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Authors alone are responsible for the statements made and the opinions expressed in their papers.

GOVERNMENT OFFICES

GOVERNMENT OFFICES, BANGALORE.

By Lieut.-Col. O. M. R. Thackwell, R.E.

This building was designed by Mr. J. E. O'Shaughnessy, M.I.C.E., a retired member of the Public Works Department resident in Bangalore, and the building was carried out under the supervision of successive C.R.Es. of the Bangalore Military District, some modifications in the design being made in course of construction.

It provides accommodation for the Courts and Offices of the District Magistrate, the 2nd Magistrate and the Bench Magistrates, for the Resident's Treasury, and for an Excise Office: a Police lock-up for prisoners under trial is provided, and various waiting rooms for the Pleaders and public attending the Courts.

The building is double-storeyed, and the style of the architecture is Florentine. The roof of the 2 end portions is a sloping roof of local Mangalore tiles; these are joined by a flat roof of the kind known locally as Madras terrace: the whole of the roof is surrounded with a low panelled parapet wall.

The lower storey is built of granite of which there is an abundant local supply, the upper storey was designed of brick for the sake of lightness; both storeys are lime plastered on the outside. For similar reasons the floors of the lower story are of stone, while those of the upper storey are of tiles on concrete over corrugated iron jack arches supported by steel girders.

Both roofing and flooring tiles were obtained locally, being manufactured in large quantities in the South of India: good bricks are however difficult to obtain, and those used in the work had to be specially made by the contractor.

The building was commenced in 1902 and took nearly 2 years to complete. There was at first great difficulty in obtaining a contractor to undertake the work at the rates laid down: once however that difficulty was overcome, the work proceeded without hindrance.

The actual cost of the building was Rs.1,78,000, or 8 rupees 14 annas per square foot of plinth area; the cost per cubic foot (plinth area × average height of roof above plinth) was 3 annas 2 pies.

THE TACTICAL USE OF R.E. FIELD UNITS.

By Major C. S. Wilson, R.E.

It seems unfortunate that in the new edition of *R.E. Training* no mention has been made of the tactical handling of R.E. field units. In *Combined Training*, also, there is an absence of guiding in this subject, almost the only mention being of the use of R.E. in advance guards. Whilst recently in command of a field company I found this omission a great handicap in obtaining the most useful training results from field days and manœuvres, as it was not only necessary to devise the best method of utilizing the unit, but it was also necessary to get the General to adopt them and embody them in his orders. However ready the General may be to listen to views submitted to him, at present a field company commander's proposals embody his own personal opinions only, instead of properly laid down general principles. If such existed the General would at once realise that the suggestions submitted to him are accepted principles and not original ideas of your own. Of course, in peace time, the work must be to a very large extent imaginary, but it is most important to accustom the R.E. themselves to be in their proper places in any scheme of attack and defence, and other arms should be taught to realise that this will always be the case.

In a recent article in the *R.E. Journal* Capt. E. E. B. Wilson, D.S.O., dealt with this question on the march, and the same reasoning, viz. that it is the duty of the R.E. to clear the way for the infantry, applies equally in the attack. In order to do this the R.E. must be well to the front and not kept in reserve. Judging from the foreign journals, this is being realized on the continent, and divers proposals are being put forward either of attaching sections of engineers to the infantry or of training sections of infantry as engineers. Both these suggestions seem undesirable as they would probably result in the engineers being used as infantry when they might be better employed elsewhere, but they show that the importance of having the engineers always up with the infantry is becoming recognized.

The first duty of engineers in the attack is to clear the way for the infantry through any natural or artificial obstacles which may hinder the advance. This entails very careful reconnaissance, both before and during the attack, as the exact nature of the obstacles close up to the position can rarely be ascertained beforehand.

The second duty is to seize every opportunity of improving cover

and entrenching against a counter attack, and of preparing gun positions where required as each successive feature of the ground is made good in the advance.

In peace time this work although imaginary needs very careful organization and training, especially as regards the following points:—

Reconnaissance.—Men must be trained as scouts in the same way as is done in the infantry, and they must be taught to go forward with the infantry scouts and send back accurate reports of the obstacles to be cleared and the tools required; this will require a great deal of practice in getting reports back quickly and in time to be of service.

Supply of Tools.—This is also a question which requires very careful consideration and forethought, as we cannot hope to get the tool carts much nearer than 2,000 to 2,500 yds., or the pack animals within 1,500 yds., excepting on particularly favourable ground. Beyond this point the sappers must carry their own tools, and as they can only take about one tool a man, the need of early and accurate information as to the work to be done is evident. There will be no possibility of changing at the last moment if the wrong tools are brought, and the delay in getting the right ones up from the tool cart, over a mile of fire-swept ground, would be disastrous. The use of grenades and portable mortars of the Japanese pattern, when close to the position, must also be thought out and arranged for.

Another important point is the training of the mounted N.C.O.'s and men in getting their pack horses and tool carts under cover as close up as possible to their sections, and also in keeping in communication with them. To carry this out, the use of any cover afforded by the natural features of the ground, as well as the best way of crossing exposed places, will have to be very thoroughly taught.

Training is also required for officers and N.C.O.'s not only in rapidly recognising the salient features for defence as the attack progresses, but also in strengthening them as quickly as possible, and further, as the advance goes on, information of what is being done must be passed to the rear, so that the second line may be ready to take over and complete the work when it reaches it.

From the above it will be seen that there is a great amount of useful training to be got out of a drill attack. But to get this the R.E. must be up in their places and allotted to the sections of attack. Within this section they should have freedom of movement, and although a section might be ordered to move with a battalion it should not be tied to any particular formation or position, these details being left entirely to the discretion of the R.E. officer in charge.

The following arrangements, carried out in an attack last summer, will explain this idea. The attacking force consisted of 1 brigade R.F.A., 1 field company R.E., and 1 infantry brigade. The front was divided into 2 sections, one battalion allotted to each. The

left battalion, employed in the main attack, was supported by another battalion, and the remaining battalion was in reserve. One section R.E. was allotted to the 1st line of each battalion, the remainder of the company following in the second line. The country was open heath crossed by wire fences, banks and stone walls. Each of the sections in the front line sent forward 2 or 3 men as scouts, and a few men with wire cutters and crowbars to clear the fences and to loophole walls, etc. The remainder of the section followed the supports, improving cover made in the advance, and preparing any special points for defence. The remainder of the company completed the work as the second line advanced. During the whole advance, communication with the main body was kept up by message and signal from the scouts and sections. This was very imperfectly done, partly owing to the shortness of a peace attack and partly through evident want of practice. It is most important however that the successive lines should know what is going on in front, so that the work begun may be carried on at once without wasting time by looking out for what has been done, and this depends on good signalling. The rapidity of the peace attack is really an advantage, as it emphasises the necessity of information, as to work and tools required, being passed rapidly, if any use is to be made of it.

A point to be observed is, that the R.E. must not wait to finish the work they start, but must move on with the troops, leaving its completion to the R.E. with the line behind.

It will be seen that a field company just about fills the requirements of a brigade, and I am strongly of opinion that each brigade should have a field company available, even though they should still be Divisional Troops and not part of the brigade.

The increasing use of prepared obstacles in the defence, and of the spade in the attack, makes the engineer arm of particular importance, and it should therefore be accustomed to work with the other arms as much as possible. One point of view, sometimes held, needs contradicting, and that is that the R.E. are too valuable to be used. Their work, which is their real value, is lost if this opinion is insisted upon.

The above is really only a short outline of what may be done, but I hope that others may be induced to give their views more fully, so that in time the principles of the tactical use of R.E. may be recognised and included in the text books.

MILITARY v. NAVAL HOME DEFENCE.

By Major W. A. Harrison, R.E.

In the November number of the *R.E. Journal*, Major Fuller not only disagrees with the system of Home defence advocated by Colonel Hickson, but goes further and advocates in its place the Naval defence of Great Britain as part of the Empire only, instead of the Military defence of Great Britain as the heart of the Empire, and, as such, its most vital organ. If, as his article would lead one to believe, he is an advocate of the "Blue Water School" principles, many will surely hold his views as far more unsound than those which he opposes.

These "Blue Water School" principles may be summed up as :—

(1). The whole Home defence entrusted to the Fleet.
(2). A military force large enough to act as a striking force, but totally inadequate to protect England against invasion.
(3). The impossibility of such an invasion on account of our Fleet always being in sufficient force, where needed, to guarantee the safety of our shores.

Major Fuller may disclaim any connection with No. 3 of the above tenets, but the two first principles are evidently unsound unless absolute reliance is placed in the third.

An exponent of this school—Mr. Harold Cox—writing to the *Broad Arrow* on the 2nd of November, 1907, says: "The question of whether foreign troops can be prevented from landing on our shores is entirely a Naval one . . . and the only authority on this is the Admiralty. Their opinion is that the Navy can prevent the landing of any force exceeding from 5,000 to 10,000 men . . . therefore we may dismiss altogether from our minds the fear of invasion."

Even if Major Fuller does not entirely agree with the above extreme opinion, it will show him the great danger there is of the views such as he holds being dangerously misapplied by civilians.

Owing to the susceptibilities of other nations, it is always undesirable to specify what nation might find herself almost compelled, by self-interest, to take advantage of a favourable opportunity of striking a blow direct at the heart of the Empire, so as either to increase her over-sea dominions, or to supplement her foreign markets. It is equally undesirable to point out what combination of circumstances might lead to such an opportunity occurring.

It is owing to this that the advocate of the "Blue Water School" has such an advantage with the "man in the street," he is able to put all his arguments forward, whereas those of his opponent are mostly "Confidential."

Before going further it may be interesting to consider not only the present distribution of the Fleet consequent on the acceptance of the "Blue Water" theories, but also some of the disadvantages which will result from a Naval defence of Great Britain.

The present distribution of our Fleet is as follows :—

	Battleships.	Cruisers.	T. B. Ds.	Attd. Ships.
The Channel Squadron consists of	14	9	24	7
The Atlantic Fleet...	6	7	—	1
The Mediterranean Fleet... ...	6	8	11	3
Home Fleet (divided into Nore, Portsmouth and Devonport Divisions)	23*	37†	108‡	—
North American and West Indies Fleet	—	3	—	3
China Squadron	—	6	7	16
East India	—	4	—	3
Australia	—	9	—	—
Cape of Good Hope	—	3	—	—
West Coast of North America ...	—	1	—	—

Comparing this with the distribution in 1897 as given by Whitaker, we find that at that time the ships in Home waters, including the Mediterranean, were :—18 Battleships, 15 Cruisers, 10 Torpedo-boat destroyers, and 10 "attached" ships; whilst those for the protection of the rest of the Empire were :—2 Battleships, 52 Cruisers, 9 Torpedo-boat destroyers, and 48 "attached" ships of various sizes. In addition to those commissioned in Home waters, there were about 14 effective Battleships, 50 Cruisers (principally IInd and IIIrd Class) and some 80 Torpedo-boat destroyers out of commission, but apparently the number given above were considered sufficient to meet any emergency and protect our commerce if called upon suddenly to do so. In 1897 although Great Britain was practically as unprepared for a military defence of her shores as she is now, theoretically a military as against a naval defence was provided for, and for this reason the ships of the Home Squadrons might be considered as commerce protectors and destroyers of an enemy's Fleet only. Since 1897 the trade of the United Kingdom has increased by 300 millions, whilst that of the rest of the Empire has increased by

* 11 "Special Service."
† 10 "Special Service."
‡ 28 Full Crews, 80 Nucleus Crews.

200 millions, but whereas the Squadrons in Home waters have been practically trebled, the number of ships available for the protection of our trade elsewhere has been more than halved. Some may urge that this increase at Home is due to the increase in the French and German Fleets, but on the other hand the Russian Fleet has practically disappeared, and the Fleets of Japan and America have more than equally increased in the Far East and America. If the increase of trade in these parts of the world, not only needed no extra protection, but even allowed of a reduction of protecting ships, it is fair to assume that the enormous increase of ships in Home waters is due to our Naval protection against invasion. Thus the first great disadvantage of Naval defence is that, even in peace time, it ties up in Home waters an undue proportion of our fleet, to the detriment of our prestige and trade in the more distant parts of our Empire.

What applies in peace applies doubly in war. It is all very well for "Blue Water" enthusiasts to claim that, whilst our main fleet is seeking out and destroying the hostile fleet, our residue would more than suffice to secure the Channel, but when it comes to the time itself it will be found that every ship is required to place victory beyond the possibility of doubt. During the Russo-Japanese War, whilst the main Japanese Fleet was awaiting a sortie of the damaged and dispirited Russian Fleet from Port Arthur, the Vladivostock squadron came right down to the mouth of Tokio Bay, and hung about there for 4 or 5 days in the hope of capturing certain neutral vessels which were known to have contraband on board. Admiral Kamimura's Squadron, although theoretically free to deal with these ships, left them severely alone, as Admiral Togo needed his fleet to put the issue beyond doubt in case the Russian Fleet made a sortie. So with us; however many "Power" standard our Fleet may be theoretically, it will be found, when war is actually declared, that our Admirals will not wish to spare any of their ships to play "Coast-guard."

A second disadvantage is that Naval warfare is very much like the letter x—an unknown quantity. Our fleet has had no real experience of naval warfare for nearly 100 years, and although we believe and trust that it will prove as capable at modern warfare as it did in the Naval warfare of 100 years ago, still it is surely unwise to entirely trust our National existence to a pious belief.

"Blue Water" enthusiasts may talk of our fleet "seeking out and destroying" the enemy's fleet, but in case of war actually occurring, popular "funk" would probably develop to such an extent that it would result in a very strong portion of our fleet being kept on patrol duty in the Channel, so as to guard against any possibility of hostile transports slipping through and landing a large invading force.

The increase of commissioned ships due to Naval defence has been shown above as being approximately 31 Battleships, 46 Cruisers, and 133 Torpedo-boat destroyers, the initial cost of these ships may be put approximately at £70,000,000 at least, and the annual deterioration at £3,500,000. When it is realised that in 1907 the pay for the whole of the Regular Territorial Regiments of the Line was put at £2,320,000, it will be obvious that the saving in deterioration alone would be sufficient to bring our defending force up to the required strength. In addition to the above sum however the coal bills, the percentage on the original cost of construction, the pay of the crews (a considerable army in themselves), the annual cost of repairs, and finally the dead loss which is incurred by the accidents which so frequently occur, would provide a sum far in excess of what the Military defence of Great Britain would cost. The Naval Estimate for 1896—1897 for effective services only was £19,659,000 net; last year it had increased to £28,908,708 and this increase of £9,300,000 may, I think, be fairly put down to the theory of Naval Home defence. The argument that, with so large a number of ships available, the protection of our commerce is better assured, is an argument which has only come into existence since Naval defence supplanted Military defence in England, and is also one which is hardly justified, seeing that our increased commerce is met by a reduction of protection in all parts of the world excepting in the vicinity of Great Britain. And finally, to all the above disadvantages, is added the overwhelming danger of a sudden invasion of Great Britain. Of course the advocate of naval defence objects even to the suggestion that such an invasion is possible, but as the leading soldier of our day—Lord Roberts—has, in the House of Lords, openly stated his belief that such an invasion is perfectly possible under present conditions, not only on a small but also on a large scale, military men may feel pretty sure that sound reasons exist for such a belief.

It is not proposed to consider such an eventuality separately, as it is evident that, if a suitable scheme of Military Home defence is carried out to protect England against invasion during wartime, the number of men required will more than suffice to protect her against a sudden unforeseen invasion, even though it be on a very large scale.

There is one further great advantage in Military Home defence, and that is that it would free the Navy at once for the proper protection of our far distant interests and commerce. For this, if for no other reason, the question of Military Home defence is worth considering.

The main disadvantage of Colonel Hickson's scheme of defence is that the attempt to be strong everywhere generally ends in the result of being strong nowhere. If a single line of forts, as suggested by Colonel Hickson, was by any chance penetrated at any one point, the whole system would at once become useless, and the "defending

force," having been calculated on the assumption that it would be required to work only in conjunction with the forts, would probably prove to be too weak to meet, unsupported, a large invading force.

Besides the above, such a chain of forts as proposed would have the following further disadvantages :—

(1). The cost of building and maintaining them would be very great, if not absolutely prohibitive.
(2). The forts would either have to be constantly brought up to date, or would probably be obsolete when the threatened invasion took place.
(3). They would tie up a large number of men, as garrisons, when their presence would be needed in the field army.
(4). Permanent works, unless they act as auxiliaries to the field army, are never justified except in the defence of Dockyards, Arsenals or Naval Bases.

Colonel Hickson lays stress on the fact that his suggestions apply to the South coast alone, as this is, in his opinion, the danger point of England. In these days the East coast is surely looked upon as far the more dangerous, at least from the point of view of invasion.

For all these reasons many will be found to disagree with Colonel Hickson's proposals.

But there is an alternative and less costly way of preparing our Home Defence.

Soldiers are constantly having it pointed out to them, that it is not only instructive, but also absolutely necessary for them to make a minute and thorough study of all possible theatres of war where British troops may be engaged. The Franco-German and the Russo-Japanese wars are held up as brilliant examples of the efficacy of such study. As a matter of fact, in most of our wars, such a study is difficult, if not almost impossible. The enormous extent of the British Empire, the savage and unexplored lands in which we fight, added to the impossibility of gauging the moves of semi-savage enemies, all hamper the British general from working out a preliminary plan of campaign. The case, where such a preliminary plan could be worked out with comparative thoroughness, is the invasion of England.

Of course the possible number of invaders would first have to be arrived at, and this should be fixed by the most disadvantageous and yet possible combination of circumstances which might occur. For instance it might be roughly fixed as follows :—

Our Australian Colonies—coerced as they are by trade unions—find it necessary at times to entirely or partially restrict the immigration of alien workmen. A few years ago such restrictions were carried out only on a small scale, and affected the subjects of

powers weaker than the Colonies themselves. Every year however the subject becomes a more burning one. The trades unions with their increasing influence, make, year by year, increased demands, and the immigrants refused admission are now subjects of Powers, whose increasing naval strength is likely to become a serious menace to British Far-Eastern superiority in the near future. In case therefore of these immigration laws being resented and leading ultimately to an appeal to arms, a very strong contingent of the British Fleet would be needed in Far-Eastern waters. If in addition to this (or even perhaps on account of this) a serious recrudescence of the recent Turkish trouble with regard to Egypt took place, it would lead to the presence of our Mediterranean Fleet in the vicinity of Turkey, and an enemy might be found strong enough to hold the Channel against the residue of our fleet for say 9 days, *i.e.* 3 days of preparation and 6 days actual transportation of troops. Nine days are taken as available, as it is assumed that, on receipt of the first news, the Mediterranean Fleet would at once hurry home, and the North American Fleet would also hurry over to England and each of these fleets would take about 9 days to reach the Channel.

Working on this basis, the force required to repel such an invasion might be arrived at by considering the problem under every possible condition, in each case the most unfavourable combination of circumstances being assumed against the defending force. Each possible landing place might be taken in turn, and the objective of each, the roads of advance, probable moves with the corresponding countermoves, difficulties of transport, communications, etc., being considered in turn.

The best positions of offence and defence on the various lines of advance, in connection with each scheme, might be thoroughly studied and surveyed, their weak points noted, and the number of men required to ensure success carefully considered. By this means some idea of our requirements in case of invasion would be formed, and, by testing and re-testing the problem, a really practical scheme of defence would ultimately be arrived at.

When the number necessary for Home defence under every condition had been finally arrived at, the logical conclusion is that the regular Home army should be raised to, and maintained at, that number. If the opinion of the late Colonel Henderson is of any value, we may assume that the Territorial Army will be unfitted, until some months after the outbreak of war, to cope with an army composed of Regulars. It can, therefore, only be considered as supplementary to the force required for Home defence, and our defensive force should be fixed irrespective of it. If such an army be provided, it will include the "striking force" which is apparently considered of such primary importance. It is evident that the circumstances which make for invasion are so dissimilar from those which

require the provision of a "striking force," that it is unnecessary to provide for both the "striking force" and the "defending force" at one and the same time.

Some may hold that the above scheme is carried out piecemeal in the General Ideas of Staff Rides, etc., but, when any details of it do occur, the defending General is always given ample troops either to hold his own until help arrives, or else to tackle the enemy "on his own" with a more than equal chance of success, and this makes the problem an entirely different and much easier one to solve. If an invader really came, the General would find it a very different job to repel him with about $\frac{1}{10}$th the required number of men.

It is just possible that some such scheme, as outlined above, already exists in the safes of the Intelligence Department, but, if so, it has never been carried to the logical conclusion mentioned above.

Finally, even if an invasion never takes place, England would surely benefit by having ample troops always ready to press home any advantage gained by the fleet, and also in case of a war such as we have recently had in South Africa, our having them would obviate the necessity of having to pay patriotic yeomen 5s. a day to render semi-amateur aid. In addition to this the fleet would be free to patrol the Empire and to show the flag as it used to do, and the knowledge that it was again an ever-ready weapon of offence, would be sure to add weight to our wishes or opinions in the Councils of other Nations.

For all these reasons, plausible though the "Blue Water" theories may be, many will hold that Military Home defence is the only really satisfactory solution of the defence of the heart of the Empire. Unfortunately this mode of defence does not commend itself yet awhile either to the bulk of our politicians or to the "man in the street." Some of the former possibly study their popularity and the latter thinks of his comfort. Military Home defence would ruin the one and destroy the other, for, were it adopted, conscription, in some form or other, would only be a question of time, and this terrible bugbear of many a working-man and "patriot" of to-day, is the insuperable obstacle which at present stands between England and Military Home defence.

THE FOUNDATION OF THE ROYAL ENGINEER ESTABLISHMENT AT CHATHAM.

By LIEUT.-COL. B. R. WARD, R.E.

As the S.M.E. may well be termed the "Alma Mater" of the Corps, the history of its early days, as also that of Sir Charles Pasley, its founder, should prove of interest to all R.E. Officers.

Capt. H. W. Tyler has written an interesting sketch of Pasley's life in the *R.E. Professional Papers*, and in addition Colonel Vetch's article in the *Dictionary of National Biography* and Major-General Porter's *History of the Corps* give good accounts of his services.

I propose in the following pages, however, to show how the necessity for a school of R.E. instruction first came to be realised, and further what circumstances led to the selection of Pasley as its organiser and first Director. A short summary of his services before the foundation of the School in 1812, taken from the above memoirs, may not be out of place, showing as it does the experiences on which both the original conception and organization of the School were based.

Born at Eskdalemuir, Dumfriesshire, on the 8th September, 1780, Pasley joined the R.M.A. at Woolwich in August, 1796. On the 1st December, 1797, he was gazetted 2nd Lieutenant in the Royal Artillery, and on the 1st April, 1798, he was transferred to the Royal Engineers. On the 28th August, 1799, he was gazetted 1st Lieutenant, on the 1st March, 1805, 2nd Captain, on the 18th November, 1807, 1st Captain. From 1799 to 1807, he was on service in the Mediterranean, at Minorca, Malta, Naples, and Sicily. In 1804, while still a subaltern, he was sent from Malta on a confidential mission to Lord Nelson, during the period of the long and tedious blockade of Toulon. On the 4th July, 1806, he was present at the battle of Maida in Sicily, and in 1807, he was present at the bombardment of Copenhagen and the seizure of the Spanish Fleet.

In the spring of 1808, while on duty in England, he wrote the first two chapters of his famous *Essay on the Military Policy and Institutions of the British Empire.* In the same year he served in Spain under Major-General Leith, who was acting as Military and Diplomatic Agent to the various revolted Spanish Juntas, and on the 18th November, on account of his knowledge of Spanish, he was appointed extra aide-de-camp to Sir David Baird. A

week later, on the 25th November, he joined Sir John Moore's staff, and accompanied him throughout the famous retreat which had commenced the day before, and which culminated at the battle of Corunna on the 16th January, 1809. Later on in the year he accompanied Lord Chatham on the ill-fated Walcheren expedition.

On 14th August, while leading an assaulting party at the siege of Flushing, he received a bayonet wound in the thigh, and almost immediately afterwards he was struck by a bullet which caused an injury to the spine. In consequence of his wounds he was invalided for a year. For a long time he was not expected to survive the shock but an excellent constitution enabled him to pull through. So severe were these wounds that they completely incapacitated him from any further active service, "and it tells much for the character of the man," says General Porter in his history, "that he did not permit the misfortune to damp his ardour or blast his career. Debarred from the prospect of earning further distinction in war, he devoted his energies to the good of the service and the improvement of his Corps."

His connection with the work to which he was to devote the next 29 years of his life, came about in the following way :—Although the necessity for a well-disciplined and instructed Corps of Sappers and Miners was not fully realized by the senior officers of the Engineers in the early years of the nineteenth century, the younger officers, who had been engaged for so many years on expeditions all over the world, were fully alive to the shortcomings of the Corps. As Pasley records :—"It had been deeply felt and lamented by those officers who had commenced their military career in the first war with the French Republic in 1793, and had afterwards served in Egypt and on other expeditions terminating in a less satisfactory manner. Young, or in the prime of manhood—full of enterprise and zeal, meeting and comparing notes together in the metropolis after the desultory expeditions in which they had served, and afterwards those employed in 1810 in the construction of the lines of Torres Vedras—meeting from time to time in some central spot, they excited in each other, and inspired their juniors with an *esprit de corps* and a devotion to the service of their Sovereign and country, that I do not suppose were ever exceeded. Capt. Charles Lefebure, who had served in the West Indies and in Holland, and had been the Commanding Engineer under Sir John Stuart in Calabria, afterwards unfortunately killed at Matagorda, near Cadiz, was at first the most influential of these officers. He it was who first pointed out to me and other officers, his juniors, as early as 1805, the inefficiency of the Corps for want of well-disciplined and instructed Sappers and Miners, which fatal experience afterwards proved to be too true. Of those employed in the Spanish Peninsula some years later, Capt. John Squire, a man of superior literary and

classical, as well as of professional attainments, contributed most to keep up this noble spirit, and it was gratifying to me to find that our opinions on the state of the Corps, and on the management of the war always agreed."

Pasley writing again in 1809 says :—"The important Department in which I have the honour of serving, was so imperfectly organized, that I considered the British Army, though admirably adapted for battle, from the excellent discipline of the Cavalry, Artillery, Infantry, and Riflemen, or other light troops, was incapable of succeeding in a siege, though one of the most important operations of war, without either having recourse to the barbarous measure of incendiary bombardment, or without an enormous sacrifice of the lives of officers and soldiers in sanguinary assaults, which might be rendered unnecessary by a more efficient organization of the Royal Engineer Department, and especially in forming a well-instructed and a well-disciplined body of Engineer soldiers diligently exercised in all the operations of a siege, particularly in military mining; and also in the formation of military bridges. The better instruction of the junior officers of the Royal Engineers appeared no less essential, for at that time they were not even taught the theory of the attack of fortresses at Woolwich Academy. . . . As for practical instruction, they had none; for they were sent on service without ever having seen a fascine or a gabion, without the smallest knowledge of the military passage of rivers, of military mining, or of any other operation of a siege, excepting what they might pick up from French writers, of which a striking proof occurred in Sir John Moore's retreat, when all the attempts to blow up stone bridges, to impede the progress of the enemy, failed in affecting complete demolition, with the exception of one only, which Lieut. Davy, a very promising young officer, succeeded in completely destroying, but at the expense of his own life, which he lost from not understanding the very simple precautions necessary to ensure the safety of the person who fires the train of a mine. For my part I should not even have known how to make a battery in the attack of Copenhagen, the first siege in which I was employed, but for the information I derived from a French book on the subject."

Further, before the Walcheren expedition had taken place, Pasley sent in a report to the Earl of Chatham, then Master-General of the Ordnance, drawing attention to the inadequacy of the instruction given at the Royal Military Academy, Woolwich, and offering to submit to the loss of his commission if he failed to make good his charges against the system. Again, early in 1811, he appealed to the Earl of Mulgrave, the new Master-General, earnestly soliciting him to remove these defects in the instruction of the officers and soldiers of the Royal Engineer Department, as he anticipated great disasters in case any important siege should be undertaken if this were not done.

Napier also describes the urgent need for such training in the British Army at this time in the following striking words :—"Without a Corps of Sappers and Miners, without a private soldier who knew how to carry on an approach under fire, they were compelled to attack fortresses defended by the most warlike, practised, and scientific troops of the age ; and the best officers and the finest soldiers sacrificed themselves in a lamentable manner to compensate for the negligence and incapacity of the Government, always ready to plunge the nation into war, without the slightest care of what was necessary to obtain success. The sieges carried on by the British in Spain were a succession of butcheries, because the commonest materials and means necessary for their art were denied to the Engineers."

The R.E. Department whose organization led to the above scathing criticism, consisted of the officers of the R.E., and of several companies of Military Artificers. A Royal Warrant dated 6th March, 1772, authorized the raising of the "Military Company of Artificers" at Gibraltar, and their strength was raised to two companies on the 30th June, 1786, both companies being stationed at Gibraltar. On the 10th October, 1787, six companies of "Royal Military Artificers" were raised, and were quartered at Woolwich, Chatham, Portsmouth, Gosport, Plymouth, and the Channel Islands. The two Gibraltar companies of soldier artificers were incorporated with the Corps of Royal Military Artificers in 1797. On the 1st September, 1806, the establishment was increased to twelve companies, the new stations being Dover, Cork, Gibraltar, the West Indies and Nova Scotia.

At the time that Pasley took command of the Plymouth company in 1811, none of these companies had been employed on active service, with the exception of the original "Soldier-Artificer Company"—as it was generally called—which was raised at Gibraltar in 1772 and employed at the siege of that fortress (1779—1783). The reason for the non-employment of the Royal Military Artificers is explained by Sir John Jones in his *Journals of Sieges in Spain and Portugal* in the following words :—"After a perusal of the foregoing journals, and observing how very much the want of Sappers and Miners prejudiced every siege operation in Spain, it will be learnt with surprise that, during the whole of the war, from 1793 inclusive, England paid, fed, clothed, and lodged a very large body of Engineer troops, legitimately Sappers and Miners. These, however, being designated the Corps of Royal Military Artificers, and composed chiefly of mechanics, were considered as more immediately intended for permanent works ; and the most limited number were reluctantly spared for field service, it being difficult to make it understood how mechanics could be required in any great number with an army. . . . The men were generally of superior requirements and well disposed ; but changing their officers incessantly, and their value

being thought to consist altogether in their labour as mechanics, their discipline naturally became relaxed, and their habits irregular."

The chief reforms necessary were, it will thus be seen, three. 1st. To establish a closer connection between the Corps of Officers known as the Royal Engineers and the Corps of N.C.O.s and men designated the Royal Military Artificers. 2nd. To imbue the Royal Military Artificers with soldierly *esprit de corps*. 3rd. To train practically in field duties both the officers of the Royal Engineers and the N.C.O.s and men of the Royal Military Artificers.

Fortunately, after the two unsuccessful sieges of Badajos in 1811, urgent applications were made to the home authorities by Lord Wellington asking "that half-a-dozen companies might be selected from the Royal Military Artificers to be formed into a body under the name of Royal Sappers and Miners, that officers should be permanently attached to the companies so selected, and, after some instruction in their art, the six companies should be sent out to aid the troops in their future siege operations." Again, towards the close of the year 1811, this application was forcibly repeated.

These urgent representations from the seat of war, combined with Pasley's equally pressing letters at home, at last produced the desired effect and enabled him to write as follows in the third edition of *An Essay on the Military Policy of the British Empire*:—"The author sincerely congratulates his countrymen upon the hopes of a speedy improvement in one of the most inefficient departments of our military establishment; the defects of which have, for many years, filled his mind with constant apprehensions of the failure and disgrace, if not of the absolute destruction of some British Army."

A Royal Warrant dated 23rd April, 1812, was issued by H.R.H. the Prince Regent acting in the name and on behalf of King George III. authorizing an establishment at Chatham for the instruction of R.E. and Pasley (who after he had sufficiently recovered from his wounds to return to duty had been put in command of a company of the Corps of Royal Military Artificers at Plymouth Dock) was transferred from that station to start it.

Had he not been prepared with a remedy, the reform of the R.E. Department would, no doubt, have been delayed for a long period; but his powers of organization were at least equal to his critical ability, and he was ready with a cut-and-dried scheme for providing at the earliest possible date the trained Military Engineers so urgently required in the Peninsula. The most serious evils and inconveniences soon showed themselves inseparable from the system of having a Corps of Engineer Officers without any troops or even stores under their own immediate command, and who had to demand the former when required, from the Infantry, and the latter from the Artillery. In all armies it had been ultimately found necessary to attach a permanent body of non-commissioned officers and soldiers to the Engineer

Department, as the experience of warfare fully proved, that however great the science or talents of any officers of Engineers were, their exertions in the field were in all cases much crippled, and were often liable to failure, unless supported by a proportionable degree of zeal, knowledge, and ability, on the part of the men, who acted under their immediate orders. It was the training of such N.C.O.s and men that proved one of the greatest difficulties Pasley had to contend with, and his system of overcoming it is best shown by the following extracts from the preface to his *Course of Instruction for the Use of the Royal Engineer Department* published in 1814 :—

"In the year 1811, having the command of Plymouth Co. of Royal Military Artificers, I was induced to embrace the opportunity which the conveniency of a Garrison life afforded, in order to ascertain by experiment the best and most practicable mode of improving the Corps in general in point of knowledge. It had long been considered desirable that the non-commissioned officers and soldiers should be able to understand the nature of a rough sketch, plan, or section. To this object my attention was consequently directed, but I soon discovered that the common methods of teaching practical geometry and plan drawing, were by no means calculated for the purpose in view.

After instructing one or two individuals of the most promising abilities, books and manuscripts were put into their hands, and they were employed to teach the others; but although they themselves perfectly understood what they had learned, it was found that they were unable to communicate the knowledge which they had acquired. The reason of this is, that the common books of practical geometry, etc., leave too much to the discretion of the master, so that no man, however well qualified himself in this simple branch of learning, is capable of instructing a number of other men properly, unless he possesses a superior degree of judgment, a tolerably good education, and some experience in the art of teaching.

To have carried on a general system of the proposed species of instruction according to any of the books in common use, would therefore have required an establishment of regular mathematical masters. But it must be evident, that the difficulty of finding qualified persons willing to undertake this office, added to the liberal salary which men of education must have been entitled to, would have operated as almost insuperable objections to such an establishment.

To surmount these difficulties; to lay down a course of instruction suited to the most untutored minds, and capable of being conducted by any man of good abilities, no matter how illiterate or ignorant in other respects; in short, to establish a system of instruction, which might be perpetuated like the drill of recruits, by the exertions of steady non-commissioned officers employed as teachers, without the necessity of calling in the assistance of scientific masters of any kind:

these are the points which I had in view in first commencing the present work; and the success has fully equalled my expectations.

After the practicability of the system of instruction had been sufficiently ascertained by the improvement of the Plymouth Company, it was, by order of Lieutenant-General Mann, submitted to a committee of senior officers of the Corps of Royal Engineers in the month of March, 1812, and having been honoured by their approbation, it was soon after sanctioned by the authority of the Master-General of the Ordnance, and has since been conducted on a much greater scale at Chatham."

The next twenty-nine years of Pasley's life were spent in organizing and directing the School of Instruction at Chatham, the establishment of which followed so soon after his practical recommendation on the subject.

Mention has been made above of Pasley's *Essay on the Military Policy of the British Empire.* The first edition of this essay was published in November, 1810, the second in March, 1811, and the third and fourth in October, 1811, and November, 1812, respectively. The second edition of his Part I. had been described in the *Quarterly Review* for May, 1811, as "one of the most important political works that had fallen under the Reviewer's notice." There is reason to suppose that the reviewer was none other than the late Foreign Secretary, Mr. Canning, at that time in retirement from public life, consequent on his duel with Lord Castlereagh, arising out of the Walcheren Expedition. When this essay was first written it was described as Part I., as Pasley intended to round it off with a Part II., criticising British Military Institutions. So arduous were his duties however in connection with the foundation of the S.M.E. that he was never able to find time to leave us a review of our Military Institutions as they then were: he has done better in leaving us the complete reorganization of one. How effective this reorganization has been is best seen by comparing the efficiency of the Engineer branch of the British service in the Waterloo, Crimean, Egyptian and South African Campaigns, with the poor results achieved by it in the Peninsular War.

It was from such beginnings that the S.M.E. has gradually developed into the important Institution of to-day, with its wide range of subjects and numerous schools of instruction. Its efficiency and its undoubted influence on the training of officers, who, during the last 100 years, have had so large a share in both the extension and development of the Empire, are, not only, the best monument to the organizing genius of Sir C. Pasley, but they also give us good grounds for congratulation that its original foundation was entrusted to so wise a reformer, and that he was enabled to direct its destinies for so many years.

MEMOIR.

MAJOR-GENERAL WILLIAM SPOTTISWOODE TREVOR, V.C.

THE death of William Spottiswoode Trevor on November 2nd recalls an historical period upon which the student does not care to linger.

Major-General Trevor, V.C., was the second son of Capt. R. S. Trevor, of the Bengal Cavalry, one of the party of three who were murdered with Macnaghten when he went out of cantonments at Kabul to conclude, as he thought, a treaty with the Afghan Chiefs.

William Trevor, a boy of ten, with Mrs. Trevor and his younger brother (now Sir Arthur), an infant in arms, were among the band who were detained in captivity by Akbar Khan for nine months in Afghanistan. The events of this captivity made a deep impression on Trevor and he carried through life the recollection of the scenes he had witnessed at that time.

He had been taught to read and write Hindustani and Persian and he used to relate how Akbar Khan endeavoured without success to avail himself of this knowledge to discover what was being talked about by the prisoners, and to induce him to translate letters received from India. A favourite amusement of Akbar's was to get up fights between Trevor and the Afghan boys, offering as prizes legs of mutton.

On their release from captivity by the avenging army, Mrs. Trevor and her two sons came to England and after a preliminary education at the Edinburgh Academy and elsewhere, William went to Addiscombe. Of this period of his career General Craster—who joined with him—writes :—

"W. Trevor did well at Addiscombe and in his third term was 1st in his term and became senior Corporal, but in his fourth term he was unwell during the final examinations and came out 3rd, Craster and Brownlow being 1st and 2nd. Owing to want of tact on the part of the authorities a spirit of great discontent sprang up during his last term, and Trevor's task as senior Corporal was made very difficult; but whatever the difficulties might be Trevor always, as he did throughout life, faced them bravely, and succeeded in overcoming them.

"On leaving Addiscombe Trevor joined the Royal Engineer Establishment at Chatham and during his stay there was employed on special duty under the Commissioners of the Great Exhibition of 1851. Arriving in India early in 1852—preparations were being made by Lord Dalhousie to send a man-of-war to Rangoon to demand reparation from the King of Burmah for his unjust treatment of our

merchantmen at Rangoon, and for the imprisonment of some of their officers. Consequently all the young Engineer officers who had arrived from England were detained in Calcutta in case their services should be required. Eventually an expedition sailed under General Godwin in March, 1852, to which Trevor and three other young officers of Engineers were attached. On arrival of the expedition at Rangoon—where it was joined by a strong force from Madras—an attempt was made to communicate with the Governor, but the steamer conveying the messenger, was fired on and on the following day the stockades on the river in front of Rangoon were bombarded by the men-of-war and destroyed—on the 12th April, 1852, the troops were landed to attack the large stockade thrown up round the Rangoon Pagodas. The attack was cleverly opposed by the Burmese troops who occupied the tree jungle and outlying forts in great numbers, bringing a heavy fire of guns and muskets to bear on the attacking party of the 51st K.O.L.I., supported by the Madras troops. The advance was checked with considerable loss of officers and men—Donaldson of the Engineers was mortally wounded, Trevor's arm was broken by a bullet and several officers of the 51st were disabled.

"As it was most important that this stockade, which commanded the line of advance, should be taken without delay—Major Fraser, Commanding the Sappers, directed the Engineer officers to advance with their ladder parties, and a party of volunteers from the Royal Irish, to take the stockade—Fraser leading the attacking party. An advance was made under heavy fire, ladders were raised and Trevor was the first man to mount a ladder; the pain of his broken arm however caused him to fall from the ladder and prevented him from entering the stockade. But others followed and the stockade was quickly taken and cleared.

"General Godwin, in his despatch of 22nd April, 1852, wrote:—'Major Fraser, Commanding Engineer, has been indefatigable in his own department and indeed everywhere. . . . He has requested me to bring to the notice of the Governor-General in Council the gallant conduct of 2nd Lieut. Trevor. . . .'

"Trevor was sent back to the field hospital, put on board the hospital ship and sent with the wounded to Moulmein where he remained until his wound—a fracture of both bones—was healed. In the autumn of 1852 he had sufficiently recovered to join the expedition under Sir J. Cheape to Donabew where a noted leader had taken up a strong position and had repulsed a strong party of sailors with the loss of two of the naval guns. The advance, from the river to Donabew, lay for several miles through thick tree jungle, the Burmese from the shelter of the trees bringing a heavy fire to bear on the advancing troops. Their main position was a strongly placed earthen parapet protected by a deep wet ditch; the only causeway across which was defended by the two captured naval guns. As the

storming parties advanced these guns were fired and swept away the head of the column; this occurred twice, when a third column was formed to which Ensign (now F.M. Lord) Wolseley and Trevor with other officers were attached. As they advanced the guns were again fired and Wolseley fell severely wounded. Taylor, a Madras officer, was also badly wounded. Trevor avoided the fire by advancing along the slope of the causeway and made good his way, through the parapet. Alone and concealed he watched the men who were again loading the guns and then shot them down with his revolver (being an expert shot). In this way he prevented the Burmese firing the guns again. The storming party was re-formed, and the place taken without further loss."

For his conduct on this occasion, when he was again wounded, Trevor received the thanks of the Government in a Notification dated 22nd April, 1853. On the conclusion of the war he was employed on the Pegu survey and later on the Bassein river with a view to making a sanatorium at the mouth of the river, which was to be called Dalhousie. The site however proved unsuitable and the project was abandoned. During these years his position was very insecure and one very serious attempt on his treasure was only averted by a timely and daring attack on a considerable body of marauders.

In October, 1857, Trevor was transferred to Bengal and sent to Darjeeling to construct barracks for the European soldiers on a site at Senchal which had been selected by Craster under the orders of Colonel R. Napier. Here he found the only opportunity of taking part in the operations connected with the mutiny, by accompanying the "Darjeeling Field Force," under Capt. The Hon. E. Curzon, H.M. 52nd, to intercept the mutineers of the 75th N.I. from Dacca who were endeavouring to join their comrades at Julpigoree, and with whom they had an engagement at Cherabunder on the Bhutan frontier. Following on the construction of the barracks at Senchal, he was employed on the construction of the Ganges and Darjeeling Road. This occupied him till April, 1861, when he was appointed Garrison Engineer at Fort William. About this time he undertook the design and laying out of the Eden Gardens in Calcutta by converting a tract of waste land on the bank of the Hooghly into an attractive pleasure resort. In this he seemed to have a natural bent and the work laid out with so much skill and taste was completed by his brother, S. T. Trevor, who succeeded him. In February, 1862, he officiated as Superintending Engineer of the Northern Circle and under his superintendence the "Ganges and Darjeeling Road" was completed to the foot of the mountains, and the mountain road in continuation to Darjeeling laid out, and partly executed. It was during these years that Trevor became critical of the manner in which accounts in the Public Works Department were being carried out. He formed the opinion that they were too harassing to

the Engineers, and did not sufficiently represent the progress of the work, and he endeavoured—not without resistance from those responsible for existing methods—to obtain adhesion to his views. In May, 1863, he was called upon to assume the office of Controller of accounts—a complete justification of the views he had advocated.

During this period, he assisted at a special inquiry in the Railway Department and also for a short time took charge of the Calcutta mint and in February, 1865, his services were placed at the disposal of the Military Department for service with the Bhutan Field Force, and here he found the opportunity for gaining the distinction most prized by soldiers. The attack on Dewan-Giri has been told in many ways, but without entering into such details as would require illustration with a plan, it will be sufficient to say that the position was a gorge defended by two blockhouses, one large and one small; a house called the "Guru Lamas" and a stone entrenchment in advance. General Tombs in his despatch of 7th April, 1865, after describing the preliminary steps and the expulsion of the enemy from the stone entrenchment, writes: "It was at this moment that I sounded the advance, covered by the fire of the rifles of the 55th in the stone entrenchment, and whom I had ordered to remain there for that purpose. . . ." The remainder of the story is succinctly told in the War Office Notification conferring the Victoria Cross:—

THE VICTORIA CROSS.

(From the *London Gazette* of last night).

WAR OFFICE, DEC. 31.

The Queen has been graciously pleased to signify her intention to confer the decoration of the Victoria Cross on the undermentioned officers, whose claims to the same have been submitted for her Majesty's approval, for their gallant conduct in Bhootan, as recorded against their names, viz.:—

Royal (late Bengal) Engineers.—Major William Spottiswoode Trevor and Lieutenant James Dundas—For their gallant conduct at the attack on the Block-house at Dewan-Giri, in Bhootan, on the 30th of April, 1865. Major-General Tombs, C.B. V.C., the officer in command at the time, reports that a party of the enemy, from 180 to 200 in number, had barricaded themselves in the Block-house in question, which they continued to defend after the rest of the position had been carried, and the main body was in retreat. The Block-house, which was loop-holed, was the key of the enemy's position. Seeing no officer of the storming party near him, and being anxious that the place should be taken immediately, as any protracted resistance might have caused the main body of the Bhooteas to rally, the British force having been fighting in a broiling sun on very steep and difficult ground for upwards of three hours, the general in command ordered these two officers to show the way into the Block-house. They had to climb up a wall which was 14 feet high, and then to enter a house, occupied by some 200 desperate men, head foremost

through an opening not more than two feet wide between the top of the wall and the roof of the Block-house. Major-General Tombs states that on speaking to the Sikh soldiers around him, and telling them in Hindoostani to swarm up the wall, none of them responded to the call, until these two officers had shown them the way, when they followed with the greatest alacrity. Both of them were wounded.

Trevor's own version was that at the critical moment when the storming party hesitated to attack, Tombs turned round to him and said "Will no officer give the men a lead?" Trevor said "I will, sir," and throwing away his scabbard he took his sword in his teeth and with Dundas proceeded to climb the stockade with a shower of stones falling on them and cutting them. On reaching the interior of the stockade, Trevor was badly wounded from below by a spear thrust before he had received assistance but here his revolver served him in good stead and he was able to counter any further attack with deadly effect until others coming in resistance ceased. Referring to Trevor in his despatch Tombs wrote: "Trevor is an officer not only of great talent but of rare coolness and courage."

In Vibart's *Addiscombe: Its Heroes and Men of Note* the following extract refers to this episode :—"How Trevor and Dundas escaped death was a marvel. Perhaps the restricted space at the point of entrance had something to do with their success; the defenders being unable to use their swords effectively; and getting jammed in their eagerness to close with them" (pp. 372, 5), and, it may be added, to the fact that the defenders on the gallery were only armed with a cutting sword.

Trevor was suffering from illness at the time of the attack and was afterwards sent back to Gowhatty for treatment, after which he took leave and on his return became Superintending Engineer at the Presidency. During his superintendence many important Public buildings were constructed. He again took leave in 1870 and during that time saw a good deal of the earlier phases of the Franco-German war of which he had many amusing stories to tell.

On his return to Calcutta he found that in consequence of settlement in the foundation of the new High Court some uneasiness was felt as to the construction of large buildings on the soil of the Delta of the Ganges, and he conducted experiments and made elaborate calculations to determine the pressure that could safely be applied to such foundations. In 1874 he was appointed special Chief Engineer for the Famine relief works north of the Ganges and received the thanks of Government for his services, in connection with those operations. After this he assumed for a time the duties of Inspector-General of Military Works; in January, 1875, he was transferred as Chief Engineer to Central India and in December of the same year was appointed Chief Engineer of British Burmah, a post he held till 1880. Here he was principally concerned with the organization of

the Department and the preparation of schemes for future work ; the defences of Rangoon and of the Railway from Prome to the frontier were also considered. Before leaving Burmah his services were required by the Government of India to assist in drawing up a scheme for the re-organization of the Engineer establishment for which he received the thanks of Government.

In February, 1882, Trevor was appointed Secretary to the Government of India in the P.W.D., a post that he held for five years retiring from the service in February, 1887, with the rank of Major-General. The duties of a Secretary to Government are of a confidential nature and necessarily excluded from notice in this memoir. His work during these years is contained in the records of the Government of India, with one interruption when in July, 1882, he was invited to make a professional inspection of the Corps of Sappers and Miners. His report, which was suitably acknowledged, was considered conclusive as to the satisfactory condition of the Corps. His early and lifelong friend General Craster who has so faithfully recounted Trevor's service in Burmah, while modestly concealing his own conspicuous share in that episode, writes: "He was a firm friend always ready to uphold the right, regardless of any consequence to himself with a clear brain which enabled him to see clearly to the bottom of a subject and to detect all fallacies that enveloped it."

General Brownlow another lifelong friend writes: "Morally and intellectually he was a grand man, upright, fearless, broad-minded and modest." Similar testimony could be gathered from without as well as within the Corps. No man had more or truer-hearted friends and it may be safely asserted that he never made an enemy.

After his retirement Trevor kept up his mathematical studies and devoted much time to solving the problem of the best form for a projectile. He had been an extensive reader, especially of history and science, and having a retentive memory and a faculty of digesting and analyzing what he had read his conversation on any subject was always interesting and instructive ; and his daily visits to his club were looked forward to by a large and now rapidly decreasing circle of friends, to whom he would at times, with characteristic humour and by way of illustration to the subject matter under discussion, recount some incident in his eventful life that would have lent interest to a biography ; but which are now unhappily lost.

It has been said in a recent notice (*Pioneer Mail*, November 15th) that "Had fortune allowed him to be with the Delhi or Lucknow forces during the Mutiny, he would, no doubt, have made his reputation as a soldier rapidly, having every qualification for eminence in the profession of arms—strong mental capacity, decision of character, a daring spirit and a robust frame ; but he was employed in Lower Bengal when the rebellion broke out and could not succeed in getting

to the front. His turn came in the Bhutan campaign where he led the assault on Dewan-Giri and should have been infallibly killed but escaped with a number of wounds and the Victoria Cross. In 1870 he saw a good deal of the earlier phases of the war from the German side. He had no introductions but managed to get to the front for a time by taking the place of a special correspondent who had been sent out knowing nothing of the business and was quite content that Colonel Trevor should see the fighting while he got the credit of the descriptions. . . . By those who knew him personally he will always be remembered as a man who might have been anything as a soldier if circumstances had been more generous to him in the way of opportunities." This is indeed true for he had all the instincts of a soldier, and—under an unassuming manner—rare courage and determination. He was a deadly shot with a revolver—to which on several occasions he owed his life—and an expert swordsman. More than once in his young days, it occurred that some one who fancied himself with either foil or sword learnt from Trevor the lesson he thought to teach. The Calcutta Tent Club knew him as a daring rider even among men of lighter weight and better mounted than himself. But his was a many-sided character and in more ways than one will William Trevor be remembered.

Those who served under him, and whom he inspired to a remarkable degree, with a feeling of affectionate loyalty, will recall his readiness to give advice or assistance to help anyone whose heart was in his work, and the chivalry of his nature in awarding praise that he might have appropriated to himself. Those associated with him later in public life in his own immediate profession will remember his unerring judgment; his determination to uphold the right fearless of any consequences to himself, and his desire to combine the lessons of experience with the deductions of scientific inquiry. Those in the wider circle of Administration will remember him as a man whose opinions were always worth having, and whose contributions on such different subjects as the re-organization of the Indian Army, the Public Works Department, the Currency, the defence of our frontier and the purchase of Guaranteed Railways by the State were always interesting and in some cases helped to shape the policy of the Government. To the friends of his later years the most pleasing reminiscences will perhaps be the extent of his knowledge, the charm of his conversation and the warmth of his friendships, and they will note, with a sense of personal injury that the Government he served so well, allowed him to go to his grave without any other decoration than that which he earned at the cost of a lifelong injury.

He married in 1858 the daughter of the Rev. H. Fisher, of the Indian Ecclesiastical Department, who died in 1863, and leaves one daughter married to Colonel Brackenbury, R.E. To her the memory of such a father will remain a priceless possession.

J. P. STEEL.

TRANSCRIPTS.

THE USE OF ENTRENCHMENTS AND FIELD FORTIFICATION IN THE ATTACK.

By MAJOR E. J. M. WOOD, 99TH DECCAN INFANTRY.

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ALTHOUGH there is abundant evidence from works still existent that entrenchments and field fortification were employed and their advantages thoroughly understood in the remote ages when primitive man fought with primitive weapons, it is equally evident that they were utilised solely in the defence, and their employment considered as incompatible with the freedom and activity required from the attacker.

Later on, when war had developed into a science, armies become more mobile, and weapons more accurate and long-ranging, it came to be recognised that field fortification, though a valuable and in fact indispensable adjunct to a successful defence, was nevertheless but a means to an end and that, in order that a complete success be obtained, the assumption of the offensive, at some period of the fight, on the part of the defender was essential. It was, however, a very long time before this fact was fully recognised, and defences long continued to be constructed in such a manner as to offer as great an obstacle to an advance by the defenders as to an assault by the attackers.

The advantages of the Offensive—Defensive once recognised, field fortification came to be relegated to its proper sphere, as an auxiliary only, and not the main desideratum to the successful defence of a position.

It is only in very recent times that it has begun to be recognised that field fortifications and entrenchments may likewise prove a most valuable auxiliary in the attack. The whole idea of field fortification, or what was an almost synonymous term—"field defences," seemed to negative any connection between them and the attack. Not that the value of what has been termed "aggressive fortification" has not been recognised on occasions, for it was employed as long ago as the American Civil War and the Russo-Turkish War of 1877; while in the Franco-German War, there were several instances of its use—notably at the Battle of Mars la Tour, where the Prussians in their attack, having gained possession of Vionville, promptly proceeded to entrench, and so strengthened their position in that village that, in spite of the desperate attempts of the French to retake it, it remained in their hands and formed a valuable *point d'appui*.

Thus here and there scattered examples may be found of the employment of field fortification by troops acting on the offensive, but it has been left to the South African and Russo-Japanese Wars to demonstrate that the spade is second only to the rifle in the winning of battles, and that on the modern battlefield it is almost of as great value in the attack as in the defence.

It would seem advisable before proceeding further to explain what is no doubt meant to be understood by the expression "in the attack" in the sentence which forms the subject of this essay. It has of course no reference to the deliberate attack on a fortress, or a position so strongly fortified that the attackers are compelled to sit down to a deliberate siege, as the Russians were eventually compelled to do before Plevna.

The necessity for entrenching and fortification in this kind of attack has always been recognised, and the approach, by means of trenches, redoubts and parallels, pushed gradually nearer until the time for the final assault, has been the normal procedure from the earliest times, but this species of entrenching hardly comes within what is usually known as field fortification. On the other hand, it is not restricted to the typical "attack," *i.e.*, an advance on a defined position by an attacker culminating in an assault and bayonet charge, for it may be held to include all those various tactical movements contemplated in attacking an enemy in position, which are referred to in section 110 of *Combined Training*, where the best type of an offensive battle is defined as "a methodical progression from point to point, resolving itself into a series of distinct engagements each raging round a different locality and each protracted over many hours." The expression too, no doubt, is meant to include offensive action on the part of the defenders, and all the "variations in a combat which resolve themselves into attack and defence."

With regard to the selection of the "recent wars" from which to seek for examples of the use of entrenchments and field fortification in the attack, it seems superfluous to look further than those already referred to, viz., the Boer and Russo-Japanese Wars. In both these campaigns rifle and cannon had reached practically to their present state of perfection as regards range, accuracy and rapidity of fires, the conditions as regards armament were therefore as nearly as possible the same as will obtain in the future, at any rate for some time.

The very extensive use of the spade by the Japanese with such good results to themselves furnishes an example such as could be obtained from no other campaign, while the many occasions during the Boer War on which we failed, owing to lack of experience to realise the value of entrenching in the attack may be held to furnish an equally valuable object-lesson.

It next remains to decide on the best method of deriving instruction from these wars as to the various uses to which, and the circumstances under which, entrenchments and field fortification may be usefully employed in the attack. It is considered that this could be best achieved by taking one by one, the different uses to which entrenching in the attack may be put, as gathered from a study of these campaigns, and illustrating each one by examples of occasions when they were actually

employed with advantage, or when they might and should with equal advantage have been so employed.

In describing the various methods of employment the principle has been followed of taking them in the order in which they would usually be adopted, from the initial stages of a battle up to the final assault. No doubt some of these uses, which have been classed separately, might come under one heading and, in some cases, they naturally merge one into the other, but for the sake of clearness and illustration it seems better to keep them thus separated. They are as follows:—

VARIOUS USES OF ENTRENCHMENTS IN THE ATTACK, WITH EXAMPLES.

The Construction of Entrenchments by an Attacking Force in Anticipation of an Advance to Attack, either to serve as a "Point d'Appui" or upon which to fall back in Case of a Reverse.

A good illustration of this is furnished by the Japanese preparations prior to the action at Yushiu-lin, fought on the 31st July, 1904. On the 19th July, the 12th Division of the 1st Japanese Army had defeated the Russians and driven them out of their position at Chao-tao. On the night of the 20th July General Inouye, under cover of his outposts, set to work to dig a line of entrenchments about 2,000 yards beyond the Chao-tao position, and about 3,000 yards from a position at Yushiu-lin beyond which the Russians had retired, but which from its nature was unsuitable for occupation by the Japanese.

These entrenchments were made right across the valley leading from Chao-tao to Yushiu-lin, and the General's intention in making them was doubtless—(*a*) to have a good *point d'appui* or starting point for an attack on the Yushiu-lin position, and (*b*) to have good cover to rally on in case such an attack should fail, there being no natural cover anywhere in the valley, as far back as Chao-tao, from guns on the Shisan Ridge (part of the Yushiu-lin position).

These entrenchments had small trenches in advance of them for double sentries at night; they thus in addition afforded good protection for the outpost line, and kept back the enemy's reconnoitring parties; the whole were concealed from the enemy by the kaoliang fields. The attack by the Japanese on the Russian position at Yushiu-lin did not take place until the 31st of July, so this preliminary entrenching was carried out over ten days before the actual attack.

The battle of the Sha-ho furnishes another example of this use of field fortification. The Japanese had become aware that the Russian forces in front of their right, viz., that portion held by the 1st Army, were being strongly reinforced, and Marshal Oyama, divining their intention to turn his right flank, had resolved to make a counter-move against the whole Russian front as the best means of defeating the scheme.

On the 24th September the 2nd Division of the 1st Army was advanced and ordered to entrench itself along a position north of the Yentai coal-mine, with its right in the valley of Daisan and its left near the village of Hakoreishi. The trenches were elaborately prepared with head cover

made by notches in the parapets, and traverses for protection from enfilade fire, while bombproof shelters constructed of logs roofed with sods were provided every few yards. In addition, positions were entrenched for the batteries, with bombproof shelters for the detachments. These elaborate entrenchments must have taken some days to make, and there can be no doubt, were constructed to form a starting point from which this Division should commence their forward movement, as well as to serve as a rallying point in the event of this forward movement being repulsed, or perhaps to enable the Division to hold its ground should the Russians attack before the Division was ready itself to advance.

On both these occasions the Japanese did not hesitate to expend a tremendous amount of trouble and labour on entrenchments which might possibly never be used, but their doing so is in keeping with their careful deliberate methods throughout the campaign. As a matter of fact the Russians did make an advance towards the position on the 10th October, about a fortnight after the entrenchments had been constructed, and shelled the Japanese batteries, which, however, were too well entrenched to suffer; the Russian infantry also made a show of advancing but never came within rifle range. On the night of the 10th October the 2nd Division emerged from their trenches and assumed the offensive.

An example of an occasion when field fortification, under similar conditions, might have been employed with advantage is furnished by the battle of Colenso in the Boer War. The attack on the Boer positions along the Tugela near Colenso had been contemplated by General Buller some time before it actually took place; the ground south of the river over which the troops were to advance to the attack was absolutely open for miles in front of the excellent cover afforded to the enemy by the kopjes and hills on the north bank. It would have been of enormous advantage to have had a line of entrenchments, with good cover for guns, constructed within about 3,000 yards of the river, under shelter of which the troops could have been concentrated at a comparatively short distance of their objective, and which, as the event showed, would have been the saving of the situation, in providing a rallying point behind which they could have retired when the unexpected strength of the Boer position was disclosed.

Here there could have been a reorganisation and re-forming of the troops, after which a renewed attack could easily have been made, aided immensely by complete information of the enemy's strength and dispositions. With such a position the recovery of the abandoned guns would have been a certainty. Nor should there have been any difficulty in executing such entrenchments, for had the Boers attempted actively to interfere with the work they would have had to assume the offensive and completely disclose their own dispositions, neither of which proceedings would have at all suited their plans, while the naval guns could easily have kept down any fire from the Boer long range guns, had the latter considered it worth while to shell the working parties. The work too could have been carried on entirely at night, if it had been found necessary or desirable

The advisability of some such preparation seems to have been impressed on General Buller by his subsequent operations against the Boers, for, prior to his final and successful advance to the relief of Ladysmith by means of an attack on the Boer positions south of the Tugela, he on the 14th February took up a position along the Hussar Hill heights with Lyttelton's Division on the right, Warren's on the left, and the mounted troops on both flanks, and entrenched. The actual advance from this position was not made until the 17th.

It is obvious that this use of field fortification would not be desirable on occasions where surprise forms the main consideration, but this does not detract from the advantages to be derived from its employment under suitable circumstances.

2. *The Construction of Cover for Artillery.*

The long range and marvellous accuracy of modern artillery makes it imperative that artificial cover be provided for guns in future in the attack as well as in the defence; there can be no more trotting or galloping into action and unlimbering under the enemy's fire; such action would mean annihilation before a shot was fired. The Japanese recognised this fact at once, and it was only on very rare occasions throughout the war that their guns opened fire without first providing shelter for the detachments; as a rule gunpits or epaulments were most carefully prepared before a shot was fired, and cover provided for everyone, officers included. This entrenching was carried out both prior to and during an attack.

(*a*). *Before an Attack.*—The Russo-Japanese War furnishes many examples of this. At the very first battle of the war the Japanese took the precaution to provide beforehand artificial cover for their artillery. On the night of the 29th April, 1904, positions for their howitzers, from which the Japanese hoped great things, were very carefully prepared and thoroughly entrenched on the island of Kin-tai-to in the River Yalu, and everything possible was done to conceal them. The fire from these howitzers on the Russian position at Chiu-lien-cheng was most telling, and no doubt it was largely due to it that the Japanese infantry were able to cross bare ground and ford a bad stream in the face of fire of infantry entrenched only 800 or 1,000 yards away, while so effectively were they concealed and protected that no Russian shells fell even in their vicinity; the gunners were thus able to maintain their fire undisturbed by the enemy's shells.

Again at the action at Yushiu-lin on the 31st July, 1904, the Japanese prepared positions for their artillery close to the entrenched position previously referred to, but, whereas the position had been prepared days beforehand, the cover for the guns was only constructed on the night immediately preceding the attack, in order that the Russians should have no idea of their whereabouts. Here again the cover was most carefully prepared with good rear and lateral communications. The result justified the precautions, for again the Russians were unable to locate the Japanese guns, which suffered very little in consequence.

It was not always possible for positions for the Japanese guns to be prepared with so much care; at the action of Chao-tao on the 19th April, 1904, they only took up the positions assigned to them just before daybreak, but all the same they hastily entrenched before opening fire.

The occasions during the war when cover for artillery was constructed beforehand by the Japanese were numerous, it was in fact their invariable custom whenever possible to select the positions for the guns by daylight and construct the epaulments, etc., after dark, the guns being placed in them before dawn.

This practice might have been followed with advantage more frequently than it was in the Boer War, though no doubt the knowledge of the numerical inferiority of the Boer artillery led to the neglect of such precautions. On one occasion at least, however, the results obtained by the placing of artillery in position beforehand were such as to thoroughly commend the practice. This occasion was Buller's attack on Botha's Pass on the 8th June. On June 6th the South African Light Horse seized Van Wyk's Hill, a prominent feature opposite the Pass, and after reinforcement by Coke's Brigade repulsed a bold attempt of the Boers to retake it. That night with great difficulty some heavy guns were brought up on to the hill whence they could command the Boer position on the summit of the Pass. During the 7th June more heavy guns were placed on advanced features more or less commanding the Boer positions. It was not until June 8th when a large number of these long range guns had been got into position and were ready to open fire that the attack on the Pass commenced.

As a result of the fire of these heavy guns the Boers were unable to occupy their trenches along the crest, and the infantry were thus able to advance up the steep slopes of the mountain practically unmolested, and when they had once reached the crest the Boers made but a short fight before retiring.

The capture of the Pass would have been a very different matter had not the artillery by its fire from these carefully selected and prepared positions driven the Boers away from the crest.

(*b*). *During an Attack.*—The great duration of many battles in the recent war, when for day after day the Japanese pushed their advance against the Russian positions, afforded many opportunities of constructing cover for artillery during the attack. In the majority of cases advantage was taken of the cover of darkness to prepare these positions, partly on account of the great difficulty of entrenching under fire, and partly that, under modern conditions, it is a highly risky proceeding to move guns from one position to another within range of the enemy's artillery, except of course the change under cover from one previously prepared position to another, and consequently the guns were not often moved in daylight.

At the battle of the Sha-ho the Japanese began their forward move on the 10th October; resistance was stubborn, the fight for the possession of each village held by the Russians constituting a separate struggle with attack and counter-attack.

During the 12th October the 6th Division, 2nd Japanese Army, had failed to make much progress and General Oku resolved to push on

under cover of night, and attack with that Division at dawn the villages of Erh-shih-chia-tsz and Hsiao-tung-tai; the 6th and 13th Regiments of Artillery were accordingly advanced after dark, took up entrenched positions whence they could effectively cover the infantry attack, and opened fire directly daylight dawned.

These guns were largely instrumental in bringing about the success of this attack.

Similarly in the case of the 3rd Division, 2nd Army. On the night of 11th October this Division was in occupation of the village of Hsiao-chien-kou, which they had captured after severe fighting just before sunset; preparations were at once made for the advance next day, and the artillery of the Division, together with some guns previously captured from the Russians, took up positions to cover the further advance.

These positions were as usual most carefully prepared with deep trenches for the detachments as well as pits for ammunition wagons and the guns moved into them before daylight.

The above are examples of cover for artillery constructed during the attack by night, but when compelled to advance their guns by daylight the Japanese invariably prepared cover for the detachments before opening fire.

At the battle of the Sha-ho on the 12th October the Russians were retiring at about 10.30 a.m. from the Shotatsuko valley; the Japanese artillery of the 2nd Division were too far off to do much damage so advanced; before firing a round, however, the gunners set to work to dig up cover. This caused some delay and the opportunity afforded to open fire on the excellent target offered by the retiring Russian infantry was to a certain extent wasted. Again on the same day about 4 p.m. three field batteries were moved up to a position close to the hill of Tera-yama, but did not open fire until they had spent half an hour in digging gun-pits. Directly they did open fire they were located by the Russian gunners who directed rafales at them; this fire had the Japanese batteries been unentrenched would speedily have silenced them.

At the battle of Mukden on the 2nd March the 5th Regiment of Mountain Artillery was detailed shortly after 1 p.m. to cover the attack by the 5th Japanese Division on the village of Chou-kuan-pu; it accordingly came up under cover of a village, and the gunners at once set to work making emplacements for their guns along the east side of this village. No guns were brought up until the emplacements were all completed, and fire was not opened until 2.45 p.m.

It may be maintained that this reluctance of the Japanese gunners to open fire without first entrenching was apt to lead to delay at important junctures and the loss of valuable opportunities; this was the case on the occasion above referred to; but having regard to the rapidity with which unprotected guns can be placed out of action by the fire of modern artillery, the circumstances would have to be very urgent and exceptional to justify guns disclosing their positions by opening fire before some cover had been prepared.

That the Japanese recognised that there were occasions on which cover for artillery could and should be dispensed with is shown by the fact that, after the pursuit of the Russians began on the 8th March after the battle

of Mukden, the Japanese batteries did without cover, everything being sacrificed to the necessity of causing as much damage to the retreating enemy as possible, while the risks involved were of course proportionately less.

In the South African War, as has been said, the numerical inferiority of the Boer artillery rendered the elaborate preparation of cover of less importance, and guns were frequently moved from one position to another in the daytime and within range of the enemy's guns without incurring serious risk, though this did not always hold good. Experience, however, showed that the value of good cover was by no means to be ignored. During the operations on the Tugela which led to the relief of Ladysmith, Lyttelton's Division was ordered to carry out an attack on the Boer position at Monte Cristo at dawn on the 18th February. In order to provide artillery support for this attack the guns of the 64th Battery were dragged up on to a knoll half way up the Cingolo Nek, and the gunners, aided by the Devons, spent the night in getting the guns into position and erecting emplacements for them.

The guns so placed were of the greatest value in covering the infantry attack on Monte Cristo Hill.

Reference has been made to the desirability of recognising that the preparation of cover for guns must be subordinated to the necessity of not losing an opportunity of opening fire on a target which is likely to repay the risk incurred. An example of this was afforded during these same operations on the Tugela. On the 18th February the Boers, on being driven from their position on the line Green Hill—Monte Cristo, began to retreat from their position on the left bank also. Two naval guns were brought up to the top of the Monte Cristo Hill about 3 p.m. on the 19th, whence some of the retreating Boer laagers offered an excellent target; they, however, waited to make epaulments before opening fire and the opportunity was thus lost.

3. *The Construction of Entrenchments after an Advance made under Cover of Darkness.*

This method of utilising field fortification will certainly be extensively employed in future wars. It seems to be universally recognised that, in order to get within such a distance of an enemy's position as will offer some reasonable probability of an attack on such position being successful, especially in the case of a frontal attack over exposed ground, there will have to be an advance under cover of darkness followed by a vigorous offensive at daylight.

The desirability of having some cover at the point thus reached as a protection from the fire, which the enemy is sure to concentrate on the attacking force immediately daylight makes him aware of his presence and enables him to aim with accuracy, is sufficiently obvious, while trenches so constructed will afford the attackers a definite line to hold on to, from which they can resist the enemy's attempt to drive them back by counter-attack, and behind which, if their assault be repulsed, they can rally for further efforts.

The examples of this use of field fortification were very numerous in the Russo-Japanese War. In the attack by the Russians on the Motien-ling Pass on the 17th July they entrenched themselves before dawn along the wooded ridge south of the old temple, which they had reached in their night advance.

The attack by the 45th Regiment of Japanese infantry on the village of Erh-shih-chia-tsz during the battle of the Sha-ho is another conspicuous example. This Regiment formed the left of the 6th Division, 2nd Army; the village of Yang-chia-wan, distant about one mile from the above village, had been captured from the Russians about 3 p.m. on the 11th October, but attempts to advance further were unsuccessful. General Oku accordingly decided to advance after dark; the objective of the 45th Regiment was the village of Erh-shih-chia-tsz which formed the right of the Russian position on the Shih-li-ho. The 1st Battalion of the Regiment was to work up the right bank of the Sha-ho, the other two battalions up the left bank, one battalion in the first line and one in the second.

The 2nd and 3rd Battalions moved out of Yang-chia-wan about 8 p.m., but had only gone about 600 yards when the leading battalion was fired on; it promptly halted and began to entrench; on the enemy's fire ceasing the advance was resumed, but this time the leading battalion had only advanced about another 200 yards before it was again hotly fired on, whereupon it halted and again entrenched and scouts were sent out.

The battalion managed to push on for another 150 yards, where it was within about 600 yards of the enemy's position; here a third line of trenches was dug and completed before dawn. By this means the battalion had by daylight established itself in a good entrenched position only 600 yards from their objective and with very little loss. The 1st Battalion similarly worked forward under cover of the river bed; on its reaching the stream which flows into the Sha-ho to the west of the village of Erh-shih-chia-tsz it was discovered by the enemy and fired on; it thereupon halted and dug entrenchments. On the fire slackening it again advanced in a more easterly direction for another 300 yards; here the firing line halted and set to work to dig and by daylight had completed their trenches. They were now in position on the flank of the Russians and within a comparatively short distance, and between 10 and 11 a.m. this battalion, with the other battalions of the regiment, carried the village by assault.

Had Colonel Carlton's men not been deprived of their entrenching tools by the stampeding of the mules on reaching Tohrengula Hill, or if they had had more practice in the construction of cover, the Nicholson Nek's disaster might have been avoided or minimised.

The battle of Colenso has been quoted as an instance when Method 1 of utilising field fortification in the attack might have been employed with advantage; an advance by night and the construction of entrenchments before dawn would have been of equal advantage, the advance being made from the entrenched position referred to in 1, or if this had not been prepared, from the camp.

The actual use made of this method of advance at Paardeburg is perhaps more instructive than the object lesson afforded by its omission at Colenso. The close approach to the Boer laager, which had offered so much difficulty and cost so many lives on the 18th February, was accomplished subsequently by the gradual pushing forward of entrenchments at night without loss of life. That this advance was so slow was due to the fact that it was understood that the Boers were trapped, that there was no hurry, and that casualties were not to be risked. The final advance by the Canadians affords an excellent example of this use of entrenching in the attack.

The six companies detailed for the enterprise were formed up in two lines, the first with fixed bayonets and the second carrying picks and shovels; they were accompanied by some engineers to help in the entrenching. At 2.15 a.m. on the 27th February the companies moved forward from the point, distant about 600 yards from the Boer trenches, to which the British entrenchments had already been made. For nearly 500 yards they advanced undetected, then a furious fire was opened on them, the front line threw themselves down and opened fire, while the second set to work to dig, and for two hours continued digging covered by the fire of the other line. When dawn broke the companies were in the entrenched position within ninety yards of the enemy, and enfilading the whole of his trenches parallel to the river. The Boer surrender immediately followed.

There is little doubt that had this bold action been imitated by all the enveloping troops at a much earlier date it would have met with success, though not perhaps without incurring some losses.

4. *The Construction of Cover for Troops covering the Attack.*

It is one of the recognised principles of an attack on a position that the advance of the firing line, or portions of it, should be covered by the fire of other portions of the force. In many cases it is possible to arrange beforehand for this covering fire by some of the attacking troops from a suitable position. It is obvious that if these troops can be protected by entrenchments from the enemy's long range or artillery fire, they will be able to shoot with far greater care and accuracy than if exposed to fire in the open. This entrenching should preferably be done under cover of darkness, but it may often have to be made hastily in the daytime and even under the enemy's fire. At the battle of Liao-yang the 18th Regiment of Japanese infantry, forming part of the 3rd Division, 2nd Army, was ordered to carry out an attack on the hill known as "Rocky Ridge" situated to the east of the Shou-shan-pu Hill; the assault was to take place at dawn on the 3rd August, and the Regiment marched out at 3 a.m.; the three battalions were disposed as follows:—

1st Battalion—To cover the attack from a ridge to the east of the hill which formed the object of the attack.

2nd Battalion—Firing line and supports.

3rd Battalion—Reserve.

The 1st Battalion sent two companies to a point on the ridge, from which they could bring a fire to bear on the enemy's position on Rocky Hill, where they entrenched. Although the attack on the hill failed these companies of this covering battalion, thus entrenched on the ridge, were able to greatly assist their comrades of the other battalions, both when making their desperate attack on the hill and later when they were checked and lying in the open behind such cover as they could scrape up.

During General Buller's operations for the relief of Ladysmith, in the attack on Monte Cristo by the 2nd Brigade on the 18th February, arrangements were made for covering the advance by long range rifle fire; for this purpose some companies of the Queen's and West Yorkshires and some Maxims were placed on the northern crest of Cingolo and on the slope of the Cingolo Nek. These troops took up their positions under cover of darkness, and were able to entrench themselves before opening fire at dawn. Their fire was most effective in keeping down that of the Boers from Monte Cristo during the crossing of the open Nek by the attacking companies.

5. *The Construction of Entrenchments under Shelter of which to form a Strong Firing Line, and from which to bring an Overwhelming Musketry Fire on the Enemy's Position prior to the Assault.*

The establishment of a strong firing line in good fire positions within decisive range is one of the principles laid down for the successful carrying out of an attack on an enemy in position. The building up of this firing line is a matter of great difficulty. The Japanese endeavoured to overcome this difficulty by digging trenches at night, and massing troops in them ready to bring an overwhelming fire to bear on the enemy's position at dawn. Examples of entrenchments made under similar conditions have been quoted in Method 3. Perhaps a clearer illustration of this particular use of field fortification is furnished by the desperate efforts of the Japanese to adopt the same tactics at the battle of Mukden, when the frozen state of the ground rendered any attempt at digging almost hopeless. The 8th Division, 2nd Army, on commencing its forward movement in conjunction with the other Japanese armies on March 1st, 1904, was ordered to attack the Russians in the village of Yueh-pu-tsz, this village formed a portion of the Russian defences which they had been holding since the battle of the Sha-ho. During the night, digging being impossible, the Japanese carried up and laid down within 800 yards of the village, rows of sandbags to form a low breastwork about two feet high. Before dawn the firing line took up a position lying down behind these parapets and remained there while the artillery shelled the village. This line was hardly near enough, and the Japanese were compelled to advance from it; this they did to within about 300 yards of the village where they endeavoured to establish another line by bringing up half-filled sandbags under fire, but the bags were heavy and the progress of the carriers necessarily slow, and here the casualties were heavy. Their persistent efforts were however successful, and the hot fire brought to bear on the village from the further position

forced the Russians to retire, and at 2 p.m. on the 11th March the Japanese occupied Yueh-pu-tsz.

The failure of the Japanese attacks during the battle of Mukden on the Russian positions in the villages of Yang-shih-tun, Kan-kuan-tun and Sha-to-tsz on the 6th March was largely due to their inability to build up a strong firing line within decisive range of the villages owing to the impossibility of making entrenchments in the frozen ground. The attempt to make up for the inability to entrench by laying down sandbags was not so successful on this occasion.

6. *The Construction of Entrenchments to enable Reinforcements to Advance.*

This method of employing entrenchments in the attack was made use of by the Japanese during the battle of the Sha-ho; though partaking more of the nature of entrenchments used for the deliberate attack of a fortress than hasty fortifications used in the field, it was nevertheless considered by the Japanese worth the time and trouble expended and is typical of their deliberate and painstaking methods.

The occasions on which field fortification will thus be used in the attack may possibly be rare, but the necessity or the desirability for its employment may arise, and it has therefore been referred to here and an example quoted.

At the battle of the Sha-ho the 2nd Japanese Army commenced its advance on the 10th October; the Russians in their front were occupying a position south of the Shih-li-ho from the villages of Erh-tai-tsz to Wu-li-tai-tsz. Just before sunset on the 11th the enemy was driven out of both these villages and retired on to the line of the Shih-li-ho, where he held a very strong position. At 10 p.m. on the 11th the 3rd Division, 2nd Army, set to work to entrench themselves 300 yards north of Hsiao-chien-kou, a village just north of Wu-li-tai-tsz, and in order to enable them to reinforce under fire the troops holding this line of entrenchments they connected it to the village by a zigzag approach. The enemy opened fire while this was going on, but in the dark most of his shells went overhead and the Japanese did not cease their work. In addition, in order to get reinforcements up from one village to another, short trenches with a frontage of about two yards were dug at every 25 paces.

These preparations no doubt largely contributed to the successful advance next day when the Russians were driven from their position on the Shih-li-ho.

7. *The Construction of Entrenchments on a Captured Position in order to hold it, to resist Counter-Attack, and to form a "Point d'Appui" for a Further Advance.*

This is the most usual and also the best known method of employing entrenchments in the attack, and has for a long time been recognised as a suitable opportunity for aggressive fortification. If any reference at all is made in the text-books to the use of entrenchments in the attack,

it relates as a rule solely to their utility as a means of securing ground already won. This applies to the text-books of foreign countries equally with our own.

There were naturally many examples of it during the Russo-Japanese War. At the action of Yushiu-lin on the 31st July the Japanese, after capturing the Makurayama heights by a surprise in the morning and hanging on all day under fire from the Russian batteries and infantry on the Shi-san ridge and heights in the neighbourhood spent the night in entrenching on the crest of Makurayama and constructing gunpits for their artillery, in readiness for all eventualities in the morning.

The position on the Makurayama Hill has been compared to that on Spion Kop.

At the battle of Liao-yang the 48th Regiment, forming part of the Japanese 6th Division, was told off on the 30th August to attack the village of Ku-chia-tzu, situated at the foot of the Shou-shan-pu Hill on the east side. Finding their progress checked by the fire from the village of Chiu-chia-pu-tzu on their left flank, the 1st Battalion was sent against this village and captured it at about 5 p.m. The village was at once put in a state of defence and, thanks to this precaution, a determined counter-attack by the Russians that night with the object of retaking the village, was repulsed.

At the battle of the Sha-ho the 6th Division, 2nd Japanese Army, was engaged on the 14th October in attacking the enemy in the vicinity of the Sha-ho-pu Railway station; the Russians were occupying the village of Ling-sheng-pu north of this place; at about 4 p.m. the Russians were driven out of Ling-sheng-pu after desperate fighting. At once the Japanese troops set to work to prepare the place for defence, a work which they carried out in spite of the concentrated fire of six Russian batteries. It was as well they did so, for at about 11 p.m. that night three battalions of Russian infantry made a vigorous counter-attack and nearly surrounded the village; as it was, however, they were driven back with heavy loss. At 6 a.m. next morning several Russian battalions again made a most desperate counter-attack against this village, getting quite close up under cover of a hamlet which lies adjacent to it, but were, however, again repulsed after a severe bayonet fight. A third counter-attack on the village was made about 1 p.m. but with no better success, the Russians losing heavily in all these attacks.

The Russians continued their counter-attacks on this devoted village again next day, the 16th October; no less than six times did they attempt that day to retake the village, the first being made at 6.30 a.m. and the last about 7.30 p.m., but all were repulsed. These desperate attempts to retake Ling-sheng-pu indicated the value the Russians put upon its possession.

To take another example from this battle. On the 11th October the 15th Brigade, 1st Japanese Army, was ordered to take the hill of Tera-yama, or Temple Hill as it has been called from the Chinese Temple on its summit. The attack began at 3.30 p.m.; the Russians had good cover and fought desperately. The temple itself was taken about 5.10 p.m., but it was much later before the Russians were all driven off

the hill; the Japanese at once set to work to dig and during the night made excellent trenches all round the temple buildings.

They were thus enabled to repulse three separate counter-attacks on the hill made by the Russians after dark; the large number of cartridge clips seen lying about next morning showed the severe nature of the fighting. The position so prepared served as a *point d'appui* for the further advance on the enemy's positions on the hills to the north.

In the Boer War the benefits to be derived from at once entrenching any position seized was frequently demonstrated, though the reluctance of the Boers to counter-attack did not emphasise this necessity to such an extent as would have been the case had our enemy been of a more enterprising nature.

In the operations on the Upper Tugela, as soon as the South African Light Horse had driven the Boers from Bastion Hill on January 20th they at once proceeded to entrench this important point on the flank of the Boer position. The possession of this hill enabled the hill to its right, known as Sugar Loaf Hill, also to be taken, and eventually the whole southern crest line in front of the Boer right. Here the troops entrenched and remained until their withdrawal after the failure of the Spion Kop enterprise. Had it been decided to press the attack on the right of the Boer line of entrenchments, these positions would have afforded a valuable *point d'appui* from which to advance.

Again after the capture of Vaal Krantz on the afternoon of the 5th February by the 4th Brigade steps were taken to prepare cover; had this very necessary precaution been neglected the troops would have suffered very heavily next day from the concentrated fire of the Boer guns. The Boer counter-attack on this hill on the afternoon of the 6th was beaten off.

The cover so prepared was so much improved on the evening of the 6th that the casualties from the Boer artillery fire next day were insignificant. That the possession of this important point was not eventually made use of for pushing the advance on Ladysmith in no way detracts from the value of the lesson as to the advantages of entrenching under such circumstances.

In the action of Houtnek on the 30th April to the 1st May, the troops, on getting possession of the first plateau of Toba Mountain, should have at once thrown up cover in order to maintain themselves on the position won; had they done so, the Boer counter-attack led by Colonel Maximoff, or more serious attacks had they been made, might have been beaten off more easily. The Boers still held the crest of Toba Mountain until midday on the 1st May, and had they been more enterprising would doubtless, during the night of the 30th April, have endeavoured to drive the British from the positions they had gained during the day.

At Colenso the Queen's would no doubt have been able to maintain themselves in that village by putting it in a state of defence had not the situation in other parts of the battlefield necessitated their withdrawal.

An example of the desirability of mounted troops being instructed in the necessity of making cover to enable them to hold on to positions they may have seized pending the arrival of the infantry was afforded during

French's great flank march on Kimberley. His sudden appearance at Ronddavel Drift over the Modder River on the afternoon of February 13th so surprised the small force of Boers there, that his cavalry were able to seize this drift and the line of kopjes beyond, covering both it and Klip Drift two miles upstream. The putting of these kopjes in a state of defence was of the greatest importance, for had the Boer force under Commandant Froneman, despatched by Cronje to attack the British force at the Drifts, carried out its orders and made a prompt attack that night, the outposts holding the kopjes would have had all they could do to hold their own and prevent the bivouacs being rushed and the drifts over the Modder lost. This outpost line was not taken over by the infantry until the morning of the 15th February.

Again on February 17th, when French by his forced march from Kimberley succeeded in heading off Cronje at Vendutie's Drift, his position was distinctly precarious and his object might not after all have been attained had not the cavalrymen been able to turn to full advantage the cover afforded by the kopjes they had seized, and so defeated the counter-attack of the Boers from the Kodoesrand with the object of recapturing Kameelfontein.

This was also forcibly demonstrated in a small way during the Zand River operations. On the 10th May a detachment from Porter's Cavalry Brigade pushed on and seized the Vredes Verdrag kopje, an important hill in rear of the Boers' right flank. Shortly afterwards a party of the Waterburg Commando crept up under cover of a donga and made a counter-attack on the kopje. The detachment was driven in confusion down the hill and lost fourteen killed, thirty-six wounded, and two officers and twenty-seven men taken prisoners.

In the operations round Johannesberg, 28th to 29th May, 1900, it fell to the mounted troops again to seize an important position, viz., the ridges east of the Klip Spruit, which were taken by Alderson's and Hutton's Mounted Infantry. This ridge was like a wedge driven into the middle of the Boer position and protected the bridge at Van Wyk's Rust. The troops hung on to this position in spite of being exposed to flanking fire from the Boer guns. Here is a case where entrenching by mounted troops was most essential.

These examples demonstrate in the most practical way the necessity of at once setting to work to entrench any position taken during the attack, also that to wait for nightfall on the plea that it is impossible to entrench under fire may very possibly lead to the loss of a position, won perhaps at the cost of many lives and heavy fighting. Had the Japanese waited till dark before entrenching and putting the village of Ling-sheng-pu in a state of defence on account of their being under the concentrated fire of several Russian batteries, they would not have been ready to repulse the counter-attack by the Russians late that evening.

8. *The Construction of Cover to enable Troops to cling to the Ground they have reached, but from which they are unable to Advance.*

This description of entrenching in the attack is to a certain extent included in the one just described, but, whereas that had reference to

some definite position either a village, height or line of entrenchments, this refers to points where attacking troops are checked before they reach the objective.

In many cases to retire from such a point would be disastrous, not only to particular troops concerned, but perhaps to other troops engaged in the enterprise in different parts of the battlefield. Troops so situated are particularly susceptible to counter-attack; of this the enemy will be well aware, and, unless some entrenching is done and cover provided to assist them in maintaining their ground, they are likely to be driven back with heavy loss.

At the battle of Teh-li-sz on the 15th June the 3rd Division, 2nd Japanese Army, was told off to attack the left and left centre of the Russian position, while the 5th Division and a portion of the 4th were to turn the Russian right. The right of the 3rd Division, from the nature of the ground, could not receive artillery support, and could not advance against the heavy fire from the Russian trenches; the troops of the Division however clung desperately to the ground they had reached, and drove back the frequent counter-attacks made by the Russians.

They hung on until the success of the 4th and 5th Divisions on the Russian right enabled them to again advance and occupy the position.

This Division's obstinate refusal to be driven from the point it had reached was of the utmost importance to the result of the battle, for it seems that it was the Russian General's intention to counter-attack by throwing his left against the Japanese right, and there can be little doubt that the failure of the Russians to drive back the Japanese in this part of the field, even though the latter were unable to advance, entirely upset the Russian plans.

At the battle of Mukden the general advance of the Japanese armies commenced on the 1st March, 1905. The Guards Division forming part of the 1st Japanese Army was pushed on the night of the 2nd March to attack the Russian positions at Tang-chia-tun, in order to assist the advance of the Yalu Army operating on the right of the 1st Army. The Russian position was, however, too formidable and too well defended to be taken by a frontal attack, and after suffering severely the Guards stopped the attack. They hung on however to the ground they had won, and, though they were unable to advance, they maintained their precarious position until the night of the 7th March when the Russians generally gave way, and the pursuit began. Throughout this period the position of the Guards Brigade was most critical, during the 4th March there was no communication between their front line, clinging to the foot of the Russian position, and the reserves on the south side of the valley. They occupied bits of dead ground among the low hills, throwing out firing lines sheltered behind low sandbag parapets.

So close were these to the Russian trenches that the men behind them could not move hand or foot during the daytime.

The situation was only slightly relieved on the 5th March by a distribution of the 12th Division. It was their skill in making cover, and making the best use of that already existing, backed by splendid courage, which enabled these troops, in spite of the dangers and difficulties described, to

hold their ground, and their stubborn maintenance of their position not only assisted the Yalu Army to advance but no doubt prevented the Russians from reinforcing their right, which was being threatened by the Japanese 3rd Army.

In the attack on the Boer laager at Paardeberg on the 18th February, 1900, the attacking troops, in spite of every effort, were checked in their attempts to reach the laager both on the east and west; in both cases the attack got to within about 500 or 600 yards of the Boer trenches, but, owing to the deadly fire, could not advance further in spite of the gallantry of the troops. Here was an opportunity for the employment of this method of entrenching. It was not long before dark that the last desperate attempts by the Mounted Infantry, Essex and Welsh Regiments on the east, and the Cornwalls on the west, were brought to a standstill. Directly darkness came on the troops might have at once entrenched themselves at the furthest points they had been able to reach. They would thus have been enabled to cling to the ground they had won, and have established themselves within a short distance ready for a fresh advance on the morrow. It is true that the troops had had a most exhausting day's fighting, following on even more exhausting marches without proper sleep or food, but it was the lack of training and ignorance as to the value of entrenching in such circumstances rather than lack of spirit that led to the omission of this necessary operation. It was doubtless Lord Kitchener's intention that the troops should entrench where they were, ready to renew the attack that night or early next morning, but his subordinate commanders, unused to the notion of at once making good with the spade the slightest advantage gained and knowing the exhaustion of their troops, with a few exceptions, ordered the withdrawal of their men after dark.

The action of the Gloucesters who had been ordered to drive the Boers under De Wet from the hill known as Kitchener's kopje showed an appreciation of the value of entrenching under such circumstances. They had been unable to advance beyond the foot of the hill by dusk, but promptly entrenched, and, though no fresh advance was made from this line of entrenchments that night, or till the afternoon of the next day, yet they were able by their rifle fire to keep down to a considerable extent the Boer fire from the hill during the day, and, when at last they were allowed to advance late in the afternoon, they quickly succeeded in establishing themselves on one end of the hill. Here they again promptly entrenched, and had they not, in consonance with other plans, been ordered to retire, they would no doubt have secured the hill, the possession of which was of considerable importance that night or early next morning.

Had the Gloucesters pressed on from their entrenched position on the night of the 18th, or early morning of the 19th, they would have surprised De Wet while making desperate efforts to drag a Krupp gun and a pom-pom on to the top of the kopje and prepare emplacements for them, and might possibly have succeeded in capturing the guns as well as the hill.

After the severe fighting which attended the taking of the crest of the line of kopjes known as the Wynne Hills on February 22nd during

Buller's advance on Ladysmith, the Boers, though driven from the crest, had only retired to their real line of defence further back on the hills. The British troops holding the crest could not advance and spent the night in making such cover as they could to enable them to cling to the edge of the hills: here they, their position thus strengthened, were enabled to hang on all next day (23rd) and were relieved by fresh troops that evening.

9. *The Construction of Slight Cover by the Firing Line while advancing to the Attack.*

Here again this use of entrenching may be considered as included to a certain extent in the above, but the method now described refers only to cover, made as a rule under fire, and while the firing line is temporarily checked, or halted pending the completion of movements by other troops working in conjunction with it. It is in this use of entrenching that the absolute necessity of the soldier, carrying an entrenching tool, and being thoroughly instructed in its use, is shown; the circumstances which necessitate this kind of cover preclude the possibility of tools being brought up either in carts or on pack animals, and the same applies to their being sent up by hand.

The necessity of the provision of some such tool will be referred to more fully below; in the meantime some examples of the many occasions during the South African and Russo-Japanese Wars when the use of this method of entrenching was found invaluable, or would undoubtedly have proved invaluable had it been employed, may be quoted.

At the battle of Liao-yang the attack by the 18th Regiment on the south-east extremity of "Rocky Hill" on the early morning of the 31st August has already been referred to; one battalion of the Regiment was detailed as a reserve, there was no cover for it, and when day broke the men were lying in the open; they however protected themselves by cover thrown up under the enemy's fire.

In the same battle in the attack by the 48th Regiment on the village of Ku-chia-tzu the advance of the 3rd Battalion, forming the firing line, was checked at about 3.30 p.m. when about 500 yards from the village on account of the heavy fire from the front and from the village of Chiu-chia-pu-tzu on the left flank. The firing line thereupon halted and threw up cover, while another battalion of the regiment advanced against and captured the village on the flank. This cover was improved when darkness fell, and the line thus reached was held until the early morning of the 1st September in spite of several counter-attacks by the Russians.

During the battle of the Sha-ho the Japanese 3rd Division was ordered to attack the Russian line along the Shih-li-ho, from the village of that name to that of Yin-te-niu-lu. The attack began in the early morning of the 11th October. A portion of the troops of the Division was detailed to take the village of Nan-kuan-tsz, a hamlet about 200 yards south of Yin-te-niu-lu. The Russian troops in this hamlet were however strongly reinforced and the Japanese advance was checked; the ground was perfectly open and exposed to artillery fire, but the Japanese managed to

throw up slight shelter at the point they had reached, and were thus able to drive back a determined counter-attack by the Russians made at 12.30 p.m., supported by the concentrated fire of their artillery. After the repulse of this counter-attack there was a lull, during which this slight cover was improved into trenches, and ammunition brought up for the next advance which took place shortly after and the hamlet was taken.

On the 11th October the 3rd Brigade, 2nd Division, Japanese Army, advanced to the attack of the Russian position on the San-joshi-san Hill. About 1.30 p.m. after a desperate encounter the Japanese occupied the low hills west of San-joshi-san, they could not push on to that position owing to the stubborn resistance offered by the Russians there, so they at once grubbed up shelter with their small entrenching tools and hung on to the ground they had won.

In the same battle on the 14th October the 6th Division, 2nd Japanese Army, was attacking the village of Lin-sheng-pu, the subsequent defence of which against the numerous counter-attacks by the Russians has been referred to above; at 12 noon on that date the troops of this Division reached about 600 yards from the village which was strongly held; here the Japanese advance was checked and cover made by them in the open under fire. A little later in the day assisted by an attack by a portion of the reserve on the Russian flank, the Japanese advance was resumed and the Russians driven out of the village at about 4 p.m.

During the battle of Mukden the frozen condition of the ground made the construction of this kind of cover almost impossible; the heavy entrenching tools of the engineering equipment were powerless to make any impression, and the light tool carried by the men was of course quite ineffective. In spite of this however the Japanese made every attempt to create cover of one sort or another, using various expedients.

The most common of these was sandbags which were distributed to the men, and, before the attack was launched, some earth was placed in them and they were carried forward so that a few inches of cover might be obtained. Sometimes earth was thus carried forward on pieces of *tente d'abri*. In other cases the men filled their haversacks with frozen lumps of earth and placed them in front of them where they lay, and again on other occasions their packs were taken off and used as cover and were found to be of great use as a protection against shrapnel.

In the attack by the 8th Division, 2nd Army, on the village Yueh-pu-tsz on the 1st March, a breastwork of sandbags had been constructed 800 yards from the village at night; in order to advance from this line it was necessary to make some attempt to make cover between it and the village. Partially filled sandbags were accordingly carried forward by short rushes up to a point 300 yards from the village, but even when only partly filled the bags were heavy, the rushes were consequently very slow and only for short distances of 20 or 30 yards at a time, and the casualties amongst the carriers were heavy. The forward move was however made about noon and the village itself taken about 2 p.m.

Again in the attack on the village of Sha-to-tsz by the 5th Division on the 8th March, the first line of the attacking troops reached a point some 400 yards from the Russian entrenchments. Here they remained and

endeavoured to make what cover they could by scraping up the ground and using the expedients referred to above. The fact that most of the killed in the attack were shot while lying down showed the value of even slight cover.

In the Boer War the actual use of entrenching of this description was rarely made, for one reason that the troops were not provided with an entrenching implement carried on the men and for another that they had not been trained in the making of cover under such circumstances. There were however many occasions when its employment would have been of the greatest value. In the action of Elandslaagte on the 4th October the Devons, after commencing their attack on the Boer position on the hill, had to remain lying down under fire waiting for the flank attack to develop, taking advantage of what cover the ant-heaps afforded; the ant-heaps were as it happened plentiful, and being 18 inches or more in height and hard as sun-baked bricks gave good cover to those who could get behind them; but the circumstances afforded an instance of an occasion where cover hastily made with an entrenching implement would have been invaluable.

Again at the Modder River on the 28th November, 1899, when the Guards and 9th Brigades were surprised by the fire suddenly opened upon them at 1,200 yards' range by the Boers concealed in the bed of the river, there was absolutely no cover. The men could do nothing but throw themselves down on their faces behind scattered ant-heaps or the low leafless scrub and attempt to reply to the fire proceeding from the dark belt of green marking the river bed. By making short rushes the 2nd Coldstreams and the Grenadiers managed to advance to within about 1,100 yards of the Boer trenches, but they could advance no further.

They held on to their ground, but in the absence of any vestige of cover they could not open fire with effect, and remained prostrate on their faces in the burning sun. Had the men been able to employ themselves in making cover the advantage would have been twofold—in the first place they would have been able after a slight delay to open fire with some confidence, and, secondly, the moral strain involved by being obliged to lie thus idle and motionless would have been eased by the effort to make cover without attracting the keen-eyed enemy's unpleasant attentions.

The situation of the Highland Brigade, after the failure of the night attack on the Magersfontein trenches, was similar but worse, for the shattered remnants of the Brigade lay all along the front of the Boer trenches, in many cases at point blank range; it cannot be denied that to have made cover at such close proximity to the enemy's rifles was well nigh impossible, but men trained to use a suitable implement in the prone position might have managed it, and the effort would, as in the previous case, have served to relieve the strain on the mind.

They were not all at such close range and those who might have been able to protect themselves would have been in a better position to help their comrades by keeping up an accurate fire on the Boer trenches. The Seaforths on the right would also have had a better chance of maintaining their position had they been able to improve the slight natural

cover afforded by the ridge which they had reached immediately after the disaster to the Brigade at dawn.

One more example. On the afternoon of the 21st February, 1900, the troops advancing to the relief of Ladysmith began crossing the Tugela by the pontoon bridge west of Hlangwane; the 10th Brigade crossed first and occupied the kopjes covering the bridge without much opposition, but when the leading battalion advanced on to the plain beyond they came under a very heavy rifle fire from the Boers in the bed of the Onderbroek Spruit. The advance was eventually brought to a standstill, and the men had to remain lying in the open for the rest of the afternoon, exposed to heavy rifle fire at a comparatively short range. This was a situation when ordinary entrenching tools could not possibly have been pushed forward and probably could not have been used if they had, but with an entrenching tool each man could have made cover for himself where he lay, and the firing line could thus have gradually dug itself in: the cover so made could have been improved during the night, and the Boers in the Spruit would have possibly retired next morning, or in any case their fire which proved so galling to the troops engaged in seizing and holding the Wynne Hills on the 22nd would have been largely neutralised.

10. *The Construction of Entrenchments by Troops whose Assault has been repulsed, from whence to make a Fresh Effort or resist a Counter-Attack.*

Troops unless well disciplined and well led are particularly liable under these circumstances to become demoralised, and, if they be allowed to retire unchecked too far, the retirement is only too apt to degenerate in a rout, more particularly should the enemy seize the opportunity to make a counter-attack. The desirability of halting as soon as the troops have withdrawn out of close range and hastily throwing up cover behind which the men can rally is obvious. The cover thus improvised will provide a point to limit the retirement, will assist the troops to recover their morale, and enable them to resist the almost inevitable counter-attack. The cover can be gradually improved and will prove valuable as a *point d'appui* from which a fresh effort, probably after reinforcements have been pushed up, can be made to assault the enemy's position.

At the battle of the Sha-ho use of this method of entrenching was made by the Russians. On the 11th October they began their advance to turn the Japanese right, and attacked the Umezawa Brigade in an advanced position north of the Tsu-men-tzu Ling Pass. The Russians were unable to reach their objective that day, but on the early morning of the 12th renewed the attack and assaulted the position with the bayonet. The assault was repulsed after desperate fighting, and about 2 p.m. the Russians gradually, a few at a time, began to retire, taking advantage of whatever cover there was. At about 800 yards from the position they rallied and threw up shelter trenches where they stayed. At 2 a.m. on the 13th they again made an attack which was also repulsed; they maintained their entrenched position throughout the 13th, but retired together with other portions of the Russian forces on the night of the 13th.

At the battle of the Sha-ho the troops of the Japanese 5th Division on

the morning of the 5th March attacked the Russians holding the railway embankment in front of the villages of Sha-to-tsz and Mi-chia-pu; after severe hand-to-hand fighting the Japanese got possession of the embankment, the Russians retiring into Mi-chia-pu and Sha-to-tsz. The Japanese hung on to the embankment until midnight on the 7th March when the large reinforcements received by the Russians in the villages indicated the probability of a vigorous counter-attack. The Japanese in their present position were not well situated to meet this, so retired to a position on some sandhills further west, where they made entrenchments. The threatened counter-attack did not come off and the Japanese again advanced on the evening of the 8th.

At Colenso it would seem that this use of entrenchments might have been made with the best results. After the general failure, owing to various causes, of the attack of the Brigades on the Boer position, it would have been quite possible, instead of retiring the troops altogether to the camp at Frere, to have withdrawn them out of rifle range and there constructed a line of entrenchments. Behind these the troops, who were in no way demoralised by their ill success, could have been re-formed, their fire would have protected the deserted guns of Colonel Long's batteries, and enabled them to have been brought in after dark, while, had it been considered desirable to renew the attack with the knowledge now acquired of the Boer position, the troops would have been much better situated for carrying it into execution. The spirit of the troops themselves and the reluctance of the Boers to leave their positions would have made the task of making such a line of entrenchments an easy one.

11. *The Construction of Entrenchments in the Local Counter-Attack.*

The main counter-attack by an army, holding a defensive position, assuming the offensive does not differ materially from the attack, and the various methods of entrenching, above described, apply equally to it. Even in local counter-attacks, however, occasions may occur when it may be advisable to entrench. At the battle of the Sha-ho the Japanese 4th Division was attacking the village of Ling-sheng-pu on the 14th October, the left wing of the Division being thrown back. At 11 a.m. and again at 3 p.m. about four Russian battalions supported by artillery made a counter-attack on the Japanese left wing. Being checked in their advance at about 600 yards from the Japanese, they set to work to entrench; as, however, this work was attempted not in the prone position, the target offered to the Japanese riflemen was a good one, and the Russians in consequence suffered so severely that they broke and fled. Had they been able to maintain the position gained the taking of the important post of Ling-sheng-pu by the Japanese would have been greatly delayed.

THE JAPANESE ENTRENCHING TOOL AND HOW CARRIED.

Admitting the fact of the successful employment by the Japanese of entrenching in the attack under the various circumstances cited above, for it is undeniable that it is to them we must look for the most useful and

valuable lessons, it at once becomes of interest to know with what kind of entrenching tools they were provided, tools put to such good use throughout the campaign. Each Japanese company (roughly 200 men) was provided with 67 light spades, 17 light picks, 5 hand axes and 5 folding saws; these tools were carried by the men themselves (the N.C.O.'s carrying the saws). The front and rear ranks carried the tools on alternate days. In this way wherever the company might go and under whatever circumstances it might find itself, there were sure to be a certain number of entrenching tools on the spot. The spades were carried vertically, handles downwards, on the left side of the valise, the picks and axes were carried horizontally across the top of the great coat; they were fastened by string, etc., to the blue holdall when the valise was discarded. In addition to these tools each battalion (4 companies) was followed by two ponies carrying tools in light kajawahs, twenty shovels and eight picks on each pony, or forty shovels and sixteen picks per battalion. These latter were no doubt very useful for night work, but circumstances must very often occur when to bring up tools on ponies, or even by hand, to the neighbourhood of troops engaged in the attack is absolutely impossible.

THE USE BY THE JAPANESE OF ENTRENCHING TOOLS.

The Japanese infantry soldier was taught to look on his entrenching tools as second only in importance to his rifle; whenever he halted in the attack he endeavoured, so to speak, to go to earth and traces of their spade work could be seen whenever infantry halted in an attack. They won their way forward with their rifles, but got their grip of what they had won by means of the spade. There was no attempt to make the necessity for entrenching an excuse for not pressing on to the attack, each bit of cover thrown up, each trench made, was regarded only as a stepping stone, a footing from which to make another stride in the advance on the enemy's position. Packs were often discarded in the attack, entrenching tools never.

As to the type of work usually made that depended entirely on circumstances; when time and opportunity offered trenches of strong profile were made, usually 4 feet deep and 3 feet wide, with about 1 foot cover in front; a trench of this section was made by the Japanese infantry in three-quarters of an hour working in three reliefs, but often the only shelter was that which could be scraped up by men lying on the ground, while, as has been related, when the frozen ground forbade digging, haversacks and valises were made use of.

THE ENTRENCHING TOOLS OF THE JAPANESE ARTILLERY.

The Japanese batteries carried 6 spades, 3 picks, 2 axes (1 large and 1 small), 1 saw, and 1 billhook per sub-division, strapped underneath and to the sides of limbers and wagons and inside the store wagon. The good use made of these tools is evident from the examples already quoted.

The Japanese engineers were frequently employed in assisting the gunners in preparing cover for the guns, approaches, etc., but the gunners were independent of the engineers, and many were the occasions when they had to rely entirely on themselves for the making of the necessary cover. The type of cover for the detachments usually consisted of pits 4 feet to 5 feet long, 3 feet wide and from 2 to 5 feet deep, a similar pit being usually made beside the ammunition wagons. As has been pointed out above the Japanese almost invariably threw up artificial cover for their artillery before coming into action; even though such cover had to be made during a fight and in daylight, the results were well worth the trouble expended.

The Japanese themselves, as a result of their experience gained in the war, came to the conclusion that it was necessary to provide still further facilities for entrenching, and accordingly in future every Japanese soldier is to be provided, when mobilised, with an entrenching tool. The number of entrenching tools per battalion carried by the pack ponies is to be increased while an attempt is to be made to render the light entrenching spade carried by the men more efficient.

THE RUSSIAN ENTRENCHING TOOLS AND HOW CARRIED.

The Russians have long been noted for their extensive use of entrenchments, but these have usually been employed in the defence. It has been alleged against them that in their case the rifle has been subordinated to the spade, and that they are wont to commit the error of making their tactical plans subservient to their defensive preparations. During the campaign the Russian soldier carried the Linneman entrenching tool, which is very similar to the light spade carried by the Japanese, it was worn on the right side in a case handle downwards. The proportion of tools carried was 80 Linneman spades and 20 light axes per company. The artillery was likewise provided with entrenching tools, the number of which, owing to the experience gained, was increased during the course of the war.

THE BRITISH ENTRENCHING TOOLS AND HOW CARRIED.

There is no need to describe here in detail our own system of carrying entrenching tools in the field, but, as regards India, it might be noted that hitherto the tools of a battalion of infantry, which consisted of 8 felling axes, 40 pickaxes, 40 shovels, 40 billhooks, 2 crowbars and 2 spokeshaves have been carried on six obligatory mules, which immediately followed the battalion. By a recent Indian Army Order the proportion of pickaxes and shovels have been increased to 48 and 160 respectively, while the number of mules has been increased to eight. This is distinctly a move in the right direction as each company thus will have its own mule carrying 6 picks and 20 shovels, and will, to that extent, be independent and self-contained.

THE NECESSITY OF AN ENTRENCHING IMPLEMENT CARRIED ON THE SOLDIER.

But though a step in the right direction, this cannot be considered, judging from the lessons of these recent wars, as providing an adequate supply of tools, or a satisfactory solution of the question of their availability at all times and under all conditions. In accordance with the principle hitherto followed in the British service of making the soldier carry on his person as little as possible, a principle partly due no doubt to the fact that he has often to fight in tropical climates where to carry a heavy kit is too exhausting, and partly to the necessity of not imposing too heavy a burden on the men of a voluntary army, the carrying of an entrenching tool by the soldier himself has not been insisted on. It is possible too that until recently the necessity of his doing so was not sufficiently clearly proved. But whatever sound reasons there may be for carrying as much of the British soldier's kit for him as possible, recent wars have indubitably proved the necessity of his carrying an entrenching tool. What would have happened to the Japanese soldier time and again had his ability to make cover depended on the possibility of pack animals being pushed up into the firing line or even to the supports, the occasions were rare indeed, except at night, when this would have been possible, while even at night entrenching had often to be done under a hot fire which would have made very precarious a supply of tools which depended on the ability to bring up pack animals. No better example of the danger of the infantry soldier being so dependent could be found than that furnished by the plight of the troops forming Colonel Carleton's column on reaching the Tchrengula Hill on its way to Nicholson's Nek for the stampede of the mules left them without the means of making any cover other than that obtainable from sangars of piled-up stones; these offered ideal targets to the Boer riflemen while affording only insufficient protection to their occupants.

Foreign countries have for some time recognised the necessity of the infantry soldier carrying an entrenching tool; as has been said, both the Russian and Japanese infantry were provided with them before the war. Such tools are now carried by the French and German infantry, while only recently experiments have been carried out in the United States Army with a new pack for the infantry soldier, with which is worn, attached to the belt, a short pickaxe, a small broad axe and a shovel for entrenching.

That well-known authority, General de Négrier, has said*:—"In attack the entrenching implement has become a necessity to every infantry soldier. He should be practised in making entrenchments when lying down, gaining cover gradually in this way until he is completely hidden." While His Excellency the Commander-in-Chief in India, in his speech at the conclusion of the recent Meerut Rifle Meeting, said "The late Japanese War has shown us how impossible it is for troops to advance over exposed ground, within range of the enemy's guns and

* "Some Lessons from the Russo-Japanese War." *Revue des Deux Mondes*—January, 1906.

rifles, without the cover of darkness or hasty entrenchments.' Hence night operations to gain advanced positions and light entrenchments thrown up thereon to enable them to be held in daylight, should form an important part of our training. Every man will, I hope, soon be supplied with a handy entrenching tool, and his life may often depend on the proficiency with which he handles it."

Backed by such weighty opinion the necessity for the provision of an entrenching tool to be carried on the infantry soldier may be considered as proved. It then only remains to decide—(*a*) On the best kind of tool, (*b*) The method of carrying it, and (*c*) The number to be allowed per company.

THE REQUIREMENTS OF AN ENTRENCHING IMPLEMENT.

As regards (*a*)—The requirements of such a tool seem to be as follows:—

(i.) Portability.
(ii.) Strength combined with lightness.
(iii.) Suitability for the particular work required of it
(iv.) Accessibility.

To fulfil the *first* requirement the tool must not be unwieldy in length or breadth; it must in no way interfere with the soldier's movements either when marching or doubling, or with various positions adopted when firing.

To ensure the *second* it must be made of the best hardened steel, and weigh not over 3 lbs.

For the *third* it must be capable of being readily used by a man lying down, and must be such as to produce the best results in different kinds of soil.

As to the *fourth*, since the tool will often have to be used while the soldier is lying down exposed to fire, it must be within easy reach and capable of being detached and replaced with one hand while in the lying position.

The entrenching tool carried by the Japanese troops in the late war was in the form of a light shovel with light pickaxes in the proportion of about one pick to four shovels.

Although the Japanese achieved such good results with these tools they were not altogether satisfied with them, and are experimenting with a view to improve the shovel. The Russian soldiers were provided with a very similar tool, shovels and pickaxes in the same proportion. The proportion of tools to men in the former army was about two to three, and in the latter one to four.

In the German Army 400 small shovels and 40 small picks are carried by the men of an infantry battalion, which works out to about a proportion of three tools to four men.

The drawback to the above distribution of tools is that, though the shovel is undoubtedly the most useful all-round tool for digging, there are many occasions when a man requires a pick, *e.g.*, to tackle a particularly hard bit of ground, to remove the earth round, or lever up a

stone, etc. Now the circumstances under which these tools are utilised are often such as to preclude an interchange of tools between the men, consequently the man with a shovel must make shift to get on with his shovel, and the same the man with a pick. The intention nowadays in selecting a soldier's kit is to make him independent and, so to speak, self-contained; it is therefore obvious that, for such an important item as the entrenching tool is likely to prove in future, he should be independent of his fellows. The ordinary shovel too is from its nature not well adapted for use while lying down.

Long experience has proved that the pickaxe and shovel are the two most useful implements for digging, and having regard to the above remarks, it is obvious that it is a combination of these two in one useful tool that is required.

This desideratum has been recognised before and was endeavoured to be met by the introduction of the Wallace patent entrenching tool; the drawback to this implement was that, when using the pick or grubber, the blade of the shovel was apt to cut the arm, and it was also not wholly suitable for use by men lying down.

DESCRIPTION OF AN IMPLEMENT SUGGESTED.

The tool described below would, it is believed, fulfil all the above requirements, it being borne in mind that the intention is that such a tool is not intended to do away with the necessity for the ordinary entrenching tools accompanying troops, but for use under circumstances when these latter are not available, and could not be used if they were.

The accompanying rough sketch (not reproduced.—ED., *R.E.J.*) will explain the nature of the implement, and gives its dimensions (Shovel, length, 7″; width, 6″. Pick, length, 7″. Handle, length, 9″; width, 2″ at bulge.—ED., *R.E.J.*). The particular points in its favour are :—

(i.) It combines the two descriptions of tool essential for entrenching.

(ii.) It is particularly adapted for use by men lying down, and can, if necessary, be worked with one hand.

(iii.) It can be worn attached to the belt without in any way interfering with the wearer's movements.

(iv.) It can easily be detached for use by the wearer when lying down and equally easily refastened.

The swelling of the handle midway between the two ends should afford an easy grip and reduce the liability to blister and cramp; the length of this portion is such as to admit of its being grasped with two hands, one above the other, whichever end of implement is being used. What usually forms the "treads" of the spade, not being required in an implement of this sort, are slightly sloped so as to obviate the possibility of the user's hands being cut or bruised by the edges when using the spade portion. For comfort in use the handle is covered with leather.

MANNER OF CARRYING THE IMPLEMENT.

As regards (*b*)—The intention is that the tool should be carried suspended from the waist belt, on the opposite side to the bayonet, in the manner here described:—The point of the pick fits into a pocket of stout sole leather, connected with a leather loop, to slip on the belt, by a stout leather strap about an inch and a-half wide lying along the back of the handle of the implement, the weight of the implement being thus borne by the loop.

To the loop is also sewn a leather flap of such a size that, when folded over, it will form a cover, for the spade portion of the implement. A small strap is sewn through the lower part of the flap to the loop; this strap is passed round the handle of the implement and fastened to a stud sewn on to the folded-over portion of the flap, and in this way secures both the flap and implement. Thus by one movement the flap can be opened and the retaining strap released.

The hollow of the shovel and the curve of the pick are made to face in opposite directions, in order that the former may sit more comfortably under the wearer's arm and the latter turn outwards from his leg.

DISTRIBUTION.

Now with regard to (*c*)—There should be no doubt whatever as to the necessity of every infantryman carrying a tool. There were many occasions during the Russo-Japanese and Boer Wars when the situation was such that, unless a man was himself carrying a tool, he must and did go without; such occasions are instanced in Nos. 8 and 9 of the various uses of entrenchments in the attack quoted above. This fact has been recognised by the Japanese authorities and arrangements are being made accordingly. It should, however, be clearly understood that the arrangements for carrying tools, as recently laid down, should not be interfered with in consequence or the number of tools per battalion decreased.

THE IMPLEMENT NOT MEANT TO SUPERSEDE THE ORDINARY TOOL.

The soldier should be thoroughly practised in the use of his entrenching implement under the various circumstances in which it would be utilised on service; he should be taught to regard it as second only to his rifle in importance, and that as Lord Kitchener said, "his life may often depend on the proficiency with which he handles it." At the same time it should be impressed upon him that, to quote Lord Kitchener again, "such artificial cover (as is intended to be made with the implement) should be entirely distinct from entrenchments made to defend a position when time is available and more efficient tools can be used," and that the implement should be reserved for such.

THE ISSUE OF SANDBAGS FOR USE WHEN THE GROUND IS ROCKY OR FROZEN.

One more point seems to require notice and that is the great difficulty experienced during the battle of Mukden by the Japanese in making use

of entrenchments during the attack, owing to the frozen state of the ground. Allusion has already been made to the various expedients resorted to by them to overcome this serious difficulty, the most important and successful of which was the issue to the infantry and artillery of sandbags. The use of sandbags, however, will not be limited to occasions when the frozen condition of the ground prohibits the digging of entrenchments; many will be the occasions when the rocky nature of the soil will be as prohibitive of entrenching as though it were frozen, in any case as far as deep entrenching is concerned. Here the sandbag will prove equally indispensable.

The troops sent up to occupy Spion Kop were plentifully supplied with entrenching tools, and engineers to guide and assist, but on the mountain top the solid rock was covered by but a shallow layer of earth, and the trenches could not be deepened. Here sandbags would have been invaluable for there was ample earth on the surface to fill them, and they would have provided the necessary depth of cover, which could not be obtained by digging down; they would also have been most useful for improving the natural cover provided by the rocks. Sandbags, however, formed no portion of the entrenching equipment of regiments, and, though it is said they were to have been issued, the fact remains that they were not. Under General Warren's orders several thousand sandbags were sent to be distributed among the troops that were being sent up to reinforce those on the summit, but the circumstances, viz., broad daylight and a withering fire concentrated on the hill were such as to prevent effective use being made of them. The nature of the country in which our forces in India may have one day to operate is likely to provide both frozen and rocky soils, it seems therefore a reasonable suggestion that when circumstances are likely to necessitate their use, sandbags should be issued to infantry and artillery, every man of the former being supplied with one, if not two; these could easily be carried rolled up, while a certain number should always form part of the equipment of the pack mules carrying the entrenching tools.

There are not wanting those who maintain that digging is now being rather overdone, that the main object of the attacker, viz., to drive the enemy from his position with as much loss to him as possible is apt to be lost sight of, and that it will be difficult to get troops to advance once they have got under good cover. Such arguments show either that the proper use of entrenchments in the attack has not been thoroughly understood, or that the training or *morale* of the troops is deficient. It must always be remembered that in the attack, equally as in the defence, entrenchments and field fortification must be regarded as but the means to an end.

As the Alpine climber, when cutting footholds in the ice with his axe, or supporting himself with his alpenstock, is bent only on reaching the summit of the mountain, using such aids merely to enable him to cling to the height he has reached and to provide a footing from which to climb higher, so must the use of entrenching be regarded by the attacker, *i.e.*, solely as a means of enabling him to reach his goal—the enemy's position.

EXPLOSION OF GELIGNITE IN PEMBROKESHIRE.

The following extracts, from a Report by H.M. Inspector of Explosives, on the circumstances attending an explosion which occurred during the operation of thawing gelignite in connection with G.W.R. extension in Pembrokeshire, 26th February, 1906, will be read with interest:—

Circumstances of the Accident.—The construction of the line was being carried out by Messrs. J. I. Firbank, Ltd., and the explosion severely injured one man, and slightly injured two. The severely injured man, George, was the chargeman, and it was his duty to prepare the charges and fire shots in the holes which had been drilled in the cutting on the previous day. The cartridges used were of unusual size, being 2 in. in diameter, and weighing $1\frac{1}{4}$ lbs. each. At the season at which the accident occurred these cartridges were congealed, and it was therefore necessary that they should be rendered plastic before use. A fatal accident, which had occurred before on the same works, had been attributed to the use of a partially softened cartridge, and had probably awakened all to a lively sense of this necessity.

George therefore had risen very early on 26th February, and at 2.30 a.m. had got out the gelignite which he wanted, amounting to 30 cartridges, or about $37\frac{1}{2}$ lbs. He had only two warming pans, and into each of these he placed six cartridges; the remaining 18 he placed in a bucket which he stood in another bucket containing hot water, and covered up. This procedure which was irregular, had no bearing on the subsequent explosion, as the cartridges in the bucket were not involved. At 4.45 a.m. he found that some of the cartridges were sufficiently soft. He therefore took 3 of them out—these also were not involved.

He now took 2 of the cartridges from the second warming pan and placed them in the first, to take the place of those which he had removed. He then went to the fire, and fetched a can of water which was heating there; this water he states was not so hot but that he could bear his hand in it. He returned to the warming pan containing the 5 cartridges, and set the can containing the hot water on the ground, while he emptied out the cooled water from the jacket of the warming pan. It should be noted that the ground in the cutting was very wet. He then proceeded to pour the hot water into the outer part of the warming pan, when he heard a slight hissing noise, and immediately afterwards the explosion occurred.

Effect of the Explosion.—George was knocked down, but was not rendered unconscious. He sustained a large number of punctured wounds, from which pieces of the warming pan were subsequently extracted.

The effect on the warming pan itself was most remarkable. Of the lid no traces were found except the small pieces taken out of the wounds; the body of the pan on the other hand showed no signs of an explosion. The internal dimensions were the same as those of a new pan, and the only damage was the fusing of the upper margin for about ½ an inch. In the bottom of the pan was found a considerable quantity of residue similar to that which remains when gelignite has burned away quietly without explosion.

What Probably Occurred.—The hissing was produced by active decomposition of the gelignite due to causes mentioned later. This generated sufficient gas to blow off the top of the pan, and the top cartridge. On the lid reaching the ground the cartridge, already in an extremely sensitive condition, was detonated by the blow, and exploded, blowing the lid to pieces.

Causes of the Explosion.—If this theory is correct it only remains to ascertain the cause of the decomposition. Experience shows that raising the temperature rapidly, even assuming that the water was hotter than George stated, should not decompose the gelignite if pure. An ignition by a spark, which is unlikely as the lid of the pan was on, would have caused a bright yellow flame which would have been far more noticeable on a dark morning than the hissing sound.

Unstable Explosive.—This leaves the alternative that the explosive was unstable. A sample was obtained, and submitted to the "Heat test" which it stood well—too well indeed, for the chemist had suspicions that it might have been treated with a "masking agent" which, whilst having no action in improving stability, effectually prevents any indication by the heat test.

The gelignite was then subjected to the test employed when examining a new explosive. In the result the figures would have been sufficiently serious to have caused it to be rejected without hesitation.

A surprise visit to the factory revealed no trace of the use of "masking agent," but further tests leave no doubt that one had been used.

The conclusions therefore are as follows:—

(i.). That the explosive ignited spontaneously in the warming pan.

(ii.). That the explosion occurred outside the warming pan, but in close proximity to the lid.

(iii.). That one at least of the cartridges was made of very unstable explosive.

(iv.). That an unauthorised and illegal ingredient had been added to the explosive which had the effect of concealing its lack of stability.

Since the report was submitted the presence of mercury (part of the "masking agent") was definitely proved by the spectroscopic method in a number of samples, and the firm was convicted in the one case which was taken into court.

E. G. GODFREY-FAUSSETT.

NOTICES OF MAGAZINES.

Engineering Record.

November 23rd, 1907.

Density of Pavements.—The density or specific gravity of the pavement as laid, is found to be a good measure of its wearing quality. In a bitulithic pavement laid in Boston, where the crushed stone was very carefully graded by sizes and so mixed as to obtain a very small percentage of voids, a specific gravity of 2·69 was attained, as compared with a specific gravity of 2·96 in the stone used for crushing. Asphalt pavements, as used in the U.S., vary in specific gravity from 1·90 to 2·25, while the constituent stone has a specific gravity of 2·60—2·70. By taking the density of other paving material such as asphalt, brick, wood, etc., a fair measure of their wearing qualities may be estimated, but of course other considerations, such as the surface obtained, etc., are of high importance in considering the wear and cost.

Road Tarring and Dust Prevention.—Both U.S. experience and the results of the British road tarring trials are quoted. A variety of binding agents have been used, *e.g.* heavy oil, coal gas tar, water gas tar, oil gas tar, and various patent compounds. Assuming the binding powers to be equal the results appear to depend greatly upon the actual penetration effected. Before laying on the tar, etc., the surface usually needs to be cleaned so as to remove fine dust and ground-up stone.

Both sand mixed with stone screenings, and peastone have been used with fair success, but generaliy speaking the latter seems the better. Calcium chloride has also been tried successfully as a dust preventive in some places, "keeping new macadam moist and holding it in dry weather." There are some notes on tar-spreading machines, which are usually fitted with rotary spreaders. The descriptions are hardly sufficient to permit of comparison between different types.

C. E. Vickers.

Memorial de Ingenieros.

July, 1907.

A Token of Gratitude.—The pay of the staff for Engineer services, viz. of the foremen of works, artificers, clerks, and draughtsmen, has recently been very considerably increased owing to the efforts of the senior officers of the Corps, who highly appreciate the good work and loyal service rendered by them. In token of their gratitude, the staff for

Engineer services has presented, to the head of the Engineer section of the Ministry of War and to his colleagues, a very handsome bronze plate bearing a design typifying the various duties of the Corps such as fortification, ballooning, telegraphy, surveying, railways, etc., the whole designed and executed by members of the staff. This was accompanied by an album containing the signatures of the donors, and has been deposited in the museum of the Corps, where it will form an interesting memorial of the good feeling which exists between all ranks.

STUDY OF THE WORK DONE BY THE CABLE OF THE TIBIDABO FUNICULAR RAILWAY UP TO 31ST DECEMBER, 1906.—By Lieut.-Colonel D. Mariano Rubio.—Tibidabo is a mountain near Barcelona, and its summit, a popular resort of the inhabitants of that city, is reached by means of a funicular railway. The track is single and straight, except in the centre where there is a siding 100 mètres long to enable cars to pass one another. The curves at the entrance to, and exit from, this siding have a radius of 250 m. The line may be divided into three sections, the lowest 60 m. long has a gradient of 17 p.c., the central 300 m. long a gradient of 23 p.c., and the highest 690 m. long, one of 25·7 p.c. The rails are of the Vignoles type. There are two carriages, each weighing 6,400 kgs. and having accommodation for 80 passengers. They are connected by a steel cable formed of 96 wires round a hemp core. This wire at the summit of the line passes round a drum actuated by a motor. The diameter of the cable is 28·8 m.m., metallic section 3·03 sq. c.m., weight 2·75 kgs. per mètre, breaking weight 44·5 tons. It runs on guide rollers, and, in the event of its breaking, the cars are held by brakes which automatically clip the rails the moment the strain is taken off the cable. From its opening in 1901 to the end of 1906 the line has carried 634,000 passengers on the upward journey and 567,000 downwards. The author calculates the strain on the cable in the various sections of the track, and arrives at the total work performed during the period under consideration.

THE SIMPLON TUNNEL.—By Major D. Francisco Ricart.—The author gives an interesting account of the tunnel and of the work connected with its construction.

HERO'S FOUNTAIN.—By Major D. Alfredo Amigó.—Although the principle of this fountain was discovered by Hero 120 years before the Christian era it has never been more than a scientific toy. The author considers this to be due to the difficulty and expense of constructing pressure chambers of sufficient capacity, but now that armoured concrete has been introduced, these difficulties can be readily overcome. If this is so the author considers that, with a given head, Hero's fountain will prove more efficient than any form of turbine for raising water from the reservoir furnishing the power. The writer shows that the capacity of the upper pressure chamber should be equal to that of the lower, divided by the effective pressure in atmospheres in the latter.

MILITARY REVIEW contains a note on the organization of a British Balloon Company and its *matériel*.

August, 1907.

THE SIMPLON TUNNEL (*concluded*).—This number contains an interesting account of the difficulties which were met with in the construction of the tunnel, and of the means which were adopted to overcome them. They were mostly due to the presence of water in the limestone rock. In the summer of 1901 work had to be suspended, as the tunnel was flooded to a depth of 2 feet and a large part of the plant was washed away. Before work could be resumed a drainage tunnel had to be constructed at a level lower than that of the main gallery, a difficult proceeding as the miners had to work in water up to their knees and were soaked by the springs which constantly burst out from the walls. The quantity of water dealt with on this occasion amounted to about 200 gals. per second.

Further on, a zone of shifting and decomposed rock, about 132 feet in thickness, was met with and caused great trouble. The rate of progress dropped to about 10 inches a day. A lining formed of 12″ × 12″ timbers was found to be of insufficient strength and had to be replaced by iron, whilst the permanent masonry lining was given a thickness of 6′ 7″ on the invert, 6′ at the footings, and 5′ 4″ at the crown of the arch, a whole year being occupied in its construction.

At the end of April, 1904, a hot spring was met with at a point 10,270 mètres distant from the Brigue end of the tunnel. Its temperature was about 120° F. and it discharged some 1,800 gals. a minute at a pressure of from 3 to 4 atmospheres. An attempt was made, unsuccessfully, to block it up, and eventually an iron shield was fixed in position from which the water was led away in pipes, the pressure being sufficient to force it up to the highest point of the tunnel, whence it flowed down to the Brigue entrance.

Hot springs caused even greater difficulties in the boring of the main gallery on the Italian side, and refrigerating appliances had to be installed in order to reduce the temperature to one at which work could be carried on.

INSTRUCTIONAL TOURS CARRIED OUT BY THE STUDENTS OF THE ENGINEER ACADEMY DURING THE YEAR 1906–1907.—The students at the Engineer Academy at Guadalajara are taken, during the fourth and fifth years of their course, on instructional tours, similar to those carried out from the S.M.E., though the amount provided for the purpose in the estimates is somewhat inadequate. During last year the 4th year students went on an 18 days' tour to Madrid, Zaragoza, Monzón, Monistrol, Barcelona and Tarragona, and visited the chief military establishments and engineering works at those places, such as the military hospital at Carabanchel, the engineer laboratory at Madrid, the military railway which is under construction from Madrid to San Martín de Valdeiglesias, the Aragón canal, the Monistrol rack railway, the harbour works at Barcelona with its floating dock, etc., etc.

The 5th year students visited Madrid, Ferrol, and Segovia between the 1st and 16th May. Ten days were spent at Ferrol in visiting the dockyard and the various men-of-war, S.M. test-room and barracks, and lectures

were given, by the professors of the Naval school, on different types of ordnance, machinery, etc. The fortifications of the port were also visited, and lectures were given by artillery officers on the various coast defence guns and mountings, and by the Commanding Engineer on the fortifications. At Segovia the students were attached to the Regiment of Siege Artillery and witnessed practice from the guns, howitzers and mortars which belong to it.

AN AERO-MARITIME VOYAGE.—By Capt. D. Alfredo Kindelán.—At 7 p.m. on the 24th July, 1907, Capt. Kindelán ascended from Valencia in the balloon "Maria Teresa," the wind at the time blowing towards the land. A storm came on and he was driven out to sea in the direction of the Balearic Islands, and a further change of wind carried the balloon in a northerly direction towards Barcelona. At about 6 a.m. on the 25th the heat of the sun caused the balloon to rise to an elevation of about 12,500 feet at which it remained until about 9 a.m. when, owing to the sky becoming covered with clouds, the temperature fell very considerably, and caused it to drop very suddenly to a height of only about 100 feet above the sea. In spite of throwing out everything possible the balloon continued to sink and by 12.30 p.m. the car was in the water. The wind again changed and blew the balloon in the direction of the island of Iviza. The unfortunate aeronaut remained hanging on to the balloon until 7.30 p.m., when as the wind commenced to again carry him away from land, he decided to try to swim towards the shore, which was about 10 miles distant. At 8 p.m. he was sighted by the s.s. *West Point*, and was picked up and landed at Garrucha on the 27th July. Capt. Kindelán gives a very clear and modest account of his adventures which had awakened the greatest interest in Spain.

'M.'

NATURE.

December, 1907.

A TOTAL SOLAR ECLIPSE will take place on 3rd January, 1908. The line of totality passes from a point in the Pacific, east longitude 155° and north latitude 12°, in a curved path through Polynesia, terminating in Mexico. The only two portions of land from which totality can be seen are two small Pacific islands, viz., Hull Island, in the Phœnix group, and Flint Island, to the north of Tahiti. Hull Island is surrounded by a coral reef which makes landing very difficult—except by boats on the N.W. side—and there is no anchorage. Flint Island is 2½ miles long and half a mile wide; is also surrounded by a coral reef; landing is very bad even for surf boats. The Americans have, however, determined, in spite of all these difficulties, to occupy Flint Island. The navy department is providing a war vessel to transport the Lick Observatory Expedition, under the direction of Prof. W. Cambell, from Tahiti to Flint Island

and back. Mr. W. H. Croker, of San Francisco, who has defrayed the expenses of five previous expeditions, has again offered to finance this one. At Flint Island the duration of totality will be 4 minutes, and the sun will have an altitude of 74°. The epoch of minimum sun spots will be at time of eclipse in 1912, while that of the greatest solar activity was in 1905, so that the eclipse of 1908, occurring in an intermediate year, renders it important even from this view alone.

THE FUTURE WATER SUPPLY OF LONDON (*p.* 132).—The Metropolitan Water Board is the largest and most important water authority in the United Kingdom, being responsible for the supply to one-sixth of our population. The distribution of rainfall, on which water supply depends, is, speaking broadly, the inverse of the distribution of the population. Taking the part of England and Wales south of the Trent, it may be said that most people live in the Thames Valley, while most rain falls in Wales. The works at present in existence or authorised will supply London until 1917, and to provide the additional works, required at that date, it will be necessary to approach Parliament in 1910.

The total amount of water which the Board can abstract from the Thames under existing conditions is 228,500,000 gallons a day, and even this amount cannot be obtained until additional storage reservoirs have been constructed. The maximum supply to be relied on, from sources other than the Thames, is 120,000,000 gallons per day, the whole total thus available being 340,500,000 gallons per day. If London increases in population at the present rate, this amount will suffice till about 1940, but not longer. The chief engineer believes that, by constructing very large reservoirs, 450,000,000 gallons per day could be taken economically from the Thames. Under these circumstances the Water Board "desire to urge upon Parliament the necessity for regulating the appropriation of water-supplying areas, so that the needs of the Metropolis, as well as of other populous places, may receive due consideration."

ASCENT OF THE TRISUL IN GARHWAL (p. 135).—Dr. Longstaff, Major Bruce, with Mr. A. L. Mumm, the secretary of the Alpine Club, went to India with a desire to attempt the ascent of Mount Everest (29,002 feet in height) from the Thibetan side, but for political reasons this was found to be impossible. It was decided then to go to Garhwal and from that locality to attempt Trisul (about 23,000 feet). The summit was reached on 13th June, but the cold was so bitter that it was only possible to remain there for a quarter of an hour.

[From the foot of this mountain, with a glass, snowstorms and drift snow are constantly seen on the three peaks. The Garhwalese say that they are caused by demons who live on the top of the mountains, and that no human being could possibly escape with his life, should he have had the temerity to undertake the ascent of this devil-haunted sanctuary.—WM. E. W.]

TRAIN RESISTANCE (p. 156).—Mr. C. Wilson has found that the resistance of the air with a train of bogie coaches, running at 60 miles an hour,

amounts to about one half the total tractive effort required to draw the train. A large reduction can, however, be made in the front and rear air-resistance by shaping the ends, and that by this means a saving can be effected of 10 per cent. of the total tractive effort with a long passenger train, and 30 per cent. with a single coach.

LORD KELVIN (p. 175).—At the ripe age of eighty-three, Lord Kelvin has passed away. To three generations of scientific men, his work, his presence, his mathematical genius, and his enthusiastic faith in first principles, have been an inspiration and a perpetual stimulus. The notice of his life in *Nature*, by Prof. Silvanus P. Thompson, is well worth reading.

BALLOON OBSERVATIONS (p. 187).—Twenty-five balloons, with registering instruments, were sent up in England and Scotland during the week July 22—29. Fourteen of the registering instruments have been found. The heights ranged up to more than 12½ miles, the average being about 7½ miles. The records showed that above 7½ miles the temperature remained almost unaltered with change of height.

THE SALMON (p. 173).—Mr. Calder Wood has collected into a book a great deal of most valuable information bearing upon the life and habits of the salmon. The first two years of the salmon's life is normally spent in the parr stage. It then assumes the silvery livery of the smolt when, on reaching the sea, it eludes for a time the ken of man, until it reappears as a grilse a year after it left the river as a smolt.

W. E. WARRAND.

RIVISTA DI ARTIGLIERIA E GENIO.

October, 1907.

CHANGES OF MILITARY OPINION AS REGARDS THE VALUE OF FORTRESSES.—Under this title H. Frobenius in the Supplement No. 103 of the *Internationale Revue*, traces in an interesting article the changes of Prussian Military Opinion from the days of Frederick the Great, on the subject of the value and importance of permanent fortifications.

Frederick valued fortresses highly as aids to war, but, after his death, the greater number of commandants of fortified places, as well as the Prussian army, were dominated by the genius of Napoleon, and considered that it was better for a country not to risk the safety of her troops in the defence of a fortress. After 1815 Prussians had not the heart to defend their frontier with permanent works.

Later on the great advance in siege guns, the effects of curved fire on masked works, and finally the siege of Sebastopol all combined to injure the returning confidence in fortresses (1856–57), and the siege operations in the American war were of insufficient importance to influence prevalent opinions. The vast improvement in artillery jeopardised the very existence of fortresses by bringing their power of resistance into question.

The War of 1870–71 dispelled these illusions, and the power of the Prussian siege artillery fell far below expectation. The renewal and construction of numerous fortresses was the result of these experiences, even though sieges were treated as "accessory matters" in the work of the Great General Staff.

Opinion next veered towards "improvised" fortifications owing to the resistance at Plevna, and at the same time the development of railways diminished the value of fortresses as supply bases.

Moltke strengthened this view by enunciating that, "when taking the initiative, railways can defend a country better than fortresses." Now, however, it is realised that railways and fortresses are of equal importance.

In 1880 new champions of improvised works arose, viz. Sherff and Sheibert, and they further argued the possibility of strong forces making their way through the intervals in a chain of forts. This idea was long held in Germany, but was looked upon as absurd at Port Arthur.

The armoured constructions of Major Schumann again raised the prestige of fortresses, as the explosive shells and mephitic gases were of little use against the cement and steel armoured works, and could not render the indestructible redoubts uninhabitable. These peace demonstrations received thorough confirmation at the Siege of Port Arthur, where the Japanese artillery neither annihilated the Russian force nor sensibly diminished the strength of the works. It also failed either to drive out the garrison, or to facilitate the final attack.

Thanks to this siege the fortress has recovered its former great reputation, and artillery has been shown to be nothing more than an indispensable auxiliary to the infantry.

MAGAZINES FOR EXPLOSIVES.—Experiments have lately been made in Germany in the construction of magazines with gravel cement to contain explosives. In order to diminish the danger of fragments, in the event of an explosion, these explosives are generally stored in shelters of light construction. But shelters so constructed are equally badly adapted for protecting their contents against external agents (heat, moisture, lightning, etc.) as they are for guarding them from theft. They were however adopted as it was argued that they were less dangerous in the event of an explosion than gravel cement magazines.

To test this assertion two magazines of cement were constructed at Cummersdorf. The vault was 50 c.m. in thickness at the key and was supported on walls 1·25 m. thick. The fronts of the magazines consisted of thick walls 50 c.m. formed with gravel cement. In each of the magazines one of the front walls had an opening which was kept secured by a gate of strong steel plates in one case, and in the other by a simple wooden gate strengthened with thin plates. At 2 mètres distance from the gate a bank of earth was thrown up to stop the fragments.

The charge exploded for the first magazine was 1,500 k.g. of gelatine explosive, for the second 500 k.g. only.

The result of the trials was not very characteristic, but clearly showed that the danger from the fragments is not greater in a gravel cement magazine (which is in fact completely disintegrated), than from those of

a light shelter. The gate of strong steel also gave more fragments than the light wooden one which was completely destroyed. The utility was also proved of a bank of earth in front of the gate, as it arrested the horizontal fragments and these are by far the most dangerous.

RIVISTA DEI LIBRI E DEI PERIODICI.—The "Provisional German instruction in field fortification" is a translation by Gustavo Suchet, colonello del genio: Rome, 1907. In April of this year, in this Review, was published a study entitled "The new provisional instruction in field fortification," relating to a publication which appeared lately in Germany under the title: *Feldbefestigungsvorschrift* (Enwurf).

At a very convenient time, the War Minister has allowed the whole of the valuable translation to be published of the Instruction made by Colonel Suchet, and this work will serve a useful purpose in instructing all officers in the new principles which should regulate the construction of works of field fortification.

The first part of the Instruction relates to the general principles of the employment and method of field fortification. The second part continues the rules for the execution of works and offers numerous types for adoption according to the conditions of time and place. The third part deals especially with the use of field fortification in the attack of fortresses. The fourth part relates to various technical particulars.

The German Instruction is dedicated to all branches of the army, and especially to the infantry, whose officers should be able to learn from it to apply the methods of fortification on the battlefield in all conditions of warfare.

From which we may infer that the volume will be read and consulted, with much profit and under varied circumstances, by all the officers of our army.

EDWARD T. THACKERAY.

GOVERNMENT OFFICES, BANGALORE.

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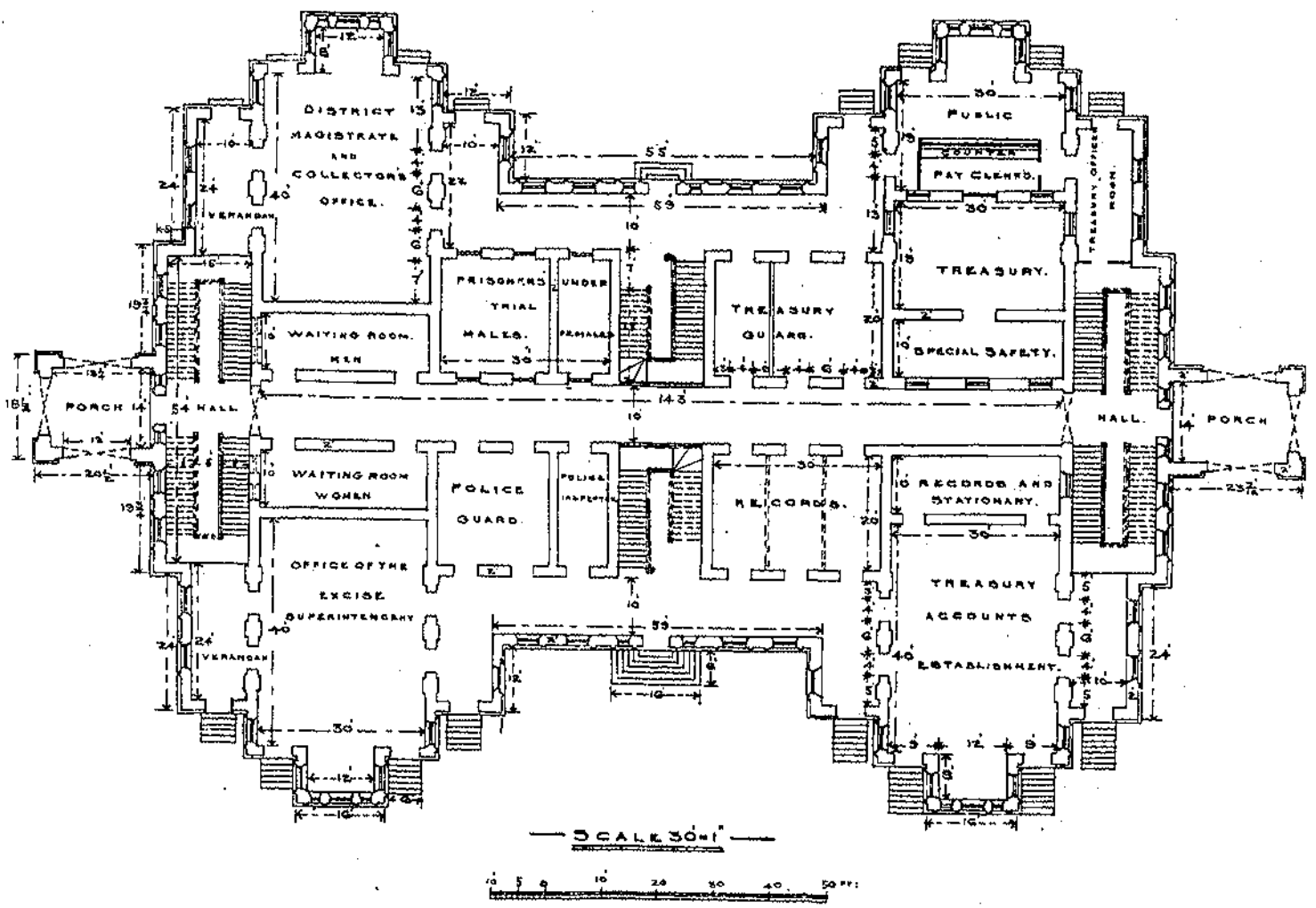

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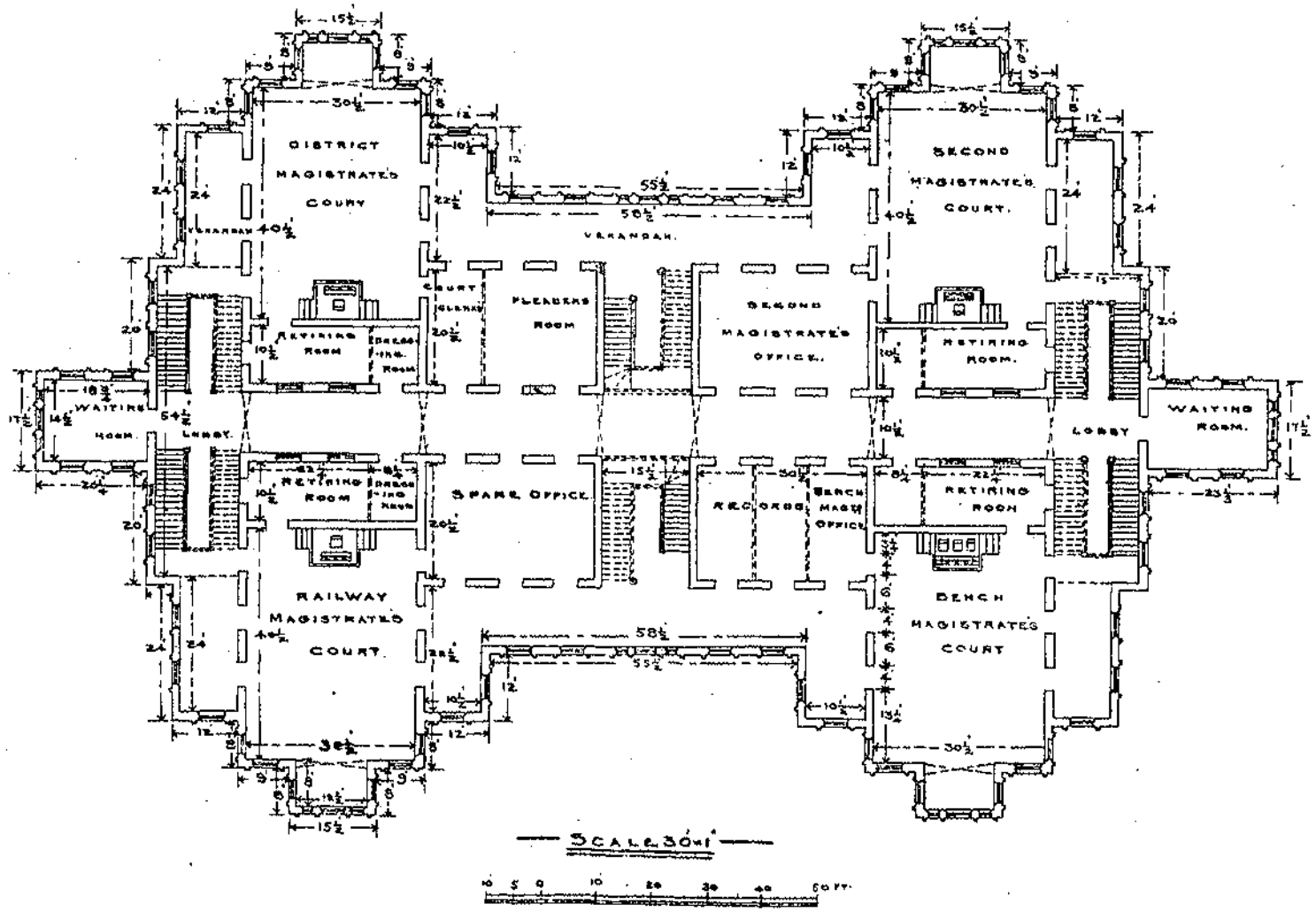

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