite clear as to how the attacker was to cross the near foreground; on the one hand sapping was said to be impossible in the face of modern fire, on the other mining was declared to be impracticable as it was too slow. One British authority went so far as to say that "the engineer attack is either absolutely impossible or unnecessary."

But in addition to this, other points are of interest. In the first place, the attempt to carry the position by main force in the early

days of the siege was defeated with very heavy loss. This was to be expected; the Japanese could hardly have reckoned on the Russians being of the same calibre as the defenders of Port Arthur in 1894. This idea of rushing a fortress, to try and take advantage of any possible unpreparedness, has generally been discounted, although it has its advocates on the Continent. The circumstances of this last unsuccessful attempt form a very strong argument against its repetition, except under very special conditions.

Again, the front of attack selected by the Japanese appears a little strange. Of course, to attempt criticism here without a detailed knowledge of the ground itself is distinctly presumptuous; but, from a study of the map, the besiegers appear to have chosen, without absolute necessity, the strongest side against which to push home their first attack. One foreign critic suggested that the western side would have been better than the one chosen, as being weaker and leading to better results. But might not a word be put in for the eastern side from Fort Higashi Kei-kwan-shan Tonan to the sea? Here the defence works were certainly weaker than elsewhere; the ground was very steep, affording more cover to the attackers and allowing artillery fire to support an assault up to the last moment; and the results of piercing the line here would apparently have been as great as on the north-eastern side, while the attacking batteries would have been at least as near the base and the railway.

The position of the forts may also present a lesson. As in every fortress these were well advanced and very prominent. A few had guns mounted in them, and these were soon put out of action. But all the forts suffered badly from the besiegers' artillery; and was this to be wondered at? With heavy howitzers firing from behind cover at splendid targets, the conclusion was obvious; in fact the only wonder was, that the forts did not suffer more; it says a good deal for the modern casemate.

Thinking it all over, has not the time arrived for selecting a different position for a fort, whenever the ground allows? Why not withdraw it, and put it on the rear crest, instead of on or below the front one, provided it can get a clear field of fire of 100 or 200 yards and can see fairly well to its flanks? Such a position would permit of the reduction of command, reduce the cost of glacis-making, and immensely increase the difficulty of the task of the attacking artillery. The front would still have its trenches and communications as in the intervals. We have given up putting field redoubts in the front line, where they can be recognized as such (*Manual of Military Engineering*, para. 81). So why should we put larger works there?

But to the field engineer the point of interest above all others is the "engineer attack," the advance of the besieger across the near foreground of the fortress. To a certain extent this followed the anticipated programme. A front of about 4,000 yards was attacked,

including 3 permanent forts; and along the whole front a series of approaches were made against these forts and the principal intermediate works. Here it is not unnecessary to note that the forts themselves became the real aim of the attack; the intermediate trenches, valuable as they were, depended on the forts, and by them they had to stand or fall.

When once driven to a systematic siege, the Japanese commenced sapping in the ordinary way, and it soon became evident that the sap is not so defunct as was supposed. Details of the work are still wanted; such as, how far away trenchwork merged into the real sap? how deep was it necessary to go? how fast did the work progress? etc. But the broad fact remains, that the Japanese did carry out an engineer attack on an extended front; and entrenched and sapped and mined their way up to, and finally captured, a large fortress; and did this, in spite of many reverses and of constant interruption of the sap-heads by the Russians, in less than half the time which it took the French and ourselves to conquer the improvised works of Sebastopol. It even seems that the time might have been reduced, if the engineer attack had been systematically followed from the outset. At all events the casualty roll would have been much smaller.

When the later stages of the siege are considered, one cannot help asking if the Russian engineer at Port Arthur was equal to his predecessor in 1854. Owing to the intensity of the defender's fire and to the discovery of the existence of counter-scarp galleries, which seem to have been unknown to the Japanese (a thing difficult to understand), the besieger commenced to mine. Counter-mining was tried by the Russians, but was very ineffective; in fact it often did more harm than good by forming craters on the surface and, in one case, exposing the back of the revetment. There was none of the scientific use of counter-mines such as Todleben employed. At Sebastopol the French in front of Bastion No. 4 were practically forced to give up their attack, and the counter-mine beat the mine up to the end of the siege. A vigorous mine warfare and the extensive use of counter-approaches might have delayed the capitulation, and this siege was one in which the element of time was of peculiar importance.

While on the subject of mining, it may be noted that, from the accounts given, this does not seem an art in which the Japanese excel. Their mines varied largely in amount, even for similar objects, and were uncertain in action; one correspondent mentions that in one case 50 (*sic*) Japanese were killed by one of their own mines blowing back through the galleries, the result evidently of defective tamping. It is also stated that in another case the Japanese made no attempt to destroy a counter-mine which they knew the Russians were preparing.

It would be interesting to know the speed at which the mining was carried out, as this is a branch of our art which has made little progress for many years. Surely it must be possible in these times to drive a gallery in ordinary soil by some means more rapid and efficient than a pick and shovel. Is a minehead too small for a mechanical or electrical excavator?

The hour at which the later assaults were delivered was an unusual one, namely the late afternoon; this was adopted to prevent the Japanese being forced by shell fire out of any captured works before night, and there seems something to be said for it. The assaults were in each case preceded by the customary heavy bombardment. Is not this a mistake? Does it not serve to give good notice and put the defenders on the watch? The majority of the work to be expected from the siege guns should have been done by their ordinary fire.

Still another point claims attention, namely the use of obstacles. Undoubtedly we are inclined to place them too far to the front; they must be under the closest fire of the defenders. As to the form of the obstacle for permanent fortifications, from Port Arthur experience the deep revetted ditch would be difficult to beat. It has many defects, the worst of which is its cost. But the odds are very strong in favour of its still being in existence at the critical moment, while the same cannot be said of the best barbed wire entanglement that can be made, even if it is well sunk, and then at once we get the commencement of a ditch.

In the closing scenes of this latest of sieges one point more than any other asserts itself, though it seems an anachronism, and that is the large amount of close-quarter fighting which took place. When one is accustomed to consider 500 yards as a short range, distances of from 30 yards to 6 feet are almost revolutionary, and yet such occurred. Trenches were so close that hand grenades could be used; the Russians held one end of a counter-scarp gallery and the Japanese the other, while they struggled for long periods over the centre portion; "crowning of the covered way" may be said to have gone on, and also sapping across the ditch. All this step-by-step defence affords food for much reflection; it was unexpected; while it certainly redounded to the credit of the intrepid Japanese soldier and the dogged Russian. On the other hand one does not hear of any attempt being made at using flying bridges; and the escalading came to nothing.

There are of course many other points of interest in this great struggle, such as the use of the searchlight, the failure of the balloon, the prevalence of night fighting, etc., not to speak of those connected with the siege batteries. But the above are a few of those most in debate. They have only been touched upon in a very sketchy manner, but it is to be hoped that other pens will take them up and

that something of value to our training and instruction may be elucidated.

To speak generally, the siege of Port Arthur has once more brought home the old truth, that skill and method will accomplish more than mere strength alone. The progress made by the Japanese towards their goal was slow and spasmodic, not to speak of its costliness in life, so long as they tried to gain their end by mere weight of numbers. Real advance was only made when they started to use the spade systematically. It seems likely, too, that the repulses of these premature assaults, and the consequent frightful losses, may have had an effect on their army which it would have been better to avoid and which, as has been seen, might have been avoided.

As stated above, the siege operations of the Japanese were so far an experiment, owing to the great advances in war material which have been made. But has it not often happened that, when such an advance has been made,—*e.g.* the introduction of the breech-loader, the Q.F. gun, high explosives, etc., etc.,—it has too readily been assumed that our former plans of action are at once completely obsolete and impracticable and that an entirely new line must be struck out. Instead of which it is generally found that some modification of the old plan will really meet and counterbalance the new factor. Too often are we told that some new invention "will completely revolutionize warfare."

The truth is, that changes in tactics and fortification take place very slowly. But, on the other hand, we must not be caught napping; we must realize that the change does take place, and be prepared.

Notes on
NEW MATERIALS FOR SANITATION.

By Lieut. P. O. G. Usborne, R.E.

It is not proposed in any way to go into the general principles of sanitation, but only to give a few of the most modern and useful devices for ensuring cleanliness and ornamentation.

The main points necessary for cleanliness in a public building of any kind are, that the walls and floors should be capable of being washed down easily, that there should be plenty of light and air, and that there should be no corners or crevices in which dust or dirt may lodge.

Some of the best jointless wall and floor coverings will therefore be touched on here, with their approximate cost and their method of fixing. A comparative table of costs is also given.

Floors.

Concrete no doubt makes a very admirable floor and wears well if properly laid, but it is cold and cheerless, giving a very barren appearance to any room in which it is employed.

Improvements in this matter have been sought for a long time, and lately many excellent floors have become cheap enough to fall within the scope of all ordinary design.

GRANOLITHIC.

The simplest improvement on plain concrete, giving a very hard floor surface, is known as a "Granolithic Floor." It is perhaps the most practical floor where very much wear has to be contended with, but it cannot be claimed that it is ornamental.

It consists simply of a top coat of Portland cement and granite siftings. The granite should be from $\frac{1}{8}''$ to $\frac{3}{16}''$ in size, and care should be taken that it is exposed on the surface in order that the hard stone may take the wear and not the cement.

It must be laid while the underlying concrete is still unset, as if this be not done it will crack.

Sometimes, owing to the difficulty of applying the granolithic surface while the concrete is still green, it is desirable to cast the concrete into slabs with granolithic surfaces and lay these slabs as paving stones.

The cost varies from 4s. to 6s. per yard super, laid.

MOSAIC.

For work that calls for more ornamentation a Roman mosaic is very hard to improve upon. One of the best firms for this type of work is "Diespieker" (60, Holborn Viaduct, E.C.).

This firm does the most ornamental pattern of floors at about 16s. to 20s. per yard super. Such work, however, is of very little use for foreign stations, requiring, as it does, highly skilled labour; and in practice we are compelled to resort to the commoner form of mosaic floor, called "Terrazzo." This costs 7s. 6d. to 11s. per yard super, fixed. It consists of marble chips carefully laid and bedded in cement. The firm as a rule prefer to lay such floors themselves; but skilled labour is *not* a necessity, and, provided the foreman has seen such a floor laid before, it should present no difficulty.

Many instances of the use of "Terrazzo" in W.D. work could be quoted, notably the floors of the New Electrical School, Chatham, and the floors of the vestibules of C.O.'s quarters and Officers' Messes at Tidworth Barracks.

The firm claim that these floors will never crack, but in the R.E. Institute, where they have been laid, very considerable cracks have appeared. One of these cracks has been cut out and appears to be due to bad bedding. It is therefore essential, if these floors are to be used, that the underlying base must be absolutely rigid and safe against vibration.

When completed, the floor is certainly ornamental, and is unaffected by all ordinary liquids which may come upon it. It will not, however, stand acid, as this reacts on marble.

Another and similar material is Porphyrolith. Flooring material of this nature can be got from the makers ready mixed in bags for export, with instructions for laying; or their methods may merely be copied. The main essential is a good hard concrete bed underneath the floor surface.

STONWOOD, EUBŒOLITH, ETC.

There is another class of materials for flooring, viz., "Stonwood," "Teranno," "Segalith," "Torgament," and "Eubœolith."

These all differ from the former class in that they are softer to the touch and not so cold. They feel rather like linoleum, and contain a certain amount of sawdust in their composition. They are suitable for such buildings as hospitals, infirmaries, schools, public buildings of all kinds, motor garages, lavatories, and restaurants. They apparently stand the action of petrol and lubricating oil dripping on them better than cement concrete.

The best of these appears to be "Stonwood" (Stonwood Fire Resisting Flooring Co., Ltd., 109, Victoria Street, S.W.), though there is not much to choose between them. It consists of a composition of magnasite and chloride of magnesium and sawdust. It costs 4s. 6d. to 5s. 6d. per yard super, depending on the amount of floor space to be covered. It can be laid on a plain wood floor or on a cement bottom. Skilled labour is not required provided the instructions issued by the makers are followed out carefully.

An experiment was made with this flooring at Chatham in 1904. A patch was laid on a wood floor in the passage-way leading from Brompton Barracks Square to the Canteen. The traffic on this was the heaviest that could be found in the Barracks.

The first patch laid down did not wear well, giving out in 9 months, but the second patch, laid by the firm themselves, after a year has shown no signs of wear whatever.

"Stonwood" has been used in many W.D. buildings, notably at Borden Camp for the floors of N.C.O.'s Messes and similar buildings. The C.R.E. Woolmer recently reported very favourably on its use in huts, claiming that the mode of laying enabled it to be carried up the wainscoting of the walls, which is most desirable from a sanitary point of view. He recommends it for wood, brick, or concrete floors, and goes so far as to advocate its use throughout the service in every building.

It works out at about 6d. a yard super cheaper than the floor usually laid down for W.D. buildings, viz., solid wood on sleeper joists in concrete.

Perhaps its most practical use is in the repair of worn-out wooden floors. The boards need not be taken up and replaced but may simply be covered with a $\frac{3}{4}$" layer of "Stonwood."

Repairs to this material itself, however, are not easy of concealment and never seem to join properly on to the original flooring.

"Eubœolith" (F. P. Day, 3, Victoria Street, Westminster, S.W.) costs 7s. 6d. per yard super, but it requires a half-inch screening of Portland cement and coarse sand underneath it, bringing the total cost up to 9s. It has been used in Millhill Barracks, and in the operating room of Queen Alexandra Hospital, Millbank; also throughout the Cadets' College at Osborne.

It appears to stand fairly well, but has been known to rise in patches where it is exposed to constant wet.

The other materials mentioned above are all similar and the addresses of the manufacturers can be obtained from any engineering paper.

The main advantage of all jointless floorings is that they can be turned up the walls in an easy curve. This does away with the rectangular crevice in which dirt and dust is so prone to lodge.

Fig. 1 shows the usual way of doing this. A wooden ground is used to secure the base of the plaster.

WOOD BLOCKS.

Where wood flooring is employed an attempt should always be made to employ a hollow quadrant skirting as shown in *Fig.* 2. This applies to all hospital buildings, and in a lesser degree to all dwelling rooms or other places where cleanliness is essential.

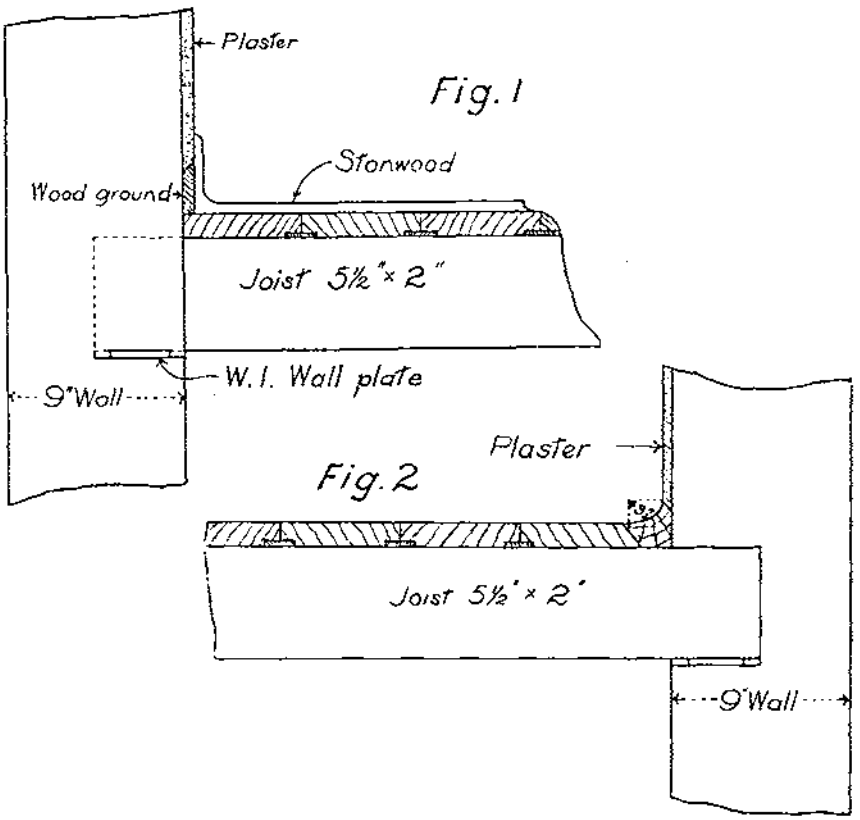
The best wood-block flooring, should one be required, is the

"Acme" (Acme Wood Flooring Co., Ltd., Gainsborough Road, Victoria Park, London, S.E.).

This requires no further remarks.

WALLS.

Sanitation in the matter of wall coverings is not at all an easy subject. Of course plain brick walls, flat jointed and lime-whited, are the simplest and cheapest form of sanitary wall; but they are unsightly and, however smoothly built, are apt to collect dust.



SYRAPITE.

Plaster of some kind is nearly always resorted to, the best form being "Syrapite." This was alluded to in a previous article. It may be used by itself (one part of "Syrapite" to three of sand), or may be mixed with ordinary lime plaster. In this form it gives a very much improved surface over the ordinary plastered wall, and two-coat work with "Syrapite" is equivalent to any other three-coat work. It sets quickly and enables the plasterer to follow on with his second coat, without having to wait, as is usually the case. It can safely be claimed for "Syrapite" that it gives the best possible

surface without any increase in expense, and the surest proof of this is that all contractors like using it.

GRANITE SILICON.

Another plaster of the same nature, though not so popular, is "Granite Silicon" plaster. (36, King's Road, St. Pancras, N.W.). For use on brick walls the best proportion is one part of plaster to four of sand by weight; but different grades of plaster must be purchased for the rendering and finishing coats, and for this reason it is not suitable for export.

TILES.

For corridors, the walls of lavatories, subways, or other such places, tiles of some sort are advisable, in fact essential. The use of glazed bricks, although once very much in vogue, is now disappearing. For work abroad glazed bricks are, of course, out of the question, owing to the cost of export or difficulty of manufacture. Glazed tiles as a substitute are expensive, and they also are difficult to export.

The newest method of covering such walls is with glass tiles, viz., "Newellite," "Opalite," or "Duralite." These glass tiles are made about $\frac{1}{8}''$ thick in the ordinary sizes of a brick. They can be obtained in any shape for hollow or bull-nosed angles, reveals to windows, etc. They can also be obtained in any colour, although some colours are more expensive than others. They are very light and consequently most suitable for export. The different makes really only vary in the nature of the backing that is provided. Each firm naturally claims that their own method of backing these glass tiles is the one and only method that will prevent cracking; but, however that may be, the backing in all cases is slightly plastic and gives a little to settlement.

"Newellite" is by far the most popular of the three, and can be fixed without skilled labour in the same way as ordinary tiles. (Newellite Glass Tiles, 139, Cannon Street, E.C.).

The firm prefer to fix the tiles themselves, and in this case give a guarantee against cracking within two years after erection; but they are also willing to supply full instructions if the engineer prefers to carry out the work himself. The wall surface to be covered requires a rough rendering of cement mortar, about $\frac{1}{2}''$ thick; then a thin coat is applied on to which the tiles are stuck after buttering their backs with cement in the usual way.

"Newellite" costs 10s. per yard super fixed in England. It is 30% cheaper than glazed brick and 45% cheaper than any wall tiles when fixed on a 9" wall, including walls. For export the difference becomes very much more marked owing to its lightness.

Instances of the use of "Newellite" are legion. A few cited are

the new War Office buildings, the Walker Hospital at Madras, the Law Courts at Rangoon, and all the new Underground Railway Stations in London.

The other glazed tiles mentioned above are very similar and cost about the same as "Newellite."

Of course such tiles can be got for borders or dados, a large variety of patterns being always in stock.

PAINTS.

The question of paints for wall surfaces is a very difficult one. A short time ago the one and only paint was "Velure," but this has been somewhat superseded. "Velure" gives an excellent surface, stands the action of sea-water, and only the final coat need be "Velure," the previous three being ordinary paint of the same colour. But it is extremely expensive, very difficult to apply, and takes a long time to dry.

The best paints on the market now are "Ripolin" and "Paripan." (Ripolin, Ltd., 110, Fenchurch Street, E.C.). There is nothing very special about these paints any more than there was about Aspinall's Enamel. They both take on wall surfaces, on wood, or on metal. They are plastic, and will stand a great deal of knocking and bending about without cracking. They both stand washing down without losing their gloss, and can be procured in any tint required. Their use for hospital walls is extremely common, and they are thoroughly recommended.

The Table of prices for floor and wall surfaces given here is taken as far as possible from actual experience, rather than from makers' statements.

The variation in cost shown depends on the amount of surface to be done at one time and its position. The prices have been worked out for the London District, where transport or railage is an inconsiderable item. At the bottom of the Table is given the comparative cost of a 9″ wall covered with glass tiles, or with heavy glazed tiles, and a wall of glazed bricks.

It will be seen that, whereas the difference in cost in England is considerable, it will become much more so abroad, when shipping rates have to be considered. But at the same time it is also noticeable that these sanitary wall and floor coverings are not so expensive as to be out of the question for W.D. work. For instance "Stonwood" costs less in a floor than the ordinary solid wood floor on concrete.

COMPARATIVE COST OF WALL AND FLOOR SURFACES.

MATERIALS.	COST, PER YARD SUPER.	REMARKS.
	FLOORS.	
Marble	16/- to 20/-	
Stone	12/- to 16/-	
P.C. Concrete { 4:1	2/-	
P.C. Concrete { 4:1 (with trowelled face)	2/6	
Terrazzo	7/6 to 11/-	
Cube Mosaic	17/- to 20/	
Roman Mosaic	14/- to 17/-	
Granolithic	4/- to 6/-	
Tiled	6/- upwards.	
Ornamental Tiles	12/-	
Parquet in Oak, etc	18/-	
Oak and Teak	11/-	1½" boarded floors, 4½" widths, grooved, tongued, rebated and secret nailed.
Common Parquet	7/6	
Wood Block	6/-	
Maple	4/- to 5/-	
Pitch Pine	4/6	1½" grooved, tongued & rebated.
Deal	3/-	1¼" " " "
Asphalte	4/- to 10/-	Val de Travers mastic, 1¼" to 1½".
Stonwood	4/6 to 5/6	
Linoleum	2/8 to 3/8	
Eubœolith	9/-	
Torgament	2 prices, 4/7 and 5/7	
	WALLS.	
Glazed Tiles	10/- to 12/-	White and salt glazed.
	14/-	Ceramic.
Glazed Bricks	18/-	
Glass Tiles	10/- to 15/-	Newellite, Crystopal, Opalite.
Plasters	3/4	P.C. 3:1 and ½" trowelled face.
	4/6	Keene's & Parian.
	2/6	Robinson's.
	1/3 to 1/8	Syrapite.
	1/9	Patent Selenitic.
Enamelled Paints	3d. to 5d. per coat	Ripolin 20s to 25s. per gallon.
		Paripan 20s. per gallon.
		Calley's 32s per cwt.
		Scerelaay 11s. per gallon (Stone preservative).
Distempers	1d. to 1½d. per coat	Hall's washable 22s. per cwt.
		Wapiott 28s. per cwt., said to cover 850 sq. yds.
A 9" brick wall, covered with Newellite Glass Tiles O.S., costs	17/- (including bricks)	
Glazed Bricks	20/3 "	
Heavy Glazed Tiles	24/9 "	
Syrapite, 2 C.C.C. and 2 C. Velure	9/11 "	

*THE LE MESURIER SYSTEM OF ROOFING.**

SPECIFICATION.

SHEETING.

THE roof covering will consist of plain sheet-iron, galvanised or ungalvanised, as may be separately specified, and of the gauge decided on. Ungalvanised iron will be given a coat of tar, laid on hot on the underside, before being placed in position, and will receive two coats of Olphert's paint after laying is completed.

When no ridge planking is laid and sheets 3 ft. broad are used for the roof, the ridging should be of 20 B.W.G. sheet-iron except in unexposed situations; in other cases 22 B.W.G. sheets may be used for the ridging.

Before laying, the sheets (when not imported in a finished condition) will be bent in a press; after pressing, the two long sides of the sheet will be as in *Fig.* 4 of accompanying *Plate.*

PLANKING.

The sheeting will be laid on planking of the timber separately specified. The planks will be 6 or 7 in. broad and 1 in. thick, laid horizontally. In the majority of stations, when the span does not exceed 25 feet, it will be found most economical to lay this boarding direct on the wooden principal rafters of trusses. The distance apart of these trusses, or of the common rafters where purlins are used, should not exceed 6 ft. with local planking of average quality. In subsidiary buildings the sheeting may be laid either on "open boarding" or on purlins as with corrugated iron.

Before the sheets are laid the planking and battens will be given one coat of tar, laid on hot.

BATTENS.

The battens will be 6 in. long by 1½ in. broad, rounded on the top to a semicircle of ¾-in. radius; they should be roughly cut from any scraps of wood which may be available. They will be fastened to

* This Specification of the system of roofing invented by Capt. H. G. Le Mesurier, R.E., is published here by permission of the Director General of Military Works, India. It will be embodied in the *Military Works Handbook.* The system is patented.

the planking by one 1¾-in. screw driven from above, and by one 2-in. screw driven diagonally through the clip as shown in *Fig.* 4. One batten is required for each clip.

The battens will be tarred on the underside before laying.

CLIPS.

The clips for joining the sheets laterally will be made of 1½in. × 14 B.W.G. mild steel hoop, and will be of the form shown in *Fig.* 6. When not imported they should be galvanised locally where the appearance of the roof is an object; otherwise they should be tarred hot. They should be fixed to the roof planking and battens by two 1-in. screws and one 2-in. screw as shown in *Fig.* 4.

The ridge clips will be of the form shown in *Fig.* 2, the short end before fixing being as in *Fig.* 6. The gauge and number of screws will be as for the roofing clips described above.

When 6 ft. × 2 ft. sheets are used for the roof covering, one clip is required at the centre and at each end of the long sides of each sheet. With 6 ft. × 3 ft. (except in unexposed situations) and 8 ft. × 3 ft. sheets four clips should be given on each side, one being placed distant a third of the length of the sheet from each end. The clips at the top and bottom of each sheet should be fixed so that the lower side of the clip is 2¼ in. from the lower edge of the overlapping sheet: and in all cases the centre of the clip will be immediately over the centre of the batten.

The junction shown in *Fig.* 4 is at the centre of a sheet; at the top and bottom the section would show two sheets over the clip and two sheets under as in *Fig.* 3. For 6 ft. × 2 ft. sheets the total number of clips required is 2 per sheet; for 8 ft. × 3 ft. sheets, 3 per sheet: to these must be added the extra clips required at the eaves and along one short side of the roof.

HOOKS.

As in the "Naini Tal" pattern of roofing, hooks are required at the eaves and ridge; these are shown in *Figs.* 5 and 2. They should be made of 1½ in. × 14 B.W.G. mild steel, and the portion exposed to view should be galvanised if the roof clips have been so treated.

METHOD OF LAYING.

The roof must always be laid so that the exposed ends of the clips are on the leeward side of the battens with reference to the prevailing wind during the rains.

The distance apart of the clips having been determined as above, an overlap in the length of sheets of 6 in. being allowed for, the first line of battens is laid 1⅛-in. clear of the leeward edge of the roof. Gauges, consisting of pieces of hoop iron bent to the exact shape of a

prepared sheet, are then placed in the position the sheets will occupy on the boarding, one over the bottom batten and one over the top. A string is then stretched between the points thus determined, and the second row of battens fixed by a single 1¾-in. screw driven 1½ in. from the upper end of the batten. This process is repeated throughout the roof, care being taken to get the screws fixing the batten in a straight line. The last line of battens will be laid 1⅛ in. clear of the windward edge of the roof.

The battens fixed, the first row of clips is laid, one over the centre of each batten on the leeward edge of the roof, and fastened by three screws as in *Fig.* 4. The first line of sheets is then laid over these clips, an overlap of 6 in. being given, and each sheet fastened by a single 1-in. screw placed 1½ in. from its upper edge midway between the battens. The upturned exposed end of the clip is then hammered down with a *wooden* mallet to the position shown in *Fig.* 4.

The first line of sheets having been laid, the second line of clips is laid over their outer (windward) edge and screwed down; then the second line of sheets; and so on until the whole roof is covered.

The sheets in the last line (on the windward side) have in all cases to be specially bent, as the two long sides must be similar, and usually require to be cut to a special breadth.

The sheets should be laid from the eaves upwards. The uppermost sheet should be cut to such a length as will ensure the ridging sheet overlapping it by at least 10 in.; and its upper edge should be turned up approximately in the form of a semicircle of ½-in. diameter, the long edges being cut to enable this to be done.

With inexperienced work-people it is advisable to lay the battens and sheeting simultaneously as the work proceeds, the work on the battens being kept slightly ahead of the laying of the sheets. When the carpenters in charge fully understand the work, it will be found best to lay all the battens first. When it is necessary to lay a large roof as quickly as possible, two parties should be employed, one fixing the sheets and clips, the other the battens.

RIDGING.

The ridging will be laid on the same principle with a special clip as in *Fig.* 2.

The breadth of the ridge sheets will be separately specified, but should usually be 2 ft. before pressing.

The ridge sheets may be bent in the same press as the roof sheets, the necessary splay on either side being given by driving hard wood wedges of the proper shape under the sheets while still in the press.

The ridge sheets should overlap at least 6 in. longitudinally, and should as a rule be laid on planking as shown in *Fig.* 2. In subsidiary buildings it may be laid direct on the uppermost battens.

Notes for
*THE TACTICAL FITNESS EXAMINATION.**

By Major A. T. Moore, R.E.

Having recently passed this ordeal, under exceptional conditions as to preliminary preparation, it has occurred to me that the experience gained may be useful to others.

The exceptional conditions, in the Eastern Command at Home, consisted of:—(1) A week's instruction under the Lieut.-Colonel of the General Staff; this took the form of two schemes daily on the basis of Part I., Subjects (i.) and (ii.), of the Syllabus in Appendix VIII., *King's Regulations*, the 6" schemes being also checked and discussed on the actual ground: (2) A week's Staff Ride, under the direction of the Examining Board, immediately followed by the Examination in Part I.: (3) Attachment to units during the Sussex Manœuvres, immediately followed by the Examination in Part II. in the manœuvre area.

This system deserves to be made general. With such preparation the Examination is shorn of most of its terrors, and it becomes an education of considerable value as well as a mere test.

The following notes are intended for officers whose duties have kept them out of touch with troops and necessitate their passing the examination with the maximum of benefit and the minimum of unnecessary study. Without such preparation as we were fortunate to have, the wonder is that officers thus circumstanced can manage to pass at all.

The compiler of the notes is indebted for much assistance received from Bt. Lieut.-Colonel A. G. Hunter-Weston, D.S.O., R.E., Lieut.-Colonel of the General Staff, Eastern Command, from Major T. Birchall Wood, R.G.A., Staff Officer for Defences, Thames and Medway Defences, and from several fellow candidates at the recent examination.

SCOPE AND CONDITIONS.

King's Regulations contain conditions affecting the examination as follows:—

Brevet rank does not carry exemption. Brevet majors are not eligible.

Staff College graduates are exempt from Part I.

Officers on leave from abroad can be examined at home.

* Copies of these Notes, in pamphlet form, can be obtained from the Secretary, R.E. Institute, Chatham; price 1s. each, post free. The Editor will be glad to publish similar notes dealing particularly with the conditions of this Examination in India.

Senior Captains and Majors may be attached for 6 weeks' training to other branches of the Service, and may be exercised in the command of mixed forces.

It is well to be quite clear at the outset as to what the examination consists of. There are two alternatives, Appendix VIII. and Appendix VIIIA., *K.R.*

Appendix VIIIA. legislates for a Staff Ride or Tour of not less than 3 days, and is entirely paper work, note-books and aide-memoires carried on service being allowed. It is meant chiefly for officers who have recently proved their tactical fitness on active service or on manœuvres. The tendency at Home and the rule in India is to examine all other officers under the other syllabus; so Appendix VIIIA. will not be considered further in this article.

Appendix VIII. legislates for an examination which is partly written and partly practical. No books whatsoever are allowed.

Parts I. and II. can be taken up at different times, but Part I. must be passed before Part II. can be entered upon. If any officer fails in either subject of Part I. or of Part II., he must be re-examined in both subjects.

The syllabus is as follows:—

PART I. (WRITTEN). SUBJECT (i.).

A tactical problem involving the operations of a force of one or two battalions of Infantry, one battery of Field Artillery, and one or two squadrons of Cavalry or one or two companies of Mounted Infantry. A large scale map is to be used (preferably the 6" O.S.). The candidate has to write:—

(*a*). *A general Appreciation of the Situation with special reference to the ground.*

(*b*). *Operation Orders.*

and (*c*). *To mark the Dispositions of the troops on the Map.*

The object is to test an officer in *map reading* and in the details of the *correct disposition of troops. Two hours are allowed.*

SUBJECT (ii.).

A tactical problem involving the operations of a force not exceeding a brigade of Infantry, a brigade of Artillery, a regiment of Cavalry, and a portion of R.E. and A.S.C. A small scale map should be used (preferably the 1" or ½" O.S.). The candidate has to write:—

(*a*). *A general Appreciation of the Situation.*

(*b*). *Operation Orders.*

The object is to test an officer's capacity to *devise an operation* for a particular purpose and to *frame correct orders* to carry out his intentions. *Two hours are allowed.*

PART II. (PRACTICAL). SUBJECT (iii.).

Handling, in tactical operations in the field, a regiment of Cavalry, brigade of Field Artillery, or battalion of Infantry, at the option of the candidate.

The object of this test is to ascertain that the candidate is thoroughly capable of *commanding his unit* with intelligence in any situation.

SUBJECT (iv.).

Commanding in the field a force of all arms—as specified for Subject (i.)—in any minor tactical operations which may be ordered.

N.B.—Imaginary or skeleton troops are not allowed.

The "General Idea" may be sent to the candidate overnight. The candidate must hand in his orders to the Board within half-an-hour after receiving the "Special Idea." As the Board has to note the actual time which elapses between the receipt by an Officer of the "Special Idea" and the handing in of his orders, these orders should be completed as quickly as possible. The candidate has also to explain verbally to the Board his appreciation of the situation.

The Board should allow time for all ranks to become acquainted with the Commander's orders before operations commence. During the operations the Board may further test the candidate by changing the military situation, thus necessitating the issue of fresh orders.

The Board should award credit for intelligence, judgment, common sense, and readiness of resource in making the best of any unforeseen situation. A candidate must always be able to support his solution of a tactical problem by sound reasons.

The following points are worthy of notice :—

(*a*). The *objects* of the various tests.

(*b*). The small size of the forces employed; indeed the troops usually available for Subjects (iii.) and (iv.) amount to considerably less than the maximum given. It is noticeable that in Subject (ii.) no Medical unit is included.

(*c*). The *2 hours limit* in Part I. This is the whole crux. It would be fairly easy to evolve a reasonable solution and write an Appreciation and Orders in 3 hours; but to do it sufficiently well in 2 hours requires much practice.

(*d*). In Subject (iv.) officers are tested in a duty which few have the chance of performing beforehand. In Subject (iii.) officers of the Garrison Artillery and the Engineers have to command units which are not their units, ones which they never command in peace and would seldom (if ever) command in war. (R.G.A. candidates usually choose field artillery, and R.E. officers infantry).

(*e*). As troops in defence are more easily shown on a map than those in attack, Subject (i.) is usually a defence problem; consequently Subject (ii.) is usually a problem in attack.

BOOKS AND MATERIALS.

BOOKS.

The only books which it is absolutely necessary to read are :—

Combined Training
and the *Training Manuals of Cavalry, Artillery, and Infantry,*

and it is recommended that reading should be confined to these.

Combined Training is a remarkably good précis of the whole art of tactics. Read it first to get a general idea. Then read the three other manuals, especially that part of *Infantry Training* which deals with infantry in attack and defence. Then read *Combined Training* again and again until you have absorbed all the principles.

For War Organization and Establishments get the official *Field Service Pocket Book* (now in the press) and the *Abstract of War Establishments* prepared by I.T., S.M.E.

If you have time, work through Griepenkerl's *Letters on Applied Tactics* or Bürde's *Tactical Problems* and read Marindin's *Staff Rides.*

Having completed a sufficient course of reading, get as much practice as possible in working out problems as in Part I. of Examination. But this must be done *under examination conditions, i.e.* with the 2-hour limit, orders written half-margin, proper names in capital letters, and so on. It is useless merely to read solutions written by other people, and the candidate is therefore recommended not to read them until he has worked out enough himself to be in a position to criticize those written by others.

Problems can be taken from Sherston and Shadwell's *Tactics Applied to Schemes* or Wilkinson Shaw's *Tactical Operations for Field Officers.* Any one who has passed this examination recently or the Staff College can criticize your solutions.

Similar practice should be obtained in writing orders in the field, in 20 mins., for Part II., Subject (iv.).

As regards the handling of troops, few (if any) officers can obtain previous experience. The best they can do is to get attached to some infantry unit on manœuvres, and get a day or two with cavalry and artillery. But every candidate should at any rate endeavour to spend two days in the examination area and learn as much as he can of the ground.

MATERIALS.

For Part I. :—Plenty of *white* foolscap paper.
Stylograph pen.
Black pencil.
Red, blue, green, and sienna chalk pencils.
Pocket dividers.
Transparent scale (in yards).
Paper fasteners.

The dividers are quicker for measuring distances than a map measurer, and the latter requires some practice.

A transparent scale may be made of tracing cloth; one side marked with a scale of 6″ = 1 mile, the other with scale of 1″ = 1 mile; on both scales the effective and decisive artillery and infantry ranges should be shown. Hugh Rees of Pall Mall supplies transparent celluloid scales, made by Ormiston and Glass; but these are divided into inches and sixteenths.

Some people may find flags or pins with coloured glass heads useful for marking the opposing troops on the map.

For Part II.:—Pocket Compass.
Black pencil, marked in inches.
Transparent scale.
Order Book.

Army Book 153 contains too little space on each page for writing orders in the field. It is best to get an ordinary shop order-book with alternate leaves tissue. If every 2nd and 3rd thick pages are torn out, orders written on the remaining thick pages can be triplicated on the intervening tissues, making four copies in all. Blue carbon paper is better than black.

EXAMINATION HINTS.

Firstly, develop self-confidence.

Secondly, remember that tact is four-sevenths of tactics, and do not argue with the examiners.

Thirdly, when you have evolved a reasonably good solution, stick to it, and do not waste time in trying to find a better; *Le mieux et l'ennemi du bien.* Nearly every problem has more than one solution, and the examiners give credit for any good one, even though it is not the one they had in view. At the same time, when the examiners obviously expect you to adopt a particular line of action, avoid doing something quite different; for instance, if the problem is obviously meant to produce an attack, do not take up a position and wait for the enemy to attack you.

Above all, remember that an error in judgment may often be pardonable; but the neglect of proper military precautions, and a disposition that renders any portion of your force liable to annihilation, even if the enemy fail to take advantage of your mistake, must invariably be condemned.

PART I.

Begin by getting a thorough grasp of the country. Colour in sienna the contours that show all the highest ground and the isolated higher features of the lower ground, and shade in sienna all the hill tops to make them show up; also colour the one or two contours

(there is generally one), which best show the general nature of the terrain. Mark all the valley bottoms in blue. Underline all places named in the Scheme. In doing all this you will get a good idea of the country, and during the process you can be thinking out your solution.

Then roughly tabulate the various courses open to the enemy and to yourself, with their *pros* and *cons*, and note down your proposals for action; and rough out your orders.

Then, for Subject (i.), mark your troops on the map,—in lead pencil only, in case you wish to alter them later on.

Finally, write fair copies of your Appreciation and Orders. But be sure you have first made up your mind; otherwise, when you write your Orders, you may find yourself carrying out a scheme which differs from your Appreciation or from the Dispositions on the Map.

The 2 hours may be divided up as follows :—

1. Colouring the Map ... ... ¼ hr.
2. Making rough notes in the form of Appreciation and Orders ... ... ½ hr.
3. Writing the Appreciation ... ... ½ hr.
4. Writing the Orders ... ... ½ hr.
5. Colouring the Troops on the Map ... ... ¼ hr.

5 is for Subject (i.) only. In Subject (ii.) this ¼ hr. may be added to the ½ hr. allotted to 2.

PART II.

Here again self-confidence is essential. *L'audace, l'audace, toujours l'audace* is a good motto.

You are allowed the use of a staff officer, who, however, may not assist you in writing your orders. Sometimes he is provided by the Examining Board, sometimes you have to obtain one for yourself.

You are given ½ hour to write your orders after receiving the Special Idea. The troops are usually allowed to move ¼ hour after the expiry of this limit. This latter period is insufficient for you to explain your intentions to your subordinate commanders and for them to explain matters to their units and give their own orders.

Therefore it is best to write your orders in 20 mins., and to have the subordinate commanders ready to receive their copies of your orders and your verbal explanations. In the meantime your staff officer can organize a signalling service, and also get 2 cavalry orderlies and 2 cavalry signallers for your own use (dismounted signallers will not be able to move about with you). He can also arrange for your cavalry and artillery to be ready mounted and the infantry told off in march formation before the expiry of the ¼ hour; the cavalry, and possibly the artillery, can then be sent off at once; your success may depend on your cavalry reaching some point before that of your adversary.

During the fight, remember that your place is *not* in the firing line. Always be on the look-out for the enemy's artillery. (The targets fired at are usually notified at manœuvres by 3 guns in rapid succession for cavalry, 2 guns for artillery, and 1 gun for infantry). Record all messages sent and received, with their times, and keep notes of the progress of the fight, so that at the subsequent conference you can explain your own dispositions and criticize those of the enemy; and at the conference remember that *qui s'excuse s'accuse*. As the strengths of the opposing forces are usually equal, one side must lose; but the question of success or defeat, given good orders and good dispositions, does not affect the question of passing the test.

Some Boards are fond of surprise questions. *E.g.* whilst your battalion is marching in column of route, you are told that artillery fire has been suddenly opened on you from a given unexpected quarter, and you are asked what you would do. Therefore be prepared for rapid deployment, etc.

TACTICAL HINTS.

The following notes contain :—Firstly, certain elementary remarks, the perusal of which should facilitate the understanding of the text books; secondly, definite figures, which the text books purposely and rightly omit so as to prevent the use of hard and fast rules for dispositions of troops.

The notes are intended to apply to small forces. They do not deal with savage or mountain warfare or with night operations. Further remarks are included under "Writing Orders."

The organization (*i.e.*, transport, etc.) of auxiliary units, and consequently their road spaces also, are liable to alteration.

MAP READING.

The visibility of any one point from any other, over an intervening third point, can be obtained rapidly with sufficient accuracy by comparing differences in level and distances.

For example, suppose there are three points A, B, and C, B being 20′ lower than A and C 40′ lower than B, and the distances AB, BC being respectively 630^{x} and 420^{x}.

$$\text{Then} \quad \frac{20'}{630^{x}} : \frac{40'}{420^{x}} = \frac{2}{63} : \frac{4}{42} = \frac{1}{32} : \frac{1}{10\frac{1}{2}},$$

Therefore the slope between A and B is more gentle than that between B and C, *i.e.* the surface represented by the line ABC is convex, and C is not visible from A.

If the vertical differences were 40′ and 15′ and the distances 780^{x} and 345^{x},

$$\text{then} \quad \frac{40'}{780^{x}} : \frac{15'}{345^{x}} = \frac{4}{78} : \frac{3}{69} = \frac{1}{19{\cdot}5} : \frac{1}{23}$$

and the surface represented by the line ABC would be concave, and C visible from A.

MAP REFERENCES.

Railways and roads should be described by naming *two* places on them; thus, "The road from —— to ——," not "The road through ——."

The terms "right" and "left," looking down stream, should be used in mentioning the banks of the river, and the points of the compass should never be referred to in this connection.

Points should be denoted with special exactness; for example, "Knoll 300 yards due N.W. of the L of HALSEY." When possible, however, it is advisable not to refer to a point by details which are given on the map but do not exist on the ground; *e.g.* a letter of a name or a contour that is not a knoll.

RANGES.

It is absolutely essential to remember the long, effective, and decisive ranges of field artillery and the effective and decisive ranges of infantry.

ORGANIZATION.

It is necessary to know the component parts of a Division and a Cavalry Brigade; also the internal organization of *all* minor units. For example :—

A Divisional Transport and Supply Column	is divided into	3 Companies.
A Field Ambulance (for a Division)	„	3 Sections.
A Field Company, R.E.	„	Hd. Qrs. and 4 Sections.
A Field Artillery Battery (6 guns)...	„	3 2-gun Sections.
An Ammunition Column (R.F.A.)...	„	3 Sections.
A Cavalry Regiment	„	3 Squadrons.

There are 2 Field Ambulances to a Division; and each of the 3 Sections of each Ambulance is sub-divided into (1) Bearer Division, (2) Tent Division.

There are 2 Field Artillery Brigades to a Division; each Brigade has, as an integral part of it, an Ammunition Column in 3 Sections, of which (1) and (2) carry ammunition for their own Artillery Brigade and (3) carries S.A. ammunition for 1 Infantry Brigade and ½ the Divisional Troops.

The Sections of a Battery are further divided into Sub-divisions of 1 gun each. But 2 guns is the smallest fighting unit; and consequently guns should not be disposed in threes.

Each Squadron of Cavalry is composed of 4 Troops, each containing 4 Sections. The front rank of a Troop consists of 17 men, the odd man, in the centre, being the "Troop Guide."

An Infantry Brigade consists of 4 Battalions and nothing more.

STRENGTHS.

It is not necessary to know the total establishment of each unit with absolute accuracy; strengths vary daily on active service, and such knowledge would be useless. For instance, it is sufficient to remember that a cavalry regiment numbers approximately 500; but it is unnecessary to burden one's mind with the details of 25 officers, 511 other ranks, 21 A.S.C. drivers.

ROAD SPACES.

The same remark applies to road spaces. For example, a Field Company, R.E., occupies 210×; but it is of little importance whether the figure is remembered as 200× or 220×, so long as one guards against extreme errors such as 150× or 280× would be.

The following figures (which include an allowance for 'opening out') may be taken as sufficiently accurate for the Fighting Force and 1st Line Transport of Combatant Troops:—

Cavalry Regiment	...	550×
*Battery, R.F.A.	...	370×
Field Company, R.E.	...	210× (4 × 40× + 50× for Hd. Qrs.).
Mtd. Infy. Battalion	...	700×
Infantry „	...	600×
†R.F.A. Bde. Ammn. Col.	...	630×

For their 2nd Line Transport take $\frac{1}{3}$ of above figures for artillery, $\frac{1}{4}$ for other arms, and $\frac{1}{2}$ for ammunition columns.

For Non-Combatant Troops the road spaces may be taken as:—

Divisional Transport and Supply Column	900×
Field Ambulance	400×
1 Section of do. = 40× (Bear. Divn.) + 90× (Tent Divn.)	130×
Single vehicles (pair-horse)	10×

For large units, the figures for (*a*) fighting force plus 1st Line Transport and (*b*) 2nd Line Transport are, roughly:—

	(*a*).	(*b*).	
Infantry Brigade (4 battalions only) ...	1½m. +	½m. =	2 miles.
Division complete	4½m. +	3m. =	7½ miles.
Cavalry Brigade	1½m. +	1½m. =	3 miles.

PACE.

The distances in miles covered in 1 minute by the various arms at different rates are:—

Infy.	Cavy. and Arty. (walk).	Cavy. and Arty. (trot).	Cavy. (gallop).
$\frac{1}{20}$ m.	$\frac{1}{16}$ m.	$\frac{1}{8}$ m.	$\frac{1}{4}$ m.

* For new 18-pr. Q.F. gun.

† For old field gun. The ammunition column for the new 18-pr. Q.F. will probably occupy 1200×, inclusive of 2nd line transport.

A small force of all arms (say an Infy. Bde.) will march at the rate of 3 miles an hour by day; a larger force at 2 to 2½ miles. By night not more than 2 miles can be expected.

MARCHES.

When contact with the enemy is expected, troops should march in the order in which they will be required. Otherwise mounted troops and those with vehicles should march separately to the dismounted, starting later or even following a different route.

Field Companies, R.E., supply parties to Advanced or Rear Guards, the remainder marching near the head of the main body.

Ammunition Columns are grouped in rear of the fighting troops to which they belong.

Bearer Divisions, when fighting is expected, follow the units to which they are allotted. Tent Divisions usually march with the non-combatant troops.

The *2nd Line Transport* and the *Supply Column* may march 2 miles behind the fighting troops. An officer should be detailed in orders to command the 2nd Line Transport; and, if it marches separately to the fighting troops, a Baggage Guard (in addition to the small party provided by each unit for its own wagons) is required. Supply Columns are commanded by the senior officer with them. If the Supply Column and the 2nd Line Transport march together the whole are under the supreme command of the senior officer present.

In calculating the time that will be taken by any body of troops in carrying out a march, the length of road occupied by the troops (including distances) should be added to the length of the march.

In a combined march, a starting point should be named, which the head of the main body will pass at a certain hour; the various units join the column in their proper sequence under the orders of their own commanders.

The length of an average march for a column of all arms is 15 miles.

PROTECTION ON THE MARCH.

Commanders of detachments are responsible for keeping touch with the main body.

At the end of a march the Advanced Guard remains responsible for protection until the Commander of the Force makes other arrangements. At the commencement of a march the Outpost Troops remain out until the Advanced Guard passes through them, unless otherwise ordered.

An *Advanced Guard* is usually composed of all arms, and must include a proportion of Engineer and Medical (Bearer Division) units. Its usual strength is ¼ of the whole. Mounted troops, either of the Vanguard or of the Independent Cavalry (if any) should be 4 or 5 miles in advance of and on the flanks of the main body.

A *Flank Guard* must have its own Advanced and Rear Guards. It

may be required to hold its own without any support. (A type of Flank Guard is shown at the end of these notes).

A *Rear Guard* to a force retreating should be strong in artillery and mounted troops, which, especially the latter, are usually employed on the flanks. Its strength may be $\frac{1}{3}$ of the whole. In occupying a position the greater part of the force should be in the fighting line from the outset. Successive positions should be far enough apart (say 2 miles) to induce the enemy, after seizing one, to re-form into column of route before deploying for the attack of the next.

The *distances* of Advanced, Rear, and Flank Guards from the bodies they protect should be indicated by the Commander of the Force. At the commencement of a march a suitable distance for an Advanced Guard may be obtained by naming in orders the hour at which it is to *clear* a certain point and the hour at which the head of the Main Body should *pass* the same point. As a rough rule the distance between an advanced guard and its main body may be equal to the length of road occupied by the fighting troops of the main body.

All detached forces or units are responsible for their own immediate protection against surprise, irrespective of other troops specially detailed for this purpose.

PROTECTION WHEN AT REST.

The first points to settle are the Line of Observation and the Line of Resistance; the actual dispositions then follow.

The Line of Resistance should, when practicable, be within infantry long range fire of all positions whence the enemy's artillery could bring effective fire on to the main body.

Outpost Troops should consist of mounted troops by day and of infantry by night. Their strength may be $\frac{1}{8}$ of the whole, but the minimum possible number of troops should be employed. Small parties of cavalry may with advantage be attached to outpost companies.

The number of troops required on any particular length of line depends on the defensive capabilities of the ground. As a rough rule, if the Outpost Line is more than $1\frac{1}{2}$ miles long, it should be divided into Sections of from $\frac{1}{2}$ to 1 mile, the responsibilities of each Section being clearly defined.

It is usual to allot to each Outpost Company a definite length (say 500× to 800×, according to the nature of the ground), with the limits marked by natural features. The Picquet and Support should belong to the same unit, 1 or 2 sections forming 1 or 2 Picquets, and the rest of the company the Support. Sentries may be $\frac{1}{4}$ mile in front of the Picquets, and the latter $\frac{1}{4}$ to $\frac{1}{2}$ mile in front of the Supports.

Sentries are preferably in "groups" relieved at long intervals, and not in "double sentries" posted direct from the Picquet and relieved at short intervals. Picquets should not be in houses or high-walled enclosures with difficult exits.

The Line of Resistance is usually the line of Picquets.

Mounted Reconnoitring Patrols may go out as far as 10 miles to the front, and infantry up to 4 miles. Standing Patrols (of mounted men or cyclists) are valuable for watching particular points or approaches, especially at night. Sentries and Sentry Groups formed of mounted troops are called Vedettes and Cossack Posts.

A Special Reserve is not required with a small force. The purposes of a reserve can be fulfilled by an Inlying Picquet from the troops furnishing the outposts.

Detached Posts should never be employed if it can be avoided.

Billets are preferable to bivouacs. Horsed troops should be nearest the water supply, if the water has to be carted.

ATTACK AND DEFENCE.

All tactical problems resolve themselves into questions of attack and defence, in which the object of each side is the concentration of superior power (*i.e.* a greater and more effective fire, not merely greater numbers) at the decisive point.

All operations are more likely to be successful if they are in the nature of a surprise.

The Commander of every force, however small, should retain a portion of his command as long as possible under his own orders; for it is only whilst he has a reserve that he can retain an influence on the fortunes of the fight.

Aim at being strong at the decisive point at the critical moment.

THE ATTACK.

It is usually a good course to ascertain the most vulnerable point of the enemy's position, usually a flank, and to strike at it heavily.

In addition to the covering fire of artillery, the main attack should be assisted by long range fire of the reserve and by one or more secondary attacks, in order to hinder the enemy from changing front or reinforcing the point most threatened. Turning movements by small forces are as a rule inadvisable.

A flank attack may become a frontal one; and both flank and secondary attacks may become main ones. So troops detailed to such attacks should be prepared to press forward with vigour.

A definite task should be assigned to each body of troops. The objectives should be defined by points for the centre or one flank to march on; otherwise direction will be lost and gaps created, especially in undulating country, and such mistakes can seldom be remedied.

Frontages should be specified. A battalion in front line, between other battalions, may be given 600 yds.

The *Cavalry*, after performing their primary duty of procuring information, may be withdrawn to operate on the most exposed flank or to occupy ground whence they can bring enfilade fire on the position.

The "preparatory bombardment" by *Artillery* is a thing of the past; the artillery support of the infantry must be continuous.

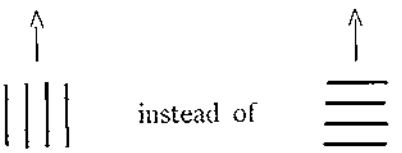
The first position of the artillery, unless a nearer one can be approached under cover, should not be within decisive range of the enemy's guns; its first target is the hostile artillery. When the attacking infantry advances to within effective rifle fire of the position, the greater portion of the attacking artillery should be directed to keeping the defending infantry in their trenches; for this purpose the attacking guns can be advanced much closer; but a change of position entails loss of time and temporary loss of power, so a position affording effective fire should not be abandoned for a nearer one unless some very obvious advantage will be gained.

The co-operation of the artillery is of such importance that it is advisable to send with the attacking infantry an artillery officer, whose duty is to keep the artillery informed of the progress of the attack and the manner in which it can best be supported by the guns.

Indirect laying enables artillery to come into action and keep up fire without being seen; but the delay caused by this method in changing targets renders it unsuitable for decisive ranges.

Provided it can be brought up and retired without unduly endangering the teams, artillery with shielded guns can remain in action in exposed positions within decisive range of hostile artillery.

The *Infantry* should be kept in controllable formation, preferably line of company columns, as long as possible. These columns can subsequently open out to deploying interval, and can extend on reaching the limit of effective rifle fire; but premature extension is to be deprecated. A company column may conveniently march as in fours to a flank instead of in the usual formation, thus



Entrenching will usually be necessary during the progress of an attack. So tools, and parties of engineers, should be within reach of the first line.

THE DEFENCE.

The method of occupying a position depends:—(1) On the strategical object (*i.e.* temporary defence by a rear-guard, or stubborn defence as part of a line to be held at all costs); (2) on the time and material available for constructing artificial cover; (3) on the positions open to the enemy's artillery. The position should always be viewed from the enemy's point.

Avoid the two common errors—to go too far forward, and to take up too extended a line.

Salients are a weakness unless their slopes can be covered by cross fire from other points.

Advanced Posts, too far off to be under effective infantry fire from the main position, should be avoided.

Usually the first consideration is a good field of fire over the immediate foreground (except in a rear-guard position, which would be vacated before the attack arrived so close); the second is concealment for all arms; the third is artificial cover.

The *Cavalry*, after delaying the enemy as long as possible, can be massed where it can best operate on the enemy's flank.

The *Artillery* may confine its fire to forcing the attacking infantry to an early extension, and decline to engage the hostile guns.

Alternative emplacements should be prepared for the guns of the defence.

The position can be held lightly by the infantry until the attack develops, the greater number being in General Reserve; and the infantry should never expose themselves either to view or to fire unless compelled to do so by the advance of the hostile infantry.

The General Reserve should not be endangered by being placed too near (say less than 250 yds.) to the guns.

When the position is longer than ½ mile, it should be divided into sections, each section being assigned to a distinct unit, with its limits marked when possible by natural features. A battalion, acting between other battalions, can be given 800 yds. of front.

Opportunities for counter-attacks must be looked for by both Local and the General Reserves. But such attacks should not be undertaken unless an advantage is obviously to be gained. An Officer of the General Reserve should be detailed to watch the fight, so that when this reserve is wanted its commander may be acquainted with the situation.

A "rallying position" should be selected in rear of the first one; it should not be nearer to it than 2,000 yds.

CONVOYS.

The most vulnerable portions of a Convoy are the flanks.

The Escort,—except a small "Immediate Escort," which reinforces the Baggage Guard (3 or 4 men per unit) by small parties in front, centre, and rear—marches some distance away from the Convoy, on its exposed flank.

For the defence, the Escort may march parallel to and simultaneously with the Convoy; or occupy a series of successive positions on the route; or picquet and hold points all along the route. If attacked the Convoy should push on.

The method of attack, unless the attacking force is sufficiently strong to first beat the Escort and then destroy the Convoy, consists of one portion of the force holding the Escort while the other attacks the wagons. Surprise should be aimed at, and the wagons attacked at a point where they will be under a disadvantage, the animals being the first targets.

Usually a convoy problem on a small scale means a race by the mounted troops of each side for one or more tactical points.

FIELD ENGINEERING.

Though details of Field Engineering are outside the scope of this examination, yet the solution of a problem may depend on the possibility of effecting the demolition of a bridge, or of constructing a temporary bridge, or on the time and tools available for digging entrenchments.

Demolitions.—A Field Company, R.E., carries 600 lbs. of gun-cotton, the Pioneers of a Cavalry Regiment 150 lbs.

For the purpose of tactical schemes on paper, it may be assumed that a Section of a Field Company can destroy 3 masonry bridges, and the Pioneers of a Squadron 1 bridge, in 4 hours. For iron-girder and wooden-trestle bridges $\frac{1}{3}$ the time and explosives are required.

Bridging.—The Headquarters of a Field Company, R.E., carries 2 pontoons, capable of forming 15 yds. of medium bridge (for all arms) or 25 yds. of light bridge (for infantry in file). One Section can make such a bridge, exclusive of approaches, in $\frac{1}{2}$ hour from time of arrival at site.

Entrenchments.—A Field Company, R.E., carries 100 picks, 100 shovels, and 100 miscellaneous tools; a Battalion 150, 220, and 100. An average untrained soldier with service tools can dig 2 paces linear of an open trench, $3' \times 3'$ in section, in 2 hours; for head cover add 1 hour, for over-head cover 2 hours.

WRITING APPRECIATIONS.

It is advisable to adopt the system which is officially recommended, and to divide the Appreciation into the following heads :—

1. Object in view.
2. Situation and Strength of Enemy.
3. „ „ Own Forces.
4. Courses Open to Enemy, with *pros* and *cons* of each course.
5. „ Own Side. „ „ „
6. Proposals for Action by Own Side.

When the wording of the Scheme causes any uncertainty on points affecting the solution of the problem, it is permissible to commence

by making an *Assumption* to clear up such points. But assumptions should be very sparingly used.

1. *Object.*—This should be defined clearly and concisely. Care must be taken not to confuse the *Object* with the *Objective.* For instance, if you are in command of a force detailed to destroy an enemy's railway communications which are known to be guarded, your *Object* is the destruction of the railway, but your *Objective* will probably be the enemy's protective force, for without first beating it you may not be able to carry out the intended destruction.

2 and 3. *Situation and Strengths.*—In an Appreciation of a campaign or in a review preliminary to operations on a large scale, this heading would cover consideration of numerous factors affecting the opposing forces, *e.g.* :—Influence of politics; the nature and security of the lines of communication by road and railway; the hostility of the inhabitants.

But in appreciating a tactical problem involving very small forces, few of these factors would be relevant. However, in Part I., Subject (i.), (*a*), the Appreciation is "with special reference to the ground," and it is necessary to draw attention to facts which affect the problem; *e.g.* the positions available for the enemy's and your own artillery, points which can be reached within a given time by the enemy's troops and your own, the effect of convexity of ground on fields of fire for infantry and of enclosed country on reconnaissance by cavalry or defensive tactics. The unessential must, however, be avoided; and to give written topographical details that are as well, in fact generally better, given on the map is a mistake.

Sometimes one of the forces in a Scheme may be retiring after a defeat, in which case *moral* may be mentioned. Sometimes the weather is assumed to be "as to-day," and this may have a distinct bearing on the operations.

4. *Courses Open to Enemy.*—Look at the situation from the enemy's point of view. Make a concise tabular statement of the different courses of action open to him as far as can be foreseen; discuss each course in turn *briefly;* and give its *salient* advantages and disadvantages.

What action on his part will interfere most effectively with your plans? What counter measures are advisable?

State what course he is most likely to take, and always give him credit for acting soundly.

5. *Courses Open to Own Forces.*—Here comes in your Objective. Look at the situation from your point of view; and make another concise tabular statement showing the various courses you can adopt, with their *pros* and *cons*.

If the enemy remain where he is, where should he be attacked? If he is in position, where are his flanks? If he retire, where can you come up with him? If he advance, where will you meet him?

What preparations are advisable? What time is available for artificial cover? Are your flanks and line of retreat secure?

Having considered such of the above factors as affect the situation, decide whether you can at once proceed to the attainment of the object in view. If you can, decide which of the alternative courses open to you is recommended. If you cannot, state what action on your part will most effectively assist your own side and interfere with the plans of the enemy.

6. *Proposals for Action by Own Side.*—Conclude by describing the line of action you think best; this should be stated in general terms only, and should not be in the nature of detailed orders. It is important to add which side has the initiative, and to say to what extent you are justified in expecting success in the attainment of your object.

Remember that:—

The main point in an appreciation is a clear and concise enunciation of what you consider to be the best course of action.

The point of next importance is the argument you adduce in support of your proposal.

Above all think clearly, and then express concisely only what is essential.

WRITING ORDERS.

Orders in the field are now divided into three categories.

(*a*). Routine.
(*b*). Standing.
(*c*). Operation.

(*a*). *Routine Orders* deal with administration, discipline, and all matters not connected with operations; so they have no concern with the subject of this article.

(*b*). *Standing Orders* deal with both operations and routine, and are drawn up to save frequent repetition in other orders. They only concern us to the extent that we may assume that they contain instructions for:—Halts during marches; baggage guards from units; issue of extra rations and ammunition prior to engagements; the retention of outpost lines until the advanced guard has passed through them; keeping touch; etc. We may therefore omit such recurring details in Operation Orders.

(*c*). *Operation Orders.*—While it may be said that battles can be won on orders that are not written according to sealed pattern, yet it is obvious that the adoption of a recognized system tends to facility of understanding and to rapidity of issue of dependent orders.

Operation Orders cover all forms of operations—rear guard, attack, defence, outposts, etc., etc. They should be written with half margin, and should be divided into numbered paragraphs, with clear spaces between them, as follows :—

1. Information. (*a*). As to Enemy.
(*b*). As to Own Forces.
2. Intention—of the Officer Commanding the force.
3. Orders to Combatant Troops.
4. Orders to Non-Combatant Troops.
5, 6, 7. etc. Orders for any Special Arrangements.
Last. 9 (say). Position of Officer Commanding.

1. *Information* should contain sufficient to enable subordinate commanders to understand the situation. (*b*) should include the intention of the officer superior to the one in whose name the orders are issued, and the proposed movements of other forces commanded by that superior officer.

2. *Intention* should be very brief.

3. *Orders to Combatant Troops* should be divided into sub-paragraphs; either dealing with the separate arms, usually in the order (*a*) Cavalry, (*b*) Artillery, (*c*) Infantry, (*d*) Engineers; or dealing with separate operations, *e.g.* main attack and flank attack, each again subdivided for the various arms.

In march orders the troops referred to in each sub-para. should be detailed in the margin. This course may also be adopted for other orders, when clearness or brevity is gained thereby.

In mentioning troops in orders the sequence is from front to rear for marches, and from right to left for attack, defence, and outposts.

If any portion of the force is to be detached or to act independently—*e.g.* advanced, rear, and flank guards, general reserve, outposts, 2nd line transport—an officer should be appointed to command, and be named in orders.

(*a*). It is advisable to particularize any information specially required from the Cavalry; *e.g.* "The direction of the advance of the enemy's main body," or "Whether a certain ridge is occupied by the enemy."

(*b*). Artillery in the attack prefer to choose their own positions; so these should not be too precisely named. It is best to say "The O.C. Artillery will select a position in the vicinity of ——," or "It is suggested that a suitable position may be found near ——." A lengthy description of the position may be avoided by saying "In the vicinity of a point which will be indicated by a Staff Officer." Similarly it is advisable not to lay down definite targets for the artillery to fire at.

No special escort for guns is necessary when the disposition of other troops affords protection. When an escort is required in an attack, it should be mobile; and should consist of mounted troops when there are enough to render available the required number (say 1 company mounted infantry or ½ squadron cavalry to a single battery).

The O.C. Ammunition Column makes his own arrangements for its disposition. But the O.C. Force can name the position of the section carrying S.A. ammunition.

(*c*). Field Engineers may be distributed between the units to whom they are most likely to be useful, especially in the defence. When not required by the infantry they can be with the artillery.

4. *Orders for Non-Combatant Troops* cover Medical units, Supply Columns, and 2nd Line Transport. These orders should also be subdivided whenever necessary; and when the baggage, etc., marches on a different road to the fighting troops, an officer should be named to command.

5, etc. *Orders for Special Arrangements* include *Signalling Communication, Artificial Cover, Demolitions*, and so on. Each should have a separately numbered paragraph.

It is not necessary to give orders on these points unless anything definite is required; and then it is advisable to particularise. For example, orders for a defence may specify that "Signalling posts are to be established at —— and ——," and that "Particular attention is to be paid to the construction of artificial cover at —— and ——."

Last. 9 (say). *Position of Officer Commanding.*—The O.C. should be where he can easily be found, with the reserve or the artillery. He need not be actually alongside the guns; but messengers can find guns easily, and can thus reach the O.C. if he is in their vicinity.

At the top of the orders should be the sequence number, the place and date of issue, and a reference to the map concerned. At the foot should be a list of the *individuals* to whom the orders are issued, and the hours and modes of issue. It is not sufficient to enter merely "O.C.s Units"; a complete list should be made out, on which the staff officer can tick off each individual as the orders are issued to each. When copies are sent by hand, the name and description of the bearer must be recorded in the mode of issue.

Orders must of course be complete. They should also be clear, concise, and precise; that is, they should be incapable of being *mis*understood. Conditional phrases, such as "if possible," are not permitted. Doubtful terms, such as "dawn" and "dusk," must be avoided, and definite hours named. The hour of 12 must be followed by "noon" or "midnight." A night should be described by mentioning both days concerned; *e.g.* night 6/7 July.

All proper names, including names of officer commanding and place of issue, must be in capital letters.

Units must be described by their proper abbreviations* ; *e.g.* Rgt., Sqn., Bty., Bn., Co., Fd. Amb. If portions are excluded, those portions should be mentioned in brackets ; *e.g.* 1 Cav. Rgt. (less 1 sqn.). In paper schemes it is unnecessary to give fictitious titles, such as 30th Hussars, etc., to the units dealt with. With actual troops, however, their correct Army List abbreviated titles† should be used ; *e.g.* 1st/King's Own, 14th Hrs.

Pernicious interference with subordinates is to be particularly guarded against. Orders must contain everything that a subordinate commander cannot arrange for himself, but *nothing more*. The selection (*i.e.* detailing) for detached duties of any portion of any unit should be left to the officer commanding that unit. The dispositions of any body of troops detailed for any duty must be left to the discretion of the commander of that body. Subordinate commanders in turn write their own orders, so that the smaller the force the more detailed the orders.

When two different forms of operations are involved, separate orders should be issued for each. For example, for a night halt in the proximity of an enemy, to be followed by an advance, there should be separate orders for (1) the Outposts and bivouac and (2) the March.

Arrangements for a possible retreat must not be published in orders. They should be communicated confidentially in "Instructions" to senior officers.

When orders refer to a body of troops reaching or starting from a given place at a certain time, the *head of the main body* is intended, unless otherwise stated.

SAMPLE SCHEMES WITH SOLUTIONS.

Two Schemes with Solutions—an attack problem on a 1″ map and a defence problem on a 6″ map—are appended to show what can be done, after sufficient practice, within the 2 hours limit. The names on the maps are fictitious.

Owing to the exigencies of printing, the spaces between the paragraphs of the Appreciations and Orders are in many places not as conspicuous as they should be in manuscript.

The schemes are not ideal ones ; they are merely given as being typical of attack and defence, of open down country and of enclosed

* It is usual to confine the use of these abbreviations to the margin of orders ; but, so long as the quantities of units referred to are given in words and not in figures, there appears no reason why abbreviated descriptions (*e.g.* three Cos. Inf.) should not be used also in the body of orders.

† These abbreviated titles, and also those of principal officials and of Corps (*e.g.* G.O.C., P.M.O., C.R.A., A.S.C., R.A.M.C.), may be written in the body as well as in the margin.

low land. Nor is it claimed that the solutions given are the best possible.

The following remarks are explanatory of the solutions :—

SCHEME ON 1″ MAP.

Appreciation.—The "Assumption" is legitimate for the disposition of the Blue cavalry at 9 p.m. and the state of the bridges both affect the solution.

It is obvious that both banks of the R. Avon must be captured before Blue can use the harbour.

Red's main position is south of Avonmouth, and this must be attacked from the south because of the open flats and the river on the north side.

Red's weakness lies in the fact that both his positions are either enfiladed or taken in reverse from the high ground to the north-west of Avonmouth.

Orders.—The march orders would be separate to those for the attack; but they are not given as the problem deals with the attack only.

Col. A. and Brig.-Gen. C. are both left to make their own dispositions of the troops under their command; and the officers commanding the artillery and infantry brigades are allowed to select respectively the battery and battalion to be detached from their units.

The Artillery is given discretion to find its own targets. A special escort is not required, as it is protected by the disposition of the other troops; but as a precaution the cavalry on the south bank are made responsible for its safety.

SCHEME ON 6″ MAP.

Appreciation.—The Object is two-fold.

There is (fortunately for the time limit) little scope for enlarging on the features of the ground. The "high thick hedges containing numerous large trees" are a fact; the statement is included in order that the reader may understand the solution; but, except in one or two places, this peculiarity of the country could hardly be understood from the map.

Orders.—The Cavalry are particularly asked for early information as to the direction of advance of the enemy's main body.

The entrenchments are particularized; as also are the special signalling posts required.

SCHEME ON 1″ MAP.

ATTACK ON AVONMOUTH.

GENERAL IDEA.

A BLUE invading Force has landed at WHITBY and is advancing on DARLINGTON.*

BLUE has detached a Force to seize the Port of AVONMOUTH.

SPECIAL IDEA: BLUE DETACHED FORCE.

The BLUE Detached Force is ordered to take AVONMOUTH as quickly as possible, as its Harbour is urgently needed by BLUE as a Base.

AVONMOUTH is believed to be held by 2 battalions of RED Volunteer Infantry, 1 squadron Imperial Yeomanry, and some Volunteer Engineers and Artillery with two 5″ howitzers and two 15-pounders.

SITUATION.

BLUE DETACHED FORCE.—On Monday, 9 p.m., BLUE'S Cavalry have gained the line BRANSCOMBE CLIFFS—PRESTLAND—FLOWER HILL—Coast Guard Station a mile south of TINFORD. The remainder of BLUE Detached Force at this hour is bivouacked in the valley that runs N.N.W. from PANGDON to BROAD DEAN.

RED FORCE.—BLUE Cavalry report RED Infantry holding the line MONK BAY—KING'S DOWN, and RED Imperial Yeomanry holding the ridge north of AVONMOUTH from above FILMER to CROW'S NEST.

PROBLEM.

BLUE FORCE.
1 *Cav. Rgt.*
1 *Fd. Art. Bde.*
1 *Inf. Bde.*
1 *Fd. Co., Eng.*
1 *Sect. Fd. Amb.*
1 *Co. Div. T. & S. Col.*

You are Commander of the BLUE Detached Force, strength as per margin. As Commander, write

(*A*) *An Appreciation of the Situation at 9 p.m.*

(*B*) *Your Orders for the attack of AVONMOUTH.*

* WHITBY is 15 miles south and DARLINGTON 50 miles west of AVONMOUTH.

SOLUTION.

(*A*). AN APPRECIATION OF THE SITUATION
AT 9 P.M. MONDAY, 2ND JUNE, 1906,
FROM THE POINT OF VIEW OF
THE COMMANDER OF BLUE DETACHED FORCE.

References to 1″ Map issued.

Assumption.—It is assumed that half the BLUE Cavalry Regiment is north of the AVON at 9 p.m.; also that CRICHTON Bridge is destroyed, but the HINGFORD Bridge intact.

Bivouac south of HOWTH Coast Guard Station,
Monday, 2nd June, 1906.

Situations and Strengths.

As given in Scheme.

Our Object.

Our Object is to capture AVONMOUTH so as to use its harbour as a Base.

In order to effect this, we must capture the positions on both banks of the River AVON; for, as long as RED holds either bank, he can deny us the use of the harbour.

COURSES OPEN TO ENEMY.

Courses open to Enemy.

(*a*). RED might abandon his positions south of the River AVON and retire to the north bank.

By this course he would gain nothing, for the FILMER—CROW'S NEST position is weak, being enfiladed and commanded from STONE HILL.

Moreover, if we get artillery on the lower slopes of CRICHTON HILL, in prolongation of the line of the harbour, this course will be denied to him.

(*b*). Practically the only course open to RED is to hold his present positions to the last.

COURSES OPEN TO US.

Courses open to Us.

(*a*). To transfer our whole force to the north of the River AVON and attack the FILMER—CROW'S NEST position.

This position could be quickly and easily captured by an advance east from STONE HILL, whence it is commanded and enfiladed.

But when we have gained this position, we are but little nearer the attainment of our object; for we cannot attack AVONMOUTH from the north over those perfectly open flats, nor are we likely to be able to cross the AVON.

But, after we have taken BLUE's positions on the south bank, it would be easy to transfer our force to the north bank, and then capture this CROW'S NEST position in the unlikely event of it still holding out.

(*b*). To attack AVONMOUTH south of the River only.

This would concentrate all our force, but would give up the advantage of enfilading and reverse artillery fire.

(*c*). To attack on both banks.

To send any infantry to the north bank would be to divide our forces dangerously.

But we have such great preponderance of guns and cavalry that we can safely send two squadrons and a battery to the north bank, where they will be more than double the strength of the RED Imperial Yeomanry on that bank.

By sending a battery to the north bank we shall also be able to bring enfilade and reverse artillery fire to bear on RED's main position south of the River, and yet retain great superiority on the south bank where our main effort is to be made.

The attack on the south bank can be delivered :—

(i.) Against RED's front,
or (ii.) Against RED's right flank from PRESTLAND. His left flank rests on the sea.

(i.). Except on the extreme east, where the small undulations and the cliffs give a little cover, the ground south of the eastern and central parts of RED's front is very open and glacis-like.

South of the western part of his front the valleys become more pronounced, and there are some banks, fences, and buildings that would afford cover.

(ii.). West and south-west of RED's right flank there is much dead ground close up to his position; and this flank is exposed both to enfilade and reverse artillery fire from the hills on the other bank of the River.

PROPOSAL FOR ACTION BY BLUE.

Proposal for Action by BLUE.

From a consideration of the above, it is recommended that the main attack on AVONMOUTH be made eastwards from PRESTLAND, supported by :—

(i.) Artillery fire from BALMY DOWN on the south bank, and from CRICHTON HILL and STONE HILL on the north bank.

(ii.) A subsidiary Infantry attack northwards from the vicinity of BELLEVUE FARM.

(iii.) An attack by a small body (say one Squadron) along the coast by MONK BAY,

and (iv.) A strong attack by the Cavalry Regiment (less one Squadron) eastwards from STONE HILL on the FILMER—CROW'S NEST position.

We have the initiative, and our force is more than double that of the enemy, whose troops moreover are auxiliaries; so we are justified in expecting success.

Major

(*B*). OPERATION ORDERS
BY THE G.O.C. BLUE DETACHED FORCE.

Reference to 1″ Map issued.

Assumption.—It is assumed that half the BLUE Cavalry Regiment is north of the AVON at 9 p.m.; also that CRICHTON Bridge is destroyed, but the HINGFORD Bridge intact.

No. 10.

Bivouac south of
HOWTH Coast Guard Station,
Monday, 2nd July, 1906.

1. (*a*). The *Enemy* are reported by our Cavalry to be holding positions on both banks of the River AVON: on the south bank Infantry occupy the line MONK BAY—KING'S DOWN; on the north bank Yeomanry are on the ridge FILMER—CROW'S NEST.

(*b*). *Our* Cavalry have gained the line BRANSCOMBE CLIFFS—PRESTLAND—FLOWER HILL—TINFORD.

Our Detached Force is ordered to capture AVONMOUTH as quickly as possibly for use as a Base.

2. The *Intention* of the G.O.C. is to capture RED's positions south of the River AVON to-morrow, the main attack being directed on his right flank, east of PRESTLAND.

Colonel A.
Cav. Rgt. (less one Sqn.).
1 Bty., Fd. Art.

3. (*a*). The *Cavalry Regiment* (less one Squadron), reinforced by a Battery, will operate north of the River under the orders of Colonel A.

His principal object will be to support the main attack, by artillery fire from STONE HILL and the eastern slopes of CRICHTON HILL and by rifle fire from the north bank of the River.

His secondary object will be the capture of RED's position on the north bank.

The *half Squadron* now south of the River will form the escort to the Battery during its movement across the River *viâ* HINGFORD.

1 Sqn.

The *remaining Squadron* will operate on our right flank along the coast by MONK BAY. It will also be responsible for the safety of the guns on BALMY DOWN.

Inf. Bde.
Fd. Co.
Bearer Div. of Sect. of Fd. Amb.

(*b*). The *Infantry Brigade*, with the Field Company, R.E., and the Bearer Division of the Section of Field Ambulance, will march at midnight 2/3 July (under the march orders issued herewith) and gain the deadground in the valley just east of DEAN'S FARM.

MAIN ATTACK.
Brig. Gen. C.
Inf. Bde. (less 1 Bn.).
Fd. Co. (less 1 Sect.).

The *Infantry Brigade* (*less one Battalion*) and the Field Company, R.E. (less one Section), under the command of Brig.-Gen. C., will move eastwards from DEAN'S FARM, PRESTLAND, at 3 a.m. to-morrow, and make the main attack on the right flank of RED's position. Assisted by the other attacks, it will capture RED's position south of the AVON.

One Bn.
One Sect. Fd. Co.

1 *Battalion* and 1 Section, Field Company, R.E., leaving the Brigade at the mouth of the valley west of LODGE HILL, will take up a position in the vicinity of BELLEVUE FARM. It will assist the main attack by an attack northwards against the western portion of RED's front.

Fd. Art. Bde. (less 1 Bty.).

(*c*). The *Field Artillery Brigade* (less 1 Battery) will march with the Infantry Brigade at midnight 2/3 July (under march orders issued herewith). It will leave the column of march north of BRANSCOMBE and proceed to the western slopes of BALMY DOWN. As soon as light permits, it will support the main attack.

One Bty., Fd. Art.

One Battery will march at once *via* HINGFORD, under escort of half Squadron, to join Colonel A.'s command.

4. The *Company of the Divisional Transport and Supply Column,* the *Tent Division of the Section of Field Ambulance,* and the *2nd Line Transport* will march with the Infantry Brigade at midnight 2/3 July (under march orders issued herewith). They will halt in the valley west of BALMY DOWN.

5. *Signalling Communication* is to be established between troops of the main and secondary attacks and the Headquarters on BALMY DOWN.

6. The *General Officer Commanding* will be with the artillery on BALMY DOWN.

Copies issued personally at 10 p.m. to
Bde. Maj. Inf. Brig.
Adjt. Art. Bde.
O.C. Fd. Co.
O.C. Sect. Fd. Amb.
O.C. Co. Div. T. & S. Col.

J. SMITH,
Lt.-Col., Gen. Staff.

Copies sent by (Mounted Orderly) at 9.45 p.m. to
O.C. Cav. Rgt.
O.C. Sqns. (1½) north of R. AVON.

SCHEME ON 6″ MAP.

DEFENCE OF CUXTON BRIDGE.

GENERAL IDEA.

The River ISIS is unfordable. All bridges over it have been destroyed except that at CUXTON MILL.

RED is mobilizing a Division at WEYBRIDGE and a Division, less 2 Battalions, at BASING.*

RED hopes soon to assume the offensive; but during mobilization the Ordnance Stores at FINBURY, guarded by only one Battalion, are very vulnerable.

SPECIAL IDEA: RED FORCE.

A BLUE Force, strength about 1 Infantry Brigade, 1 Artillery Brigade, and 1 Squadron, is reported to have reached HALLDEAN from the east at 2 p.m. to-day.

A RED Force as per margin is detached to hold CUXTON BRIDGE and to cover FINBURY.

PROBLEM.

RED FORCE.
1 *Sqn.*
1 *Bty. Fd. Art.*
1 *Bn.*

You are Commander of this RED Detached Force which reaches CUXTON BRIDGE at 4 p.m. As Commander, write

(*A*) *An Appreciation of the Situation at 4 p.m., with special reference to the ground,*

(*B*) *Your Orders for the defence of the Bridge by day,*

and (*C*) *Show your Dispositions on the 6″ Map.*

* To save expense the 1″ map on which the major tactics of this Scheme are based is not published. WEYBRIDGE is 12 miles S.W., BASING 25 miles N.W., FINBURY 15 miles N.W., and HALLDEAN 12 miles E. of CUXTON.

SOLUTION.

(*A*). AN APPRECIATION OF THE SITUATION AT 4 P.M. ON WEDNESDAY, 4TH JULY, 1906, FROM THE POINT OF VIEW OF THE COMMANDER OF RED DETACHED FORCE.

References to 6″ Map issued.

CUXTON MILL,
Wednesday, 4th July, 1906.

Our Object. *Our Object* is to hold CUXTON BRIDGE *and* cover FINBURY.

Situation and Strengths. (*a*). Of *Enemy* as in Scheme.

(*b*). Of *Our Forces* as in Scheme. Our reinforcements at WEYBRIDGE and BASING *hope* to assume the offensive soon, so it is evident that we cannot expect any assistance before the Enemy reaches the line of the River ISIS.

Terrain. The country in the neighbourhood of CUXTON is very low lying and close; consisting of (*a*) thick woods, (*b*) pasture intersected by water ditches, and (*c*) cultivation with high thick hedges containing numerous large trees. It is very unsuitable for cavalry reconnaissance; affords no good artillery positions; and is difficult for moving infantry to keep touch in. The facilities for concealment favour the attack rather than the defence.

COURSES OPEN TO ENEMY.

Courses open to Enemy. (*a*). BLUE might attack CUXTON BRIDGE only. This he can do either

(i.). From the East. This would be his most direct route; his right flank would be protected by PLASHETT WOOD; and the knoll just south-east of CLAY HILL would afford a good position to cover the final assault.

(ii.). From the North-East. His advance would be well concealed, and his left flank would be protected by PLASHETT WOOD; but his right flank would be liable to enfilade from the right bank of the River ISIS, the front for attack would be narrow, and a long detour would be necessary.

(iii.). From the South-East. This would involve even a longer detour, with no countervailing advantage.

In either case the attack would be supported by artillery fire from MALLING HILL, which commands the whole country on both banks of the River within the vicinity of CUXTON BRIDGE, or from the spur ending at RINGMER WINDMILL.*

(*b*). BLUE might make a feint only on CUXTON BRIDGE and effect a crossing at some other point. Such points are

(i.). OLD MILL, ISFIELD. Here his advance would be under cover throughout, and there are knolls from which the actual crossing could be covered; but there are several tributary streams which would delay his advance.

(ii.). WELLINGHAM. Here there is a salient bend in his favour, but open ground for some distance on both sides of the River.

(iii.). STONEHAM FARM.† Here again is a salient bend in his favour; also a good position near, whence his artillery could cover the crossing, and a good road west of the River ISIS by which to cut off our retreat.

As BLUE appears to have no engineers he is unlikely to adopt alternative (*b*), for his infantry would probably be unable to construct a bridge over the ISIS, even if materials were to be found at the farms within reach.

Moreover, he probably knows that we have no engineers either, and that consequently we cannot effect much damage to CUXTON BRIDGE; and he wants to push on by the quickest way.

He will therefore probably attack CUXTON BRIDGE only.

COURSES OPEN TO US.

Courses open to Us.

(*a*). To occupy the left bank of the River ISIS.

There are no good positions on the left bank, on which our small force could make a stubborn resistance; and a retirement under fire over the single crossing at CUXTON would be extremely difficult, and might hinder us in carrying out our second object.

(*b*). To occupy the right bank.

In this case the open fields east of the railway on either side of CUXTON STATION would afford a fairly good field of fire from the railway bank; a second tier of fire could be obtained by the Reserve on the low spurs just west of this railway; and there are several roads by which a retirement could be effected.

* MALLING HILL is 2¼ miles due S. of CUXTON MILL, its height being 500′. RINGMER WINDMILL is on a spur of it, running N.E., the mill being on the 150′ contour and 1½ miles distant.

† STONEHAM FARM is just north-west of the foot of MALLING HILL.

In either case the only possible artillery positions are on the right bank. They are all low and with very limited views. Probably the best would be just north of BANKS FARM.

CUXTON MILL is a difficult place to defend; but obviously it must be held, and it is also a difficult place to attack. There are two weirs and two masonry arch bridges, with a winding road between them.

The head of the enemy's main body must now be within 6 miles of us, and his infantry attack will probably be developed by 6.30 p.m. This will give us time to construct a certain amount of artificial cover, and we may *possibly* obtain explosives in the neighbourhood for the demolition of the bridges.

PROPOSAL FOR ACTION BY RED.

Proposal for Action by RED.

It is recommended that CUXTON BRIDGE and its immediate neighbourhood be held with the greater portion of the infantry, supported by artillery on a position in rear; the cavalry to delay the enemy as long as possible on the left bank, and after crossing to the right bank to patrol both up and down stream. The MILL buildings to be placed in a state of defence, and entrenchments dug for the companies in front line; and endeavours made to prepare the MILL bridges for demolition.

The Enemy has the initiative; but his course of action is practically restricted to an attack on one point, so that he has not the advantage of surprise. Though our position is not a strong one, there seems no reason why we should not hold it until 9 p.m. against a force double the strength of ours.

(*B*). OPERATION ORDERS
BY THE O.C. RED DETACHED FORCE.

Reference to 6″ Map issued.

CUXTON,
No. 15. Wednesday, 4th July, 1906.

1. (*a*). The *Enemy* (strength about 1 Infantry Brigade, 1 Field Artillery Brigade, and 1 Squadron) is reported by our Cavalry to have reached HALLDEAN from the east at 2 p.m. to-day.

(*b*). *Our Forces* are mobilizing as follows:—

1 Division at WEYBRIDGE,
1 Division (less 2 Battalions) at BASING,

but these will not be ready to assist us before we meet the enemy.

2. The *Intention* of the O.C. Force is to cover the Ordnance Stores at FINBURY by holding the road bridges over the River ISIS at CUXTON MILL and also preventing the Enemy from crossing the River at any other point in this neighbourhood.

1 Sqn. 3. (*a*). The *Cavalry* will delay the enemy as long as possible on the left bank. When forced to retire they will cross the River at CUXTON BRIDGE, and will then patrol along the right bank from HAMSEY to ISFIELD.

Early information is particularly required as to the direction of the advance of the Enemy's main body.

1 Bty. (*b*). The O.C. *Artillery* will select a position whence he can best operate against the Enemy's advance and also support the defence of CUXTON BRIDGE.

It is suggested that a suitable position may be found in the vicinity of BANKS FARM.

1 Inf. Bn. (less 3 Cos.).

(*c*). The *Infantry* Battalion (less 3 Companies) will occupy CUXTON MILL and enclosures, and also the railway bank on each side of CUXTON STATION at points whence a cross fire can be brought to bear on the approaches to the MILL from the east.

3 Cos.

3 Companies will remain in reserve at RIPPLE STATION.

4. *Demolitions.* The two bridges at CUXTON MILL will be prepared for demolition if possible, but will not be destroyed without orders from the O.C. Force.

All locks between HAMSEY and ISFIELD will be closed, commencing from down stream, so as to increase the obstacle afforded by the River.

The above work will be carried out by parties from the Companies detailed to the Reserve.

5. *Artificial Cover.* CUXTON MILL will be placed in a state of defence; and entrenchments will be dug on the west side of the railway bank, where occupied.

6. *Signalling Posts* will be established near CUXTON RECTORY and MONGER'S FARM.

7. The *Officer Commanding* will be with the Reserve.

Dictated at 5 p.m. to
Adjt. Inf. Bn.
O.C. Bty.
Copy sent by (Mounted Orderly) at same hour to
O.C. Sqn.

J. BROWN,
Capt., S.O.

(*C*). DISPOSITIONS.

The disposition of the RED Force is shown on the map in red.

TYPE OF FLANK GUARD.

The following shows an order of march for a Flank Guard, on one road, composed of:—

1 Squadron, Cavalry.
1 Brigade, R.F.A.
1 Field Company, R.E.
1 Infantry Brigade.
Bearer Divn. of 1 Section of Field Ambulance.
1 Company of Divl. Transport and Supply Column.

It is assumed that the mounted troops are well out to front and flanks.

VANGUARD ...
- Point of 2 men.
- 100×.
- Rest of 1 Sect. of Inf.
- 200×.
- Rest of 2 Cos. of No. 1 Bn.

½ mile.

MAIN GUARD ...
- 2 Cos., No. 1 Bn.
- 2 Sects., Fd. Co., R.E.
- 4 Cos., No. 1 Bn.

1¼ miles.

MAIN BODY ...
- 2 Cos., No. 2 Bn.
- 1 Bde., R.F.A. (less Ammn. Col.).
- 6 Cos., No. 2 Bn.
- No. 3 Bn.
- Hd.-Qrs. and 2 Sects, Fd. Co., R.E.
- Bearer Div. of 1 Sect. of Fd. Amb.
- *Ammn. Col. of 1 Bde., R.F.A. (600×).
- 2nd Line Transport. (1300×).
- 1 Co., Div. T. and S. Col. (310×).
- 4 Cos., No. 4 Bn.

¾ mile.

REAR GUARD ...
- 3 Cos., No. 4 Bn.
- ½ mile.
- 1 Co., No. 4 Bn.

TOTAL LENGTH OF ROAD OCCUPIED.

Point to head of Main Body	2¼ miles.
Main Body	2¾ ,,
Tail of Main Body to tail of Rear Guard ...	1½ ,,
Total	6½ miles.

The above distribution of the Guard and the distances between its various portions are given merely as a guide. In practice both distribution and distances would depend on circumstances, such as the immediate object, the proximity of the enemy, and the nature of the country.

The reader can fill in the details of the lengths of the various portions of the combatant units.

* See footnote on page 274 as to probable increase in length of Ammn. Col. of R.F.A. Bde.

TRANSCRIPT.

CLEARING FOREST LAND.

Extracts from an article* by Franklin Williams, Jr., in the Supplement of the *Scientific American*, dated 15th and 22nd September, 1906.

THE suggestions contained are the results of practical work carried on for years. The writer has been constantly engaged in clearing land, usually covered with bushes and timber of various sizes, including most species of forest trees common to the Middle Atlantic States. The task has been slow, laborious, and expensive, but very necessary.

The problem is not only how to clear overgrown land, but whether it will be profitable to do so. Manifestly much wooded land had better be left for timber and fuel purposes. The reckless use of an axe for a few hours will inflict damage that it will take nature years to repair. To cut away young growth, which would within reasonable time possess timber value, is usually a mistake. To leave bush land idle, when it will require a hundred years for it to develop into profitable timber, is folly.

The timber consideration is not the only one that enters into the advisability of clearing land. The location of the tract, together with the density and size of the wooded covering, must be considered. If a living has to be earned upon it, poor or foul land is dear at a gift. Generally the expense of clearing will exceed the original cost of the land. The cost per acre will vary from $5 or $10 to $30 or $40, conditional on the kind, density, and size of wooded covering. In many localities there is a fair demand for wood, the proceeds of which will help to defray the cost of clearing. In fact, it might be profitable in some instances to dispose of the wood to the best advantage, and then to give away, if it cannot be sold, the land with all its stumps and roots and purchase improved land.

If for any reason it is decided to clear land, then the method to be employed becomes all important.

The nature of the soil is the first thing to be considered. For instance, if soft or marshy the use of heavy machinery would be impracticable, and if stones are thickly embedded in it great difficulty would be experienced in keeping mattocks sharp. Whether the land is desired for immediate cultivation and a good yield is expected the first year or not, are also matters for consideration. It is evident that the wisest method to be pursued depends upon local conditions.

* The article appears to have been originally published in the *Farmer's Bulletin*, issued by the Department of Agriculture.

METHODS OF CLEARING.

PASTURING.

If the wooded tract is adapted to pasture and stock are available, pasturing would undoubtedly be the cheapest means. If the timber consists of kinds that rot readily, it would be wise to simply cut away the wood and leave stumps and roots to decay for several years before attempting to cultivate. If the wooded growth is small, the mattock will usually prove the most satisfactory and expeditious means of removing the brush.

If the growth is large and the clearing is to be a profitable investment, pasturing is probably the best method that can be pursued.

The purpose of this method is to change the field from woodland to pasture and from pasture to cultivated ground. The stock will keep down new growth while stumps and roots decay.

In pursuing this course the timber should be cut low, leaving the stumps in the most favourable condition for rotting. The bush and trash should be burned. The stock ought to be allowed the run of only so large a tract as they can keep pretty well subdued. The quantity of sprouts and young bushes an animal will nip off will depend upon whether or not it has access to other vegetable matter.

It is desirable in late summer to go over the pasture lot, and with an old axe remove the sprouts and bushes which the stock have failed to subdue. If this method is carefully followed for a few years, surprising results will follow. When the stumps of one tract are dead and decaying, another lot should be added to the pasture.

Sheep and goats are preferable, but any kind of stock is suitable for this kind of pasturing. Horses and cattle, and even hogs, will answer well for this purpose.

CLEARING BY CUTTING AWAY TIMBER.

Men who cut away and burn the brush imagine that they have cleared the land because it looked clean. This is usually a mistake. Such land is untillable, and from each stump a number of sprouts will start and soon innumerable new bushes will be making headway. In a few years the land so recently apparently cleared will be more unsightly and expensive to clear than it was originally. Of course if it is practicable to remove immediately all starting sprouts the stumps must soon die. All vegetation requires leaves as well as roots to survive.

If, however, the cutting is relied upon it is wise to do it in late summer. In clearing hardwood it will not do to cut off and wait for stumps to decay; they should be immediately removed, or some method pursued that will at least keep down the sprouts and prevent objectionable plant growth.

Usually in clearing land, as in everything else, that policy is best which leaves a finished work.

Pines.—In clearing most pine land the cutting method is the most expedient. The pine genus, excepting two or three species, is happily peculiar Contrary to the rule in forestry, when the pine is cut off just

above ground it does not throw up shoots. Consequently it soon dies, and if the stump be small it rapidly decays.

Many pine lands may be cut off and safely left idle for several years with assurance that the roots and stumps will rot. The white pine is the chief exception to this rule. Pine soil is not so impregnated with objectionable growth in an embryo state, waiting for an opportunity to develop into bushes, as is hard-wood land.

This non-sprouting characteristic of the stump of most species of pine, together with the relative freedom of pine soils from foul growth the first years, render pine land comparatively easy and inexpensive to clean, especially if the timber is not large. New pine land is much more amenable to cultivation than lands from which other kinds of timber have been removed by cutting. This is owing to the semi-taproot system of the pine and the brittle nature of its roots.

Yellow Poplar.—The yellow poplar or tulip tree (*Liriodendron tulipifera*) is another tree species which, for purposes of clearing, should be classed with the pine. The rapidity with which the stumps and roots of this tree rot renders the cutting method of clearing land an eminently wise one in disposing of this member of the forest family. Unlike the pine, however, the poplar stump will send up numerous and vigorous shoots. Hence these should be sprouted off or grazed back, and then in a few years the stump, however large, will be a crumbled mass of vegetable mould.

There are other species of trees which resemble the pine and poplar in the susceptibility of their stumps to decay, and to which the cutting method is consequently applicable. Cottonwood, soft maple (red or water maple), and sycamore, all rot fast, though the sycamore has great vitality.

Alder.—This is usually found in dwarf-bush size and in clusters. Its habitat is lowlands and swampy bottoms. It is master of the land upon which it thrives, and its masses of interlocked roots present an impregnable obstacle to cultivation; yet, if its vulnerable points are understood, it may be quickly and easily disposed of. In August, cut the alders off at or below the crown, leaving the brush where it falls. The following spring, after vegetation has started and the ground is thoroughly dry, burn the area over. If the cutting and burning have been thorough, the alders will never return to plague you. The next year the ground may be cultivated with comparative ease.

CLEARING WITH DYNAMITE.

In the removal of large stumps dynamite is serviceable and economical. While it will seldom blow the stump out of the ground, it will usually split it in several parts and lay bare the roots, thus enabling the grubber to take out the stump piece by piece, which is less laborious than removing the whole stump. When occasional stumps are scattered over the field or plantation, along the roadway, or near the buildings, their immediate removal is desirable and for this purpose dynamite is serviceable.

But it is too expensive for general use in clearing land, and its cost will not justify its use on stumps under 6 or 8 inches in diameter.

The most effectual destruction of the stump is achieved by inserting the charge in a hole bored into it as low down as possible, thus adding considerably to the force of the explosion. This method, however, adds to the time and labour and hence to the cost per stump; while the more common method of digging down by the side of the stump, and hollowing out a place under it where the charge is placed, will generally split up the stump sufficiently to make its removal an easy matter.

CLEARING WITH MACHINERY.

There are many different makes of stump-pulling machinery upon the market. The promoters of these various grubbing devices claim great merit for their respective machines, but catalogue claims should be accepted with great caution.

The difficulty with most stump-pulling machines is that, if they are strong enough for the work desired of them, they are too expensive, cumbersome, and unwieldy.

When these machines are once properly adjusted, their work, provided nothing breaks, will be satisfactory. But the labour of moving and the care of adjusting, together with the liability to breakage, more than outweigh the virtues of any stump-pulling machine known to the writer. Moreover, usually, when the timber is large enough and thick enough to suggest recourse to machinery for clearing, it will not pay to clear such land at all unless it can be devoted to some specially profitable crop.

However, it may be said of machinery-cleared land that the clearing is thorough. The machine removes practically all the roots of any size from the ground, leaving the land in a good tillable condition.

When it is the intention to use a machine the timber should be cut away and removed and the brush burned. Such preparatory work will greatly facilitate the moving and operation of the machine. The stumps should be left high enough to conveniently loop with a chain, for it is much easier to get a secure hold above than below ground.

The best time to operate a machine is immediately after a heavy thaw or rain. The stumps will draw much easier when the ground is soft and loose than when it is dry and hard.

CLEARING WITH HORSES AND CHAIN.

This method consists in pulling the young trees out of the ground. Where conditions are favourable it is surprising how rapidly this may be accomplished. The best results can be obtained where the growth consists of saplings, say 2 to 4 inches in diameter, which have a lateral root system such as possessed by the locust, maple, or dogwood. The ground should be soft and loose.

The plan is simple. It consists in fastening one end of a long log chain to the trunk of the sapling (as high above the ground as the flexibility of the tree will permit) and hitching a steady horse, or, if necessary, a team of horses to the other end of the chain. While the horses are pulling at the tree a man should be at its base with an axe, and assist by severing such roots as seem loath to give away. In this manner, when the saplings are of the right size and kind, the ground in proper

condition, the horses true and steady, the man with the axe alert and discreet, wonderfully good and fast work can be accomplished.

Stumps also may be pulled up with chain and horses. One end of a log chain should be fastened around one of the large roots of a stump, a team of horses being hitched to the other end. The chain is placed across the top of the stump, which acts as a fulcrum and furnishes leverage for its own removal.

A cheap and efficient means is a simple stump-pulling tackle, consisting of two triple blocks and 300 feet of 1-inch rope. One block is attached to a solid stump and the other is attached to the stump it is desired to pull. When secured in this way the horses are hitched to the rope and driven up slowly, and the stump usually comes out without trouble.

When the stumps are 12 inches in diameter, or when cut low so as to afford no leverage, a device of two timbers about 6 feet high, fastened together in the form of a letter A, can be used. To the top of this A is attached a chain or wire rope, some 4 or 5 feet long and terminating in a hook. The A leans against one side of the stump and the hook is attached to a large root on the other side. The power is then applied to the top of the A, and as this is raised up the stump is tilted over. The device simply affords greater leverage than when the block is secured directly to the stump.

CLEARING WITH MATTOCK.

The mattock is king of new ground tools. No other instrument is so widely or satisfactorily used for grubbing. Wherever there are bushes the farm equipage is incomplete without its quota of mattocks in good condition. This tool is the most simple and convenient of all clearing implements.

In most instances economy and convenience require that clearing be done gradually, an acre or two being added each year. For such work the mattock is undoubtedly the most economical and best adapted. When a large tract is to be cleared without intermission, then other methods may be more suitable.

It is not generally advisable to cut off timber with a view to grubbing out the stumps afterward. It is much easier to grub the standing timber than the stumps after the trunk and tops have been severed; for it is the tap roots that are most inaccessible and difficult to reach and cut, and the tops, by serving as a lever, greatly assist in loosening these.

REMOVAL BY WIND AND RAIN.

In the removal of trees of considerable size much labour may be saved by digging a trench immediately around the base of the tree, cutting all the laterals, and leaving the tap roots for the action of rain and wind. Water will collect in the trench and soften the subsoil, and the wind with its swaying force will soon throw the tree. Indeed, when the side roots and the earth have been removed from around a tree, the prying force which the top will exercise upon the remaining roots will be irresistible. Each drop of rain and each puff of wind will contribute toward loosening and breaking those tap roots, which on account of their position almost

defy the mattock. The assistance which nature is capable of affording in clearing away trees is wonderful. The spring season, when the ground is loose, the rains heavy, and the winds strong, is the most opportune time to pursue the above method.

VARIATION OF ROOT SYSTEMS.

There is a marked variation in the root systems of different species of trees. The roots of some strike deep into the ground, while others extend out laterally, and still others traverse the ground in every direction. Some varieties are much more persistent in renewing themselves than others. The stumps of some kinds will survive for years, while those of other species will soon decay.

It is obvious that these varying characteristics of root and stump must affect the method of dealing with the different species of trees.

For our purpose we may classify trees according to their root characteristics and the durability of their stumps. To illustrate, we will indicate a number of a pronounced type belonging to these several classes.

TREES WITH A TAPROOT SYSTEM.

The *hickory*, *black gum*, and *white oak* will represent this system. They have a typical taproot. (See *Fig.* 1). Indeed, so pronounced are these

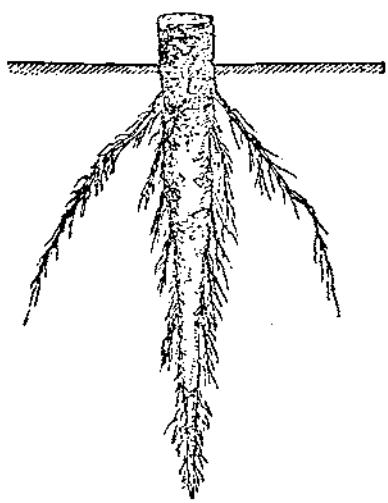


FIG. 1.—*Stump with Taproot.*

characteristics that the root frequently holds its full trunk size for several feet underground. Sometimes these large taproots break up into several smaller ones, but they invariably pursue a deep course downward. They send out to the side numerous small feeders, but exceptionally a lateral root of much size. This is evidenced by the facility with which cultivation may be carried on around stumps having this root character.

Still further evidence of the varying root character of trees is manifested by the ability of some species to withstand wind storms while others easily succumb. The forest may be full of uprooted trees, but the hickory, black gum, and white oak stand erect, resisting the force of wind and the

ravages of time until age has caused them to decay and crumble back to earth.

The taproot system of such trees makes it exceedingly difficult to remove their stumps. Roots of this character are very inaccessible to the mattock and resistant to force, whether applied by machinery or explosives. Hence, in clearing land covered with timber possessing this root system, either pasturing or cutting back and cultivating should be pursued. The comparative ease with which the farmer may cultivate among stumps of this character, and the extraordinary labour required to remove them, unite in suggesting the pursuance of one or the other of these methods.

TREES WITH A SEMI-TAPROOT SYSTEM.

This system embraces that numerous class of trees which throw out their roots in every direction. (See *Fig.* 2). The *pines*, *poplars*, and

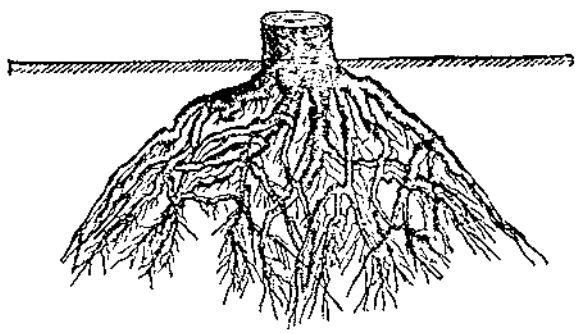


FIG. 2.—*Stump with Semi-Taproot.*

chestnuts are good specimens of this system and are widely distributed Not only does this class include the largest number of trees, but also the greatest number of species.

Stumps with a semi-taproot system are not as expensive to remove as those with the system previously described; but, on account of their surface root, ploughing among them is much more difficult. However, removing stumps of this class is an unthankful and laborious task.

TREES WITH A LATERAL ROOT SYSTEM.

The varieties of this kind are much less numerous than those of the preceding classes. It embraces all trees whose roots are of a distinct surface character. (See *Fig.* 3). The *elms*, *soft maple*, *locust*, *dogwood*,

FIG. 3.—*Stump with Lateral Roots.*

and *alder* are representatives of this class. These species do not always attain the size of trees, but their roots invariably belong to the lateral system. In fact, their roots all extend immediately upon or just under the earth's surface.

It is exceedingly difficult to plough among stumps having this lateral system of roots. Practically all their roots are within the reach and path of the plough. Happily, stumps of this class are comparatively easy to remove. The roots are readily accessible to the mattock, or easily yield to the force of machinery or explosives.

TREES WITH AN INDETERMINATE ROOT SYSTEM.

There are several varieties of trees possessing not only a peculiar root system but a wonderful capacity for reproducing themselves. On account of their wide distribution, common occurrence, and annoying character, it is advisable to briefly advert to the several leading specimens of this class.

*Sassafras.**—This is found most frequently in bush form. While it is occasionally observed growing to large size amid other forest trees, its favourite location is in old fields. Its chosen companions are hen grass, briers, and scrub pines. The growth for the first and second years is most vigorous; after that age very stunted.

The sassafras possesses a very singular root system. The roots strike perpendicularly into the ground for approximately 8 to 16 inches, then turn at right angles, rarely both ways, and pursue a horizontal course for about the same distance, when they split into numerous laterals. Another and unfortunate peculiarity of the sassafras is the rapidity with which it reproduces itself.

The usual custom of grubbing sassafras off several inches under the ground serves only as a temporary expedient. While it will permit the plough to pass unmolested the first year, the next season and each succeeding one the mattock will have to proceed the plough. Constant and careful ploughing and cultivation, if maintained for several years, will gradually exterminate this bush; but due regard for the condition of the soil will usually not permit such treatment. The improvement of the soil also tends to subdue the sassafras. Rich land does not seem to be congenial to it. It thrives best upon poor lands that are left idle at intervals.

The most satisfactory method of dealing with sassafras, if it is large enough, is to pull it out root and branch. Any clamp device, adjusted to a strong handle 5 or 6 feet long, and in such manner as to give strong leverage, will answer. There are such implements upon the market. They are most serviceable, not only in clearing sassafras, but for all other kinds of small bushes. This device can only be used on bushes of medium size. If too small the bush will break, and if too large the clamp cannot take hold or the man power at the other end will not be sufficient.

The sassafras may be exterminated by one grubbing, if the root is followed and cut beyond where it makes the turn or angle, but this method is laborious.

Persimmon.†—This species exists in various sizes over a wide range of territory. Its frequent form is that of a small, slender sapling. Its most common habitat is lowlands and swampy bottoms. In many particulars the persimmon is like the sassafras. Their root systems are practically identical. They are similar in their propensity for sending up sprouts

* The ague tree (*Laurus Sassafras*).
† The date plum (*Diospyrus Virginiana*).

when grubbed off in the usual manner, just under the surface. The lower limbs of both gradually die away as higher ones are thrown out. All trees are more or less given to this self-pruning process, especially if growing in close proximity with others, but this feature is very pronounced with sassafras and persimmon. It is evidenced even by small isolated bushes of these species.

The several methods suggested for the eradication of the sassafras apply with equal force to the persimmon. There are many old fields thickly set with specimens of these two bushes. Such infestation, if not wisely treated, will prove a perennial plague. If the bushes are too small to admit of pulling by a hand grubber, then the best treatment for such fields is close pasturing. In lieu of that, frequent deep ploughing with a sharp plough point will suffice.

*Locust.**—This variety, in some respects, is quite similar to the preceding. Its roots are usually nearer the earth surface, more numerous, attenuated, and tenacious than those of the sassafras and persimmon, but they pursue the same curious course. Cutting the locust off at or under the surface simply adds vigour to its offspring and increases its tendency to throw off more shoots.

The locust is valuable for timber purposes, and it is evident that is the mission for which it was created. Nature has not only given it a most difficult root system to subdue, but she has fortified its tops with numerous prickly thorns. If it must be cleared, use the device recommended for pulling sassafras, or the horse-and-chain method advised for drawing saplings.

DURABILITY OR PERISHABILITY OF STUMPS.

This feature of stumps manifestly and materially affects the problem of their removal. It is expensive to remove them, whatever method is employed, and if they are readily perishable it will be wise to leave their disposition to the processes of nature.

On the other hand, cultivation among stumps is slow and unsatisfactory, and if they are very resistant to decay it will be well to take them out.

The inclination of stumps to resist or succumb to the corroding effects of time are most striking and varying. For instance, the stumps of the locust and cedar are almost unaffected by the waste and ravages of age.

Stumps of the chestnut and white oak, if large, will, though not so durable as the locust and cedars, easily survive for a generation. While other species of the oak genus, the yellow poplar, and most species of the pine will soon perish; the white pine is, however, very durable.

When the durability of stumps renders their removal advisable, if they are large, it is well to wait a number of years after cutting away the timber until the smaller roots have rotted, when the stumps may be removed with much less labour. Meanwhile the land should be pastured or cultivated to keep down foul vegetation.

A PRACTICAL ILLUSTRATION IN CLEARING LAND.

In view of the various methods above referred to in clearing land and the varying conditions of the land to be cleared, it may be helpful to the

* The false acacia (*Robinia pseudoacacia*).

reader to take a certain lot and describe from the beginning the clearing process to be pursued. In presenting such a practical illustration, however, we will not discuss the method of "Clearing by Pasturing." That method is, when time and circumstances permit, one to be highly commended, but it presents fewer difficulties than other methods.

We will suppose a five-acre lot covered with a variety of wooded growth, as is usually the case, including white and black oak, chestnut, hickory, poplar, pine, and dogwood, varying in size from the small sapling to medium-sized trees, and the whole covered with more or less, perhaps considerable, underbrush.

The first step, regardless of what subsequent methods may be pursued, will be to select a dry time, probably in middle or late summer, to fire the underbrush and thoroughly burn over the lot. A good burning at this season will clear much of the small growth and consume the litter, both of which will be of considerable assistance in future treatment, whatever that may be.

Now, were the character of the growth on this lot fairly uniform as to the age and kind of timber, the undergrowth being burned away, a uniform method of clearing could be adopted to remove the timber still standing; but, as we have said, the growth varies in size from the small sapling to the medium-sized tree. The character of the timber includes more or less of the kinds and varieties referred to above under the head of taproot, indeterminate root, and lateral root systems. Consequently it will be necessary for the owner to resort to more than one means to effect a complete clearing of this land. It is obvious that the mattock and the axe must be provided and considerable dependence placed on these tools.

The first thing to be undertaken should be to cut down those trees of a sufficiently large growth to make serviceable timber for firewood or other purposes, whose stumps may be allowed to remain in the ground, either because of their tendency to quickly rot and decay or because of their deep taproots making the removal of the stump difficult and costly, bearing in mind also that the taprooted stumps offer comparatively little obstruction to the plough. In the case of trees of medium growth, of which, owing to the nature of their roots, the stumps must be removed, it will be well to dig down around the base, making a trench, as it were, around the tree, severing with an axe all roots extending laterally from the stump; if these remained unsevered they would serve to keep the tree upright. The trees thus treated will, for the most part, succumb to winds and storms, pulling up the stumps with them as they fall.

The next process will be to tackle the young saplings by means of a chain and team, pulling them out of the ground, stumps and all. Where the stump has to be removed by pulling, whether in the way just described or by the stump puller, it is important to select for the purpose a day succeeding a wet spell or a thaw, when the earth is soft and wet for a considerable depth below the surface, a condition which will greatly facilitate the operation. As the work progresses it may be necessary from time to time to again resort to firing, burning worthless timber and litter, the timber designed for lumber or fuel having been previously removed and piled for future use.

At this time we have our lot pretty well cleared of standing timber, save such as has been left for the influence of wind and weather; and work must now be undertaken on such stumps as it has been found expedient to leave in the ground up to this time, but which from their position or nature it will be necessary to remove before undertaking to plough the land. In these cases the chain and team or the stump puller, if available, may be called into service. Possibly in a few cases, probably exceptional on this lot, recourse may have to be had to dynamite. Toward the spring those trees which have been dug around and which have succumbed to winter storms will in turn have to be removed.

By pursuing systematically the course above set forth on a lot of the character indicated, the owner will doubtless have it in proper condition for the plough by the spring following the year in which he began the clearing.

CULTIVATION OF NEW LAND.

The quantity of roots remaining in the ground after it has been cleared is always surprising. No matter what clearing method has been pursued or how carefully it has been done, the plough will discover an aggravatingly large number of roots. When stumps are pulled out by machinery many more roots are removed than by any other method. But even in machinery-cleared land the ground will still be full of roots, mostly small it is true.

For ploughing new ground oxen are preferable to horses. They are steadier and stronger.

There are several patterns of ploughs made especially for new-ground work. These grub ploughs, however, while strong and handy, are not essential. Any standard plough with a good cutter properly and securely adjusted will do good work.

When ploughing new land always have a mattock conveniently fastened to the plough handles, and cut all roots that do not break. When the plough becomes "hung" in roots it is better to cut it loose than to back and pull out. The root that stops the plough will interfere with cultivation, and the same root, unless severed, will occasion this annoyance for several successive seasons. In ploughing new land, leave no skips; turn a continuous furrow. The time saved in cultivating the crop, together with the increased harvest, will more than pay for the pains taken.

The second season the plough furrows should be run at right angles to those of the first. If these two ploughings are thoroughly done, the ground will be completely broken and subdued.

If the land is very stumpy it will be quite difficult to level down for planting purposes. When the stumps are too thick for the old-fashioned "A" harrow to be used, a heavy brush or cultivator, run opposite to the way the land was ploughed, will answer fairly well. When the land is not too stumpy, or the stumps are cut very low, the spring-tooth harrow will do excellent work. The teeth will bound over stumps and roots that are fast and comb out a great many that are loose or broken. If the roots are plentiful, and they usually are, many of them will have to be removed. With an improved adjustable spring-tooth harrow, many of the loose roots may be combed out and windrowed and then burned or hauled off.

In bringing new land under cultivation, cultivate for several successive

seasons or until all roots are thoroughly broken and all foul vegetation completely destroyed. If cultivated for only one year and then seeded down or left idle any number of roots and small bushes will revive and start into renewed life.

CROPS ADAPTED TO NEW LAND.

New land, because of the large quantity of vegetable matter it contains, is exceedingly loose. Humus or decomposed vegetation is an essential element in productive soils. It imparts a wholesome physical character and furnishes properties that enable it to retain heat, moisture, and plant food. But soils may contain too much organic matter, especially if it is not well decayed. Ordinarily, however, in the long run, this excess of vegetable trash on recently cleared woodland tracts will, by its fertilizing value, and adding humus to the soil, more than compensate for the immediate loss in the earlier years.

Corn is a good crop for new land, not that it is especially adapted to such land, but because it is the easiest of all crops to cultivate on rough and rooty soil. The cultivation that corn requires is the very kind most desirable for new land. After several corn crops have been removed the land should be in good condition for any grass, cereal, or vegetable.

Oats should not follow corn on new land, or for that matter should not be seeded to any foul land, for they, especially spring oats, are the foulest crop upon the farm. The early spring preparation of the ground required for sowing oats serves as an excellent inducement to the vigorous growth of weeds, briers, and bushes; and the inability to cultivate oats during the growing season will enable this foreign matter to again secure a foothold.

Among the grasses, *clover* seems best adapted to new land. Indeed, upon such soil it will invariably thrive, while upon old neighbouring fields it may be difficult or impossible to secure a stand. In seeding new land to clover select the largest and most vigorous variety. The denser the growth the more difficult it will be for foul matter to secure a lodging; and the higher the clover stands the more shade it will afford, and this will facilitate the decay of roots and stumps.

Fruits of all kinds do well upon cleared woodland, provided, of course, that the location and mechanical condition of the soil are suitable. But it is not wise to plant trees on such land until it has been thoroughly ploughed and is in a condition to be conveniently cultivated. In planting an orchard upon stumpy land, stumps should not be allowed to remain in proximity to the newly-set trees. The stumps will not only interfere with cultivation but greatly endanger the trees by bruises from horse or plough.

Among small fruits the strawberry thrives especially well on recently cleared land. Upon such soil it makes a most satisfactory growth and fruitage, and much less labour is required to keep the weeds and grass down, as the ground is not impregnated with foul seed.

For *vegetable growing* new land is very desirable, not only because of its comparative freedom from foul growth, but because such soils contain a large supply of organic nitrogen, the most necessary and expensive of vegetable fertilizers.

The physical condition of such soils greatly encourages the development of those tuberous vegetables that grow by a process of expansion under ground. Potatoes, both sweet and Irish, will certainly thrive on this soil. The tomato is another vegetable most congenial to new ground. Neither should tobacco be omitted in enumerating crops adapted to new land.

Indeed, there is no question about the profitable cultivation of new land. The problem is when and how to clear it. When once the clearing has been completely accomplished the yield from such lands will be more satisfactory than the harvest from old fields. In fact, in many instances it would be wise and economical for the farmer to plant his old worn and washed fields to forest and clear other land for cultivation.

REVIEWS.

BUILDING CONSTRUCTION AND DRAWING.

By CHARLES F. MITCHELL, Head Master of the Polytechnic Technical School, etc.—($7\frac{1}{2} \times 5$. 3s. B. T. Batsford).

In bringing out a seventh edition of this book, intended for those preparing for the Elementary Stages of the Board of Education's Examination in Building Construction, the author, who has been so successful in instructing candidates for these Exams., has furnished all students of the various branches comprised by that very comprehensive term 'Building Construction' with a hand-book of great value for a very small price.

Special attention has been paid to detail; and the text is illuminated by over one thousand illustrations, which are dimensioned in a very clear manner.

The book contains a chapter on Building Quantities and Memoranda which will be found useful to others besides students.

All those who have to deal with detail in Construction will find it of the greatest value; and it can be recommended to all who are in charge of works, and have to superintend trades.

It has a special value for any N.C.O.s and men who are aspiring to be Foremen of Works, as it will give them a good grounding in the questions which will engage their attention during their course and afterwards.

J. WINN.

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In treating the question of American "Bird Cage" construction, we are provided with the latest sections recently standardized by the British Committee.

In discussing Ferro-Concrete we are wisely counselled, in the present state of building practice, to entrust any important work to specialists, who have made it a study; at the same time we are given the most recent specification for Portland cement drafted by the Engineering Standards Committee.

The book is thoroughly well illustrated, well arranged, and well printed. Though primarily intended as a Text Book for Students preparing for the Higher Stages of the Examination of the Board of Education, it will be found invaluable by all who are engaged in building operations; and the low price at which it is published brings it within the reach of all.

J. WINN.

NOTICES OF MAGAZINES.

Eenzhenernee Zhoornal.

March, 1906.

Notes on Field Engineering from the Experience of the Russo-Japanese War.—An article by V. Polyanski.—During the Russo-Japanese war the value of entrenching tools in counteracting the effect of modern fire-arms exceeded all expectations. The troops arrived in the theatre of war without any knowledge of digging; but they soon learnt to realize its importance, and instances of men forsaking their shovels during the fatigues of long marches became rarer and rarer. It is no exaggeration to say that in modern war a rifle without a shovel is like one without cartridges.

The writer objects to the custom in vogue at the beginning of the war of giving the troops working pay for work on fortifications. It encourages the idea that this is not their *proper duty*, and they are inclined to grumble if they find civilian workmen getting more pay than themselves.

The fortification of the positions in Southern Manchuria dates from the arrival on the scene of Major-General Velichko, who carried out the many lines of works intended to bar the enemy's advance from the South and East. Of the so-called southern positions (Vafangu, Tashichao, Haichen, etc.) the flank to the west of the railway rested on level ground; on the east side the ground rose from small to larger hills; and the positions on the left flank (Motienling, etc.) were situated at the heads of mountain passes. The two lines of advance culminated in the powerful defences of Liaoyang.

The preparation of the mountain positions entailed a great deal of blasting. The fortification of such positions must begin by the construction of roads of approach for men and guns, an additional advantage of such roads being that they help to show the way in enclosed country, especially by night. In addition to the gun roads, zigzagging upwards at slopes not exceeding $\frac{1}{3}$, arrangements should be made to lower the guns down by means of tackles in case of a hurried retirement.

Trenches should be well concealed and must have covered communications with the ground in rear. In mountainous country it is almost impossible to conceal them and they are sure to suffer heavily from artillery fire. Three means of mitigating this evil are suggested:—(1) The free use of dummy trenches manned by stuffed dummies; (2) the provision of scarped cover, in rear of the hills, connected with the trenches by covered communications; and (3) giving the trenches a sufficiently strong profile. For parapets in stony ground, where only a small supply of earth is obtainable, it is advised to build them of stones and cover them with a thin layer of earth.

As points of support in their mountain positions the Russians used "ring trenches" encircling the higher peaks; these proved to be very

unsatisfactory, and trenches in *échelon* supporting one another are recommended. The Japanese did not use "ring trenches"; they showed a tendency to sacrifice field of fire for the sake of covered communications; dead ground frequently lay immediately below their trenches, but they would command it by mounting on the crest of the parapet.

In *level* ground the best form of trench is that without any parapet; but free egress in case of a bayonet fight must not be forgotten, for examples occurred of men in a trench being stabbed from above without being able to strike back. The drainage question is serious in level ground, but each case must be decided by the ingenuity of the man on the spot. The communications of these trenches are very important; they should be as deep and narrow as possible, the least width of trench which will allow the passage of a stretcher being 3′ 6″.

As to villages, the text books give many reasons against making use of them; but in the Russo-Japanese war the battles on level ground became almost exclusively a series of struggles for their possession. In open country, cover even from view is eagerly sought after and hence the attractiveness of villages. As points of support they are extremely strong if suitable for defence; but if not suitable, they become traps in which the troops suffer great losses. Redoubts are undoubtedly better; they are more easily prepared and require less time and material. During the war many villages were taken by storm, but only one redoubt.

To be suitable for defence a village must have a broad front towards the enemy, to enable it to develop a strong frontal fire, but it must be open to the rear. As its well-marked edge offers a distinct target for artillery fire, this cannot be made the chief line of defence; this line must therefore be thrown forward 80 to 100 paces so as to be safe from shrapnel aimed at the village. The edge itself should be fortified as a second line.

The Chinese villages were surrounded by mud walls of varying thickness; those that would stop a Japanese bullet were put in a state of defence and the rest were levelled. It is a mistake to loophole thin walls, under the impression that the moral effect of being behind any cover will enable the riflemen to fire more deliberately. Nothing is so conspicuous as a loopholed wall; it can be seen for miles, and proclaims the fact that the village is defended. The writer prefers a low parapet with an ample supply of filled sandbags with which each rifleman can provide head cover for himself at the critical moment. Some of the walls, 6′ high and over, were prepared for a double tier of fire, the lower loopholes being near the ground level, and their defenders standing in a trench in rear, while the men firing through the upper loopholes stood at ground level on a step which served the others as an elbow rest.

In large villages trenches for reserves were placed in the market places, in small villages in the open ground in rear. Field casemates were built in the most secure places, and brick temples, if not exposed to artillery fire, were organised as keeps. Hedges at right angles to the front were left standing and roads parallel to the front were blocked. Hedges parallel to the front were mostly levelled, unless they were required for defence or to conceal the movement of troops in the village;

but even in the latter case it was better to level them and erect in their place screens of wattle or millet, which would not stop a bullet. All inflammable material should be removed.

As regards obstacles, entanglements of barbed wire were most effective. A breadth of 21′ was aimed at, but better considerably less than none at all. Abattis were rarely used because of the scarcity of timber, but when used and interwoven with wire they gave good results; they were however very conspicuous. Military pits without a wire entanglement do not offer a serious obstacle, and an instance is recorded of Cossacks riding over some Japanese pits; they are only admissible when no material for obstacles is to be found and the ground is suitable; they have the serious objection that, if the enemy can creep into them by night, he can easily convert them into a shelter trench. Fougasses were very successful. A useful obstacle was formed from the standing millet by breaking it down to within 1½′ to 2′ from the ground and entangling the stalks; besides obstructing the passage of men and horses it effectually concealed the defenders, and not once was it regretted that the crop had not been levelled. Obstacles should be concealed as far as possible, but in modern defences their great length makes the excavation of an earthen glacis out of the question.

As the object of an obstacle is to detain the enemy under effective fire from the work, it is important to ascertain at what distance on level ground rifle fire is most effective. It is a mistake to think that the nearer the better, for experiments have shown that the rifle is most effective at from 150 to 300 paces from the muzzle. Therefore, for the distances of obstacles from the works they protect, the text-book figures (between 50 and 150 paces) should be increased to between 100 and 250 paces. An obstacle at 100 paces would give more confidence than one at 50 paces. By night or in a fog one at 250 paces would be as easily guarded as one at 150 paces. In the attack the enemy's shrapnel must be turned off when their troops arrive within 300 to 600 paces of our works, and therefore it cannot prevent the defence of an obstacle placed at the longer distance. But the greater the distance the larger is the quantity of material required. If time and means permit, a second line of obstacles should be erected round the works, and trenches as well as works should be protected by them.

Obstacles in front of a battery must be placed at such a distance that they will receive the full effect of shrapnel fired from the battery, with time fuze at zero. This would appear to be not less than from 300 to 400 paces from the battery.

F. E. G. SKEY.

NATURE.

September, 1906.

NITRIC ACID PRODUCTION (*p.* 445).—The oxidation of atmospheric nitrogen by means of the electric arc is now being carried out on a large scale at Notodden in Norway, following on the successful experimental work of Lord Raleigh, who took up the old work of Priestley published in

1775, and with better apparatus and appliances repeated the experiments which ultimately led him in 1893 to the discovery of argon and to the production of nitric acid from atmospheric nitrogen.

In the process which is worked at Notodden, a high-tension arc flame is produced between two pointed copper electrodes. The electrodes are attached to a high-tension alternator, and are placed equatorially between the poles of a powerful electro magnet, so that the terminals of the electrodes are in the middle of the electric field. The working potential employed is 5,000 volts, the current is an alternating one of 50 periods per second, and the distance between the terminals is 8 mm.

The alternating current disc flame is enclosed in special furnaces lined with firebrick and surrounded by metal casing. The air is driven in by a blower; the volume of the air thus treated is 75,000 litres per minute, which after passing through the furnace contains about 1 per cent. of nitric oxide. The gases then pass through oxidising chambers, thence into an absorption system consisting of 5 towers filled with broken quartz; through the last tower milk of lime trickles, and this absorbs the now rarefied nitrous gases, forming calcium nitrate and nitrite. The nitric acid leaves the towers with a strength of 50 per cent.; it is then evaporated down to 80 per cent., run into 300-litre drums, where it solidifies, and appears on the market in this form at a selling price of £8 per ton.

"THE NILE AND ITS BASIN" (*p.* 461).—Capt. Lyons, Director-General, Survey Department, in this work gives an interesting discussion of the climate and rainfall of the districts from which the waters of the Nile are supplied. The Nile basin may be divided into eight regions. (1). The Lake plateau, with an elevation of 5,000 feet, composed of various metamorphic rocks, supplies from 500 to 1,000 cubic mètres per second to the Nile volume. (2). The Bahr el Jebel and Bahr el Ghazel, although having a heavy rainfall, do not augment the Nile, but with their great marsh vegetation absorb a large percentage of rainfall coming from the Lake plateau. (3). The Sobat Basin, with its rapid fall, adds a varying amount to the waters coming down from the White Nile. (4). The White Nile Basin is the most constant element in the supply of the Nile waters. (5). The Blue Nile, the Atbara, and the Khor el Gash drain a plateau of from 6,000 to 10,000 feet elevation with a great rainfall. (6). From Khartoum to Aswan the united waters of the White Nile, Blue Nile, and Atbara flow in a single stream, the river having attained its maximum. (7). From Aswan to Cairo the Nile winds through the flood-plains caused by its own deposits, a thickness of 17 feet of alluvium during the 5,000 years of which we have a record. (8). The Nile Delta, the floods in which have been trustworthily recorded for the past 175 years, and have been critically studied by Capt. Lyons with the view of discovering the determining causes of their variations. Admirable plates illustrate this work, which adds much to the present state of our knowledge of Nile hydrography.

THE BOMBAY LOCUST (*p.* 481).—Mr. Lefroy, of the Indian Agricultural Department, has investigated the life history of the locust. He describes

the formation and movements of locust swarms, their egg-laying, hatching, development, and the description of the "hoppers" after each moult. The methods for their destruction by brushes, bags, poison baits, bonfires, etc., are detailed, but the preservation of the crops was mainly due in 1904 to the Juari birds, who arrived in large flocks earlier than usual and devoured the locusts greedily. Eggs equivalent to 3,000 million "hoppers" had they lived were collected and destroyed by the ryots at a cost of £15,000 to the Bombay Government.

"LHASA AND ITS MYSTERIES" (*p.* 518).—Colonel Waddell in this book gives an interesting account of our recent expedition to Tibet; it has excellent maps and plans, and more than 150 illustrations.

Colonel Waddell gives the translation of a Tibetan prophecy, copied by himself a year before our expedition was heard of, in which the astrologers of Tibet were able to predict this distressful storm which was in store for their country, and to specify that it should occur in this very year!!! A popular history of Tibet and descriptions of Gyantse and Lhasa are given, as well as a very readable and clear account of the British invasion of Tibet.

W. E. WARRAND.

ORGAN DER MILITÄRWISSENSCHAFTLICHEN VEREINE.

3rd Number. 73rd Volume.

NOTES ON COAST DEFENCE.—In this essay, which concerns itself mostly with the artillery questions raised by the defence of Port Arthur, the effect of submarine mines on coast defence and the part they play therein have been entirely left out of the discussion owing to the want of reliability in the information obtainable concerning them.

It is admitted, however, that the heavy loss in ships on both sides is sufficient proof of the terrible effect of submarine mines; and the author considers that the freedom of action of both fleets was severely hampered by mines, and that the Japanese in particular were forced to take precautions which in the absence of mines they would never have adopted.

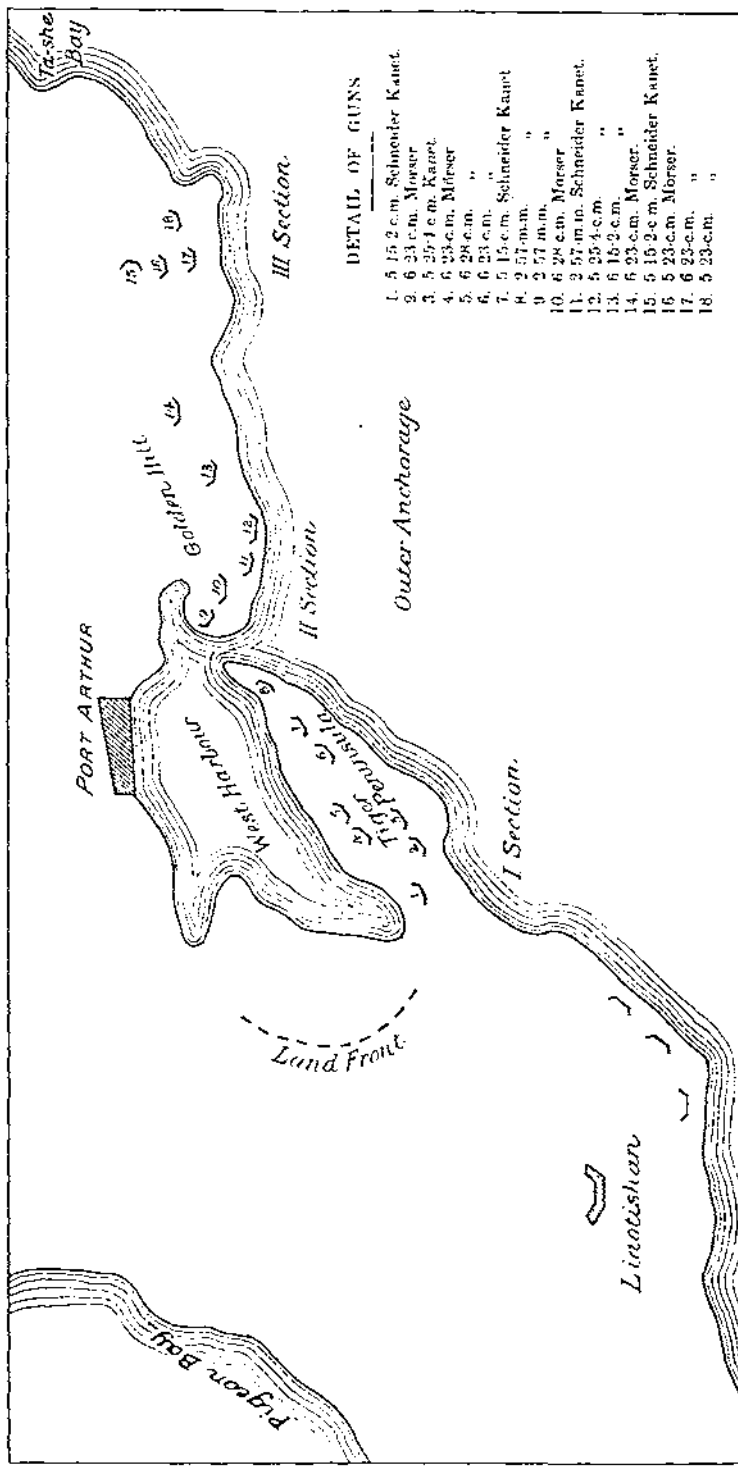
The fighting at Port Arthur has shown once more that in the struggle for naval supremacy a strong naval base is essential.

The protracted resistance offered by Port Arthur was due to the liberal adoption of offensive tactics by the defenders, to their excellent use of favourable positions, and to their ample supply of artillery.

The coast defences more than fulfilled their object; they kept the Japanese from the harbour, and enabled the Russian fleet on several occasions to make what would otherwise have been very risky sorties.

Although no actual naval attack was made by the Japanese during the siege, it is worth while to consider the conditions which must have influenced the Russians in designing their coast defences.

A naval port must possess either permanent or temporary works in


Ta-she Bay
III Section.
Golden Hill
PORT ARTHUR
West Harbour
II Section
Outer Anchorage
Tiger Tail
I Section.
Land Front
Liaotishan
Pigeon Bay
DETAIL OF GUNS
1. 5 15·2 c.m. Schneider Kanet.
2. 6 33 c.m. Morser
3. 5 25·4 c.m. Kanet.
4. 6 23 c.m. Mörser
5. 6 28 c.m. "
6. 6 23 c.m. "
7. 5 15 c.m. Schneider Kanet
8. 2 57 m.m. "
9. 2 57 m.m. "
10. 6 28 c.m. Morser
11. 2 57 m.m. Schneider Kanet.
12. 5 25·4 c.m. "
13. 6 15·2 c.m. "
14. 6 23 c.m. Morser.
15. 5 15·2 c.m. Schneider Kanet.
16. 5 23 c.m. Morser.
17. 6 23 c.m. "
18. 5 23 c.m. "

order to be able to ward off the various methods of attack which may be brought against it, the most common being bombardment.

The formation of the coast round Port Arthur is highly favourable for the construction of works to command open anchorage; it also, however, offers facilities for the bombardment of the port and town.

The promontory of Liaotishan on the south-west had an important influence on the defence. It protected the West Harbour and rendered a landing in Pigeon Bay impossible. But the high and perpendicular cliffs covered the approach of hostile vessels, and therefore facilitated an attack on the outer anchorage and the entrance to the harbour. In order to overcome this danger, and also to protect works on the Tiger Peninsula from enfilade fire, Liaotishan was included in the defence works. The conformation of the ground was not, however, favourable to the construction of coast defence batteries, because the high site involved a large amount of dead ground (or rather sea) which could not be covered from Golden Hill owing to the extreme range.

The Japanese, who were thoroughly acquainted with the local geography, employed indirect fire with great effect from Pigeon Bay and Ta-she Bay upon the harbour and town; and at the same time other portions of their fleet kept up a hot bombardment of the coast defence works, especially those on Tiger Peninsula, and even at long ranges obtained good results. The success of such bombardments show that in the construction of coast defence works, even on sites well adapted for them, it must be borne in mind that protection from direct attack alone is not sufficient. The harbour of Port Arthur, where a large amount of front could not be swept by fire on account of the high cliffs, could only be protected from such attacks by the activity of the Russian Fleet, which however sadly failed to fulfil expectations.

There is no doubt that the isolated works of Liaotishan, which were constructed and armed during the siege, played a most important part in the defence. Soon after the storming of 203-Mètre Hill the Japanese broke through the cordon of works connecting Liaotishan with Port Arthur and completely isolated the former.

Though Port Arthur was badly protected from bombardment it was well defended from direct attack from the sea front.

The chief object of the coast defence works was to ensure the use of the outer anchorage to the Russian fleet and thus obtain room for them to move in; for this purpose a number of heavy long-range guns were required, and with these the Russians were well provided. But they also considered it desirable to mount in their coast defence works guns of the same calibre (heavy, medium or light) as those which were likely to be employed against them by the opposing ships. Heavy guns with a high muzzle velocity were essential to keep the hostile fleet at a distance and to engage their battleships, while quick-firing guns of medium calibre were required to repel torpedo boats and landing parties.

The events of the siege, however, showed that light Q.F. guns with a calibre of 5 to 6 c.m. were of very little effect against torpedo craft; and it therefore seems that such guns may be dispensed with in defending a sea front.

The author considers that in modern coast defence works only two types of guns are required, viz. :—

A 30-c.m. (=12″) gun with high muzzle velocity
and a 10-c.m. (=4″) Q.F. gun, capable of firing 400 rounds in the hour.

He calculates that one 12″ gun and three 4″ Q.F. guns mounted in coast batteries could compete on even terms with three battleships of the *Magnificent* type, because all guns of smaller calibre could be neglected; but he does not show how he arrives at this rather surprising result. He thinks that the percentage of hits from coast batteries is generally underestimated when taken at 10% at a distance of 3,500 yards.

The Russians had a high opinion of the value of heavy howitzers, which formed 30 per cent. of the total armament.

Their most important gun was the 25·4 c.m. (10-inch), firing a projectile weighing 225 k.g. (500 lbs.) with a muzzle velocity of 2,400 f.s., and capable of firing twelve rounds in the hour.

They also had the following guns:—

A 15·2-c.m. (6″) Q.F., firing 300 rounds per hour.
23-c.m. and 28-c.m. (11″) howitzers, firing a shell weighing 110 k.g. (240 lbs.) and with an effective range of 9,000 yds.

They rightly aimed at uniformity of armament, and their batteries often consisted of 5 or 6 guns of the same size and type, a result seldom achieved, I think, in our coast defence batteries.

For purposes of fire control the sea front was divided into 3 Sections numbered from west to east. The harbour entrance was in the 2nd Section, which also included Golden Hill and Tiger Peninsula, a thoroughly sound arrangement as a channel of this description should never be on the boundary of a section of defence.

The entrance itself had a very light armament, only designed to repulse a torpedo-boat attack. But the remainder of the Section was heavily armed; and the batteries on the high ground were so favourably placed, and had such thorough command of the outer anchorage, that the Japanese gave up all idea of an attack on the sea front.

The author considers that the results of this struggle show that it is not difficult to make coast defences almost impregnable, if the artillery at disposal is sufficient in quality and quantity. But the cost of modern heavy guns is so large that the greatest economy should be aimed at in the actual construction of batteries and forts. An exception to this rule may sometimes be made in the case of coast defence works in very exposed positions, when infantry cannot be called in to assist in repelling attacks. Many of the coast batteries at Port Arthur were very primitive earthworks and yet answered every purpose.

The author proceeds to point out a few characteristics of the Russian defences, which differ from those to be found in German works.

The guns fire *en barbette*, and are usually mounted on circular racers so that they can if required fire over the gorge. This arrangement, though sometimes advantageous, diminishes the cover both of the gun and the detachment.

The magazines are placed underneath traverses constructed between the guns. The traverses are kept down to the level of the parapet, and this with the absence of embrasures permits the battery to be easily concealed and consequently difficult to locate.

The batteries had no casemates under the parapet, and they were remarkably simple in design; thus the cost of construction was considerably reduced, particularly in rocky ground.

They were seldom provided with a ditch or any other obstacle, as the Russians rightly considered that their sea front, well swept by artillery and heavily mined, formed the best obstacle to an attack in force; whereas attempts at surprise by a comparatively small force could be easily repulsed without recourse to these expensive additions.

It is unfortunate that no serious attack was made on Port Arthur by the Japanese fleet, as many uncertain problems concerning coast defence would have been satisfactorily solved by such an attack.

In coast, as in land, warfare the attainment of a superiority in artillery fire contributes largely to ultimate success; it is only the method that differs. In land warfare superiority of fire is striven for at the beginning of a battle; at the critical phase it is absolutely essential to success, and is only obtainable by masterly employment of the reserves. In coast warfare, however, the superiority of fire at the beginning of an action always lies with the defence, but it diminishes proportionally with the distance of the hostile fleet.

The defence will seldom have at its disposal a suitable and sufficient reserve of guns so fortunately located as to enable them to recover at the decisive moment the superiority of fire lost at a previous stage in the combat. It must therefore be the aim of the defenders to bring hostilities to a decisive conclusion at such ranges as will ensure to them an undisputed superiority of fire.

The Russian Regulations indicate how the attainment of this object should be effected. The progress of the fight is divided into two stages:—

(1). The Introductory Stage, in which only the heavy guns are employed, at practically extreme ranges.

(2). The Decisive Stage, in which the heavy howitzers and high angle fire guns also take part.

Throughout the Introductory Stage the object aimed at must be to inflict as much damage as possible on the enemy, in order to compel him to abandon his attempt or at least to alter his formation and line of approach to his own disadvantage. As the result of this stage will have a considerable effect on the Decisive one, the orders for the former must be drawn up by the Coast Defence Commander personally. It will generally be possible for him to anticipate the intentions of his opponents by carefully watching their formation, speed, and direction, and to make his dispositions before the hostile ships are in range of his heaviest guns.

Although it is recognised that in modern guns the most favourable results as regards accuracy and penetration are obtained at medium ranges, this should not prevent the commencement of fire at extreme

ranges, as it is at extreme ranges that the advantages of the defence are proportionately greatest.

The Introductory Stage will always be of short duration, for modern vessels take only ten minutes to approach from 10,000 to 6,000 yards. Therefore great accuracy and rapidity of fire will be required from the defence to compel the attacking fleet to alter its purpose. As soon as the fleet arrives within effective range of the howitzers the Decisive Stage is entered upon.

The author contends that the aim of the attacking fleet will be to advance at full speed to such a close range as will definitely establish their superiority of fire and enable them to crush the fire of the defence. But it seems to me that this would be a very desperate venture, and that the almost certain loss of several ships which could not possibly be replaced would hardly be justified by the silencing of the hostile batteries.

The Russian Artillery Regulations lay great stress on the accuracy of naval guns at short ranges. At a range of 800 yards 50 % of hits may be expected against batteries, and it is estimated that 6 % will hit either the guns or mountings. Consequently the regulations emphasise the necessity of keeping the hostile fleet at a distance of from 4,000 to 6,000 yards. If the defence succeed in keeping their opponents at this distance, they prolong the period during which they possess superiority in fire effect.

This period is therefore the most critical phase in the battle. If the batteries succeed in inflicting such damage on the fleet that they cannot approach nearer, the victory will be theirs. But if the fleet succeed in getting within 3,000 yards of the works, the volume of fire they can concentrate on the guns of the defence will split up the fight into a number of individual struggles, and in the author's opinion victory will probably lie with the fleet.

C. OTLEY PLACE.

RIVISTA DI ARTIGLIERIA E GENIO.

August, 1906.

WIRELESS TELEGRAPHY AND ITS MILITARY USES.—By Pietro Aliquo-Mazzei, Capitano del Genio.—The increasing size of armies, the efficacious uniting of offensive methods in relation with those of the defence, and the improved technical instruction of the masses, whilst they have shown the necessity of adopting systems of warfare more in accordance with the times, have also made evident the importance of a good *service of communication* between the various elements of the mobilised forces; so that there does not exist to-day an army which is not seriously occupied in giving to this service its greatest development, and in rendering it always more rapid and secure.

The means of rapid correspondence in regular use with the armies are limited to the telegraph, the telephone, and the apparatus for visual signalling; afterwards come as auxiliary means vehicles directed by man,

such as automobiles; then animals such as horses; and finally, as part of the category, balloons which have the means of observing and communicating at the same time.

To these systems has lately been added *radio telegraphy*, which has, it is affirmed, been tried with success in the solution of military telegraphic problems, revealing valuable results in cases in which no other means were practicable.

Radio telegraphy, which as a means of transmission is less rapid than that of wire telegraphy, is, on the other hand, more rapid than visual signalling; compared with wire telegraphy it presents the advantage of economising material; and in respect to visual signalling it permits correspondence between two or more stations, whatever may be their reciprocal positions, and, what is more important, almost without preventative measures of the enemy.

In the field of warlike operations its influence may be exerted under each of three phases—location of masses, arrangements for preparing the line of battle, and for the combat—and naturally in different ways according as it is used for operation on land or sea. In war on land it is especially in its last phase that this influence attains its greatest value.

Independently of the character of the war, radio telegraphy is always a most valid means of assuring the connection of the operating army with its base of operations.

Opportunities for the employment of radio telegraphy are also to be found in the following cases:—

(*a*) In the preparation for the defence of an important line of battle, by forming communication between the advanced positions and those in the rear without being subject to the enemy's attacks.

(*b*). On the march of a large army, to unite the columns in advance or again to bring them back to the main army.

(*c*). To establish a continual connection between the brigades or divisions of cavalry employed in advance reconnaissance and the commander of the main army on which they may depend.

(*d*). In military expeditions and in colonial wars, to communicate with the central command and with the various posts of stationary occupation, whilst waiting for a regular network of telegraphs to be established.

(*e*). To establish permanent communication between the colonies and the mother country.

In Germany the studies in wireless telegraphy which have been developed for some time did not give a completely satisfactory practical result. The first trials made in 1900 placed in evidence the experience of Marconi, known to all the scientific world. From this time we find many trials of wireless telegraphy carried out by Slaby, Slaby-Arco, Braun, Braun-Siemens, all seeking new methods for the transport of the plant, for syntonising the apparatus, and for extending the new system of correspondence to siege warfare; and in 1903 we find the societies exercising diverse systems united in one great society (Telefunken), ready

to give to the State all possible assistance towards the solution of this important military problem.

During the last military operations in the German Colony in the south-east of Africa, three field stations were established, each consisting of three wagons, of weight about 600 k.g., carrying respectively (*a*) the source of electricity, (*b*) the apparatus, transmitter and receiver, (*c*) poles, of length 200 m., and small balloons of 10 cubic mètres or kites, and many different accessories and reserve materials. All the three stations took an active part in the operations of the war, and established complete communication between the single columns and the central command. The limit of distance is said to have been 150 kilomètres.

The formation of stations on three wagons seems to have answered sufficiently well for practical purposes; and it is said that by further improvements it was found possible to increase the distance for correspondence to 200 k.m. But the German system does not endeavour to send messages for great distances; it seeks to co-ordinate the apparatus, and to ensure its regular working for medium distances such as are frequently found necessary to overcome.

Italy, the first country to establish organised detachments of telegraphists for the army of the first line and to organise a good service of visual signalling, was not behind the other nations in studying the questions relating to the application of wireless telegraphy to warfare.

After preliminary trials in the district of Terra di Lavoro three stations were established, which could be moved in the regions of the great manœuvres with which they were used,—one with the central station of the manœuvres, and one with each of the two other commands. Each of the stations was equipped as follows:—

1 stationary carriage for the apparatus,

1 small carriage for the accumulators,

1 Drachen balloon of 100 cubic mètres, carried on a wagon with the quantity of hydrogen necessary for inflation (200 cubic mètres of gas compressed in a cylinder to 215 atmospheres).

1 four-wheeled wagon for transporting the antennæ, station accessories, equipment instruments, forage, etc.

1 four-wheeled wagon, for an antenna of 32 m. fixed to a dismountable mast strengthened with supports.

E. T. THACKERAY.

REVUE DU GÉNIE MILITAIRE.

September, 1906.

TELEPHOTOGRAPHY.—A previous article, published in the May and June numbers, described a mathematically correct method of plotting objects on a map from photographic plates. The present article deals with another and simpler method, which is claimed to be correct enough for all practical purposes. The article will be continued.

DIRIGIBLE BALLOONS.—This is a continuation of the article published in the August number. The pitching motion of elongated balloons is largely caused by the inertia of the gas; with every alteration of speed the gas is driven towards the stem or stern of the balloon, from which it in due course rebounds. In a similar manner the air in the ballonet acting as a pendulum prolongs any oscillations that may be set up.

In addition to the horizontal movements of the gas, there are slight vertical pulsations which alternately inflate the upper and lower portions of the envelope. Any alteration of the position of weights in the car must of course produce additional oscillations. As the screw shaft is not situated at the centre of pressure of the whole system, the thrust of the screw tends to depress the stern of the balloon, and ultimately to destroy its stability. If the screw is placed far aft the balloon spins round as soon as the clutch is put in,—like a motor car on a greasy road. To reduce the pitching movement to a minimum the balloon should be divided into compartments by permeable diaphragms, so that any sudden displacement of the gas will be prevented, and the envelope should be kept fully inflated. It is desirable also to stay the top of the ballonet to the interior of the envelope to prevent the former oscillating. In maintaining vertical stability a certain amount of gas and ballast may be saved by the use of aeroplanes, and by tilting the stem of the balloon up or down, so that the action of the screw helps to keep it at the desired level.

A dirigible balloon rarely rolls and no special precautions are required to prevent this motion. 'Yawing' is a very common fault. This is caused by the oscillations set up in the gas whenever the course is changed.

Before leaving the subject of design, the author enumerates twenty-two more or less conflicting conditions which must be satisfied if a balloon is to be a success. He considers twenty-five miles an hour as the maximum speed attainable by a balloon under present conditions. The last part of the article deals with the shape of propeller blades. The article will be continued.

J. E. E. CRASTER.

CORRESPONDENCE.

TRAVERSED FIRE TRENCHES.

SIR,

On page 148 of the September issue a suggested form of Traversed and Recessed Fire Trench is illustrated. It is stated in the letterpress that "it appears to have no disadvantages."

This form of traverse was experimented with during the late war in South Africa, and was found to have the following marked disadvantages:—

(i.). When viewed from the enemy's side a row of such traverses has an appearance as marked as a line of Martello Towers. This is due to the steep slope on the side facing the enemy, and to the necessary difference of height between the traverse and the firing parapet.

(ii.). Such traverses provide less full-sheltered crouching space against frontal and oblique shell fire than the ordinary pattern.

The first objection can be minimized by the extra height gained on the firing parapet by the addition of head cover.

The second objection remains, namely that, except from reverse or dead-enfilade fire, the trench is practically altogether deprived of the traverse shown as an "ordinary" traverse in *Fig.* 1 of the same article.

As an expedient for gaining rifle frontage there would appear to be no objection to this traverse, when employed on the flank or gorge of a closed work, or in a flanking retrenchment at right angles to a main line of fire trenches.

Yours faithfully,

E. E. B. WILSON,

Capt., R.E.

Curragh, 18th September, 1906.

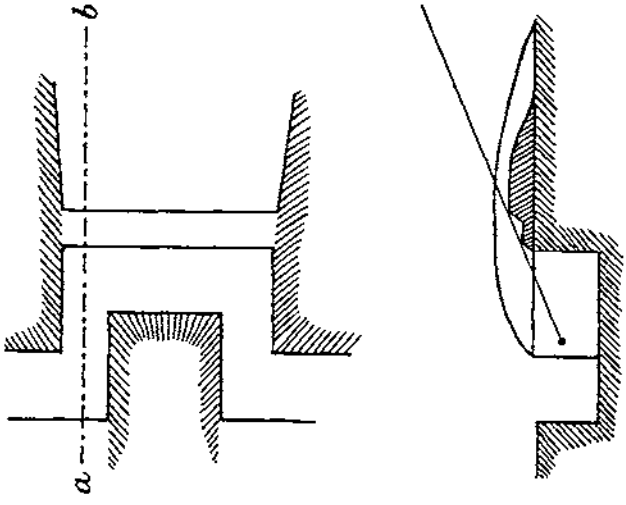
SIR,

The system of Traverses shown on p. 148 of the September number, as proposed by Mr. W. H. Alexander, was used to a considerable extent in the entrenching of a position by the Mandalay Brigade near Maymyo, Upper Burma, in March last.

It was first made (by accident I believe) by an officer of the 2nd/10th Gurkha Rifles, and was adopted for other trenches as it seemed at first sight an improvement. But on further consideration I came to the conclusion that under ordinary circumstances the proposed system was not so good as the usual one, for the following reasons:—

(i.). Communication round the front of the traverse is much more difficult.

(ii.). Part of the trench on either side of the traverse is much exposed to frontal fire (*vide* sketch).



Plan. *Section on a b.*

(iii.). It has been stated that the experiences of the Russo-Japanese war show that it is unnecessary to place men in trenches at a closer interval than 2 or 3 yards. If this is so, the advantage of having 3 men firing on a front of 9 feet, instead of 2 men on 13 feet, is not very great.

D. FORSTER,
Capt., R.E.

22nd September, 1906.

RECENT PUBLICATIONS.

Lessons of the Russo-Japanese War, by General De Négrier, translated by E. Louis Spiers, 8th Hussars. ($8\frac{1}{2} \times 5\frac{1}{2}$. 2s. 6d. Hugh Rees).

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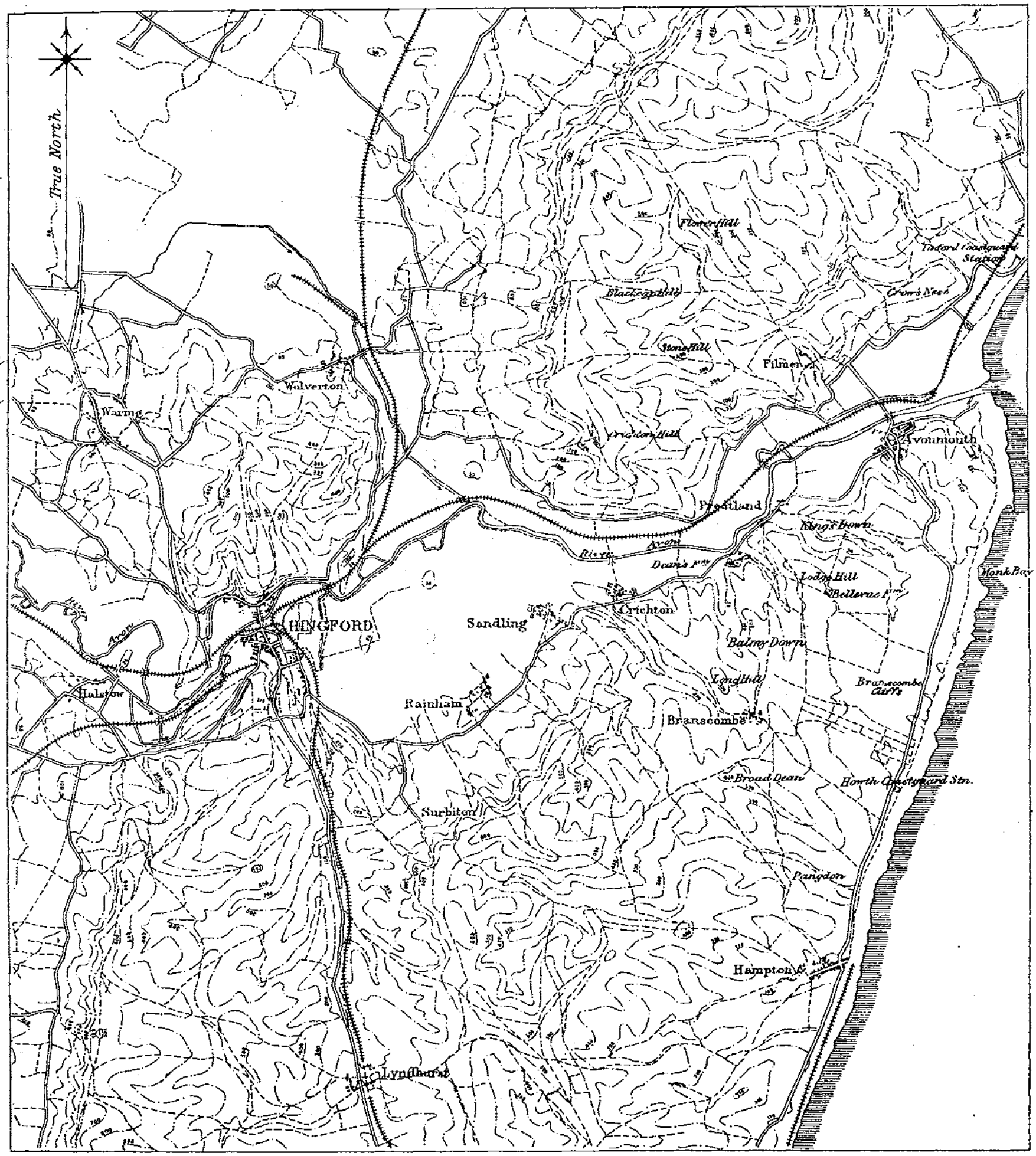
SCHEME ON 1" MAP: ATTACK ON AVONMOUTH.



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THE CAVALRY JOURNAL.

Published with the sanction of the Army Council and under the direction of Major-General R. S. S. BADEN-POWELL, C.B., Inspector of Cavalry in Great Britain.

Published Quarterly, Price 2/6 net; or 10/- net per annum.

READY OCTOBER . No. 4.—OCTOBER, 1906. READY OCTOBER .

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LE MESURIER SYSTEM OF ROOFING

FIG. 3.
SECTION ON L.M. OF FIG. 7.

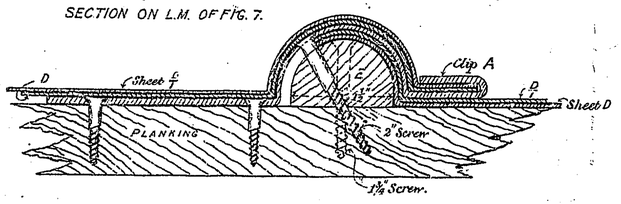


FIG. 4.
SECTION ON N.O. OF FIG. 7.

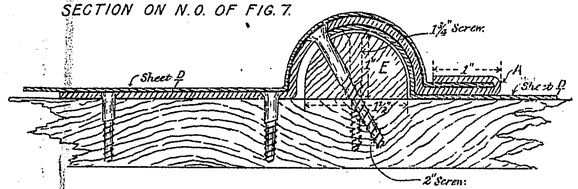


FIG. 7.
PART PLAN OF ROOF

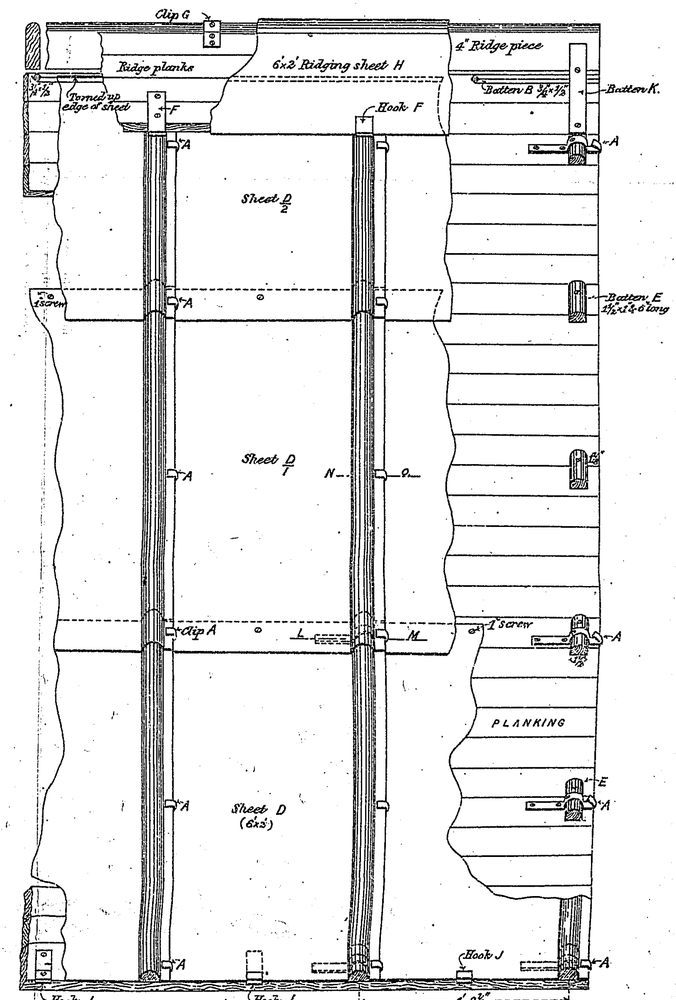


FIG. 2
CROSS SECTION OF RIDGE

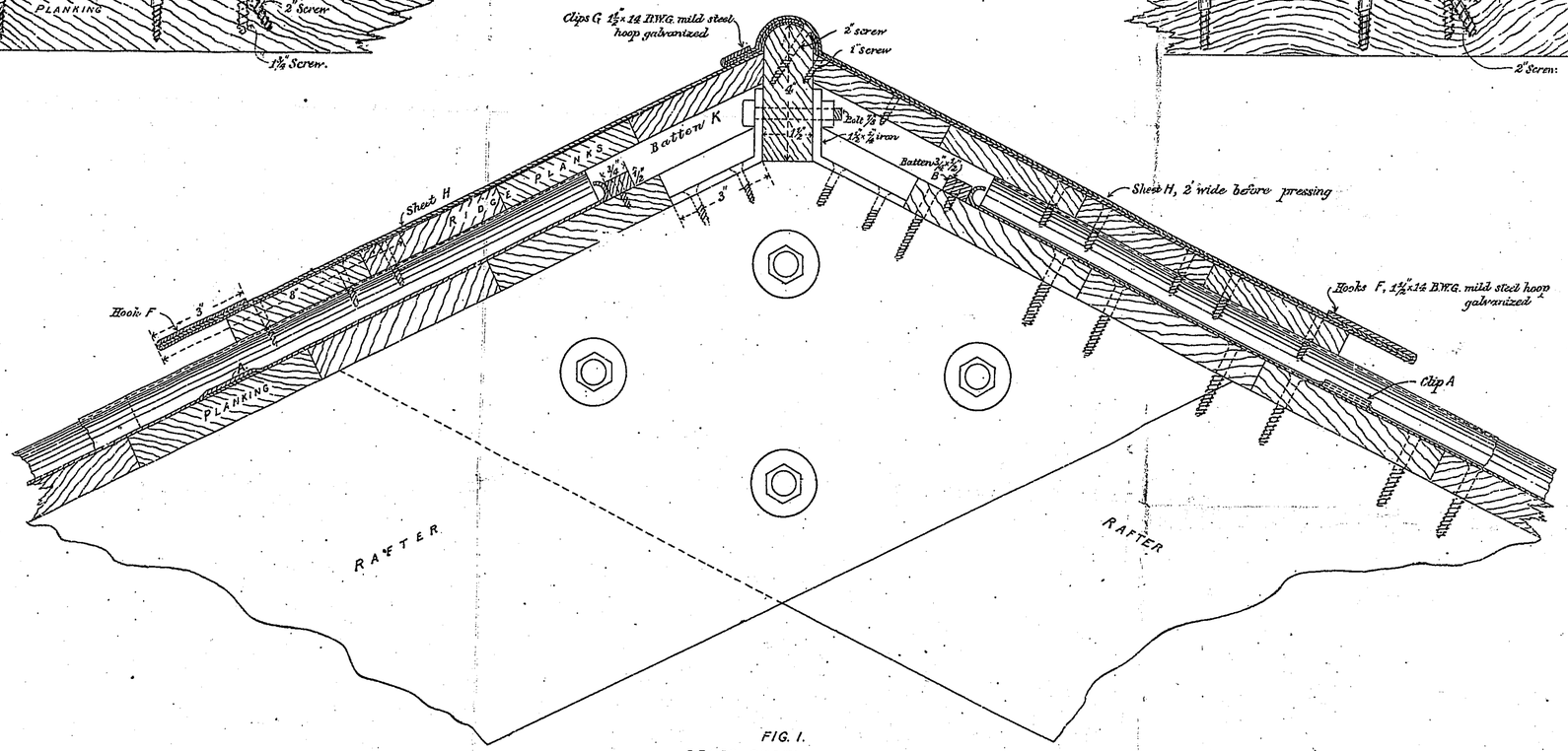


FIG. 5.
ENLARGEMENT OF P OF FIG. 1.

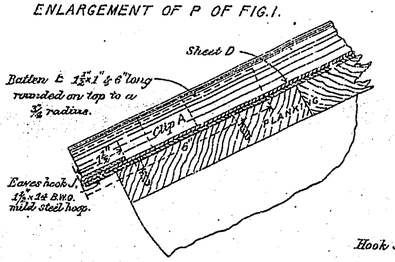


FIG. 1.
CROSS SECTION OF ROOF

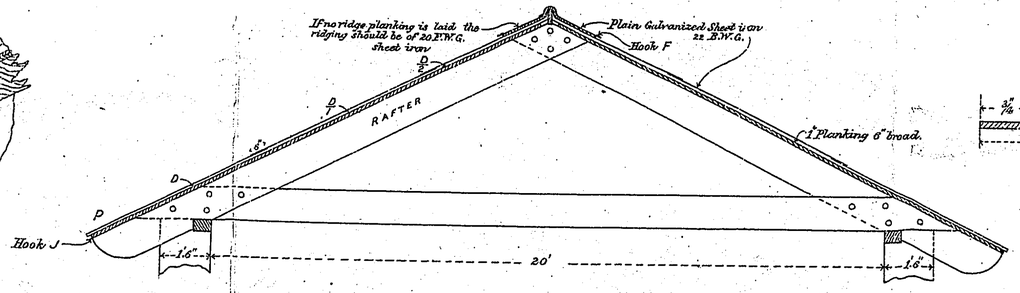
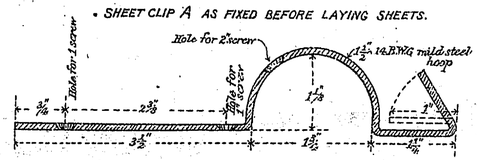
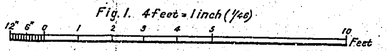


FIG. 6.
SHEET CLIP A AS FIXED BEFORE LAYING SHEETS.



Scales

Fig. 1. 4 Feet = 1 inch (1/48)



Figs. 2 & 5. 4 inches = 1 inch (1/4)

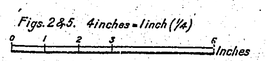
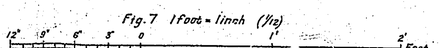
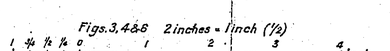


Fig. 7 1 foot = 1 inch (1/12)



Figs. 3, 4 & 6 2 inches = 1 inch (1/2)



Scheme on 6" Map: Defence of Cuxton Bridge.

Basing.
2.5 m. N.W. of Cuxton.

Finbury.
1.5 m. N.W. of Cuxton.

Weybridge.
12 m. S.W. of Cuxton.

Halldran.
1.2 m. E of Cuxton.

Malling Hill
2½ m. S. of Cuxton Mill

Scale 6 inches = 1 mile.

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By post, SEVENPENCE. Applications to be made to the Chief Attendant, Royal United Service Museum, Whitehall, S.W.

MR. E. CARLISLE, M.A. (Cantab.),

AND

MAJOR M. H. GREGSON, late R.E.,

Prepare Candidates for the Navy and all Army and Civil Service Examinations at

5 & 7, LEXHAM GARDENS, KENSINGTON, W.

We have retained the services of all the Tutors who have been so remarkably successful in past years, and continue to receive both resident and non-resident candidates.

Recent Successes Include:—

STAFF COLLEGE, AUGUST, 1906.

The following Officers, whose names are arranged in regimental order, were successful from us at the recent Competitive Examination for admission to the Staff College.

Capt. C. Evans, R.F.A.
,, G. C. Merrick, D.S.O., R.G.A.
,, W. H. Moore, D.S.O., R.G.A.
,, J. P. Mackesy, R.E.
,, B. W. B. Bowdler, R.E.
,, F. D. Farquhar, D.S.O., Coldstream Guards.
*Capt. R. G. Parker, RI. Lancaster Regt.
Capt. G. N. T. Smyth-Osbourne, Devonshire Regt.
Capt. V. H. M. de la Fontaine, East Surrey Regt.
Capt. and Bt. Major F. R. Hicks, Hampshire Regt.
Capt. H. S. Williams, Dorsetshire Regt.
,, B. D. L. G. Anley, D.S.O., Essex Regt.
Capt. R. S. Hamilton-Grace, Durham Light Infantry.
*Capt. H. F. Baillie, Seaforth Highlanders.
,, P. S. Allen, Gordon Highlanders.
,, J. K. Cochrane, Leinster Regt.
,, R. L. Rickett, Indian Army.
,, W. K. Bourne, Indian Army.
,, F. W. Lumsden, R.M.A.

The following Officers received nominations:—

Capt. H. C. Bickford, 6th Dragoon Guards.
Capt. C. J. C. Grant, Coldstream Guards.
Capt. W. D. Wright, V.C., Royal West Surrey Regt.
Capt. C. H. Harington, D.S.O., Liverpool Regt.
Capt. H. Wake, D.S.O., King's Royal Rifle Corps.
Capt. and Bt. Major N. J. G. Cameron, Cameron Highlanders.
Capt. G. P. Grant, D.S.O., Indian Army.

SANDHURST, JUNE, 1906.

FIRST	A. G. Armstrong 5,541	129th	R. P. T. Ffrench..... 3,827
48th	H. G. Gauntlet 4,515	181st	C. W. Molony..... 3,445
67th	D. Macdonald..... 4,299	186th	P. J. I. Synnott 3,386
89th	W. G. Bagot-Chester..... 4,115	190th	R. M. Aylmer 3,339
90th	A. G. Ottley 4,109	197th	O. Gough..... 3,262
93rd	A. P. Williams-Freeman 4,094	201st	P. W. J. A. Stomm 3,151
115th	D. M. Black 3,940	213th	B. W. Molony 2,881
125th	W. J. King-King 3,846		

WOOLWICH, JUNE, 1906.

31st ... ... J. S. Barkworth 6,483

DECEMBER, 1905.

SECOND	H. G. MacGeorge 7,196	16th	R. Crofton 6,330
FOURTH	G. Walton 7,046	45th	D. Stephenson 5,899
FIFTH	H. A. Cox 6,967	54th	J. Kennedy 5,711

This was the First Examination under the new regulations, and our pupils secured THREE out of the first FIVE places.

MILITIA COMPETITIVE, MARCH, 1906.

A. E. Hardy	2,304	W. F. Anderson	1,947
N. H. Hutcheson	2,105	D. C. Robinson	1,879
F. D. Frost*	1,949	F. A. Bowring	1,876

*Read partly at the Army College, Aldershot.

ARMY QUALIFYING, 1906.

Nineteen passed.

Special Arrangements have been made for the Army Qualifying in next Examination.