JUL 1906

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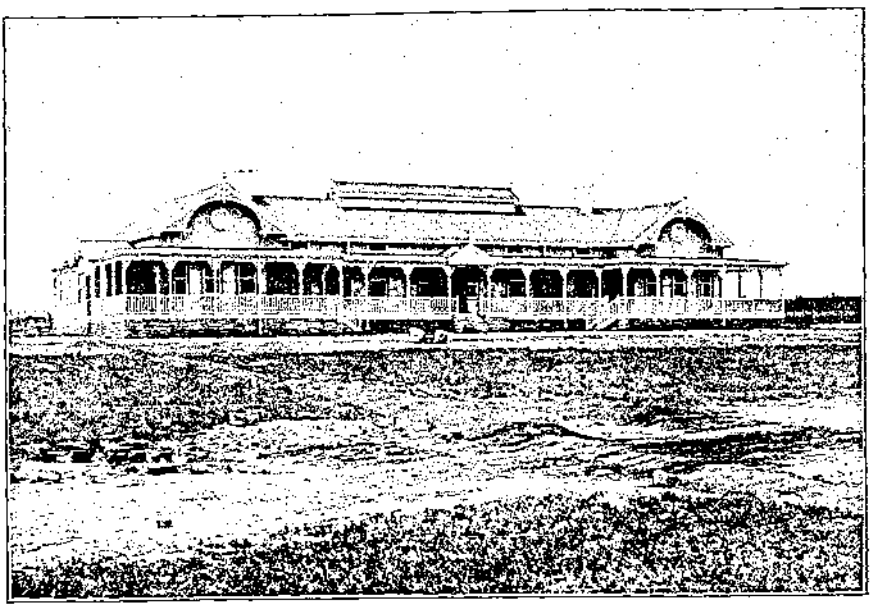
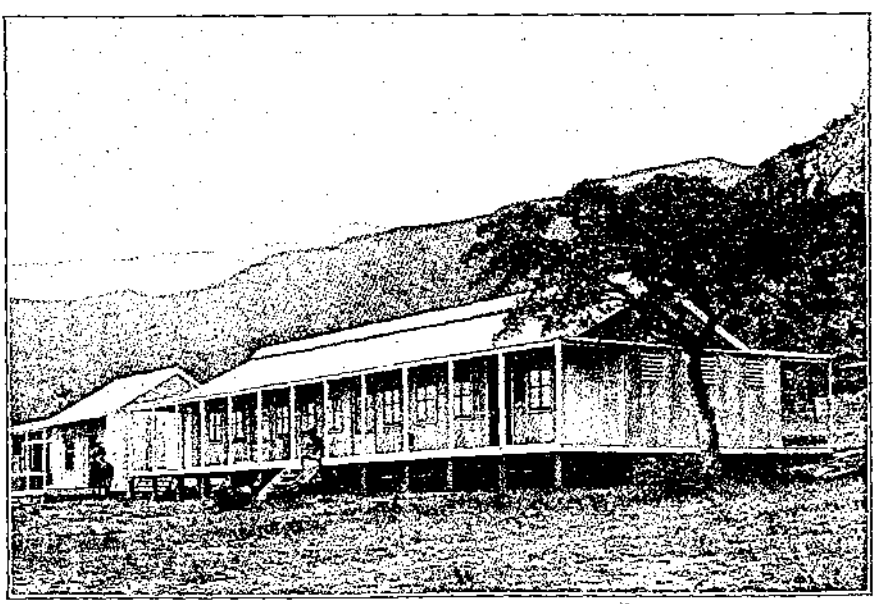
CANTONMENT BUILDINGS IN SOUTH AFRICA.



Officers' Club at Middleburg, Transvaal.



Sergeants' Mess at Barberton, Transvaal.

ENGINEER RESERVES.

By Col. E. R. Kenyon, R.E.

That there is much engineering work to be done in war is now universally recognized; and it is also universally, or almost universally, admitted that much of the work which has hitherto been considered in our army to be the duty of the Royal Engineers must in future be done by the Infantry.

From these truths, which may be accepted as axioms, it is sometimes deduced that in future the Royal Engineers may become merely Pioneers, in fact if not in name; and that all real engineering work can be done by civilians obtained when the emergency arises. There is so much of a substratum of truth in this idea as to make it necessary to consider it. Granted that Infantry and Artillery must ordinarily construct their own entrenchments, that all arms must carry out (with proper advice and supervision) their own sanitation works, and that all should be able to make simple water-supply arrangements, what remains for the R.E.? and can this be done by Pioneers and Civil Engineers?

What remains consists of:—

(*a*) Construction of redoubts and preparation of buildings, etc., for defence,
(*b*) Demolitions,
(*c*) Preparation of obstacles,
(*d*) Bridging,
(*e*) Ballooning,
(*f*) Telegraphs and telephones,
(*g*) Search Lights,
(*h*) Railways,
(*i*) Roads,
(*j*) Survey and reconnaissance,
(*k*) Maintenance of machinery,
(*l*) Siege works,
(*m*) Construction of standing camps and hutments,
(*n*) Construction or adaptation of storehouses, etc., at bases and depôts,
(*o*) Guiding and assisting other troops in the attack on fortified positions and posts.

Many of these duties must obviously be done under fire or risk of fire, and therefore require a soldier's thought, sight, and instinct if they are to be done successfully. It will therefore be admitted that a military corps is necessary, even though civilian assistance may be largely utilized.

Would it then be safe to allow the standard of knowledge, skill, and trained intelligence for that corps to fall below that which is now required of the R.E., and to be content with a corps of Pioneers? I think not.

Everyone will admit that engineers are needed for bridges, electrical work, railways, and roads; surveyors for survey; mechanics and mechanical engineers for machinery; aeronauts for balloons. Therefore, unless these are deemed to be duties which can be entrusted to Civil Engineers, it must be admitted that a Corps of Military Engineers, not merely Pioneers, is needed. My own opinion is that Engineers are also needed for the other duties which I have named. But as I am not now considering the strength required, but merely seeking to prove the need of maintaining a corps of trained military engineers, I wish to use only those arguments which will be universally admitted. No one can deny that in war bridges and field telegraphs and telephones have to be constructed under fire; that balloons must be worked under fire; that roads must be laid out and constructed under risk of fire; and that railways must be worked under fire. This is therefore enough to prove my immediate point; and although far more could be added, it is unnecessary to do so for my present purpose. I wish to be able to take it as admitted that a Corps of Military Engineers is necessary, and to pass on to the question of how this corps is to be augmented—as *all* military corps must be—to enable it to fulfil its duties in time of war. This brings us to an entirely different line of thought.

Even in war there will be much engineering work which has to be done far from the actual fighting zone; such as the improvement of harbour and landing facilities, the maintenance of roads and railways from the base to the neighbourhood of the fighting forces; the construction of storehouses, barracks, etc., at certain bases and depôts; the repair and maintenance of portable machinery, etc. There will also be a large amount of work to be done under engineer direction but which need not be done by soldiers.

Thus our reserves for the military Engineers should consist of civil engineers and of trained labour—not necessarily all of it 'skilled' labour in the technical sense, for a large amount of it may be supplied by labourers. Thus we want civil engineers, artisans, and navvies. The artisans and navvies for the works at the base could no doubt be obtained by offering sufficiently high wages. Those for work nearer the scene of fighting could also probably be similarly obtained, though it would no doubt be of very great advantage to have them supplied

by units which possess a military organization. The civil engineers would be more difficult to obtain in the open market in sufficient numbers, except at very great cost or under circumstances where a very strong appeal to patriotism could be made.

I suggest therefore that the Engineer Reserves should consist of :—

(*a*) Militia Engineer companies, which could be employed as complete units and which would be liable for foreign service,

(*b*) Volunteer Engineer companies, to be similarly employed for home defence,

(*c*) Individual civil engineers enrolled in the reserve of officers.

The militia and volunteer companies might be skeleton units in time of peace ; but they should have ample lists of suitable men who would be willing to join in case of war. The individuals for the reserve of officers would be found in such men as the young civil engineers in the employment of the Admiralty and other Government Departments, those who have passed through the various engineering training colleges (such as the Crystal Palace), etc. It would surely be reasonable that it should be a condition of receiving an engineering appointment under Government that for a certain number of years the engineer should be liable to be called on to give his services (of course under special rules as to pay, etc.) with the army in the field ; and there can be little doubt that a small retaining fee would obtain for the reserve a large number of very capable young men who are just entering the engineering profession but who are still without permanent business connections.

On these or similar lines I believe we can and should maintain

(1) A force of Regular Military Engineers, whose general training should be as high as that of the R.E. now is, and which should include an increased number of specialists in different branches (such as electrical, railway, and mechanical engineering),

(2) Two Auxiliary forces of Militia and Volunteer Engineers,

(3) A Reserve of Engineers, who in war would have the status of officers and who would, mainly or entirely with hired artisans and labourers, carry out such works as might be required, especially at the bases and on the parts of the lines of communication least exposed to hostile attack.

To ensure a full establishment for this Reserve all construction work for the army should be superintended by men who would in

time of war be at the full disposal of the War Department for home or foreign service. The Barrack Construction Department might be staffed partly by half-pay or retired officers; partly by supernumeraries from the active list, who would serve for a limited number of years in this Department and would then elect to return to military duties or to retire and go on the civil establishment; and partly by civilians, who would sign a contract binding them to serve abroad if required in war time. Thus the Construction Department would be kept in touch with the army during peace time and would form a very valuable reserve for war.

AN IDEAL FIELD COMPANY, R.E.

By MAJOR R. U. H. BUCKLAND, R.E.

MANY writers have urged the desirability of increasing the mobility of a Field Company, but I do not think the Irish jaunting car, which seems to me the type of vehicle most likely to prove useful in this connection, has as yet been sufficiently tried. Most readers of this *Journal* will know the general features of the Irish car, but not all will realize its carrying capacity. In Dublin it is no uncommon sight to see one "little horse" trotting along with a load of six full-grown men; two sit on either side, the "jarvey" on the front of the raised body between the seats, with his feet on the shafts, and the sixth man with his back to the jarvey dangles his legs down behind the car.

Now I would not by any means propose that all the sappers of a company should always be carried. What seems to me really necessary is that we should be able to count on carrying some 20 to 30 men, at the rate of 8 to 10 miles an hour along a road, so that they may arrive fresh and ready to work at a point 7 or 8 miles off. If their work lies away from the road, the sappers, having been carried so far as the road is available, must march on foot, and, if they come to really steep or difficult ground, they may have to assist their car with drag ropes. After the experience of trekking in South Africa across open veldt some of us may fail to remember the important part that roads play in European warfare. Infantry and Artillery will normally march on the roads; and as it is for their assistance that we exist, we shall not as a rule be required in a hurry for work very far from practicable roads. Every vehicle must primarily be intended to carry equipment, and my acquaintance with Irish cars leads me to think that they could easily be adapted to this purpose.

The Commander of a mixed force containing one Field Company will usually detail half of it to the advanced guard. This is where mobility is required. For such work as will most probably fall to the lot of the advanced guard tools of a certain class only will be required,—one might say the *destructive* tools, viz., picks, shovels, crowbars, axes, saws, explosive gear, and material for temporary bridging expedients such as dogs and rope. The *constructive* tools, such as those contained in the filled boxes of the carpenter, smith, mason, or fitter, may well stay with the main body.

It is essential that along with mobility should go divisibility; any morning it may be necessary to send off a Section by itself, so that all absolutely essential tools must be carried equally by each Section. It is beyond the scope of this article to lay down what tools are essential, but a Section of R.E. that cannot undertake all possible work in connection with water supply is of no use to the force to which it belongs. This presupposes pipe cutters, gas tongs, stocks and dies, plumber's tools, ratchet brace, etc., but these need not always be carried on the light vehicles of the Section.

In the latest organization each Section has one G.S. wagon, and in this must be carried such of the equipment as will not go on the cars. On the other hand the cars will always carry the blankets (folded as cushions) and one day's rations for six men.

Another point which must have struck anyone who has considered the amount of work done by a company in relation to the number of men in its ranks (214) is the non-productive character of a large number—the driver class—and the fact that one may often see highly skilled men of the artisan class performing duties which could be equally well carried out by men of no trade.

Specially trained men of the driver class are not required for the long-rein driving of a small cob in an Irish car or a pair of cart horses in a G.S. wagon along a road. What we want are men of the class from which come carters and vanmen—men of the superior class of unskilled labourers. Their first training should be in musketry and fieldworks, as is the case with all sapper recruits; after that they can learn to look after a horse in addition to their ordinary work. We have hitherto aimed at the ideal of an artillery driver, whereas for our work—as far as the Field Companies are concerned—we do not want a man of the groom class at all, except a few as officers' bâtmen.

I would urge most strongly that at least two mounted N.C.O.s per Section are necessary, but let them be of the sapper class, and let their horses be available to impart to as many N.C.O.s and sappers as possible a knowledge of riding to the point of being able to get about with safety and some comfort on a quiet pony. Intelligent mounted men are most necessary for reconnoitring roads, and for going off to distant places to do small jobs or to look for material. The two buglers would of course be mounted for use as orderlies, and would be taught map reading, to find their way about at night, and to take verbal messages. You can teach a *boy* anything!

There are several duties, such as cooks and cook's-mates, on which skilled artisans are wasted. Further it is well known that on most jobs the man who is detailed to do the work requires a "matey," to hold things for him, carry material, or what not. In the Field Companies of twenty years ago these duties were performed as far as possible by men rated as "miners," and remarkably useful men some

of them were. The cost of a company would be considerably reduced by substituting for skilled artisans some 50 men, whose engineer pay would never rise higher than the 6th rate; whilst as regards field fortification, on all jobs in which trade skill is not required they would be as readily taught as men of the artisan class.

It all comes to this; think out what work the company may be called on to do, and approximately the number of artisans you will require. Allow sufficient miners (avoid the term labourers—it is unpalatable to the would-be recruit) to assist these artisans. Then work out the tools required. Next consider how many men of each section you will want to be mobile, and how many can accompany the G.S. wagon. You will then arrive at the number of cars required for each Section, each car to carry a load of tools and one sapper to drive, with the possibility of mounting on it 4 or 5 more sappers (in addition to the tools) if required. As a rough indication of what I mean I would propose that, if a total strength of about 200, is adopted the various classes of men would be as follows:—120 artisans, 4 shoeing smiths, 4 collarmakers, 4 tailors, 4 shoemakers, 50 miners, 14 bâtmen (grooms). For the mobile portion of each Section five cars would probably suffice, but as these would take the place of the tool cart the establishment of horses would be only slightly increased.

In each Section you will then have your car squad and wagon squad. In the case of a whole company with a Division, it might often be desirable to allot two or more car squads to the advanced guard, but it must be remembered that the two squads of any Section cannot be permanently separated without considerable loss of efficiency to both. The analogy of this organization to that of the Field Ambulance is obvious; the essential point is to evolve an organization suited to the work which we shall have to do under the conditions of modern war.

The tool cart was an advance on the G.S. wagon in respect of mobility, but many have thought it insufficiently adaptable as regards its carrying capacity. The minutiæ of drill are now abhorred, just as much as formerly they were worshipped. All we need be able to do is to march along a road and keep distance. Let us hope to be judged in future by the quality of the work we do and the rapidity with which we get at it.

A SUSPENSION BRIDGE MADE OF WIRE FENCING.

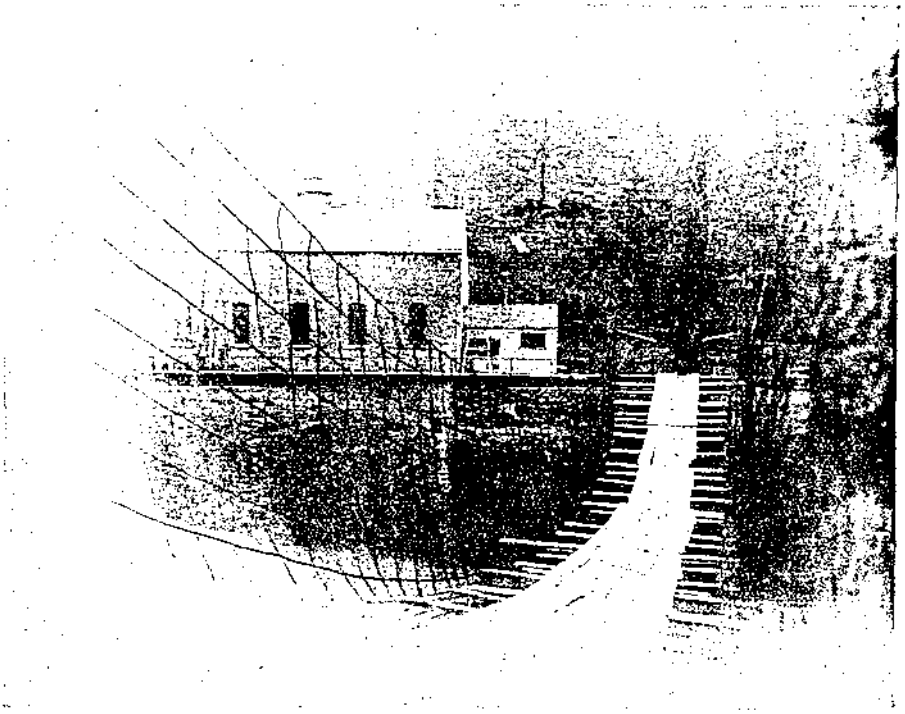
By MAJOR T. E. NAISH, R.E.

THROUGHOUT the more recently settled parts of the United States and Canada, with their enormous lengths of single-line railways running often through what might be called a veritable wilderness, there is a great demand for cheap and readily-erected fencing.

Such fencing is also much used by farmers, being less clumsy and not much dearer in the long run than the snake-fence of felled trees.

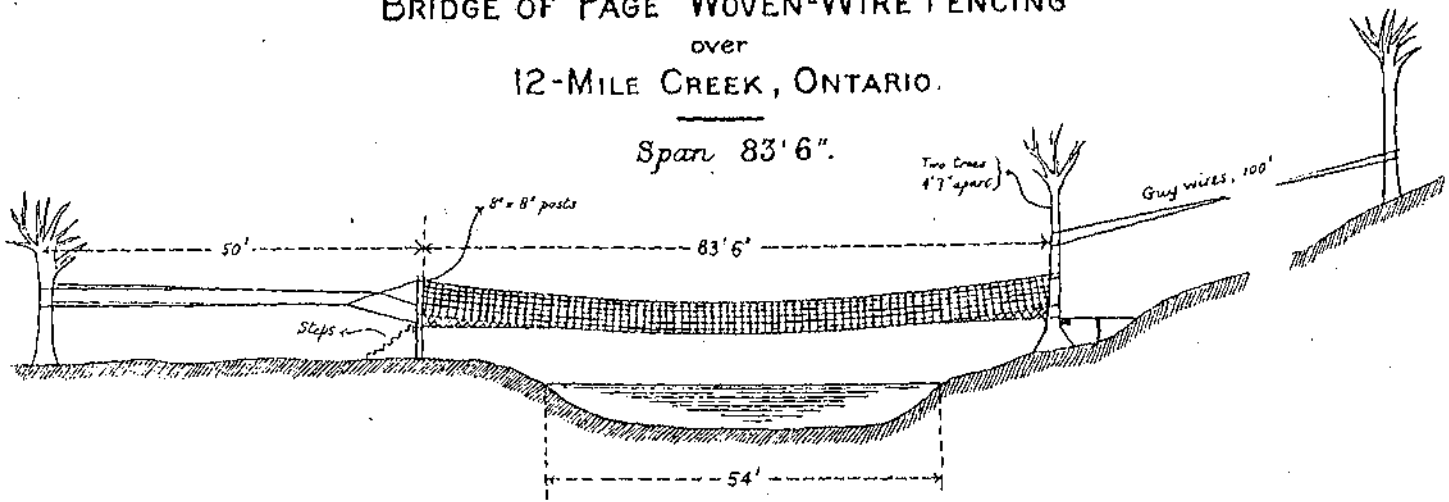
The "Page" pattern is one among the many types of woven-wire fencing (very much alike in outward appearance, but differing in manufacture) that have sprung into being to meet this demand.

Curiously enough this material forms the most admirable ready-made material for a military suspension bridge. Such a bridge is shown in the accompanying photograph and drawing, as it was actually erected across 12-Mile Creek close to the power house of the Hamilton Cataract Power, Light, and Traction Company at the foot of the Niagara escarpment, about 3 miles from St. Catherine's, Ontario.



Bridge of "Page" Woven-Wire Fencing over 12-Mile Creek, Ontario.

Span 83'6".



Scale 1" = 25'.

Notes:– (1). Constructed entirely of "Page" Woven-Wire Fencing, 9 strand, 50 inches wide.
(2). Width of bridge 4'6" (average); width of walk 2'4", supported on cross-pieces 2'6" apart.
(3). Floor made of 1" boards. (4). Dip at centre, unloaded, 3'6".

The "Page" woven-wire fencing used in its construction consisted of a top strand of galvanised steel wire, No. 7, B.W.G., a bottom strand of No. 9, seven intermediate strands of No. 12, and verticals of No. 13 gauge, at one-foot intervals, close twisted round the horizontals where they crossed them, the whole being 50 inches high.

The bridge was put up to enable the workmen engaged on the water-power development to cross a rapid stream between the huts in which they lived and the site of the works.

Three lengths of fencing were used, one for each side and one for the bottom; the sides being attached to the bottom by wire fastenings.

Trees 4 ft. 7 in. apart served for the piers on one side, and two 8 in. × 8 in. posts on the other.

The roadway, 2 ft. 4 in. wide, was made of 1-in. boards, supported on cross-pieces 2 ft. 6 in. apart and about 4 ft. 6 in. long; and is well shown in the photograph, though the wire of the fencing under and to the right of the roadway shows but faintly.

The total span between piers was 83 ft. 6 in., and the width of the 12-Mile Creek, where crossed, was about 54 ft.

The writer crossed the bridge once or twice on the occasion of his visit to the Works, and in his opinion troops could pass such a bridge very rapidly. The bridge, moreover, has the advantage that it is impossible for a man to fall off.

The assistant engineer (Mr. R. P. Rogers) informed me that he has seen the bridge crowded from end to end by the Italian workmen, and Mr. R. W. Leonard the chief engineer (to whom I am indebted for the illustrations) tells me that he has seen 8 men swinging on it.

The fencing is most portable, being rolled up like a carpet and so transported. A few rolls of woven-wire fencing carried by Field Companies, R.E., on active service would enable a river or deep chasm to be bridged quicker than by any other method.

When used for a fence, the fencing is attached by staples to wooden posts.

THE ROYAL ENGINEERS IN BRITISH COLUMBIA, 1858—1863, AND 1893—1906.

THE departure for England of the garrison of Esquimalt, British Columbia—the last of the Imperial troops in Canada—was made the occasion of an interesting presentation from the citizens of Victoria, B.C., on the 9th May, 1906. Amongst those present were the Lieut.-Governor, Sir Henry Joly de Lotbinière, and the Premier, Mr. Richard M'Bride. (It is worthy of record that the former has two sons who are officers in the Royal Engineers and also two daughters married to R.E. officers).

The presentation took the form of a silver cup of very handsome design and an address. On the base of the cup are silver replicas of the regimental badges of each of the corps in the garrison and also the following inscription :—"Presented to the officers, non-commissioned officers, and men of the Esquimalt Garrison in commemoration of the departure of the Imperial troops from Canada by the citizens of Victoria, B.C., 1906." Surmounting this is the British Columbia coat of arms, while upon the cup proper is emblazoned the Imperial coat of arms.

The address was as follows :—

To Lieut.-Colonel C. E. English, R.G.A., Officer Commanding, and to the officers, non-commissioned officers, and men of the garrison at Esquimalt.

On behalf of the citizens of Victoria, British Columbia, I have the honour and pleasure to present you with the accompanying cup in commemoration of the departure of the last of the Imperial forces stationed in Canada.

For upwards of a century and a half troops of the Imperial army have been stationed within the borders of what is now Canada, their presence being a guarantee of security, although of recent years they have been chiefly regarded as a visible sign of that union of hearts which is the true Imperial tie.

While we are proud that the Dominion has reached a stage when it is able and willing to assume the full responsibility of a military character in North America—responsibilities heretofore borne in large measure by the United Kingdom,—it is not without regret that we say "good-bye" to the troops, who in an especial manner represent the glorious traditions of the British Army.

Forty-seven years have passed since the first British force, the Royal Engineers, came to British Columbia. Their arrival was at a critical

period in the history of the Pacific Coast of British North America, and they not only served as guardians of law and order, and by their skill aided in the development of the country, but unquestionably preserved this part of the continent to the British Empire.

The personal relations between the citizens and the garrison at Esquimalt have always been of the most agreeable character, and never more so than with yourselves. The severance of these relations affects us deeply, and we believe our feelings in this respect are reciprocated by you.

We most earnestly hope and believe that the men of Canada who are to take your places, will, when occasion calls, ever keep untarnished the lustre surrounding the name of British soldiers, and show themselves worthy to be called your comrades in arms. We look forward to a day when the Union between the Dominion and the Motherland will be closer than it now is, and when the term "Imperial Forces" will mean not only those raised in the United Kingdom but the soldiers and sailors of the Empire, by whatsoever government they may be maintained.

We are glad to know that some of you have decided to remain with us and enter the Canadian militia. We welcome them to citizenship in the Dominion. To those who are leaving us we say "God speed you," and we hope that you will carry with you pleasant memories of your stay with us and our heartfelt assurance of loyalty to our King and fidelity to the flag and all it represents.

A. J. MORLEY, *Mayor*,
Chairman of Committee.

The Cup and the original Address are to be deposited in the Royal United Service Institution, and each member of the garrison is to receive a copy of the address.

The R.E. Officers present at this ceremony were:—Major E. H. Bland, O.C.R.E., Capt. C. H. Versturme-Bunbury, Capt. D. Brady, Capt. L. F. Blandy, Lieut. Hon. F. G. Hood, Lieut. A. St. J. Yates.

We are indebted for the above to Capt. C. H. Versturme-Bunbury, R.E. Lieut. and Quartermaster T. H. Tennent, R.E., kindly sent further particulars and also a copy of the *Victoria Times* of 15th May, 1906, from which the following account of the first occupation of Esquimalt by British troops is extracted:—

The military occupation of British Columbia dates from 8th November, 1858, when the advance guard of a detachment of 145 officers and men of the Royal Engineers reached Esquimalt. This body left England on 2nd September on the steamer *La Plata*, under command of Capt. R. M. Parsons, R.E., and came by way of Panama. They immediately went to Fort Langley, removing afterwards to the site chosen for a permanent camp, about a mile above what is now New Westminster, and gave it the name Sapperton that exists to-day. The actual location was that now covered by the British Columbia penitentiary.

Shortly afterwards another small body, chiefly carpenters, under the command of Capt. J. M. Grant, R.E., arrived *viâ* the same route, and proceeded to erect buildings at the new camp. Colonel R. C. Moody, the senior R.E. officer, who was also appointed Chief Commissioner of Lands and Works and Deputy Governor, arrived on Christmas Day, being sworn in on January 4th, 1859.

The main body of the troops, consisting of 118 non-commissioned officers and men, 31 women, and 34 children, commanded by Capt. H. R. Luard, R.E., with Lieuts. A. R. Lemprière and H. S. Palmer, R.E., and Staff Assistant-Surgeon J. V. Seddell, took the long trip round Cape Horn in a sailing vessel, the *Thames City*. They left Gravesend on October 10th, 1858, arriving at Esquimalt on April 12th, 1859, from where they at once proceeded on the steamer *Eliza Anderson* to the new camp. During the voyage a most interesting newspaper was published weekly, called "The Emigrant Soldiers' Gazette and Cape Horn Chronicle." This was afterwards printed at the men's own expense, and the few remaining copies are cherished by the survivors. It is interesting to note that the original edition in manuscript has been preserved in the archives of the Province.

Colonel Moody had two sources of dispute thrust upon him almost immediately upon arrival, but finally arranged them to his own satisfaction. The first was regarding the location of the camp. Governor Douglas had selected Langley, now a prominent farming community on the south side of the Fraser, as the capital, but the location did not appeal to the military instincts of the commander. He chose what is now New Westminster, and finally his wishes prevailed. The two detachments at once went to the new location and proceeded to lay out the camp at Sapperton, erect buildings, and prepare for the main body that was shortly to arrive.

But even then Colonel Moody's troubles were not ended. There was a small settlement at the point called Queensborough, a name which came in conflict with several other places of prominence, and he thought it would be wise policy to eliminate the "s." This aroused a storm in a teapot and finally the dispute was referred to Queen Victoria, who cut the Gordian knot by choosing New Westminster as the name of the city that was to be. Such a small matter was probably never decided by Her Majesty before, and had New Westminster remained the capital the name was particularly appropriate, recalling associations with the home of the British parliament in Westminster.

The good work done by this body of Royal Engineers should not be forgotten by the people of the Province. They designed and built the first Anglican churches at New Westminster and Sapperton, and also the first school house there. They surveyed and laid out the Royal City, Hope, Yale, Lytton, Douglas, Lillooet, Clinton, Richfield, and other townsites. They acted as the escort that brought down the golden harvest of Cariboo, and last, but not least, established the lands and works department and government printing office in this city. From the latter was issued the first number of the *B.C. Gazette* on January 1st, 1863. To an Engineer officer also was given the appointment of colonial treasurer, in

the person of Capt. W. B. Gosset. Under his direction the treasury and assay offices were established, together with a branch of the Imperial mint at New Westminster. The latter was abandoned after a short time and permitted to go to ruin. A few specimens of its coinage remain that are being carefully preserved by their lucky owners. To the Royal Engineers must also be given the credit of designing the first provincial coat of arms and the old British Columbia postage stamps. It will thus be seen that during their four years' sojourn, with headquarters on the banks of the Fraser, these pioneers did great work that will always remain a monument to their ability.

October, 1863, saw them finally mustered out of the service. All the officers and about thirty men returned to England, but the large majority of the men decided to cast in their lot with the new country. Of these only eighteen are now known to reside here, and their names, to those acquainted with subsequent provincial affairs, afford a roster of honourable achievement, sterling patriotism, and a high ideal of public trust. Many picturesque figures have crossed the great divide whose names even it is impossible to mention here, but one and all proved good citizens and a welcome addition to the population of British Columbia.

The Capt. J. M. Grant referred to in the above extract was subsequently D.A.G., R.E. An account of the early settlement is given in Mrs. Herring's book, *In the Pathless West with Soldiers, Pioneers, Miners, and Savages*, which was reviewed in these columns in May, 1905. Amongst the survivors of the original Engineer detachment is Lieut.-Colonel Richard Wolfenden, V.D., I.S.O., King's Printer, and lately in command of the B.C. Garrison Artillery; some notes of his career were published in the *R.E. Journals* of January and March, 1904.

On the departure of the Royal Engineers the garrison was provided by the volunteer forces of British Columbia until 1871, when the Province joined the Confederation. Since 1873 the troops in occupation have been the Victoria Battery of Garrison Artillery, the British Columbia Brigade of Garrison Artillery, the 5th Regiment of Garrison Artillery, the 6th Regiment of Infantry, and other units belonging to the Active Militia of the Dominion of Canada.

In 1889 the Imperial authorities resolved to establish a naval base at Esquimalt, and a small party under Lieut. J. I. Lang, R.E., with C.S.M. (now Lieut. and Qr.-Mr.) E. J. Hopkins was ordered from Halifax to make a preliminary survey of the country round the city and the naval headquarters. The survey occupied some 2½ years, and on its completion an agreement was arrived at between the Imperial and Dominion governments for constructing defence works at joint expense. The Dominion was to pay the entire cost of administration and to hand over Work Point barracks at a valuation; the Imperial government, as its share, was to undertake the supervision of the works, to provide armament and also stores

for submarine mining, and to defray half the cost of the defence works.

In 1893, in pursuance of this agreement, Major H. H. Muirhead, R.E., was sent out with a small staff consisting of Q.M.S. Engineer Clerk (now Lieut. and Qr.-Mr.) T. H. Tennent, Q.M.S. Foreman of Works G. Reeve, and Sapper G. Longman (draftsman) with a view to preparing a scheme for fortifying the harbour. At the same time a detachment of Royal Marine Artillery was sent out from England to form the British Garrison, and was trained in submarine mining by the Royal Engineers.

In the following year it was decided that the construction of the defence works should be carried out by civil labour, on day work, under Sapper supervision; and Lieut. H. W. Gordon, R.E., was transferred from Halifax, N.S., with a detachment of 21 N.C.O.s and men of the 18th (Fortress) Company.

Lieut. Gordon was relieved in 1897 by Lieut. G. C. E. Elliott, and in 1898 Lieut.-Colonel Muirhead was succeeded by Major A. Grant, R.E. In September, 1899, the Royal Marine Artillery were replaced by a company of Royal Garrison Artillery; and a small detachment of 6 N.C.O.s and sappers was sent out from England for Submarine Mining duties under Lieut. B. W. B. Bowdler, R.E.

In May, 1900, half the 44th (Fortress) Company and the 48th (Submarine Mining) Company arrived from England under 2nd Lieut. P. H. French, R.E. In 1903 Major Grant was relieved by Major E. H. Bland, R.E.

During the time that they were at Esquimalt the Royal Engineers erected the following, amongst other, buildings:—Eight batteries for heavy, medium, and light Q.F. guns, a Submarine Mining Establishment, an Army Ordnance Depôt, and a considerable amount of extra Barrack Accommodation. For several years the R.E. carried out the duties of the Army Service Corps and of the Army Ordnance and Army Pay Departments; and Majors Muirhead and Grant were Officers Commanding Troops.

As in 1863 a proportion of the N.C.O.s and men of the British garrison have accepted permanent transfer to the Colonial Forces, and some of the officers have been temporarily appointed to the Canadian Army.

ARCHÆOLOGIA MILITARIA.

Notes by Col. O. E. Ruck, R.E., F.S.A., Scot., on Joyden's Redoubt, Bexley, Kent.

In the course of collaboration with J. Chalkley Gould, Esq., F.S.A., in connection with the earthwork section of the new Victoria History of the County of Kent, it became necessary to endeavour to unravel, by the light of up-to-date methods, some of the many subtle problems presented by numerous earthworks in the northern portion of this county.

Quite a number of these were found on consideration to be wrapped in no little obscurity; such for example as the Mote or Mount, known as Roughcastle, at the junction of the Milton creek with the river Swale; the rectangular (supposed) Roman station near Teynham on the Watling Street route; the little known but typical (supposed) Norman stronghold lookout post near Rings-Hill Farm, Wouldham; the rectangular (supposed) Roman camp at Queenborough at the junction of the Swale with the Medway.

Few of these offer a more interesting study than does the subject under discussion in the present notes.

The Field Redoubt in Joyden's Wood near Bexley, as the plan will indicate, is located on a site covered with primitive, almost primæval, works, the origin of which literally bristles with controversial theories well known to the scientific modern antiquary in general, but more so in particular to the local or county archæologist.

The immediate surroundings of this excellently preserved Field Work include some one hundred or more Dene-Holes, the periods of construction of which probably extend from the pre-metallic or neolithic age, B.C. 2000, up to the fleeting so-called present time; curved ditchways, usually without any ramparts, connecting the localities of these Dene-Holes; two very antient British roads or tracks; signs of a Neolithic Hut Circle settlement; besides a possible Tumulus or two.

The choice of the site of the main Redoubt itself has apparently been selected with a view to the domination of the whole occupied area, with an exquisite military taste. It has been fixed on a spot on a sloping plateau declining gently towards the north-north-east. It commands both of the pre-Roman Roads at their junction J (*see Plan*); one of these, the main British Way, running north-north-

east towards Dartford and south-west in the Ruxley direction, has been curiously re-appropriated for a short portion of its length in order to form a widened Fastigiate Fosse for the south-east face of the Field Redoubt.

This main British road was evidently one of the many older ways in Kent, which were antecedent to the Chatham-Dover Road—a Roman street christened Watling Street by the Saxons. The other (supposed) British Way, commanded by the north-east face of the Redoubt, ran north-west from the point of junction J in the direction of the Cavey Wood and thence onward, it is presumed, towards a possible ford crossing the River Cray—which at that time was almost certainly (as its Anglo-Saxon derivation tells us) a creek of the River Thames.

On the north-west face of the Redoubt, after a suitable glacis has been left, a steep ravine is encountered running north-east towards one of the Tumuli.

The whole locality is enshrouded in a dense forest of indigenous beech trees, undershadowed by a thick growth of hazel and alder; and to this fact may be attributed the exceptional state of preservation of the existing works. Some stone arrow-heads and roman pottery have, at one time, been found in the interior of this Redoubt.

The type of construction of the work itself cannot be reconciled with any forms known to be Saxon; on the other hand the weight of comparative evidence points to a Roman origin.

Various reasons may be adduced in support of this assumption; for instance, a very similar Redoubt, consisting of a single rampart and outer ditch, has recently been surveyed at Inchtuthill in Perthshire, within 150 yards of an undoubted Roman masonry Fort, and flanking the Via Principalis of the same as well as the old course of the River Tay.

The rectangular Redoubt at Inchtuthill measures 163 yards by 140 yards and contains 4·7 acres; its fosse is about 18 feet wide by 4 to 5 feet in depth; its rampart 20 to 24 feet in width by 4 to 5 in height. Neither sign of occupation nor gateways are discernible.

Our Kentish quadrilateral semi-rectangular Redoubt in Joyden's Wood measures 133 yards by 140 yards on faces meeting at south-west corner, and 130 yards by 159 yards on those meeting at north-east corner. Its ditch on three sides measures about 10 feet in width by 3 to 5 feet in depth; its rampart scales from 15 feet in width on the cutting line, and from 3 to 5 feet in height above that line, its width on top being 6 feet.

A section of the south-east face is given on the plan, showing how and where the antient British road, which is flanked by this face, has been re-appropriated as a defensive fosse, thus changing the former rounded shallow trough-shaped section of a pre-Roman trackway into a deep double-banked V-shaped ditch.

As a further comparative instance, it may be mentioned that this curious section is similar to and has its analogue in the section of the ditch near the main entrance of the undoubted Roman masonry Fort of Gelly-Gaer, South Wales—so constructed by Ostorius Scapula, with a view to supporting the wooden frameworks of its bridge approach, about the years A.D. 50—70.

Some further clue as to the date of construction of Joyden's Redoubt is afforded by the knowledge that by the year A.D. 48 the whole of Southern Britain as far as the Severn line was in the firm grip of the Roman power; thus we may, it is opined, legitimately infer that the Field Work under consideration may approximately be assigned to the period A.D. 43—53.

At this date the defended British Oppidum*, 10 miles to the eastward, sited on the summit of the Cobham Park hill, had probably already played its part in a defence against the Roman advance in A.D. 43, and had either been overpowered or outflanked and contained. Owing to indications of fallen-in caves and ditchways and shafts still existing in the interior of the Redoubt, it is likely that even an earlier occupation than that of the Romans applied to the Joyden's site.

The locality to the south-west of the Redoubt containing Hut Circles is curiously marked on the 6-inch O.S. map of 1863 as the site of the antient city of Caswallon, *i.e.*, the castle by the Vallum, thus pointing to a Celtic origin of these pit dwellings, a theory which has been investigated in the laborious researches of General Pitt-Rivers. This theory connecting the origin of Hut Circles with the iron age has been now relinquished in favour of one pointing strongly in the direction of a closer association of these dwellings with the neolithic and early bronze epoch, thus co-ordinating them with some of the environing Dene-Holes.

The supposed Tumulus to the north of the Redoubt is traditionally and locally known as the Roman Graveyard; it has, however, been opened quite recently with the result that no sepulchral remains could be discovered therein.

Whether Joyden's was a winter camp surrounded by the hutments of peaceful natives, who sought to enrich themselves by freely trading with their gallant conquerors, a Castra Cestiva or summer camp, or a Castra Stativa or stationary camp, it is difficult to say; one thing seems to be clear, and that is that it was not intended to form a very strong defensive work. The Romans, like their latter-day disciples the Japanese, did not shirk the labour of digging themselves in; for it is well known that, as a point of discipline, a Roman army never halted for a single night without forming a regular entrenchment as an essential precaution against surprise.

* See *R.E. Journal* for May, 1906.

For great diggers, marchers, and weight carriers were the Roman legionaries, that is when in their prime during the times of Scipio the younger; the probable result of a long series of campaigns brought to a successful close through the instrumentality of hardy territorial Militia troops raised at that time from country districts. For the Roman Empire, as Mommsen has well said, was as much a confederacy of provinces as a centralized administrative organization.

It certainly appears that the main object of the Joyden's Redoubt was to command the two British Roads at junction J; and situated as it was in the midst of Dene-Holes, it served also to control the local supplies in these debateable Caches or hidden store depôts for food, arms, or whatsoever else they contained.

No signs of Roman masonry have been found in the Redoubt, and it is very doubtful if further excavation would reveal much of importance; the ramparts like those of Inchtuthill are of aggested earth and gravel, including the spoil from the outside fastigiate ditch.

A typical Dene-Hole is depicted on the plan. It is one of the finest specimens of many such holes, which are supposed to be of smaller inside capacity in direct proportion to their age. That on the drawing is in Stankey Wood, Bexley; it is 70 feet deep and supported by four pillars, besides possessing two more which are now fallen down; the cubic capacity of its interior is sufficient to comfortably accommodate a medium-sized haystack. It is not one of those Holes which have been excavated by a stone or a bone implement, but has its origin in the iron age, and has its own pickmarks; its interior construction proclaims it to be not of neolithic type. It may possibly have been used during the Roman period as a rubbish pit, such as have in the past furnished the modern world with many a Roman relic.

The weight of recent evidence tends to point out the probability of these Dene-Holes having been chiefly constructed and utilised as hidden magazines for corn, forage, straw, hay, etc., the excavated material being used in its turn for enriching the fields adjacent to the hut dwellings of the native locations.

The curvilinear ditchways, with very slight (if any) ramparts, may either have been surface drainage channels, cross communications with a view to connecting Dene-Hole localities, or boundaries of tribal or family areas on the antient village sites; they do not appear to have been of a defensive nature.

An atmosphere of brooding mystery hovers about this historic scene. However jealously guarded are its secrets that there is continuity throughout forces itself on the perceptions as a fact to be conceded.

The mind is carried back away in imagination to those far distant times when the infantile native, Caractacus Minimus, jauntily beating the twilight retreat with the marrow bone of a badger upon the long

beetling skull of a recently unearthed neolithic man, dives into the forest only to encounter the last-joined Italian, Caristanius Junior, who has been tending a herd of Boves Longifrontes near the neighbouring creek of Creccaford, and be presented by the swarthy young foreigner with the latest up-to-date form of Roman toy in the civilized world, a wooden doll with jointed limbs complete.

But echoing through the woods upon the Hill Redoubt above may be heard the stirring call to arms of a martial race, in the harsh and fear-inspiring tones of their gracefully curved Cornuae and straight elongated Tubae. The uncanny mocking silence and awe-compelling dignity of this time-worn scene in Joyden's Wood cannot but fill the retrospective mind of the scientific military archæologist with the haunting memories of a long vanished but stormy period in the history of his own ancestral country.

*TEMPORARY WORKS ON SERVICE.**

By MAJOR E. P. BROOKER, R.E.

PART I.—ORGANISATION, ETC.

TEMPORARY BUILDINGS.

THESE are required in large wars, where armies may "sit down" for long periods even on the front line. They are always wanted on communications. Examples are:—Hospitals, rest camps, store depôts, remount depôts, etc. As they are required for other branches of the service than your own, you need to be acquainted with the work of such branches in order that your energies may be directed into proper channels.

It is a mistake to suppose that officers of other branches when they come to the R.E. for help will always hand you a site plan sketch, showing all the buildings, kraals, yards, sidings, platforms, water supply, and sanitary requirements that are necessary for their job. The average man is not trained in details and will forget half these things, or may make the most erratic demands for those he remembers. You have to closely cross-examine him on all he remembers and forgets, clarify his ideas for him, and generally put yourself in his position before you can decide what he really wants—quite a different matter from what he may have asked for. Hence the more you learn about these things in peace the better, and there is much to learn. This study has hitherto escaped attention, and the man on the spot has often done something voted creditable (in the absence of special training), something comparable to the first locomotive of Stephen Watts, or the first impenetrable pastry of a blushing bride.

To form some idea as to the amount of temporary building work a great war may demand, take the late South African war—hospitals only and excluding field hospitals. The wards were sometimes marquees, but their wooden floors, and the accessory sanitary buildings, stores, cookhouses, water supply, and drainage arrangements were constructed by the R.E. In the middle of the war, 1st November, 1901, there were 72 hospitals with 18,677 beds. Not many R.E. officers with units can have escaped work on that single heading. Four hospitals, all with hutted walls, fell to me. The Corps accumulated considerable experience on the various requirements of temporary buildings, and it seems very desirable that the

* Lecture delivered at the School of Military Engineering.

School of Military Engineering, our repository of knowledge, should not let remembrance fade before culling a residuum for instructional purposes. We may go to war again.

The subject is extensive when one goes into detail, and detail is soon forgotten from a lecture. I propose only to touch on it for illustration. But it is detail we want when faced with a job; and I hope the Construction or Field Works School will get out pamphlets with as much detail as can be collected, so that we may stuff one in our kits when we embark for the next considerable campaign.

As war engineers we are directly concerned in what I will call Superintendence, in organising both civil and military labour for rapid execution. We must be able to deal with large sums of money and all classes of men (including war sharks); and we must understand the workings of the staff and the duties of every branch of the army. As soldiers we must approximate to the staff in military matters, as engineers to the business-man builder rather than to the scientist architect. That latter phrase makes some of you sad. "Is it," you ask, "for your beggarly temporary works that we have approached the integral calculus, or dallied with the moody subtleties of Greek irregular verbs?" To this I would reply—"No, but learn your field construction first: it will not take long: and then, guided by the very useful start given you here in permanent work, you can take up any special scientific line afterwards." Do not, however, underrate this serious construction. War in a civilised country may want a deal of it, when large permanent works will need repairs requiring highly expert handling.

It is true that this permanent works knowledge required will be chiefly of a practical kind—applied engineering—and we are sensible of the difficulty that Division work at home does not always offer facilities for application. Personally, I have not been privileged to be in a home Division. But, if asked what I should do if I were sent to one, or what you should do, I should say something like this. If the Division work is routine and not heavy, it will not take much of your time. This country teems with engineering works, some of which your duties may connect you with. Use your opportunity to get into touch with civil works, and learn all you can there.

The difficulty in the case of young officers visiting works, or being attached there for special courses, is that they do not know what to look for and may consequently derive little good. But, they could do much if they would systematically use their imagination. Dissect the works in detail, and imagine what operations done might occur in war. The works themselves might not apply to war. No matter: many details do. How were those heavy weights got into those awkward positions? What is the engine-room staff, and why are five men needed rather than six? How is the coal consumption calculated and checked practically? Who does it? Why did that

man go and change that oil feed ? A cart goes by with a name on it not that of the contractor : what does he pay for hire ? If piece work, who checks the loads ?, how ?, what is paid per load ?, how many loads carried a day ? what are government paying in your district ?—in fact once you imagine yourself the contractor you soon perceive the hundreds of practical points that crop up. Here let me say that to find out things you must get known on works, and will learn more from the leading hand with the clay pipe than from the gentleman from the office in the frock coat. One visit with the latter should only be your introduction, and permission should then be obtained to stroll round informally when you like ; a cigar or two to the clay pipers will do the rest.

You are learning men and organisation, and when you are on service you will handle jobs with soldiers or civilians with a trained grasp that will not pass unnoticed. Therefore, put away the notion that on works you cannot be qualifying for active service ; on the contrary it is often your best chance as regards the real thing. Given the essential knowledge for every soldier contained in "Field Training," and by that I mean its practical application to problems on the ground, so that you understand its tactical value, then as a Sapper you may have to organise labour and carry out works of defence or attack. This will be child's play to the organisation required on large building works, and you need have no fear of comparison with the officer who has done nothing but purely regimental work, to any purpose.

What applies to the officer applies also to the men. When you are a practical engineer you are more efficient as a Company officer. You now can discriminate as to their trade qualifications, and their values as superintendents. You can try to make opportunities for some to improve their knowledge. In the 5th Company we had a N.C.O. whose name is on the Memorial Arch—Corpl. Dixon—one of the very best. It was chiefly owing to his practical skill and energy that we were able to grind captured corn and supply the Division with flour when supplies had failed. The Boers had destroyed parts of the milling machinery and Corpl. Dixon was able to patch it up.

What sort of knowledge is demanded for most temporary works ? Let us consider a typical case of such likely to occur. Suppose your Division has captured a town, where it is ordered to form an advanced base, leaving a garrison. The R.E. are ordered to provide a hut hospital for 200 beds, and you are told off to the job with a Section of your Company. Or it might be a remount depôt for 2,000 horses. Take the former case.

Firstly, you must understand how to organise your forces. Otherwise you feel overwhelmed and make the fatal blunder of trying to do everything yourself. Remember you are the directing brain to organise other people's labours : so sit down with pencil and paper

and rough out a skeleton of what this job involves. Then arrange your R.E. Section by trades and pick out the men most suited to staff the works, writing them against your skeleton headings. With so few R.E. the bulk of the work must be carried out by civil artisans and labourers—natives probably. It is not a question of your being able to fiddle about with a few R.E. carpenters for a month of Sundays: the sick in tents are waiting to come in.

The following is a sample of skeleton headings:—

Rough Scheme.

1. *Survey of Site Area.*—Plan 200′ = 1″, lines of levels to spring and drainage outfall.

Lieut. A. and 2 surveyors. Borrow Sapper X. (leveller) from other ½ Company. Looks up Survey Stores at Company Headquarters. Calls on Town Surveyor and gets map and a Y Level with Staff, arranges with carpenter in town for 500 pickets, etc., 2 draftsman's tables, etc.

2. *Collection of Materials.*

	Lieut. B.	
(*a*) Timber, nails, etc., for huts.	(*a*) Sergt. Plank	Round the town noting stocks and firms at ports, etc., any contractors.
(*b*) Water supply.	(*b*) Cpl. Plumber	
(*c*) Bricks, lime, sand, cement, etc.	(*c*) Cpl. Stock	
(*d*) Drainage.	(*d*) Cpl. Pipe	
(*e*) Smiths.	(*e*) 2nd Cpl. Hammer.	

3. *Collection of Labour.* Required on.....

(*a*) Skilled Labour. When camps ready?

(*b*) Unskilled. No. of each trade required to start.

4. *Works Camps.*

(*a*) R.E.
(*b*) Transport.
(*c*) Artisans.
(*d*) Natives.
(*e*) R.A.M.C.

} Fix Sites, erect cookhouses, etc. Water supply and drainage. See myself.

5. *Workshops.*—Sites, tools, etc. Temporary shops in town.

6. *Stores and Yards.*—Sites and buildings required. *Storeman*, Corpl. Cute; *Issuer*, Sapper Short; *Receiver*, Sapper Counter.

7. *Office Staff and Offices.*

Officers' room.

Clerks' room. Correspondence, finance, Corpl. Quill.

Draftsman's room.—Sergt. Compass; Lance-Corpl. Ruler; Sapper Scale.

You have now mapped out some definite method of procedure with individuals told off, who next day can all be co-operating busily in different directions, and with settled functions in front of them for executing the work. They will therefore be keen on it. You are also saving time by going on with preparations whilst the survey and site plan is being made, with plans for the first huts.

In making the plans be sure to talk them over with the Medical Officer. It is a general principle never to fail to consult the people who are going to use the buildings you are to put up. Show them your proposals in the rough, and say you would like to talk them over as a matter of courtesy—not for "approval" officially, because of course you take no orders from them, and reserve the right to decide R.E. matters subject to proper authority. Do not let us be "put off" this common-sense action because some individual may want tact, may try to give orders or ask for absurdities. In such cases it is better to listen patiently, and thank him for his views without promising anything. With some people you will only prolong the waste of your time and raise opposition by argument; so avoid it, though you feel certain to shine like Arcturus. There is nothing unnatural in the man for whom your work is done wanting to have a very big say, and whenever it does not really matter let him have what he wants. When it does matter stick to your guns and refer it if necessary. Your chief pride should be to execute your job well *without* having quarrelled with anyone. The more junior you are the more tact you require. Never send plans if you can take them. It is the natural tendency of people to sit down and make all the alterations they can if you give them time. But, for fittings and details try and get a word with the Quartermaster as to stores and with the cook as to his cookhouse. These are the people who instigate all sorts of demands for alterations and additions afterwards, and you save all this by consulting them first. Moreover, they generally know their job.

HOSPITAL SITE.

The site will probably be settled by a meeting with the Principal Medical Officer and a Staff Officer. So be prepared to give your opinion and to safeguard engineering requirements. These latter are suitability for

Water Supply.
Drainage and its disposal.
Lands.

Of course you will have to know something of the local conditions beforehand, and point them out.

Water.—(*a*). Springs.—Better keep clear and fence off, bringing in with, say, a 4-in. pipe main.

(*b*). Mains.—Best sited on the up side of the town. You control supply. For both watch the levels. Tap big mains little, and put in control valves at junctions.

Drainage.—Suitable slope and point of discharge.

Lands.—Public to be preferred. In Colonial towns building "stands" and roads are often laid out on plans—nothing on ground.

Town Hall office will show. Avoid "stands" sold to private persons. and the sites of projected roads.

Let us suppose the site settled. Unless the slopes are obviously apparent, you can set the surveyor to work levelling down from the water source and up from the drainage outflow point. To make a site plan, a contoured area about the size for the main aggregation of huts is wanted. For normal war requirements the R.E. officer should know these areas as he knows those of camping grounds. A pacing over the area selected would show him how he must vary type arrangements for this site owing to the ground. Take a hospital. If a small one it would have two main groups of wards separated by a dividing row of administrative huts; if a large one 4 groups, with 2 dividing rows at right angles through the centre.

Let us take your main block as 400 yds. by 150 yds. Fix banneroles on the ground at the corners. For right angles, if there is no instrument to be picked up, you can use a plane table. Peg out the sides every 100 ft., then across the middle, pencilling the pegs in letters on side and figures on end boundaries, and your interior pegs to correspond. Hand the surveyors a diagram and set them to fill in spot levels. From it you can make a plan, say 200 ft. to 1 inch with contours interpolated. On this plan plot the huts and drainage scheme; this will take a day or two; and some materials will have been collected meanwhile. From the plan, the rows of huts have then to be pegged out. This must be done carefully.

It saves time and errors to methodically work by a site plan on which the drainage and water has been considered. Do not be bustled by excited persons into what they call "making a start" before this is done. It will be a false start probably. You can keep them quiet by driving pegs and dumping some material handy.

MATERIALS.

The ease and rapidity with which tin buildings can be erected makes the use of the materials peculiarly adapted for war. One would, therefore, expect R.E. officers and men to be past masters in their manipulation. As we know they are not seriously trained in the matter. I have never seen a tool for cutting up corrugated iron in any tool box, and doubt if one can be obtained from the Ordnance. Our specifications and designs for corrugated-iron buildings are not the best for war conditions; this is not so surprising when we consider how seldom these buildings are wanted in peace.

In designing temporary buildings we should not proceed on the same lines as for permanent ones—*i.e.* we need not use expensive joints because theoretically they are correct, nor allow large factors of safety. We require neither the best materials nor the best workmanship, and should not waste money on them. If we find out the

general standard in use in the country, that should do, and in conforming thereto we make our work cheaper and easier. If the quality of deals imported is low you will probably get nothing else, though you may pay more by specifying higher grades.

Therefore, if you have to go into the market to buy materials, as you must in war, do your best to find out the prices and qualities of material in the market. There are such sources of information as quotations in the papers; you can ferret out information from local men not merchants; and if you run down to a coast port to get stuff you need not disclose your personality and errand until you have found much out.

If you are buying deals you want to get your eye in as to what a fair quality is. Go over the first arrival with a local carpenter or two, and notify the merchant you will deduct so much per foot for the twisted deals. Otherwise, he will see that you failed to notice anything and you will get all the rubbish in his yard. Another trick suitable for Government work is to rail up "by unfortunate error" 200 of 20 foots and 400 of 18 foots in response to your order for 300 each; that makes £2 or £3; the firm may be innocent, the money going to their yardman. It is seldom wise to write indignant letters. Indignation in business is waste of moral force. Keep morals in their business units, and deduct some money with a smile.

LABOUR.

The same applies to dealings with contractors and piecework labour. The profession has a keen instinct, and will size up what you know about values in about five minutes conversation. Do not think him a scoundrel because he asks 100 per cent. profit, and protests he will be ruined. If he judges this profit is only waiting to be picked up, rest assured he will try to take it. We all like golden sovereigns. To him it is a legitimate war of wits in which Government pays for its failure to insure against ignorance. Holding such cards he must go "no trumps."

In contracts there is a widespread delusion that the officer is quite safe here because he can, and by regulation should, put all his contracts up to open tender. No matter how contemptuous he may have been of business, he is supposed to be certain to get the cheapest possible price. For will not open competition make one contractor bid against the other? In restricted markets, such as towns in war, it will not. Ignorance of business will very soon be ringed in. Even in England, where the provisions of the Pawnbrokers' Act prescribe public auction of pledged goods, the law is in practice a dead letter. No mechanical systems, such as regulations, vouchers, and returns can ever secure economy of themselves. They can only prove it—on paper.

In South Africa ignorant officers were a mine of wealth to the astute contractor. But if you know what works should cost, either the game of ringing you in will not be tried at all, or you can defeat it.

It is clear that we cannot know the value of work in a hut, say, unless we have some system of estimating. Any of you who have been initiated into the War Office system will readily agree that this is practically useless for the hurry of war. It is the result of years of specialist effort and is probably the most perfect in the world. Practically it is based on repairs. But it should be kept for repairs, and for specialists. A much shorter method is needed for new works, and a still shorter method for approximate estimates and war services. The cube system is too vague.

The Colonial is eminently a practical person; and it appears to have struck him that taking such a lump sum price as 15s. for a square of framing (with the iron) over all the walls without deducting openings was near enough. Some walls would have more openings than others, but he had to cut the iron round them which takes longer than covering it. Moreover, as he rightly argued, why our virtue about accuracy when we add 15 per cent. for contingencies? The only test worth anything is how long does it take.

You may be sure the Colonial carpenter in South Africa did not enlighten us as to the various figures. We had to find them out. All we knew was that the men talked of squares, *i.e.* 10 by 10, or 100 square feet for iron surfaces or wood floors. Though any other measurement would do, it was as well to adopt local practice. By quietly keeping the time of unsuspecting men slogging away on a small contract figures came out, and the game of bluff as to prices was up. Once it was clear that you *knew*, the men would work quite amicably at reasonable rates.

The question has been put—why take this trouble? why not put the whole thing out to a big contractor, or employ daywork? You cannot put a large contract out without complete drawings and specifications, and the war will not wait while you try without any trained staff to make them. Some buildings are going up while you design others to follow. Hence your only methods are two—small piecework contracts and daywork.

Taken in order of expensiveness, we get

1. Piecework contracts, based on knowledge—1.
2. Large lump sum (not feasible) 1½ to 2.
3. Daywork under foremen—3 to 4.

A long way the slowest, most expensive, and troublesome is daywork—the refuge of the incompetent.

When one is ignorant one does not like to embark on piecework by small contracts; more especially as the men do not as a rule

encourage the idea for it only pays the really efficient. All the "wasters" are against it, because it shows them up. But your best course is to boldly dash into it without worrying that probably the first buildings given out will be at much too high a price. Most of the workmen will not know what the cost should be till a few buildings have been tried; and you may concede a high price for the first experiment and to get the system started without friction. By the finish they will know all about it; and you must keep the record of times secretly so that you will know too. Even if your price turns out twice too much, remember daywork would have cost nearer three times.

The whole atmosphere of works on piecework is different to that on daywork. I could always tell in a few minutes which the system was on any works visited. In daywork you and your foremen are the sole persons interested in progress; everyone else is against you, under the surface. When you go round—say twice a day, for you have too much to do to make more visits—there is a tremendous hammering and activity, for the lookout man, posted for the purpose, has signalled your approach. Then the "green" officer is pleased and remains blissfully unconscious that his cool and contented workmen are idling two-thirds of their time,—enjoying the rights of labour. By idling I include dawdling over the pleasant jobs—planing, sandpapering, etc. On piecework the pressure is from below; your foremen and storemen are besieged by the workmen, who snatch at the material and transport, and your R.E. staff, far from liking the bustle, are worked off their legs. It is a mistake that we have not latitude to give R.E. extra pay at discretion for such extra work. They are the only people on such a swinging job with a grievance.

I hope I have made it clear that with the best foremen daywork cannot compare in efficiency with piecework, and on active service the only foremen are the men of your unit. It is true that contractors sometimes employ daywork. But they know exactly what a day's work for each man is and see that he does it. They know their men and only keep the picked ones. Lieut. O'Connor, who knows all the points I have brought to your notice, tells me that, when visiting Lysaght's (a leading firm for corrugated iron) the other day, he went into the packing and despatch room and at once ejaculated the word "piecework." The foreman said "Yes—a wonderful improvement, but we had difficulty to get the men to take it on; now they like it." The wasters of course had to go, or be content to earn what they were worth.

ESTIMATES.

Let us just glance at an example of the rapid system of estimating which we evolved in South Africa, just to illustrate the possibility of arriving at the cost within a few pounds. As the father of this system, I may say that my object was to lump together items that

usually occurred in all huts, so as to get a few different unit prices as possible. Thus, 15s. was a fair price for making the framework of a wall and covering it outside with iron. Then I found that if you took a wood floor, and lumped in the piles for foundations, the plates and joists and flooring boards, you got another 15s. a square. The same with roofs measured on the iron, including trusses, purlins, iron, ridging, fascia, and plain barge-boards and soffits. One soon got accustomed to lower these prices or put them up a bit to suit abnormal cases.

Take a simple hut, say a linen store 60 ft. by 20 ft., with 10-ft. walls, 3 ready-made Swedish sash windows and 1 door to fix, etc.

Carpenter.

Calculations.		Items.	£	s.	d.
Walls—Sides,	2 × 60 × 10 = 1200	77 squares at 15s. ...	57	15	0
Ends,	2 × 20 × 10 = 400	Fixing 3 windows, 15s.	2	5	0
Gables,	2 × 20 × 7 = 280	„ 1 door, 20s. ...	1	0	0
Roof	2 × 63 × 13 = 1638	Flight of 3 steps—3′ wide	1	0	0
Floor	60 × 20 = 1200	1 Box ventilator, 3′ × 2′		12	6
Ceiling	60 × 22 = 1320	2 Gable louvres at 12s. 6d.	1	5	0
Matching.....	2 × 60 × 10 = 1200	3 Tiers racking, 3″ × 2″, framework and flooring, 40′ long, 5′ wide	5	10	0
Walls	2 × 20 × 11 = 440				
	76,78	£	69	7	6
= say 77 squares.					

Say £70 = 466 hours at 3s., or any other local rate.

By checking results I found these prices very reliable when the total price paid was compared with total hours worked. I reckoned on the basis that the men should be able to make 25s. to 30s. a day, working overtime—the daywork wage for 8 hours was 22s. 6d.; and I reckoned that, compared with daywork, the cost to the public was about half to a third for labour, and the speed quite three times—a most important factor on service.

DESIGN.

For temporary work you do not want the best material and workmanship. The R.E. officer who designs huts that will stand up for 60 years is a public nuisance. Troops should not be put off permanently with temporary accommodation, and it is your duty to see that your tin buildings will fall down by the time they become insanitary.

It is a matter of common sense to decide in each case what the quality of the work should be. Thus, your drainage and water can seldom be too good. Then, because you decide to go in for light construction, do not confuse this with the shoddy and ugly. Nothing is more necessary than comfort and cheerfulness; and by your business-like piecework system you can provide good accommodation and pleasing exteriors where for the same money the ignorant man will supply discomfort and eyesores. You give better accommodation because with the same material you use lighter scantlings and cover more space (see drawings); and you can use decorative designs because you employ no daywork men to spin out this work and make it expensive.

The accompanying photos show some of the huts erected at Barberton and Middleburg, Transvaal, in the late war. The design is not so very important for service: the really important thing is good practical knowledge of organising your jobs on business lines. I have drawn your attention to the few points time allows; but trust I have said enough to persuade young officers that their object should be to acquire all the practical engineering knowledge they can which is likely to be useful in war. In that sense we may truly subscribe to the much-discussed adage "Soldiers first: engineers afterwards."

The best practice for the Corps in peace at home would be to treat "works" like musketry, whole units being given some definite building work for a definite period during the year. The Commanding Officer should be given a ledger and funds, form a staff out of his unit, employ civil labour, buy stores, and carry out the job as a sub-district. If no suitable works are available at any unit's station, put the unit under canvas where there is work. This would be war training. It should be carried out under the Financial Regulations for war, not those for peace; and any loss due to freedom from peace regulations should be considered as money spent in training. In a few years time, when units had accumulated experience, blunders would be avoided; and it might prove that work so carried out was cheaper than work done under peace regulations. The gain to the Corps in practical business knowledge would be very considerable, if officers had this opportunity of making their own prices and fixing rates of labour, as they must in war. Had the spending branches of the Army been trained during peace on these lines, there would have been no such scandals as have necessitated the present Commission on the sale of War Stores in South Africa. Ignorance must always cause blunders, and prove an irresistible temptation to dishonesty. A financial system which is incompatible with education and consequent efficiency, is never found in the business world. There would be no dividends.

TRANSCRIPT.

SOME FIELD FORTIFICATION DEDUCTIONS FROM PORT ARTHUR.*

By A. B. von Swartz.

In this article A. B. von Swartz continues his "Notes from an Engineer's Pocket Book." His experiences were drawn from the fortification of the Kin-Chow (Nanshan) position and the smaller works constructed in connection with the Port Arthur defences, and deal more with semi-permanent than with the more rapid forms of field defences.

1. Rifle Trenches.

Rifle trenches must have good view and good field of fire. They should be protected from shrapnel and, as far as possible, from rifle fire; the chances of a direct hit from a shell are small and may be neglected. When trenches proved untenable it was always from one of two causes, either (1) the fire of big guns, which literally exterminated them, or (2) unskilful construction. The men in a badly constructed trench, without casemates and traverses, had no confidence and did not fire calmly.

A trench should be well adapted to the site, cleverly masked, and provided with the necessary cover from front and flanks. These are very elementary principles, but it is noted with regret that they are often neglected.

The following are the requirements of a good rifle trench:—It must

(1). Allow the rifleman to fire in comfort.
(2). Give cover from shrapnel and rifle bullets of the enemy.
(3). Be protected against flanking fire and splinters.
(4). Be as little as possible visible from the front.
(5). Give necessary communication without impeding the shooting.
(6). Have covered communication with neighbouring trenches and with the reserve.

Condition (1) is attained by using a profile suitable for firing standing and making the men get as close as possible to the front parapet, with left elbows on an elbow rest; (2) by loopholes and "hoods" (light overhead cover over the loopholes), and by giving the trench vertical sides;

* Translated by permission from articles in the November and December, 1905, numbers of the *Eenzhenernee Zhoornal*.

(3) by traverses of sandbags or other suitable material; (4) by careful masking, and reducing the height of the parapet; and (5) by making a step for the men firing, and widening the trench in rear of them to 1½ or 2 ft. The trench shown in *Fig.* 1 is a good example; it was constructed, in stony ground, in front of Fort No. 3 (Erlungshan) at Port Arthur.

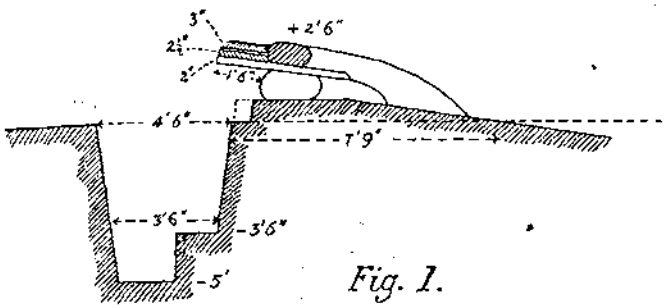


Fig. 1.

Of late there has been a tendency towards abandoning parapets altogether. This idea can be carried too far; and it would be more correct to say that, depending on the ground, object, and site, a parapet may be anything from 0 to 4½ ft. high. If the site allows a good field of view and fire from the ground line and the soil is not too hard, then it is best to have no parapet; but it is not sound to fatigue the men with heavy work in hard ground, especially on the eve of a battle, when the object can be obtained by lighter methods.

For example, when arranging the defences of Kinchow in the winter of 1904, very hard ground, almost continuous rock with only 6 inches of earth above it, was met with on the right flank; at the same time the work was pressing owing to the special importance of this flank. At first blasting materials were not available and the parapet was made up with earth carried from the neighbouring fields, being made 3' 6" high and 3' 6" thick, with an exterior slope of 1/1 and a small trench in rear about 18" deep. Later on it was improved to the profile shown in *Fig.* 2; the

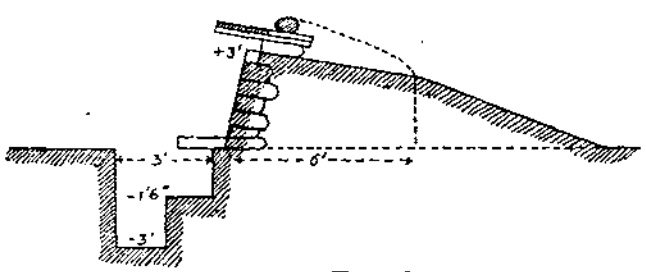


Fig. 2.

outer slope was made flatter, and the inner trench deepened and made wider; the parapet was also loopholed, and a great number of splinter proofs provided. The "hoods" over the loopholes, for protection against shrapnel, were of 2½" planks without a covering of earth. By day the riflemen stood on the step and fired through the loopholes; and

at night the planks were taken down and fixed at the ground level, and the men stood on them and fired over the top of the parapet. The result of this was so good that during the whole day of the battle of 26th May the company occupying this trench, in spite of the terrible fire of the enemy, lost only one man wounded.

But this form of trench is only suitable against field artillery. Against heavy guns the trenches should be sunk as low as possible. In order to make a trench less conspicuous and less vulnerable, it may sometimes be advisable to sacrifice fire and leave a certain amount of dead ground in its front; but in this case neighbouring trenches must support one another and in combination command all the ground in front.

For example, in part of the second line covering the ground in rear of Forts 2 and 3 (Kikwanshan and Erlungshan) at Port Arthur the trenches were under fire from 11-inch howitzers and were cut very low into the rock, with only an 18-inch parapet; but dead ground was avoided by suitable combination in siting them.

At Port Arthur a trench for one company was constructed in front of Fort No. 3; traverses were provided in it, but later on it was decided not to hold it and no splinter proofs were built. Subsequently, after the capture of the Aqueduct and adjacent redoubts, it became necessary to offer a stubborn resistance to the enemy's advance on Fort No. 3, and the trench was then made use of. During the three months' interval the parapet had become overgrown with grass and was well concealed. The ground was soft. The riflemen were spaced at $3\frac{3}{4}$ paces apart, and each dug himself into the parapet and built up small traverses with sandbags; they also prepared loopholes and "hoods" and small recesses to hold cartridges and food. Its total length for 200 riflemen was 700 paces (*Fig.* 3). The work was completed in two nights and the

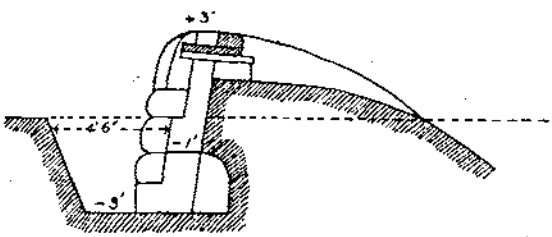


Fig. 3.

results were excellent. Though between 800 and 900 paces from the Fort, with difficult communication, and weakly supported, it held out for nearly a month.

The usual dimensions of the trenches at Kin-Chow were as follows:—parapet 2' high and 4' thick, firing step 2' 6" deep, and trench 4' deep. The parapets of the trenches were not destroyed by field howitzers, but the exterior slopes should not be steeper than 2/3 to 1/2 or even 1/3. When fortifying a position some time before it may possibly be used, the precaution should be taken of sowing grass seed on the parapet.

Fig. 4 shows a trench for men lying down. It is narrower than the pattern formerly made, and the rifleman has to fire lying on his side, but he is considerably better protected.

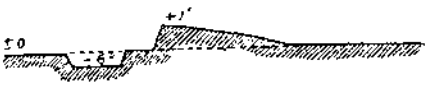


Fig. 4.

Trenches for fire kneeling would probably be made so for want of time, and consequently there would probably be no time for making traverses or loopholes. Under these circumstances it is a good thing to make the crest of the parapet undulating, between (say) 1′ and 1½′ in height, with the trench 1½′ deep. This arrangement partly compensates for the absence of loopholes, helps to disguise the trench, and does not take any more time than if the parapet were level. The Japanese trenches constructed in this way were hardly visible.

2. DISTRIBUTION OF TRENCHES ON A POSITION.

The unit of rifle trenches is the trench for one (double) company. In rear of the company trenches lies the communication trench, with which the company trenches are connected by approaches.

It is open to question whether the company trenches should be directly connected with one another. If so connected they have the great advantage of rapid communication between one another, but if disconnected it is more easy for the company commander to look after his own men. Moreover, if a few of the enemy get into a continuous trench, they can cause a panic under the influence of which the men will run away right and left, which could hardly occur in disconnected trenches.

There is also the question of occupying the intervals between companies in a continuous trench, either by placing in them the local reserves or by occupying the whole length at (say) 10 paces interval instead of 3. In the one case the reserves would not be where they may be most wanted; and in the other the firing line would be too thinly held to develop the required intensity of fire.

The balance is in favour of disconnected company trenches. But of course, if there are enough troops to man them thoroughly, continuous lines of trenches throughout the whole length of a position should prevent all possibility of the enemy bursting his way through, which is always possible when intervals exist between the trenches. The defending force, however, must be large enough to supply:—

(1). Suitable outposts.
(2). A strong firing line.
(3). Local reserves.
(4). A general reserve.

The Kin-Chow position was strengthened by continuous lines of trenches in two, and in some places three, tiers; but they were thinly held, there

were no local reserves, and the general reserve remained inactive, so the position was consequently lost. At Wolf's Hill there was also a continuous line of trenches at the foot of the position; but it was only occupied in parts, and on the 30th July the Japanese crept up secretly and appeared in the trench side by side with the men of the 13th Regiment, who forthwith began to fall back.

The size of the intervals between trenches depends, (1) on the number of men available for the defence of the position, and (2) on the nature of the ground; but it should not be greater than half the length of a company trench, *i.e.* not more than 200 to 300 paces.

The distance of the communication trench in rear of the company trenches depends on the nature of the ground; but it should not be so small that both communication and company trenches can be hit by the same shrapnel, *i.e.* it should not be less on level ground than from 400 to 500 paces. Of course the case is somewhat altered if the communication trench, in addition to its real object, is also utilised for bringing a second tier of fire to bear on the ground in front.

During the fortification of the Kin-Chow position some experimental firing was carried out against dummies, a reserve (20 head targets) being placed 200 paces in rear of a firing line (25 waist targets placed in a trench 1½ paces in rear of the parapet). Six common shell and thirty shrapnel were fired from light field guns at 1,925 yards range. Three shell hit the parapet without doing any harm; while 16 targets in the front line and 12 in the reserve were hit by shrapnel. This large percentage of hits was explained, (1) by the accuracy of modern artillery, (2) by the fact that the front line targets were standing too far back from the parapet, and therefore were not protected by it from bullets descending at a slope of 1 in 6, and (3) by the reserve being too near the firing line and directly behind it. This experiment shows that, (1) the reserve must be fully 400 to 500 paces from the firing line, and not directly behind it, (2) that the riflemen must be close up to the parapet, and (3) that the destructive effect on trenches of the explosion of field artillery shells is insignificant.

Trenches should be sited to avoid as far as possible the risk of enfilade fire. Otherwise they must be strongly traversed, but the existence of many traverses in a trench interferes with the free movement of reserves coming up and hinders the removal of the wounded.

3. FIELD CASEMATES.

In a well-arranged trench, besides cover from splinters and shrapnel bullets, there must be a certain amount of cover from field howitzer shells. The late war has also shown that now combatants are not contented with field artillery, but generally manage to bring up long range guns of 120 or 125 millimètre calibres. Owing to the difficulty of transport the presence of 150-m.m. (6-inch) guns is less probable.

In the Kin-Chow position the casemates were about 6′ wide; they were roofed with one row of beams, 8′ long × 15″ × 12″, over which were laid sheets of matting, and on top 3′ 6″ to 5′ 0″ of loamy earth. Not one casemate was

pierced by shells of the enemy's guns, either field or 120-m.m. When a casemate was hit there was a great vibration. The craters were found to be, for field guns, 6″ to 9″ deep and 1′ to 2′ diameter, and for 120-m.m. guns, 2½′ deep and 4′ diameter.

It is important that the beams should be dogged together. In the Port Arthur defences an instance occurred where a 6-inch shell ricocheted off a casemate in which the beams had not been carefully secured, and a beam was dislodged. It is not certain that anything but a greater thickness in the earth covering would have prevented this, but dogs would certainly prevent the casemate from being shaken to pieces.

The 'hoods' for protection against shrapnel were constructed as follows:—A stake was laid across over the loophole, and two more stakes were driven into the parapet above it, projecting about 18 inches; on the latter 2½″ planks were laid, and on these 3″ of earth. It is not important that the earth should be more than 3″ thick, so long as the whole of the 'hood' is covered; and if damaged the men repair it. Sometimes, however, no earth at all was used, and the planks were kept at the bottom of the trench and only put up during the fighting.

Some more examples of casemates are given. In one the roof consisted of 9″ beams with two layers of rails and 2′ of earth above them; this was struck by 6-inch howitzer shells and completely destroyed, the rails being bent into knots. In another the roof consisted of two layers of beams 12″ and 8″ thick with 1′ 6″ of earth; this was destroyed by the shells of field howitzers, and the beams were broken and scattered. The casemate shown in *Fig.* 5 gave very good security against shells, and was not hit though made in a trench in the firing line; it is of course very narrow.

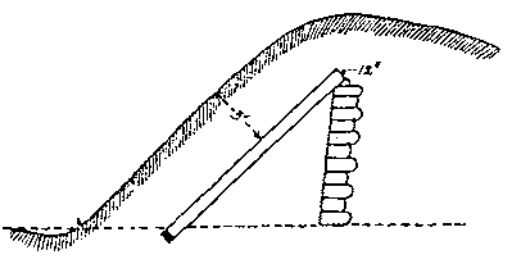


Fig. 5.

Casemates with 3′ of earth resting on 12″ beams were proof against the shells of field and 120-m.m. howitzers, but could not resist 6″ howitzer shells. To protect them against the latter they were given an additional 18 inches of stone and on the top were laid sheets of mild steel ⅝″ thick. One of these was struck by a 6″ shell and was not pierced, but the steel sheets were scattered and a crater was formed 2½′ deep and 6′ to 8′ in diameter.

In the roof of a casemate the earth is the essential feature and the beams or rails are only necessary as supports for the earth. To be proof against the shells of field howitzers 3′ of earth is sufficient, but against 120-m.m. howitzers it is necessary to have 4′ to 4½′.

4. Loopholes.

The Japanese appear to have favoured sandbag loopholes somewhat less than the Russians, the latter considering them quite essential. But they must be carefully made. It is of no use to lay two sandbags on a parapet and place a third across them and call it a loophole; such a loophole only shows up the crest of the parapet and the position of the men behind it. It is quite possible to make a loophole which cannot be seen from the front; it must combine well with the parapet in front and on the sides and its opening must not be seen against the sky.

Some of the loopholes at Port Arthur were very badly screened, so that it was often possible from the front to count how many there were and in that way ascertain the number of men in the trench. The work of constructing a loophole is very delicate and requires great attention. The loopholes in the trench in front of Fort No. 3 were perfectly screened. *In order to conceal the opening of a loophole it is best to hang from the 'hood' behind it a small curtain, and then neither the opening nor the movements of the men behind it can be seen.*

5. Siting Field Casemates in Trenches.

It is interesting to note that the Russian and Japanese methods of siting field casemates in trenches were diametrically opposite to one another. While the former at Kin-Chow and Port Arthur placed their casemates in the trenches themselves, the latter placed theirs slightly in rear of the trenches and connected with them by short approaches. In constructing their second line at Port Arthur, however, the Russians more nearly approximated to the Japanese method, especially where they were able to place their casemates behind a knoll with their trenches running round the front of it.

The Japanese method has the advantages that the casemates do not impede the traffic in the trench and do not take up room in the firing line. But the casemates are certainly more useful in the trenches themselves. The whole question of field casemates should be reconsidered, as these structures are not really safe against either indirect or direct fire and only one method can be called thoroughly reliable—that of mining. A mined casemate can be excavated at the same time as the trench and requires much less material, especially in hard ground (*Fig.* 6).

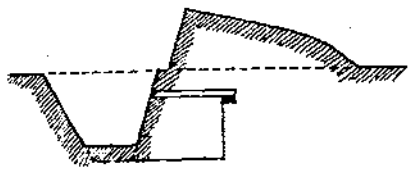


Fig. 6.

Mined Casemate in Trench.

6. MASKING TRENCHES.

To make a trench invisible from the front it should be masked. The best means of doing this is to make its parapet the same colour as the surrounding ground. When the defences are being made some time before they may be used, the parapets should be sown with grass seed; otherwise they should be covered with sods. But these precautions are useless where the exterior slope of the parapet is too steep. An exterior slope of 2/3, as hitherto accepted, is too steep, and with such the lines of a parapet, even if covered with good turf, are distinctly visible.

The Chinese wall at Port Arthur was a good example of this. It had been made by German engineers during the Sino-Japanese war, and was covered with grass exactly like the surrounding ground. But with its height of 4 to 9 feet the exterior slopes of 1/1 and 2/3 made it distinctly visible. On the other hand a parapet with an exterior slope of 1/2, or better still 1/3, if well masked with sods or growing grass, can be made completely invisible.

Dummy trenches placed either behind or to one side of the real trenches are useful for drawing the fire of the enemy; but they should not be made too conspicuous or the deception will be quickly discovered.

At Port Arthur the soil for 1′ to 1½′ below the surface consisted of yellow and red clay; below this it was stony with some rock The grass on the hills was too thin and in the hollows too rank to yield good sods, and these could not be obtained nearer than the valley of the Lun Tse, so that they came in very slowly and were very expensive. A great portion of the defences were consequently left unmasked.

But the expedient was tried in a few cases of painting the parapets the colour of the surrounding ground, the paint being poured on with watering cans. Disguised in this way a parapet could not be seen with field glasses at 80 paces, and many more would have been similarly treated if the material had not run short. At first it was expected that the colour would either be washed away by the rain or blown away in the dust, but by careful preparation of the solution a crust of it was formed on the parapet and lasted well. The possibility of varying the shades made the work more realistic than sods themselves, while it proved to be very economical, took less time than turfing, and required less men, no small consideration in war time.

7. SITING TRENCHES WITH REFERENCE TO WORKS.

In arranging trenches and works with reference to one another, two general systems were adopted, and all the positions in Kwang-Tung are examples of one or the other.

In the Kin-Chow position, in the front line, the works stood somewhat in advance of the trenches; the latter started from the gorge angles and were to a certain extent curved towards the rear of the position. The works were open to the rear, except that the trenches were carried

across their gorges for the convenience of communication. These lines were in the lower part of the position; in rear of them, on higher ground, was a line of closed works from which they were completely commanded. The two lines were connected by communication trenches.

The second system was exemplified by the defences of the Aqueduct and the gorge of the Lun Tse at Port Arthur. Here the trenches lay in front and the five works were somewhat in rear of them. This happened in the following way. In June, 1903, the site for the Aqueduct (Kuropatkin) redoubt was chosen on a knoll in front of the reservoirs. When it came to be built in February, 1904, it was found that, if it was placed on the front end of the hill summit, dead ground would be left in rear, where the enemy could collect if they had succeeded in passing round the flanks. To avoid this dead space the redoubt was placed farther back and then dead ground appeared in front. To command this ground a trench was carried round the front of the hill and joined to the two redoubts which stood on either side; behind the western of these redoubts were placed two lunettes.

It should be added that there were wire entanglements in front of both systems. But at Kin-Chow they were from 175 to 300 paces distant from the front line, and at the Aqueduct redoubt only 30 or 40 paces; while at Kin-Chow there were barbed wire entanglements in the ditches of the works themselves, and at Port Arthur there were none.

On examining the Kin-Chow system we see that the works were really points of support to the trenches, and the latter were curved somewhat inwards, so that without depriving them of their power to develope a strong fire to the front, they were enabled to bring a cross fire in front of the works to combine with the flanking fire of the works themselves. This arrangement, by making any attack on the intervals between works exceedingly difficult, caused the attacks to be directed against one or more of the works themselves, which by construction and equipment were especially well qualified to withstand them. Such a work in the front line should of course take the form of a lunette open in rear, so that it may afford the enemy, should he capture it, no position from which to resist a counter-attack.

In the battle these opinions were completely justified. The Japanese directed their attack against Lunette No. 4, which lay in the left of the front line, and two companies were destroyed in the wire entanglements. After this no more attacks were undertaken, and no further advance was made until the turning movement compelled the Russians to evacuate their position.

Entirely the opposite took place in the first attack on the Aqueduct position. Here in the first assault the enemy carried the trench and even occupied the outer ditch of the redoubt itself. An heroic counter-attack surprised the Japanese during the following night and drove them from the ditch of the redoubt. But the trench was never re-taken, and it served as a base for the systematic attack on the redoubt, which ended successfully on the 20th September; and when it fell the neighbouring redoubts were also lost, and with them the lunettes in rear of the western one. If

there had been open works instead of the redoubts, and closed works where the lunettes were, this would not have happened, as the forward works would probably have proved untenable owing to the fire from those in their rear.

The following points should be noted in the combination of trenches with works :—

(1). They should give each other mutual support.

(2). Works serving as points of support should be drawn somewhat forward to enable them to flank the trenches in their intervals.

(3). The trenches should start from either the gorge angles or the centres of the flanks of the works ; and should have a certain amount of concavity of trace to enable them both to develop a strong frontal fire and also to support the works with their cross fire.

(4). Works in rear should be closed, *i.e.* redoubts.

(5). Works in the front line should be open, *i.e.* lunettes.

The only case when a closed work should be placed in the front line is on an extreme flank when there is a possibility of its being turned.

Further examples of the mistake of placing closed works in the front line were the redoubts called East and West Panlung Shan, between Forts Nos. 2 and 3 at Port Arthur. They had dead ground in front and also in the hollows on their flanks, and were encircled by trenches, and from their gorges connecting trenches ran to the Chinese wall about 200 paces in rear of them. Owing to the configuration of the ground the Chinese wall gave them but little support, and after they were captured their gorges enabled the Japanese to resist all counter attacks made on them. But for these unfortunate gorges the fire from the Chinese wall would have rendered the redoubts untenable.

In only one instance was a lunette placed in the outer line at Port Arthur, and there the experiment was attended by the most excellent results. This was the Kuropatkin lunette, south of No. 2 (North Kik-wan-shan) Fort, which was actually occupied by the Japanese ; but owing to the fire from Fort No. 2 and the Chinese wall they were unable to hold it. If it had been a closed work they could not have been driven out, and Fort No. 2 itself must have been evacuated. This was fully appreciated by the Japanese.

8. DETAILS OF FIELD REDOUBTS, ETC.

The essential difference between redoubts, lunettes, etc., and trenches lies in the exterior ditch. In all other details they are identical, except that the dimensions of the former are generally somewhat greater than those of the latter. Therefore all the requirements of a well-constructed trench apply equally to redoubts and lunettes, and the degree of resistance afforded by the latter depends on the extent to which the outside ditch can be made into an effective obstacle which the enemy must surmount under the direct fire of the garrison.

The following are important points to be attended to in constructing ditches :—

(1). They should be made as deep and as wide as time and available labour permit.

(2). Obstacles should be made in them, if the nature of the ground or other circumstances do not allow of the ditch itself being made an effective obstacle.

(3). The plan and profile of the work should be so arranged that every part of the ditch is under either flanking or frontal fire.

As regards the parapets, if the configuration of the ground allows, they should be dispensed with.

Experience shows the following to be desirable :—

(i.). No parapet above the ground level.

(ii.). Field casemates constructed by mining.

(iii.). Means of safe observation of the enemy during the bombardment preceding an assault.

In fortifying the Kin-Chow position, four old works in the main line were repaired and four new works were made in the front of the position. Of these last four, three were made open with no defences in the gorge, except that a communication trench was carried across to connect together the trenches which started from the rear angles of the works; the fourth, which protected the right flank of the position, was made closed. All these works were placed on the front slope of the position, and it was consequently necessary to raise their parapets above the level of the ground. But the works on the main line of the position had very low parapets, in no case more than 2′ high.

Three of the Kin-Chow works are described in detail. The first, Redoubt No. 2 on the right of the front line and south of the railway, was intended to cover the right flank and prevent a turning movement in that direction. Its front commanded the ground between the railway and Hand Bay and the outskirts of the village of Madotun; its left flank supported the trenches and flanked the wire entanglements in front of them; and its right flank fired over the shallow waters of the Bay and flanked a short length of trench which protected a well and the village of Teedyaten. As the work was on a flank, and as there were no works in rear to fire into it if it were captured, it was made with a closed gorge. A company of 300 men was told off for its defence, and, after deducting 75 for reserve, the parapets were constructed at the rate of 7′ per man. The parapet was 4½′ high, built up of earth carried from the neighbouring fields, for the ground was so hard that it was impossible to dig more than 6″ below the surface, there were no blasting materials, and the work was urgent. Later on, when blasting materials were obtained from Port Arthur, a considerable amount of excavation was done, especially in the exterior ditch which was made 3½′ deep and 14′ wide at the bottom and 17½′ at the top. To improve the ditch as an

obstacle a barbed wire entanglement was put into it, with three-pronged spikes on the posts, and a gently sloping glacis was made to screen the entanglement from sight. Inside, at right angles to the parapet, were built up sandbag traverses and between them four field casemates, one for the company commander, one in the gorge for the wounded and telephone, one for the cookhouse, and one for the garrison. In a casemate in a small trench in rear was placed the latrine. At intervals in the parapets were niches for cartridges, and in all firing lines were loopholes protected by "hoods" from shrapnel. The casemates were made with stout 12″ beams, with 3′ to 3½′ of earth over them. The gorge parapet was screened from the front by rear traverses (*Fig.* 7). At the outer angles of

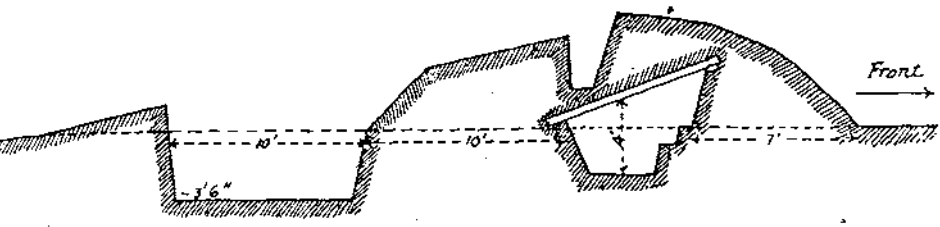


Fig. 7.

orge parapet of Redoubt №2 Kinchow, shewing casemate & parados.

the front face were two barbettes for light guns for opposing assaults and close by were pits for keeping them in; during the battle of 26th May these guns proved undoubtedly useful. The Japanese, having crushed the Russian artillery, decided to move up their own batteries to shorter ranges; one of these came to within 2,400 paces of this redoubt, whereupon the commander gave the order to bring the two guns into action and, though the redoubt was at that time under the fire of two more hostile batteries, this battery was forced to retire. During the battle this redoubt also achieved its object successfully, and owing to the good cover which it afforded only one man of the garrison was wounded.

The most northerly work, Lunette No. 4, had a parapet 3′ high, ditch 3½′ deep with breadth at bottom 14′ and at top 21′; outer slope of parapet 2/3. In the ditch was a barbed wire entanglement with three-pronged spikes on the posts. Communication trenches connected the front face with the light trench—also for purposes of communication—across the gorge. This lunette, being the point of support to the trenches on either side, received the full shock of the Japanese assault and repelled it splendidly. It should have had more traverses in its front face, which was enfiladed from the village of Lioodyap, but the possibility of the town of Kin-Chow being captured was overlooked at the time it was designed.

The third example was Redoubt No. 8, which was situated on the summit of the northern spur of the position. The right part of the work was on level ground and the left part on the rear slope of the spur. From

the front face a traversed road of communication, somewhat similar in shape to a cube sap, led back to the main line of splinter proofs, which extended right across the redoubt parallel to the face and contained separate casemates for the wounded, telephone office, and the garrison, while in the face itself there was a casemate for officers. Altogether in this redoubt there were 1,176 square feet of casemated cover. The roofs of the casemates were constructed with rows of beams 15″ to 20″ thick, with 2″ planks above them and on the top 3′ of earth. In rear of the casemates ran the gorge of the work, which was provided with a large number of traverses; the interior trench was 5½′ deep with two steps, the height of the parapet was 2′. The exterior ditch was quite insignificant. The trenches began at the right angle of the gorge. In the battle of the 26th May this redoubt was not thoroughly tested, as the Japanese were more than 1,500 paces distant when it was evacuated. Some of the casemates on the left half were broken by 10-inch shells. The good points about the design were the separate position of the casemates and the large number of them, the depth of the interior trench, and the arrangement of the lines of communication. The bad points were the absence of an exterior ditch and the insufficiency of traverses on the line of the face, in the whole length of which there were only small traverses of sandbags.

Redoubt No. 8 had been constructed in 1900 and was only remodelled by the Russians in 1904, all the casemates being added by the latter. If they had been free to select the site for this work, they would probably have placed it further back. This would have enabled them to dispense with a parapet altogether, an arrangement which should be sought after on all possible occasions.

Other points to be noted are that field casemates should be given up altogether in favour of deep caverns in the ground made by mining, and that every work should contain means of safe observation of the opponents. In this war loopholes were made use of for this latter purpose, but some special arrangement should be devised; it is a question of the greatest importance.

As to the intervals between riflemen in the firing line of a redoubt, in view of the power of modern artillery fire they should not be less than 3 paces. To place the men nearer to one another would be dangerous to themselves, and further apart their fire would be too weak. One-half reserve should be kept inside the redoubt. In the 3-pace interval between the riflemen there should be placed traverses and splinter proofs, and each man should be encouraged to dig himself into the parapet.

To protect the flanks of a work from enfilade fire it is useful to make them like a cube sap. It is also necessary to have in a work separate casemates for officers, for telephone, and for dressing the wounded; and there should be a casemated latrine. It is also most important to provide drains to carry away rain water from the interior trenches through the angles of the gorge. The casemated latrine and storm-water drains are as important to a fort as its ditches and traverses; the fort is a barrack for use in battle, and it is the duty of those who design it to provide for the comfort of the inhabitants.

9. ON THE SITING OF REDOUBTS, ETC.

The following are points to be observed in fixing the sites of redoubts, lunettes, etc. :—

(1). They should combine with the surrounding country, and not be raised above it so as to be visible from some distance in front.
(2). There should be a good field of fire, and no dead ground either in front or on the flanks.
(3). The faces should not be liable to be enfiladed.
(4). There should be secure communication with the reserve.

When laying out a work one should go to all the possible positions of the enemy and observe it from them. Such examination always gives valuable information.

The first of the above points is attained when the work can be made without a parapet, for then the shape of the hill is not altered and there is nothing to show that there is anything there.

In fortress warfare, or when preparing a position some time before it may be required, it is often useful to level ground in the immediate neighbourhood of the work in order to secure a good field of fire. It is better to dig away many cubic yards of earth than to leave dead ground in the near neighbourhood of the firing line. When the site of Lunette No. 4 was being selected, the first object was to obtain a good field of fire over the ground between it and the lunette on its right, and a very good site was obtainable in the fork of a double ravine, which satisfied this first requirement. But unfortunately it gave no field of fire to the left, so that a site had to be chosen on the far side of the ravine and a considerable area of ground in its immediate front had to be excavated to obtain a clear field of fire. In the end this work had in its front a ditch, three ravines, and two rows of wire entanglements (*Fig.* 8). It had also an excellent field of fire, and it was perfectly suited to the site both in outline and colour. Communication with the rear was obtained through the ravine, which was adapted to this object.

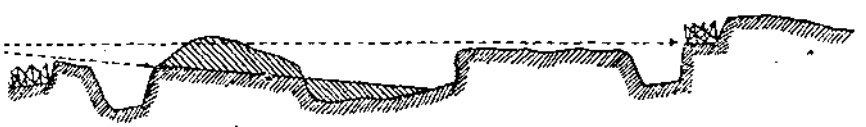


Fig. 8.

Section of ground in front of Lunette № 4 Kinchow, shewing excavation and arrangement of entanglements.

10. BATTERIES FOR LIGHT GUNS.

The complete revolution in artillery due to the introduction of quick-firing guns and smokeless powder has necessitated considerable changes in fortifications. In old times a high position with a good view and

field of fire to the front was considered a good artillery position. Now batteries can occupy such positions only in exceptional cases; they are better placed on the reverse slopes of hills, in hollows or ravines, at the edges of woods, and in such-like places; in fact the guns should be placed anywhere where the enemy would have difficulty in finding them. At Port Arthur the Japanese frequently placed their field guns in native huts and fired through the windows.

In the battle of the 16th May a Russian battery took up an exposed position on the top of a hill. It was in the act of coming into action against the hostile columns when it was struck by a shower of shells from some unseen battery firing at fully five times the rate of which the Russian guns were capable. In less than a quarter of an hour all the officers were wounded and half of the gunners were killed. Other Russian batteries posted behind the crest did good service without being hit themselves. After this first experience the Russian guns were always posted behind cover.

It became a rule that in hilly country the batteries must be placed on the reverse slopes of the hills, and on level ground in whatever ravines or gullies were available for concealing them. However, occasions occurred where this was not possible, as for example when the back slopes were too steep or from some other reason due to the nature of the ground. Then, when it was necessary to post the guns on the front slopes, great care was taken to render them invisible. It should be remembered that no reliance can be placed on smokeless powder for concealing the position of a gun, as the flash from the muzzle, if visible to the front, will always disclose its position.

Two examples are given of batteries of this class prepared at Kin-Chow. The first was constructed for four 87-m.m. guns, two firing to the front and two to the left flank. The summit of the spur was left untouched and the battery was placed somewhat down the front slope, the emplacements being excavated to a depth of about 6' and the earth removed leaving no parapet. Behind the guns was a casemate in which were a number of separate niches for ammunition; the casemate was completely concealed by the earth filling on the top of it. The guns were separated by traverses, and in front of them was a small trench provided with 'hoods' against shrapnel. The battery was so well disguised that it was not noticeable even from a short distance.

The other example was the case of an old battery which had been made in 1900 and which was repaired by the Russians. The parapet was visible from the front, though in colour it combined well with the surrounding ground. To deceive the enemy a traverse was constructed on the crest of the hill behind the battery, and during the battle the enemy mistook this traverse for the battery and directed their fire on it.

The 'open caponier' slightly to the front in the interval between West Panlung Redoubt and Erlungshan Fort is also described. It was situated in rear of a very small knoll; and consisted of emplacements for two 3-inch guns, which fired right and left, flanking the approaches to the above-mentioned works. The emplacements were excavated out and the earth spread on the sides; and in the natural traverse between them a

passage with a casemate for the gun detachment and a recess was excavated by means of mining. The ground round the battery, which was trampled and discoloured during the work, was dyed to the natural colour of the surrounding ground. The battery was quite concealed from the front. It gave great assistance to the defenders of West Panlung during the attack of the 27th to 28th August, and also prevented any attack on Erlungshan until it was itself captured.

On all other occasions it was insisted on that batteries constructed for field guns should be made without parapets.

11. COVER FOR INFANTRY SUPPORTS TO ARTILLERY.

All the batteries constructed by the Russians during the siege of Port Arthur were provided with trenches for infantry supports either in front or on the flanks. The distance between the trenches and the batteries varied according to circumstances. In the case of the 'open caponier' just described the trenches lay 200 paces to the front; in another battery some were 180 paces in front, and others lay close to the flanks. In another instance they were only on the flanks; and in another, where the ground in front fell rather steeply, the trench was only 50 paces to the front, but the author never heard any complaint that the infantry in the trench and the gunners in the battery were hit by the same shrapnel.

The author mentions parenthetically that a single wire entanglement round a battery is not sufficient, as it was clearly shown during the Japanese night assaults on the Wantai batteries on the 23rd and 24th August that such an obstacle was easily surmounted.

On level ground the trenches should be fully 400 paces in front of the battery, this opinion being based on the experiment with light guns carried out at Kin-Chow. In the battle of the 26th May the field guns were placed in rear of the position at a distance of over 1¼ miles from the trenches.

12. OBSTACLES.

Obstacles in the form of wire entanglements and land mines, especially the former, were very largely used during the war. Stockades and abattis were little used owing to the absence of timber; military pits also were not popular owing to the hardness of the ground. But wire entanglements were made in great quantities and on many occasions were extremely useful.

The Japanese first encountered these at Kin-Chow, where they were constructed almost continuously along the whole position except in a small portion of the left flank.

A. WIRE ENTANGLEMENTS AND FOUGASSES.

The entanglements were constructed with five rows of stakes placed chequerwise, on which was stretched wire of 5 to 3 m.m. thickness. In some places the total width of the entanglement was 21′ and in others 17½′. In the odd rows the stakes were 5·8′ long and in the even rows 4′, all buried 1′ in the ground.

The distance of the obstacles from the trenches in rear was from 375 to 170 paces according to the ground. In places roads of communication for use in counter-attack were left through the entanglements; these roads were constructed so that they should not be seen from the front by making the ends of the entanglement overlap. The entanglements were generally placed in the open; but, in order that they should not be seen, the white wooden stakes were painted with mud and water.

On one occasion only was the entanglement completely screened from view and then it played a very important part. In front of Lunette No. 4 at Kin-Chow, at 375 paces distance, there was a deep double ravine which was not visible from the front. The entanglement was placed under cover of the front side of this ravine and was under fire from the lunette (*Fig.* 8). The Japanese probably knew of the existence of the ravine and proposed to work their way up it into the position. With this object two companies came out of the village of Khuan and made a rush for the ravine. Here they were stopped by the unsuspected obstacle and all were destroyed by the Russian volleys.

It is undoubtedly advantageous if the obstacle can be placed under cover so that it comes on the enemy as a surprise; but care should be taken that it is under very effective fire from the work so that full advantage may be taken of the disorder of the enemy. There is also this risk in making a special trench for the entanglement in front of the position, that it might be converted into cover by the enemy when he arrives at it; this should not be possible.

At the time of the reiterated attacks at Port Arthur the entanglements were very useful, but they would have been better if they had been masked. The Japanese usually destroyed them by night, making use of pliers and grapnels.

A variation of the usual pattern were the barbed wire entanglements in the ditches of the works on the Kin-Chow position. To prevent them from being surmounted with the help of fascines or mattresses of kowliang straw, sharp three-pronged iron spikes were stuck in the tops of the stakes. Another variety, the electric fence, promised great things, but fell short of its working in peace time.

At Port Arthur fougasses were used in large quantities, and on a few occasions produced good results. It was found that a single row of mines is not sufficient. There should be several rows; and the last row should be as near as possible to the work, so that the opportunity given by the momentary panic caused by the explosion may be seized for a counter-attack with the bayonet. Solitary explosions of fougasses at 300 or 400 paces from the works will not stop an attack.

B. OTHER ARTIFICIAL OBSTACLES.

Other kinds of obstacles employed at Port Arthur were :—

(1) Nooses, like those used for catching birds,
(2) Planks studded with nails,
and (3) Frames made of bar iron.

The first were used in the defence of Subsidiary Work No. 3, and the second at Erlungshan Fort and on other occasions. In work No. 3 the snares were laid on the glacis and on the top of the parapet, and carefully concealed, the standing ends being made fast to pickets. The writer cannot vouch that they were of use against assaults, but believes they were; at any rate he knows of an occasion on which their own visiting patrol was caught up in them.

For the planks old $1\frac{1}{2}''$ boards, coloured grey, were used, and from both sides 3", 4", and 5" nails were driven through them. These planks were securely anchored to the parapets of the fort and of some of the trenches. As they could not be torn down they offered a serious obstacle to assaults, and eye witnesses say that in places they were covered with corpses literally 'nailed to the spot.'

The frames were made of iron rods, 8 to 10 m.m. thick. They were made in the form of cubes, truncated pyramids, prisms, etc., with the ends projecting at the angles, and were used fastened together with wire for obstructing narrow passages. Individually they were not of much use; and as they can hardly be made anywhere except in suitable workshops, they are not likely to be much used in field warfare.

The author concludes with some useful remarks on the principle of "festina lente." To secure success nothing should be done in a hurry. Better do little well and finish one thing thoroughly than leave a lot of work only half done, rushing spasmodically now to one thing now to another. Success is more likely to be attained by cool steady work than by that done under the influence of nervous haste or of the jumpiness induced by long expectation of the enemy.

F. E. G. SKEY.

REVIEWS.

A HISTORY OF TACTICS.

By Capt. H. M. Johnstone, R.E. (Retired).—(10″ × 7″. 15s. London: Rees; Chatham: Mackay, 1906).

Works on tactics abound, but their treatment of the historical side of the subject is apt to be sketchy, and a good English History of Tactics would be most welcome. Capt. Johnstone's book falls short of the expectations raised by its title, for the last half century occupies four-fifths of it. But except for this discrepancy between the title and the contents there is no reason to complain. As military lecturer to Edinburgh University he has rightly had in view primarily the wants of his hearers, who are more concerned with the present than the past.

Capt. Johnstone thinks for himself; his comments and criticisms are clear and definite, sometimes peremptory. His style is crisp and incisive, and there is no waste of words. Here, for instance, is his summary of the leading features of the Seven Weeks' War:—

"The triumph of the infantryman armed with the breechloader; an insufficient use of the great power of artillery; hardly any use of cavalry or engineers; great extension in the lines of infantry attack, instinctive tendency to lap round flanks, as the line of least resistance; immense importance of the company leaders, and of the training of the individual man's intelligence; the self-sacrificing action of the Austrian cavalry and artillery in the retreat; the inability of pursuing cavalry to effect much by direct pursuit, if the defender's cavalry and artillery act thus; the increasing power of artillery to stop infantry when the artillery is not required at the same time to engage with a superior hostile artillery."

The choice of apt instances is perhaps the chief crux in a history of tactics. It is easy to fill pages with miscellaneous facts about any big battle; but when we fasten upon particular points we find that reports are loose and vague, witnesses are silent or contradict one another. For instance, Home gives as the frontispiece of his *Précis* a reproduction of an old engraving showing Desaix's advance at Marengo. The right and left regiments have their centre battalions deployed, their flank battalions in column of double companies; the centre regiment has all three battalions deployed. Capt. Johnstone sees here an application of the *ordre demi-plein*. But the brigade reports printed in the latest work on the campaign (Cugnac's "L'Armée de la Réserve") speak of the left regiment as having two battalions in line and the third 200 paces in rear,

and the formation of the other regiments seems to have been similar. So Macdonald's description of the massive column which he led at Wagram does not agree with the reports of his divisional generals, nor do they agree with one another.

Evidence must be accumulated and carefully scrutinised, and it is this which makes the war of 1870 so instructive. For the earlier part of it we have now the French official history as well as the German, with numberless personal narratives to supplement them. The facts have been brought together and sifted with a thoroughness to which there is no parallel to be found in earlier or later wars. Consequently the chapters dealing with the Franco-German war are the best in Capt. Johnstone's book. In contrast with the results of Bredow's charge at Vionville, it is remarked that "at Custozza in 1859 (1866 by the bye) the Austrian cavalry attacked two infantry divisions with the greatest bravery, but did not break a square." This, though strictly true, does less than justice to the effect they produced, which has won them a place in Sir Evelyn Wood's "Achievements of Cavalry."

Capt. Johnstone says that the Prussians never adopted the view which found favour after 1866, that the power of the breechloader made it best to fight on the defensive. They certainly did not hold that the defensive was bound to win, but it was the course of events rather than preconceived theory that made them habitually the assailants in 1870. In the instructions drawn up by Moltke shortly before the war it was laid down:—"If we are able to take up a position which the enemy is likely to attack, whether for military or political reasons or from mere national vanity, it seems thoroughly advisable to avail ourselves of the advantages of the defensive before we assume the offensive."

There are two good chapters on the American Civil War, dealing with the battle of Gettysburg and the cavalry raids. "The splendid work done by the special companies of scouts is particularly worthy of notice; this scouting on the great scale requires picked men and much training, and it is worthy of very careful consideration whether we should not have in the British army a *corps d'élite* of scouts, specially recruited, specially trained, specially paid."

After touching on warfare against uncivilized races,—Turcomans, Afghans and Soudanese,—the author comes to the late Boer war which is illustrated by Lord Methuen's actions on the road to Kimberley, the cavalry charge at Klip Drift, and the fighting at Paardeberg. Here as with the Russo-Japanese war he has to work on materials incomplete and unverified.

Turning to the earlier chapters, its seems a mistake to say that "the British tactics [in the Peninsula] were on a higher level altogether than those of the French, just as Mesnil-Durand's system was on a higher level than that of Frederick." The methods cannot be classed according to their abstract merits, apart from the conditions under which they were used, the character of the troops and their commanders. So far as regulations go, the British tactics were based on Dundas's adaptation of Frederick's tactics. Too large a part in the development of the French tactics is assigned to Mesnil-Durand. The French drill book of 1791

was not his work, but the work of his opponent, Guibert. It was agreed on all hands that columns should be used for attack in certain cases; the real problem, which exercised Napoleon's mind, was how to combine the advantages of line and column. Wellington gave the pith of the matter when he wrote after the action at Sabugal:—"We have given the French a handsome dressing, and I think they will not say again that we are not a manœuvring army. We may not manœuvre so beautifully as they do; but I don't desire better sport than to meet one of their columns *en masse* with our lines."

If here and there one may dissent from Capt. Johnstone, one recognises none the less that he has written a most useful book, which must have cost him a great deal of labour. It is well provided with maps, most of which are excellent; some (*e.g.* Rosbach) might be improved. A list of the more important works from which he has drawn his materials might be added with advantage.

E. M. LLOYD.

THE ART OF ATTACK:

BEING A STUDY OF THE DEVELOPMENT OF WEAPONS AND APPLIANCES OF OFFENCE FROM THE EARLIEST TIMES TO THE AGE OF GUNPOWDER.

By H. S. COWPER, F.S.A. (Demy 8vo. Pp. xviii., 312, with 361 illustrations. Price 10s. net. W. Holmes, Ltd., Ulverston, 1906).

This is an eminently painstaking detailed work, the result of much reading, careful observation, and discriminating judgment.

It is the story of the evolution, in all their variety, of weapons of attack, from those prehistoric times when Homo-Primigenius, slowly developing into a so-called Homo-Sapiens, commenced to appreciate the advantages of his own cunningly devised tools, both as a means of supplying his omnivorous appetite, and also in order to steal a march on his less nimble-witted brother by slaughtering him at a personal disadvantage.

This book deals with the simplest up to the more elaborate forms, down to the days when the new idea of gunpowder as a propellant was used to give increased power and penetration to projectiles.

After a general introductory chapter and a fanciful sketch termed the "Genesis of Arms," Mr. Cowper opens his subject by discussing the arming of the hand, beginning with unhafted appliances for mauling, striking, bruising or ripping. Some of the weapons of the primitive knuckle-duster type are truly terrible. In the same chapter the simpler forms of bashing clubs, as well as swords made of wood and of bone, ar described with appropriate diagrams.

The next chapter, termed "Reinforcing the Arm" treats of the developments which began in the combination of the stone and the club, and th early methods of attachment are dealt with at some length.

The thoroughness of the book is shown by a whole chapter of quite twenty small-type pages being devoted to the point of early weapons as developed from the horn weapons of animal and other nature models, such for instance as the old-time horn dagger carved out to represent a reindeer in full gallop, the extended hind legs of the animal being formed into the pointed piercing part of the apparatus.

Hooking and catching weapons are described in a curious section, giving details, *inter alia*, of various forms of catch-poles as catch can.

Full of interest also is the section on missiles, such as Boomerangs, Arrows, Javelins, and Throwing-Spears, the Bolas, Noose, and antient and modern Lassos.

Three whole chapters are devoted to the different forms of missile-projectors, such as the Sling, the Stone-Bow or Pellet-Bow, the Long and Cross-Bow for arrows, the Throwing-Stick, the Whip-Sling, and the Blow-Pipe.

The last part deals with the great War-Engines such as the Catapult and Ballista of the antients and the Trebuchet of Mediæval times; with inflammables such as Greek Fire; and then with the Horse, Chariots, and Animals under arms. This last class includes not only elephants, but dogs, cats, and even birds, described by the early writers as thoroughly instructed and carefully trained to carry Fire into the enemy's camps and quarters. That there is good classical authority for these examples is evidenced by the record of Samson's 300 foxes coupled up in pairs "Tail to Tail," whilst inserted in the midst between every two tails was a red-hot firebrand.

This book, which is entirely *sui generis*, would be most helpful for reference in any military or sporting library, clearly proving as it does that there is still no finality in the evolution of warlike weapons; it concludes with a bibliography of the subject and a good index.

The illustrations are liberal, numbering 361; they are the work of the author himself and admirably serve their purpose as explanatory of the letterpress.

O. E. RUCK.

NOTICES OF MAGAZINES.

Engineering Record.

The Croton Dam.—The completion has recently been announced of the dam, which was commenced more than 13 years ago, and has cost over £1,600,000, exclusive of the land but inclusive of some 15 miles of highways. It was built in connection with the supply of water to New York, and is one of the largest constructions of the kind in existence, ranking in engineering importance with the most famous waterworks of the world. The *Engineering Record* of New York has given a very interesting description of the work, from which the following facts are taken.

The dam forms a reservoir 18 miles long, and impounds about 32,000,000,000 gallons of water. It is built of solid granite ashlar and rubble, except the south extension, which is backed with cyclopean concrete, and contains altogether about 855,000 yards of masonry. Its total height is 300 feet from the lowest point in the foundation to the crest, so it is thus the highest dam in the world. There is a spillway 1,000 feet long at right angles to the axis of the dam and 16 feet below its crest; the spillway is crossed by a stee larched bridge of 200 feet span.

A large power plant was permanently installed a short distance below the dam site.

The river, which has a flood flow of 15,000 cubic feet per second, was diverted by means of a canal 200 feet wide and 1,000 feet long, cut in rock, with a crescent-shaped wing dam at each end, built of earth, stones, piles, and crib work. The upper dam was 30 feet high, and joined a masonry wall 23 feet high and 630 feet long. These barriers excluded the waters from a pit excavated 150 feet below the old river bed and drained by a battery of seven steam pumps, which raised the water from the deepest part into two lifts and sometimes handled as much as 10,000,000 gallons in 24 hours. Earth was excavated by hand and by steam shovels; and was removed to the adjacent spoil banks by teams, by locomotives, by an inclined plane and hoisting engine serving depths of over 70 feet, and finally by three cableways about 2,000 feet long, parallel with the axis of the dam and nearly 300 feet below the lowest excavation.

The gneiss and limestone rock underlying the earth had a very irregular surface, and much of it was so unsound that it had to be excavated to a considerable depth. Very interesting work was done in filling the fissures and seams with concrete and cement, and in handling the strong springs which rose through them to a considerable height.

The masonry was laid by the aid of the cableways and about 30 large stiff leg steam derricks, which were carried up on top of the masonry as it progressed.

W. H. Bunbury.

MITTEILUNGEN ÜBER GEGENSTÄNDE DES ARTILLERIE-UND GENIEWESENS.

May, 1906.

MOTOR VEHICLES IN THE AUSTRIAN MANŒUVRES, 1905.—This article is interesting as showing the growing appreciation of motor transport for military purposes. The 1905 manœuvres were held in South Bohemia and the Tyrol, and a large amount of motor transport, consisting of cars, wagons, trains, and bicycles, was employed, with unusually good results.

The cars, on account of their great speed and the high state of efficiency they have now reached, were found invaluable in conveying orders and intelligence.

The wagons were most usefully employed throughout; and according to the statement of the authorities the mobility of the 8th Corps would not have been maintained at the high standard it actually reached if it had not been that the two mechanical transport trains of the supply depôt at Prague kept up an uninterrupted service to the above Corps.

The bicycles did good work, though wet or very sandy roads were prejudicial to their employment. But with a side car attached they worked very well even under these bad conditions, and had also the advantage of being able to carry a second person.

MOTOR CARS.

These belonged for the most part to officers of the Reserve, who were attached to the staff with their vehicles and in this way carried out their prescribed annual training.

It is noteworthy that the cars were largely used in mountainous country, in very bad weather, and very often by night; and under these conditions did such valuable work in carrying orders, and reports on positions, etc., that all the chief commanders reported that the provision of several motor cars was an absolute necessity.

No cases of accidents were reported. This may be partially attributed to the careful preliminary instructions in driving motors and in their management when meeting vehicles or mounted troops.

The enormous front occupied by the armies of the future, and the fact that telephones and telegraphs cannot always be available in every direction and when available are not completely reliable means of communication, make it advisable that the value of the motor car in this respect should not be neglected. The force which has several cars for communication and conveyance of orders has a great advantage over the force that has none; and usually the private car will be most valuable for this service. It requires however a very good car to meet the demands made on a vehicle used for military purposes. An 8-H.P. car proved itself too weak on the first day, but the high-power cars carried out the work admirably.

Private cars will be very useful for reconnaissance and communication, but in the author's opinion a special car is required for staff officers, in which they can write orders, lay out maps, and if necessary sleep.

The following is a list of the cars in the various commands:—

4th Infantry Division.—One 28-H.P. and one 32-H.P. Mercedes, which worked very well.

4th Corps—Staff.—One 10-H.P. Peugeot Car.

9th Corps—Staff.—(*a*). One 40-H.P. Mercedes was used from 21st August till 7th September, and covered 974 kilomètres; 38 kilomètres were on country tracks and over stubble fields. This car never "refused" once.

(*b*). An 8-H.P. De Dion covered 895 kilomètres, but a number of small mishaps occurred and it was worn out at the end.

(*c*). A 28-H.P. Mercedes covered 585 kilomètres in 12 days, but then an axle broke and it could not be further used.

14th Corps.—A 24-H.P. Pengeot covered 1,185 kilomètres over bad roads, and worked well.

A 28-H.P. Mercedes covered 1,265 kilomètres between the 4th and 31st August, without any damage, though heavy calls were made on it.

44th Militia Division.—A 14-H.P. Oppel Darracq car was used, and was most efficient over very bad roads.

MOTOR WAGONS.

The following types were used:—

(1). A wagon belonging to the supply depôt at Prague, constructed for local work only.

(2). Mechanical Supply Train, Mark I., which had already done service in Vienna.

(3). Improved Mechanical Supply Train, Mark II.

(4). Supply Train from the Györer Factory.

No. (1) weighed 3,000 kilograms (3 tons approx.) and would carry a 3-ton load. The motive power was an 18-H.P. Daimler, constructed in 1901 and therefore considerably out of date. But it worked well with an average load of $2\frac{1}{2}$ tons.

(2). The Mark I. Supply Train consisted of a motor with two trucks. The former was of 29 H.P. with 4 cylinders and magneto ignition. Any speed up to twelve miles an hour could be maintained. The weight of the motor was $2\frac{3}{4}$ tons and the trucks weighed 13 cwt. The average working load was $5\frac{1}{2}$ tons, but under favourable circumstances nearly 7 tons could be carried.

(3). The Mark II. Supply Train was not available for preliminary practice before the manœuvres began as the motor was not finished.

It was built on the same lines as the Mark I. with the following modifications:—(*a*). Increased size of driving wheel. (*b*). Omission of differential gear. (*c*). Improved type of truck.

In order to have an opportunity of testing the value of these modifications under service conditions, a number of extra hands were put on the motor and by working night and day it was completed in time. It was a 35-H.P. motor, and its average load was $5\frac{1}{2}$ tons as for Mark I., the improvements being mainly designed to produce an increased speed especially up hill.

Subsequent tests with a new 60-H.P. motor, specially designed for this

train, have resulted in a carrying capacity of from 8 to 10 tons up a gradient of 1 in 10 and of 22 tons on level ground.

(4). The Supply Train from the Györer Factory had a 40-H.P. motor with 4 cylinders, drawing a train of 4 trucks.

These 4 trains started from Pilsen to the manœuvre area together. The Györer train, however, only developed a speed of 3 miles an hour, and soon broke down owing to defects in the brakes and steering gear.

The two Supply Trains went right through the manœuvres, and did exceptionally good work without any serious break-down. They were mostly employed in taking supplies to the various corps stationed at some distance from the railway, and had to work on hilly ground and in very bad weather. The author considers they may be regarded as a most valuable means of transport for an army in the field, even under unfavourable conditions, and he also considers them ecónomical.

MOTOR BICYCLES.

These are favourably spoken of on the whole. It was found, however, that they were usually not powerful enough for work in hilly country, and that they became overheated so that the rider had to wait while they cooled.

The author suggests that for a motor bicycle with side car not less than a 6-H.P. machine should be employed.

The inclusion of motor cyclists with the distant patrols proved most valuable in obtaining rapid intelligence.

Wet or heavy ground proved quite insuperable obstacles to the motor bicycle. The addition of a side car quite overcame this difficulty.

The author's conclusion is that the manœuvres proved beyond all doubt the great and increasing value of motor vehicles for military purposes.

C. OTLEY PLACE.

NATURE.

May, 1906.

BALLOONS AND KITES IN THE SERVICE OF METEOROLOGY (*p.* 35).—The means of observation available are kites and small unmanned balloons carrying self-recording instruments, aided to some extent by direct observations made from manned balloons. The free balloons possess the advantages of reaching heights unattainable by other means, and of being independent of weather conditions; they are made of paper or rubber and are from six to ten feet in diameter. These balloons are filled with hydrogen, and carry up with them a self-recording meteorograph; they frequently reach heights exceeding two miles and it is seldom that they are lost; in general the meteorograph is re-covered in Germany within a month. The balloon is only partially filled with gas; as it rises the gas inside expands, until finally the rubber is no longer able to stand the strain and the balloon bursts, so that it falls not very far from the starting point. A small parachute is used to prevent the too rapid fall of the

meteorograph. Observations obtained by the help of kites have the advantage of being less costly, but they are dependent on weather conditions, and it is not often that heights exceeding two miles are reached. It has been found that when balloons have reached a great height they fall in some locality lying to the east of their starting point. This confirms the statement that, in the temperate latitudes, the upper currents are always from some westerly point. Balloons sent up in a cyclone tend to move away from the centre at great heights, showing that the cyclonic circulation is not a mere surface phenomenon. At two-mile heights the air is warmer over the cyclone and colder over the anti-cyclone.

ACOUSTIC WAVES FOR EXPLODING MINES (*p.* 40).—The method is based on the property that when a disc, free to turn about its diameter, is placed in the interior of a cylindrical resonator and the fundamental note sounded, the disc will place itself in a plane perpendicular to the cylinder. By causing the turning disc to complete an electric circuit, a mine can be exploded by means of a signal given by a syren on a warship, tuned to the same note as the resonator.

PORTABLE WIRELESS TELEGRAPHY APPARATUS (*p.* 60).—Sir Oliver Lodge showed, at the Royal Society conversazione, a portable pack-transport set of wireless telegraphy apparatus for military field purposes, available across country for distances up to 50 miles, or 150 miles over sea, with electric valves employed to accumulate the impulses of a small coil and battery, or small dynamo, so as to give discharges of energy only otherwise obtainable from a large and heavy source of electric supply. The arrangement needs no earth connection, nor must it have any where it is required to work over long distances with the greatest efficiency.

"TOPOGRAPHICAL AND GEOGRAPHICAL SURVEYING."—By Major C. F. Close (*p.* 99).—The body of this book consists of seventeen chapters on instruments and methods, sketching, map projections, the reproduction of maps in the field, field astronomy, and the theory of errors as applied to field work. Tables are given of the quantities required for plotting graticules and computing astronomical results. The thirty-four plates include admirable examples of sketch maps of different kinds, specimen sheets of British and foreign topographical maps on different scales, and four new star charts. That the extent of the field before the topographer is great is evident from a paragraph which states that, excluding Canada, Australia, and India, the total unmapped area of the British Empire amounts to about 3,700,000 square miles.

W. E. WARRAND.

RIVISTA DI ARTIGLIERIA E GENIO.

April, 1906.

METALLIC REVETTING MATERIALS FOR FORTIFICATIONS.—For sieges an extraordinary quantity of revetting materials has always been found necessary in the past; it is the same at the present time and will be in the

future, whether in the case of improvised defensive works, or should it be desired to attack an entrenched camp or position constructed with masonry and armoured works. In such cases a constant strife takes place between the two belligerents for cutting down and denuding the neighbouring woods and forests, and extensive laboratories have to be established for peeling and twisting the branches and for constructing the fascines, gabions, and other revetting materials. Failing these resources on the spot it becomes necessary to procure them from a distance by the railway.

The idea was then naturally suggested of adopting such arrangements as might be possible in case of need for constructing in haste a large quantity of the materials required.

The first trials made in France some years ago were not successful; especially, the metal gabions were shown not to be serviceable, owing to the material not being very common and to their great weight (sheet iron, iron plates, and the like). The trials made to reduce the weight of the materials were also unsuccessful; such as the *half gabions* experimented on by the Russian sappers, and the *little gabions* of the German pioneers. Little improvement was effected by the substitution of lattice work of metal sheeting and the wire netting of commerce. However, according to the *Revue du Génie* of March very favourable results seem to have been obtained with fascines and gabions made with metal wire netting according to the designs of Major Duval.

GABIONS.

The various types proposed for gabions are the following:—

1st Type. This is constructed of galvanised metal wire netting, strengthened with 8 vertical supports of wire 6 m.m. thick let into the netting. The network is hexagonal, and its width varies from 10 to 35 m.m. according as greater or less strength is required. To avoid the sifting of the earth through the meshes it is inadvisable to exceed the width of 35 m.m.

For the construction of the regular gabions adopted by the French Engineers (gabions having a diameter of 60 c.m. and a height of 80 c.m.) a band of netting 80 c.m. in height and 2·15 m. in length is used. Three bindings made with thin galvanised iron wire, bending without the aid of pincers, serve to keep the gabions in the required form. The weight of these gabions is 3·5 k.g. when the mesh is of 10 m.m., and 3 k.g. with a 16-m.m. mesh.

2nd Type. Is of the same construction as the former one, but has a height of 1·20 m. A top layer of fascines is, however, not required in the construction of regular parapets.

3rd Type. Has a height of 1·50 m. Owing to its increased height it requires three hoops or bands of wire of 6 m.m. Weight 6·7 k.g.

Failing a supply of wire netting with hexagonal meshes or of wire of 6 m.m., metal sheeting and supports of 5 m.m. can be used. Netting with larger meshes can also be used when there is occasion to double the interior revetments with tarpaulins, canvas sheets, etc.

4th Type. Is composed of a canvas bag without a bottom, kept open by two circular pieces of wire at the ends and a spiral of galvanised iron wire,

4 m.m. thick; there are 50 eyelet holes conveniently arranged, in which can be inserted six supports of iron wire of 6 m.m. not galvanised. These supports carry a ring at the bottom, and are pierced at the top so as to be able to insert pieces of iron wire for bindings. The canvas bag has a diameter of 60 c.m. and a height of 80 c.m. Pieces of pack thread are attached, and the bags can be packed in bundles for transport. The total weight of this gabion is 3·5 k.g.

FASCINES.

The type of fascine designed by Duval consists of a long band of wire netting, in the form of a cylinder having the dimensions of the fascine required. The cylinder is strengthened with wire of 6 m.m., and is filled with earth at the foot of the work or parapet in the following manner.

The band having been placed on the ground, it is formed in the shape of a pipe or tube, which is filled in as far as possible with earth. The cylinder is then fastened in the middle with pieces of iron wire and strengthened with other bindings. The ends are folded over and closed with branches and twigs.

E. T. THACKERAY.

VOËNNYI SBÓRNIK.

January, February, and March, 1906.

PLAN OF MOBILIZATION OF A FORTRESS AS REGARDS ENGINEERING WORKS.—The above numbers contain a series of articles on this subject. The work to be carried out, after reception of the orders to mobilize, is divided into two categories, the first of which should be completed before the second is commenced. The clearing of a 900 paces field of fire in front of the fortress is declared to be of primary importance, while the laying of mines and the making of inundations are to be left to the last moment. The question of the division of the available labour, both civil and military, so as to obtain the best results is carefully gone into, and a variety of data as to working parties, time, and tools are given to enable calculations to be made. Although laying down that a man can with a large spade dig 20 cubic feet in an hour, this rate should be considerably reduced in calculating for a 10 hours' working day.

From actual experience the following figures have been arrived at :—

(1). Digging and throwing the earth not higher than 5 ft. or further than 12 ft.—

In clay	343 cub. feet.	4 man-days.	100% spades, 25% picks, 15% crow-bars, 10% axes.
In sand	„ „	2 „ „	

In sandy soil picks and crowbars are not required.

(2). Cutting woods of medium thickness, including trimming branches and stacking timber according to size—

Up to 18·9 acres ...	Per 2·7 acres.	200 man-days.	100% axes, 25% cross-cut saws, 5% crowbars.
„ „ ...	588 sq. ft.	1 „ „	
From 18·9 to 32·4 acres	Per 2·7 acres.	300 „ „	
„ „ „	392 sq. ft.	1 „ „	

(3). Demolition of buildings—

(*a*). Non-habitable wooden ones.	49 sq. ft. in plan.	1·8 man-day.	50% axes, 10% crowbars, 2% cross-cut saws.
(*b*). Inhabitable ones made of beams.	„ „	27 „ „	
(*c*). Brick walls ...	343 cub. ft.	6 „ „	80% picks or mattocks, 20% crowbars.

(4). Clearing brushwood—

2·7 acres.	50 man-days.	100% axes, 20% knives.
2,450 sq. ft.	1 „ „	

For preparing and filling sandbags, 18″ × 9″, 100 can be sewn by one man in a day, and 100 can be filled by one man in a day.

For making abattis, 21 feet wide, in places where timber has to be carted, one should calculate on ·2 man-day per 7 feet run of abattis, and allow for one cart and horse, and 50% axes, 25% spades and 20% crowbars.

Where floating bridge material exists in the fortress, for purposes of calculation one can allow 3 days and a working party of 150 men with 25 sappers and 10 carts and horses to construct a bridge 700 feet long capable of carrying siege artillery. For longer bridges the working party is the same, but the time occupied is proportionately longer.

Recesses for ammunition boxes should be built in the interior slope of the breastworks, not further than 210 feet apart. For making one 2′ × 4′ × 4′ with a wooden frame, 3 man-days are required, together with one sapper, and the materials are 84 ft. run of 8″ × 2½″ planks and 4 lbs. of 4″ to 6″ nails.

A wire-entanglement, 35 ft. wide, having 6 rows of large stakes 7 ft. long, and 5 rows of small ones, arranged chequerwise, including

digging ditches 1½ ft. deep, requires for every 7 ft. run of obstacle the following tools, men, etc.:—

Preparing and fixing stakes		·6	man-days.
Fastening wire to the stakes		3	„ „
Digging ditches 1½ ft. deep by 35 ft. wide, equals for every 7 ft. run approx.		3	„ „
Total, say		7	„ „

Stakes 7 ft. long	6
„ 5 „ „	5
Anchors 2 ft. long	4
Wire 1,120 ft. run or	68 lbs.

RAFTS.—In the January number a description is given of some experiments carried out last summer, on the River Ijora and subsequently on the Great River at Pskoff, for ferrying cavalry equipment by means of rafts made of guttapercha bags and planks. These bags, of guttapercha 1 millimètre thick, are 5′ 8″ long by 2′ 4½″ wide when empty, weigh 2¾ lbs. each, and when folded lengthways take up about the same room on the saddle as a cavalry soldier's folded overcoat. Each bag, when inflated, can support 400 lbs.; but in spite of all precautions the air escapes, and they should be filled again at the end of 45 minutes. The inflation takes from 2 to 3 minutes and is carried out by means of a leather bellows, 7·2 inches in diameter. Rafts were made of planks, with 2, 3 or 4 bags, bound with linen bands instead of cord, which is apt to injure the guttapercha. The rivers chosen were ideal for the purpose, the Ijora being 210 feet wide, with a current of not more than 3 inches per second, and temp. 64° F., while the Great River is 574 feet wide, with a current of 1 ft. per second, the water at the time being cold, only 57° F. The operations apparently were not carried out systematically, as details of the total time taken to transport a squadron or other body of cavalry are wanting. Individuals, however, and small groups were conveyed across quite easily on the rafts, which were chiefly used for carrying clothes, equipment, and rifles, the men either swimming alongside them or with their horses, and frequently using the raft as a flying bridge by means of ropes.

C. G. FULLER.

RECENT PUBLICATIONS.

Aids to Scouting, by Major-General Baden-Powell. Revised and enlarged edition. ($4\frac{1}{2} \times 3\frac{1}{2}$. 1s. Gale & Polden).

A Narrative of the First Burmese War, 1824–26, by G. W. de Rhé-Philipe. (10 × 6. 3s. 6d. Government Printing Office, Calcutta).

La Guerra Russo-Giapponese. 1. Nell' Anno, 1904; 2. Nell' Anno, 1905; 3. Considerazioni e Deduzioni, by Capitano d'Artigleria Luigi Giannitrapani. 2 vols. and 2 vols. plates. (9 × 6. 14 l. Enrico Voghera, Rome).

Erfahrungen und Lehren des russisch-japanischen Krieges, 1904–05, *für Heer und Truppenführung.* (4.50 mks. Berlin).

Die Kämpfe der deutschen Truppen in Südwestafrika. Heft 2. von Grosser Generalstab. (8vo. 35 pf. Berlin).

Sébastopol: Guerre de Mines, par Capt. F. Taillade. (8vo. 2.50 fr. Berger-Levrault, Paris).

Napoléon en Italie, 1800—1812, par J.-L. Driault. (8vo. 10 fr. Alcan, Paris).

Questions de Défense Nationale, by Gén. H. Langlois. (8vo. Paris).

Comment se Défend un Fort d'Arrêt, par Lieut.-Colonel L. Piarron de Montdesir. (1.25 fr. Paris).

The Art of Attack. A Study of the Development of Weapons and Appliances of Offence from the Earliest Times to the Age of Gunpowder, by H. S. Cowper, F.S.A. ($7\frac{1}{2} \times 5\frac{1}{2}$. 10s. W. Holmes, Ltd., Ulverston).

Heresies of Sea Power, by Fred T. Jane. (9 × 6. 12s. 6d. Longmans, Green).

Veltzé's Armee-Almanach. Ein militär-statistisches Handbuch aller Heere, von Haupt. Alois Vetzé und Haupt. Hugo Kerchnawe, Generalstabskorps. (7 × 5. Stern, Vienna).

Stonehenge and other British Stone Monuments Astronomically Considered, by Sir Norman Lockyer, K.C.B., F.R.S. (9 × 6. 10s. Macmillan).

La Locomotive Actuelle. Etude générale sur les types récents de Locomotives à grande puissance, par M. Demoulin. (8vo. 40 fr. Béranger, Paris).

Practical Pattern Making, by F. W. Barrows. (6s. Crosby, Lockwood).

Electric Wiring, Diagrams and Switchboards, by Newton Harrison. (5s. Crosby, Lockwood).

Electricity Meters: Their Construction and Management, by C. H. W. Gerhardi. (9s. *The Electrician* Publishing Co.).

Die Luftschiffahrt. Ihre Vergangenheit und ihre Zukunft, in beziehung auf die Luftschiff im Verkehr und im Kriege, von H. W. L. Moedebeck. (2.50 mks. Berlin).

An account of the Scientific Work of the Survey of India, by Lieut.-Colonel S. G. Burrard, R.E., F.R.S. Survey of India Professional Papers, No. 9. (4to. Calcutta).

Hints to Travellers. Scientific and General. Edited for the Council of the Royal Geographical Society by E. A. Reeves, Instructor in Surveying and Practical Astronomy to the Society. 9th edition, revised and enlarged. 2 vols. (7 × 5. 15s. (for Fellows, 10s.) R.G. Society, 1, Savile Row, W.).

Persia by a Persian, by the Rev. Isaac Adams. (9 × 6. 7s. 6d. Stock).

The Physiography of the River Nile and its Basin, by Capt. H. G. Lyons, late R.E., Director-General, Survey Department, Egypt. (10¼ × 7. Cairo).

A Century of Continental History, 1780—1880, by T. Holland Rose, Litt.D. 5th edition, revised and corrected. (8vo. 6s. Stanford).

Hindustani for Every Day, by Colonel W. R. M. Holroyd, M.R.A.S., Director of Public Instruction, Panjab. (9 × 6. 8s. Crosby, Lockwood).

Royal Commission, St. Louis International Exhibition, 1904: The British Section, by Sir Isidore Spielmann. (Folio. London).

TEMPORARY BUILDINGS ON ACTIVE SERVICE

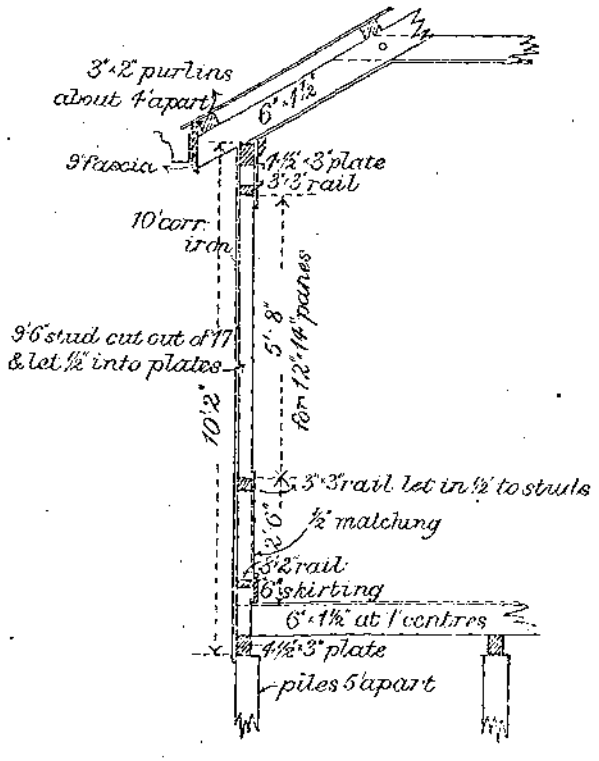


Fig. 1 (12' to 16' Spans)

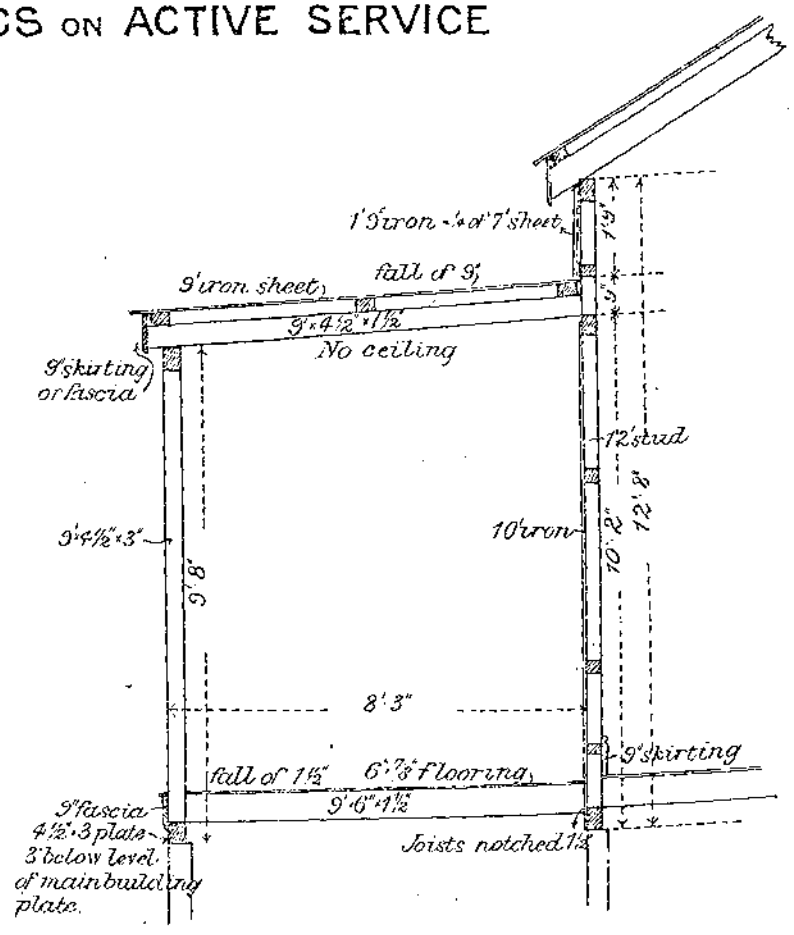


Fig. 2 (16' to 20' Spans)

NOTES

(1) To use 10' iron on walls with no waste in studs:-
9'6" studs let ½" into 4½"×3" plates (buy 17' deals)
= 9'5" in clear
Add two plates = 9"
Out to out = 10'2"

(2) Ready made box windows
For size of opening in framing add 1" to glass sizes:- eg 12 light, 12"×14" glass.
Opening Height = (4×14") + 12" = 68"
Width = (3×12") + 12" = 48"

SECTIONS OF WALLS

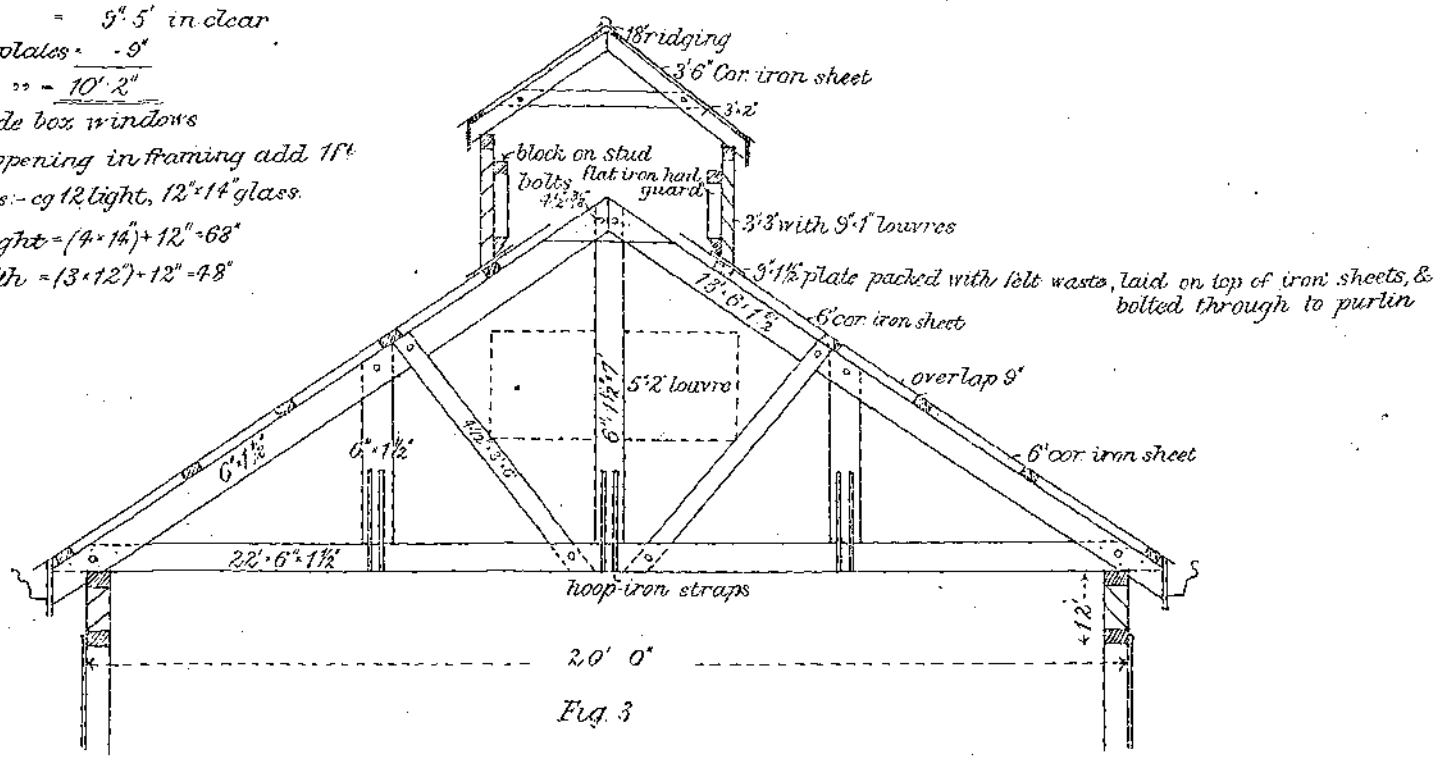


Fig. 3

CROSS SECTION OF ROOF