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

General view of bridge from West bank.

Ferry boat on the Beas River.

Bridge cut to allow rafts to go through.

BRIDGING BY THE 1ST P.W.O. S & M

BRIDGING BY NO. 1 COMPANY, 1ST P.W.O. SAPPERS AND MINERS, DURING THE LAHORE DIVISION MANŒUVRES, 1909.

By LIEUT. W. CAVE-BROWNE, R.E.

IN November and December, 1909, the 3rd (Lahore) Divisional Manœuvres took place over the country lying between Amritsar and Hoshiarpur.

As the greater number of the troops came from west of the river Beas, which formed the western boundary of the manœuvre area, it was necessary to arrange for crossings for them, as there are no permanent road bridges over the Beas in this district and all the country traffic crosses by ferries.

It was decided that two temporary bridges should be built, one just below the North Western Railway's bridge and the other about 50 miles upstream at Naoshera. No. 1 Company was detailed to build the latter bridge and left Roorkee on October 5th by train for Jullundur, whence a four days' march brought them to the site of the bridge.

The site of the bridge had been previously reconnoitred and a rough estimate of materials had been sent to the Divisional Headquarters, but on arrival it was found that, by some mistake, nothing had been collected. It was therefore necessary to make arrangements with all possible haste, as the bridge was required by November 8th. Thanks to the assistance of the Forest Department and a local contractor, the necessary material was not only obtained, but obtained free of charge. The forest authorities gave permission that all Government wood, which was being floated down the river in rafts, might be stopped for this work, on condition that it was neither cut nor spiked, and that it should be re-rafted after the bridge was dismantled. Besides this, the contractor who rafts wood down the Beas from the Kulu forests for all the smaller traders, agreed to send down rafts of sleepers and spars on the same conditions as above.

All wood comes down the Beas in form of spars or sleepers, the latter, being $10'' \times 5''$ in cross section, vary in length from $6'$ to $12'$, while the former are of all lengths up to $22'$ and of all sizes up to $10''$ in diameter.

The other material available was seven ferry boats belonging to the local ferry. The loan of these was also obtained free of charge, for directly the bridge was complete it was open to all traffic, including

bullock carts carrying not more than 30 maunds (about 1 ton), and the ferry contractor was allowed to charge the usual ferry fees for all civil traffic crossing the bridge.

At the site of the bridge the river was 680′ broad; out of this for 50′ from the west bank a causeway was made of earth and grass, and of the remainder for a distance of 180′ the stream was from 9′ to 15′ deep and running at 3 miles an hour, while over the remaining 450′ the depth was in no place greater than 5′. In the deep water the ferry boats were used and in the shallow water, trestles.

These ferries are large flat-bottomed boats, their average length being 35′ and their breadth at the stern 16′; towards the bow the breadth decreases to 10′. The gunwale all round is about 2½′ high, except for a length of 10′ on one side where it is only 1′ high to allow of carts and animals embarking and disembarking. At the bow the gunwale is continued up in the form of a large triangular screen to a height of 10′. Tradition has it that the followers of Alexander the Great built boats of this type with the triangular screens to protect themselves from the arrows of the natives when crossing the river.

The boats are made entirely of sheesham wood and have cross ribs on the bottom at intervals of about 2½′; on these ribs a cribwork was built up to about 6″ above the gunwales, as shown in *Fig.* 1.

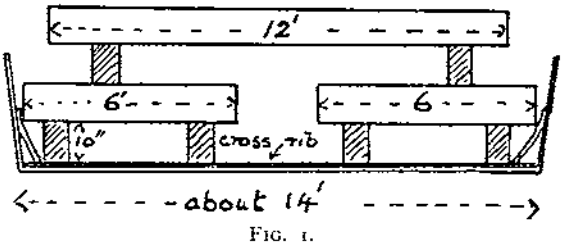


FIG. 1.

The centre line of the crib was about 12½′ from the stern of the boat, as by this arrangement the bows were just clear of the water when the roadway was loaded.

The bays between boats were from 13′ to 15′ long, and five of the best spars were used as road bearers over each bay.

The boats were all anchored to a 3″ steel cable stretched across the river about 100′ upstream of the line of the bridge, carried at each end over sheers.

Photo No. 2 gives some idea of the boats and their usual load. In bridge they drew 9″ when fully loaded.

To allow rafts of wood to pass through, one boat was arranged for a cut, and a snatch block was fixed on the anchorage cable, over which ran a 3″ rope fixed to the boat, and by this means the boat was pulled above the bridge and then pushed aside by bamboos. The breadth of the cut was 36′.

In the shallow water two-legged trestles were used throughout, as it was found that four-legged trestles offered too much resistance to the water, with the result that it scoured out the sand below and the four-legged trestles kept on sinking.

The legs were all of spars of 5" diameter and greater. For the transoms the best 12' sleepers were chosen, and on them were laid three sleepers on edge for road bearers, and the flooring throughout was of sleepers with 6" of grass strewn on top. At one time it was feared that sufficient sleepers for the roadway would not be obtained, and so the expedient of using reed fascines, interposed between sleepers, was tried. There were acres of high reeds growing in the neighbourhood, standing about 12' high which made excellent fascines. The fascines were 10" in diameter and two were placed between every two sleepers. With this arrangement, instead of three sleepers on edge, five on the flat were used for road bearers (*Fig.* 2).

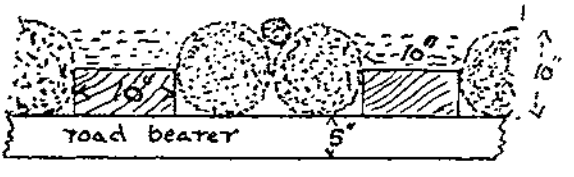


FIG. 2.

This was found highly satisfactory, as the fascines formed good cushions and saved the lashings a large part of the jar caused by field guns. This arrangement was, however, only used over a few bays, as sufficient sleepers arrived in time and this somewhat lengthy process was abandoned.

The distance between trestles was 10'. The bridge was cross-braced parallel to its length, and downstream struts were placed for every second trestle.

The lashings were entirely of wire; No. 14 S.W.G. being used. It was calculated that 29 returns on the transoms were required, and so it was decided to first wind the wire treble and put on only 10 turns. By this means much time was saved and the lashings were considerably stronger, as it was found that when the lashings were of single wire, only the top returns took the strain at first, and until these snapped the lower ones were doing no work.

The bed of the river was sandy, and considerable trouble was caused by the sand constantly shifting. A boat was originally put in the middle of the trestles, for it was intended to have the cut there, but within a week of completing the bridge the stream changed its channel to such an extent that the boat was left in only 1' of water. It was therefore necessary to take out the boat and replace it by trestles and arrange for the cut elsewhere.

It is difficult to say how many days the erection of the bridge actually took, for on two or three occasions the work was stopped for two days, waiting for more wood to come down the river. These days were spent in improving approaches and making a road over the sand from the bridge to the nearest metalled road.

From the time the bridge was open to traffic on November 4th it was in constant use, the chief traffic being bullock carts, mules, carts and pack camels.

On the day that the troops dispersed, two batteries R.F.A., two cavalry regiments, and three infantry regiments with all their 1st and 2nd line transport crossed the bridge in three hours.

The dismantling of the bridge and forming the material into rafts occupied 16 hours.

Photo No. 3, taken from the west bank, shows the bridge cut to allow rafts to go through; the cut boat is seen upstream of the bridge.

Photo No. 1 gives a general view of the bridge from the west bank.

THE CALCULATION OF WORKING PARTIES IN A DEFENCE SCHEME.

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

The planning of defences is a great deal more interesting, and gives opportunity for much more genius, than the after calculation and organization of the work. Organization, however, takes so high a place to-day among the military virtues, that it may almost be said that the good military engineer is not he who plans the best defences, but rather the man who gets the work done in the quickest time. The textbooks too, which give the most excellent descriptions and pictures of the various military engineering works, say but little about the organization of their construction. It is true that in the *Manual of Military Engineering*, 1905, there is a specimen given (on page 136A) of a "detail of working parties," but the description is rather hard to follow, and the latest edition (1908) of Part I., *Military Engineering*, says even less on this subject. As however it is a matter in which practice is needed more than in most things, and as, incidentally, officers going through promotion examinations have to exhibit great readiness in such calculations, it will perhaps not be out of place to describe a system somewhat more precise than has hitherto been in vogue.

A defence problem has two parts :—

(A). "What to do?" This includes the decisions as to the use of the ground and the tactical position of the troops thereon. These decisions are based upon (1), the inspection of the ground with a map, or of the ground alone, or (chiefly in the case of examinations) of the map alone, and (2), of the special idea and orders of the commander of the force.

(B). "How to do it?" That is to say an investigation of the work required to place the ground in the state of defence decided on in (A), resulting in complete tables of reliefs of working parties.

The first step in the organization of the defence of a position is, usually, to split it up into sections, and it is assumed that we are treating of the defence of one of these sections and that its commander, in conjunction probably with technical advisers, has come to the conclusions which the first part of the problem requires.

The question at once arises, "Can the work be done in the time available and by the working party available?" If not, the tactical scheme (A) must be modified unless more time can be hoped for or a larger working party obtained.

The time available is of course doubtful. Still something, the probable minimum, must be assumed, and the defences must be planned and constructed, not only so as to be complete in their way at the expiration of that time, but also so that, if more time is eventually available, the whole defences will admit of strengthening and of enlargement.

The working party available is generally fixed, and is usually the force which is to occupy the works together with any civil labour which can be obtained.

It will be seen therefore that the question resolves itself into a kind of equation between the work to be done on the one hand and the time and labour on the other, and will be treated as such.

Hitherto it has been the custom as soon as the work to be done has been decided upon, to embark at once upon detailing the working parties. The wisdom of this step is however questionable. The commander of a force will naturally call for as strong defences as possible, but, unless the work is first measured up, no idea as to how long it will take can be arrived at, and it is more than likely that the defences will be quite unfinished in the time allowed. To start big works only to find them unready when the enemy attacks is much less satisfactory than to have completed smaller works.

It is therefore recommended that, as soon as the defences have been planned, an estimate of the time and labour they will take to complete be at once made out. Such an estimate is here called the "Table of Work." As a mere arithmetical process it will not take long to do, nor will it delay things, as the troops can be started at work on such jobs as clearances, immediately they arrive on the ground. Moreover such a table will be of great assistance when making out the detail of working parties afterwards.

THE TABLE OF WORK.

1. Write down the "Conditions" of the situation under the following heads :—

(*a*). *Garrison.*—(On this will depend the length of fire and support trenches).*

(*b*). *Working party available* (distinguishing between Infantry, Artillery and Engineers), and transport available.

* A rough rule, sufficiently accurate for general purposes, is to prepare accommodation for $\frac{2}{3}$ (firing line and supports). If N be the number to be housed in the support trenches, since each man requires at least 2′ laterally :—

Minimum length for a support trench accommodating men in a single row = $2N$ feet.

Ditto for a trench accommodating two rows of men = N feet.

These dimensions should be considerably increased, if time allows, for comfort.

(*c*). *Time available.*

(*d*). *General decisions* as to the preparation of the ground, under the usual main heads of field defences, cited in *Military Engineering*, Part I., para. 125, (*Manual of Military Engineering*, para. 1).

These main heads are as follows:—

(I.). *Clearance* (including demolitions and marks to show ranges).

(II.). *Cover.*—This will include fire trenches, support trenches, cover for guns, defence of houses, stockades and all improvement of existing cover.

(III.). *Provision of Obstacles.*

(IV.). *Improvement of Communications.*—This will include communication trenches* between fire and support trenches, improvement of roads for artillery, lateral communications for machine guns, etc.

These general decisions should be in the form of a *numerical* summary.

When the defence scheme is planned details and dimensions are not exactly laid down. They are therefore alterable and the amount of work in the scheme can thus be modified. Certain assumptions as to quantity and dimensions of the various works are made at this stage of the calculations, and these assumptions can be and will have to be altered if it is subsequently found that the work to be done does not correspond with the "men-hours" labour available to do it.

(*e*). *Tools Available.*—Including tools obtained from civilian sources. It is useful to note here the number of men who can concurrently be employed with (1) cutting tools, (2) entrenching tools. These facts will have to be borne in mind when getting out the detail of working parties later.

(*f*). *Materials Available.*—It is again useful to note down the quantity of certain descriptions of work which can be undertaken with the materials available, *if there is any scarcity of materials, e.g.*,

Overhead cover, in square feet.
Revetment, in square feet.
Abatis, in foot-run.
Wire entanglement, in square yards.

2. The number of men-hours labour available should be written down. It is usual to allow each man to work $\frac{1}{3}$ of the total time,

* In calculating communication trenches proceeding from front to rear of the position, wherever these are liable to enfilade (as is commonly the case), they must be either (*a*) traversed at frequent intervals, or (*b*) covered in (with air openings at intervals), or (*c*) zigzagged at a sufficiently sharp angle.

We may roughly estimate that in such cases 50 per cent. should be added to the time required to excavate a straight uncovered trench between the two points joined by the communication trench. This estimate will however vary with the frequency of the traverses, the span of the covering or the angle of zigzag.

though for a short time and if the work is not too arduous, he can be called upon to work 12 hours out of the 24.

The men-hours available of Infantry, Artillery and Engineers must be kept distinct. Artillery are not usually required to do work other than prepare their own emplacements and communications, for which they generally have sufficient labour without outside help. Engineers are employed either to superintend infantry working parties, or on the more difficult and technical work.

3. The work to be done can next be written down in tabular form. This may be called the "Table of Work." It should be in the following form :—

Table of Work.

Nature of Work. *e.g.*	Quantity.*				Rate per M.H.	M.H. Labour Necessary.	Remarks.
	Length.	Breadth.	Depth or Height.	Contents.			
Clearance							
Excavation.....							
Revetment.....							
Loopholes							
Overhead cover ...							
Stockade							
Sangar							
Cover for guns							
Defensible buildings							
Obstacles							

* The dimensions shown in these four columns will be expressed in the following units :—

Clearance.—Length in yards. Breadth in yards. Contents in square yards.
Excavation.— ,, feet. ,, feet. Depth in feet. Contents in cubic feet.
Revetment.— ,, ,, Height in ,, Contents in square feet.
Loopholes.—Contents show number of loopholes.
Overhead Cover.—Length in feet. Breadth in feet. Contents in square feet.
Stockade.— ,, ,, Contents show foot-run.
Sangar.— ,, ,, ,, ,, ,, ,,
Cover for Guns.—Contents show number of emplacements.
Defensible Houses.— ,, ,, ,, houses.
Obstacles.— (1). Abatis, length in yards. Contents show yard-run.
(2). Wire entanglement, length in yards. / breadth ,, } Contents in square yards.

Only the most usual kinds of work are quoted in the first column of the foregoing table. If other jobs have to be executed, they can be included and the M.H. labour necessary to complete them will have to be estimated and added in to the total.

The "quantity" columns have to be filled in, partly from the conditions laid down in the "general decisions," and partly, where these conditions do not completely specify the dimensions, by a rough estimate. For example the average cross-section for a fire trench might be 15 square feet, the height of revetment for a high relief trench 3′ to 4′, the breadth of overhead cover 4′ for single row and 8′ for double row accommodation, etc. It is impossible for such estimates to be accurate and it is waste of time to try to get them so. Any attempt, for instance, on the part of the superintending engineer to lay down what should be the exact command of a fire trench (on which the cross-section depends) is unsound, unless he has had time to examine carefully the site of each trench, which is not often the case in large schemes on service. Such points must be left to the judgment of the executive officer. For the same reason it is difficult to see how candidates at examinations can be expected to state what size of parapet they would build at any point on an ordinary map. Engineers in general charge must rely on estimates, and the more practice an officer obtains in such estimates the fewer will be his errors, and such errors as remain will tend to neutralize each other in the calculation of several works.

The column in the table "Rate per man-hour" may be taken from a "Table of Rates of Work" such as that given at the end of this article. This table has been compiled partly from the textbooks and partly from other experience.

The column "Men-hours labour necessary" is of course obtained by dividing the number shown in the "Contents" column, by the number shown in the "Rate per man-hour" column, taking care that both are expressed in the same units.

The total number of men-hours labour necessary to carry out the whole defence scheme is then obtained by adding up the column "M.H. labour necessary."

4. The following has now been obtained :—

(*a*). The number of men-hours labour available.

(*b*). The number of men-hours labour required.

These two must be roughly equalized in order that the whole work may be completed approximately in the time available.

If (*a*) is less than (*b*) the scheme is too ambitious and cannot be carried out in the time. Alterations and reductions must be made, but as far as possible without affecting the decisions of the commander of the force, which were arrived at in (A) (see page 69).

We have however some latitude of choice without affecting these decisions. Certain assumptions were made in the numerical summary of the work to be done which can now be altered. The principal assumptions which can be altered are as follows :—

Cross-section of fire, support and communication trenches. (But the *command* of fire trenches cannot be interfered with).

Length of support trench.

Nature of Obstacle.—If the apparent efficiency of an obstacle is maintained it may be less carefully built. High wire entanglement is usually quicker to build than an abatis covering the same area.

Width of belt of obstacle (parallel to the advance of the enemy).

Number of communication trenches between fire and support trenches.

If the two sides of the equation cannot be made approximately equal by such alterations, it will be necessary to revert to the general scheme (A) and to modify it. This however will probably involve some tactical rearrangements. Such a change is open to the criticism that tactical considerations are being hampered by the technical services. Unfortunately this must often occur as even tacticians have to cut their coat according to their cloth.

If (*b*) is less than (*a*), the works can be improved and strengthened as thought desirable, not forgetting, however, that the *materials* available may be limited. All defence schemes should be planned with an eye to possible enlargements, if time allows.

5. Before proceeding to get out tables of working parties it may sometimes be worth while to ascertain roughly :—

Firstly, that the work proposed does not call for more material than is available.

Secondly, that there is no such overwhelming proportion of work of one kind, *e.g.* entrenchments or clearance, that the tools available will not allow the whole of one relief to work simultaneously.

THE DETAIL OF WORKING PARTIES.

6. We can now get out the table of reliefs of working parties which is a document intended for the use of subordinates and should therefore be quite clear. It may take the following form * :—

* The form here given is substantially the same as that on page 136A, *Manual of Military Engineering*, 1905. The only alterations are :—

(*a*). Each party is given a letter for convenience of reference.

(*b*). The column "Task per man" is omitted, being a detail which may be left to the executive officer.

(*c*). Tools and materials are not so closely specified, for reasons given later.

Detail of Working Parties.

Col 1.	Col. 2.	Col. 3.	Col. 4.	Col. 5.	Col. 6.	Col. 7.	Col. 8.	Col. 9.
Letter of Working Party.	Inf.	R E.	Where at Work.	Nature of Work.	Total Quantity to be Executed.	Tools.	Materials.	Remarks.
A. B. C. etc.	The total in each of these columns must equal $\frac{1}{3}$ or $\frac{1}{2}$ of the total available working party, according as it is proposed to work men 1 relief in 3, or in alternate reliefs.		Refer to the letter on the plan of the ground by which the work is designated.	Should be expressed in the following units :—(1). Cubic feet of trench. (2). Yard-run of abatis. (3). Square yards of H. W. E. or L. W. E. (4). Foot-run of stockade. (5). Number of epaulements and defended houses. (6). Square yards of clearance.				This column should state :— (*a*). If a trench is to be traversed and concealed. (*b*). If a dummy parapet is to be formed and where. (*c*). If the trench is to be covered. (*d*). The width of the obstacle. (*e*). Cross-sections of trenches, obstacles, epaulements, stockades, etc., or reference to figures in the instructional manuals. If the executive officer is to use his own discretion as to such points (as will usually be the case with sections of *firing* trench) it will be so stated. (*f*). Transport available.

1st *Relief*.—8 a.m.—12 a.m.

Place and hour of parade for drawing tools { .....
.....

In making out the above table, Columns 2, 5 and 6 are the important ones and should first be dealt with.

Column 5 is the decision arrived at as to the chronological order of the various works.

The following points should be borne in mind :—

(*a*). Execute the work in the order of importance, which is generally—clearance, cover, obstacles, communications. For example, if a house has to be put in a state of defence loophole it first and barricade the entrance afterwards.

(*b*). Do not lay down an impossible order of work, such as building an abatis before cutting down the trees of which it is to be composed.

(*c*). Begin preparations simultaneously along the whole position, so that in case of sudden attack there may be no localities absolutely unprotected from an enemy's assault.

(*d*). Do not employ more men simultaneously at one kind of work, *e.g.* entrenching or clearance, than there are tools for.

(*e*). Remember that there is a limit to the number of men who can be put to any job at the same time. If too many are detailed, they will get in each other's way, or some will be idle.

A good rough rule for the greatest number who can be employed in trench work is as many men as there are yards-run of trench. This allows a certain number to be employed in collecting sods, filling sandbags, and concealing the parapet, and may also provide for double-manning tools, cross-lifting earth, etc.

Column 6 presents no difficulty when the work is begun and finished in the same relief. In such a case the total work, in the units laid down, will be inserted, and the word "Finish" may be added.

If however the job will take several reliefs to complete, the matter requires a little more detail.

It has been the custom to calculate and lay down precisely in the table of working parties how much each relief shall complete in such cases. This system gives much work to the officer who compiles the table and is contrary to the true principles of organization. Nor is the method a practical one. The difficulty, and therefore the rate of executing work, varies greatly with the nature of the soil or of the undergrowth in clearances, and with the weather, etc., and is sometimes affected by the chance of annoyance by the enemy. All these are matters for the executive officer, and the following system is therefore proposed instead :—

If a job extends over more than one relief, the total task will only be shown in Column 6 of the relief in which it is begun. But in this column will be shown in each relief the *fractional proportion* of the work which should be completed by the end of that relief (obtained by dividing the number of men-hours allotted to the job up to the end of that relief by the total number of men-hours labour allotted to the job from the table of work). The word "Finish" may be inserted in Column 6 of the relief in which the job is to be completed.

Now as a practical measure, in order to ensure continuity of work and to see that each relief does its fair share of work, an officer should be placed in charge of any such job, which continues through several reliefs. His duty will be to decide how much work each relief is to complete before breaking off, *i.e.* what work is the equivalent of the fraction shown in Column 6. This officer will be responsible that the job is completed at the end of the last relief allotted to it, unless there is good reason to the contrary, such as unexpectedly hard ground, bad weather or the enemy's bullets. If necessary he must be empowered to keep his reliefs longer at work by double-manning the tools.

An example of this system is given. Suppose there is an entrenchment, containing 14,000 cubic feet, to be dug, and that it requires 800 men-hours to complete. The troops are working in 4-hour reliefs. Let us suppose that 60 men are told off to the job in the first relief, 100 in the second and 40 in the third. (This will provide the necessary 800 men-hours).

Under the proposed system the execution of the work would be shown in the Detail of Working Parties as follows :—

1st Relief.

D	60	2	Trench "w"	Excavate	14,000 C.F. $\frac{3}{10}$	40 picks 60 shovels	.....	Pl.... Fig....

2nd Relief.

K	100	3	Trench "w"	.....	$\frac{5}{8}$	70 picks 100 shovels	.....	*Vide* D

3rd Relief.

Q	40	2	Trench "w"	.....	Finish	20 picks 40 shovels	.....	*Vide* D

In short by this system the executive officer is given a certain number of "men-hours," and is then held responsible for carrying out the work with them.

Keep the number of parties in each relief as few as possible. It is better to delegate responsibility to *officers* in charge of large parties (each party being perhaps distributed in detachments at several similar jobs) instead of to *N.C.O.'s* in charge of single small parties.

Column 2 is the selection of the strength of parties, on which depends the rate of progress of the various works. The note given in the table should be attended to.

Column 3 is filled in after Column 2. The number of R.E. superintending infantry labour should be roughly proportional to the size of the parties, though as a rule constructive works, such as entrenchments, require more supervision than destructive works, such as clearance. Works, such as defence of houses, demolition of houses (with gun-cotton), loopholes, overhead cover and stockades require a much larger proportion of R.E. labour. When R.E. supervise infantry they are not included in the M.H. labour done.

The remarks column (9) should give sufficient information as to the job itself for the executive officer to have no doubt as to what is required. The note given in the table explains what are the principal points upon which information is likely to be needed.

Columns 7 and 8 will next be filled in. As regards tools (Column 7) :—

Although hitherto it has been the custom to name these in precise detail, this is not absolutely necessary and there often will not be time to do so. Indeed if there were unlimited stores in the depôt or park, it would not be the place of a staff or R.E. officer to detail tools at all, as every executive officer ought to know what he requires for a job and is the man chiefly interested in getting the right tools. Since however the tools available are generally very limited, it is necessary that the allotment of the *principal* ones should be decided by a central authority to avoid disorganization. Not only the officer in general charge but also the storekeeper must make sure that they have enough important tools for all parties in each relief and to this extent the issue must be controlled. It is scarcely necessary however for the compiler of the working party tables, unless he has abundant time, to detail *minor* tools; this duty may be left to the storekeeper, who will of course have a detail of the working parties. It will be the business of this official to allot these tools fairly. If they are to be had, they will be issued to the parties in due proportion.

A distinction has been made between "principal" and "minor" tools. The distinction lies in this :—*principal* tools are those without which it is impossible to execute the work; *minor* tools are those which can, at some inconvenience, be dispensed with.

Under the denomination "*principal*" tools are included :—

For entrenchments.—Pickaxes ... ... ½* to 1 per man.
Shovels ... ... 1 „ „

If the front slope of the parapet is to be sodded—
Spades ... ... ⅓ „ „

(If entrenching tools are to be double-manned, half these numbers are needed).

For clearances.—Felling axes, hand axes, billhooks, cross-cut saws and hand saws may be classed together as "cutting tools." One per man will generally be detailed, and the storekeeper and executive officer should settle between them which kinds are required, which will depend on the nature of the timber and the quantities of tools in store. If the party has to cart the material after clearing it, a proportion of the men, varying from ⅛ to ⅓, will need no tools. In such cases some lashings should be issued for loading and the transport should be noted in the column of remarks.

If buildings or walls have to be knocked down without explosives, it will usually be done with improvised levers. Some heavy hammers will be useful.

For demolitions with explosives...Pickaxes, shovels, augers, saws, hammers, and lashings are the chief tools used. The work is always in the hands of an experienced officer, who details his tools.

For wire entanglements ...	Cutting tools (billhooks preferred)	⅓ per man.	
	Pliers	⅛ „ „	
	Mauls	1/16 for L.W.E. / ⅛ for H.W.E.	per man.
For abatis	Cutting tools ...	⅔ per man.	
	Mauls	1/10 „ „	
	Pickaxes	⅛ „ „	
	Shovels	⅛ „ „	
For revetments and loopholes—			
(*a*). *Sandbag*	Shovels	⅛ „ „	
(*b*). *Sod*	Spades	½ „ „	
(*c*). *Brushwood*	Cutting tools ...	½ „ „	
	Mauls	⅛ „ „	
(*d*). *Plank*	Hammers ...	½ „ „	
	Saws	½ „ „	
For defending walls and buildings	Pickaxes ... ... / Crowbars ... ... / Cutting tools ...	1 of sorts per man.	
For overhead cover (exclusive of placing the top covering of earth or sods)	Mauls	⅛ per man.	
	Pliers	⅛ „ „	
	Cutting tools ...	½ „ „	

* According to the nature of the soil.

Under the denomination "*minor*" tools are included :—

For entrenchments ... ... Rods, tapes, mallets and field levels.
For clearances ... ... Grindstones, whetstones, gloves and ropes.
For defending walls and buildings ... ... Carpenters' tools for erecting platforms, making barricades, etc.

and so on for other kinds of work.

Of course special jobs, such as blockhouses or bridges, would have to be considered in greater detail; but such work would be put into the hands of an experienced officer, who would prepare his own list of tools.

As regards material, *i.e.* expendable stores. Column 8 will state generally the *kind* of material needed, where it will be obtained and whether the working party are to fetch it or whether it will be brought to them. In the former case transport will be noted in the column of remarks.

In a few cases, mentioned below, *quantity* also must be shown.

The following will be the materials usually referred to :—

For Entrenchments.—Nil. (But see loopholes and overhead cover below).

For Clearances.—Nil.

For Demolitions with Explosives.—The *quantity* of the main explosive used. The minor materials for demolitions, viz., matches, fuze, detonators, primers, twine, planking, nails, sandbags, etc., must be arranged for by the executive officer.

For Wire Entanglements.—Quantity of wire and where the pickets can be cut. (One foot-run of wire is required per square foot of low entanglement and one yard-run per square foot of high entanglement).

For Abatis.—Where the trees will be got. If the abatis is to be wired, a good rough rule is to provide five times as much length of wire as the length of the abatis.

For Revetments and Loopholes.—

(*a*). *Sandbag.—Quantity* of sandbags. (About 13 per loophole in earth and 2 per square foot of revetment).
(*b*). *Sod.—Nil.*
(*c*). *Brushwood.*—Where the brushwood is to be got.*
(*d*). *Plank.—Quantity* required. (For loopholes, 12 square feet per loophole in earth).

For Defending Buildings.—Nil. (There will generally be plenty of material on the spot).

For Overhead Cover.—Where the brushwood will be got.

Finally Columns 1 and 4 will be filled in.

* One G.S. wagon load of brushwood will cover from 60 to 80 square feet of trench, and will revet 350 square feet of parapet.

Each succeeding relief is dealt with in the same way. It is always sound, in the case of entrenchments and obstacles, to start along the whole line at once with the first relief, deepening the trench and widening the obstacle with succeeding reliefs.

Such then is the method here proposed for organizing the work of the defence. The unwelcome arithmetical prospect which it presents is unfortunately inseparable from the subject; for military engineering is largely a matter of figures. Those who devote exclusive attention to the tactical problems of defence, where every man can claim the right of private judgment, may find that they are building, if not castles, at least parapets in the air. They are in fact likely to discover, as the Americans say, that they have bitten off more than they can chew. And finally if they are not so adept at this the less imaginative, though equally important branch of the subject, valuable time will be lost through the misapplication of the labour at their disposal.

Rates of Work.

Notes.—The rates given are exclusive of fetching material, except where stated.
For skilled labour (R.E. or trained civilians) increase the rates by one-half.

Nature of Work.	Unit.	Quantity per M.H. (Untrained Men).	Remarks.
Excavation (heavy tools, ordinary soil).	Cubic ft.	30 in 1 80 in 4 reduce rate if using longer reliefs than 4 hours.	Apply factors modifying the rate as follows :— Very easy soil $\frac{3}{2}$, Light tools $\frac{1}{2}$. Difficult ,, $\frac{2}{3}$, Double-manning $\frac{1}{4}$. Stony $\frac{1}{2}$, If parapet is concealed and trench drained $\frac{3}{4}$. If trench is traversed and recessed $\frac{2}{3}$.
Cutting down trees (up to 12" diameter).	—	1 man per minute per inch diameter.	Above 12" diameter the time in *hours* = $\frac{1}{3}$ diameter cubed (in feet).
Cut down small fir wood or brushwood, or mixed.	Sq. yds.	25	Reduce the rate if reliefs are longer than 4 hours.
Ditto, including sorting, binding and carting.	,,	10	Ditto.
Make a fascine	No.	$\frac{1}{6}$	These rates can be increased by 50 per cent. after a little practice.
,, a gabion	,,	$\frac{1}{2}$	
,, hurdles (of any size)	Sq. ft.	$1\frac{1}{2}$	
Sandbag revetment (including filling and tying bags and carrying, say 20 yds).	,,	6	—
Sod revetment (including cutting sods and carrying).	,,	4	—
Brushwood or plank revetment.	,,	35	Includes fetching brushwood from the *heap*.
Clearing strong hedge	Yds.-run	8	—
Building overhead cover ..	Sq. ft.	9	Varies greatly with difficulty of propping, span, etc.; double row support trenches take longer proportionally than single row.
Sod, plank, or sandbag loophole.	No.	$1\frac{1}{3}$	Carpenters can make timber loopholes 3' long at the rate of 4 an hour.
Brickwork loophole in wall	,,	2	Notches take $\frac{1}{3}$ as long.
Stockade.....	Ft.-run	$\frac{1}{2}$	Varies greatly.
Abatis (small trees) single row.	Yd.-run	$\frac{1}{2}$	—
High wire entanglement ...	Sq. yds.	3	Half these rates, if barbed wire is used.
Low ,, ,,	,,	10	

The above rates are founded on experiments in peace and under reasonably good working conditions. An officer will be well advised to reduce the rates on service by at least 20 per cent.

MAJOR-GENERAL SIR WILLIAM REID, R.E., G.C.M.G., K.C.B., F.R.S.

(*Continued*).

By Col. Robt. H. Vetch, c.b., late R.E.

Major Reid had been appointed Adjutant of the Royal Sappers and Miners at Woolwich in April, 1816, and, with the exception of three months when he was away with the fleet on the expedition to Algiers, continued to be Adjutant of that corps either at Woolwich, or Chatham, until July, 1824.

His uncle, Peter Fyers, at the same time held the appointment of Lieut.-Colonel Commanding the Rocket Brigade of the Royal Artillery at Woolwich, and Reid was able to see a good deal of his uncle and aunt, both while he was at Woolwich and later when he was moved to Chatham.

It will be remembered by those who have read the earlier part of the paper on "The Fyers Family," that Colonel Peter Fyers married, in 1812, Frances Bolland (b. 1791), daughter of John Bolland, Esq., M.P., a merchant of Mark Lane, and of his wife Elizabeth, daughter of Mr. Gipps of Hythe, Kent, and Howletts, near Canterbury, and M.P. for Ripon. Mr. John Bolland's family consisted of one son, who died unmarried, and seven daughters. There were, however, at this time only two daughters out of the seven still unmarried and living at home. Three had married before Colonel Peter Fyers came on the scene: Anne, in 1797, to Mr. George Field; Kate, in 1804, to the Rev. Herbert Oakley, D.D.; Elizabeth, in 1810, to her cousin William Bolland, afterwards Sir William Bolland, Baron of the Exchequer; then two years later Colonel Peter Fyers had married Frances; and, in 1815, Sophia married the Rev. John Lonsdale, afterwards Bishop of Lichfield.

Mr. J. Bolland and his family lived at Clapham, which was at that time a favourite place of residence, combining the advantages of country with proximity to the City and Westminster. It was then quite a country village within a short drive of town. Major Reid became a welcome visitor to his aunt's relatives at Clapham and it was not long before he lost his heart to one of the remaining daughters of the house. Miss Sarah Bolland, the youngest but one, was born on the 16th October, 1795, and at this time must have been a singularly

attractive young lady. A description of her as she appeared in November, 1816, just two years before her marriage, when she was on a visit to Edinburgh, is given in a letter from Mrs. Grant of Laggan to her friend Mrs. Rucker at Bath. It appears in the "Memoirs and Correspondence" of Mrs. Grant published by Longmans in 1845. The following is an extract from the letter dated Edinburgh, 30th November, 1816 :—

"I ventured out in a chair last night to Mrs. Miller's, where I met a very pleasant select party and of moderate size.

"There was in particular a Miss Bolland, who is on a visit to Sir William Fettes.

"I have very much lost the wish of seeing strangers, but she is one that I think none can see without a wish to meet her again.

"She has, in the first place, a very fine person, with much unconscious dignity in her air and aspect, a countenance noble and almost beautiful: mental in no common degree; and illuminated by large black liquid eyes, full of thought and feeling. She is very intelligent and quite natural, admires fine scenery and elegant literature without the least affected rapture; in short, I have not of long seen anyone that pleased me half as well."

From another source we learn that Miss Sarah Bolland "proved a devoted wife of great wit and beauty." The marriage took place at Holy Trinity Parish Church, Clapham, on the 5th November, 1818, the Rev. J. G. Bolland, Rector of Fetcham, Surrey, officiating.

The British Army of Occupation in France was gradually reduced in 1817 and 1818 and was altogether withdrawn at the end of the latter year. In 1817 many companies of the Royal Sappers and Miners were brought away and that corps was in consequence largely reduced and the adjutancy was moved to Chatham.

It was to Chatham that Reid took his bride and they lived in quarters at Brompton Barracks. Shortly after her arrival there, a reduction of the Royal Engineers took place and Reid, being a junior captain, was among the officers who were placed on half-pay on the 1st February, 1819. Fortunately his services were not lost to the State. He was continued in his appointment of Adjutant of the Royal Sappers and Miners, although on half-pay in his own corps.

During the next four years and a-half that he held this appointment at Chatham, he was Colonel Pasley's right-hand man. He threw himself with all his energy into Pasley's plans of instructing and training the men so that they might become not only smart soldiers, but good artizans, with a sound general knowledge of their duties as Sappers and Miners.

It is noticeable that about this period the officers of Royal Engi-

neers stationed at Chatham were, for the most part, men more than usually anxious to acquire scientific knowledge in many different subjects. Inventions, experiments, chemistry, geology, for which they took walking tours, improvements in pontoons, bridging and mining, not only occupied their attention, but were studied with enthusiasm. Yet they were by no means bookworms. Sport, and walking and riding exercise are constantly referred to in contemporary diaries. The bachelors of the time must, however, have been endowed with exceptionally good constitutions, for these same memoirs tell of parties in one another's quarters when they sat up till 3 or 4 in the morning playing cards and drinking punch.

While Reid was Adjutant of the Royal Sappers and Miners at Chatham four children were born to him. His eldest child Frances, or Fanny, was born in Brompton Barracks on the 5th August, 1819, but she died the following February; the second daughter was born in their quarters on the 3rd November, 1820, Lucy Alexandrina; a third was born at Woolwich on the 5th December, 1822, and named Maria; and a fourth, Sophia Lonsdale, was born at Brompton, Chatham, on the 9th January, 1824.

In 1823 Reid published two little works which were the result of his experiences in the Peninsular War. One was *The Defence of Fortresses* and the other *The Defence of Towns and Villages*. In the same year he also published translations of two French books, which he thought might be useful to his brother officers. These were *The Instructions issued by the French Imperial Minister of War for the Defence of Fortresses in 1813;* and *Instructions issued by the French Minister of War for the Defence and the Destruction of Bridges in 1814*.

Reid was restored to the full-pay list on the 24th March, 1824. He appears to have paid a visit to Dublin about this time. His uncle, Lieut.-General William Fyers, was still alive and Commanding Royal Engineer in Ireland, and no doubt it was in consultation with him that he applied to be allowed to join the Trigonometrical Survey of that country then in contemplation, and for which a Bill had been brought into the House of Commons.

In the following June the Committee of the House, to which the Bill had been referred, recommended that a trigonometrical survey of Ireland should be made with the view of apportioning equally the local burdens, and of obtaining a general valuation of the whole country. The Bill became law, and Colonel Thomas Colby, R.E., was appointed to superintend the work.

On the 24th July Major Reid was named to assist him and, resigning his adjutancy, he proceeded to Dublin. As it was intended that the survey should be conducted by the Royal Engineers under the Board of Ordnance, Reid suggested to Colby the advantage that

would be derived from utilizing the Royal Sappers and Miners in carrying out the subordinate details of the survey. After a lengthy correspondence, lasting over six weeks, Colby was convinced that the proposal was not only a practical one, giving a benefit to the Sappers by survey practice in the field, but would be also an economical way of carrying on the work. Accordingly he put forward the proposal to the Master-General of the Ordnance, then the Duke of Wellington. On the 12th December, 1824, a Royal Warrant was issued for the formation of a company of 62 non-commissioned officers and men for employment in the survey of Ireland. Reid was appointed to command the first Survey Company, which was numbered the 13th Company of the Royal Sappers and Miners.

The company was at once organized at Chatham. The men were selected from the most intelligent men at the station, and were specially trained under Colonel Pasley for the particular duties they would be called upon to perform. The first detachment of the company, consisting of 21 rank and file under Lieut. E. Vicars, R.E., arrived in Dublin in March, 1825, and the remainder of the company followed in April. The men were distributed in small sections over the North of Ireland—at Antrim, Belfast, Coleraine, Dungiven, and Londonderry, etc.

Reid lived with his family at Engineer House, Island Bridge, at first, but, when the company arrived, he went to live in the house at Mountjoy Barracks, in the Phœnix Park, where the head-quarters of the company were quartered; he remained there three years from April, 1825, until June, 1828. There his only son, Edward Hay, was born on 20th October, 1825, and there he died 10 months later. There also his fifth daughter, Elizabeth Oakeley, was born on the 5th November, 1827. Reid travelled about the country as his work required, but all the map drawing was done at Mountjoy.

He remained on the Ordnance Survey in Ireland until June, 1828, and was then placed on the unemployed list for six months. He returned to England and stayed in London and Chatham until October when he occupied his father-in-law's house at Clapham for three months. He was promoted to be 1st Captain on the 28th January, 1829, and sent to Exeter, then the headquarters of the Western Engineer District, where he remained for nearly three years. During this time serious disturbances occurred in S. Wales and districts round Bristol, and Reid took part in the military arrangements for quelling the riots.

His duties carried him all over South Wales; he had to visit all works of defence and barracks in the counties of Somerset, Gloucester, Hereford, Monmouth and Worcester; and his time was much occupied in travelling. The only personal glimpse

which we get of Reid, during all the years that had gone by since his war services ceased, is found in the solitary letter that has been preserved which was written from Exeter to his friend Colonel Pasley.

From Major Reid to Colonel Pasley, R.E.

"EXETER, *10th June*, 1829.

"MY DEAR COLONEL,

"I was much pleased to find that the packet I had got from you stitched with green cord was all in your own handwriting, and the contents interested me much.

"I have never changed my opinion respecting your geometry and fortification as being the best books for beginners, and I advised Macauley to introduce them, at least the fortification. If they are simple they would be the quicker gone through, and after going through them the cadets could commence, as you say, what Macauley wishes to prepare.

"I know no other elementary book, which deserves to be so called, on fortification. It might perhaps be modified with advantage as Colonel Williams suggested, and as you yourself would approve; but with so clear and simple an introduction to fortification, I think it is a pity that it is rejected at Woolwich for something yet to be prepared and which when produced may not be half so good.

"The Dublin Education Society sent me half-a-dozen copies of their geometry; I wished them to have taken yours as it was, but when they had resolved to ask your permission to compile from it instead, I thought it no use to say anything on the subject. I don't like theirs as well as your first edition, nor is it so well suited for schools.

"I think it is a pity that classics are not required to be read before the cadets come to Woolwich, at least a moderate share.

"Indeed, I have no doubt but that the labours of your committee will be very valuable.

"Like you I have melted my silver crucible; I am recommencing a few chemical amusements and mean to send you my results from time to time. I now procure the silica in complete solution, not in the semi-fluid glutinous state I got it to at Chatham. I believe that we failed principally from not using materials sufficiently pure and always distilled water. Great chemical changes take place by the addition of so very little new matter that pure ingredients are absolutely necessary. I found common coal and even gas coke to injure seriously the platinum capsule by giving out to it different oxides which combined with it. I partly oxidized the platinum by not cleaning off my mortar with an acid, after having had potash in it, though I scrubbed it with a cloth.

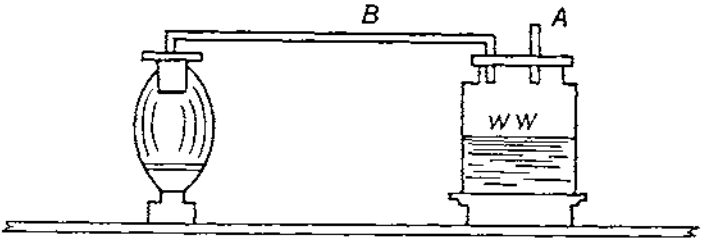
"Farraday's *Manipulation* I find an excellent book. I have used his method of applying india-rubber for lutes and corks successfully, and I have sent to London for some sheet caoutchouc recommended by him.

"We have had a very good lecturer here who is gone to Plymouth, and would go to Chatham. He is a candidate for the Chemical Lectureship at the London King's College. His terms are, I believe, 35 guineas for a course of twelve lectures, and his address is at Mrs. Ridd's, Portland House, Hull.

"He was engaged by the Mechanics' Institution here for a fixed sum, and all that was got beyond that was gain to the Institution.

"I find the chemistry an agreeable and useful amusement and I hope I shall pursue it.

"I burnt myself once with the Fluo Silica acid; but after preparing a better apparatus I succeeded in precipitating the silica very easily.



"The tube A became a safety valve; the one B just went through the cork; WW was the height of the water. The gas was decomposed and is well described by Turner; on touching the water it formed film after film on the surface and then fell to the bottom. This is the hydrate of silicate which must get a red heat, mine was pure white. I find that thin glass tubes are bent by the heat of the spirit lamp without the blowpipe, and they are of great use and frequent application.

"I sent Matson a box of stones with a smaller one inside for Miss Pasley; some of which may amuse you though they are of very little value.

"I am glad that chemistry and geology are to be taught at Woolwich on a rational system.

"Mrs. Reid has written to Mrs. Pasley, I hope she is pretty well.

"Pray tell Hay that I reproach myself for not writing to him, we hope to see him.

"Mrs. Reid intends to go to Brecon with me. We shall be back by the 12th or 15th July at Exeter.

LONDON, *Friday, 13th June*, 1829.

"I had written thus far at Exeter when I heard of Mr. Bolland's death and I have come up to London to attend his funeral; after it I return immediately.

"He was 86 and had nothing to live for, both body and mind being decayed after having been both of them unusually vigorous until nearly 80.

"I have been to Newman's and made a few small purchases, and should like to take a look into your vestry at Brompton but return to Devonshire on Tuesday. Newman told me that Mr. Murray, whom I mentioned as a lecturer, had got into debt in London and lost his credit; that he knew him very well. His language is absurdly fine, but if you ever get anyone to come to Chatham I would recommend him to your consideration.

"I continue to teach my little girls in whom I take great pleasure.

"Our eldest is greatly pleased at demonstrating the truth of the first part of your geometry. It shows her at the same time the application of Euclid, the first four books of which she knows pretty well.

"Another amusement we have is filling a border in the garden with the numerous pretty native plants which abound in the hedgerows in Devonshire, and we plant them arranging them at the same time in the Linnæus system. It is a nice occupation I think for little girls, and a healthy one, and adds much interest both to their walks and mine. It is teaching them the first principles of botany correctly.

"I shall tell you how our garden gets on also. I must now conclude.

"Yours sincerely,

"Wm. Reid.

"They dance every day. It is of great value. Young women don't in general take exercise enough."

Reid spent more than two years after this letter was written at Exeter. On the 14th September, 1831, he was placed under orders for foreign service, his destination being the West Indies and, obtaining leave of absence, he went to stay at Plymouth to prepare for the voyage.

On the 8th December, 1831, he embarked with his family for Barbados where he arrived on the 12th February, 1832. He lived in the Quarter for the Resident Engineer, as the second in command was called, at St. Ann's. The island had been visited by a fearful hurricane on the night of the 10th August, 1831, and the results had been even more destructive than the great storms of 1675 and 1780. The loss of life was estimated at 1,500 and the injured numbered nearly 5,000. The value of private property destroyed, exclusive of the shipping, was reckoned at a million and a-half sterling. One of Reid's duties, immediately after his arrival, was the rebuilding of various Government buildings which had been blown down in the hurricane, and the blowing up of the *Arethusa*, a Liverpool vessel of 350 tons, which had foundered in the hurricane and had become dangerous to the navigation of the roadstead in Carlisle Bay. Major Reid commanded the 19th Company of Royal Sappers and Miners at Barbados and he considered that the destruc-

tion of this wreck afforded an excellent opportunity for teaching his men practical demolition under water. A number of successive small charges of gunpowder were placed under the ship's bottom along the keel and as near to it as possible; these charges were successfully exploded, and Reid was the first to blow up a wreck by submarine mines. Some years later his friend Colonel Pasley followed his lead and blew up the wreck of the *Royal George* at Spithead. This ship of war of the line had lain there since that fatal day, the 29th of August, 1782,

"When Kempenfelt went down,
With twice four hundred men."

The difference between the demolition of the *Arethusa* and of the *Royal George* was that in "the forties" Pasley for the first time used electricity to explode charges; whereas, when Reid blew up the *Arethusa* in the "thirties" he had not this novel and valuable help, but nevertheless, as the saying is, he established a record in 1832.

But after all it was the hurricane itself, much more than taking measures to remedy the destruction it had caused, which occupied Reid's mind at this time. The devastation and misery he witnessed led him, as he himself says: "to search everywhere for accounts of previous storms in the hope of learning something of their causes and mode of action." In his researches he was materially assisted by the previous labours of Mr. Redfield of New York, who, in the previous year (1831), had published in the *American Journal of Science*, the first of a series of papers in which he argued, not only that the hurricanes of the American coast were whirlwinds, but that they were progressive and moved in curved tracks with a considerable velocity.

Reid found himself in complete agreement with Mr. Redfield's theories and, fully acknowledging his obligations to that meteorologist, he set himself to confirm and extend his deductions by laboriously collating the log books of British men-of-war and merchantmen. Impressed also with the idea that to the south of the equator, in accordance with the regularity evinced in all natural law, storms would be found to move in a directly contrary direction to that in which they moved in the Northern Hemisphere he collected all the facts available to aid further enquiry on the subject.

From October, 1833, to January, 1834, Reid was the Engineer officer in St. Vincent where he and his family lived in the Engineer Quarter. Then in January, 1834, he returned to Barbados and occupied the quarter he had been in before for the remaining few months of his period of foreign service.

Reid arrived home from Barbados in May, 1834. The congestion in the upper ranks of the Artillery and Engineers was still great. Many officers were unemployed, and as there was no vacancy for Reid to fill he had to join this number. While he was thus officially unemployed he was a very busy man. After a month in London he spent four months on the Continent and a month at St. Leonards and then took a house at Hampstead. He was not sorry to have complete leisure for a time and to be able, in a way he could not do in the midst of his military duties in the West Indies, to devote himself to the subject of discovering the laws that govern storms. For the next year he was engrossed with his investigations, shifting evidence, weighing opposing statements in the balance of his judgment, and studying every feature of the phenomena. But while he was so absorbed, events were happening in Spain which led to an abrupt, albeit temporary, suspension of his labours.

On the death of Ferdinand VII. in 1833, his widow, Queen Christina, assumed the regency of Spain during the minority of her daughter, Isabella II. Don Carlos claimed the throne and in July, 1834, appeared in Spain to support his claim. This caused no small stir in this country. England had successfully turned Joseph Buonaparte out of Spain and placed Ferdinand on the throne to which he was entitled. This same title was now disputed in the person of his daughter.

Lord Melbourne's ministry gave way that summer to that of Sir Robert Peel. The Duke of Wellington, who was Foreign Minister, was opposed to any intervention in Spanish affairs and in spite of a good deal of sentiment in favour of the Queen Regent and the legitimate heiress to the throne, no official support was offered from this country in the shape of armed intervention.

In April, 1835, Lord Melbourne returned to power with Lord Palmerston as his Foreign Minister. The latter was strongly in favour of lending Spain armed support and of redeeming the pledges which England had given in common with France and Portugal, when Isabella II. was recognized as the rightful successor to Ferdinand VII. by the Quadruple Treaty of the 22nd April, 1834. But to have sent a British army to Spain would probably have brought about the downfall of Lord Melbourne's government. It was decided therefore to render assistance in other ways. An Auxiliary Force, to be composed of several foreign legions of volunteers, was to be formed, at the instigation of the Spanish ambassador in London and sent to the assistance of Spain.

As Alasa, the Spanish ambassador, was a friend of the Duke of Wellington, having had the unique experience of serving against Nelson at Trafalgar and with Wellington in the Peninsula and at Waterloo, the opposition was not likely to take serious objection to

the proposal. Alasa settled matters personally with Palmerston. The British Legion of Volunteers was to be a force of 10,000 men of all arms raised for service in Spain. Lieut.-Colonel (afterwards Sir) George de Lacey Evans was appointed to the chief command. The Foreign Enlistment Act was suspended and by the summer of 1835 the enlistment had been fairly successful.

It is true that there was much difference of opinion as to the wisdom of the policy. King William IV. was strongly opposed to it and to the appointment of Evans to command the British Legion. Don Carlos took great umbrage and issued a proclamation protesting against the semi-official interference in Spanish affairs of British and other foreign volunteers, and ordering that no quarter should be given in the field to any foreign volunteer auxiliaries.

British officers on full pay desiring to serve in the British Legion had to obtain permission to be placed on the Half-pay List with a view to receiving a commission in the Legion.

Lieut.-Colonel George de Lacey Evans had served with distinction with Wellington in the Peninsula and at Waterloo. He had also served in the American War of 1814 at Washington, Baltimore, and New Orleans, where he was wounded. He had no doubt seen something of Reid both with the Light Division in the Peninsula and afterward at New Orleans, and had formed a high opinion of his ability as a leader of light troops. He therefore offered Major Reid the command of the Light Infantry Brigade of the Legion.

Reid had been employed since April, 1835, as the resident Engineer officer at Weedon, but the offer of this command of a light infantry brigade appealed strangely to him. The old war spirit which had been laid to rest for close on 20 years awoke within him. Spain for which he had fought and bled, and where he had gained the laurels with which he had never yet been crowned, called to him. Bright recollections of his youthful days in that sunny climate stirred within him. To fight for the young daughter of the King he had then helped to restore to his throne, was to him, the practical soldier and scientist, an irresistible claim. Confidence in his own powers of command in the field and of the fascination of light infantry work added its spell. He accepted the offer and went to Spain in September, 1835, leaving his wife and family at Brighton. He was gazetted to the temporary Half-pay List on the 7th of that month. At the same time a very talented officer of artillery, Capt. Colquhoun, who had served in the Peninsular War, accepted the command of the British Legion Artillery, and was also gazetted to the temporary Half-pay List.

Over these two officers a fierce paper war was waged. The Artillery and Engineers being under the Board of Ordnance had different regulations from those applying to the rest of the Army as regarded half-pay. The General Commanding-in-Chief, at that time

Lord Hill, better known as Sir Rowland Hill of Peninsular fame, had laid it down that officers on full pay could not serve with the Legion, but that officers on half-pay would be allowed to do so. Nevertheless an officer in the cavalry and infantry on full pay could, if eligible, be placed on half-pay in order to join the Legion, and returning when he wished to do so, could be brought back to full pay in any regiment that might be available. There was no arrangement in the Ordnance Corps at that time by which an officer of Artillery or Engineers who was voluntarily placed on half-pay could be brought back to resume his place in his regiment or corps.

The Master-General of the Ordnance, Lieut.-General Sir Richard Hussey Vivian, Bart. (afterwards Lord Vivian), K.C.B., who was a cavalry man, had known Reid in the Peninsula. Vivian then commanded a light cavalry brigade and Reid was a lieutenant but senior Engineer officer in the same light division. Vivian had no doubt formed an high opinion of Reid and was glad to further his views. He also was friendly to de Lacey Evans and was pleased to do what he could to help the Legion to be a success. When the question arose how these two officers, Reid of the R.E. and Colquhoun of the R.A., were to be enabled to serve in the positions in the Legion that had been offered to them and yet be able after serving in Spain to resume their places in their respective corps, it was urged by Lord Palmerston that they should be put upon temporary half-pay. The Master-General was sympathetic and agreed, but pointed out that no such thing existed for the Ordnance Corps and that the King's sanction must be obtained. Sir Hussey went away from town on inspection duty and through some misunderstanding the King's pleasure was not taken by Lord Palmerston. His Majesty approved the appointments without noticing the new departure. When it was brought to His Majesty's notice there was trouble.

The correspondence is in the Record Office, and since it is mainly about poor innocent Reid who saw himself gazetted and went to Spain believing he went with the King's approval, and found himself the victim, not for the first time in his life, of the errors of others, I am including the correspondence, a copy of which has been lent me, in this memoir. Before however giving this somewhat amusing and rather lengthy correspondence between well-known Statesmen and the Private Secretary of the Sovereign about Major Reid and Capt. Colquhoun I will continue the narrative.

The King, hostile to the Legion and worked upon by enemies of Lieut.-Colonel de Lacey Evans, took exception to the arrangement made and ordered that it should be cancelled, and that Major Reid and Capt. Colquhoun should be informed that, if they continued in the service of Spain, His Majesty would never consent to their being restored to full pay and resuming their places in their regiment or corps.

Reid had already arrived in Spain and assumed his command when, like a pistol put to his head, came the King's commands that he should either at once return to his corps or that he should be cast out of it for ever. He knew nothing of the correspondence that had taken place, of the mistake that had been made. He only knew that, whereas he had specially applied for the King's permission to be allowed to accept the command in the Legion on the terms and conditions offered, he had found himself gazetted to the temporary Half-pay List as he anticipated. He had proceeded to Spain under the impression that the King not only approved of his going but also of the arrangement made for bringing him back to the Corps when his engagement to Spain was over. Now he had to face the alternative of breaking his engagement with Spain or of leaving the Corps he loved. With that shrewd judgment he showed in difficulties he did not hesitate. To the first his honour was engaged, the second was a severe punishment for no fault of his own, but it must be borne. It was a case of Hobson's choice, there was no alternative.

Actually at the head of his brigade in the field he could not under any consideration leave it, and yet he saw himself, a married man with a family, cut off from his profession, and having to begin life afresh at 44 years of age. He wrote that he felt himself to be personally pledged and, as he could not in honour leave, he must reluctantly accept the consequence of remaining.

In the November following two things happened which greatly relieved his mind and strangely both at Brighton. On the 3rd November the King, who was at Brighton, relented and approved of the original arrangement, on the understanding that it should not be made a precedent. On the 21st of the month his sixth daughter, Charlotte Cuyler, was born at New Steyne, Brighton, and the welcome news was despatched to him that mother and child were both going on well.

I do not propose to dwell upon Reid's active service in the British Legion in Spain at any length. He saw a good deal of fighting, but this war was very different from the war with the French. If the enemy were greatly inferior as soldiers to the French armies of Napoleon and his marshals the men of the Auxiliary Force were as much inferior to Wellington's men. Many of them had no stamina and were quite unfit for hard active service. Reid did his best with the Light Brigade and it did him credit. He took it to the Siege of Bilbao in November, 1835, and early in 1836 he co-operated with Espartero in the attack on Arlaban. In May of that year he assisted in raising the Siege of St. Sebastian. On that occasion the death roll was heavy; 97 officers and 500 men were lost out of a force of 5,000. Reid was wounded in the neck while attacking the lines in front of the fortress. It is a curious coincidence that 23 years before

he was wounded in the neck at the siege of this very fortress in storming a breach. At the end of May and beginning of June, 1836, he took part in the repulse of the Carlists who had made a desperate attack on the position of Sir de Lacey Evans. For his services under the Queen of Spain he received the Spanish medal for the Carlist War and was decorated with the Spanish Order of St. Ferdinand.

Reid returned to England in August and on the 19th of that month was restored to the full-pay list. He was not, however, employed owing to there being no vacancy. He resided with his family at Brighton first and then at Blackheath. On the 10th January, 1837, he was promoted Brevet Lieut.-Colonel and on the 17th of the following month was sent to Portsmouth. There he did duty living in the Engineer Quarter at Portsmouth until the 14th November, 1838, when he was again unemployed and went to London. But the year 1838 was the year of his triumph. In this year the results of his many years of scientific research were published by John Weale, of Holborn, in an 8vo. volume entitled, *An Attempt to Develop the Law of Storms by Means of Facts, arranged according to Place and Time, and hence to Point Out a Cause for the Variable Winds.* This volume was illustrated by charts and woodcuts. A second edition with additions was published in 1841, and a third in 1850.

Of this work Major-General Sir John Henry Lefroy, R.A., F.R.S., one of the most careful and exact observers of magnetic phenomena, whose method of observation has been universally recognized as the ideal standard for all work of its kind, says in the *Proceedings of the Royal Society :*

"None but those who have attempted a like task can fully appreciate its difficulties:—observations which the investigator dare not reject, although convinced that they are wrong; provoking silence where a word would clear up a doubt; still more provoking record of useless details, to the omission of those that are important. Nevertheless, Reid persevered and, gaining confidence in the key he had obtained to the real nature of these intricate phenomena, he ventured, in 1838, to lay down, for the guidance of the seaman, those broad general rules of navigation which are known as the 'Law of Storms.' He showed that it is possible to deduce from the facts, rules applicable to every emergency; to tell unerringly when ships must run before the hurricane, when they must lie to, and on which tack, so as to avoid being taken aback by the veering of the wind; lastly, how to anticipate its coming changes, and shape the course which best turns them to account. The announcement of this law, so important to the mariner, and to every naval and commercial nation, was received with the greatest interest by the scientific world: and Lieut.-Colonel Reid's work, entitled 'An Attempt to Develop the Laws of Storms' has gone through several editions and has been translated even into Chinese."

If Reid's deeds of glory as a soldier had failed to win for him the recognition which he might have expected, far otherwise was it with the patient investigator of physical law. He was elected a Fellow of the Royal Society in 1839, and, 10 years later, Vice-President. Many learned bodies hastened to enrol him among their numbers and to do honour to his work. Whether it was that his merits were beginning to dawn on the military authorities, or that a lurking feeling that their predecessors had behaved shabbily to Reid in the days that had gone by, at last he was given a Companionship of the Bath on the 19th July, 1838, and the following January was appointed Governor of Bermuda. As his uncle had told him justice would be done to him in the long run; but who can measure the difference that must for ever exist between the prompt acknowledgment of the services of the young and the honours held back to be bestowed when middle age is reached, when the ambitions of youth have faded, the fire has gone out, and duty for duty's sake has taken their place.

(To be continued).

MEMOIR.

COLONEL HENRY FYERS TURNER, C.B., R.E.

By Col. Robt. H. Vetch, c.b., late R.E.

It is now a considerable time since I was asked to write memoirs for this Journal of two brother officers who died last year. They were Major-General E. R. James and Colonel H. F. Turner. By virtue of their mothers they were both members of the Fyers family, and it was proposed to notice them in due course in the article on that family which has been running its rather lengthy series for some months past. This article has indeed much outgrown my original intention, and the Editor has wisely agreed to place memoirs, it may be desirable to insert, of officers who are members of the Fyers family through the female line, under their own surnames, instead of including them in the general article.

Colonel H. F. Turner was the eldest son of Major-General Henry Austin Turner, Royal Artillery, and of his wife, Renée Theresa Fyers, third daughter of Major-General Thomas Fyers, R.E., and granddaughter of Lieut.-General William Fyers, Colonel Commandant, Royal Engineers. He was born on the 8th November, 1840, at Mauritius, where his father was then serving as a subaltern of Royal Artillery, having married the daughter of the Commanding Royal Engineer there on the 12th February of the same year.

Major-General H. A. Turner, born at Slane, in Ireland, on the 16th November, 1814, was the second son of the Rev. Joseph Turner (1772—1853), D.D., and J.P., Vicar of Duleek, and Rector of Raddenstown, co. Meath, by his wife, Margaret Jane Lhoyd, of Llwydiarth Anglesea. General Turner's great-grandfather was Timothy Turner, of Dublin, who died in 1765.

The writer remembers well General Turner and his wife, when he was in Bermuda in 1861–2. The General was then a lieut.-colonel commanding the artillery in Bermuda, whose headquarters were at St. George's, where there was a joint R.A. and R.E. Mess. Mrs. Turner was a very gentle little lady, rather sad after the loss of many children—three were carried off in an epidemic of yellow fever at Barbados some years before and two others later. As her son was in the writer's batch he received many kind attentions from both Colonel and Mrs. Turner during the short time he was quartered in Bermuda.

Their eldest son, Henry Fyers Turner, or Harry Turner, as he was called by his contemporaries, was not long in Mauritius; on the day

he was one year old he embarked with his parents for England in the troopship *Adelaide*. When he was little over eight years old his father was ordered to the West Indies, and sailed in the s.s. *Great Western* in January, 1849, for Barbados, taking his family with him. In the epidemic of yellow fever in Barbados in the autumn of 1852, three out of five children died, and Capt. Turner was sent to Grenada. He returned to England with his family in the s.s. *Vulcan* in January, 1854, when Harry was sent to Dr. Bridgman's School to be prepared for Woolwich. He entered the Royal Military Academy in January, 1856, having passed in November of 1855 the last examination of nominated candidates. Before introducing the new system of public competition open to all, it was decided by the authorities to allow all the nominated candidates who had attained the prescribed age to compete among themselves for the vacancies. If I remember right there were some 120 to 130 of these candidates and there were some 30 vacancies. After two years at the "Shop" Turner got his commission in the Corps on the 23rd December, 1857.

He spent only 10 months under instruction at Chatham and was then sent to Portsmouth. There he was employed on the defence works at Hilsea Lines under Major F. C. Hassard (afterwards a Major-General and C.B.). The Commanding Royal Engineer of the district was the well-known Crimean soldier, Colonel Sir J. W. Gordon, K.C.B. At the end of 1861 the seizure of the Confederate delegates, Messrs. Slidell and Mason, on board the Royal Mail steamer *Trent* by Capt. Wilkes, commanding the Federal warship *San Jacinto*, made a war with the United States of America imminent. Immediate action was taken by sending a large force to Canada. Sir J. W. Gordon was sent in command of the Engineers, and Turner accompanied him. Before he left Portsmouth Major Hassard wrote the following letter to the C.R.E. showing how well Turner had done his work at Hilsea :—

"ROYAL ENGINEER OFFICE,
"HILSEA, *3rd December*, 1861.

"SIR,

"Lieut. Henry Fyers Turner, R.E., having been ordered to proceed forthwith to Canada I should be neglecting my duty did I not bring to your notice the great zeal and ability which this officer has evinced during the three years that he has been employed at Hilsea. He has had duties to perform both onerous and of great responsibility which he has done to my entire satisfaction. He is an officer of much promise and likely to prove an honour to the Corps to which he belongs.

"I have, etc.,
"F. C. HASSARD,
"*Major, R.E.*

"To COLONEL J. W. GORDON, C.B., A.D.C.,
"Commanding Royal Engineer,
"Portsmouth."

"Forwarded to the D.A.G. of Engineers.

"It gives me great pleasure to confirm and to forward this report of Lieut. Turner's good services.

"J. W. GORDON, *C.R.E.*"

When Messrs. Slidell and Mason were surrendered to the British Government on 1st January, 1862, most of the troops so hurriedly sent to Canada were recalled, but Turner, being due for foreign service, was sent to Toronto, where he remained for the next five years.

On 7th September, 1864, he was married at St. John's Church, Toronto, to Harriet Eliza Spragge, eldest daughter of the Hon. John Godfrey Spragge, Vice Chancellor (afterwards Chief Justice) of the Province of Ontario.

In 1866 the Fenians in the United States held a great mass meeting in New York on the 4th March in sympathy with the disaffection in Ireland. At this meeting the invasion of Canada was threatened, and on the 31st May the threat was carried into execution by Colonel O'Neil, who, with a large body of Fenians, crossed the Niagara and entered Canada; conflicts ensued with bloodshed; the Fenians were driven back and many of them were captured by the United States' Generals Grant and Meade.

When this Fenian raid took place Turner was attached to the Flying Column under Colonel R. W. Lowry, commanding the 47th Foot, who had served on the Staff throughout the Crimean War. For his services in this successful little campaign Turner received the medal with clasp "Fenian Raid, 1866." In the middle of June, the affair being practically over, the Commanding Royal Engineer in Canada wrote to enquire when Lieut. Turner would be at liberty to return to his ordinary duties, and what duty he was then employed upon. The following letter from Lieut. Turner in reply shows what was the varied nature of his duties during the repulsion of the raid and after :—

"CAMP FORT ERIE, *15th June*, 1866.

"SIR,

"In accordance with instructions contained in your letter of the 13th instant, calling upon me for a report for the information of the C.R.E. on the duties I am, and have been, employed in, with the view of ascertaining the necessity of my staying here, and of supplying my place at Toronto, I have the honour to report that on the 2nd June, I was directed to join the Flying Column under Colonel Lowry, under orders to proceed with the utmost expedition to intercept the retreat of the Fenian forces on the Niagara frontier.

"I did so, and during the rapid advance and occupation of Fort Erie endeavoured to assist the officer commanding by every means in my power: in establishing the volunteers in their camp; in providing means for the removal of guns, etc., from the trains; by assisting him to receive and answer telegrams, by conveying messages night and day to the different regiments and generally by placing my services at his disposal.

"After the camp was established here, I sketched its position and made myself acquainted with the ground in the neighbourhood.

"After the departure of Colonel Wolseley on the 4th instant I was directed to perform the duties of the Quartermaster-General's Department, and have ever since made all arrangements connected with the conveyance of reinforcements, and then stores to the various out-stations under Colonel Lowry's command, etc.

"To-day I visited with him Fort Colborne and Dunville.

"As attacks on these places, especially the former, are almost nightly expected, I advised the officers commanding on the position, form, and construction of some rough entrenchments which it seemed advisable to construct with the cord-wood there collected.

"I have assisted in the examination of prisoners and in all the multifarious duties connected with a force in the field.

"As at one time it seemed probable that the column would be called on to make some rapid movements I organized (as reported by telegraph) a small Volunteer Engineer Brigade of 12 men to carry out any repairs to bridges, railroads, etc., etc., which might quickly be required.

"I have caused the entrenching tools brought by various corps to this place to be collected, sorted, and stored ready for use.

"In the absence of any storekeeper I have collected the reserve ammunition from the cars in which it was mixed with other stores, and had it properly stored in safety.

"I am not at present engaged in any strictly professional duties, and am not aware whether my services as an Engineer officer will be further required.

"I have, etc.,
"H. F. TURNER,
"*Lieut., R.E.*"

"Forwarded for information of C.R.E. in Canada. Should there be no further disturbances General Napier will order Lieut. Turner to return to Toronto next week.

"I am glad to say this officer has performed his duties with his usual zeal and ability.

"F. C. HASSARD,
"*Lieut.-Colonel, Dist. C.R.E.*

"*16th June*, 1866."

"R.E. HEADQUARTER OFFICE, MONTREAL, *19th June*, 1866.

"SIR,

"I enclose a report from Lieut. Turner, R.E., giving an account of his proceedings while attached to a Flying Column under Colonel Lowry in the Niagara District during the late inroad of Fenians from the United States, and have much pleasure in adding my testimony to that of his immediate commanding officer as to the manner in which Lieut. Turner discharges the duties entrusted to him.

"I have, etc.,
"CHARLES E. FORD,
"*Colonel, C.R.E. in Canada.*

"The D.A.-General, R.E., Horse Guards."

On leaving Canada, in January of the following year, to return to England, his old commanding officer at Hilsea had the pleasure of repeating his former commendation of the services of Lieut. Turner while under his command, in the following terms :—

ROYAL ENGINEER OFFICE, TORONTO, *1st January*, 1867.

"SIR,

"On a former occasion when Lieut. Turner, R.E., quitted my command I had the pleasure of bringing the very satisfactory manner in which he had performed his duties to the notice of the Commanding Royal Engineer of the South Western District. During the second period that Lieut. Turner has served under my immediate command I see no reason to alter the opinion I then formed of him; and have the honour to bring to your notice the great zeal, diligence and intelligence displayed by this officer in the execution of every duty that he has been called upon to perform.

"I need hardly remind you of the favourable mention made of him when attached to the field force at Fort Erie during the Fenian raid, when in addition to his own duties he was employed as Deputy Assistant Quartermaster-General. I trust therefore you may be inclined to bring his name to the notice of the Deputy Adjutant-General of Royal Engineers, as should any important service be required from an officer of the Corps, and he be selected, I am quite certain that Lieut. Turner will always support the high character he has obtained from everyone during the time he has been in the Service, and continue to be a credit to the Corps to which he belongs.

"I have, etc.,

"F. C. HASSARD,

Lieut.-Colonel, C.R.E., 1st Military District.

"D.A.G., R.E.

"Cordially agreeing with Lieut.-Colonel Hassard in all he says in favour of Lieut. Turner, R.E., I have much pleasure in forwarding this report.

"CHARLES E. FORD,

"*4th January*, 1867." "*Colonel, C.R.E.*

On the 1st April, 1867, Lieut. Turner joined the South Eastern District, and was employed for the next four years at Dover on fortification and barrack work and on company duties. His company was in command of Capt. (afterwards Major-General) J. P. Maquay, R.E., of whom he often spoke in high terms.

From Dover he went in 1871 to the Postal Telegraphs and here it must be explained that in the month of May, 1870, the Royal Engineers were employed for the first time under the Post Office. It had been realized that to have a military telegraph service which should be efficient in time of war, it was necessary to continually exercise it in similar work in time of peace. That a large area of

country was required, over which the Engineers should be constantly exercised in peace time in constructing air and underground lines and repairing them, and in manipulation of instruments, and in office work. Fortunately the proposals came at a time when the Post Office was in need of every assistance in coping with new telegraph lines required, and the War Office proposal to place one company of Royal Engineers under the Post Office was welcomed by the Postmaster-General.

The company selected was the 22nd under Capt. (afterwards Major-General) C. E. Webber, R.E., with Lieut. (now Colonel Sir) Herbert Jekyll, and Lieut. (now Capt.) J. Ramsay, as his subalterns. Owing to the pressing necessities of the Post Office for the rapid extension of the telegraph system, an additional company of Royal Engineers, the 34th, was placed at the disposal of the Post Office in the autumn of 1871, and Turner was appointed to command it.

When Turner left Dover to join the Postal Telegraphs he was still a subaltern and joined the 22nd Company under Capt. Webber, doing duty first in London, and then in Edinburgh. On the 12th August, 1871, he got his promotion to 2nd Captain and in the autumn went to Inverness, where the headquarters of the 34th Company were to be.

The total strength of the Royal Engineers at that time under the Post Office was 6 officers and 153 non-commissioned officers and sappers. From a note in the *R.E. Journal* of March, 1872, it would appear that they were employed in the construction of new lines and the reconstruction of old lines, both over and under ground. The mileage constructed and rebuilt in 1871 was over 1,000 line-miles and over 3,200 wire-miles. A few N.C. officers and sappers were employed as clerks in telegraph offices, and others in the maintenance of existing lines and in offices chiefly in the eastern counties, called the Eastern Division, Postal Telegraphs. This division of the country for the employment of the military was extended later to comprise all that portion which lay east of a line drawn from Lynn, through Cambridge, London, and Tonbridge to Beachy Head on the South Coast.

On the 1st April, 1872, Capt. Turner had the misfortune to lose his wife, who died at Inverness. On the 6th July he moved with the headquarters of the 34th Company to Ipswich which was the official centre of the new Eastern Division of the Postal Telegraphs. For nearly six years Capt. Turner remained at Ipswich in charge of this division, doing good work.

In 1877, Major Webber, anxious to have a permanent arrangement and impressed with the necessity of having a large body of skilled telegraphists instructed in time of peace by means of the Post Office service, put forward a scheme to the War Office asking that a settled establishment should be agreed to and the South of England appor-

tioned for the training and exercise of military telegraphists. The Postmaster-General, Lord John Manners, arranged that 5 officers and 160 men should be borne on the Post Office Votes and employed under the Post Office; that the whole of the South of England from the mouth of the Thames to the Land's End, including the Channel Islands, should be their sphere of work; that the engineering work throughout this district should be done exclusively by the Royal Engineers; that 60 of their men out of the 160 should be employed as manipulators and distributed among the principal towns in the same district.

Accordingly, on the 30th April, 1878, Capt. Turner again moved with the headquarters of the 34th Company to Bristol, and took charge of the new South of England Postal Telegraph District. In the following year he succeeded Major Webber in command of the Military Telegraph Establishment under the Post Office retaining Bristol as his headquarters. He was appointed by the Inspector-General of Fortifications an Associate Member of the Royal Engineer Committee for Military Telegraph Questions. He was promoted Major on 31st December, 1878. He remained at Bristol under the Post Office for six more years, and on leaving this command at the end of 1884, after nearly 14 years' service in the Postal Telegraphs he received a letter from the Postmaster-General eulogizing his services, and commending the energy, tact, and discretion he had shown during the time he had been employed under the Post Office.

With his intimate knowledge of military telegraphs Major Turner compiled two textbooks on the subject which were adopted into the Post Office and Military Telegraph Services respectively. Major Turner's *Notes on Military Telegraph Instruments, with Diagrams,* was reviewed by Colonel C. E. Webber in the September number of the *R.E. Journal* of 1884, pp. 212 and 213.

In February, 1885, Major Turner was required to put the peace training of his men to the test of war. He was ordered to Suakin to take part in the second campaign of Lieut.-General Sir Gerald Graham, V.C., K.C.B., on the Red Sea Littoral. Shortly after his arrival at Suakin Major Turner was appointed, on the 7th March, to the Staff as Director of Army Telegraphs. He served through the campaign and took part in the action of Tofrek. He was mentioned by Sir Gerald Graham in despatches. At the conclusion of the Suakin Campaign he was sent to Cairo. He was promoted Lieut.-Colonel on the 6th May, 1885, and from the 27th of that month until the 31st July he was Director of Army Telegraphs with the Nile Expeditionary Force. He received the medal for the Egyptian Campaign, with clasps for Suakin, 1885, and Tofrek, also the Khedive's Star.

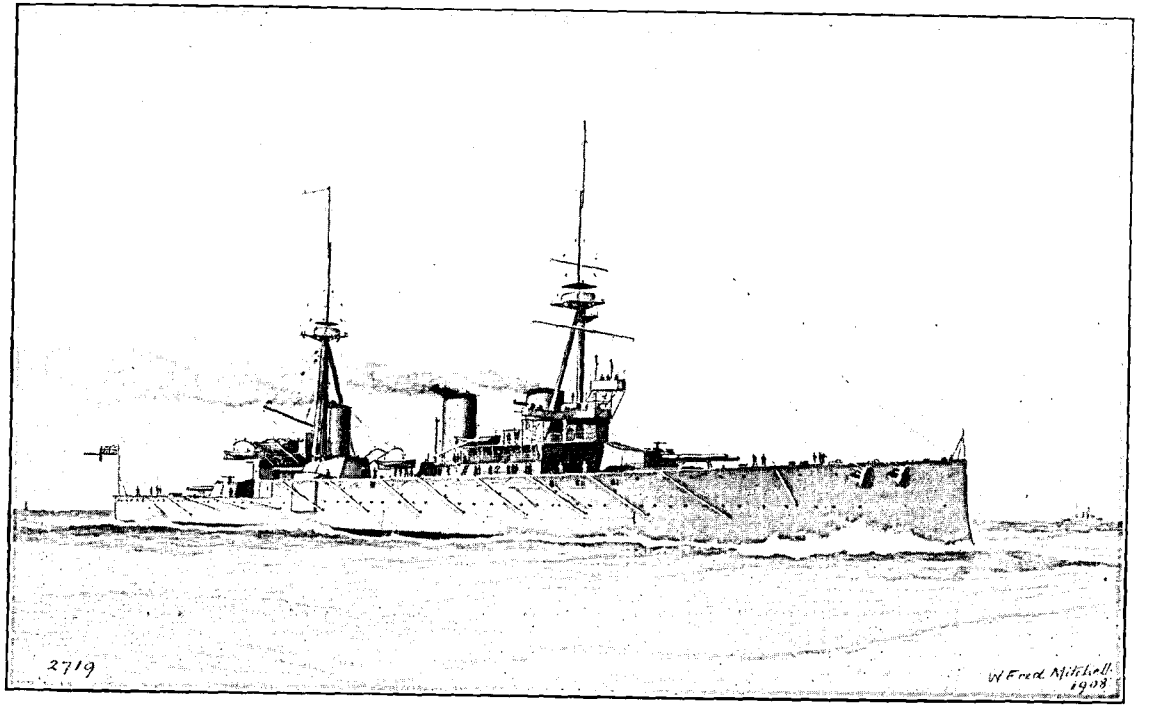
The war being over, Lieut.-Colonel Turner remained at Cairo as Executive Officer to Colonel J. M. Maitland, the Commanding Royal Engineer, until the following February when he succeeded Colonel

Maitland as Commanding Royal Engineer on the 2nd of that month. For over four years between 1885 and 1890 Colonel Turner, who had been given the local rank of Colonel while holding the appointment of Commanding Royal Engineer, lived on board a dahabieh, alongside the R.E. Mess at Kasr-el-Nil Barracks, at Cairo.

During his tour of service in Egypt Colonel Turner was commissioned by the Egyptian Government, with the consent of the War Office, to make a comprehensive inspection and report on the telegraphs of Egypt. For this he received the thanks of the Government. He took great interest and trouble in getting up a memorial to be placed in the English Church at Cairo, of the Royal Engineers who were killed or who died in Egypt in the years 1882 to 1887. The memorial was designed by him and is generally regarded as the finest of the memorials dedicated to soldiers in the church at Cairo. A photo-zincograph and a description of the memorial appeared in this Journal for August, 1888, p. 167.

On the 6th May, 1889, Turner was promoted Brevet Colonel and when, a twelvemonth later, he came home from Egypt, he was placed on half-pay. He only remained 10 months on the "Shelf." On the 28th February, 1891, he was made a Colonel on the Staff and Commanding Royal Engineer of the North Eastern District. He remained at York until November, 1894. Then he was appointed Deputy Inspector-General of Fortifications at the War Office, and it is interesting to note that the same post was held by his great-grandfather, Lieut.-General William Fyers, at the beginning of the 19th century. On the 24th May, 1896, he was made a Companion of the Bath, and on the 8th November following, having attained 57 years of age, he had to retire from the Service. After his retirement he was employed for a short time in 1900 as a Temporary Inspector under the Local Government Board from 1st January to 7th June. He then went to live at Bath where he had many associations. On the 20th January, 1907, he was awarded the pension for Distinguished Service. He died, after a long illness, at Avonside, Limpley Stoke, near Bath, on the 17th September, 1909. He was buried in Bathwick Cemetery, near many of his relatives of the families of Turner and Fyers.

Colonel Turner had three children—a son and two daughters, viz. :—(1). H. Katherine Theresa Turner, who married Lieut.-Colonel A. C. Painter, R.E. (2). Henry Hamilton Fyers Turner, Major, 2nd Lancers (Gardner's Horse), and D.A.Q.M.G., Headquarter Staff, India. He married Effie Campbell Ross, daughter of Colonel George Campbell Ross, Bengal Staff Corps, and has a son, Reginald Hamilton Fyers Turner, born in 1897. (3). Eleanor Ada Turner, who died unmarried on 12th March, 1889.



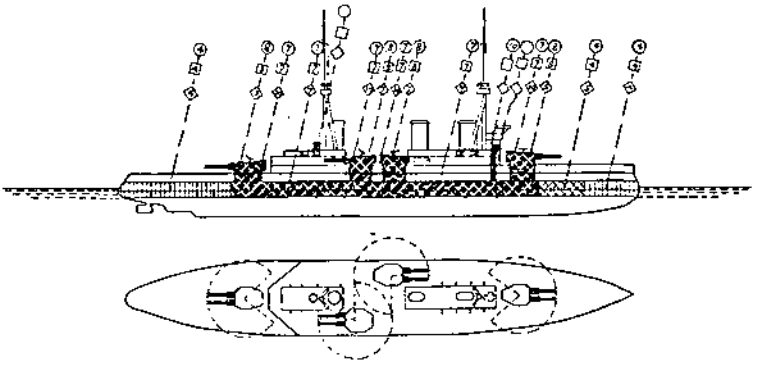
H.M.S. "Indomitable."

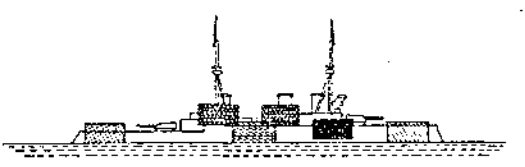
(From a block kindly lent by MESSRS. J. GRIFFIN & CO., 60, *Chandos Street, W.C.).*

TRANSCRIPTS.

A SHIP STUDY OF H.M.S. "INDOMITABLE."

THE following "Ship Study of H.M.S. *Indomitable*" by Lieut. Lull, 1st Lieut., C.A.C., U.S. Army, is likely to prove of interest, and is therefore reprinted by the kind permission of the Editor of the *Journal of the U.S. Artillery*.





ARMOR		EXTREME RANGES FOR SUCCESSFUL ATTACK.				
DISTRIBUTION	MY VALUE IN K.C.	6"	8"	10"	12"	12"M
BELT AMIDSHIP	7	1150	4400	7650	11150	
BELT FORWARD	4	3200	9200	Limit	Limit	
BELT AFT	4	3200	9200	Limit	Limit	
DECK SIDES	2½ (NS)					
DECK FLATS	2 (NS)					
BELT UPPER	NONE.					
BARBETTES	8	NONE	3250	6300	9650	
TURRETS	7	1150	4400	7650	1150	
CONNING TOWER FD	10	NONE	1000	4100	Y200	
CONNING TOWER AFT						
PROTECTION to VITALS	10	NONE	1000	4100	Y200	
PROTECTION H.A. FIRE	4 (NS)					3070 12019

1. GENERAL APPEARANCE.

Length, between perpendiculars: 530′; over all: 562′.

Beam: 78½′. Maximum draught: 26′. Displacement 17,250 tons.

Freeboard; forward: 32′; amidships: 29′; aft: 20′.

Has high forecastle deck carried back to mainmast.

Funnels, three in number, two elliptical in section between midship turrets and foremast, one circular in section between mainmast and midship turrets.

Masts, two in number, formed as tripods below the tops.

Fire control station in each top.

Identification symbol: 32–2.

Turrets, two on median line, one bow and one stern, and two *en échelon* amidships. Bow and midship turrets on forecastle deck and stern turret on upper deck.

Ram, much less pronounced than in older ships.

Very little excrescence of surface, no sponsons or protruding casemates.

Rapid fire guns mounted on top of turrets.

Forward conning tower surmounted by chart room, flying bridge and signal station, also practically under foremast and within splinter distance of forward funnel.

After conning tower practically under mainmast and within splinter distance of after funnel.

Boats on davits amidships as well as on frame work abaft the mainmast. Probably put overboard before the beginning of an engagement.

Torpedo nets on sides, only to be lowered while ship is at anchor.

2. ARMAMENT.

Eight 12″ (Mark XI., 45 cal.).

Sixteen 4″ (Model 1907).

Three torpedo tubes, 18″ (submerged).

12″ guns mounted in pairs in turrets, one turret bow and one stern on median line, and two *en échelon* amidships.

The midship turrets are on the same level as the forecastle and the freeboard is exceptionally high. The guns are, therefore, at a great height above the water line. The after pair of guns, alone, are on the upper deck level, but the deck erection to the rear of these guns is cut away at an acute angle on each side to enable the guns to train as far as possible forward of the beam.

4″ guns are mounted, two on top of each turret, and eight *en château* on shelter decks.

Total fire ahead or astern: Six 12″ and eight 4″.

Total broadside fire: Eight 12″ and twelve 4″.

12″ guns fire 850 pound projectile, using modified cordite, with a muzzle velocity of 2,900 f.s.

Rate of fire of 12″: One round per minute.

4″ guns fire a 25-pound projectile, muzzle velocity unknown.

3. Ammunition.

Ammunition supply, unknown.

Special attention has been paid to the facility with which ammunition can be supplied under unfavourable circumstances.

4. Fuel.

Capacity at load water line, 1,000 tons of coal or equivalent weight of fuel oil.

Maximum capacity, 3,000 tons of coal and 700 tons of fuel oil.

Trial trip showed the following coal consumption :—

For 8,480, I.H.P., 2·6 lbs. per H.P. per hour; speed, (calculated) 10·2 knots; consumption, 20,352 lbs. per hour.

For 29,300, I.H.P., 1·6 lbs. per H.P. per hour; speed, (calculated) 23·0 knots; consumption, 46,880 lbs. per hour.

For 43,700, I.H.P., 1·2 lbs. per H.P. per hour; speed, 26·3 knots; consumption, 52,440 lbs. per hour.

Two inner shafts are provided with cruising turbines not included in the above tests, rate of consumption unknown.

5. Speed.

Designed speed, 25 knots.

Maximum speed on trial trip, 26·3 knots.

Vessel crossed the Atlantic Ocean at an average speed of 25·1 knots, breaking the Trans-Atlantic speed record.

Vessel equipped with special turbines on inner shafts for the purpose of cruising. Economical speed unknown.

6. Cruising Radius, Etc.

Radius of action under high-speed turbines, 4,400 miles, (calculated).

Radius of action under cruising turbines, unknown.

Vessel said to be remarkably handy.

7. Best Method of Attack.

Attack to be opened with each type of gun or mortar at extreme limit of range, as follows :—

Mortars	...	...	...	12,000 yards.
12" B.L.R.	...	...	...	13,000 ,,
10" B.L.R.	...	...	..	12,000 ,,
8" B.L.R.	...	...	...	11,000 ,,
6" B.L.R.	...	...	...	10,000 ,,

Guns below 6" calibre not to engage.

Mortars will use D.P. shell at all ranges. Deck penetration may occur at all ranges in Zones III. to VIII. inclusive.

12" rifles will use A.P. shell at all ranges. Perforation of vitals may occur at ranges under 7,000 yards.

10″ rifles will use A.P. shell at all ranges. Perforation of vitals may occur at ranges under 4,000 yards.

8″ rifles will use A.P. shell beyond 1,000 yards and A.P. shot, under 1,000 yards for perforation of turrets and vitals.

6″ rifles will use A.P. shell at all ranges.

All fire to be as rapid as consistent with good gunnery.

Aiming points:—

1. Foot of foremast: Endangers conning tower, chart house, fire control station, forward funnel and forward turret. The best target.

2. Foot of mainmast: Endangers after conning tower, after fire control station, after funnel, after midship turret and boats (if not cast over).

3. Rear edge of forward deck structure: Endangers middle funnel, forward midship turret and boats (if not cast over).

4. Stern water line: Endangers screws and steering gear and may waterlog stern making ship unmanageable.

5. Bow water line: May waterlog bow, reducing speed and making ship hard to manage.

6. Water line amidships: Endangers midship turrets and, at short ranges gives promise of penetration of vitals.

'R.W.'

FORTRESS MANŒUVRES.

Translated from the *Militär Wochenblatt* of 14th and 16th October, 1909, by Major B. Atkinson, R.F.A., G.S.

THE new "Foot Artillery Regulations" marks a notable advance in that, commencing from the action of the arm in battles of encounter, it proceeds to a systematic study of the attack upon an enemy deployed in position, upon fortified positions in the field, and upon barrier forts. Finally it discusses the attack and defence of fortresses.

The training manuals of the other arms will have to be brought into line with this new development, if the fact that siege operations are no longer the domain of the purely technical troops is to be brought out. Infantry is the most important arm in siege as in field operations. "It alone breaks up the final resistance of the enemy. It bears the main burden of the battle. In compensation, it usually obtains the greater glory."—(*Infantry Regulations*, para. 264).

Generals, who will in most cases have been infantrymen, will have to attack and defend fortresses in real war; they will have artillery and engineer officers to advise them.

In order to prepare for war, officers must not only participate in exercises in siege operations, but they must also learn to direct them. Such exercises may be in the form of war games, or staff rides, or manœuvres with real troops; they may represent either an entire siege, or a single phase carried out by one, or by all arms. These exercises are indispensable to preparation for war, and will provide much valuable instruction. We wish to lay stress on the advisability of securing senior infantry officers, not only to take part in, but to direct such operations.

A glance across the eastern and western frontiers of Germany will show that fortresses must play an important part in our future wars; and that, if we are to invade hostile territory, we shall certainly be compelled to undertake siege operations. In fortress warfare, unlike field operations, many important duties can be adequately dealt with by discussions, war games, or staff rides, in which troops can be dispensed with, or in which at the most only a single arm—communication troops or foot artillery—will be necessary. These exercises may include all measures prior to the deployment of the besieger's artillery, and to the occupation of their positions by the guns of the defender; as also the arrangements made for fortifying the positions of the artillery, which will seldom be actually carried out on account of expense. Portions of these tasks may however be usefully carried out by single arms as a separate exercise. For instance, the actual deployment of an artillery brigade by night would be specially instructive; the proper quantities of stores would be drawn, and the necessary entrenchments would be executed.

Fortress manœuvres are practically a combination of war games, staff rides, and actual operations; the (strategic) war game comprising the isolation of the fortress from the larger operations; the staff rides dealing with the investment up to the beginning of the artillery deployment. Troops will not be necessary before this point is reached; the fighting in the remoter zone of investment differs very little from actual field operations, and will indeed often provide excellent manœuvre schemes which will be free from the necessity of assuming an existing fortress to be an open town.

The employment of the main reserve, and the conduct of the defence of advanced positions, provide valuable exercises which can easily be represented, together with the risks inseparable from them. As examples may be cited the employment of the main reserve in a decisive battle fought at a great distance from the fortress, or the obstinate defence of advanced positions lying beyond the range of the artillery of the fortress.

The field of action of the troops in advanced positions lies within effective range of the fortress artillery; as long as the fire of the fortress guns is effective on the inner flank of the advanced detachments, this flank will be protected and the detachments cannot be driven away from the fortress.

It will be found an interesting exercise to take the fighting during the investment of a fortress, (*e.g.* the V. Corps before Paris on the 19th and 20th September, 1870) as the basis of a manœuvre scheme, and then to pass from field manœuvres to fortress manœuvres. The execution of all duties and tasks under service conditions will be found more important than it is in field manœuvres; for slovenly work, inadequate cover, or a carelessly calculated mine charge may endanger the success of an operation. It is certainly true that, in field operations, a daring attack may, despite all principles of tactics, be driven right home; but any amount of self-sacrifice and valour will be useless in fortress warfare, if adequate passages have not been prepared through the obstacles, if means for crossing the ditch are lacking and if the fire from the works defending the ditch has not been subdued. "In both field and fortress warfare the tactical problem is the destruction of the personal element embodied in the man and his weapon. Not until the man has been crippled does the technical problem advance into prominence; this problem consists in removing the material means of resistance, prepared during long periods of peace, which may impede the tactical assault, and thus render it impossible to use cold steel against the defender who, by now, will have been shot into a state of demoralization. This combination of tactical and technical skill is the essence of fortress warfare and distinguishes it from purely field operations."

Though often little considered in field operations, the measure of rest accorded to the officers and the troops is an important factor in fortress warfare; for the exercise cannot be interrupted as long as war conditions are assumed to exist. Also the night, which during field manœuvres is usually devoted to rest, is essentially the period for fighting and working in fortress warfare. It is of course impossible to practise every characteristic of siege operations, want of space will render it necessary to be

content with a section of the circumference of the fortress as the area of a more or less vehement struggle; and the fact that the time of the troops is often limited also restricts the field of action. But, whether the deciding factor be space or time, operations against the forces which are not being actually attacked should be carried on simultaneously on paper. For instance, the directing staff may choose the phase between the artillery deployment and the establishment of the first infantry position, or they may choose the struggle at close quarters for some fort and the ground on either side of it. The possibilities offered by this latter exercise have been considerably enriched by the work of Capt. Kranz on the Siege of Port Arthur (Beiheft No. 7 to the *Militär-Wochenblatt* of 1909).

The exercise must be so arranged as to entail for the defender offensive action by spade work, by fire, and by sorties. The more active the defence the stronger will become the desire of the soldier not to abandon his position of his own free will; and as, on the other hand, the attacker must be given a chance of carrying through his attack, the decisions of the umpires will be particularly difficult. In the event of an obstinate struggle for a position, if the defence has been skilful and energetic, it may become necessary, for the purposes of the scheme to adopt the expedient of assuming the attack to have succeeded in effecting passages through the obstacles; and then, just before the assault takes place to let the defenders retire unmolested to the position where they propose to renew their opposition. This is always better than letting the troops await the umpires' decision at close quarters, with their arms at the order, and often in inextricable confusion.

Whatever phase of a siege is to be represented the directing staff must always have a clear idea of what proportion of loss the defender must be assumed to have incurred; for this loss must finally be so great as to give the attackers the advantage, notwithstanding all the measures taken in time of peace. The casualties in the front of attack will be replaced by bringing in troops from the neighbouring sections, and finally by throwing in the main reserve. These measures will provide considerable reinforcements for the troops in the main battle position. The section and main reserves are a reservoir for maintaining the firing line, the garrison of forts, and the local reserves at a constant strength; casualties are thus felt gradually by the reserves, their strength being decreased in each section of the defence in succession, until they are all absorbed in the fighting positions. The same principle will hold good in the case of artillery. The commander of the defence must be told each morning how many flat and high-trajectory guns, and how many batteries he has in a serviceable condition. As a guide, the directing staff should have some indication of the effect of the attacker's artillery; this will be best secured by obtaining graphics from group commanders, showing how many shell should, according to the orders received by them, have fallen into each separate section. For simplicity's sake, the directing staff will as a rule have to allow for alterations in the distribution of fire originally sent in to them (*e.g.* some of the artillery may find itself compelled to move to avoid hostile fire which is becoming too hot for it).

Another interesting question will now arise. It is the extent of front which the directing staff should allot to the attack and the defence. Assuming these reliefs, and taking the densest portion of the firing line at one rifle per metre of front, a width of 1,000 metres (1,100 yards) will be suitable for an infantry regiment (3 battalions) during the first phase of the attack; so that an infantry division (12 battalions) with its four regiments abreast can occupy a front of 4,000 metres (4,400 yards) This frontage would, however, appear too great for the execution of the close attack; and it will be better, in the case of an attack upon a fort, to regulate the divisional interval by retaining a regiment in second line as reserve, and finally for the assault. Then, allowing 800 metres (880 yards) per regiment, the width of a divisional section will be 2,400 metres (2,600 yards).

The defender is in a much less favourable position. Allowing one rifle per metre of the fortress circumference, and taking, as an example, a circumference of 30 kilometres (19 miles) the garrison must be 30,000 strong. Of this number some 6,000 must be told off as the main reserve; 2,000 more will form the garrison of the keep, so that some 22,000 will remain for the defence of the perimeter. Assuming now the actual front of attack to be 9 kilometres ($5\frac{1}{4}$ miles) wide, and allowing one rifle per metre, it will take 9,000 men, and another 3,000 to garrison the works; there will then remain 21 kilometres (13 miles) of perimeter to be garrisoned by only 10,000 men. It will also be necessary to consider to what extent troops may have to be taken from the sections which are not being directly attacked. The decisive battle on the front of attack (9,000 metres, (9,900 yards)), will thus take place with about four infantry divisions (48,000 men) against 9,000 men in the fighting line and 6,000 men in the general reserve (excluding the garrisons of the works).

In fortress manœuvres which are planned to terminate with the establishment of the infantry in their first position, a real fortress is by no means essential to the scheme. The works may be marked out in a simple manner by flags; or suitably sited farms and copses may be assumed to be forts and provisional defences.

The manœuvre scheme will become much more difficult when it is proposed to represent the close attack. In this case it is necessary, if only for practice in intelligence work, to have real works adapted to service conditions by labour in time of peace. The construction of a mine system is also desirable. The course of the exercise will naturally be influenced in great measure by the fighting assumed to have preceded it, and by the effect of the guns, which, in places, will have dug out craters and made gaps in the obstacles, thus lightening the task of the attack. Labour under peace conditions will, however, be unable to produce a true picture of the condition of the works as they would really appear.

However, let it be assumed that the attack has progressed to within 150 or 200 metres (160 to 220 yards) of the fort, and has dug itself into its fighting position (*e.g.* the fourth infantry position). In former days the assault might have been delivered from this distance; but the

experiences of Port Arthur demonstrate that it is necessary to approach considerably nearer, so that from the position from which the assault is to be delivered there will be only a single obstacle, such as the ditch, to be surmounted. The fight for the counterscarp—in other words, the assault—will now have to be represented; but in order to describe what the condition of the works would really be in war, still greater calls will have to be made on the imagination of all the combatants. The following paragraphs are an attempt at describing this condition from the point of view of the directing staff:—

Intelligence concerning the Condition of the Works and the Zone of Attack after the Bombardment.

A.—*The Works.*

1. The portions of the parapet of the main rampart which are visible from without have been knocked out of shape by the enemy's fire; the works give the impression of irregular heaps of earth. The guns on the rampart are unserviceable. The splinter-proof look-out towers and the armoured observation posts on the main wall can no longer be used.

2. The exposed revetment walls at the foot of the exterior slopes of the parapets have fallen in; in many places their débris provides passages over the wire entanglement at the bottom of the ditch and on the exterior slopes of the parapets.

3. The caponiers at the salients have been shot away in places. The embrasures on both sides are no longer serviceable for guns. Single infantrymen still find cover amongst the débris.

4. The caponiers at the angles have not suffered so much.

5. The caponiers in the outer wall of the ditch, and the intermediate defence are still fairly intact; but the fencing on the outer wall of the ditch, etc., is mostly shot away.

6. The heavy high-explosive shell have made numerous craters amongst the obstacles in the advanced ditch and on the glacis. Their detonations have destroyed the greater portion of the mines.

7. The blockhouses on the covered way have been destroyed, and are abandoned by the defence.

8. Only during comparatively long pauses in the firing are a few solitary sentries or patrols of the defenders visible. While the bombardment continues the works show as little life as if they were deserted by the garrison.

9. Some of the parapets of what were formerly connecting batteries are still held by infantry, who are very active in patrolling towards the flanks, and who remain in observation from these works and from adjacent rifle pits.

10. The defensive works in the defenders' main position to the south of X, Y, and Z, are masked from view. The attack cannot ascertain if guns are in position at these points.

11. The attack possesses no information concerning the condition of the interior or of the rear face of the fort.

B.—*The Zone of Attack.*

1. The attack has not succeeded in destroying the walled shelters for the infantry reliefs; nor have the artillery and ammunition stores suffered severely.

2. The trench-like rifle pits sited round the infantry redoubts have been mostly destroyed.

3. The rifle pits between the infantry redoubts and the works are difficult to locate and have suffered less.

4. Though the wire entanglements have suffered damage in many places, the artillery of the attack has not yet succeeded in creating a sufficient number of practicable passages right through them.

The defender continues to show signs of vigorous activity behind the obstacles. During attempts at demolition he lights them up by means of flares and torches, and, in spite of heavy losses, works unceasingly at their repair.

5. Up to this period sorties have issued through gaps in the wire entanglements between W on the east and A on the west.

6. The attack has been unable to determine what precautions, if any, the defence has taken to block these gaps against an assault.

7. Balloon observation has established the existence of fortifications on the southern edge of the outer town, and three earthworks to the west of X with rifle pits, etc., in the gaps and towards the rear.

8. No movements of troops have been noticed between or behind the the works. This points to the probability that numerous shelters for the reliefs are being gradually constructed in which even the reserves have found at least splinter-proof cover, excepting those in spaces A and M which are no longer being used by the artillery.

9. The searchlights are no longer working.

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The first thing to determine is the manœuvre area. Assuming the interval between forts to be 3,000 metres (3,300 yards,) a fort in a position favourable for attack should be chosen as an objective, and a space 300 to 400 metres wide (330 to 440 yards) on either side allotted to the defence. The fort garrison may consist of a single company; the spaces of 300 or 400 metres on either side will each be half of the section of the main position which would be allotted to a battalion. As a matter of fact a company which could be reinforced by the local reserve to beat off an attack, is capable of defending 500 to 600 metres (550 to 660 yards) of front; but the width of 300 to 400 metres (330 to 440 yards) is chosen with regard to the probable peace strength. In order to enable as many infantry officers as possible to take part in the exercise, the section nearest to the fort may be garrisoned by a company, and the duties of the neighbouring companies merely worked out on paper. It will be well to detail a pioneer company at war strength, and to mark the positions of the guns still serviceable. The fire of these latter can be represented by puffs. It will be an advantage if field artillery can participate in the exercise. There will thus be:—

Fort Garrison.—1 company (at war strength).

Fighting Position.—No. I. Battalion consisting of one real and one imaginary company; No. II. Battalion of similar strength, and a section of pioneers. That is, one real and one imaginary company of both No. I. and No. II. Battalions in each battalion section.

Local Reserves.—Of similar strength to the lines in front; that is, one real and one imaginary company of both No. I. and No. II. Battalions in each battalion section.

Reserve.—No. III. Battalion, one section of pioneers, and one section of machine guns (two real and two imaginary companies). This makes eight companies of infantry employed including the fort garrison of the fort *

Commanders for the above should be appointed as follows:—

Commander of the Side.—A colonel or lieutenant-colonel with artillery and engineer advisers.

Right Half Section.—The O.C. No. I. Battalion.

Left Half Section.—The O.C. No. II. Battalion (captain).

Reserve.—The O.C. No. III. Battalion (captain or field officer).

It will, as a rule, be sufficient for the commander of the side to work out the detail concerning the sections as a whole.

In the same manner No. 2 Infantry Regiment and 3 companies of Fortress Pioneers should be detailed to the attack. They will attack the fort supported by No. 1 Infantry Regiment on the right, by No. 3 Infantry Regiment on the left. In reality, the attack will be carried out with No. 2 Regiment alone, the supporting regiments to right and left being represented by only a single company, and the remainder being either imaginary or denoted by flags. The action of these imaginary troops will, however, be dealt with in orders written by officers of the rank of captain.

Thus, the attack will consist of 3 battalions, a machine-gun company, and 3 companies of pioneers. The troops in the adjacent sections will be represented by 2 field officers or captains commanding sections, and 6 companies, which will include supports and reserves.

The exercise will therefore require a strength of about an infantry brigade, the brigade commander acting as director.

Umpiring should be the special duty of the infantry, the principal fighting arm. Umpires should work in three reliefs, each of about six hours. Senior officers of engineers and artillery are especially suitable for the directing staff, juniors being employed as intelligence officers to the section commanders. Arrangements must be made to indicate to the defence, by means of a mast with balls and lanterns, when hostile artillery is firing on the works or positions, when pauses occur, and when the artillery fire is switched to other objectives. The attacker must similarly be informed when portions of his force are at work under the fire of the defence (mast with semaphore).

The pioneers should be given opportunities of executing technical duties in co-operation with the infantry, and of using the different natures

* The number of real companies appears to be seven, not eight, unless the company at war strength is counted as two.

of illuminating material; in this the counter-measures of the defence will probably create difficulties.

The artillery will be able to acquire information as to the methods of employing the observers sent forward with the infantry, and as to their own participation in the close attack. They will have to be quite certain as to the ranges up to which they can continue firing over their own infantry.

The commander will find himself confronted with numerous problems. He will have to decide if he is to attack the fort and the outworks simultaneously, or if he is to isolate the former before he attacks it. There is something to be said for either method.

But the finest and most glorious field for action is reserved for the infantry arm. Infantry officers seeking guidance in this matter need only consult Beiheft No. 7 of the *Militär-Wochenblatt* of 1909. The following items will be found of especial importance:—

1. The attack must be compelled by means of flank fire from guns, field guns, and machine guns to advance methodically and to use sap and shelter trench.

2. As he approaches by means of these devices he must be disturbed by sorties of small detachments armed with hand grenades; such sorties should likewise be made whenever the means for reconnaissance and observation prove ineffective.

3. Searchlights and machine guns are dangerous enemies. They must, without exception be destroyed as soon as possible by sorties or by fire—even field gun fire.

4. When the attacker decides to move his infantry up to within very close range of the defence, his artillery fire will have to cease. At this period the defender must not allow himself to be beaten down by infantry fire alone. The attack must employ every device to draw the defender close up to his parapet, and then attack him with a superior volume of fire. The decision of the close encounter will be by fire, and not by methodical spade work. Just as in field operations artillery fire is drawn by an infantry demonstration, so in fortress warfare the attack must secure infantry targets by the selfsame method.

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Fortress manœuvres rejoice in no great popularity in the army, partly because the men are still somewhat unaccustomed to the evolutions of siege operations. But the fond belief that the army can to-day adapt itself to the exigencies of fortress warfare, as it did in the 1870—1871 campaign, cannot hold ground for a moment. It may, it is true, be able to do so after a certain period; but what troops have neglected to learn in time of peace they will learn in the presence of the enemy only by much sacrifice of time and blood.

GENERAL REPORT ON THE ENGINEER TROOPS OF THE ITALIAN ARMY.

(Continued).

By Capt. Don Rafael Marín del Campo.

(Translated from the *Memorial de Ingenieros*, January, 1910).

III. Military Schools.

Entry of Officers.—Engineer officers, like those of the whole Italian Army, come, speaking generally, from two different sources, namely directly from the cadet schools or from the ranks.

The non-commissioned officer who aspires to become an engineer officer must pass certain tests and examinations, and afterwards go through three courses, two in the Military School at Modena and one at the Artillery and Engineer School.

The student, who has finished his secondary studies at some Lycée, Technical Institute, or Military College, and wishes to become an engineer or artillery officer, must after admission by examination pass three years in the Military Academy and two years in the Artillery and Engineer School. Both these establishments, which have been visited by the writer, are in Turin, and will be described in this article.

Military Academy.—This centre of military instruction is common to the two sister services (Artillery and Engineers); that is to say that, during the three years that the students remain there, they all wear the same uniform and no distinction is made between them.

They all form one brigade under a major, and are organized in three companies, to each of which are attached one captain, three lieutenants and the students of one term. In all they amount to a little over two hundred.

The officers named in the preceding paragraph, who receive an annual allowance of 300 lire (£12), are entrusted with the care of the students and with their instruction in purely military and practical subjects.

There is a separate staff of science professors, partly military and partly civilian—the latter predominating.

The military professors are graded as professors (majors, captains or lieutenants), or assistants (lieutenants), and receive annual allowances at the rate of 500 (£15) and 300 (£12) lire.

The civilian professors are either permanent, *i.e.* drawing the pay of the appointment, or attached, *i.e.* only receiving an allowance as being already professors of some other Government establishment.

Masters and instructors (officers, N.C.O.'s or civilians) for gymnastics, riding, and fencing, complete the instructional establishment.

The head of the Academy is a colonel, and is called the Second in Command, as there is a general above him who also controls the Artillery and Engineer School. Almost the whole of the weight of the direction of the Academy falls upon the colonel.

There are two heads of studies: one civilian professor for scientific subjects, and the Commander of the Brigade of Students for military instruction, regulations and physical exercises.

The following table will show the subjects of instruction and the time allotted to them: —

TABLE I.

General Organization of the Scientific Instruction in the Military Academy, Turin.

Subjects.	Number of Lessons or Classes (1).			Marks (2).	Programmes.
	1st Term.	2nd Term.	3rd Term.		
Military Art	25 (3)	60	30	10	I.
Mathematical Analysis, Part I.	75 (3)	—	—	10	II.
" " " II.	—	90 (3)	—	10	III.
Analytical Geometry	—	90 (3)	—	10	IV.
Mechanics	—	—	90 (3)	10	V.
Descriptive Geometry, Part I.	50 (3)	—	—	10 (4)	VI.
" " " II.	—	—	60	10 (4)	VII.
Military History	—	60 (3)	60 (3)	9	VIII.
Small Arms and Musketry	—	60	—	9	IX.
Field Fortification — Lectures	—	30 (3)	—	9 (4)	X.
Field Fortification — Drawing	—	30	—		
Artillery	—	—	60 (3)	9	XI.
Topography — Lectures	50 (3)	—	—	9 (4)	XII.
Topography — Drawing	25	—	—		
Military Literature	25	30	—	8	XIII.
Physics	75 (3)	—	—	8	XIV.
General Chemistry	—	60 (3)	—	8	XV.
Applied "	—	—	60 (3)	8	XVI.
Descriptive Geography	75 (3)	—	—	8	XVII.
Law	—	—	30 (3)	8	XVIII.
French	50	60	—	7	XIX.
Administration and Accounts	—	—	15	7	XX.
Linear Drawing	50	—	—	7	XXI.
Freehand "	25	—	—	7	XXII.
Landscape and Panorama Drawing	—	—	30	7	XXIII.
Architectural Drawing	—	—	45	7	XXIV.
German (voluntary)	—	60	60	0·10	XXV.
Total number of classes	525	630	540		

(1). Ordinary classes, those intended only for questioning and drawing classes last 1 hour and 10 minutes.
(2). Marks are allotted half for merit during the year and half for examinations.
(3). In this subject a weekly class is held solely for asking questions, apart from those which can be asked in ordinary classes.

In order to thoroughly explain the preceding table it should be stated that the entrance examinations are similar to those held in Spain in similar institutions.

TABLE II.

General Organization of the Instruction in Physical Exercises and Purely Military Subjects.

Subject.	Number of Weekly Classes.	Duration of each Class.	Marks.
Gymnastics and Cycling	4 (2)	30 to 35 min.	
Fencing	4	30 to 35 min.	
Riding	2 (2)	40 min.	
Military Subjects (Tactics, Regulations, Nomenclature, Employment and Manœuvres with Artillery and Engineer Equipment)	3	1 hr. 10 min.	7
Tactical Instruction (on Sundays)...	1	2 hrs. 20 min.	
Moral and Military Qualities (1)	—	—	10

(1). The marks for moral and military qualities are given before the commencement of the examinations by the military officers of the Academy who assemble for the purpose. All the military qualities of the students are considered, including such conduct as may show the possession of a good military spirit.
(2). In the 2nd and 3rd Terms a little less gymnastics and a little more riding are done.

From the very detailed time tables which were given to the writer he has drawn up the following table which shows the daily hours of work:—

TABLE III.

General Distribution of Time at the Military Academy, Turin.

Subject.	Average Number of Hours daily.
Purely Intellectual Work (Study and Scientific Classes, including Drawing)	8 hrs. 42 min.
Military Instruction (Theoretical and Practical)	39 min.
Physical Exercises (Gymnastics, Cycling, Riding and Fencing)	1 hr. 4 min.
Meals and Free Time	5 hrs. 35 min.
Sleep	8 hrs.
Total	24 hrs.

In what I have called "free time" is included all the intervals between the different subjects (usually 10 minutes) which are classed as times of recreation, the time lost in dressing, undressing, etc., and the hour and a-quarter of liberty which the students enjoy outside the Academy after the mid-day dinner.

On Sundays there are not classes for scientific subjects, but work goes on almost to the same extent as during the week. It will suffice to say that all the freedom allowed to the students consists of a short hour for recreation after the principal meal, another half-hour from 1 to 1.30 p.m.

and three hours outside the Academy from 6 p.m. to 9 p.m. Practically all the rest of the day is spent in study, moral instruction, the working out of scientific exercises, the cleaning of the person and the clothing, inspections and technical instruction.

I must pause here to make a few short remarks:—

I recognize that this organization of the academic life is much superior to that which exists in certain other countries where the student is looked upon merely as a thinking machine, and is denied during the greater part of his career practice in gymnastics, riding, fencing, games, and in a word all physical exercises. He might as well be denied bread, air and water, but the ideal is that he should absorb knowledge as rapidly and at as high a pressure as possible.

It is not my intention to make comparisons between Italy and those countries and armies which are so behindhand in educational matters. I intend only to inform the reader who may not have studied these very important questions, that the general order of life in the Military Academy of Turin does not completely accord with the principles and practice which now obtain amongst those nations which march in the vanguard of progress. This I do in the hope that if any of my readers should be able some day to influence more or less directly the reorganization of our establishments for military education they will perceive that it is not in the Latin countries that we must seek for models in this matter.

The last important reform in military education, as far as I am aware, which has been carried out, is that recently introduced in the training of naval cadets in England. It has been of such a transcendental character, that it has produced, even in that very advanced country, a profound and general sensation, and its results have been so excellent that many professors and university authorities have studied it.

At the Royal Naval College, Osborne, to which the English naval cadets are first sent, Sunday is quite free, and the afternoons of Wednesdays and Saturdays are also free, and the students devote them to games, excursions, and in a word to physical exercises.

The following table shows the distribution of time:—

TABLE IV.

General Distribution of Time at the Royal Naval College, Osborne.

	Number of Hours a Week, Exclusive of Sundays.	Daily Average.
Purely Intellectual Work	24 hrs. 45 min.	4 hrs. 7 min.
Workshops	16 hrs. 30 min.	2 hrs. 45 min.
Physical Exercises (Gymnastics, Games, etc.).. ...	26 hrs. 15 min.	4 hrs. 23 min.
Meals and Free Time	21 hrs.	3 hrs. 30 min.
Sleep	55 hrs. 30 min.	9 hrs. 15 min.
Total	144 hrs.	24 hrs.

But let us return to the Military Academy, Turin. The course begins on the 1st October and ends in the middle of August, the last month or month and a-half being devoted to a tour and to field exercises, which have for their main object the application on the ground of the principles which have been learnt during the previous months, and to accustom the students to life in the field where they can be practically trained in tactics, outposts, camping, fieldworks, etc., and the methods of giving first aid to the wounded in war.

During the course they fire with the revolver, rifle and field gun, and are instructed in range finding.

The equipment of the student is, of course, identical with that of the soldier. Each, therefore, carries his knapsack and shelter tent at all tactical exercises or marches, however unimportant they may be, in the same manner as I have described in the second part of my article.

The royal cipher with a number on the left arm indicates good conduct during the last term. Those cadets who are most distinguished by their conduct and military knowledge are made corporals and there are also instructors, belonging to the third class, who help the officers in the instruction of the newly joined cadets.

The public rooms, such as the dining hall, dormitories, baths, hospital, halls of study, etc., are good and well arranged.

There are physical and chemical laboratories, and a museum containing models of guns, projectiles, rifles, vehicles, mountings, engineering material, etc., and a topographical and geographical museum with large models in relief of the Alps and frontier districts and a rich collection of maps of Italy issued by the Institute of Military Geography.

The Academy also possesses several guns for drill purposes.

There is a large covered gymnasium, with few but practical apparatus, and another open gymnasium containing jumps and other obstacles; also a very good fencing room where every student keeps his mask, gauntlets, etc. In addition there is a covered manège, and it should be noted that the students of the third class carry out a mounted tour. There are about 100 horses belonging to the riding establishment of the Academy.

About 50 bicycles are provided for instructional purposes, and are used during the practical course.

The central square is very large, but is enclosed, the students play football, etc., there.

The prison or correctional establishment surprised me by its stern appearance which is undoubtedly excessive. I will omit all details, but will merely state that the repressive system employed there is being softened, as is shown by the fact that both there and in barracks the punishment diet of bread and water has been discontinued.

There is a mess in the Academy for the professors, with a dining room for those who are unmarried.

I was present at the instruction given in gymnastics, fencing, riding and gun drill, and, on one Sunday, at the tactical exercises carried out on

the garrison drill ground. The classes are divided into six small groups, so that individual instruction may be given.

One detail which pleased me very much was that the students took with them to the halls of study, not merely their books, but also their bats, racquets, etc., so that they could make full use of the 10 minutes allowed for recreation between each class.

I was much pleased with the instruction which I witnessed. This, with the fact that in all international competitions in riding, skiing and other military exercises Italian officers have for some years reached a very high standard, and also the growing favour which physical exercises enjoy both in the army and in the nation, leads me to hope that when it is decided to implant in the primary education of the officers reforms analogous to those which have been introduced in the English naval schools, they will become the admiration of the whole world.

The appearance of the students of the Military Academy is satisfactory in spite of the excessive intellectual work to which they are subjected. This I attribute firstly to their entering at the age of 18 at the termination of the secondary education—that is to say when they have developed sufficiently to undertake serious studies; and secondly to the good food they receive, the very busy lives which they lead, to their living as boarders, and to the importance which is given to physical exercises.

School of Application of Artillery and Engineers.—This establishment differs considerably from the one which I have just described.

On passing out of the Military Academy the students are posted to the Artillery or Engineers, and are promoted sub-lieutenants. They have then to go through a 2-years course in the School which will not be described.

There is here a complete separation of the instruction given to the officers of the two arms. Each course is divided into three sections, two for the Artillery and one for the Engineers.

With very rare exceptions all the professors are officers.

The Second in Command of the School is a colonel. Two lieut.-colonels, one belonging to each arm, are the heads of the practical instruction (see Table VI.). There is one captain with one lieutenant in charge of each section, with duties similar to those of the officers of a company at the Academy. The professors of the scientific subjects are either effective (lieut.-colonels, majors or captains) or assistant (lieutenants). There are also instructors (officers, N.C.O.'s or civilians) in riding and fencing. The rates of pay of the instructional staff are the same as those given at the Academy.

The programme of work of sub-lieutenants of Engineers will be seen from the following table:—

TABLE V.

General Organization of the Scientific Instruction at the School of Application of Artillery and Engineers, Turin (Engineers).

Subjects.	Number of Lessons or Classes.		Marks.
	1st Course.	2nd Course.	
Applied Mechanics, 1st Part. Strength of Materials: Lectures	50	—	10
Applied Mechanics, 1st Part. Strength of Materials: Drawing	35	—	
Applied Mechanics, 1st Part. Hydraulics, Thermodynamics, Kinematics: Lectures	60	—	
Applied Mechanics, 2nd Part	—	90	10
Explosives	30	—	10
Permanent Fortification, 1st Part: Lectures	70	—	10
Permanent Fortification, 1st Part: Drawing	30	—	
,, ,, 2nd ,, : Lectures	—	60	10
,, ,, 2nd ,, : Drawing	—	50	
Architectural Construction: Lectures	90	—	10
Architectural Construction: Drawing	40	—	
Road and Hydraulic Works	—	15	10
Construction: Lectures	—	70	10
Construction: Drawing	—	55	
Applied Electricity	—	45	9
,, Science	—	20	9
Practical Geometry	60	—	9
Architecture, 1st Part: Lectures	20	—	9
Architecture, 1st Part: Drawing	60	—	
,, 2nd ,, : Lectures	—	15	9
,, 2nd ,, : Drawing	—	65	
Artillery	35	—	9
Naval Art	—	12 (1)	—
Exercises and Visits outside the School relating to Field Fortification, Practical Geometry, Architecture, etc. (2)	—	—	—
Total number of classes	580	497	

(1). Explained by a naval officer specially detailed for the purpose. The students are not examined in this subject.
(2). Complementary to the instruction in the various subjects.

The system of instruction which is followed can be seen from an inspection of the above table. I will add, however, a few words, as I had three interviews at the School with the Professor of Construction and the assistant professors of Architecture and Fortification, who were so good as to give me much information as to the work carried out by the students.

During the construction course each student has a note book in which he works out problems—as a rule one in each subject—which are marked by the professor. This note book is retained by the student and serves as a manual compiled by himself and corrected by his professor. Once a week one analytical and numerical problem is solved to show the application of theory, and graphical solutions are worked out during the hours devoted to drawing.

The 60 drawing lessons during the first part of the architectural course are devoted, (1) to copying a series of designs, (2) to preparing a design. During the 65 lessons in the second year a complete project is drawn up, differing for each student (barracks, hospital, store, etc.).

A similar system is followed during the fortification course. During the first part the students, (1) copy drawings of fortifications, and (2) design a modern battery, different data being given to each student who has to site the battery and draw the plan and elevation which he considers suitable for the ground allotted to him so as to accord with the tactical object of the work. During the second year a complete project is worked out in the same way as in the architectural course.

This practical work of the student, guided by the professor and his assistant, is worthy of unreserved praise, as there is no better means of teaching design.

Besides this, the fact that the School is situated at Turin, a large town as well as a great military centre, allows of numerous visits being made to various works which are in course of construction.

The method of conducting the examinations is prescribed and varies according to the subject, but in all cases the drawings and projects which have been made during the course are submitted to the examiners. The following examples show the method that is used :—

Construction: Written exercise relative to the stability of bridges, walls, etc. Time allowed 8 hours. The use of books and manuals permitted. *Vivâ-voce* examination, lasting 20 minutes, on the subject of the exercise and on other matters.

First Part, Architectural Course: *Vivâ-voce* examination lasting 20 minutes.

Second Part, Architectural Course: *Vivâ-voce* examination, lasting 20 minutes on the project done during the year, and on other subjects.

In addition to the professor and his assistant, other professors and assistants who desire to do so attend the scientific classes. The size of the audience is relatively great when a lecture is being given by a professor who enjoys a good reputation.

The following table gives an idea of the remaining subjects which are taught at the School, under the supervision of a lieut.-colonel, by the captains and lieutenants of the sections and other masters and instructors :—

TABLE VI.

General Organization of the Physical, Military, and Technical Exercises (Engineers).

Subject.	Number of Hours		Marks.
	1st Course.	2nd Course.	
Riding	162	150	9
Fencing	50	50	
Military Training—Theoretical and Practical Exercises concerning the Material, Manuals and Regulations of the Engineer Regiments and Commands (1)	308	266	10
Moral and Military Qualities	—	—	10

(1). This subject has great technical importance and embraces the study of railways, telegraphy, aeronautics, photography, etc., all of which are dealt with in the regimental manuals which serve as textbooks, and which I referred to in my previous article.

The students work in their classes from 7 a.m. to 11 a.m. and from 1 p.m. to 4 p.m. on week days, and part of Sunday is also spent either in the School or in outdoor work.

The course commences on the 18th October and ends with the examinations in the middle of July. The students of the first course then go into camp until the 5th August, and between the 6th and 21st August make an instructional tour to the engineer regiments other than those in Turin.

The memoirs written by the students as a result of these tours are taken into consideration in making the final classification.

The School contains the following establishments:—A museum of model room for Artillery and Engineers; an electrical laboratory; an excellent telegraph school, and a radio-telegraphic installation.

On the first floor is the officers' mess which is used by the professors and the artillery and engineer students. It contains a large anteroom (games of cards are forbidden), billiard room, library, and mess room. It is closed every evening at 10 p.m.

The unmarried professors, though they live outside the School (and the present colonel who acts as president), take their two chief meals at the mess daily, for which they pay 65 lire (£2 12s. 0d.) a month. Places at table are frequently changed.

One servant is detailed to every two students who are treated in every way as officers, which rank they hold.

On the second floor of the School there is a department completely isolated from outside noise. It consists of a wide corridor with a number of small cubicles on each side. These are the private work rooms of the professors and assistants. They each contain a writing table, drawing table, cupboards and bookcases where the work of the students, plans, etc., may be kept.

The detailed inspection of some of these rooms was a revelation to me and gave me great pleasure, as I there saw how the professors and assistants carry out their duties, the good order in which everything is kept, the scrupulous manner in which the work of the students is examined, and lastly the real communion which exists between the masters and their pupils.

The School also contains one covered and one open manège containing various jumps, a fencing saloon, and a splendid drill ground with guns and batteries for instructional purposes.

Gymnastics are not taught, a noticeable omission as the students at the Military Academy and lieutenants in regiments are constantly obliged to practice them; and it is all the more strange because the first thing the officers have to do on joining their regiments is to instruct the recruits and trained soldiers in this subject.

Conclusion.

I cannot claim to have given a complete account of the Artillery and Engineers of the Italian Army. Owing to want of space I have been unable to touch on such important subjects as the system of promotion,

and the tendency which is becoming every day more accentuated of specializing in different subjects, though the custom is still retained of lieutenants spending a portion of their service in the Sappers or Miners, Bridging Troops, Telegraph Troops, Railway or Special Corps, and the remainder in commands.

I think, however, that I have brought into prominence the following points:—

(1) The assiduous work which is done in all branches;

(2) The progressive evolution which, as a consequence, is brought to bear on the army and on the nation, and in virtue of which Italy is rapidly raising its name and influence in the concert of civilized nations.

'M.'

TELEGRAPHY OF PHOTOGRAPHS, WIRELESS AND BY WIRE.

(A *précis* of an article in *The Electrician* of April 20th, 1910).

(1). Introduction.

The methods of transmitting photographs and pictures by telegraphy can be classed as :—

(*a*) Purely mechanical, or
(*b*) Dependent on the physical properties of selenium, or similar substances, which are sensitive to the action of light.

The latter methods, although possessed of a higher scientific interest than the former, are at the present time the less practical, and are well-nigh obsolete. There is however every promise of their being made use of later.

The system of telegraphing photographs which will now be described, is that which has been employed by the *Daily Mirror* for over a year between Paris and London, and London and Manchester.

(2). General Principles.

The effect of an electric current is to discolour certain suitable electrodes, or to set free an element or ion, that can be used to form, with a second substance, a coloured product, which can be employed to produce marks on paper.

If a photograph image be broken up into lines which interrupt the current for periods depending on their width, these interrupted currents can be used at the receiving station to form coloured marks which join up *en masse* to form a new image.

In these line photographs, the light and shade of the picture is made up of masses of thinner or thicker lines with clear spaces between them. If this fact is borne in mind, the systems themselves will be found easy to understand.

(3). General Description of the System (*Fig.* 1).

A diagram of the connections is shown in *Fig.* 1.

The "transmitting drum" is a metal drum revolved by a motor at the rate of 1 revolution every 2 seconds. An iridium stylus (S_1) traces a spiral path over it in the same way as a phonograph. A half-tone photograph broken up into lines and printed in fish-glue on a sheet of lead foil is fixed on to the drum. As the stylus traces over this photograph, its contact with the metal base is interrupted every time one of the fish-glue lines comes underneath it, for a period varying with the

width of the line. Thus the transmitting instrument sends out a series of interrupted currents whose periods of duration are determined by the width of the lines composing the photograph.

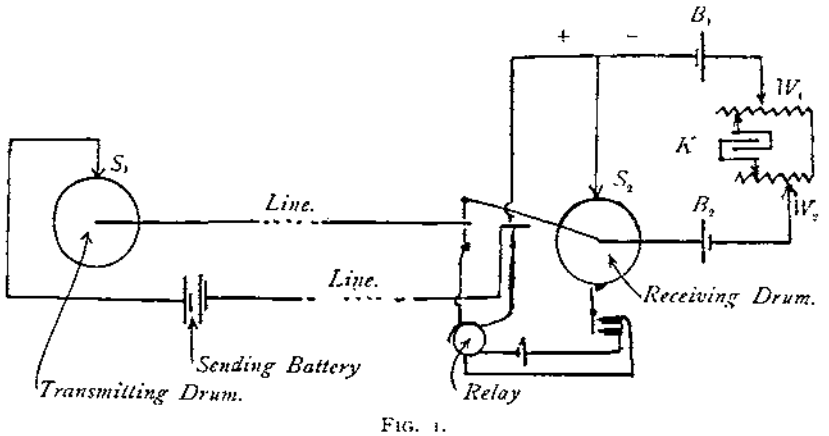

FIG. 1.

At the receiving end, a stylus S_2 is tracing an exactly similar path to S_1 on the "receiving drum," round this drum, however, is wrapped a piece of absorbent paper impregnated with a colourless solution which turns black or brown when decomposed by the electric current. Every brief current thus causes a mark to appear on the paper, and thus in time the photograph is reconstituted.

(4). PRACTICAL DIFFICULTIES.

The above is but a brief outline of the method, when it is tried in practice difficulties arise owing to the capacity of the lines. If a circuit be closed by a Morse key, assuming the time of contact of the key to be $\frac{1}{300}$th of a second, owing to the capacity of the cable, the time of discharge from it will be considerably longer than $\frac{1}{300}$th of a second. If the delaying effect of capacity be not got rid of when sending signals at the rate of 300 per second, it is easy to see that the result will be a hopeless confusion of overlapping marks.

The use of a "line balancer," a modified form of shunt as used in duplex telegraphy, which wipes out residuary currents from the cable, enables as many as 300 sharply defined chemical marks to be recorded in 1 second. This arrangement is shown in *Fig.* 1. The circuit containing the batteries B_1 and B_2, the two sections W_1 and W_2 of the 1,000 ohms resistance, and the variable condenser K forms the line balancer.

It is interesting to note that by increasing the voltage of the reverse batteries B_1 and B_2, considerably greater contrast can be obtained in pictures, and also, the finer the half-tone screen employed in splitting the photographs into lines, the higher the voltages of B_1 and B_2 must be.

The picture revolving beneath the tracer has to redraw itself, so to speak, on a piece of paper some hundreds of miles away. Each mark on the new picture must occupy a precisely similar spot on the new

paper, to that it occupies on the original drawing, *i.e.* the [transmitting and receiving drums must revolve in perfect unison.

The method of synchronizing employed is as follows:—

The drums are revolved by means of motors running at 3,000 R.P.M., geared down considerably, so that the drums themselves revolve at 30 R.P.M. The motors are run off secondary batteries, and are run for a sufficient time to allow them to warm up, before a transmission is made. They are controlled by a regulating resistance in series with the field magnets, and their speed is ascertained by means of a frequency meter. The receiving drum is revolved a little quicker than the transmitting one, and consequently finishes its revolution before the latter. It is then stopped by a steel check, and obliged to wait until the transmitting drum has caught it up. A fleeting contact then comes into play, a reverse current is sent to the receiving instrument, is led into a polarized relay, and actuating an electro-magnet releases the drum by removing the check. Both drums thus start off in unison, every revolution. Both motors should be run off batteries of the same ampère-hour capacity.

(5). Advantages of this System.

(*a*). The whole operation is in view, and by watching the marks on the drum, and by altering the sliding resistances, the operator at the receiving end can get a perfect reproduction.

(*b*). The transmitting drum can be used as a receiving drum.

(*c*). An apparatus is now ready which can be used equally well for line or wireless work.

B. WIRELESS TRANSMISSION,

(6). Description of Method.

The connections for wireless transmission are shown in *Fig.* 2.

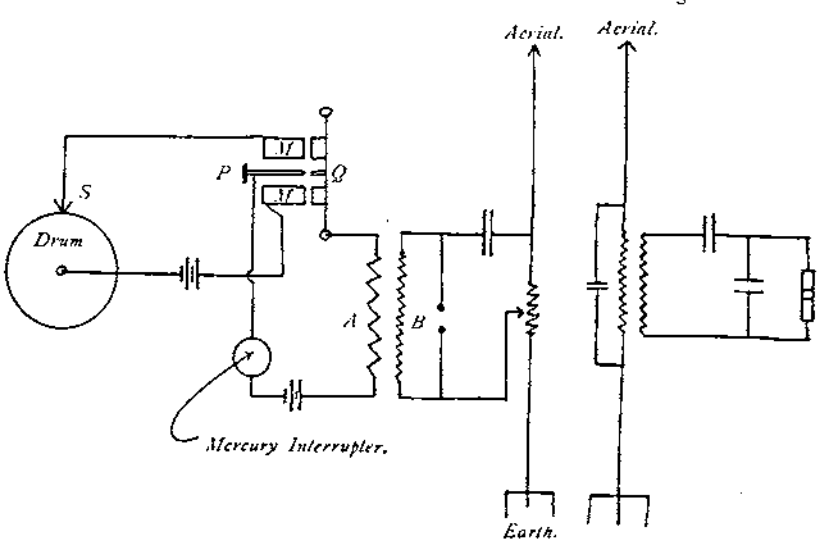

Fig. 2.

The action of the apparatus is as follows:—The line photograph is attached to the transmitting drum, the intermittent current then passes to the electro-magnet M, which attracts a soft iron diaphragm attached to two brass springs, which are fixed to two rigid supports. This attraction causes the platinum points P and Q to be brought into contact. When the current flows, and P and Q are in contact, the primary circuit is closed. The secondary circuit is inductively coupled to it, and thus a signal is sent into space, as in ordinary wireless telegraphy.

When working at high voltages in the primary circuit, such as 110 volts, arcing is liable to take place. By using a mercury motor-interrupter in the primary circuit, it was found however that this difficulty could be got over to a large extent.

The receiving apparatus depends for short-distance work upon a coherer cymoscope, with a decohering apparatus of a particular character, which is shown in *Fig.* 3:—Every time an oscillation passes to the antenna, the coherer becomes conductive in the ordinary way, and the relay R (*Fig.* 3) is actuated. This relay is connected to the electro-magnet EE,

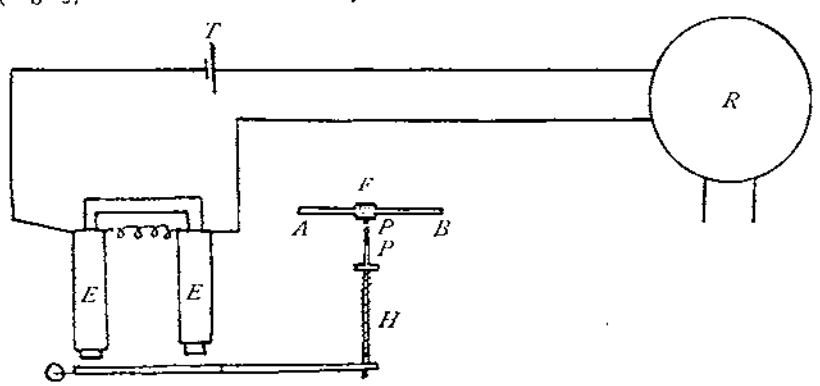

FIG. 3.

and causes it to attract the armature MN, which in moving towards the magnet poles brings the resilient hammer H, with a platinum point P, into contact with the coherer AB. The coherer being fitted with a collar F, and a contact pin, the act of striking it with the hammer, not only decoheres, but also closes a local circuit, and so causes a black mark to appear on the chemical paper. In this way, successive marks can be obtained on the paper in ·017 seconds.

(7). LIMITATIONS OF THE WIRELESS METHOD.

(*a*). So far it can only be used for distances up to about 50 miles.

(*b*). Only sketches of a simple character can at present be transmitted, it would however be very useful for transmitting line plans or written messages.

(*c*). Its great advantage is that the message cannot be tapped, as the reception of the plan depends on (1), the possession of exactly similar sets at the receiving and transmitting ends; (2), absolute synchronism. A variation of 5 per cent. to 10 per cent. in the rate of running is sufficient to make the message unreadable.

(8). Synchronism.

In wireless work, the question of synchronism is more important than ever. Two methods are employed, both are satisfactory.

In the first method both the drums are made to revolve too fast, *i.e.* they revolve once in $4\frac{3}{4}$ seconds instead of a nominal 5. They are then stopped by a check till the 5 seconds are completed, when they are simultaneously released. *Fig.* 4 shows this form of synchronizer. It

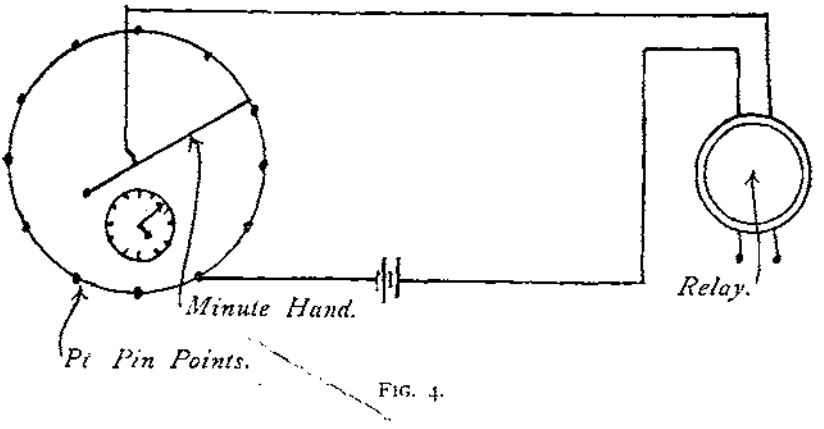

Fig. 4.

consists of a chronometer with a long minute hand, at the end of which there is a fine bundle of platinum wires. These wires rub every 5 seconds against platinum pins set round the circumference of the clock face. The pins are connected to one side of a battery, and the minute hand and a relay to the other. To this relay is connected a local circuit containing an electro-magnet, which draws back the check that retains the drum, and thus at the end of every set of 5 seconds the drum is free to revolve again. By selecting well-calibrated clocks, it is possible to get the two ends into perfect synchronism. This is the system which is being used in practice.

The second method of synchronizing the two stations is controlled by electro-magnetic oscillations. As however it is only useful over short distances, it is not described.

A. H. Scott.

REVIEW.

THE Review which appeared in the February number of the *Journal*, page 150, should be "Notes on Austrian Field Telephones" and not German as stated.

BOOKS RECEIVED.

THE WORK OF THE ROYAL ENGINEERS IN BRITISH COLUMBIA, 1858 TO 1863. By His Honour Frederic W. Howay. The King's Printer, Victoria, B.C., 1910.

ARMY ORGANIZATION AND ADMINISTRATION. A Study of the Subject by Capt. H. L. Pritchard, D.S.O., R.E. Wm. Clowes, 23, Cockspur Street, S.W. London, 1910.

THE RIFLE IN WAR. By Capt. Henry E. Eames, U.S. Infantry, Instructor, Army Service Schools. U.S. Cavalry Association, Fort Leavenworth, Kansas, 1909.

MILITARY HISTORY APPLIED TO MODERN WARFARE. A guide to the Study of Military History exemplified by Studies of the Campaigns of Austerlitz, Jena, Vimiero, Corunna, Salamanca, Waterloo, and the Shenandoah Valley by the late Capt. J. W. E. Donaldson, R.F.A., *p.s.c.* Second Edition. Revised and Enlarged by Capt. A. F. Becke, late R.F.A. Hugh Rees, 119, Pall Mall, S.W., 1907.

CO-ORDINATE GEOMETRY APPLIED TO LAND SURVEYING. By Woodford Pilkington, M. INST. C.E. E. & F. Spon, Ltd., 57, Haymarket, London, 1909.

ACTIVE SERVICE POCKET BOOK. Fourth Edition. Enlarged. Lieut. Bertrand Stewart, West Kent (Queen's Own) Yeomanry. W. Clowes & Sons, 23, Cockspur Street, London, S.W., 1910.

NOTICES OF MAGAZINES.

Revue Militaire des Armées Étrangères.

(1). The Italian Army Manœuvres, 1909.—A detailed daily account is given of these operations, which lasted from the 26th August to the 2nd September and in which 4 infantry and 2 cavalry divisions took part.

The following is a *résumé* of the report on the experiments made :—

(*a*). *Cyclist Battalions.*—Two cyclist battalions each of 3 companies (6 officers and 150 men per company) were employed with the cavalry divisions. Ten motor cyclists and 1 motor car were attached to the headquarters of each battalion and 3 motor cyclists to each company. Three companies of volunteer cyclists (3 officers and 75 men per company) were also employed. They were mostly composed of men of less than 20 years of age.

(*b*). *Machine-Gun Sections.*—These were allotted in the ratio of 1 or 2 per infantry brigade, and 1 per cavalry brigade. Their composition was as follows :—

Infantry machine-gun section :—
- 1 officer.
- 18 men.
- 7 animals.
- 2 machine guns.
- 10 panniers to carry ammunition.
- 15,000 rounds on bands.

Cavalry machine-gun section :—
- 1 officer.
- 22 men.
- 34 horses (24 riding horses and 10 pack).
- 2 machine guns.
- 16 cartridge panniers.
- 12,000 rounds on belts.

(*c*). *Motor Cars.*—41 motor cars; 34 motor bicycles and 27 heavy motors were employed. Each driver or cyclist was provided with a book containing :—

(1). Information about the vehicle and its driver.
(2). Leaves on which to record the daily journeys.
(3). Warrants for the issue of benzine, petrol, oil, etc.

(*d*). *Supply Service.*—Much use was made of motor transport for the supplies of troops. The daily ration of each man was :—

250 grammes of meat.
200 grammes of bread or rice.
15 grammes of bacon.
And either 2 rations of 10 grammes coffee and 15 grammes sugar.
Or 1 coffee ration and $\frac{1}{4}$ litre wine.

(*e*). *Field Kitchens.*—These consisted roughly of large boiling pots with a grate underneath them. They were not mounted on wheels but were carried in the battalion carts. Their capacity was 60 meat rations (60 × 250 grammes), 20 litres of water and 40 rice rations. Five were allotted to each group of 2 companies, and thus 300 meat or 200 rice rations could be supplied.

(*f*). *River Ambulance.*—This consisted of 10 boats; 7 hospital ships and 3 tugs and could accommodate 214 men. A Berkenfeld filter on each boat enabled the river water to be used for drinking and cooking purposes. The drinking water was, however, boiled after passing through the filter.

(*g*). *Automobile Searchlight.*—The motor car carried a dynamo, and dragged a two-wheeled limber on which was placed the projector. The maximum distance allowed between engine and projector when in action was 200 metres; 2,500 metres the limiting range of the light.

(*h*). *Infantry Telephone Sections.*—These consisted of 4 vehicles carrying 40 kilometres of wire. The wire weighed 5 kilogrammes per kilometre, was rolled up in drums weighing 6 kilogrammes each. For unwinding; these drums were placed on men's backs. The *Tribuna* stated that good results were not obtainable owing to the difficulty of hearing whilst firing was going on.

(*i*). *Wireless Telegraph Stations.*—Three W.T. stations of a range of 100 kilometres were employed and found to be most satisfactory. They were attached as follows; one to the Directing Staff and one to each side, and were nominally employed to maintain communication between the Directing Staff and either side.

(*j*). *Other Experiments.*—Experiments were made with :—(1). A new pattern of ambulance wagon. (2). Field searchlights. (3). A new bridging equipment. (4). A sandbag for individual protection. (5). A new form of footgear; but no details are available.

MILITARY NEWS OF DIVERS COUNTRIES.—*Austria.*—Each infantry and rifle battalion now possesses :—Four telephone stations and 6 kilometres of wire; sixteen flag stations (for day work); eight lamp stations (for night work); four of these are petrol lamps having a range of only 8 kilometres and four are acetylene lamps with a range of 15 kilometres.

Germany.—The Infantry Training Manual has been revised. It has been brought up to date on the following subheads :—

(1). *Manœuvring Formations.*—Much of the old-fashioned drill is abolished and the use of signals increased.

(2). *Night Operations.*—The importance of night operations and of night digging is insisted upon. "The reconnaissance of the enemy s position is also to be carried out at night."

(3). *Employment of Machine Guns.*—The use of machine guns in the attack is to assist the infantry by their fire, which must be kept up even during the final assault. Flanking and commanding positions offer special opportunities to machine guns.

(4). *Action of Infantry in the Presence of Entrenched Positions and Shielded Guns.*—The effect of shielded guns is that even at close ranges infantry have no fire superiority over artillery unless they can make use of oblique fire.

The distance at which to deliver the assault is reduced from 150 to 100 metres.

Russia.—In consequence of the introduction of the 3 years rule in the infantry, it has been made possible for men to get their first stripe after one year's service instead of two as formerly.

A fortress engineer brigade has been formed at Vladivostock consisting of:—Four companies of sappers; four companies of miners; one company of telegraphists; one balloon company; one wireless telegraph station; one carrier pigeon station.

The number of officers allowed to undergo the balloon course at St. Petersburg, from the 1st December to the 1st October has been increased from 4 engineer and 4 garrison artillery subalterns to 26 engineer and 4 garrison artillery subalterns.

Turkey.—The adoption of 4-gun batteries has been decided upon.

Reserve officers are to be obtained from two sources:—(*a*) Retired officers of the regular army; (*b*) young men who have taken their degree and desire to become reserve officers. The latter serve for a year. At the end of each six months they undergo an examination and are successively promoted to the ranks of corporal and sergeant. For the next 2 years they serve 8 weeks per annum and are made first of all sergeant-majors and then second lieutenants of the reserve. Thus at the end of 3 years it is possible for them to get their commissions. Backward candidates may however have to wait as long as 4 years.

The 1st Army Corps has been reorganized as follows:—Infantry.—2 divisions (each of 16 battalions and 1 rifle battalion). Cavalry.—4 regiments. Artillery.—6 regiments. The minimum length of service in each rank has been fixed as follows:—Second lieutenant, 3 years; lieutenant, 4 years; captain, 4 years; vice-major, 4 years; major, 5 years; lieutenant-colonel, 5 years; colonel, 5 years; brigadier, 4 years; major-general, 5 years; lieutenant-general, 4 years. The law has a retrogressive effect, and officers who hold too high a rank are put back to that rank which they should hold according to their length of service.

A. H. Scott.

RIVISTA DI ARTIGLIERIA E GENIO.

February, 1910.

THE DOMINION OF THE AIR IN WAR.—A long and interesting article by Capt. Ottolenghi of the General Staff, discusses fully the above subject. The characteristics of aerial navigation vary with the height to which it is intended to ascend, the time during which it is proposed to remain in the air, the length of the journey, the weight that has to be carried, and the velocity; all these opposite and contradictory elements causing embarrassment when deciding which is the best among the various dirigibles (rigid, semi-rigid, elastic), and the many aeroplanes (mono-bi-tri-multiplanes) with and without tails, helicopters, etc., now constructed or proposed. It is also necessary to consider other important requirements which cannot be calculated, such as safety when manœuvring, fittings for transport, etc., etc. Of all these elements, the most important is velocity.

The velocity of an airship depends essentially on its form—adapted more or less to overcome the resistance of the air—on its motors, propellers, and, in a subordinate manner, on its transverse, longitudinal and vertical stability; since rolling or pitching movements are not only inconvenient and dangerous, but are also obstacles to the complete fitness of the machine. The velocity is a quality which costs dear—as the necessary power for increasing the velocity increases with the cube of the velocity. Consequently, to double the velocity, it is not sufficient to double the motor power but it has to be increased eight times.

On the other hand increasing the motor power means increasing the cubic content of the balloon. For instance, in doubling the linear dimensions of a balloon the superficies offered to the resistance of the air is increased four times, while the volume of the balloon is increased eight times. The greater volume, also, although it admits of a greater velocity, requires a more powerful motor. On the whole the larger dirigibles have an advantage over smaller ones.

Greater volume moreover means greater capacity for transport, which is a very important matter in the employment of military dirigibles.

Take for example a dirigible with a volume of 3,000 cubic metres and a total transportable weight of about 1,000 kilogrammes, of which 500 are explosives and 500 useful weight. With two motors each of 60-H.P. it will travel with a velocity of 60 k.m. an hour, consuming 50 k.g. of benzine an hour. In 10 hours it would travel 600 k.m.

If instead of two motors only one be used, the propulsive force would be reduced to 60-H.P., and the velocity would be reduced to 48 k.m. per hour. But since the hourly consumption of benzine would be 25 k.g. only instead of 50, the motor could work for 20 hours instead of 10. The velocity and the capacity for transport therefore are the essential characteristics of the dirigible, and all the others are subordinate to these, and the possibility is not remote of constructing airships capable of transporting a certain weight of material, with great velocity, for long distances and at variable heights.

It may be believed that in the near future, the art of war may reckon on the assistance of new means of action represented respectively by:—

(1). Large dirigibles, with a velocity certainly more than 50 k.m. per hour transporting men and materials, and capable of sustaining themselves in the air at great heights, and of accomplishing long journeys.

(2). Aeroplanes, which will carry two persons or more with a velocity exceeding 50 k.m. per hour, manœuvring easily and regularly and capable of performing very long flights.

The advantages and the failures likely to occur in endeavouring to drop explosives from dirigibles on fortified places, bridges, etc., are fully discussed. If shells of a spherical shape are used they must be exactly spherical and the exact coincidence of the centre of the shell with the centre of gravity is not so easy to obtain, as with a hollow shell filled with an explosive the density is naturally different from that of the external casing.

Instead of spherical shells it has been proposed to use oblong shells, but it would be difficult to ensure that the shell would start with its axis perfectly vertical, and still more difficult to prevent it from overturning during its descent through the air.

Besides this, the dirigible could not remain perfectly stationary owing to the wind, so that it would be very difficult if not impossible for the rain of explosives to be effective. The dirigible would also be exposed to the fire of quick-firing guns, mitrailleuses, and even rifle fire and would have to contend with other aerial ships. For reconnoitring purposes the assistance of dirigibles and airships will be of the greatest value.

Both Moltke and Clausewitz hold that uncertainty is the greatest obstacle in war, and dirigibles and aeroplanes will serve effectually to lessen this obstacle.

During the recent military operations at Casablanca a captive balloon was largely employed. But the captive balloons can only ascend to 400 or 500 metres owing to the weight of the cord which diminishes the lifting power. Its utility also is limited, as it is only able to examine objects comparatively near. Observations from captive balloons are not easy to take. The observer, unless experienced, easily loses his bearings and fails to give the information which is looked for and anxiously awaited.

The airships will do away with all these inconveniences. They can ascend to four times the height allowed for the anchored balloons, are able to move in any direction, can approach their objective under the most favourable conditions, and the vertical vision in space is much clearer than when inclined. Their advent, if it does not radically change the operations of war, is certainly destined to influence them to a great extent.

During the period of mobilization, they will rapidly traverse the enemy's country, taking account of his dispositions and giving the most useful information as to his communications. Not only will they give information as to the armies, but also with regard to all the enemy's country and his preparations for the strife.

During the combat they will be able to determine the exact development of the enemy's front; his initial movements, and the direction of the various columns on the march.

It does not seem possible to foresee what will be the developments and phases of the battles of the future in which airships are used on a large scale. What might have happened at Gravelotte in 1870, if at the commencement of the action the Germans had learnt, by means of an aeroplane, of the extension of the right wing of the French line of battle? It was ignorance of this extension that cost such sanguinary losses to the Guards and the Saxons when the fortunes of the day remained undecided until nightfall. And what might have happened at Mukden if a dirigible had prevented the Russian reserves from uselessly wasting their energies from the right wing to the left wing of an immense battle front, by signalling the information that the army of Nogi, posted behind the army of Oku on the left of the Japanese line of battle, was ready to advance.

March, 1910.

REVIEW OF BOOKS AND PERIODICALS.—*On the Construction of Walls for Docks and Landing Stages on Muddy Foundations.*—By E. Barberis, Major of Engineers.—This very important study on the construction of walls for docks resting on mud foundations, has been published by permission of the War Minister, and is well worthy of attention on account of the author's long and practical experience of naval works and arsenals.

The publication is issued at a very favourable time, not only on account of the increase of commercial activity in the principal Italian ports, but also because of the feeling of all the nations that suitable docks for ships of war are more urgently needed in the military ports. Consequently a book which explains the difficulties to be met with in special constructions of this kind, will be of the greatest use to the engineers employed. Major Barberis' work contains the results of numerous researches and observations, and refers amply to the results obtained from the experience of eminent naval architects. The difficulties that are met with—especially in the construction of walls for docks on foundations of mud such as Brest, Bordeaux, Trieste, Kidderpore, Belfast, etc.—are fully examined.

The author describes the works now in course of construction for the docks in the military port of Spezia. Having with the aid of borings found soft mud to a depth of more than 30 metres and not being able to change the locality, the same measures were adopted as at Trieste, the latter being described by the Engineer Bömches in the *Memoires et compte rendu des travaux de la société des ingenieurs civils.*

At the same time the author gives numerous observations and data for following minutely the movements of walls and of sand banks at their base, and studies the peculiarities of improvised foundations.

Describing the results obtained by the same methods as those adopted at Trieste, the author is in favour of a new system which completely overcomes the difficulties met with, both technically and economically.

The system consists of the employment of great improvised beams, which are drawn out after the walls are constructed, and which are only required during the construction and settlement of the walls. It was found formerly that if the beams were of iron the action of sea water corroded them and rendered them almost useless.

These beams guide the successive stages of the walls in their foundations, preventing any errors in the alignment which might otherwise occur from time to time and necessitate the partial reconstruction of the work.

The middle beams permit of the work being proceeded with in safety, without being affected by any sinking of the walls due to the movements of the external sand banks.

The movements of the external scarp walls are definitely regulated and the movements cease, so that after about four or five years the middle scarp walls perform the same office as the beams did during the sinking of the foundations.

By this system, it is hoped that the safe construction of docks for great modern ships may be assured by long walls constructed on mud foundations, whatever may be the depth and the scouring.

The volume contains 31 plates illustrating the descriptions of the various works, and is sold at the price of 5 lire to the public, and at 3 lire to the military offices of administration.

Motor Cars in the Army.—*Reinforcing the Ammunition of Field Artillery.*—Similar reasons may be given for this service as for the ammunition required for rifles. The average daily consumption of field artillery ammunition from the data obtained during the war in the Far East in the Japanese Army was as follows :—

At Yalu (20th April) the 2nd Artillery Regiment fired 26 rounds per gun.

The Regiment of Artillery of the Guard, 23 rounds per gun.

At Nanshan the 1st Division fired 180 rounds per gun.

" " 3rd " " 206 " "

" " 4th " " 101 " "

At Wafangu (14th June, 1904) 6 batteries fired an average of 83 rounds per gun.

At the passage of Fisciulin (17th July) 1 battery fired 59 rounds per gun.

At Simatcen (31st July) 2 regiments (72 pieces) fired 93 rounds per gun.

At Motienling (17th July) 1 battery fired 34 rounds per gun.

At Fauzelin (31st July) 6 batteries fired 25 rounds per gun.

At Sha-ho (27th October) the guns fired on an average 43 rounds each.

At Mukden (2nd March) 3 batteries fired 189 rounds per gun.

In the war of 1870–71 the consumption of ammunition for the field artillery was as follows :—

At Mars-la-Tour (16th August) 15 batteries of the IIIrd Corps fired each 768 rounds, or 128 rounds per gun ; while 2 batteries fired 194 and 191 rounds per gun.

At Saint Privat and at Gravelotte (18th August) 10 batteries fired on an average 274 rounds each, or 46 rounds per gun ; and one of these 852 rounds, or 142 per gun.

Each of the batteries of the Xth Corps fired during the days of the 16th and 18th August on an average 262 rounds during the day, that is 43 per gun ; only one on the 16th August fired 1,048 rounds equal to 175 rounds per gun.

The average of rounds fired by the IXth Corps on the 18th of August was 526 per battery, or 88 per gun.

At Sedan the batteries of the Vth Corps fired 390 rounds, or 65 per gun; those of the XIth Corps 500 rounds, or 83 per gun, and of these one fired 731 rounds, or 122 per gun.

It should be mentioned however that in many of the combats the German batteries felt the deficiency of reinforcements: and this was owing to the difficulty of supplying the ammunition to the various columns. Some of the batteries suffered such heavy losses in men and horses that they were unable to carry out the filling of the ammunition boxes.

We see from the average daily consumption by a great group of artillery that it is necessary to allow for somewhat less than 100 rounds per gun, and considering the modern improvements in guns, and the increased speed in loading of the guns now in use over those of some years ago, we may say that 100 rounds per gun should be allowed for.

In an army corps of two divisions there are 96 guns, so that an allowance of 100 rounds is necessary per gun for which 30 wagons would be required for transport to a distance of 100 k.m.; but making a reduction of one-third for the reduced distance of transport the number of wagons required would be 20.

The author recapitulates what he has written in this and in former numbers of the *Journal*, the results obtained showing that in order to provide for a daily reinforcement of ammunition and provisions for an army corps of two divisions—that is to say for an army fighting every day and consuming its reserve provisions—6 motor cars would be required for these provisions, 18 for the supply of rifle ammunition, 20 for that of the artillery; in all 44 motor cars.

The author enters very fully into all the details of the important question of the supply of ammunition and provisions to armies in the field. Excellent diagrams and tables are also given, showing the amount of ammunition supplied during the different battles in the Far East and also the consumption, and the length of the journeys made in effecting this supply.

April, 1910.

FORTRESS WARFARE IN THEORY AND PRACTICE.—Among the numerous studies which of late years have been published on siege warfare, one very deserving of note is that of Lieut.-Colonel Frobenius, *Kriegsgeschichtliche Bespiele des Festungskrieges aus dem deutsch-französischen Kriege von*, 1870–71, the 12th volume of which has lately been published. This last volume is particularly interesting as it contains a collection of valuable studies deduced from historic examples, such as those of the memorable Siege of Port Arthur, which tend to solve problems of attack based on modern requirements.

The ideas proposed by Frobenius relating to the strategical part of fortress warfare are almost exclusively drawn from the experience of the war of 1870-71, and he naturally enters into the field of high strategy and the conduct of a war, which are always closely allied with high politics.

The author premises some considerations on the fortifications of the country which are generally designated by him as "assurances of possession." He asks: "What is to be assured by these fortifications?" and replies concisely "The gates of communication which are the heads of the vital arteries of the country."

Accepting for the moment that it is necessary to construct fortification for a country, Frobenius is opposed—and rightly—to improvised fortifications, which strategically, tactically, and technically can only be a poor substitute for fortifications prepared and organized in time of peace.

Concluding his remarks on the fortifications of a country, after considering historic examples of "Conglomerates of ancient and incomplete works with uninstructed and undisciplined garrisons (Landsturm), with hastily collected firearms of old and unserviceable patterns, with commandants advanced in age and inefficient," he adds "These are times of the past. In fact things have changed and the combatants now are confronted with organization suitable to modern times and fully efficient."

Moltke in his *History of the Franco-German War of* 1870-71 designated the 1st September as the characteristic date of the entire campaign, because of the situation after the Battle of Noisseville before Metz: "On the same day and at the same time at which one French army was annihilated at Sedan, the other retired within Metz and was hopelessly imprisoned." "To annihilate" and "to paralyze" the field army was Moltke's war scheme, he doubted not that the condition of the army at Metz would in the end lead to its annihilation, as at Sedan, provided that the lines of investment remained impenetrable.

From the method by which the head of the German Army conducted the war before Paris it is clear that he always held the fixed idea of carrying on the field operations, also, in the second part of the campaign. Moltke did not conduct the war against fortresses but against the field army, so that the latter should be compelled to retire within the fortresses and to abandon the field to its adversary.

The conduct of Moltke before Metz and Paris never had the fortresses for its objective. Such a motive may have existed only at Strasburg and for the Alsatian fortresses, where it was necessary to keep free the railway communications for the field army that was pushed forward into the enemy's country.

The author in his work avails himself both of the experiences of the war of 1870–71 ending with Belfort and of those of the Siege of Port Arthur and he also refers to several writers (Müller, Rohne, Fritsch, etc.) and to the old master Vauban.

In military history it is difficult to find two examples of sieges which, in their preparation and in their conduct, present greater contrasts than Belfort—the type of siege warfare of 1870–71—and Port Arthur.

Frobenius discusses very fully the tactics of the attacking artillery during the war of 1870–71, but says nothing of the engineers or the pioneers.

He imagines a great modern fortress, and treats especially of the necessity for the armed forces of the besieging army being fixed at three times those of the besieged, calculated at the rate of one man per metre

on the principal lines of defence (50 k.m. of circumference). There are then 150,000 men equal to 10 divisions, without counting the detachments of siege artillery and the technical troops.

The attacking forces would occupy an extended position of 75 k.m.; with 500—600 guns, and a corresponding space of about 10 k.m. for the camp of the besiegers. For this, 3 divisions more would be required with one more as a reserve, leaving 6 divisions for 65 k.m. of investment or about one man and a-half per metre.

What an extensive front compared with the preparations for fortress warfare in 1870–71! Of the siege park for the technical services and of the relative advance-guard, nothing is said.

The author however assigns to the superior in command the arrangements for the preliminary dispositions, and thinks that the said commander, or his chief of the staff, accompanied by the commandant of the siege artillery and the general of the engineers and pioneers, should make with the cavalry a rapid reconnaissance of the fortress as far as the dispositions of the garrison would permit.

According to Frobenius, the position for the final assault should be found at a distance between 250 and 350 metres from the objective. He assigns the latter distance as the maximum, and dwells upon the advantages of pushing forwards the approaches to a point where the besiegers will not run any risk from their own artillery (250 metres).

However this may be, Port Arthur has only confirmed what was known from Sebastopol, in that in face of an energetic defence, the attack would require to carry on its approaches to the brow of the counterscarp if it wishes to be secure of success.

From the idea that the counterscarp can only be destroyed by the work of the pioneers—*i.e.* by mines—as was held up to the time of Vauban, must be subtracted the effects of modern artillery. Even then the works for the defence of the ditch, the most dangerous for the assault, would remain. If these have resisted the effects of the artillery the pioneers would doubtless find these the most difficult of its duties. And where these defensive works of the ditch are protected by countermines, the assailants are constrained to a war of mines, which would offer special and difficult characteristics to the technical work of the sappers and pioneers.

EDWARD T. THACKERAY.

THE YAMATO-DAMASHII.

The Yamato-damashii or *Spirit of Japan* is the title of an official magazine issued monthly, of which the first copy appeared on the 1st January, 1910.

Its object is "To lead humanity to true happiness."

The text is printed in Japanese character with an English translation below, undertaken by Mr. J. Inouye, First Secretary of Legation, and Professor T. Okada of the Military Staff College.

Each number of the magazine, as a rule, opens with an Ode by His Majesty the Emperor, expounded by Baron Takasaki, followed by an Ode by Lord Nisshin, expounded by Admiral Togo, and usually General Count Nogi contributes an article.

The magazine is issued in close connection with the "Shiyūdan," or Military Education Society, which exists for the fostering and development of Yamato-damashii and Bushido, or the propagation of military spirit and ideas.

The *Times* Book Club is the sole agent for the magazine in Europe, and the yearly subscription is 10s. post free. The whole magazine is so patriotic and excellent that I am sure that it only requires to become known for every Officers' Mess to subscribe to it, and undoubtedly its presence in N.C.O.'s Messes and Soldiers' reading rooms would tend to inculcate *morale* and discipline to the troops of any nation. The Magazine is charmingly got up, is printed on paper of very light weight, with a small colour print of a spray of cherry blossom on the cover, and each number contains a colour print illustrating some incident in the life of some humble exponent of the principles of Bushido.

No obstacles will be able to restrain the growth of a nation imbued with the ideas portrayed in this magazine, and it lays bare the source from which is derived the patriotism and martial spirit of the Japanese troops so clearly shown in the late war.

Some extracts translated and published in the June number from Count Okuma's *National Reader*, show that the lofty aim of the Japanese Nation is to become the harmonizer of Oriental and Occidental civilization:—"Just as the sun breaks forth from clouds and sheds its light around, so it shall be our highest ideal to become a leader of the peace of the world and a guardian of humanity." The context shows that by "humanity" Count Okuma means that all men and all nations shall love one another irrespective of race or creed.

The biographical sketches are all so interesting and well told that it is difficult to select from which to quote extracts. I cannot however refrain from giving an extract from the life of Lieut.-Colonel Tachibana. "When appointed a company commander of the Training Battalion at the Toyama School, he would leave home before daybreak and reach his company before the hour for getting up, and then he would, before breakfast, himself teach fencing and bayonet exercise to such of the Non-Commissioned Officers and Privates, as desired to learn. He was always the first to commence the day's work, and when it was concluded he would study the work for the following day. He would write the record of that day's educational work, and seldom went home till after dark, and when he reached it he invariably wrote his home diary. His house on Sunday, we are told, looked like the soldiers' club. As Lieut.-Colonel in command of the 34th Infantry Regiment at Shoushanpu, wounded in a brilliant assault and carried to a trench by a Sergeant, when asked to go to the rear and have his wound dressed he replied:—'This is an important position which we have captured by sacrificing many of our men. If I die here I shall be content, and I shall not move a step from it. Only I feel infinite regret and sorrow that on this the birthday of His Highness

the Crown Prince, I should have lost so many of my brave men.' He bowed to the Eastern Sky and weeping breathed his last."

Again take the story of Hara Soemon's Mother :—

Hara Soemon as a lad, setting out to take part in a plot to avenge his late Lord's death, longing to tell his Mother before he left home, refrained for fear his younger brother would hear and his tongue might slip. After half a day's journey, whilst eating the rice cakes made for him by his Mother, he threw a morsel to a pigeon who at once took it up to her nest and gave it to her young.

Touched by this he turned back and returned to his home and told his Mother asking her to be resigned to his death. His Mother encouraged him and praised him, (Was she not a Samurai's daughter?) and he stayed the night.

Next morning going to call his Mother he found that she had died by her own hand and by her side was the following letter :—

I cannot express in words how dutiful you have always been to me and in your latest act you have shown more than ever your dutifulness. If you think so much of me as to come back 17 miles to see me again, I am sure that when in the attack on Lord Kozuke-no-suke's mansion you should happen to think of me, the courage to advance would fail you and you would show your back to the enemy. Feeling that such an act would be due to my being alive I quit the world in advance to-night. You will then have no cause for anxiety. If you go to the attack with the thought that Kozuke-no-suke is the enemy of both your Lord and your Mother the edge of your sword will grow keener than ever, and you will distinguish yourself in the fight. This is the greatest source of pleasure to me. As I am in haste to die I leave many things unsaid. Please remember me to Sozaburo.*

YOUR MOTHER.

In the February number there appears a translation of the "Imperial Precept" given to the Imperial Japanese Troops in 1882. This sums up the whole art of soldierly virtue and national patriotism in a few words.

Many of the tales related in the magazine show the effect that this Imperial Precept has produced and still produces on officers and men and on the nation at large.

The January number contains the translation of an Imperial Rescript on Education, written in 1890.

The future of a Nation undoubtedly depends on education and the Japanese nation with that unity of national purpose which so rightly distinguishes them, has recognized this more fully than other nations.

Morale and patriotism are natural instincts, but without encouragement they die an early death or become so stunted that they are of little value.

The Yamato-damashii is the unwritten law of an English public school taught to a whole nation.

"C.F.R."

* His younger brother.

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